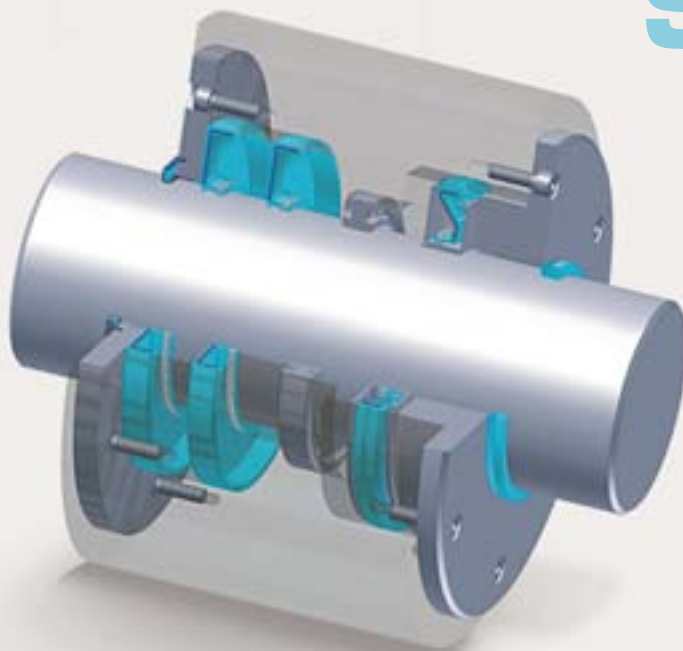


Rotary Seals



Your Partner for Sealing Technology



Your Partner for Sealing Technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer dedicated design and development from our market leading product and material portfolio; a one-stop shop providing the best in elastomer, thermoplastic, PTFE and composite technologies for applications in aerospace, industrial, and automotive industries.

With 50-years experience, Trelleborg Sealing Solutions engineers support customers with design, prototyping, production, test and installation using state-of-the-art design tools. An international network of over 70 facilities worldwide includes 30 manufacturing sites, 8 strategically positioned research and development centers, including materials and development laboratories and locations specializing in design and applications.

Developing and formulating materials in-house, we utilize the resource of our material database, including over 2,000 proprietary compounds and a range of unique products.

Trelleborg Sealing Solutions fulfills challenging service requirements, supplying standard parts in volume or a single custom-manufactured component, through our integrated logistical support, which effectively delivers over 40,000 sealing products to customers worldwide.

Facilities are certified to ISO 9001:2000 and ISO/TS 16949:2002, with many manufacturing sites also working to QS9000 and VDA 6.1. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology, Trelleborg AB.

ISO 9001:2000

ISO/TS 16949:2002

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

To obtain the best recommendation for a specific application, please contact your local Trelleborg Sealing Solutions marketing company.

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








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Rotary Seal

■ GENERAL DESCRIPTION







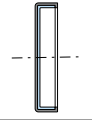
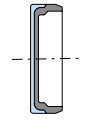

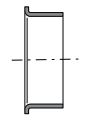




Table I Rotary seals selection criteria - Radial oil seals

| Family | Seal | | | | | Installation | Outer cover | | Dust lip | | Technical data* | |
|---|---|------|----------|----------------------|---|---------------|---------------|-------|----------|---------|-----------------|-------------------|
| | Profile | Page | TSS type | FORSHEDA /STEFA Type | Standard (Characteristics) | Size range mm | Rubber Coated | Metal | With | Without | Speed m/s | Pressure MPa max. |
| Radial Oil Seals  |  | 30 | TRA | CB | ISO 6194/1 DIN 3760 Type A | 4 - 500 | X | | | X | 30 | 0.05 |
| |  | 53 | TRE | CC | ISO 6194/0 DIN 3760 Type AS | 6 - 380 | X | | X | | 30 | 0.05 |
| |  | 66 | TRC | BB | ISO 6194/1 DIN 3761 Type B | 6 - 550 | | X | | X | 30 | 0.05 |
| |  | 73 | TRD | BC | ISO 6194/1 DIN 3761 Type BS | 15 - 400 | | X | X | | 30 | 0.05 |
| |  | 78 | TRB | DB | ISO 6194/1 DIN 3761 Type C | 20 - 760 | | X | | X | 30 | 0.05 |
| |  | 86 | TRF | DC | ISO 6194/1 DIN 3761 Type CS | 35 - 600 | | X | X | | 30 | 0.05 |
| |  | 91 | TRD_A | 1B/CC | Combined seal Rubber at backface | On demand | Half | Half | X | | 30 | 0.05 |
| |  | 91 | TRD_B | 2B/CC | Combined seal Rubber at frontface | On demand | Half | Half | X | | 30 | 0.05 |
| |  | 93 | TRU | - | Pressure seal | 8 - 120 | X | | X | | 10 | 0.50 |

* The data below are maximum values and cannot be used at the same time. The max. pressure depends on temperature.

Rotary Seal



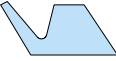


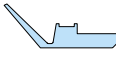


Radial oil seals - End covers - Shaft repair kit - Cassette seals

| Family | Seal | | | | | Installation | Outer cover | | Dust lip | | Technical data* | |
|---|---|------|----------|----------------------|----------------------------|---------------|---------------|-------|----------|---------|-----------------|-------------------|
| | Profile | Page | TSS type | FORSHEDA /STEFA Type | Standard (Characteristics) | Size range mm | Rubber Coated | Metal | With | Without | Speed m/s | Pressure MPa max. |
| Radial Oil Seals  |  | 97 | TRP | 6CC | Pressure seal | 11 - 365 | X | | X | | 10 | 0.5 |
| |  | 100 | TRQ_D | 12CC | Pressure seal | 15 - 55 | X | | X | | 5 | 1.0 |
| |  | 102 | TRK | CD | Low friction, no spring | 4 - 70 | X | | | X | 10 | Without |
| |  | 106 | TRG | BD | Low friction, no spring | 4 - 70 | | X | | X | 10 | Without |
| End Covers  |  | 118 | YJ38 | VK | End cover | 16 - 230 | X | | | | | 0.05 |
| |  | 122 | YJ39 | - | End cover | 22 - 270 | Half | Half | | | | 0.5 |
| Shaft Repair Kit  |  | 124 | TS | - | Sleeve | 12 - 200 | | X | | | | - |
| Cassette Seals  |  | 133 | TC5 | System 500 1HH | System 500 | 90 - 320 | | X | | | 10 | 0.05 |
| |  | 134 | TC3 | System 3000 1HHD | System 3000 | 130 - 150 | | X | X | | 4 | 0.05 |
| |  | 134 | TC0 | System 5000 1HD | System 5000 | On demand | | X | X | | 15 | 0.05 |

* The data below are maximum values and cannot be used at the same time. The max. pressure depends on temperature.

Rotary Seal







V-Rings

| Family | Seal | | | | | Installation Size range mm | Retention/Clamping possibilities | | Technical data* | |
|---|---|------|-----------------|---------------|---|----------------------------------|----------------------------------|----------------------|-----------------|-------------------|
| | Profile | Page | TSS designation | FORSHEDA-type | Standard (characteristics) | | With clamping band | With axial retention | Speed m/s | Pressure MPa max. |
| V-Ring  |  | 150 | VA | A | V-Ring Standard | 2.7 - 2010 | | X | 10 | Without |
| |  | 154 | VS | S | V-Ring Extended body | 4.5 - 210 | | X | 10 | Without |
| |  | 156 | VL | L | V-Ring Small profile | 105 - 2025 | | X | 10 | Without |
| |  | 156 | LX | LX | V-Ring Large diameter rigid lip | 135 - 2025 | | X | 10 | Without |
| |  | 159 | RM | RM | V-Ring Standard with clamping band, extended body | 300 - 2010 | X | | 10 | Without |
| |  | 159 | VB | RME | V-Ring Standard with clamping band | 300 - 2010 | X | | 10 | Without |
| |  | 164 | AX | AX | V-Ring Large diameter, flexible lip | 200 - 2020 | | X | 10 | Without |

* The data below are maximum values and cannot be used at the same time. The max. pressure depends on temperature.

Rotary Seal


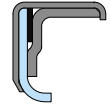

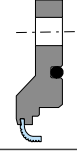
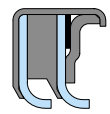

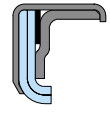
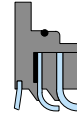
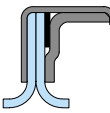

GAMMA seals, Axial shaft seals

| Family | Seal | | | | | Installation | Technical data* | |
|--|---|------|----------|------------|----------------------------------|---------------|-----------------|-------------------|
| | Profile | Page | TSS type | STEFA type | Standard (Characteristics) | Size range mm | Speed m/s | Pressure MPa max. |
| GAMMA Seals  |  | 167 | TBP | RB | GAMMA Seal standard | 10 - 225 | 20 | Without |
| |  | 167 | TBR | 9RB | GAMMA Seal with labyrinth | 15 - 108 | 20 | Without |
| Axial Shaft Seals  |  | 177 | I | - | Axial shaft seal inside sealing | 10 - 100 | 30 | 0.01 |
| |  | 177 | A | - | Axial shaft seal outside sealing | 10 - 114 | 15 | 0.01 |

* The data below are maximum values and cannot be used at the same time. The max. pressure depends on temperature.






Rotary Seal

PTFE Rotary Shaft seals - Varilip® and PDR™

| Family | Seal Type | Family | Seal Type | |
|---|---|---|---|--|
| Varilip®  |  | PDR™  |  | <p>Trelleborg Sealing Solutions manufacture and supply PTFE Rotary Shaft Seals for applications where elastomer seals cannot provide a satisfactory sealing solution.</p> <p>Through the development of both a standard range of seals and an ever increasing demand for bespoke custom designs, TSS have accumulated over 35 years experience in designing and specifying PTFE shaft seals for use in a wide range of applications in compressors, pumps, gearboxes, mixers, machine tools, blowers, bearings, hubs, crankshafts, separators and a variety of specialist equipment.</p> <p>The properties of the PTFE grades used allow a wide operating temperature range of -100°C to +260°C whilst providing superb chemical resistance.</p> <p>Seals can be produced to accommodate pressures up to 2 MPa and with specific designs surface speeds in excess of 90 m/s can be successfully sealed.</p> <p>Particular benefits can be achieved through the integration of a custom seal into the surrounding system hardware and designs can be produced which are optimized to the specific sealing requirements of the application, such as endurance, power consumption or heat generation.</p> |
| |  | |  | |
| |  | |  | |
| |  | |  | |
| <p>For further detailed information on this product range please request our separate catalogue on PTFE Rotary Shaft Seals</p> | | | | |

Rotary Seal

Turcon® rotary seals

| Family | Seal | | Application | Standard | Size range | Function | | Technical Data* | | | Material | Shaft |
|--|---|------|---|------------|------------|----------------------|---------|-----------------|---------------|---------------|------------------------|-------------------------|
| | Type | Page | | | | Field of application | ISO/DIN | mm | Single acting | Double acting | | |
| | | | °C | m/s | MPa max. | | | | | | Standard seal material | Mating surface hardness |
| Turcon® seals Elastomer energized  | Turcon® Roto Glyd Ring® O.D.  | 188 | Rotary distributors Pivoting motors: - Mobile hydraulic - Machine tools | ISO 7425/1 | 8 - 2700 | - | X | -45 to +200 | 1 | 30 | Turcon® T10 | >55 HRc |
| | | | | | | | | | 2 | 20 | Turcon® T40 | >55 HRc |
| | Turcon® Roto Glyd Ring® I.D.  | 188 | Rotary distributors Pivoting motors: - Mobile hydraulic - Machine tools | ISO 7425/2 | 6 - 2600 | - | X | -45 to +200 | 1 | 30 | Turcon® T10 | >55 HRc |
| | | | | | | | | | 2 | 20 | Turcon® T40 | >55 HRc |
| Turcon® seals Spring energized  | Turcon® Roto Variseal®  | 204 | Rotary distributors Pivoting motors: - Pharmacy - Machine tools - Foodstuff - Industry - Chemical | - | 5 - 2500 | X | | -100 to +200 | 2 | 15 | Turcon® T40 | >55 HRc |
| | | | | | | | | | 2 | 5 | Turcon® T78 | >170 HB |

* The data below are maximum values and cannot be used at the same time. The max. pressure depends on temperature.

** Temperature range is depending on choice of elastomer material.

■ Introduction

Rotating or pivoting devices require a lubrication fluid to secure the service life. To keep the lubrication fluid within the system and avoid environmental pollution, Rotary shaft seals are usually installed. In most applications the seal is either partially or temporarily immersed or is simply exposed to splashing lubricant, particularly in engines, transmissions, gearboxes or axles. In the above applications the elastomeric shaft seals are required to provide leak-free sealing even at surface speeds up to 30 m/s and temperatures up to 200°C. At the same time the seal must prevent ingress of mud and water from outside. These high-speed applications operate generally without or at very low pressure. When the speed is increasing (up to 90 m/s) the sealing lip will be produced out of PTFE based materials (Turcon® and other) to reduce the tangential friction force and consequently the heat generation.

To solve various applications with working conditions characterised by low or medium circumferential speed and high pressures up to 20 MPa, Trelleborg Sealing Solutions offers a wide range of profiles mainly produced out of PTFE based materials (Turcon® and other). Very often fluids with good lubricating properties must be sealed at high pressures, but obviously non-lubricating fluids such as water, foodstuff, or chemicals need to be sealed. The large Trelleborg Sealing Solutions material and product range will provide an adapted solution to your sealing problem provided that all working parameters have been carefully considered. A short description of the most critical parameters can be found in the next chapter.

■ Working parameters

Media

The media to be sealed influences heavily the choice of the seal and material type. Mainly liquid media need to be sealed in rotary applications. Pasty media generally restrict the use of number of rotary seals available especially in terms of circumferential velocity. Gaseous media require specially adapted seal designs.

Liquid media:

Most of the applications relate to lubricating fluids but also hydraulic fluids based on mineral oils acc. DIN 51524 or ISO 6743 or fire resistant hydraulic fluids as well as environmentally friendly hydraulic fluids. In specific application aggressive media with low lubricating capabilities must be sealed. Sealing of other fluids such as water or FDA compliant fluids require in many cases a special sealing solution and will not be handled in details in this catalogue. For specific needs please contact your local Trelleborg Sealing Solutions company. The media is the first criteria to be considered for the selection of the material type. It will influence as well the seal family as the profile.

The evaluation of the compatibility of the seal material with the media to be sealed is based on the analysis of the values of tensile strength, elongation, volume change and

hardness change resulting from an immersion test of testing slabs. A lot of compatibility tests have been carried out over years nevertheless for some media the results are not available. Please contact your local Trelleborg Sealing Solutions company for further details.

Mineral oils:

Mainly in use in transmissions, they have on average, proven good compatibility with the elastomer materials within the recommended temperature range. Some mineral oils e.g. hypoid transmission oils contain special additives allowing higher demand e.g. temperature range and/or high pressure which require a compatibility check in a field test.

Synthetic oils:

For improvement of the viscosity, high temperature and/or service life, new oils with specific additives have been launched as partial or full synthetic oils. Basically the synthetic oils show the same good compatibility with the elastomer materials as the mineral oils. Also for these oil types the compatibility needs to be checked in case special ingredients are added to improve the viscosity, temperature and pressure performance.

Grease:

Often used for roller and plain bearings, this media requires special adaptation of the sealing solution. To reduce the risk of tilting the sealing lip and allow the sealing lip to open under increasing pressure, the seal is installed in the reverse direction. Another important parameter to be considered is the maximum circumferential velocity. The maximum speed must be reduced to 50% of the permitted speed in oil, due to the poor heat exchange the grease can provide.

Above this limit the change from grease to oil or installation of seal with PTFE based lip (Turcon® and other) should be considered.

Poor lubricating media:

For those media an initial lubrication of the seal is required to avoid dry running. In such applications we recommend the radial oil seal with dust lip. The area between the lips will be used as a lubricant reservoir. Two seals in tandem Radial oil seal/ Radial oils seal or Radial oil seal/GAMMA seal will provide the same result

Aggressive media:

Generally aggressive media (e.g. solvents) have poor lubricating properties and therefore we recommend Turcon® Varilip® or PDR seals. Turcon® and other PTFE materials solve the problem of chemical resistance and the metal cage can be produced out of various Stainless Steel materials. For further details on these products please refer to our separate catalogue on "PTFE Rotary Shaft Seals"

Rotary Seal

Circumferential velocity

The trend in the market shows an important increase of the circumferential velocity and therefore new heat-resistant materials need to be developed.

Velocity mainly influences the heat generation in the sealing gap and thus limits the use of the seal. The dissipation of the heat generated by the friction occurs via the media and the shaft itself. Depending on the capability of the fluid to be sealed to convey the heat away from the sealing area, the circumferential velocity must be reduced accordingly e.g. in dry running conditions the heat generated in the sealing area can be 40 °C above the fluid temperature. In such cases we recommend to limit the use in maximum environment temperature by the above value.

In addition to the heat generation, the important criteria to be considered is the possible loss of contact of the sealing lip due to centrifugal forces. This applies to rotating seals with axial sealing lips e.g. V-Ring or GAMMA-seal. Velocity limits are specified in each individual chapter.

Problems may also occur when radial lip seals are assembled into housings rotating at high angular velocity.

Pressure

Rotary seals often operate without system pressure applied. Nevertheless the relative movements within the equipment or heat generation can create pressure peaks generally limited to 0.05 MPa.

The pressure applied to the sealing lip increases the friction force and consequently the heat generation. Therefore the operating conditions need to be adapted/reduced accordingly. See recommendations in the corresponding chapters.

Pressures up to 1MPa require either special back-up rings or special radial oil seal profiles. See selection Table II.

Rotary joints are mainly dedicated to convey various fluids under high pressures up to 30 MPa and thus require Turcon® based sealing elements either Turcon® Roto Glyd Ring® or Turcon® Roto Variseal® depending on the circumferential velocity. First selection can be made from the Table II.

Pressure influences heavily the lubricating film in the contact area of the lip and consequently the heat generation. Therefore a reduction in circumferential velocity is required when pressure is applied to the sealing lip.

Temperature

Temperature is the most critical criteria to be considered when selecting a rotary seal.

The temperature limits indicated in the selection tables are maximum operating temperatures of the sealing material in fluids for which the material compatibility is secured (good chemical resistance and controlled swelling/shrinkage).

The above descriptions show that the temperature in the sealing area is influenced by various parameters especially:

- The lubricating capability of the fluid and its ability to dissipate the heat generated under the sealing lip.
- The circumferential velocity
- The pressure applied

The resulting temperature in the sealing area must be considered to select the appropriate material. The initial temperature of the fluid can increase by up to 50% depending on the above operating parameters. For all applications please refer to the recommendations in the various chapters and don't hesitate to contact your local Trelleborg Sealing Solutions company if any doubt remains.

Hardware

In all chapters the hardware parameters are described in relation to the profile and material types.

Nevertheless one general rule is valid for all rotary seals: the mating surface (shaft surface) must be free of spiral grinding marks as they may cause pumping effects and leakage. Plunge grinding is to be the preferred machining method for the shaft.

Wear on the shaft in the contact area of the sealing lip is the most frequent failure mode the shaft seal users can meet with. It is mainly the result of unexpected metal particles carried by the fluid to the sealing lip. The particles are embedded in elastomer materials that act as a millstone and grind grooves into the shaft. To avoid such failure modes either particles must be kept away from the sealing lip or the surface roughness must be adjusted to be able to accommodate them. Therefore it requires high surface hardness. Trelleborg Sealing Solutions recommend a minimum hardness of 55 HRC on minimum 0.3 mm depth. Other material combinations are possible depending on the contamination in the system. See recommendations in the chapter "Environment".

Shaft run out and eccentricity should as far as possible be avoided as these parameters may cause leakage depending on the capability of the sealing lip to follow the shaft movements. Limits can be found in the various chapters. They may vary for the different seal materials.

Rotary Seal

■ Environment

Leakage control

When defining leakage control one must differentiate between static sealing (sealing of two surfaces without motion relative to one another) and dynamic sealing (relative motion between the two surfaces).

With a moving seal surface, a fluid film separates the sliding surfaces from one another; a dynamic seal gap forms. The leakage path is not fully closed off as with static sealing, so small quantities may escape. Seals in which a dynamic seal gap forms between the seal body and a rotating shaft cannot be tight in the physical sense.

Absolute tightness in the physical sense cannot be achieved with a seal gap alone when sealing moving parts.

For many technical applications, however, it is quite adequate if the "leakage" is reduced to such an extent that there are no negative consequences for the environment or the operation of the assembly. This is called technical tightness.

Technical tightness must be specified by the user or manufacturer of an assembly, i.e. in some circumstances maximum permitted leakage rates must be defined.

For example, leakage classes are defined for oil seals in DIN 3761 Part II (Motor vehicles). Today "zero leakage" is demanded in practice for motor vehicle applications. Zero leakage means that under various conditions the fluid being sealed must be absolutely separated from the environment.

Environmentally-friendly hydraulic fluids (bio oils)

When machines or process equipment is hydraulically operated, escaping hydraulic oil can pollute surface waters and the ground. One way of minimising the danger posed by unwanted leakage, is the use of biologically degradable, non toxic oils. In many countries, there are already statutory regulations and catalogues of requirements for dealing with materials that endanger water. Hydraulic and transmission fluids that protect the environment are already specified in some cases. Figure 1 shows the types of biodegradable fluids.

Environmentally-friendly fluids have application in all systems, which operate for example in mobile and agricultural machinery and in the water and forestry industries. In stationary systems, they are employed in plants where water is endangered, such as locks, water turbines and for foodstuffs and pharmaceutical products.

An important criterion for biologically rapidly degradable fluids is their compatibility with seals. In Table II the resistance of elastomeric materials are given to "bio-oils". They are, however, provided with a number of comments.

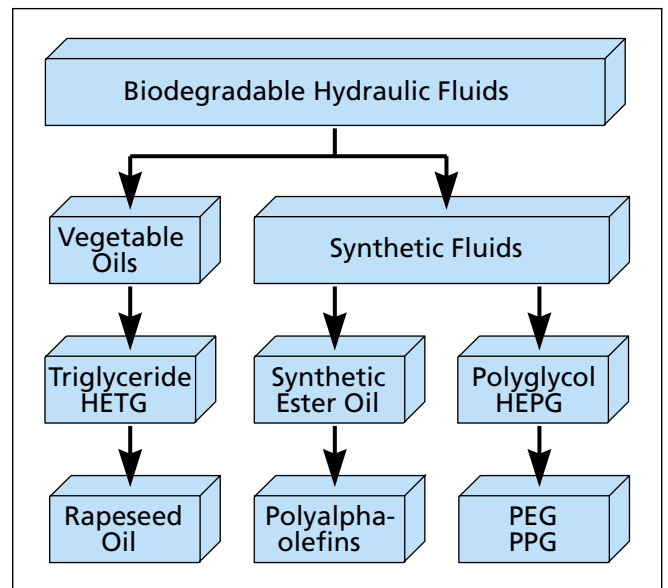


Figure 1 Biodegradable hydraulic fluids

The listings can therefore only be considered as a recommendation. Checking is advisable for the majority of the oils available commercially. In case of doubt, the use of Turcon® seals and Turcite® Slydring® guides is recommended for reasons of safety.

Special testing is generally advised.

Rotary Seal

Table II Recommendations for the use of standard elastomer materials and accordance with ISO VG 32 to 68 and VDMA Directive 24569

| Oil Temperature | < 60°C | < 80°C | < 100°C | < 120°C |
|----------------------|--|---|--------------------------|--------------------------|
| Oil Type / ISO VG | 32 - 68 | 32 - 68 | 32 - 68 | 32 - 68 |
| HETG (Rapeseed) | AU ¹ NBR HNBR FKM | AU ¹ NBR HNBR FKM | — — — — | — — — — |
| HEES | AU ¹ NBR ¹ HNBR ¹ FKM ¹ | AU ¹ NBR ¹ HNBR ¹ FKM | — — — FKM | — — — FKM |
| HEPG (PAG) | AU ¹ NBR ¹ HNBR ¹ FKM ¹ | NBR HNBR FKM ² | HNBR FKM ² | HNBR FKM ² |
| HEPR (PAO) | not yet specified | not yet specified | not yet specified | not yet specified |

1. For dynamic application, specific test required
2. Preferred peroxide cured FKM

Rotary Seal

■ Quality criteria

The cost-effective use of seals and bearings is highly influenced by the quality criteria applied in production. Seals and bearings from Trelleborg Sealing Solutions are continuously monitored according to strict quality standards from material acquisition through to delivery.

Certification of our production plants in accordance with international standards QS 9000 / ISO 9000 meets the specific requirements for design, quality control and management of purchasing, production and marketing functions.

Our quality policy is consistently controlled by strict procedures and guidelines which are implemented within all strategic areas of the company.

All testing of materials and products is performed in accordance with accepted test standards and specifications, e.g. random sample testing in accordance with DIN ISO 2859, part 1. Inspection specifications correspond to standards applicable to individual product groups (e.g. for O-Rings: ISO 3601).

Our sealing materials are produced free of chlorofluorinated hydrocarbons and carcinogenic elements.

The tenth digit of our part number defines the quality characteristics of the part. A hyphen indicates compliance with standard quality criteria outlined in this catalogue. Customer-specific requirements are indicated by a different symbol in this position. Customers who require special quality criteria should contact their local Trelleborg Sealing Solutions sales office for assistance. We have experience in meeting all Customer quality requirements.

■ Storage and shelf life

Seals and bearings are often stored as spare parts for prolonged periods. Most rubbers change in physical properties during storage and ultimately become unserviceable due to e.g. excessive hardening, softening, cracking, crazing or other surface degradation. These changes may be the result of particular factors or combination of factors, such as the action of deformation, oxygen, ozone, light, heat, humidity or oils and solvents.

With a few simple precautions, the shelf life of these products can be considerably lengthened.

Fundamental instructions on storage, cleaning and maintenance of elastomeric seal elements are described in international standards, such as:

DIN 7716 / BS 3F68:1977,
ISO 2230, or
DIN 9088

The standards give several recommendations for the storage and the shelf life of elastomers, depending on the material classes.

The following recommendations are based on the several standards and are intended to provide the most suitable conditions for storage of rubbers. They should be observed to maintain the optimum physical and chemical values of the parts:

Heat

The storage temperature should preferably be between +5 °C and +25 °C. Direct contact with sources of heat such as boilers, radiators and direct sunlight should be avoided. If the storage temperature is below +5 °C, care should be taken to avoid distorting them during handling at that temperature as they may have stiffened. In this case the temperature of the articles should be raised to approximately +20 °C before they are put into service.

Humidity

The relative humidity in the store room should be below 70 %. Very moist or very dry conditions should be avoided. Condensation should not occur.

Light

Elastomeric seals should be protected from light sources, in particular direct sunlight or strong artificial light with an ultraviolet content. The individual storage bags offer the best protection as long as they are UV resistant.

It is advisable to cover any windows of storage rooms with a red or orange coating or screen.

Radiation

Precaution should be taken to protect stored articles from all sources of ionising radiation likely to cause damage to stored articles.

Rotary Seal

Oxygen and ozone

Where possible, elastomeric materials should be protected from circulating air by wrapping, storage in airtight containers or by other suitable means.

As ozone is particularly deleterious to some elastomeric seals, storage rooms should not contain any equipment that is capable of generating ozone, such as mercury vapour lamps, high voltage electrical equipment, electric motors or other equipment which may give rise to electric sparks or silent electrical discharges. Combustion gases and organic vapour should be excluded from storage rooms as they may give rise to ozone via photochemical processes.

Deformation

Elastomeric materials should, wherever possible, be stored in a relaxed condition free from tension, compression or other deformation. Where articles are packed in a strain-free condition they should be stored in their original packaging.

Contact with liquid and semi-solid materials

Elastomeric seals should not be allowed to come into contact with solvents, oils, greases or any other semi-solid materials at any time during storage, unless so packed by the manufacturer.

Contact with metal and non-metals

Direct contact with certain metals, e.g. manganese, iron and particularly copper and its alloys, e.g. brass and compounds of these materials are known to have deleterious effects on some rubbers. Elastomeric seals should not be stored in contact with such metals.

Because of possible transfer of plasticisers or other ingredients, rubbers must not be stored in contact with PVC. Different rubbers should preferably be separated from each other.

Cleaning

Where necessary, cleaning should be carried out with the aid of soap and water or methylated spirits. Water should not, however, be permitted to come into contact with fabric reinforced components, bonded seals (because of corrosion) or polyurethane rubbers. Disinfectants or other organic solvents as well as sharp-edged objects must not be used. The articles should be dried at room temperature and not placed near a source of heat.

Shelf life and shelf life control

The useful life of a elastomeric seals will depend to a large extent on the type of rubber. When stored under the recommended conditions (above sections) the below given shelf life of several materials shown below should be considered.

| | |
|------------------------------------|-----------|
| AU, Thermoplastics | 4 years |
| NBR, HNBR, CR | 6 years |
| EPDM | 8 years |
| FKM, VMQ, FVMQ | 10 years |
| FFKM, Isolast [®] | 18 years |
| Turcon [®] and other PTFE | unlimited |

Elastomeric seals should be inspected after the given period. After this if the parts have not deteriorated an extension period is possible.

Rubber details and components less than 1.5 mm thick are liable to be more seriously affected by oxidation degradation even when stored in satisfactory conditions as recommended. Therefore they may be inspected and tested more frequently than it is mentioned above.

Rubber details / seals in assembled components

It is recommended that the units should be exercised at least every six months and that the maximum period a rubber detail be allowed to remain assembled within a stored unit, without inspection, be a total of the initial period stated above and the extension period. Naturally this will depend on the design of the unit concerned.



Rotary Seal

■ Design instructions

All relevant national and international standards containing instructions for design and assembly.

(e.g. DIN 3760/3761 and ISO 6194/1)

Installation in the gland

The static seal in the mounting bore is provided by the corresponding force fit allowance at the outer sheath of the seal.

The Radial Oil Seals are referred according to the design of the outer cover - rubber coated (smooth or corrugated) or metallic. The bore is toleranced to ISO H8.

Values for the surface roughness in the gland are specified in ISO 6194/1.

| | | | | |
|-----------------|------------------|---|-----------|---------------|
| General values: | R_a | = | 1.6 - 6.3 | μm |
| | R_z | = | 10 - 20 | μm |
| | R_{max} | = | 16 - 25 | μm |

For metal/metal sealing or gas sealing, a good score-free and spiral-free surface finish is necessary. If the rotary shaft lip seal is bonded into the housing, ensure that no adhesive comes into contact with the sealing lip or the shaft.

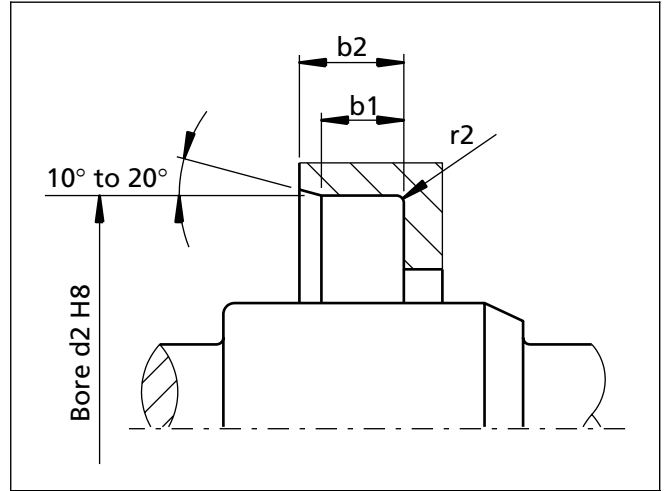


Figure 2 Installation depth and lead-in chamfer

Table III Housing dimensions

| Ring Width b | b_1 ($0.85 \times b$) mm | b_2 ($b + 0.3$) mm | r_2 max. |
|----------------|------------------------------------|------------------------------|---------------|
| 7 | 5.95 | 7.3 | 0.5 |
| 8 | 6.80 | 8.3 | |
| 10 | 8.50 | 10.3 | |
| 12 | 10.30 | 12.3 | 0.7 |
| 15 | 12.75 | 15.3 | |
| 20 | 17.00 | 20.3 | |

Installation on the shaft

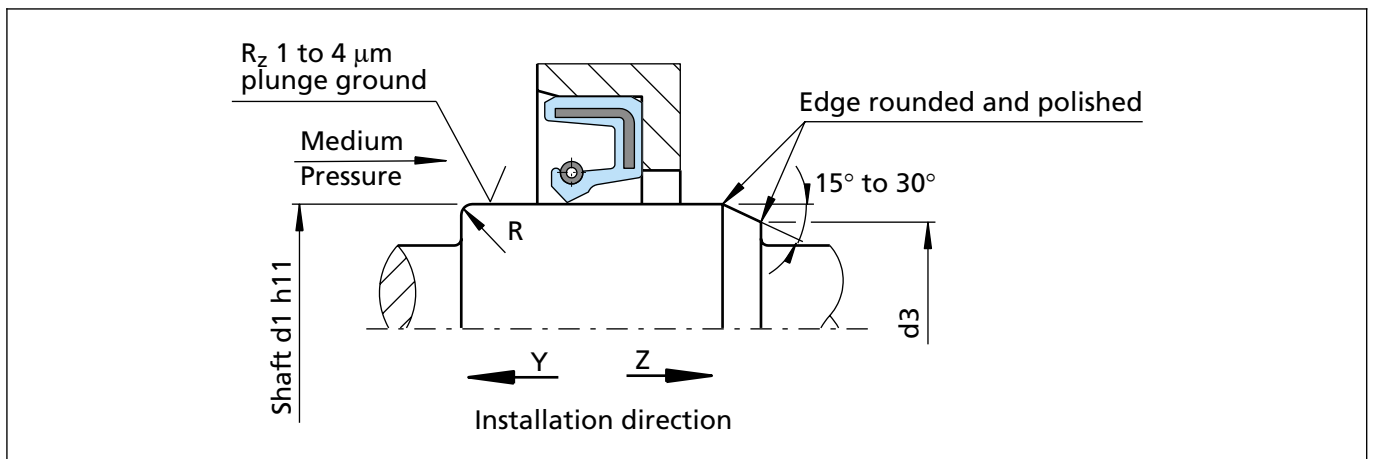


Figure 3 Installation of the Radial Oil Seal

Depending on the installation direction (Y or Z), a chamfer or radius on the shaft is recommended. The dimensions for this are shown in Figure 3 and Table IV.

Rotary Seal

Table IV Chamfer length for shaft end

| d_1 | d_3 | R |
|-----------------|--------------|----|
| < 10 | $d_1 - 1.5$ | 2 |
| over 10 to 20 | $d_1 - 2.0$ | 2 |
| over 20 to 30 | $d_1 - 2.5$ | 3 |
| over 30 to 40 | $d_1 - 3.0$ | 3 |
| over 40 to 50 | $d_1 - 3.5$ | 4 |
| over 50 to 70 | $d_1 - 4.0$ | 4 |
| over 70 to 95 | $d_1 - 4.5$ | 5 |
| over 95 to 130 | $d_1 - 5.5$ | 6 |
| over 130 to 240 | $d_1 - 7.0$ | 8 |
| over 240 to 500 | $d_1 - 11.0$ | 12 |

Installation instructions

The following points must be observed when installing rotary shaft lip seals:

- Before installing, clean the installation grooves. Shaft and seal must be greased or oiled for rubber seals
- Sharp-edged transitions must either be chamfered or rounded or else covered
- When pressing in the seal, take care that the seal ring is not twisted
- The pressing force must be applied as close as possible to the outer circumference of the seal
- After installation, the seal must be concentric and at right angles to the shaft
- The end face of the mounting bore is generally used as the contact surface; the seal can also be fixed with a shoulder or a spacer washer.

Figure 4 shows various force fit situations of the rotary shaft lip seal with suitable installation tools or devices.

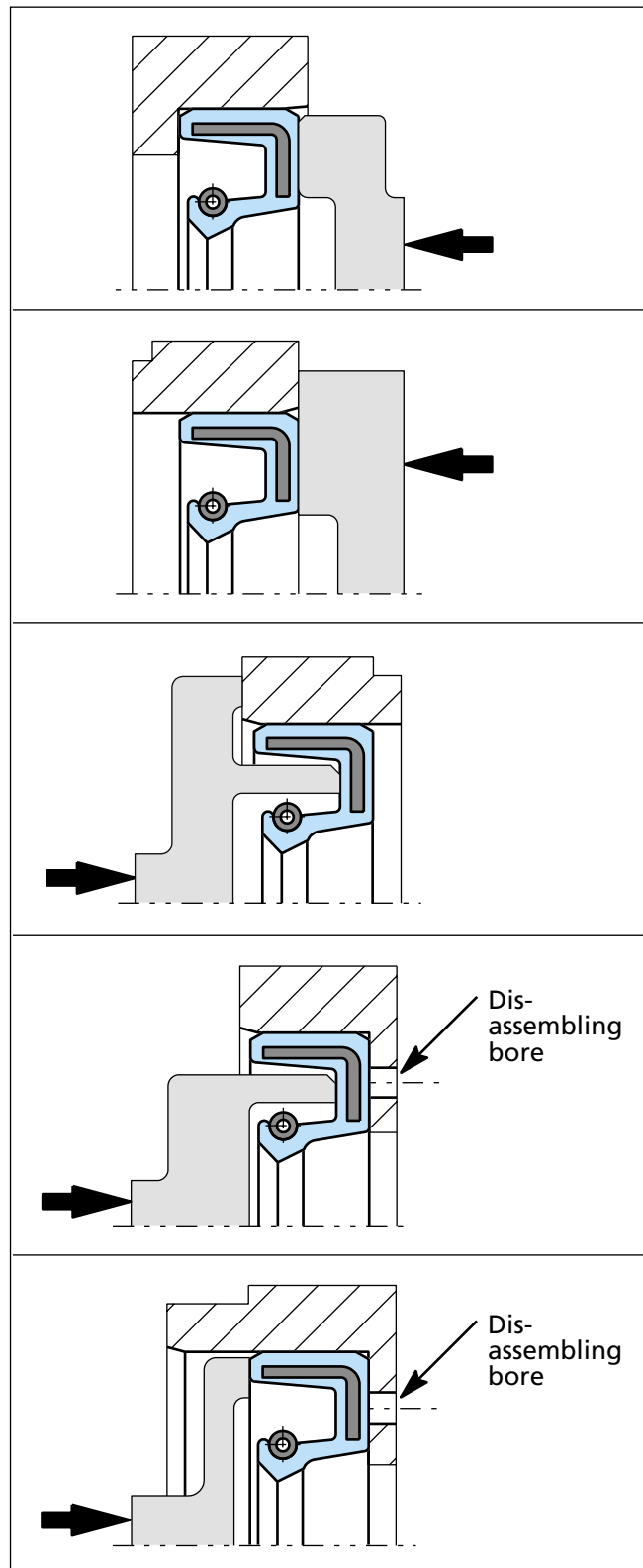


Figure 4 Installation aids for fitting rotary shaft lip seals

Rotary Seal

Surface finish

In order to achieve an optimum sealing solution, it is also necessary to select suitable material pairing between the seal and the mating surface.

Surface roughness

The functional reliability and service life of a seal depend to a very great extent on the quality and surface finish of the mating surface to be sealed. Scores, scratches, pores, concentric or spiral machining marks are not permitted. Higher demands must be made on the surface finish of dynamic mating surfaces than to static mating surfaces.

The characteristics most frequently used to describe the surface microfinish, R_a , R_z and R_{max} , are defined in ISO 4287. These characteristics alone, however, are not sufficient for assessing the suitability in seal engineering. In addition, the material contact area R_{mr} in accordance with ISO 4287 should be considered. The significance of these surface specifications is illustrated in Figure 5. It shows clearly that specification of R_a or R_z alone does not describe the profile form accurately enough and is thus not sufficient for assessing suitability in seal engineering.

The material contact area R_{mr} is essential for assessing surfaces, as this parameter is determined by the specific profile form. This in turn is directly depending on the machining process employed.


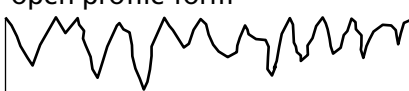
| Surface profile | R_a | R_z | R_{mr} |
|--|-------|-------|----------|
|  closed profile form | 0.1 | 1.0 | 70% |
|  open profile form | 0.2 | 1.0 | 15% |

Figure 5 Profile forms of surfaces

Characteristics of the shaft surface

The running surface for oil seals is specified in DIN 3760/61. The surface should meet the following requirements:

Surface roughness R_a = 0.2 to 0.8 μm
 R_z = 1 to 4 μm
 R_{max} = 6.3 μm

Hardness 55 HRC or 600 HV,
 hardness depth min. 0.3 mm



Radial Oil Seal

■ RADIAL OIL SEAL

■ The seal

General

Rotary shaft lip seals are components designed in a ring form, fitted between machine parts in relative rotation, with the function of separating oil or grease from the inside and dirt, dust, water etc. from the outside.

The rotary shaft seals are generally composed by an elastomeric diaphragm, shaped in a "lip form" and reinforced with a co-vulcanised metal insert. The sealing lip is energised with a "Garter Spring".

Seal design

The sealing lip design corresponds to the current state of art and is based on many years of experience in a wide range of application fields.

The sealing edge can either be ready moulded or trimmed by mechanical cutting.

The total radial force of the sealing lip is given by elastomer pre-tension together with tensile spring force. The former depends on the deformation and elasticity of the rubber material, geometry of the sealing lip and interference between shaft and seal.

Outer sheath can be either flat or wavy, fitting in both cases into ISO H8 bore.

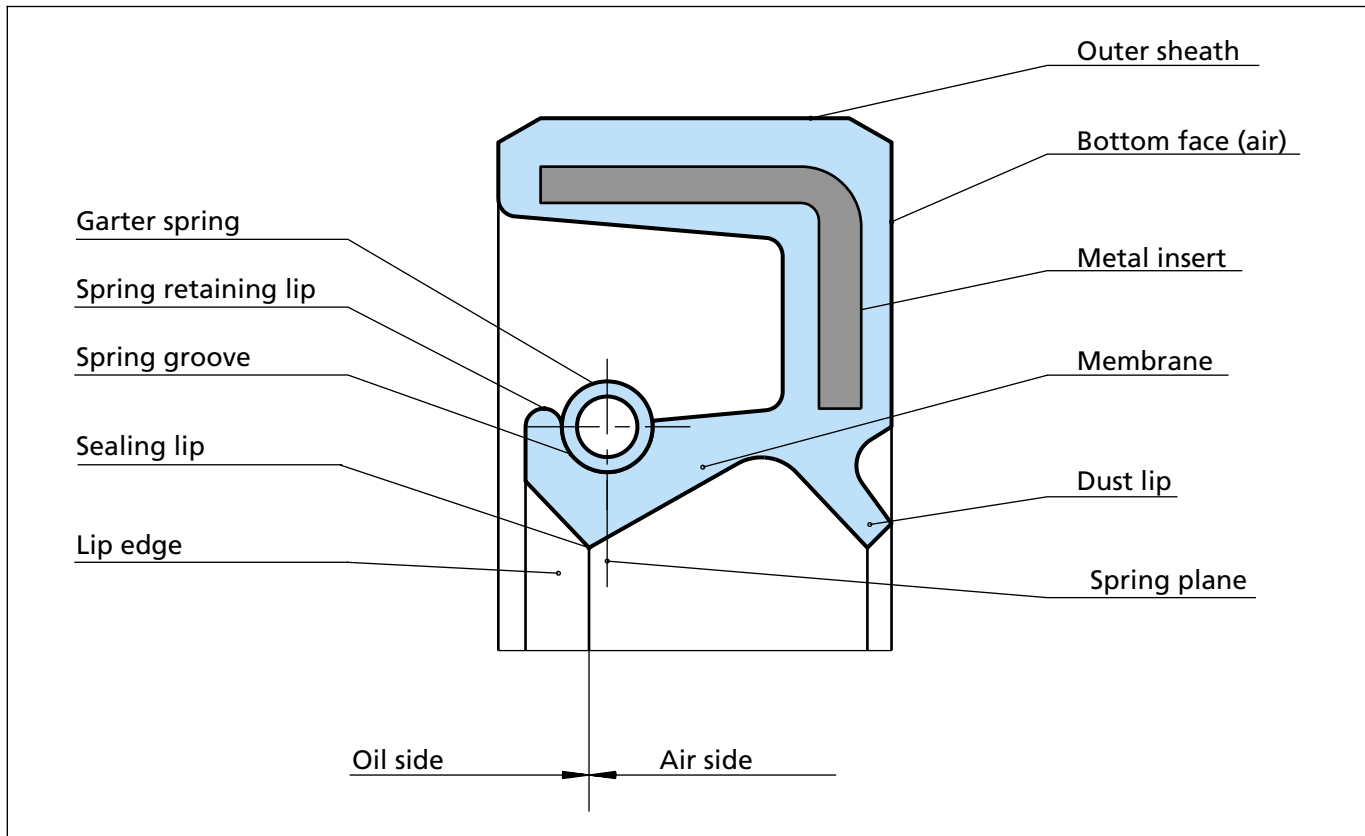


Figure 6 Designations for Rotary shaft lip seals (extract from ISO 6194)



Sealing element

Materials

The demands made on the material must take into account the environmental conditions and the function of the seal.

Some of the requirements associated with environmental considerations are:

- Good chemical resistance
- Good resistance to heat and low temperature
- Good resistance to ozone and weathering

The functional demands include:

- High resistance to wear
- Low friction
- Low compression set
- Good elasticity

In addition, cost considerations render good processability a desirable feature. No material is available today which satisfies all these requirements. The choice of materials is

therefore always a compromise between the relative significances of the factors involved.

Type and designations of materials

| | |
|-----------------------------|--------|
| Nitrile rubber | (NBR) |
| Acrylic rubber | (ACM) |
| Silicone rubber | (VMQ) |
| Fluorinated rubber | (FKM) |
| Hydrogenated Nitrile rubber | (HNBR) |

A further development of the Nitrile rubber has led to the so called hydrogenated Nitrile rubber (HNBR). The heat and ozone resistance is significantly better. This material can replace Acrylic rubber and in certain cases also Fluorinated rubber. In order to satisfy the wide range of demands made on seals, a special composition has been developed for each type of rubber. Other compositions are also available to meet some extreme requirements.

Table V Material recommendations

| Materials for sealing common media | | Material designation | | | | |
|---|------------------------------|---|--------------------------------|-------------------------------|---------------------------|--|
| | | Acrylonitrile Butadiene Rubber NBR | Fluoro carbon Rubber FKM | Polyacrylate Rubber ACM | Silicone Rubber VMQ | Hydrogenated Acrylonitrile Butadien Rubber HNBR |
| | | Material Abbreviation | | | | |
| | | N | V | A | S | H |
| | | Max. permissible constant temperature (°C) | | | | |
| Mineral fluids | Engine oils | 100 | 170 | 125 | 150 | 130 |
| | Transmission oils | 80 | 150 | 125 | 130 | 110 |
| | Hypoid transmission oils | 80 | 150 | 125 | -- | 110 |
| | ATF oils | 100 | 170 | 125 | -- | 130 |
| | Hydraulic fluids (DIN 51524) | 90 | 150 | 120 | -- | 130 |
| | Greases | 90 | -- | -- | -- | 100 |
| Flame retardant hydraulic fluids (VDMA 24317) (VDMA 24320) | Oil-water emulsion | 70 | -- | -- | 60 | 70 |
| | Water-oil emulsion | 70 | -- | -- | 60 | 70 |
| | Aqueous solutions | 70 | -- | -- | -- | 70 |
| | Water-free fluids | -- | 150 | -- | -- | -- |
| Other media | Fuel oils | 90 | -- | -- | -- | 100 |
| | Water | 90 | 100 | -- | -- | 100 |
| | Lyes | 90 | 100 | -- | -- | 100 |
| | Air | 100 | 200 | 150 | 200 | 130 |

Due to the different configurations of the media, the above-mentioned temperature ranges are for guidance only. Depending on the medium, significant deviations may occur.



Radial Oil Seal

Description of rubber materials

Nitrile Rubber (NBR)

Advantages:

- Good oil resistance
- Good heat resistance up to 100°C in oil
- High tensile strength (special compounds over 20 MPa)
- High elongation at break
- Low swelling in water

Limitations:

- Poor weather and ozone resistance
- Poor resistance against polar fluids (ester, ether, ketones and aniline)
- Poor resistance against chlorinated hydrocarbons (carbon tetrachloride, trichlorethylene)
- Poor resistance against aromatic fluids (e.g. benzene, toluene)

Fluids, mineral oils and above all high-alloyed mineral oils (hypoid oils) containing larger quantities of aromatic hydrocarbons are critical as they have a high swelling effect on NBR- compounds. The swelling behaviour can be improved by increasing the acrylonitrile content.

However an inferior cold flexibility and resistance to compression set must be accepted. The additives in high-alloyed oils can in certain cases cause an additional interaction between the elastomer and the additive, thus influencing the elasticity.

Hydrogenated Nitrile Rubber (HNBR)

Advantages:

- Good oil resistance, also in hypoid oils
- Good heat resistance, up to + 150 °C
- Good mechanical properties
- Good weather and ozone resistance

Limitations:

- Poor resistance against polar fluids (esters, ethers, ketones and aniline)
- Poor resistance against chlorinated hydrocarbons (carbon tetrachloride, trichlorethylene)
- Poor resistance against aromatic fluids (bensene, toluene)

Polyacrylic Rubber (ACM)

Advantages:

- Good resistance against oils and fuels (better than Nitrile rubber)
- Heat resistance about 50 °C better than for Nitrile rubber, 150 °C in oil and 125 °C in air
- Good weather and ozone resistance

Limitations:

- Not usable in contact with water and water solutions, even smaller quantities of water in oil
- Limited cold flexibility to about -20 °C, somewhat poorer than normal NBR
- Limited tensile strength and tear resistance, especially above 100 °C
- Poor wear resistance (considerably inferior compared to NBR)
- Poor resistance against polar and aromatic fluids and chlorinated hydrocarbons



Fluorinated Rubber (FKM)

Advantages:

- The resistance against oils and fuels is better than for any other rubber type
- The only highly elastic rubber material, which is resistant to aromatic and chlorinated hydrocarbons
- Excellent heat resistance, the best one after silicone rubber, up to 200°C
- Excellent weather and ozone resistance
- Excellent acid resistance (only inorganic acids, not suitable for organic acids e.g. acetic acid)

Limitations:

- Limited cold flexibility, to approx. -20°C to -25°C
- Limited tensile and tear strength, especially above 100°C
- High compression set in hot water
- Poor resistance to polaric solvents

Silicone Rubber (VMQ)

Advantages:

- Best heat resistance of all rubber types
- Best cold resistance of all rubber types
- Excellent weather and ozone resistance
- Resistant against aliphatic mineral oils and most grease types

Limitations:

- Poor tensile and tear strength for standard compounds
- Poor wear resistance
- Poor resistance against aromatic oils and oxidized mineral oils
- Poor diffusion resistance



Radial Oil Seal

Temperature resistance

Increasing temperature accelerates the aging of the rubber, the material becomes hard and brittle, the elongation decreases and the compression set increases. Axial cracks at the sealing edge are a typical indication that the seal has been exposed to excessively high temperature. The aging of the rubber has appreciable significance on the useful life of the seal. The temperature limits for the principal materials are illustrated in Figure 7. They should only be regarded as approximate, since the materials are also affected by the medium. It can generally be said that a temperature increase of 10°C (in air) will halve the theoretical useful life of the rubber.

Oil resistance

Innumerable types of oil are available on the market and each of these has a different effect on the rubber.

In addition, a given type of oil from different manufactures may have a different influence. The rubber is generally affected by the additives in the oil. This is the case with hypoid oil which contains sulfur. Since sulfur is used as vulcanizing agent for nitrile rubber, the sulfur additive in the oil acts as a vulcanizing agent at temperatures above + 80°C. As a result of this secondary curing, Nitrile rubber will rapidly become hard and brittle. Hydrogenated Nitrile, Acrylic and Fluorinated rubbers which are not vulcanized with sulfur, can therefore be used for this type of oil, even though the operating temperature may not require these. Oxidized oils represent another example illustrating the difficulty of tabulating the oil resistance of rubber materials. These oils are oxidized during operation and their properties will therefore change substantially. Such oils break down silicone rubber. The values specified in table V must thus be regarded as only approximate.

In case of doubt always contact your local TSS company.

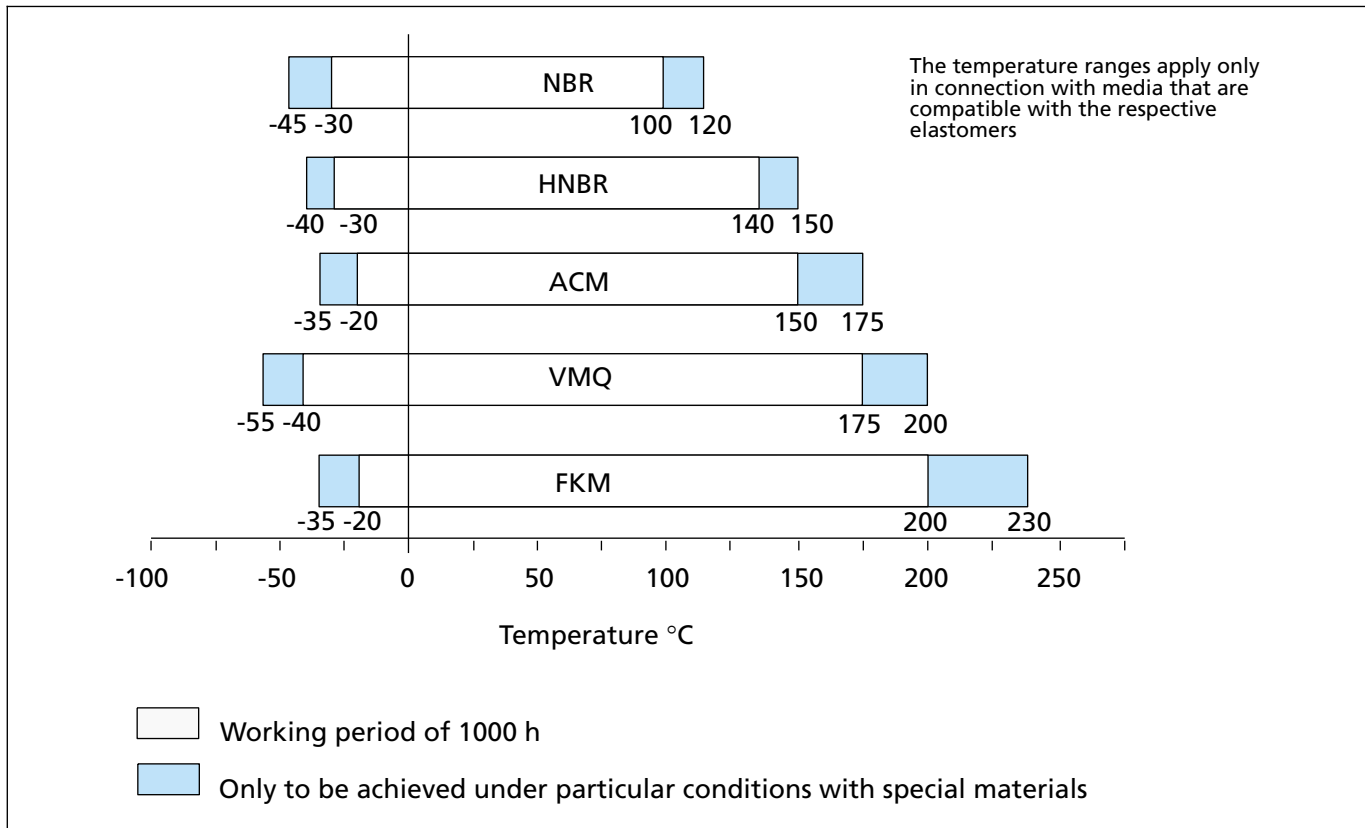


Figure 7 Temperature limits for some common types of rubber



Metal case

The principal function of the metal case is to give rigidity and strength to the seal. It must not normally be exposed to axial loads. A special design is required to enable the case to withstand axial loads.

The case is normally made of cold rolled steel sheet AISI 1008, DIN 1624. Environmental conditions may dictate other materials, such as brass or stainless steel AISI 304, DIN 1.4301.

Garter spring

Function

When rubber is exposed to heat, load or chemical action, it will gradually lose its original properties. The rubber is then said to have aged. The original radial force exerted by the sealing element will then diminish. The function of the garter spring is therefore to maintain the radial force.

Experiments have shown that the radial force must vary with the size and type of seal. Experiments have also clearly indicated the significance of maintaining changes in the radial force within narrow limits during the service life of the seal. Extensive investigations in the laboratory have formed the basis for defining the radial force.

The garter spring is close wound and carries an initial tension. The total force exerted by the spring thus consists of the force required to overcome the initial tension and the force due to the spring rate. The use of a garter spring with initial tension provides the following advantages:

- as the sealing element wears, the total radial force attributable to the initial tension will not change.
- by eliminating some of the initial tension by heat treatment, it can be adjusted to achieve the required radial force for the actual shaft diameter.
- the heat treatment of the spring takes place at a temperature above the operating thermal level of the seal, thus ensuring that the spring force will be stabilized. This procedure eliminates the risk that the original spring force will change during service.

Figures 8 and 9 show the change in the initial tension in stabilized and not-stabilised garter springs.

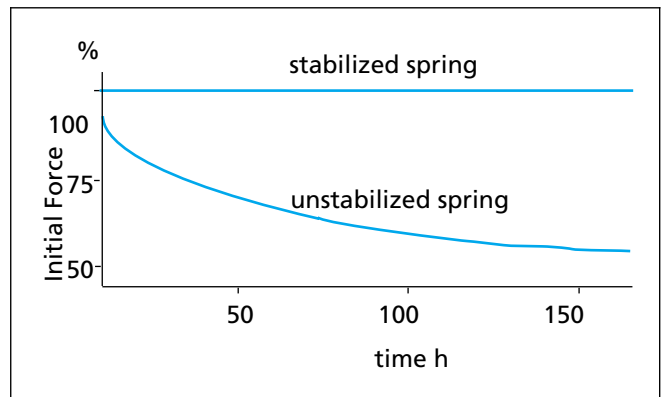


Figure 8 The change in the initial tension in stabilized and not-stabilized garter springs.

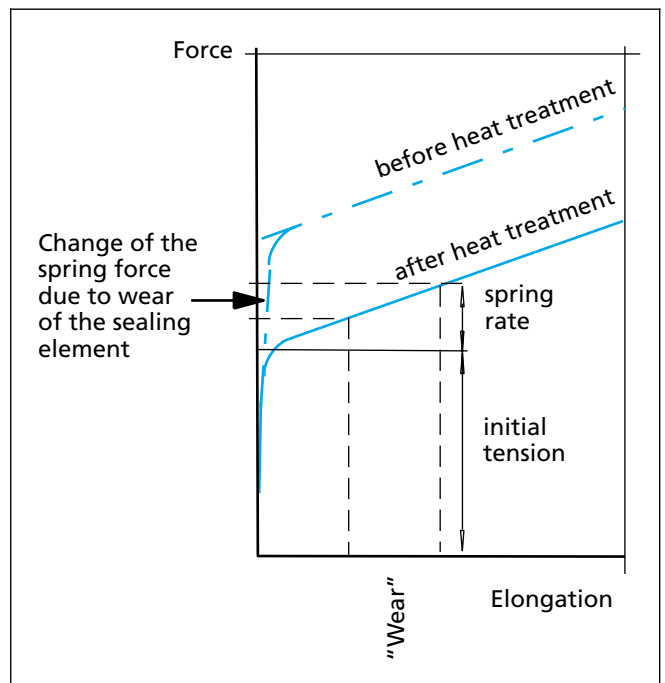


Figure 9 Spring force versus elongation

Material

Spring steel SAE 1074, DIN 17223 is normally employed. If resistance to corrosion is required stainless steel AISI 304, DIN 1.4301 is used. Garter springs of bronze or similar materials are not recommended, since they tend to fatigue after a long service life or as a result of exposure to high temperatures. In special cases, the garter spring can be protected against fouling by means of a thin rubber hose.



Radial Oil Seal

Overpressure

When the sealing element is exposed to pressure it is forced against the shaft and the area of the lip in contact with the shaft increases. The friction as well as the generated heat, increases. As a result, when the seal is under pressure, the specified values of peripheral speed cannot be maintained but must be reduced in relation to the magnitude of the pressure. At high peripheral speeds even overpressures of 0.01 to 0.02 MPa may cause difficulties. By fitting a separate back-up ring the types (TRA/CB, TRC/BB, TRB/DB) can be used for overpressure above 0.05 MPa. The separate back-up ring shape follows the rear profile of the sealing element but without mutual contact when no pressure differential exists. See Figure 10. However, the back-up ring requires much accurate fitting. Please ask your local TSS company for suitable back-up ring

drawing. The cases of seal type TRU are formed to support the sealing element. See Figure 10. The type TRP/6CC is designed with a short and sturdy sealing lip, which allows overpressures without using a separate back-up ring. When a back-up ring is installed or when the types TRU, TRP/6CC are used, overpressures of 0.4 to 0.5 MPa are permissible at moderate peripheral speeds.

At very high pressures, the seals with rubber-covered cases should be employed in order to avoid leakage between the periphery of the seal and the housing bore. When the seal is under pressure there is a risk of axial movement in the housing bore (pop-out). This effect can be prevented by locating the seal against a shoulder, with a spacer ring or a circlip.

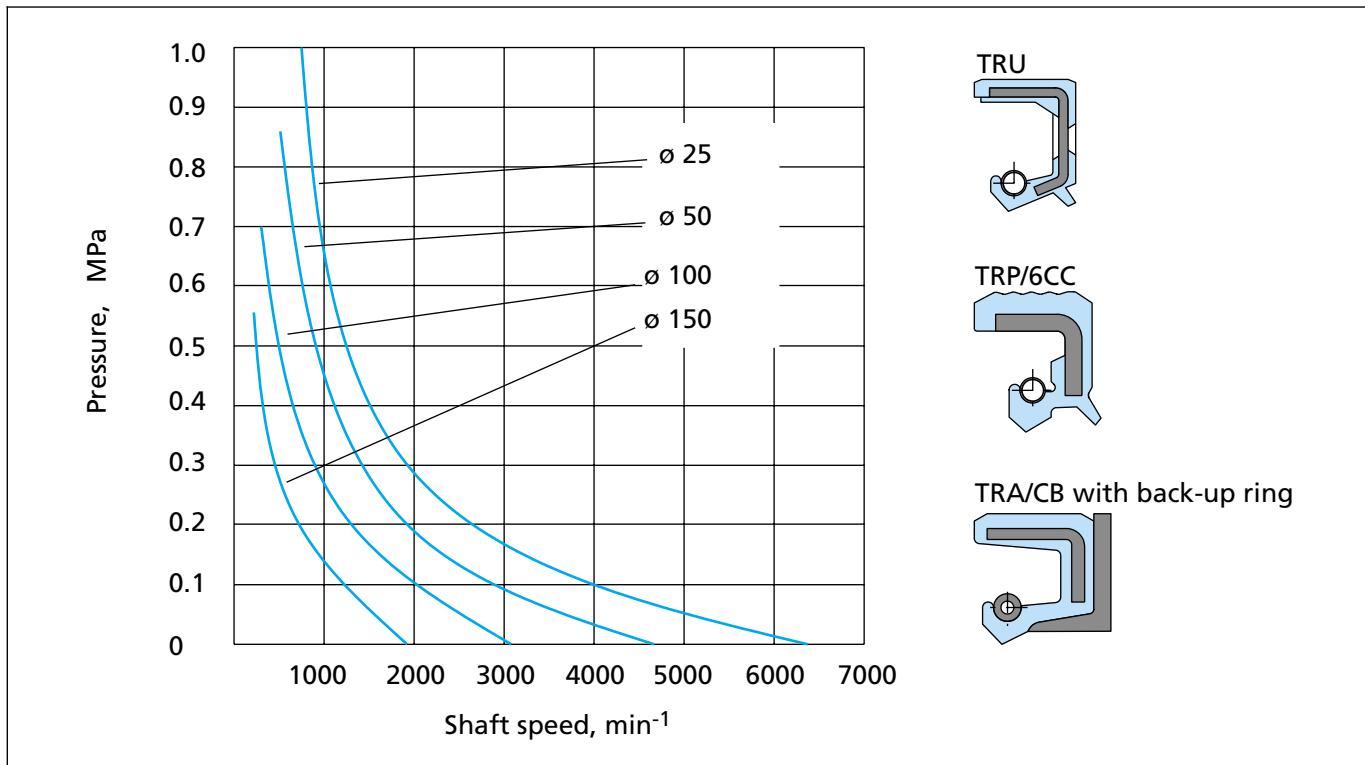


Figure 10 Permissible overpressure for supported lip seals and for pressure seals



Peripheral speed and number of revolutions

Different designs of the sealing element affect the magnitude of the friction and thus result in varying temperature rises. As a result the various designs of the sealing element allow different maximum peripheral speeds. Figure 11 shows the approximate maximum values for the permissible peripheral speed for sealing elements (without dust lip), i.e. seal type TRC/BB, TRA/CB, TRB/DB, etc, made with materials NBR, ACM, FKM and VMQ, with no differential pressure, and where adequate

lubrication or cooling of the sealing edge by the sealed medium exists. In addition the maximum permissible operating temperatures shown in Table V must not be exceeded. The curve shows that higher peripheral speeds are permissible for larger shaft diameters more than for the smaller. This is due to the fact that the cross-sectional area increases in proportion to the square of the diameter, thus increasing the heat dissipation capacity.

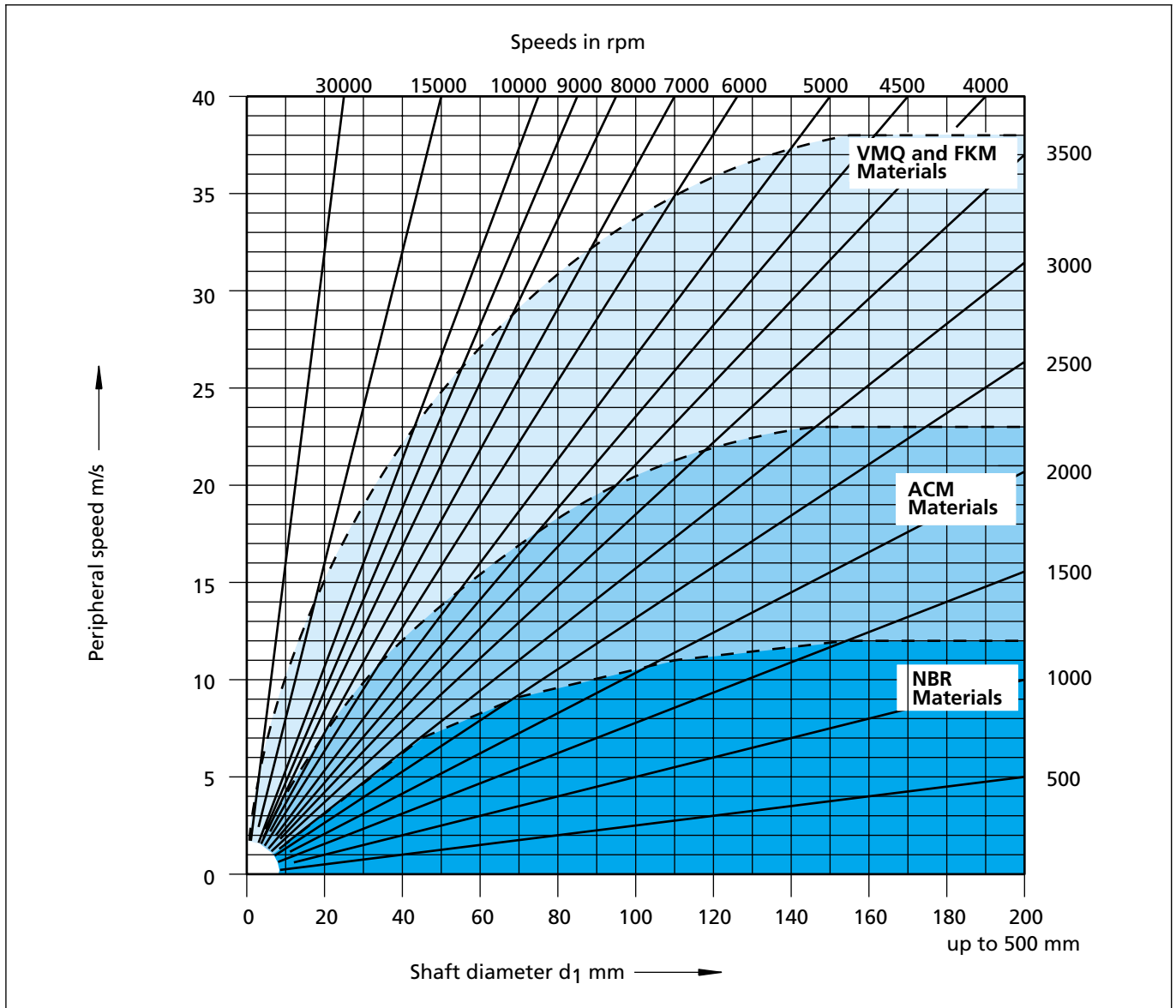


Figure 11 Permissible speeds in pressure-free state to DIN 3761



Radial Oil Seal

Lubrication

Adequate lubrication is of extreme importance as regards the function and useful life of the seal. A film of liquid must be formed between the sealing lip and the shaft in order to minimize friction and the associated generation of heat and wear and thus to avoid destruction of the lip material. In cases where the sealed medium is oil or grease, lubrication does not normally present a problem. However, care must always be taken to ensure that the lubricant comes in contact with the sealing lip. Components such as gearwheels, oil thrower and taper roller bearings exert a pumping action which either prevents the lubricant from reaching the seals or causes a heavy flow of lubricant to be directed towards the seal. In the former case, circulation passages should be provided to ensure that the seal is lubricated. In the latter case, the flow may cause a pressure rise in excess of the permissible values. In machines where the lip seal is not normally lubricated, grease or oil must be supplied by other means. Prior to installation the seal must be pre-lubricated with oil or grease. In some cases this lubrication during the installation may be sufficient. On seals with double lip the space between the lips should be filled to about 50% with grease before installation. A wide range of oils and lubricants are available on the market, and these may have different effects on the elastomers. Care should therefore be taken to ensure that the lubricant used is not detrimental to the lip material. See the resistance Table V.

Lubrication and leakage

Absolute tightness cannot possibly be achieved. The medium to be sealed also lubricates the lip and affects the service life of the seal. A complete dry running destroys the sealing lip. The German standard DIN 3761 classifies the tightness of lip seals into leakage classes 1 to 3. A so called zero-leakage is also defined. Zero-leakage means a function related film of moisture at the sealing edge to a non-drip formation of medium over the back-face of the seal. It is better to accept this "minimum leakage" rather than risking the lip to be damaged due to insufficient lubrication. The permissible leakage in class 1 to 3 is max 1 g to 3 g per seal for a test time of 240 hours.

Frictional loss

The frictional loss is often of significant magnitude, particularly when low powers are transmitted. The frictional loss is affected by the following parameters: seal design and material, spring force, speed, temperature, medium, shaft design, and lubrication. Figure 12 shows the frictional losses in watts caused by a seal without dust lip when fitted in accordance with our technical instructions. In certain cases the frictional loss can be reduced by a special design of the sealing lip, reduction of the spring force or by employing a special grade of rubber. Our technical department will be pleased to provide advice on such matters. It should be noted that the frictional loss during the "running in" period is greater than shown in the figure. The normal "running in" period is a few hours.

After a long period of standing idle the starting friction may be also relatively high.

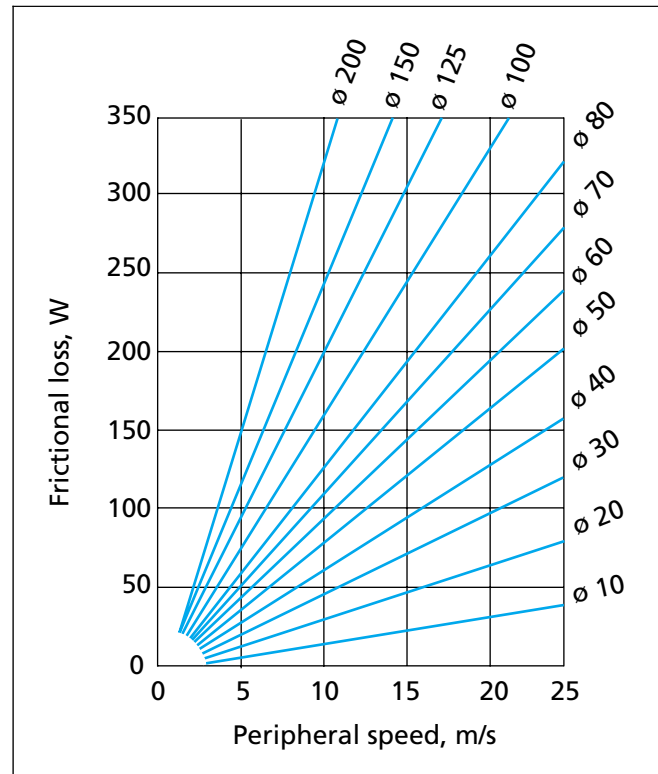


Figure 12 Frictional loss for TRA/CB type seal of nitrile rubber



■ Shaft and housing design

Shaft

Surface finish, hardness and machining methods

The shaft design is of vital significance for the performance as well as for the useful life of the seal (see Figure 3). As a basic principle, the hardness of the shaft should be higher for increasing peripheral speeds. The Standard DIN 3760 specifies that the shaft must be hardened at least 45 HRC.

As the peripheral speeds increase, the hardness must be increased and at 10 m/s a hardness of 60 HRC is required. The choice of a suitable hardness is dependent not only on the peripheral speed but also on such factors as lubrication and the presence of abrasive particles. Poor lubrication and difficult environmental conditions require a higher hardness of the shaft. DIN 3760 specifies a surface roughness of $R_t=1\ \mu\text{m}$ to $4\ \mu\text{m}$. Laboratory tests have however proved that the most suitable roughness is $R_t=2\ \mu\text{m}$ ($R_a=0.3\ \mu\text{m}$). Rougher as well as smoother surfaces generate higher friction, resulting in increased temperature and wear. We suggest a surface roughness of $R_t=2-3\ \mu\text{m}$ ($R_a=0.3-0.8\ \mu\text{m}$).

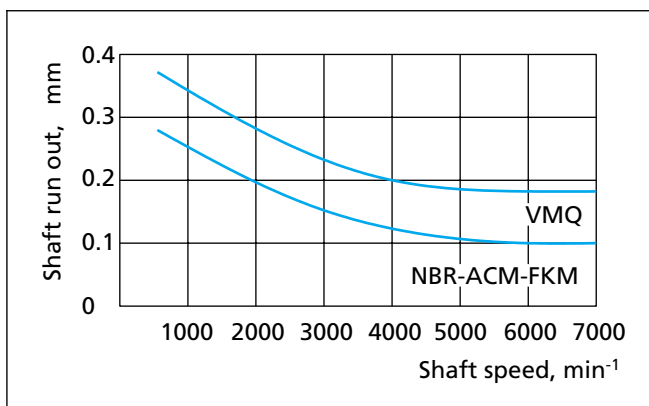


Figure 13 Shaft run out

Measurements of friction and temperature have also shown that grinding of the shaft is the best method of machining. However spiral grinding marks may cause a pumping effect and leakage and plunge grinding should therefore be applied, during which even ratios between grinding wheel speed and work-piece should be avoided. Polishing of the shaft surface with polishing cloth produces a surface which causes higher friction and heat generated as compared with plunge grinding. In certain cases it maybe impossible to provide the necessary hardness, surface finish and corrosion resistance of the shaft. This problem can be solved by fitting a separate sleeve onto the shaft. If wear should occur, only the sleeve need to be replaced (see the chapter Shaft Repair Kit).

Shaft run out

Shaft run out should as far as possible be avoided or kept within a minimum. At higher speeds there is a risk that the inertia of the sealing lip prevents it from following the shaft movement. The seal must be located next to the bearing and the bearing play be maintained at the minimum value possible. See Figure 13.

Eccentricity

Eccentricity between shaft and housing bore centers should be avoided in order to eliminate unilateral load of the lip. See Figure 14.

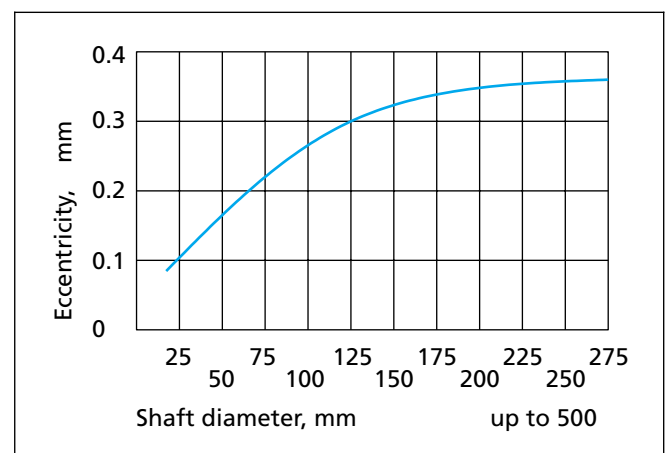


Figure 14 Eccentricity



Radial Oil Seal

Housing

Housing bore

For metric sizes the tolerances are in accordance with the German Standard DIN 3760 which provides a suitable press fit for the bore tolerance ISO H8. The inch sizes are in accordance with American Standards. In cases where the housing bore has a different tolerance the seal can be made to a suitable size. For bearing housings made of soft materials, e.g. light metals, and for bearing housings with thin walls, a special fit between the seal and the housing may be necessary. The tolerances for the seal and housing should then be determined by practical assembly trials. If a component such as a bearing is assembled through the housing bore for the seal, the bore may be damaged. In order to avoid above damages a seal with a larger outside diameter than that of the bearing should be selected.

Installation

For installation details please see the chapter "Design instructions".

Dismantling and replacement

The dismantling of seals does not normally present any problems. A screwdriver or similar tool can generally be used. The seal will then be deformed. After repair or maintenance of a machine a new rotary shaft lip seal always must be installed, even if the old ones seem to be still usable. The sealing edge of the new seal must not ride on the old contact area on the shaft. This can be achieved by:

- replacement of shaft sleeves,
- fitting the seal into the bore to a different depth,
- rework of the shaft and assemble a wear sleeve (see the chapter Shaft repair kit).



■ Standard types of rotary seals

Standard elastomeric rotary shaft seals are designed according to DIN 3760 (3761) and ISO 6194/1 recommendations.

Types DIN A and DIN AS may have wavy or flat outer sheath.

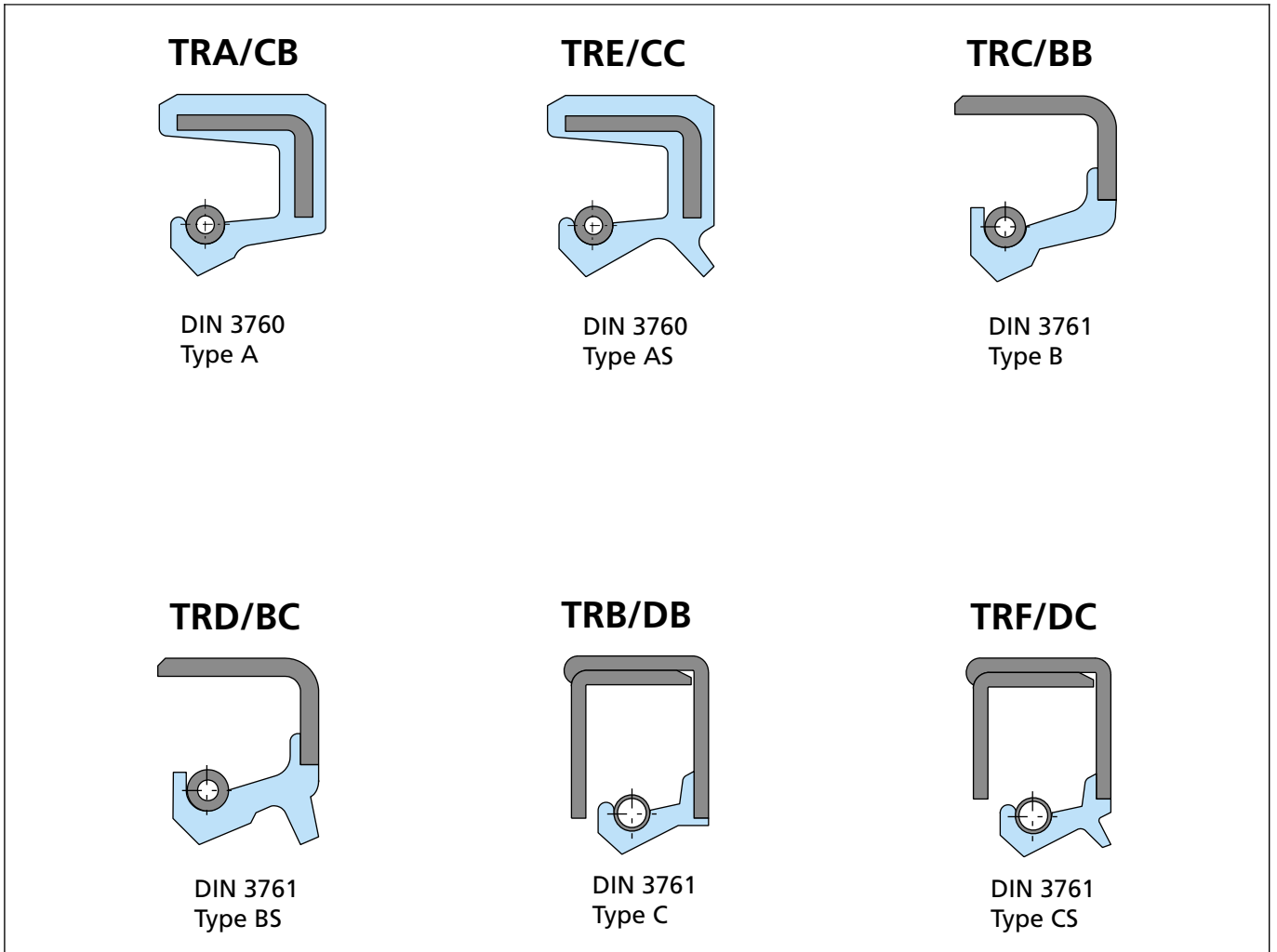


Figure 15 Standard types



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRA and STEFA type CB (DIN 3760 type A)

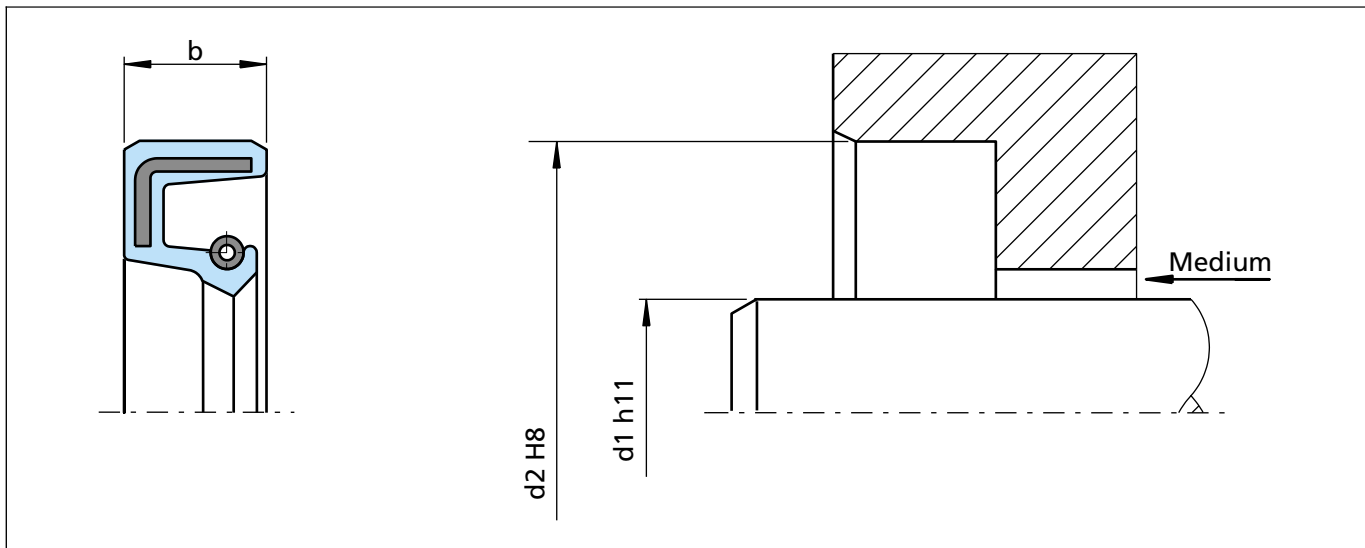


Figure 16 Installation drawing

General description

TSS type TRA and STEFA type CB are seals with completely rubber covered outer diameter. Two different O.D design are available : Flat rubber sheath as well as wavy.

This type is not recommended for use in heavy polluted environments.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Reduced risk of fretting corrosion
- Higher bore surface roughness is allowed
- Installation in split-housings
- Modern lip design provides low radial forces

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)

Technical data

Pressure: up to 0.05 MPa

Temperature: -40°C to +200°C
(depending on material)

Speed: up to 30m/s
(depending on material)

Media: mineral and synthetic lubricants
(CLP, HLP, APGL etc.)

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table VI Materials

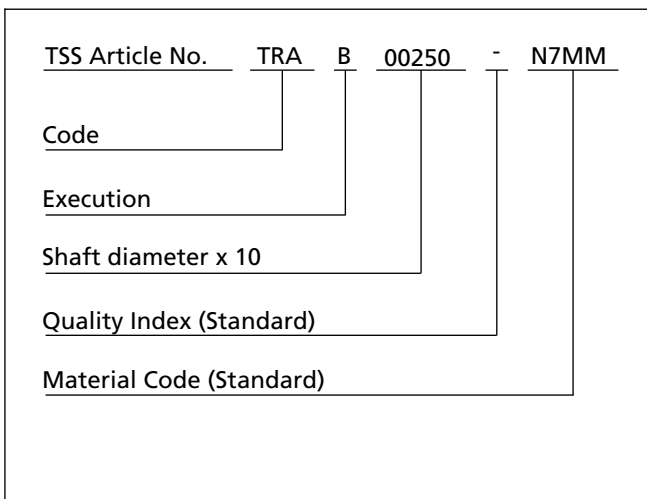
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS Type: A
 Code: TRA
 Dimensions: Shaft diameter 25 mm
 Housing diameter 40 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA Type: CB
 Code: TRA
 Dimensions: Shaft diameter 25 mm
 Housing diameter 40 mm
 Width 7 mm
 Material: NBR 1452
 Material Code: 4N011

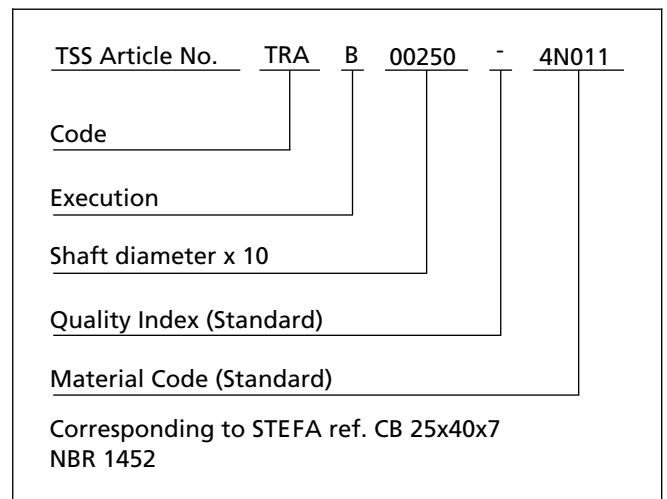


Table VII Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----|--------------|-------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 4 | 11 | 5 | TRA200040 | | | | | X |
| 4 | 12 | 6 | TRA100040 | | | X | X | X |
| 5 | 15 | 6 | TRA000050 | | | | X | X |
| 6 | 12 | 5.5 | TRA400060 | CB | X | X | X | |
| 6 | 15 | 4 | TRA000060 | | | | X | |
| 6 | 16 | 5 | TRA100060 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 6 | 16 | 7 | TRAA00060 | CB | X | X | X | X |
| 6 | 19 | 7 | TRA300060 | CB | X | X | | |
| 6 | 22 | 7 | TRAB00060 | CB | X | X | X | |
| 6 | 22 | 8 | TRA600060 | CB | X | | | |
| 7 | 16 | 7 | TRA000070 | CB | X | X | X | |
| 7 | 22 | 7 | TRAA00070 | CB | X | X | X | |
| 8 | 14 | 4 | TRA700080 | | | | X | |
| 8 | 16 | 5 | TRA100080 | | | | X | |
| 8 | 16 | 7 | TRA200080 | CB | X | X | X | X |
| 8 | 18 | 5 | TRA300080 | | | | X | |
| 8 | 22 | 4 | TRA500080 | | | | X | |
| 8 | 22 | 7 | TRAA00080 | CB | X | X | X | X |
| 8 | 22 | 8 | TRAF00080 | CB | | X | | |
| 8 | 24 | 7 | TRAB00080 | CB | X | X | X | X |
| 8.5 | 18 | 7 | TRA000085 | | | | X | |
| 9 | 22 | 7 | TRAA00090 | CB | X | X | X | |
| 9 | 24 | 7 | TRAB00090 | CB | X | | | |
| 9 | 26 | 7 | TRAC00090 | | | | X | |
| 9 | 30 | 7 | TRA300090 | CB | X | | | |
| 10 | 16 | 4 | TRA000100 | | | | X | X |
| 10 | 18 | 4 | TRA200100 | | | | X | |
| 10 | 18 | 6 | TRA300100 | CB | X | | X | |
| 10 | 19 | 7 | TRA400100 | CB | X | X | X | |
| 10 | 22 | 7 | TRAA00100 | CB | X | X | X | X |
| 10 | 24 | 7 | TRAB00100 | CB | X | | | |
| 10 | 25 | 8 | TRA500100 | CB | X | | | |
| 10 | 26 | 7 | TRAC00100 | CB | X | | X | X |
| 10 | 28 | 7 | TRA600100 | | | | X | |
| 11 | 17 | 4 | TRA000110 | CB | X | X | X | |
| 11 | 19 | 7 | TRA100110 | | | | X | |
| 11 | 22 | 7 | TRAA00110 | CB | X | | | |
| 11 | 26 | 7 | TRAB00110 | CB | X | | | |
| 11 | 30 | 7 | TRA200110 | CB | X | | | |
| 11.5 | 22 | 5 | TRA000115 | CB | | X | | |
| 12 | 19 | 5 | TRA000120 | CB | X | | X | X |
| 12 | 20 | 4 | TRA100120 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 12 | 20 | 5 | TRA200120 | CB | X | | X | |
| 12 | 22 | 4 | TRAF00120 | | | | X | X |
| 12 | 22 | 7 | TRAA00120 | CB | X | X | X | X |
| 12 | 24 | 7 | TRAB00120 | CB | X | X | X | X |
| 12 | 25 | 5 | TRA600120 | | | | X | |
| 12 | 25 | 8 | TRA700120 | CB | X | X | X | |
| 12 | 26 | 7 | TRA800120 | | | | X | |
| 12 | 26 | 8 | TRAJ00120 | CB | X | | | |
| 12 | 28 | 7 | TRAC00120 | CB | X | X | X | X |
| 12 | 30 | 7 | TRAD00120 | CB | X | X | X | |
| 12 | 30 | 10 | TRA300120 | CB | X | | | |
| 12 | 32 | 7 | TRAH00120 | CB | X | | X | X |
| 12 | 32 | 10 | TRAI00120 | | | | X | |
| 12 | 37 | 10 | TRAK00120 | | | | X | |
| 12 | 45 | 7 | TRAL00120 | CB | X | | | |
| 13 | 25 | 5 | TRA100130 | | | | X | |
| 13 | 26 | 7 | TRA200130 | CB | X | X | X | |
| 13 | 30 | 8 | TRA300130 | | | | X | |
| 14 | 22 | 4 | TRA000140 | | | | X | X |
| 14 | 22 | 7 | TRA400140 | CB | X | X | | |
| 14 | 24 | 7 | TRAA00140 | CB | X | X | X | X |
| 14 | 25 | 5 | TRA100140 | CB | X | | | |
| 14 | 28 | 7 | TRAB00140 | CB | X | | X | |
| 14 | 28.55 | 6.3 | TRAF00140 | CB | | X | | |
| 14 | 30 | 7 | TRAC00140 | CB | X | X | X | X |
| 14 | 35 | 7 | TRAD00140 | CB | X | | X | |
| 14.5 | 28.55 | 6.3 | TRA000145 | CB | | X | | |
| 15 | 22 | 7 | TRA000150 | | | | X | |
| 15 | 24 | 5 | TRAF00150 | CB | X | | | |
| 15 | 24 | 7 | TRA200150 | CB | X | X | X | X |
| 15 | 25 | 5 | TRA300150 | CB | X | | X | |
| 15 | 26 | 6 | TRA400150 | | | | X | |
| 15 | 26 | 7 | TRAA00150 | CB | X | X | X | X |
| 15 | 28 | 5 | TRA500150 | | | | | X |
| 15 | 28 | 7 | TRA600150 | CB | X | X | X | X |
| 15 | 30 | 7 | TRAB00150 | CB | X | X | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 15 | 30 | 10 | TRA700150 | CB | X | | X | |
| 15 | 32 | 7 | TRAC00150 | CB | X | X | X | X |
| 15 | 35 | 7 | TRAD00150 | CB | X | X | X | X |
| 15 | 35 | 10 | TRAJ00150 | CB | X | X | | |
| 15 | 40 | 7 | TRAN00150 | CB | X | | | |
| 15 | 40 | 10 | TRA100150 | CB | X | | | |
| 15 | 42 | 7 | TRAG00150 | | | | X | |
| 15 | 42 | 10 | TRAH00150 | CB | X | X | | |
| 16 | 22 | 4 | TRA000160 | | | | X | |
| 16 | 24 | 4 | TRA500160 | | | | X | |
| 16 | 24 | 5 | TRA200160 | CB | X | X | | |
| 16 | 24 | 7 | TRA300160 | CB | X | | X | |
| 16 | 26 | 7 | TRA400160 | | | | X | |
| 16 | 28 | 7 | TRAA00160 | CB | X | X | X | X |
| 16 | 30 | 7 | TRAB00160 | CB | X | X | X | X |
| 16 | 30 | 10 | TRAF00160 | CB | X | X | | |
| 16 | 32 | 7 | TRAC00160 | CB | X | | X | |
| 16 | 35 | 7 | TRAD00160 | CB | X | | X | |
| 16 | 35 | 10 | TRA600160 | CB | X | X | | |
| 17 | 25 | 4 | TRA100170 | | | | X | |
| 17 | 26 | 6 | TRA300170 | | | | X | |
| 17 | 28 | 5 | TRA400170 | | | | X | X |
| 17 | 28 | 6 | TRA900170 | CB | X | | | |
| 17 | 28 | 7 | TRAA00170 | CB | X | X | X | X |
| 17 | 30 | 7 | TRAB00170 | CB | X | X | X | |
| 17 | 32 | 7 | TRAC00170 | CB | X | X | X | X |
| 17 | 32 | 10 | TRAP00170 | CB | | X | | |
| 17 | 35 | 5 | TRAL00170 | CB | X | | | |
| 17 | 35 | 7 | TRAD00170 | CB | X | X | X | X |
| 17 | 35 | 8 | TRA700170 | CB | X | | | |
| 17 | 40 | 7 | TRAE00170 | CB | X | X | X | X |
| 17 | 40 | 10 | TRAF00170 | CB | X | | | |
| 17 | 47 | 7 | TRAG00170 | | | | X | X |
| 17 | 47 | 10 | TRAH00170 | CB | X | | | |
| 18 | 24 | 4 | TRA500180 | | | | | X |
| 18 | 28 | 7 | TRA100180 | CB | X | X | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 18 | 30 | 7 | TRAA00180 | CB | X | X | X | |
| 18 | 32 | 7 | TRAB00180 | CB | X | X | X | |
| 18 | 32 | 8 | TRA200180 | CB | X | X | | |
| 18 | 35 | 7 | TRAC00180 | CB | X | X | X | X |
| 18 | 35 | 10 | TRA300180 | CB | X | | X | |
| 18 | 40 | 7 | TRAD00180 | CB | X | X | X | |
| 18 | 40 | 10 | TRA400180 | | | | X | |
| 19 | 32 | 7 | TRA200190 | CB | X | | X | |
| 19 | 35 | 7 | TRA300190 | | | | X | |
| 19 | 35 | 10 | TRA500190 | CB | X | X | | |
| 19 | 40 | 10 | TRA900190 | CB | X | | | |
| 20 | 28 | 6 | TRA100200 | CB | X | | X | X |
| 20 | 28 | 7 | TRA300200 | CB | X | | | |
| 20 | 30 | 5 | TRA200200 | CB | X | X | X | X |
| 20 | 30 | 7 | TRAA00200 | CB | X | X | X | X |
| 20 | 30 | 8 | TRAJ00200 | | | | | X |
| 20 | 32 | 7 | TRAB00200 | CB | X | X | X | X |
| 20 | 35 | 5 | TRA500200 | | | | X | |
| 20 | 35 | 6 | TRA600200 | | | | X | |
| 20 | 35 | 6.2 | TRAR00200 | CB | X | | | |
| 20 | 35 | 7 | TRAC00200 | CB | X | X | X | X |
| 20 | 35 | 10 | TRA800200 | CB | X | X | X | |
| 20 | 37 | 7 | TRAM00200 | | | | X | |
| 20 | 37 | 8 | TRA900200 | CB | X | | X | |
| 20 | 38 | 7 | TRAP00200 | CB | X | | | |
| 20 | 40 | 7 | TRAD00200 | CB | X | X | X | X |
| 20 | 40 | 10 | TRAF00200 | CB | X | | X | |
| 20 | 42 | 7 | TRAG00200 | CB | X | X | X | X |
| 20 | 42 | 10 | TRAH00200 | | | | X | |
| 20 | 47 | 6 | TRAS00200 | CB | | X | | |
| 20 | 47 | 7 | TRAE00200 | CB | X | X | X | X |
| 20 | 47 | 9.5 | TRAT00200 | CB | | X | | |
| 20 | 47 | 10 | TRAI00200 | CB | X | | X | |
| 20 | 52 | 7 | TRA400200 | CB | X | | X | |
| 20 | 52 | 10 | TRAK00200 | CB | X | | X | |
| 22 | 30 | 7 | TRAK00220 | | | | | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 22 | 32 | 4 | TRAE00220 | | | | X | |
| 22 | 32 | 7 | TRAA00220 | CB | X | X | X | |
| 22 | 35 | 5 | TRA200220 | | | | X | |
| 22 | 35 | 6 | TRAF00220 | CB | X | | | |
| 22 | 35 | 7 | TRAB00220 | CB | X | X | X | X |
| 22 | 35 | 8 | TRA000220 | CB | X | | | |
| 22 | 35 | 10 | TRA100220 | CB | X | X | | |
| 22 | 37 | 7 | TRA300220 | | | | X | |
| 22 | 38 | 7 | TRAI00220 | CB | X | | | |
| 22 | 38 | 8 | TRA500220 | | | | X | |
| 22 | 40 | 7 | TRAC00220 | CB | X | | X | X |
| 22 | 40 | 10 | TRA700220 | CB | X | | X | |
| 22 | 42 | 7 | TRA800220 | | | | X | |
| 22 | 42 | 10 | TRA900220 | | | | X | |
| 22 | 45 | 7 | TRAH00220 | CB | X | | | |
| 22 | 47 | 7 | TRAD00220 | CB | X | X | X | |
| 22 | 47 | 10 | TRAG00220 | CB | X | | | |
| 22.5 | 53 | 10 | TRA000225 | CB | X | X | | |
| 23 | 40 | 10 | TRA100230 | CB | X | | X | |
| 23 | 42 | 5 | TRA500230 | CB | X | X | | |
| 23 | 42 | 10 | TRA200230 | CB | X | | X | |
| 24 | 35 | 7 | TRAA00240 | CB | X | X | X | X |
| 24 | 37 | 7 | TRAB00240 | CB | X | | X | |
| 24 | 40 | 7 | TRAC00240 | CB | X | X | X | X |
| 24 | 42 | 8 | TRA900240 | CB | X | | | |
| 24 | 42 | 10 | TRA600240 | | | | X | |
| 24 | 47 | 7 | TRAD00240 | CB | X | X | X | |
| 24 | 47 | 10 | TRA300240 | | | | X | |
| 25 | 32 | 6 | TRA000250 | | | | X | |
| 25 | 33 | 6 | TRA300250 | CB | X | X | X | X |
| 25 | 35 | 5 | TRA400250 | | | | X | |
| 25 | 35 | 7 | TRAA00250 | CB | X | X | X | X |
| 25 | 36 | 6 | TRA500250 | | | | X | |
| 25 | 37 | 5 | TRAW00250 | CB | X | | | |
| 25 | 37 | 7 | TRA700250 | CB | X | X | X | X |
| 25 | 38 | 7 | TRA800250 | CB | X | X | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 25 | 40 | 5 | TRA900250 | | | | X | |
| 25 | 40 | 7 | TRAB00250 | CB | X | X | X | X |
| 25 | 40 | 8 | TRAF00250 | CB | X | | X | |
| 25 | 40 | 10 | TRAG00250 | CB | X | X | X | |
| 25 | 42 | 6 | TRAMGA001 | CB | X | | | |
| 25 | 42 | 7 | TRAC00250 | CB | X | X | X | X |
| 25 | 42 | 10 | TRAH00250 | CB | X | X | X | |
| 25 | 43 | 10 | TRAU00250 | | | | | X |
| 25 | 45 | 7 | TRAI00250 | | | | X | X |
| 25 | 45 | 10 | TRAJ00250 | CB | X | X | | |
| 25 | 46 | 7 | TRAX00250 | CB | X | | | |
| 25 | 47 | 7 | TRAD00250 | CB | X | X | X | X |
| 25 | 47 | 8 | TRAK00250 | CB | X | X | | |
| 25 | 47 | 10 | TRAL00250 | CB | X | X | X | |
| 25 | 50 | 10 | TRAM00250 | CB | X | X | X | |
| 25 | 52 | 7 | TRAE00250 | CB | X | X | X | X |
| 25 | 52 | 8 | TRAN00250 | CB | X | | | |
| 25 | 52 | 10 | TRAO00250 | CB | X | | X | |
| 25 | 62 | 7 | TRAQ00250 | CB | X | | X | |
| 25 | 62 | 8 | TRA200250 | CB | X | | | |
| 25 | 62 | 10 | TRAR00250 | CB | X | X | X | |
| 26 | 34 | 4 | TRA100260 | | | | | X |
| 26 | 37 | 7 | TRAA00260 | CB | X | | X | X |
| 26 | 42 | 7 | TRAB00260 | CB | X | | | |
| 26 | 47 | 7 | TRAC00260 | CB | X | | X | |
| 26 | 47 | 10 | TRA300260 | CB | | X | | |
| 27 | 37 | 7 | TRA300270 | CB | X | X | | |
| 27 | 42 | 10 | TRA600270 | CB | X | X | | |
| 27 | 47 | 10 | TRA800270 | CB | X | | | |
| 27 | 50 | 8 | TRA100270 | | | | X | |
| 28 | 38 | 7 | TRA000280 | CB | X | X | X | |
| 28 | 40 | 7 | TRAA00280 | CB | X | X | X | X |
| 28 | 42 | 7 | TRA400280 | CB | X | | X | |
| 28 | 42 | 8 | TRA200280 | CB | X | | X | |
| 28 | 42 | 10 | TRA800280 | CB | X | X | | |
| 28 | 42.5 | 8 | TRAJ00280 | CB | X | X | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 28 | 43 | 10 | TRA900280 | CB | X | X | | |
| 28 | 45 | 8 | TRAI00280 | CB | X | X | | |
| 28 | 47 | 7 | TRAB00280 | CB | X | X | X | X |
| 28 | 47 | 10 | TRA500280 | CB | X | | X | |
| 28 | 48 | 10 | TRAG00280 | CB | X | | | |
| 28 | 50 | 10 | TRA600280 | CB | | X | | |
| 28 | 52 | 7 | TRAC00280 | CB | X | X | X | X |
| 28 | 52 | 10 | TRA700280 | CB | X | | X | |
| 29 | 50 | 10 | TRA300290 | CB | X | X | | |
| 30 | 40 | 7 | TRAA00300 | CB | X | X | X | X |
| 30 | 40 | 8 | TRAY00300 | | | | X | |
| 30 | 40 | 10 | TRAMGA002 | CB | X | | | |
| 30 | 41 | 8 | TRAMGA003 | CB | X | | | |
| 30 | 42 | 5 | TRAMGA004 | CB | X | | | |
| 30 | 42 | 5.7 | TRAV00300 | CB | X | | | |
| 30 | 42 | 7 | TRAB00300 | CB | X | X | X | X |
| 30 | 44 | 10 | TRA000300 | CB | X | | | |
| 30 | 45 | 7 | TRA400300 | | | | X | X |
| 30 | 45 | 8 | TRA500300 | CB | X | | X | |
| 30 | 45 | 10 | TRA700300 | | | | X | |
| 30 | 47 | 4 | TRA800300 | | | | X | |
| 30 | 47 | 7 | TRAC00300 | CB | X | X | X | X |
| 30 | 47 | 8 | TRA900300 | CB | X | | X | |
| 30 | 47 | 10 | TRAF00300 | CB | X | | X | |
| 30 | 48 | 8 | TRAG00300 | CB | X | X | X | |
| 30 | 50 | 7 | TRAI00300 | | | | X | |
| 30 | 50 | 8 | TRAH00300 | CB | X | | | |
| 30 | 50 | 10 | TRAJ00300 | CB | X | X | X | X |
| 30 | 52 | 7 | TRAD00300 | CB | X | X | X | X |
| 30 | 52 | 8 | TRAMGA005 | CB | X | | | |
| 30 | 52 | 8.5 | TRAMGA006 | CB | X | | | |
| 30 | 52 | 10 | TRAM00300 | CB | X | X | X | |
| 30 | 55 | 7 | TRAN00300 | CB | X | | X | X |
| 30 | 55 | 10 | TRAO00300 | CB | X | X | | |
| 30 | 56 | 10 | TRAMGA007 | CB | X | X | | |
| 30 | 60 | 10 | TRAQ00300 | CB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 30 | 62 | 7 | TRAE00300 | CB | X | X | X | X |
| 30 | 62 | 10 | TRAR00300 | CB | X | X | X | X |
| 30 | 62 | 12 | TRAS00300 | CB | X | | X | |
| 30 | 72 | 8 | TRAT00300 | | | | X | |
| 30 | 72 | 10 | TRAU00300 | CB | X | X | X | |
| 31 | 42 | 8 | TRA200310 | CB | X | X | | |
| 31 | 47 | 7 | TRA000310 | CB | X | | X | |
| 32 | 40 | 7 | TRAG00320 | CB | X | X | | |
| 32 | 40 | 8 | TRA000320 | | | | X | |
| 32 | 42 | 7 | TRA300320 | CB | X | X | X | |
| 32 | 45 | 7 | TRAA00320 | CB | X | X | X | X |
| 32 | 47 | 7 | TRAB00320 | | | | X | X |
| 32 | 50 | 8 | TRA400320 | CB | X | X | | |
| 32 | 50 | 10 | TRA600320 | CB | X | X | | |
| 32 | 52 | 6 | TRAJ00320 | | | | X | |
| 32 | 52 | 7 | TRAC00320 | CB | X | X | X | X |
| 32 | 52 | 10 | TRA800320 | CB | X | X | X | X |
| 32 | 54 | 8 | TRA900320 | | | | | X |
| 32 | 55 | 10 | TRA700320 | CB | X | | | |
| 32 | 56 | 10 | TRAH00320 | CB | X | | | |
| 32 | 62 | 10 | TRAI00320 | CB | X | | X | |
| 33 | 45 | 7 | TRA000330 | | | | X | |
| 34 | 50 | 10 | TRA200340 | CB | X | X | | |
| 34 | 52 | 8 | TRA300340 | CB | X | X | X | |
| 34 | 52 | 10 | TRA100340 | CB | X | | | |
| 34 | 62 | 10 | TRA600340 | CB | X | | | |
| 35 | 45 | 7 | TRA000350 | CB | X | X | X | |
| 35 | 47 | 4.5 | TRAT00350 | CB | X | | | |
| 35 | 47 | 7 | TRAA00350 | CB | X | X | X | X |
| 35 | 47 | 10 | TRAMGA008 | CB | X | | | |
| 35 | 48 | 9 | TRAMGA009 | CB | X | | | |
| 35 | 50 | 7 | TRAB00350 | CB | X | X | X | X |
| 35 | 50 | 8 | TRA200350 | | | | X | |
| 35 | 50 | 10 | TRA300350 | CB | X | X | X | |
| 35 | 52 | 7 | TRAC00350 | CB | X | X | X | X |
| 35 | 52 | 8 | TRA400350 | CB | X | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------------|----------------------|----------|--------------|-------|--------------|--------------|-------------|-------------|
| d₁ | d₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 35 | 52 | 8.5 | TRAMGA010 | CB | X | | | |
| 35 | 52 | 10 | TRA500350 | CB | X | X | X | |
| 35 | 54 | 10 | TRAV00350 | CB | X | | | |
| 35 | 55 | 8 | TRA600350 | CB | X | | X | X |
| 35 | 55 | 10 | TRA700350 | CB | X | X | X | |
| 35 | 56 | 10 | TRA900350 | CB | X | X | X | |
| 35 | 58 | 10 | TRAG00350 | CB | X | | | |
| 35 | 60 | 10 | TRAH00350 | CB | X | X | X | |
| 35 | 62 | 7 | TRAD00350 | CB | X | X | X | X |
| 35 | 62 | 8 | TRAI00350 | CB | X | | | |
| 35 | 62 | 10 | TRAJ00350 | CB | X | | X | |
| 35 | 62 | 12 | TRAK00350 | | | | X | |
| 35 | 65 | 10 | TRAL00350 | CB | X | | | |
| 35 | 68 | 10 | TRAW00350 | CB | X | X | | |
| 35 | 68 | 12 | TRAU00350 | | | | X | |
| 35 | 72 | 7 | TRAM00350 | | | | X | |
| 35 | 72 | 10 | TRAN00350 | CB | X | X | X | X |
| 35 | 72 | 12 | TRAO00350 | CB | X | | X | |
| 35 | 80 | 10 | TRAQ00350 | | | | X | |
| 35 | 80 | 13 | TRAS00350 | CB | X | | X | |
| 36 | 47 | 7 | TAA00360 | CB | X | | X | |
| 36 | 50 | 7 | TRAB00360 | CB | X | | X | X |
| 36 | 52 | 7 | TRAC00360 | CB | X | X | X | |
| 36 | 56 | 10 | TRA200360 | CB | X | | | |
| 36 | 58 | 12 | TRA500360 | CB | X | | | |
| 36 | 62 | 7 | TRAD00360 | CB | X | | X | |
| 36 | 68 | 10 | TRA400360 | CB | X | | | |
| 37 | 47.5 | 5 | TRA500370 | CB | | X | | |
| 37 | 52 | 8 | TRA600370 | CB | X | | | |
| 37 | 52 | 10 | TRA700370 | CB | X | | | |
| 37 | 80 | 12 | TRA400370 | | | | X | |
| 38 | 50 | 7 | TRA000380 | CB | X | | X | |
| 38 | 52 | 7 | TAA00380 | CB | X | X | X | |
| 38 | 52 | 8 | TRAF00380 | CB | X | | | |
| 38 | 52 | 10 | TRAL00380 | CB | X | | | |
| 38 | 54 | 6.5 | TRA900380 | | | | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 38 | 54 | 10 | TRA200380 | CB | X | | | |
| 38 | 55 | 7 | TRAB00380 | CB | X | X | X | |
| 38 | 55 | 10 | TRA300380 | CB | X | | | |
| 38 | 56 | 10 | TRAG00380 | CB | X | | | |
| 38 | 60 | 10 | TRAJ00380 | CB | X | | | |
| 38 | 62 | 7 | TRAC00380 | CB | X | X | X | |
| 38 | 62 | 10 | TRA500380 | CB | X | X | | X |
| 38 | 65 | 8 | TRAI00380 | CB | X | | | |
| 38 | 68 | 8 | TRAM00380 | CB | | X | | |
| 38 | 70 | 10 | TRAN00380 | CB | X | | | |
| 38 | 72 | 10 | TRA700380 | | | | X | |
| 40 | 50 | 8 | TRA000400 | CB | X | X | X | |
| 40 | 52 | 6 | TRA100400 | | | | X | |
| 40 | 52 | 7 | TRAA00400 | CB | X | X | X | X |
| 40 | 52 | 8 | TRA200400 | | | | X | |
| 40 | 52 | 10 | TRA300400 | CB | X | | | |
| 40 | 55 | 7 | TRAB00400 | CB | X | X | X | X |
| 40 | 55 | 8 | TRA400400 | CB | X | | X | |
| 40 | 55 | 10 | TRA500400 | CB | X | | X | |
| 40 | 56 | 8 | TRA700400 | CB | X | | | |
| 40 | 56 | 10 | TRAL00400 | CB | X | | X | |
| 40 | 58 | 8 | TRAMGA011 | CB | X | | | |
| 40 | 58 | 9 | TRA900400 | | | | X | |
| 40 | 58 | 10 | TRAF00400 | CB | X | X | | X |
| 40 | 58 | 12 | TRAMGA012 | CB | X | | | |
| 40 | 60 | 10 | TRAH00400 | CB | X | X | X | X |
| 40 | 62 | 7 | TRAC00400 | CB | X | X | X | X |
| 40 | 62 | 10 | TRAI00400 | CB | X | X | X | |
| 40 | 62 | 11.5 | TRAMGA013 | CB | X | | | |
| 40 | 62 | 12 | TRAJ00400 | CB | X | | X | |
| 40 | 65 | 10 | TRAK00400 | CB | X | X | X | X |
| 40 | 68 | 7 | TRAM00400 | | | | X | |
| 40 | 68 | 10 | TRAN00400 | CB | X | X | X | X |
| 40 | 68 | 12 | TRAMGA014 | CB | X | | | |
| 40 | 72 | 7 | TRAD00400 | CB | X | X | X | |
| 40 | 72 | 10 | TRAQ00400 | CB | X | X | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 40 | 80 | 7 | TRAS00400 | | | | X | |
| 40 | 80 | 8 | TRAMGA015 | CB | X | | | |
| 40 | 80 | 10 | TRAT00400 | CB | X | X | X | X |
| 40 | 85 | 10 | TRAU00400 | | | | X | |
| 40 | 90 | 8 | TRAV00400 | | | | X | |
| 40 | 90 | 12 | TRAW00400 | | | | X | |
| 42 | 55 | 7 | TRA000420 | CB | X | | X | |
| 42 | 55 | 8 | TRAA00420 | CB | X | X | X | X |
| 42 | 56 | 7 | TRA100420 | CB | X | X | X | X |
| 42 | 58 | 10 | TRA900420 | CB | X | | | |
| 42 | 60 | 10 | TRA200420 | CB | X | | X | |
| 42 | 62 | 7 | TRA300420 | | | | X | X |
| 42 | 62 | 8 | TRAB00420 | CB | X | X | X | X |
| 42 | 62 | 10 | TRA400420 | CB | X | | X | |
| 42 | 65 | 10 | TRA500420 | CB | X | | | |
| 42 | 68 | 10 | TRAI00420 | CB | X | | | |
| 42 | 72 | 7 | TRA700420 | | | | X | X |
| 42 | 72 | 8 | TRAC00420 | CB | X | X | X | |
| 42 | 72 | 10 | TRA800420 | CB | X | | X | |
| 42 | 80 | 10 | TRAH00420 | CB | X | | | |
| 44 | 60 | 10 | TRA000440 | CB | X | | | |
| 44 | 62 | 10 | TRA100440 | CB | X | | X | |
| 44 | 65 | 10 | TRA200440 | CB | X | | | |
| 44 | 70 | 12 | TRA500440 | CB | X | | | |
| 44 | 72 | 10 | TRA600440 | CB | X | X | | |
| 44.5 | 62 | 10 | TRA000445 | CB | X | | | |
| 45 | 52 | 7 | TRA000450 | | | | X | |
| 45 | 55 | 7 | TRA200450 | | | | X | |
| 45 | 58 | 7 | TRA300450 | CB | X | | X | |
| 45 | 60 | 7 | TRA400450 | CB | X | | X | X |
| 45 | 60 | 8 | TRAA00450 | CB | X | X | X | X |
| 45 | 60 | 10 | TRA500450 | CB | X | X | X | |
| 45 | 62 | 7 | TRA600450 | CB | X | | X | X |
| 45 | 62 | 8 | TRAB00450 | CB | X | X | X | X |
| 45 | 62 | 10 | TRA800450 | CB | X | X | X | X |
| 45 | 62 | 12 | TRA900450 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 45 | 65 | 8 | TRAC00450 | CB | X | X | X | X |
| 45 | 65 | 10 | TRAF00450 | CB | X | | X | |
| 45 | 68 | 10 | TRAH00450 | CB | X | | X | |
| 45 | 68 | 12 | TRAI00450 | CB | X | | | |
| 45 | 70 | 10 | TRAJ00450 | | | | X | |
| 45 | 72 | 7 | TRAU00450 | CB | X | | | |
| 45 | 72 | 8 | TRAD00450 | CB | X | X | X | X |
| 45 | 72 | 10 | TRAK00450 | CB | X | | X | |
| 45 | 75 | 7 | TRAL00450 | | | | X | |
| 45 | 75 | 8 | TRAM00450 | CB | X | | X | |
| 45 | 75 | 10 | TRAN00450 | CB | X | X | X | |
| 45 | 80 | 8 | TRAO00450 | | | | X | |
| 45 | 80 | 10 | TRAP00450 | CB | X | X | X | |
| 45 | 85 | 10 | TRAR00450 | CB | X | X | X | |
| 47 | 62 | 6 | TRA000470 | | | | X | |
| 48 | 62 | 8 | TRAA00480 | CB | X | X | X | X |
| 48 | 62 | 10 | TRA500480 | CB | X | | | |
| 48 | 65 | 10 | TRA000480 | | | | X | |
| 48 | 68 | 10 | TRA100480 | CB | X | X | | X |
| 48 | 72 | 8 | TRAB00480 | CB | X | X | X | X |
| 48 | 72 | 10 | TRA400480 | CB | X | | | X |
| 48 | 80 | 10 | TRA600480 | CB | X | | X | |
| 48 | 90 | 10 | TRA900480 | CB | X | X | | |
| 50 | 60 | 10 | TRAM00500 | CB | X | | | |
| 50 | 62 | 7 | TRA000500 | CB | X | | X | X |
| 50 | 62 | 10 | TRA100500 | | | | X | |
| 50 | 65 | 8 | TRAA00500 | CB | X | X | X | X |
| 50 | 65 | 10 | TRA200500 | CB | X | X | X | X |
| 50 | 68 | 8 | TRAB00500 | CB | X | X | X | X |
| 50 | 68 | 10 | TRA300500 | CB | X | X | X | X |
| 50 | 70 | 8 | TRA500500 | | | | X | |
| 50 | 70 | 10 | TRA600500 | CB | X | X | X | |
| 50 | 70 | 12 | TRA700500 | CB | X | | | X |
| 50 | 72 | 6 | TRA800500 | | | | X | |
| 50 | 72 | 8 | TRAC00500 | CB | X | X | X | X |
| 50 | 72 | 10 | TRA900500 | CB | X | X | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 50 | 74 | 10 | TRAP00500 | CB | X | | | |
| 50 | 75 | 10 | TRAG00500 | CB | X | X | X | |
| 50 | 80 | 8 | TRAD00500 | CB | X | X | X | X |
| 50 | 80 | 10 | TRAH00500 | CB | X | X | X | |
| 50 | 80 | 13 | TRAQ00500 | CB | X | | | |
| 50 | 85 | 10 | TRAI00500 | CB | X | | X | |
| 50 | 90 | 10 | TRAK00500 | CB | X | X | X | |
| 50 | 100 | 10 | TRAN00500 | | | | X | |
| 51 | 72 | 10 | TRA000510 | CB | X | | | |
| 52 | 65 | 8 | TRA800520 | CB | X | | | |
| 52 | 68 | 8 | TRAA00520 | CB | X | X | X | |
| 52 | 68 | 10 | TRA000520 | CB | X | | X | |
| 52 | 69 | 10 | TRA500520 | CB | X | | | |
| 52 | 72 | 8 | TRAB00520 | CB | X | | X | X |
| 52 | 72 | 10 | TRA100520 | CB | X | | X | |
| 52 | 75 | 12 | TRA300520 | CB | X | X | | |
| 52 | 76.2 | 10 | TRA900520 | CB | X | | | |
| 52 | 80 | 10 | TRA400520 | CB | X | | | |
| 52 | 85 | 10 | TRA700520 | CB | X | | | |
| 53 | 68 | 10 | TRA000530 | CB | X | | | |
| 54 | 70 | 10 | TRA000540 | | | | X | |
| 54 | 85 | 10 | TRA500540 | CB | X | | | |
| 54 | 90 | 13 | TRA200540 | | | | X | |
| 55 | 68 | 8 | TRA000550 | CB | X | X | X | |
| 55 | 68 | 10 | TRAM00550 | CB | X | | | |
| 55 | 70 | 8 | TRAA00550 | CB | X | X | X | X |
| 55 | 70 | 10 | TRA100550 | CB | X | | X | |
| 55 | 72 | 8 | TRAB00550 | CB | X | X | X | X |
| 55 | 72 | 10 | TRA200550 | CB | X | X | X | X |
| 55 | 75 | 8 | TRA300550 | | | | X | |
| 55 | 75 | 10 | TRA400550 | CB | X | X | X | X |
| 55 | 75 | 12 | TRAN00550 | CB | X | | | |
| 55 | 78 | 10 | TRAI00550 | CB | X | | | |
| 55 | 80 | 7 | TRAL00550 | | | | X | X |
| 55 | 80 | 8 | TRAC00550 | CB | X | X | X | X |
| 55 | 80 | 10 | TRA600550 | CB | X | X | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 55 | 80 | 12 | TRA700550 | CB | X | | | |
| 55 | 80 | 13 | TRA800550 | CB | X | | | |
| 55 | 85 | 8 | TRAD00550 | CB | X | X | X | |
| 55 | 85 | 10 | TRA900550 | CB | X | | X | X |
| 55 | 90 | 10 | TRAG00550 | CB | X | X | X | |
| 55 | 100 | 10 | TRAH00550 | | | | X | X |
| 55 | 100 | 12 | TRAK00550 | | | | X | |
| 56 | 70 | 8 | TRAA00560 | CB | X | | X | |
| 56 | 72 | 8 | TRAB00560 | CB | X | | X | |
| 56 | 72 | 9 | TRA000560 | | | | X | |
| 56 | 80 | 8 | TRAC00560 | CB | X | | | |
| 56 | 85 | 8 | TRAD00560 | CB | X | | | |
| 58 | 72 | 8 | TRAA00580 | CB | X | X | X | |
| 58 | 80 | 8 | TRAB00580 | CB | X | X | X | X |
| 58 | 80 | 10 | TRA200580 | CB | X | X | | |
| 58 | 85 | 10 | TRA300580 | CB | X | | | |
| 58 | 90 | 10 | TRA100580 | CB | X | | | |
| 60 | 70 | 7 | TRA000600 | | | | X | |
| 60 | 72 | 8 | TRA100600 | CB | X | | X | X |
| 60 | 75 | 8 | TRAA00600 | CB | X | X | X | X |
| 60 | 78 | 10 | TRA300600 | | | | X | X |
| 60 | 80 | 8 | TRAB00600 | CB | X | X | X | X |
| 60 | 80 | 10 | TRA500600 | CB | X | X | X | X |
| 60 | 80 | 13 | TRA600600 | CB | X | | X | |
| 60 | 85 | 8 | TRAC00600 | CB | X | X | X | X |
| 60 | 85 | 10 | TRA800600 | CB | X | | X | X |
| 60 | 85 | 13 | TRA900600 | CB | X | | X | |
| 60 | 90 | 8 | TRAD00600 | CB | X | | X | |
| 60 | 90 | 10 | TRAF00600 | CB | X | X | X | X |
| 60 | 90 | 13 | TRAG00600 | CB | X | | | |
| 60 | 95 | 10 | TRAH00600 | CB | X | X | X | |
| 60 | 100 | 10 | TRAI00600 | CB | X | | X | |
| 60 | 110 | 12 | TRAN00600 | CB | X | | | |
| 60 | 110 | 13 | TRAJ00600 | CB | | X | | |
| 62 | 75 | 10 | TRA000620 | | | | X | |
| 62 | 80 | 9 | TRA100620 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 62 | 80 | 10 | TRA200620 | CB | X | X | X | |
| 62 | 85 | 10 | TRAA00620 | CB | X | X | X | X |
| 62 | 90 | 10 | TRAB00620 | CB | X | X | | |
| 62 | 95 | 10 | TRA300620 | | | | X | |
| 62 | 100 | 12 | TRA500620 | CB | X | | | |
| 63 | 85 | 10 | TRAA00630 | CB | X | | | |
| 63 | 90 | 10 | TRAB00630 | CB | X | | X | |
| 63.5 | 90 | 13 | TRA000635 | CB | X | | | |
| 64 | 77 | 8 | TRA400640 | | | | | X |
| 64 | 80 | 8 | TRA000640 | CB | X | X | X | |
| 64 | 85 | 10 | TRA300640 | CB | X | | | |
| 65 | 80 | 8 | TRA000650 | CB | X | X | X | X |
| 65 | 80 | 10 | TRA100650 | | | | X | |
| 65 | 85 | 8 | TRA200650 | | | | X | |
| 65 | 85 | 10 | TRAA00650 | CB | X | X | X | X |
| 65 | 85 | 12 | TRA300650 | CB | X | | X | |
| 65 | 90 | 10 | TRAB00650 | CB | X | X | X | X |
| 65 | 90 | 12 | TRA400650 | CB | X | | | |
| 65 | 90 | 13 | TRA500650 | | | | X | |
| 65 | 95 | 10 | TRA600650 | CB | X | | | |
| 65 | 100 | 10 | TRAC00650 | CB | X | X | X | X |
| 65 | 100 | 12 | TRA800650 | CB | X | | | |
| 65 | 110 | 10 | TRA900650 | CB | X | | | |
| 65 | 120 | 10 | TRAF00650 | CB | X | | | |
| 65 | 120 | 12 | TRA700650 | | | | X | |
| 68 | 85 | 10 | TRA000680 | | | | X | |
| 68 | 90 | 10 | TRAA00680 | CB | X | X | X | X |
| 68 | 100 | 10 | TRAB00680 | CB | X | X | X | |
| 70 | 85 | 7 | TRA000700 | | | | X | |
| 70 | 85 | 8 | TRA100700 | CB | X | X | X | X |
| 70 | 90 | 10 | TRAA00700 | CB | X | X | X | X |
| 70 | 90 | 13 | TRA300700 | CB | X | X | X | |
| 70 | 95 | 10 | TRA400700 | | | | X | |
| 70 | 95 | 13 | TRA500700 | CB | X | X | | |
| 70 | 100 | 10 | TRAB00700 | CB | X | X | X | X |
| 70 | 100 | 12 | TRA600700 | CB | X | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 70 | 105 | 13 | TRAN00700 | CB | X | | | |
| 70 | 110 | 8 | TRA900700 | CB | X | | X | |
| 70 | 110 | 12 | TRAG00700 | CB | X | X | | |
| 72 | 90 | 10 | TRA000720 | | | | X | |
| 72 | 95 | 10 | TRAA00720 | CB | X | X | X | X |
| 72 | 100 | 10 | TRAB00720 | CB | X | X | X | X |
| 75 | 90 | 8 | TRA000750 | CB | X | | X | X |
| 75 | 90 | 10 | TRA100750 | CB | X | | X | |
| 75 | 95 | 10 | TRAA00750 | CB | X | X | X | X |
| 75 | 95 | 12 | TRA200750 | CB | X | X | X | |
| 75 | 100 | 10 | TRAB00750 | CB | X | X | X | X |
| 75 | 100 | 12 | TRA400750 | CB | X | | | X |
| 75 | 105 | 12 | TRAH00750 | CB | X | | | |
| 75 | 105 | 13 | TRAI00750 | CB | X | X | | |
| 75 | 110 | 10 | TRA600750 | | | | X | |
| 75 | 110 | 12 | TRA700750 | CB | X | X | | |
| 75 | 115 | 10 | TRA500750 | | | | X | |
| 78 | 100 | 10 | TRAA00780 | CB | X | X | X | X |
| 78 | 110 | 12 | TRA000780 | CB | | X | | |
| 80 | 95 | 8 | TRA000800 | | | | X | X |
| 80 | 100 | 10 | TRAA00800 | CB | X | X | X | X |
| 80 | 100 | 12 | TRAF00800 | CB | X | | | |
| 80 | 100 | 13 | TRA100800 | CB | X | | X | |
| 80 | 105 | 10 | TRA200800 | | | | X | X |
| 80 | 105 | 13 | TRA300800 | CB | X | | | |
| 80 | 110 | 10 | TRAB00800 | CB | X | X | X | |
| 80 | 110 | 12 | TRA400800 | CB | X | X | | |
| 80 | 110 | 13 | TRA500800 | CB | X | X | | |
| 80 | 115 | 10 | TRA600800 | | | | X | |
| 80 | 115 | 13 | TRAK00800 | CB | X | | | |
| 80 | 120 | 13 | TRA900800 | CB | X | X | | |
| 80 | 125 | 13 | TRA800800 | CB | X | | | |
| 80 | 140 | 13 | TRAJ00800 | CB | X | | | |
| 80 | 150.5 | 13 | TRAL00800 | CB | X | X | | |
| 82 | 105 | 12 | TRA100820 | CB | X | | | |
| 82 | 110 | 12 | TRA200820 | CB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 85 | 100 | 9 | TRA300850 | CB | X | | | X |
| 85 | 105 | 10 | TRA000850 | | | | X | |
| 85 | 105 | 13 | TRA900850 | CB | X | X | X | |
| 85 | 110 | 10 | TRA100850 | | | | X | X |
| 85 | 110 | 12 | TRAA00850 | CB | X | X | X | X |
| 85 | 110 | 13 | TRA200850 | CB | X | X | X | |
| 85 | 115 | 13 | TRA400850 | CB | X | | | |
| 85 | 120 | 12 | TRAB00850 | CB | X | X | X | X |
| 85 | 130 | 12 | TRA100850 | CB | X | | | |
| 85 | 130 | 13 | TRA800850 | | | | X | |
| 88 | 110 | 12 | TRA000880 | CB | X | X | X | |
| 90 | 110 | 8 | TRA100900 | | | | X | |
| 90 | 110 | 10 | TRA200900 | | | | X | X |
| 90 | 110 | 12 | TRAA00900 | CB | X | X | X | X |
| 90 | 110 | 13 | TRA300900 | | | | X | |
| 90 | 115 | 12 | TRAF00900 | | | | | X |
| 90 | 115 | 13 | TRA500900 | | | | X | |
| 90 | 120 | 10 | TRA600900 | | | | X | |
| 90 | 120 | 12 | TRAB00900 | CB | X | X | X | X |
| 90 | 120 | 13 | TRA700900 | CB | X | | | |
| 90 | 130 | 12 | TRA000900 | CB | X | | | |
| 90 | 140 | 13 | TRA900900 | CB | X | | X | |
| 92 | 120 | 13 | TRA000920 | CB | X | X | | |
| 95 | 110 | 6 | TRA000950 | | | | | X |
| 95 | 110 | 10 | TRA800950 | CB | X | | | X |
| 95 | 110 | 12 | TRA500950 | CB | X | X | | |
| 95 | 115 | 12 | TRA600950 | CB | X | X | | |
| 95 | 115 | 13 | TRA100950 | | | | X | |
| 95 | 120 | 12 | TRAA00950 | CB | X | X | X | X |
| 95 | 120 | 13 | TRA200950 | CB | X | | X | |
| 95 | 125 | 12 | TRAB00950 | CB | X | X | X | |
| 95 | 130 | 12 | TRA400950 | CB | X | | | |
| 95 | 136 | 13 | TRA900950 | CB | X | X | | |
| 95 | 145 | 13 | TRA700950 | | | | X | |
| 95 | 150.5 | 13 | TRAF00950 | CB | X | | | |
| 95 | 180.5 | 13 | TRAG00950 | CB | X | X | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 96 | 117 | 10 | TRA000960 | | | | | X |
| 98 | 120 | 13 | TRA000980 | CB | X | X | | |
| 100 | 115 | 9 | TRAG01000 | CB | X | | | |
| 100 | 120 | 10 | TRA001000 | CB | X | | X | |
| 100 | 120 | 12 | TRAA01000 | CB | X | X | X | X |
| 100 | 120 | 13 | TRA101000 | CB | X | | | |
| 100 | 125 | 12 | TRAB01000 | CB | X | X | X | X |
| 100 | 125 | 13 | TRA201000 | CB | X | | X | |
| 100 | 130 | 10 | TRA301000 | | | | X | |
| 100 | 130 | 12 | TRAC01000 | CB | X | X | X | X |
| 100 | 130 | 13 | TRA701000 | CB | X | | | |
| 100 | 140 | 13 | TRA50100 | CB | X | | | |
| 100 | 150 | 12 | TRA601000 | | | | X | |
| 100 | 185 | 13 | TRAI01000 | CB | X | | | |
| 102 | 130 | 13 | TRA001020 | CB | X | X | | |
| 105 | 125 | 10 | TRA001050 | | | | X | |
| 105 | 125 | 13 | TRA101050 | | | | X | |
| 105 | 130 | 12 | TRAA01050 | CB | X | | X | X |
| 105 | 130 | 13 | TRA301050 | CB | X | | | |
| 105 | 140 | 12 | TRAB01050 | CB | X | X | X | |
| 105 | 150 | 15 | TRA401050 | CB | | X | | |
| 110 | 130 | 8 | TRA101100 | | | | X | |
| 110 | 130 | 12 | TRAA01100 | CB | X | | X | X |
| 110 | 130 | 13 | TRA201100 | CB | X | | X | |
| 110 | 140 | 12 | TRAB01100 | CB | X | X | X | X |
| 110 | 140 | 13 | TRA401100 | CB | X | | X | |
| 110 | 150 | 13 | TRA801100 | CB | X | | X | |
| 110 | 150 | 15 | TRA601100 | | | | X | |
| 110 | 180.5 | 13 | TRA301100 | CB | X | | | |
| 110 | 200 | 13 | TRA701100 | | | | X | |
| 115 | 130 | 12 | TRA001150 | | | | | X |
| 115 | 135 | 10 | TRA101150 | | | | X | |
| 115 | 140 | 12 | TRAA01150 | CB | X | X | X | X |
| 115 | 140 | 13 | TRA201150 | CB | X | | | |
| 115 | 150 | 10 | TRA301150 | | | | | X |
| 115 | 150 | 12 | TRAB01150 | CB | X | X | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 120 | 140 | 12 | TRA101200 | | | | X | |
| 120 | 140 | 13 | TRA201200 | CB | X | X | X | X |
| 120 | 145 | 15 | TRAF01200 | CB | X | | | |
| 120 | 150 | 12 | TRAA01200 | CB | X | X | X | X |
| 120 | 150 | 13 | TRA401200 | CB | X | | | |
| 120 | 160 | 12 | TRAB01200 | CB | X | X | X | |
| 122 | 150 | 15 | TRA001220 | CB | X | X | | |
| 125 | 150 | 12 | TRAA01250 | CB | X | X | X | X |
| 125 | 150 | 13 | TRA001250 | CB | X | | X | |
| 125 | 160 | 12 | TRAB01250 | CB | X | X | X | |
| 128 | 150 | 15 | TRA001280 | CB | X | | | |
| 130 | 150 | 10 | TRA001300 | | | | X | X |
| 130 | 150 | 10.8 | TRA6001300 | CB | X | | | |
| 130 | 160 | 7.5 | TRA5011300 | CB | X | | | |
| 130 | 160 | 12 | TRAA01300 | CB | X | | X | X |
| 130 | 160 | 13 | TRA101300 | CB | X | | X | |
| 130 | 160 | 15 | TRA301300 | | | | X | |
| 130 | 170 | 12 | TRAB01300 | CB | X | X | | X |
| 130 | 170 | 13 | TRA201300 | | | | | X |
| 130 | 180 | 15 | TRA401300 | | | | X | |
| 135 | 160 | 12 | TRA001350 | CB | X | X | | |
| 135 | 160 | 13 | TRA101350 | | | | X | |
| 135 | 160 | 15 | TRA301350 | CB | X | | | |
| 135 | 170 | 12 | TRAA01350 | CB | X | X | X | |
| 140 | 160 | 12 | TRA201400 | | | | X | |
| 140 | 160 | 13 | TRA001400 | CB | X | | X | X |
| 140 | 165 | 12 | TRA101400 | | | | X | X |
| 140 | 170 | 12 | TRA301400 | CB | X | X | X | |
| 140 | 170 | 13 | TRA401400 | CB | X | | X | |
| 140 | 170 | 15 | TRAA01400 | CB | X | X | X | X |
| 140 | 180 | 12 | TRA801400 | CB | X | X | | |
| 140 | 190 | 15 | TRA901400 | CB | X | | | |
| 145 | 170 | 15 | TRA401450 | CB | X | | | |
| 145 | 175 | 15 | TRAA01450 | CB | X | X | X | X |
| 145 | 180 | 12 | TRA301450 | CB | X | | | |
| 148 | 170 | 15 | TRA001480 | CB | X | X | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 150 | 170 | 15 | TRA101500 | | | | | X |
| 150 | 180 | 12 | TRA201500 | CB | X | X | X | |
| 150 | 180 | 13 | TRA301500 | CB | X | | X | |
| 150 | 180 | 15 | TRAA01500 | CB | X | X | X | X |
| 155 | 174 | 12 | TRA001550 | | | | X | |
| 155 | 180 | 15 | TRA101550 | CB | X | | | |
| 155 | 190 | 15 | TRA201550 | CB | X | | | |
| 160 | 180 | 10 | TRA501600 | | | | X | |
| 160 | 180 | 15 | TRA001600 | | | | X | |
| 160 | 185 | 10 | TRA101600 | CB | X | | | |
| 160 | 185 | 13 | TRA601600 | | | | | X |
| 160 | 190 | 13 | TRA201600 | CB | X | | | |
| 160 | 190 | 15 | TRAA01600 | CB | X | X | X | X |
| 160 | 200 | 12 | TRA401600 | CB | X | X | | |
| 165 | 190 | 13 | TRA001650 | CB | X | X | X | X |
| 170 | 190 | 10 | TRA301700 | CB | X | | | |
| 170 | 200 | 12 | TRA201700 | CB | X | X | | |
| 170 | 200 | 15 | TRAA01700 | CB | X | X | X | X |
| 175 | 200 | 10 | TRA001750 | | | | | X |
| 175 | 200 | 15 | TRA101750 | CB | X | X | X | |
| 175 | 205 | 15 | TRAR01750 | CB | X | X | | |
| 180 | 200 | 15 | TRA001800 | CB | X | | X | |
| 180 | 210 | 15 | TRAA01800 | CB | X | X | X | X |
| 180 | 215 | 16 | TRA101800 | | | | X | |
| 180 | 220 | 15 | TRA201800 | CB | X | | | |
| 185 | 210 | 10 | TRA001850 | | | | | X |
| 185 | 210 | 13 | TRA101850 | CB | X | X | X | |
| 190 | 215 | 15 | TRA601900 | CB | | X | | |
| 190 | 220 | 15 | TRAA01900 | CB | X | X | X | X |
| 190 | 225 | 16 | TRA101900 | | | | X | |
| 195 | 230 | 16 | TRA001950 | | | | X | |
| 200 | 225 | 15 | TRA202000 | | | | X | |
| 200 | 230 | 15 | TRAA02000 | CB | X | | X | X |
| 200 | 250 | 15 | TRA002000 | CB | X | | | |
| 205 | 230 | 16 | TRA102050 | CB | | X | | |
| 210 | 240 | 15 | TRAA02100 | CB | X | | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 210 | 250 | 15 | TRA002100 | CB | X | | X | |
| 215 | 240 | 12 | TRA002150 | CB | X | | | |
| 220 | 250 | 15 | TRAA02200 | CB | X | X | X | X |
| 220 | 260 | 16 | TRA102200 | | | | X | |
| 230 | 260 | 15 | TRAA02300 | CB | X | X | X | X |
| 230 | 270 | 15 | TRA002300 | | | | X | |
| 240 | 270 | 15 | TRAA02400 | CB | X | X | X | X |
| 240 | 280 | 15 | TRA002400 | CB | X | | | |
| 240 | 335 | 15 | TRA202400 | | | | X | |
| 250 | 280 | 15 | TRAA02500 | CB | X | | X | X |
| 250 | 290 | 15 | TRA002500 | | | | X | |
| 260 | 290 | 15 | TRA102600 | | | | X | |
| 260 | 300 | 20 | TRAA02600 | | | | X | X |
| 265 | 290 | 16 | TRA002650 | | | | X | X |
| 265 | 310 | 16 | TRA102650 | | | | X | |
| 280 | 310 | 15 | TRA202800 | | | | | X |
| 280 | 320 | 20 | TRAA02800 | | | | X | |
| 300 | 340 | 16 | TRA003000 | CB | X | | X | |
| 300 | 340 | 18 | TRA103000 | CB | X | | | |
| 300 | 340 | 20 | TRAA03000 | | | | X | |
| 320 | 360 | 20 | TRAA03200 | | | | X | |
| 340 | 380 | 20 | TRAA03400 | | | | X | |
| 360 | 400 | 18 | TRA003600 | | | | | X |
| 360 | 400 | 20 | TRAA03600 | | | | X | |
| 380 | 420 | 20 | TRAA03800 | | | | X | X |
| 400 | 440 | 20 | TRAA04000 | | | | X | |
| 420 | 450 | 15 | TRA004200 | | | | X | |
| 420 | 460 | 20 | TRAA04200 | | | | X | |
| 440 | 480 | 20 | TRAA04400 | | | | X | X |
| 480 | 520 | 20 | TRAA04800 | | | | X | |
| 500 | 540 | 20 | TRAA05000 | | | | X | |
| 800 | 840 | 20 | TRA008000 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



■ Trelleborg Sealing Solutions type TRE and STEFA type CC (DIN 3760 type AS)

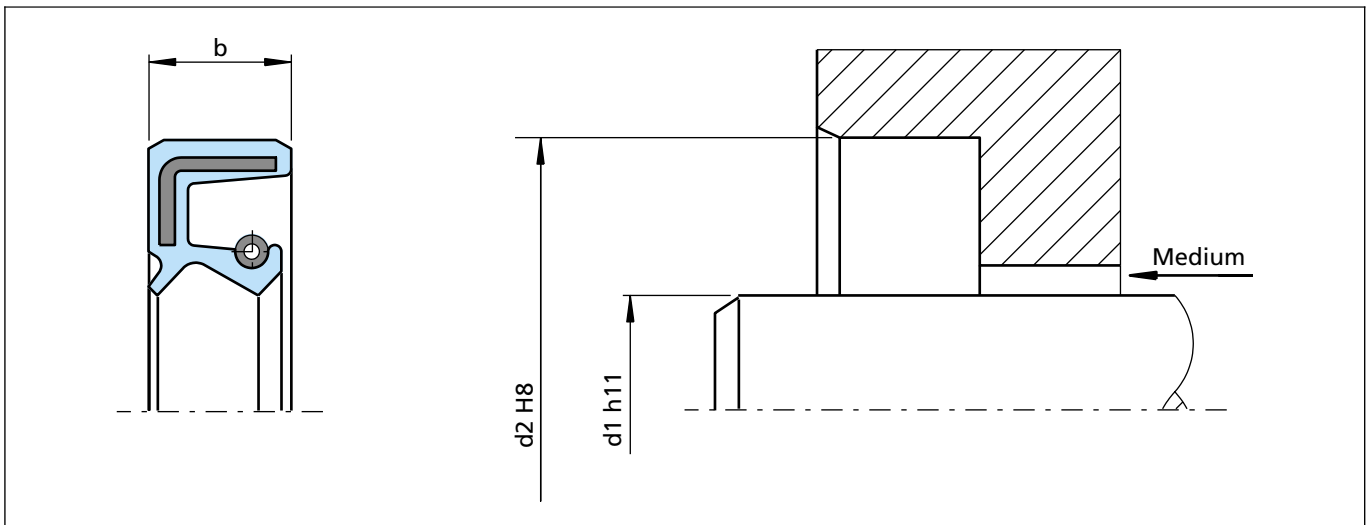


Figure 17 Installation drawing

General description

TSS type TRE and STEFA type CC are seals with completely rubber covered outer diameter. Two different O.D. design are available: Flat rubber sheath as well as wavy. The additional dust lip protects the main sealing lip against dust and other fine solid contaminants and therefore this type is recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Reduced risk of fretting corrosion
- Effective protection against air side contaminants
- Higher bore surface roughness is allowed
- Installation in split-housings
- Modern lip design provides low radial forces

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Radial Oil Seal

Table VIII Materials

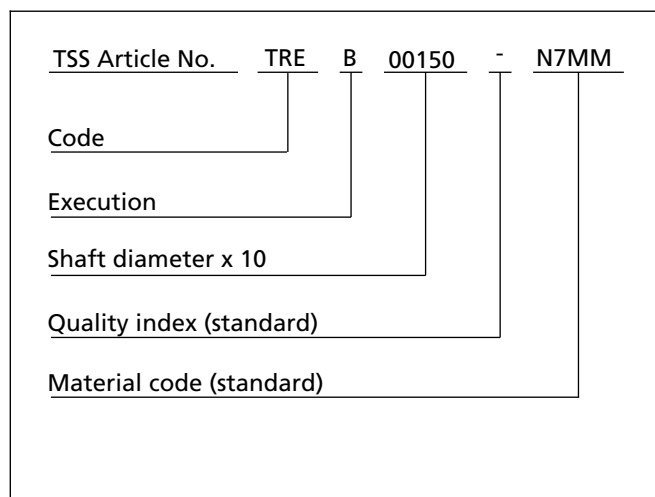
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: E
 Code: TRE
 Dimensions: Shaft diameter 15 mm
 Housing diameter 30 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA type: CC
 Code: TRE
 Dimensions: Shaft diameter 15 mm
 Housing diameter 30 mm
 Width 7 mm
 Material: NBR 1452
 Material Code: 4N011

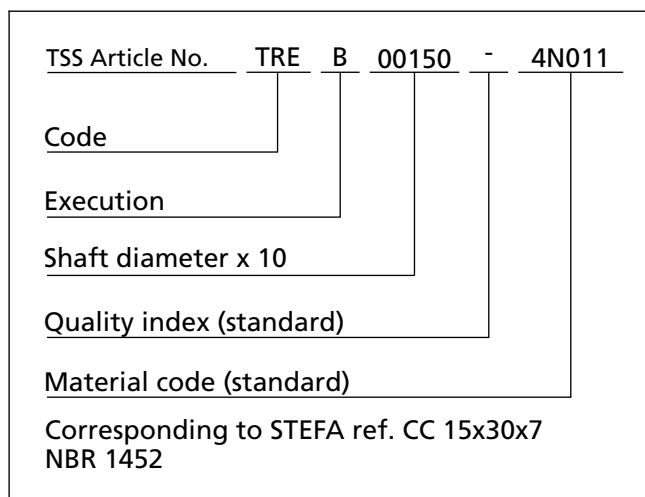


Table IX Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 8 | 16 | 7 | TRE000080 | | | | X | |
| 10 | 18 | 6 | TRE100100 | | | | X | |
| 10 | 19 | 7 | TRE200100 | CC | X | | X | |
| 10 | 20 | 5 | TRE300100 | | | | X | |
| 10 | 22 | 7 | TREA00100 | CC | X | X | X | |
| 10 | 26 | 7 | TREC00100 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 11 | 17 | 4 | TRE000110 | | | | X | |
| 12 | 19 | 5 | TRE000120 | | | | X | |
| 12 | 20 | 5 | TRE400120 | | | | X | |
| 12 | 22 | 6 | TRE200120 | | | | X | |
| 12 | 22 | 7 | TREA00120 | CC | X | X | X | |
| 12 | 25 | 7 | TREE00120 | | | | X | |
| 12 | 28 | 7 | TREC00120 | | | | X | X |
| 12 | 32 | 7 | TRE300120 | | | | X | |
| 13 | 26 | 9 | TRE100130 | | | | | X |
| 14 | 35 | 7 | TRED00140 | | | | | X |
| 15 | 24 | 7 | TRE000150 | | | | X | X |
| 15 | 26 | 7 | TREA00150 | CC | X | | X | |
| 15 | 28 | 7 | TRE100150 | | | | X | |
| 15 | 30 | 7 | TREB00150 | CC | X | X | X | X |
| 15 | 32 | 7 | TREC00150 | | | | X | X |
| 15 | 35 | 7 | TRED00150 | CC | X | X | X | |
| 16 | 28 | 7 | TREA00160 | CC | X | | X | X |
| 16 | 29 | 4 | TRE400160 | | | | X | |
| 17 | 28 | 7 | TREA00170 | CC | X | | X | |
| 17 | 30 | 7 | TREB00170 | | | | X | |
| 17 | 37 | 7 | TRE400170 | CC | X | | | |
| 17 | 40 | 7 | TREE00170 | CC | X | | X | |
| 17.8 | 26.2 | 3.5 | TRE000178 | CC | | X | | |
| 18 | 28 | 7 | TRE000180 | | | | X | |
| 18 | 30 | 7 | TREA00180 | | | | X | |
| 18 | 32 | 7 | TREB00180 | CC | X | | X | |
| 18 | 35 | 7 | TREC00180 | CC | X | | X | |
| 20 | 30 | 7 | TREA00200 | CC | X | | X | X |
| 20 | 34 | 7 | TRE100200 | | | | X | |
| 20 | 35 | 7 | TREC00200 | CC | X | X | X | X |
| 20 | 36 | 7 | TRE200200 | | | | X | |
| 20 | 40 | 7 | TRED00200 | CC | X | X | X | |
| 20 | 42 | 7 | TRE300200 | CC | X | | X | X |
| 20 | 42 | 10 | TREJ00200 | CC | X | | | |
| 20 | 47 | 7 | TREE00200 | CC | X | X | X | X |
| 20 | 47 | 10 | TREH00200 | CC | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 20 | 52 | 8 | TREG00200 | CC | X | | | X |
| 22 | 28 | 4 | TRE700220 | | | | X | |
| 22 | 32 | 7 | TREA00220 | | | | X | X |
| 22 | 35 | 7 | TREB00220 | CC | X | | X | |
| 22 | 40 | 7 | TREC00220 | CC | X | X | X | X |
| 22 | 47 | 7 | TRED00220 | CC | X | | X | |
| 24 | 32 | 7 | TRE000240 | | | | X | |
| 24 | 36 | 7 | TRE100240 | CC | X | | | X |
| 24 | 47 | 7 | TRED00240 | | | | X | |
| 25 | 32 | 6 | TRE000250 | | | | | X |
| 25 | 35 | 6 | TRE000250 | | | | X | |
| 25 | 35 | 7 | TREA00250 | CC | X | X | X | X |
| 25 | 38 | 8 | TREK00250 | | | | X | |
| 25 | 40 | 7 | TREB00250 | CC | X | | X | |
| 25 | 40 | 8 | TRE100250 | | | | X | |
| 25 | 42 | 7 | TREC00250 | CC | X | | X | |
| 25 | 42 | 10 | TRE300250 | CC | X | X | X | |
| 25 | 47 | 7 | TRED00250 | CC | X | | X | X |
| 25 | 47 | 8 | TRE600250 | CC | X | | X | |
| 25 | 47 | 10 | TRE700250 | CC | X | | X | |
| 25 | 52 | 7 | TREE00250 | CC | X | | X | X |
| 25 | 52 | 10 | TRE900250 | | | | X | |
| 25 | 62 | 7 | TREG00250 | CC | X | X | X | X |
| 26 | 37 | 7 | TREA00260 | | | | X | |
| 28 | 40 | 7 | TREA00280 | CC | X | X | X | |
| 28 | 42 | 8 | TRE200280 | | | | X | |
| 28 | 45 | 7 | TREE00280 | | | | | X |
| 28 | 47 | 7 | TREB00280 | CC | X | X | X | |
| 28 | 47 | 10 | TRE400280 | | | | X | X |
| 28 | 52 | 7 | TREC00280 | CC | X | X | X | |
| 28 | 52 | 10 | TRE500280 | | | | X | |
| 30 | 40 | 7 | TREA00300 | CC | X | X | X | X |
| 30 | 42 | 5.7 | TREQ00300 | CC | X | | | |
| 30 | 42 | 6 | TRE000300 | | | | X | |
| 30 | 42 | 7 | TREB00300 | CC | X | X | X | |
| 30 | 42 | 8 | TRE100300 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 30 | 47 | 7 | TREC00300 | CC | X | X | X | X |
| 30 | 47 | 8 | TREK00300 | CC | X | | X | |
| 30 | 48 | 7 | TREL00300 | | | | X | |
| 30 | 50 | 10 | TRE600300 | | | | X | |
| 30 | 52 | 7 | TRED00300 | CC | X | | X | |
| 30 | 52 | 10 | TRE700300 | CC | X | X | X | |
| 30 | 55 | 7 | TRE800300 | CC | X | | X | X |
| 30 | 55 | 10 | TRE900300 | | | | X | X |
| 30 | 62 | 7 | TREE00300 | CC | X | X | X | |
| 30 | 62 | 10 | TREF00300 | | | | X | |
| 30 | 72 | 10 | TREG00300 | CC | X | | X | |
| 32 | 42 | 5 | TRE300320 | | | | X | |
| 32 | 45 | 7 | TREA00320 | | | | X | |
| 32 | 45 | 8 | TRE600320 | | | | X | |
| 32 | 47 | 10 | TRE400320 | | | | X | |
| 32 | 50 | 10 | TRE100320 | | | | X | |
| 32 | 52 | 7 | TREC00320 | CC | X | X | X | |
| 33 | 50 | 6 | TRE000330 | CC | X | | | |
| 34 | 72 | 10 | TRE100340 | CC | | X | | |
| 35 | 47 | 7 | TREA00350 | CC | X | X | X | X |
| 35 | 50 | 7 | TREB00350 | CC | X | | | |
| 35 | 52 | 6 | TRE100350 | | | | X | |
| 35 | 52 | 7 | TREC00350 | CC | X | | X | X |
| 35 | 52 | 8 | TREF00350 | | | | X | |
| 35 | 52 | 10 | TRE200350 | CC | X | X | X | |
| 35 | 55 | 8 | TREK00350 | | | | X | |
| 35 | 56 | 10 | TRE300350 | CC | X | | | |
| 35 | 58 | 10 | TREG00350 | | | | X | |
| 35 | 62 | 7 | TRED00350 | CC | X | | X | |
| 35 | 62 | 8 | TREU00350 | CC | X | | | |
| 35 | 62 | 10 | TRE400350 | CC | X | | X | X |
| 35 | 62 | 12 | TRE500350 | | | | X | X |
| 35 | 72 | 7 | TREH00350 | | | | X | |
| 35 | 72 | 10 | TRE700350 | CC | X | | X | |
| 35 | 72 | 12 | TRE800350 | CC | X | X | X | |
| 35 | 80 | 10 | TRE900350 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 35 | 80 | 12 | TREW00350 | CC | X | | | |
| 36 | 47 | 7 | TREA00360 | | | | X | |
| 36 | 50 | 7 | TREB00360 | CC | X | | | |
| 36 | 52 | 7 | TREC00360 | | | | | X |
| 36 | 54 | 7 | TRE100360 | | | | X | |
| 36 | 58 | 10 | TRE400360 | CC | X | | | |
| 36 | 68 | 10 | TRE000360 | | | | X | |
| 38 | 52 | 7 | TREA00380 | | | | X | X |
| 38 | 62 | 10 | TRE500380 | | | | | X |
| 40 | 52 | 5 | TREO00400 | | | | X | |
| 40 | 52 | 7 | TREA00400 | CC | X | X | X | X |
| 40 | 55 | 7 | TREB00400 | CC | X | | X | |
| 40 | 55 | 8 | TRE100400 | CC | X | X | X | X |
| 40 | 56 | 8 | TREG00400 | CC | X | | X | |
| 40 | 58 | 9 | TREQ00400 | | | | X | |
| 40 | 58 | 10 | TREI00400 | CC | X | | | |
| 40 | 60 | 10 | TRE400400 | CC | X | X | X | X |
| 40 | 62 | 7 | TREC00400 | CC | X | X | X | X |
| 40 | 62 | 9 | TREZ00400 | CC | X | | | |
| 40 | 62 | 10 | TRE600400 | CC | X | X | X | |
| 40 | 68 | 7 | TRE700400 | | | | X | |
| 40 | 68 | 8 | TREY00400 | CC | X | | | |
| 40 | 72 | 7 | TRED00400 | | | | X | X |
| 40 | 72 | 10 | TRE800400 | CC | X | X | X | X |
| 40 | 80 | 7 | TRE900400 | | | | X | |
| 40 | 80 | 8 | TREMGE001 | CC | X | | | |
| 40 | 80 | 10 | TREF00400 | CC | X | X | X | X |
| 40 | 80 | 12 | TREMGE002 | CC | X | | | |
| 40 | 90 | 8 | TREL00400 | | | | X | |
| 40 | 90 | 10 | TREN00400 | CC | X | | | |
| 42 | 55 | 8 | TREA00420 | CC | X | | X | |
| 42 | 60 | 7 | TRE700420 | CC | X | | | |
| 42 | 62 | 7 | TRE300420 | | | | X | |
| 42 | 62 | 10 | TRE800420 | | | | | X |
| 42 | 72 | 8 | TREC00420 | CC | X | | | |
| 42 | 72 | 10 | TRE600420 | | | | | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 45 | 60 | 7 | TRE000450 | CC | X | | X | |
| 45 | 60 | 8 | TREA00450 | CC | X | X | | |
| 45 | 62 | 7 | TRE100450 | | | | X | |
| 45 | 62 | 8 | TREB00450 | CC | X | X | X | X |
| 45 | 62 | 10 | TRE200450 | CC | X | | X | |
| 45 | 65 | 8 | TREC00450 | CC | X | | X | X |
| 45 | 65 | 10 | TRE300450 | CC | X | | X | |
| 45 | 68 | 8 | TRE400450 | | | | X | |
| 45 | 68 | 10 | TRE500450 | | | | X | |
| 45 | 72 | 8 | TRED00450 | | | | X | |
| 45 | 72 | 10 | TRE600450 | | | | X | |
| 45 | 72 | 12 | TRE700450 | | | | X | |
| 45 | 75 | 7 | TRE800450 | | | | X | |
| 45 | 75 | 8 | TREI00450 | CC | X | X | X | |
| 45 | 75 | 10 | TRE900450 | | | | X | X |
| 45 | 80 | 10 | TREF00450 | CC | X | | X | |
| 45 | 85 | 10 | TREG00450 | CC | X | | X | X |
| 45 | 90 | 10 | TREH00450 | CC | X | | | |
| 47 | 90 | 10 | TRE0P0470 | CC | X | | | |
| 48 | 62 | 8 | TREA00480 | CC | X | X | X | X |
| 48 | 65 | 10 | TRE000480 | CC | | X | | |
| 48 | 68 | 10 | TRE100480 | CC | X | X | X | |
| 48 | 72 | 7 | TRE200480 | | | | X | |
| 48 | 72 | 8 | TREB00480 | | | | | X |
| 48 | 72 | 12 | TRE300480 | | | | X | |
| 48 | 72.5 | 10 | TRE500480 | CC | X | | | |
| 50 | 62 | 7 | TRE200500 | CC | X | | | |
| 50 | 65 | 8 | TREA00500 | CC | X | X | X | X |
| 50 | 65 | 10 | TREIP0500 | CC | X | | | |
| 50 | 68 | 7 | TREK00500 | | | | X | |
| 50 | 68 | 8 | TREB00500 | CC | X | | X | X |
| 50 | 68 | 10 | TRE000500 | CC | X | | X | |
| 50 | 70 | 10 | TRE100500 | | | | X | |
| 50 | 72 | 7 | TREF00500 | | | | X | X |
| 50 | 72 | 8 | TREC00500 | CC | X | | X | X |
| 50 | 72 | 10 | TRE300500 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 50 | 72 | 12 | TRE400500 | CC | X | | X | |
| 50 | 75 | 10 | TRE500500 | | | | X | |
| 50 | 80 | 8 | TRED00500 | CC | X | X | X | X |
| 50 | 80 | 10 | TRE600500 | CC | X | | X | X |
| 50 | 90 | 8 | TRE800500 | | | | X | |
| 50 | 90 | 10 | TRE900500 | CC | X | X | X | X |
| 52 | 68 | 8 | TREA00520 | CC | X | X | | |
| 52 | 72 | 8 | TREB00520 | CC | X | | | X |
| 52 | 72 | 10 | TRE000520 | CC | X | | | |
| 52 | 85 | 10 | TRE400520 | CC | | X | | |
| 52 | 100 | 10 | TRE5P0520 | CC | X | | | |
| 54 | 72 | 10 | TRE000540 | CC | X | | | |
| 54 | 72.5 | 9 | TRE100540 | CC | X | | | |
| 55 | 68 | 8 | TRE000550 | CC | X | X | X | |
| 55 | 70 | 8 | TREA00550 | CC | X | | X | X |
| 55 | 70 | 10 | TREH00550 | CC | X | | | |
| 55 | 72 | 8 | TREB00550 | CC | X | X | X | |
| 55 | 72 | 10 | TRE200550 | CC | X | X | X | |
| 55 | 75 | 8 | TRE300550 | | | | X | X |
| 55 | 75 | 10 | TRE400550 | CC | | X | X | |
| 55 | 80 | 8 | TREC00550 | CC | X | | X | |
| 55 | 80 | 10 | TRE600550 | CC | X | X | X | |
| 55 | 85 | 10 | TRE700550 | | | | X | |
| 55 | 90 | 8 | TREG00550 | CC | X | | X | |
| 55 | 90 | 10 | TRE800550 | CC | X | X | X | |
| 55 | 100 | 10 | TRE900550 | CC | X | | X | |
| 55 | 110 | 10 | TREJ00550 | CC | X | X | | |
| 56 | 72 | 7 | TRE200560 | CC | X | | | |
| 56 | 72 | 8 | TREB00560 | CC | | X | | X |
| 58 | 80 | 8 | TREB00580 | CC | X | X | | |
| 58 | 80 | 10 | TRE000580 | CC | X | X | X | X |
| 60 | 75 | 8 | TREA00600 | CC | X | X | X | X |
| 60 | 75 | 10 | TREH00600 | CC | X | | | |
| 60 | 80 | 7 | TRE800600 | | | | X | |
| 60 | 80 | 8 | TREB00600 | | | | X | X |
| 60 | 80 | 10 | TRE100600 | CC | X | X | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 60 | 82 | 9 | TRE200600 | | | | X | |
| 60 | 85 | 8 | TREC00600 | | | | X | |
| 60 | 85 | 10 | TRE300600 | | | | X | |
| 60 | 85 | 12 | TREI00600 | CC | X | | | |
| 60 | 90 | 8 | TRED00600 | CC | X | | | |
| 60 | 90 | 10 | TRE400600 | | | | X | |
| 60 | 95 | 10 | TRE500600 | | | | X | |
| 60 | 110 | 8 | TRE900600 | | | | X | |
| 60 | 110 | 12 | TREGP0600 | CC | X | | | |
| 62 | 90 | 12 | TRE3P0620 | CC | X | | | |
| 62 | 110 | 10 | TRE100620 | | | | X | |
| 62 | 120 | 12 | TRE2P0620 | CC | X | | | |
| 63 | 80 | 9 | TRE000630 | | | | X | |
| 65 | 80 | 8 | TRE000650 | | | | X | |
| 65 | 85 | 10 | TREA00650 | CC | X | X | X | X |
| 65 | 85 | 12 | TRE200650 | CC | X | X | X | |
| 65 | 85 | 13 | TRE300650 | | | | X | X |
| 65 | 90 | 10 | TREB00650 | CC | X | X | X | X |
| 65 | 95 | 10 | TRE700650 | | | | X | |
| 65 | 100 | 10 | TREC00650 | CC | X | X | X | |
| 65 | 100 | 12 | TRE5P0650 | CC | X | | | |
| 65 | 120 | 10 | TRE600650 | | | | X | |
| 65 | 120 | 12 | TRE9P0650 | CC | X | | | |
| 68 | 87 | 8 | TRE200680 | CC | X | | | |
| 68 | 90 | 10 | TREA00680 | | | | X | X |
| 68 | 94 | 9 | TRE300680 | CC | X | | | |
| 68 | 110 | 13 | TRE100680 | | | | X | |
| 70 | 85 | 8 | TRE000700 | | | | X | |
| 70 | 90 | 10 | TREA00700 | CC | X | X | X | X |
| 70 | 90 | 12 | TRE100700 | CC | X | | | |
| 70 | 95 | 13 | TRE200700 | | | | X | |
| 70 | 100 | 10 | TREB00700 | CC | X | X | X | X |
| 70 | 110 | 8 | TRE700700 | | | | X | |
| 70 | 110 | 12 | TREFP0700 | CC | X | | | |
| 70 | 110 | 13 | TRE400700 | CC | | X | X | |
| 70 | 120 | 10 | TRE500700 | CC | X | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 70 | 125 | 12 | TRE600700 | | | | X | |
| 72 | 86 | 7 | TRE100720 | CC | X | | X | |
| 72 | 95 | 12 | TREAP0720 | CC | X | | | |
| 72 | 140 | 12 | TRE3P0700 | CC | X | | | |
| 75 | 90 | 10 | TREC00750 | CC | X | | X | |
| 75 | 95 | 8 | TRE000750 | CC | X | X | | |
| 75 | 95 | 9 | TRE600750 | CC | X | | | |
| 75 | 95 | 10 | TREA00750 | | | | X | X |
| 75 | 95 | 12 | TREF00750 | CC | X | | | |
| 75 | 100 | 10 | TREB00750 | CC | X | X | X | X |
| 75 | 100 | 12 | TRE100750 | | | | X | |
| 75 | 100 | 13 | TRE200750 | CC | X | | X | |
| 75 | 110 | 13 | TRE500750 | | | | X | |
| 75 | 115 | 10 | TRE800750 | | | | X | |
| 75 | 115 | 12 | TRE900750 | CC | X | | | |
| 75 | 120 | 12 | TRE300750 | | | | X | |
| 79 | 120 | 13 | TRE000790 | | | | X | |
| 80 | 100 | 7 | TRE000800 | | | | X | |
| 80 | 100 | 10 | TREA00800 | CC | X | X | X | X |
| 80 | 100 | 12 | TRE500800 | CC | X | | | |
| 80 | 105 | 13 | TRE200800 | | | | X | |
| 80 | 110 | 10 | TREB00800 | CC | X | X | X | X |
| 80 | 115 | 10 | TRE300800 | | | | X | |
| 80 | 120 | 13 | TRE400800 | | | | X | |
| 80 | 140 | 13 | TRE900800 | CC | X | | | |
| 80 | 140 | 15 | TRE600800 | | | | X | |
| 85 | 100 | 13 | TRE900850 | | | | X | |
| 85 | 105 | 10 | TRE100850 | | | | X | |
| 85 | 105 | 12 | TRE800850 | | | | | X |
| 85 | 110 | 12 | TREA00850 | CC | X | | X | X |
| 85 | 120 | 10 | TRE300850 | | | | X | |
| 85 | 120 | 12 | TREB00850 | | | | | X |
| 85 | 130 | 10 | TRE400850 | | | | X | |
| 85 | 130 | 12 | TRE700850 | CC | X | X | | |
| 85 | 130 | 13 | TRE500850 | | | | | X |
| 85 | 140 | 12 | TREG00850 | CC | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 85 | 150 | 12 | TRE600850 | | | | X | |
| 90 | 110 | 8 | TRE600900 | CC | | X | | X |
| 90 | 110 | 12 | TREA00900 | | | | X | X |
| 90 | 110 | 13 | TRE000900 | CC | X | X | | X |
| 90 | 120 | 12 | TREB00900 | | | | X | |
| 90 | 120 | 13 | TRE200900 | CC | X | | X | |
| 90 | 140 | 12 | TRE400900 | CC | X | | X | |
| 95 | 115 | 7 | TRE800950 | CC | X | | | |
| 95 | 115 | 12 | TRE000950 | | | | X | |
| 95 | 115 | 13 | TRE100950 | CC | X | X | | |
| 95 | 120 | 12 | TREA00950 | | | | X | |
| 95 | 120 | 13 | TRE200950 | | | | X | |
| 95 | 125 | 12 | TREB00950 | CC | X | X | X | |
| 95 | 130 | 13 | TRE300950 | | | | X | |
| 100 | 120 | 10 | TRE001000 | | | | X | |
| 100 | 120 | 12 | TREA01000 | CC | X | | X | X |
| 100 | 125 | 12 | TREB01000 | | | | X | |
| 100 | 125 | 13 | TRE101000 | CC | X | | X | |
| 100 | 130 | 12 | TREC01000 | CC | X | X | X | X |
| 100 | 130 | 13 | TRE201000 | | | | X | |
| 100 | 150 | 12 | TRE501000 | | | | X | |
| 100 | 160 | 14 | TRE301000 | | | | X | |
| 100 | 180 | 12 | TRE401000 | | | | X | |
| 105 | 120 | 7 | TRE001050 | | | | X | |
| 105 | 125 | 13 | TRE101050 | CC | | X | X | |
| 105 | 130 | 12 | TREA01050 | | | | X | |
| 105 | 140 | 12 | TREB01050 | CC | X | | | |
| 105 | 140 | 13 | TRE401050 | CC | | X | | |
| 110 | 130 | 12 | TREA01100 | CC | X | X | X | |
| 110 | 140 | 12 | TREB01100 | CC | X | X | X | X |
| 110 | 140 | 13 | TRE401100 | | | | X | |
| 110 | 140 | 15 | TRE501100 | CC | X | | | |
| 110 | 170 | 14 | TRE301100 | | | | X | |
| 115 | 140 | 12 | TREA01150 | CC | X | X | X | X |
| 115 | 140 | 15 | TRE301150 | CC | | X | | |
| 118 | 150 | 12 | TRE001180 | CC | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 120 | 140 | 13 | TRE001200 | | | | X | |
| 120 | 142 | 12 | TRE501200 | | | | X | |
| 120 | 150 | 12 | TREA01200 | | | | X | X |
| 120 | 150 | 15 | TRE201200 | | | | X | X |
| 120 | 160 | 12 | TREB01200 | | | | X | |
| 120 | 200 | 14 | TRE301200 | | | | X | |
| 125 | 150 | 12 | TREA01250 | CC | X | X | X | |
| 125 | 155 | 14 | TRE301250 | | | | X | |
| 125 | 160 | 15 | TRE401250 | CC | X | | | |
| 130 | 160 | 7.5 | TRE401300 | CC | X | | | |
| 130 | 160 | 12 | TREA01300 | | | | X | |
| 130 | 160 | 15 | TRE001300 | CC | X | | X | |
| 130 | 230 | 14 | TRE201300 | | | | X | |
| 135 | 160 | 15 | TRE001350 | | | | X | |
| 135 | 165 | 13 | TRE201350 | | | | X | |
| 135 | 170 | 12 | TREA01350 | CC | X | X | | |
| 140 | 160 | 13 | TRE001400 | | | | X | |
| 140 | 170 | 14 | TRE401400 | CC | | X | | |
| 140 | 170 | 15 | TREA01400 | CC | X | | X | X |
| 140 | 210 | 15 | TRE301400 | | | | X | |
| 145 | 175 | 15 | TREA01450 | | | | X | X |
| 148 | 170 | 14 | TRE001480 | CC | | X | | |
| 150 | 180 | 13 | TRE001500 | | | | X | |
| 150 | 180 | 15 | TREA01500 | CC | X | | X | X |
| 155 | 180 | 15 | TRE001550 | | | | X | |
| 160 | 190 | 15 | TREA01600 | CC | X | X | X | |
| 160 | 200 | 15 | TRE001600 | CC | X | | | |
| 165 | 190 | 8 | TRE101650 | CC | X | | | |
| 165 | 190 | 13 | TRE201650 | CC | X | | | |
| 170 | 200 | 7.5 | TRE301700 | CC | X | | | |
| 170 | 200 | 15 | TREA01700 | CC | X | | X | X |
| 180 | 200 | 13 | TRE101800 | | | | X | |
| 180 | 210 | 15 | TREA01800 | CC | X | X | X | |
| 180 | 215 | 15 | TRE201800 | CC | X | | | |
| 190 | 220 | 12 | TRE001900 | | | | X | |
| 190 | 220 | 15 | TREA01900 | CC | X | X | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 200 | 230 | 15 | TREA02000 | CC | X | X | X | |
| 210 | 240 | 15 | TREA02100 | | | | X | |
| 220 | 250 | 15 | TREA02200 | | | | X | |
| 230 | 260 | 15 | TREA02300 | | | | X | |
| 240 | 270 | 15 | TREA02400 | | | | X | X |
| 250 | 280 | 15 | TREA02500 | | | | X | |
| 260 | 280 | 16 | TRE002600 | | | | X | |
| 260 | 300 | 20 | TREA02600 | | | | X | |
| 280 | 320 | 20 | TREA02800 | | | | X | |
| 300 | 340 | 18 | TRE003000 | CC | X | | | |
| 300 | 340 | 20 | TREA03000 | | | | X | |
| 320 | 360 | 20 | TREA03200 | | | | X | |
| 350 | 380 | 16 | TRE003500 | | | | X | |
| 360 | 400 | 20 | TREA03600 | | | | | X |
| 394 | 420 | 16 | TRE003940 | | | | X | |
| 420 | 470 | 20 | TRE004200 | | | | X | |
| 440 | 480 | 20 | TREA04400 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRC and STEFA type BB (DIN 3761 type B)

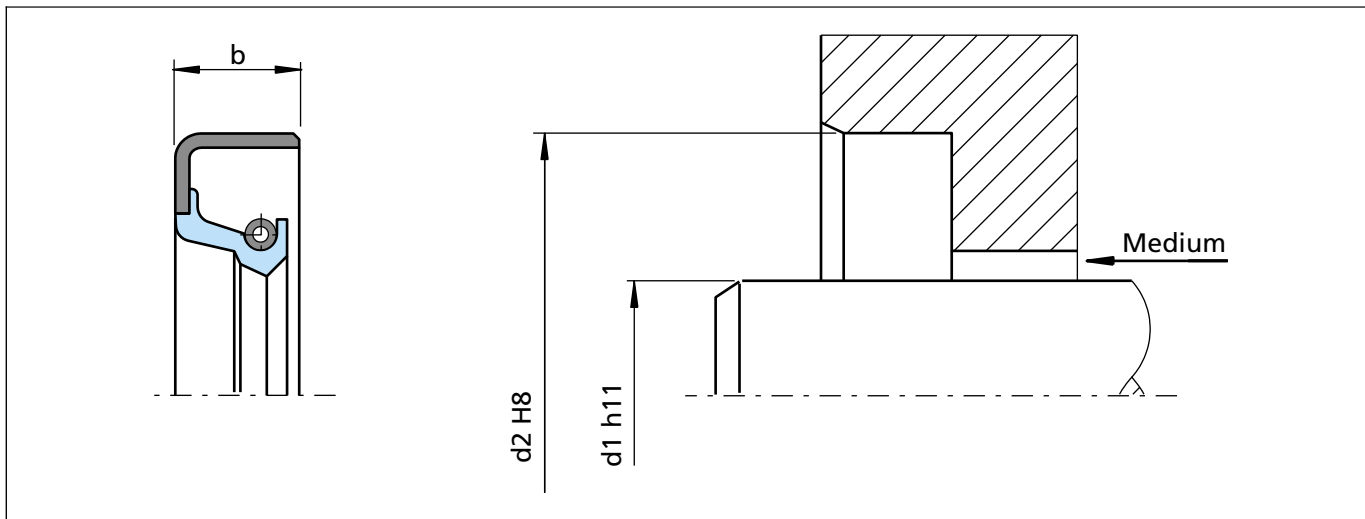


Figure 18 Installation drawing

General description

TSS type TRC and STEFA type BB are metal cased radial lip seals. This type is not recommended for use in heavy polluted environments. As the static sealing between housing and metallic shell is limited, low viscosity media can "creep". Better performance can be achieved with Epoxy-based resin O.D. coating. This special treatment is on request.

Advantages

- Good radial stiffness, especially for large diameters
- Good fitting stability avoiding pop-out of the seal
- Modern lip design provides low radial forces
- Cost effective for expensive elastomer materials
- Suitable for use in combination with axial seal (V-Ring and GAMMA-seal)

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)
- Heavy engineering applications

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table X Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: C
 Code: TRC
 Dimensions: Shaft diameter 20 mm
 Housing diameter 35 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM

Ordering example oil seal STEFA type

STEFA type: BB
 Code: TRC
 Dimensions: Shaft diameter 20 mm
 Housing diameter 35 mm
 Width 7 mm
 Material: NBR 1452
 Material Code: 4N011

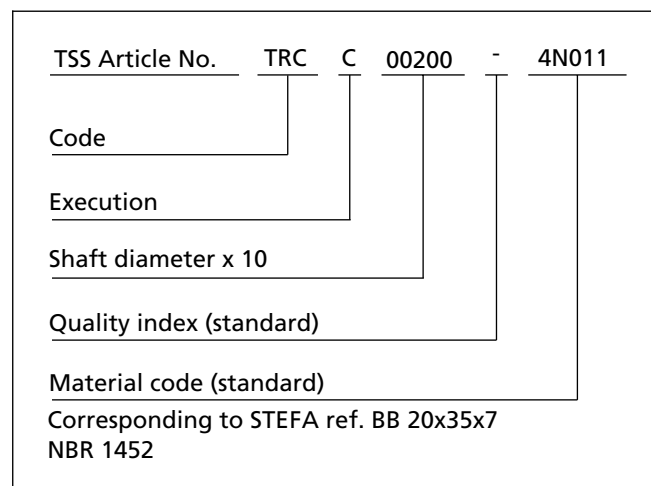
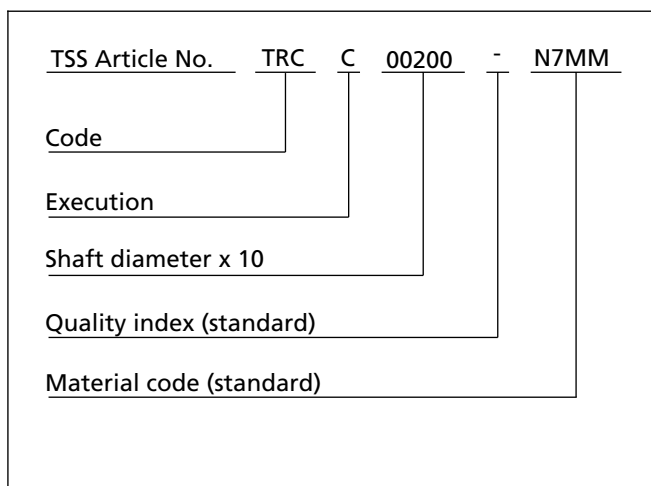


Table XI Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 8 | 16 | 7 | TRC000080 | BB | X | | X | |
| 10 | 19 | 7 | TRC100100 | BB | X | | | |
| 12 | 22 | 7 | TRCA00120 | BB | X | | X | |
| 12 | 24 | 7 | TRCB00120 | | | | X | |
| 12 | 28 | 7 | TRCC00120 | | | | X | |
| 12 | 32 | 7 | TRC100120 | BB | X | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|--------------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 14 | 24 | 7 | TRCA00140 | BB | X | | | |
| 15 | 24 | 7 | TRC000150 | BB | X | | X | |
| 15 | 26 | 7 | TRCA00150 | | | | X | |
| 15 | 28 | 7 | TRC200150 | | | | X | |
| 15 | 30 | 7 | TRCB00150 | BB | X | | | |
| 16 | 24 | 7 | TRC000160 | | | | X | |
| 16 | 28 | 7 | TRCA00160 | | | | | X |
| 16 | 30 | 7 | TRCB00160 | BB | X | | | |
| 17 | 28 | 7 | TRCA00170 | | | | X | |
| 17 | 30 | 7 | TRCB00170 | BB | X | | X | |
| 17 | 34 | 4 | TRC000170 | BB | X | | | |
| 17 | 35 | 7 | TRCD00170 | BB | X | | | |
| 18 | 24 | 4 | TRC000180 | | | | | X |
| 20 | 30 | 7 | TRCA00200 | BB | X | | X | |
| 20 | 32 | 7 | TRCB00200 | BB | X | X | X | |
| 20 | 35 | 7 | TRCC00200 | BB | X | | X | |
| 20 | 40 | 7 | TRCD00200 | BB | X | | X | |
| 20 | 42 | 7 | TRC300200 | BB | X | X | X | |
| 20 | 47 | 7 | TRCE00200 | BB | X | | X | |
| 20 | 52 | 7 | TRC400200 | | | | X | |
| 22 | 32 | 7 | TRCA00220 | BB | X | X | | |
| 22 | 35 | 7 | TRCB00220 | BB | X | | | |
| 22.22 (0.87") | 35.03 (1.38") | 7.90 (0.31") | TRC000222 | BB | X | | | |
| 24 | 35 | 7 | TRCA00240 | | | | X | |
| 25 | 35 | 7 | TRCA00250 | BB | X | | X | |
| 25 | 37 | 7 | TRC000250 | BB | X | | X | |
| 25 | 38 | 7 | TRC100250 | | | | X | |
| 25 | 40 | 7 | TRCB00250 | BB | X | | | |
| 25 | 47 | 7 | TRCD00250 | BB | X | | | |
| 25 | 52 | 7 | TRCE00250 | BB | X | | X | |
| 26 | 37 | 7 | TRCA00260 | BB | X | | | |
| 26.5 | 47 | 7 | TRC000265 | BB | X | | | |
| 27 | 37 | 7 | TRC000270 | BB | X | X | | |
| 28 | 40 | 7 | TRCA00280 | BB | X | | | |
| 28 | 47 | 7 | TRCB00280 | BB | X | | | |
| 28 | 47 | 8 | TRC200280 | BB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
() values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 30 | 40 | 7 | TRCA00300 | BB | X | | X | |
| 30 | 42 | 7 | TRCB00300 | BB | X | | X | X |
| 30 | 43 | 8 | TRC600300 | BB | X | | | |
| 30 | 45 | 8 | TRC700300 | BB | X | X | | |
| 30 | 47 | 7 | TRCC00300 | BB | X | | X | |
| 30 | 50 | 7 | TRC100300 | | | | X | |
| 30 | 52 | 7 | TRCD00300 | BB | X | | | |
| 30 | 62 | 7 | TRCE00300 | BB | X | | X | |
| 31.5 | 52 | 7 | TRC000315 | BB | X | | | |
| 32 | 42 | 7 | TRC000320 | BB | X | X | X | |
| 32 | 45 | 7 | TRCA00320 | BB | X | | | |
| 32 | 47 | 7 | TRCB00320 | | | | X | |
| 32 | 52 | 7 | TRCC00320 | BB | X | | | |
| 34 | 52 | 10 | TRC100340 | BB | X | | | |
| 35 | 45 | 7 | TRC000350 | BB | X | | X | X |
| 35 | 47 | 7 | TRCA00350 | BB | X | | X | |
| 35 | 52 | 6 | TRC300350 | | | | X | |
| 35 | 52 | 7 | TRCC00350 | BB | X | | | |
| 35 | 52 | 8.8 | TRCL00350 | BB | X | | | |
| 35 | 55 | 12 | TRCM00350 | BB | X | | | |
| 35 | 57.2 | 10 | TRCN00350 | BB | X | | | |
| 35 | 62 | 7 | TRCD00350 | BB | X | | X | |
| 35 | 62 | 12 | TRC700350 | BB | X | X | X | |
| 35 | 72 | 10 | TRC800350 | | | | X | |
| 35 | 72 | 12 | TRC900350 | | | | X | |
| 38 | 52 | 7 | TRCA00380 | | | | X | X |
| 38 | 52 | 10 | TRC100380 | BB | X | | | |
| 38 | 54 | 10 | TRC300380 | BB | X | | | |
| 40 | 52 | 5.5 | TRCI00400 | BB | X | | | |
| 40 | 52 | 7 | TRCA00400 | BB | X | | X | |
| 40 | 55 | 7 | TRCB00400 | BB | X | | X | |
| 40 | 55 | 10 | TRCG00400 | BB | X | | | |
| 40 | 57.2 | 10 | TRCJ00400 | BB | X | | | |
| 40 | 58 | 12 | TRCK00400 | BB | X | | | |
| 40 | 62 | 7 | TRCC00400 | BB | X | | X | |
| 40 | 65 | 9 | TRCH00400 | BB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 40 | 72 | 7 | TRCD00400 | BB | X | | | |
| 41 | 56 | 7 | TRC000410 | BB | X | | | |
| 42 | 55 | 7 | TRC000420 | BB | X | | X | |
| 42 | 62 | 10 | TRC100420 | BB | X | | | |
| 45 | 55 | 7 | TRC000450 | | | | X | |
| 45 | 59.1 | 10 | TRCF00450 | BB | X | | | |
| 45 | 60 | 7 | TRC100450 | | | | X | |
| 45 | 60 | 8 | TRCA00450 | BB | X | | X | |
| 45 | 62 | 8 | TRCB00450 | BB | X | | X | |
| 45 | 65 | 10 | TRC400450 | | | | X | |
| 45 | 85 | 10 | TRC800450 | | | | X | |
| 48 | 62 | 8 | TRCA00480 | | | | X | |
| 48 | 62 | 10 | TRC100480 | BB | | X | | |
| 48 | 75 | 8 | TRC000480 | | | | X | |
| 50 | 62 | 7 | TRC000500 | | | | X | |
| 50 | 65 | 8 | TRCA00500 | BB | X | X | X | |
| 50 | 68 | 10 | TRC900500 | BB | X | | | |
| 50 | 72 | 8 | TRCC00500 | BB | X | | X | |
| 50 | 72 | 10 | TRC400500 | BB | X | | | |
| 50 | 80 | 8 | TRCD00500 | BB | X | | X | |
| 50 | 80 | 10 | TRCF00500 | BB | X | | | |
| 50 | 80 | 13 | TRCG00500 | BB | X | | | |
| 52 | 72 | 12 | TRC100520 | BB | X | | | |
| 55 | 70 | 8 | TRCA00550 | BB | X | | X | |
| 55 | 72 | 8 | TRCB00550 | BB | X | | | |
| 55 | 72 | 10 | TRC000550 | BB | X | | | |
| 55 | 80 | 8 | TRCC00550 | BB | X | | X | |
| 55 | 80 | 10 | TRC200550 | BB | X | | X | |
| 55 | 85 | 8 | TRCD00550 | | | | X | |
| 56 | 72.6 | 9.7 | TRC000560 | BB | X | | | |
| 60 | 70 | 7 | TRC000600 | | | | X | |
| 60 | 72 | 8 | TRC100600 | | | | X | |
| 60 | 75 | 8 | TRCA00600 | BB | X | | X | |
| 60 | 80 | 8 | TRCB00600 | BB | X | | X | |
| 60 | 80 | 10 | TRC200600 | | | | X | |
| 60 | 85 | 8 | TRCC00600 | BB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 60 | 90 | 13 | TRC700600 | BB | X | | | |
| 65 | 80 | 8 | TRC000650 | | | | X | |
| 65 | 85 | 10 | TRCA00650 | BB | X | | X | |
| 65 | 90 | 10 | TRCB00650 | BB | X | X | X | |
| 65 | 90 | 13 | TRC200650 | | | | X | |
| 68 | 85 | 10 | TRC000680 | | | | X | |
| 68 | 90 | 10 | TRCA00680 | | | | | X |
| 70 | 85 | 8 | TRC000700 | BB | X | | X | |
| 70 | 90 | 10 | TRCA00700 | BB | X | | X | |
| 70 | 95 | 10 | TRC300700 | | | | X | |
| 70 | 95 | 13 | TRC600700 | BB | X | | | |
| 70 | 100 | 10 | TRCB00700 | BB | X | | X | |
| 70 | 110 | 10 | TRC200700 | | | | X | |
| 75 | 95 | 5 | TRC000750 | | | | X | |
| 75 | 95 | 10 | TRCA00750 | BB | X | | X | |
| 75 | 95 | 13 | TRC200750 | BB | X | | | |
| 75 | 100 | 10 | TRCB00750 | BB | X | X | | |
| 80 | 100 | 10 | TRCA00800 | BB | X | | X | |
| 80 | 100 | 13 | TRC000800 | BB | X | | | |
| 80 | 110 | 10 | TRCB00800 | BB | X | | | |
| 80 | 110 | 12 | TRC500800 | BB | X | | | |
| 85 | 100 | 9 | TRC000850 | | | | X | |
| 85 | 105 | 10 | TRC100850 | | | | X | |
| 85 | 110 | 12 | TRCA00850 | BB | X | | X | |
| 90 | 110 | 8 | TRC000900 | BB | X | | X | |
| 90 | 110 | 12 | TRCA00900 | BB | X | | X | |
| 90 | 120 | 12 | TRCB00900 | BB | X | | | |
| 95 | 110 | 9 | TRC000950 | | | | X | |
| 95 | 115 | 13 | TRC100950 | | | | X | |
| 95 | 120 | 12 | TRCA00950 | BB | X | | | |
| 96 | 135.7 | 12 | TRC000960 | BB | X | | | |
| 100 | 115 | 9 | TRC001000 | | | | X | |
| 100 | 120 | 8 | TRC101000 | | | | X | X |
| 100 | 120 | 10 | TRC201000 | | | | X | |
| 100 | 120 | 12 | TRCA01000 | BB | X | | X | |
| 100 | 130 | 12 | TRCC01000 | BB | X | X | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 105 | 125 | 12 | TRC001050 | | | | X | |
| 105 | 125 | 13 | TRC201050 | BB | X | | | |
| 105 | 130 | 12 | TRCA01050 | BB | X | | | |
| 110 | 130 | 12 | TRCA01100 | | | | X | |
| 110 | 140 | 12 | TRCB01100 | BB | X | | | |
| 110 | 150 | 15 | TRC201100 | | | | X | |
| 120 | 140 | 12 | TRC301200 | BB | X | | | |
| 120 | 140 | 13 | TRC001200 | | | | X | |
| 120 | 150 | 15 | TRC101200 | BB | | X | | |
| 125 | 150 | 12 | TRCA01250 | BB | X | | | |
| 130 | 160 | 12 | TRCA01300 | BB | X | | | |
| 130 | 160 | 13 | TRC001300 | BB | X | | | |
| 140 | 160 | 13 | TRC101400 | BB | X | | X | |
| 140 | 170 | 13 | TRC201400 | BB | | X | | |
| 160 | 185 | 10 | TRC101600 | | | | X | |
| 160 | 190 | 15 | TRCA01600 | BB | X | | X | |
| 170 | 200 | 15 | TRCA01700 | BB | X | X | | |
| 180 | 210 | 15 | TRCA01800 | BB | X | X | | |
| 260 | 300 | 20 | TRCA02600 | | | | X | |
| 270 | 310 | 16 | TRC002700 | BB | | X | | |
| 275 | 294 | 12 | TRC102750 | BB | X | | | |
| 340 | 372 | 16 | TRC103400 | BB | X | | | |
| 350 | 380 | 16 | TRC003500 | BB | X | | X | |
| 370 | 410 | 15 | TRC003700 | | | | X | |
| 460 | 500 | 20 | TRCA04600 | | | | X | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



■ Trelleborg Sealing Solutions type TRD and STEFA type BC (DIN 3761 type BS)

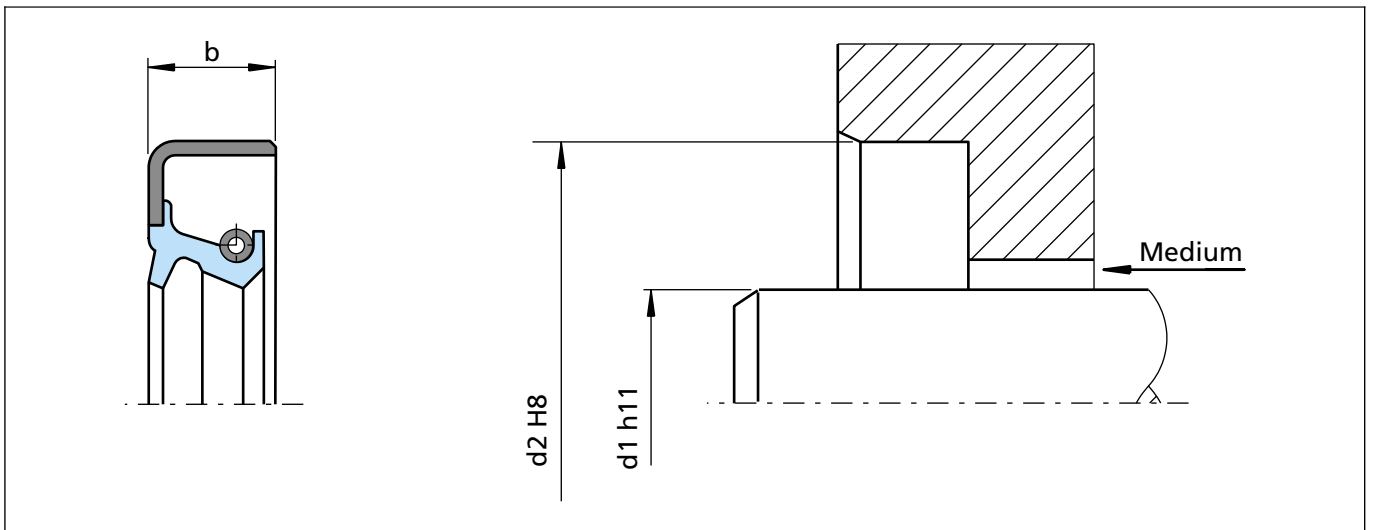


Figure 19 Installation drawing

General description

TSS type TRD and STEFA type BC are metal cased radial lip seals. The additional dust lip protects the main sealing lip against dust and other fine solid contaminants and therefore this type is recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied. As the static sealing between housing and metallic shell is somewhat limited, low viscosity media can "creep". Better performance can be achieved with epoxy based resin O.D. coating. This special treatment is on request.

Advantages

- Effective protection against air side contaminants
- Good radial stiffness, especially for large diameters
- Good fitting stability avoiding pop-out of the seal
- Modern lip design provides low radial forces
- Cost effective for expensive elastomer materials

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)
- Heavy engineering applications

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Radial Oil Seal

Table XII Materials

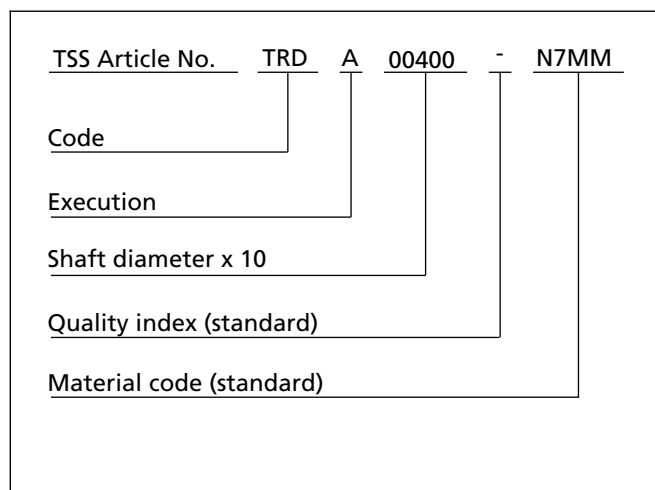
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: D
 Code: TRD
 Dimensions: Shaft diameter 40 mm
 Housing diameter 52 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA type: BC
 Code: TRD
 Dimensions: Shaft diameter 40 mm
 Housing diameter 52 mm
 Width 7 mm
 Material: NBR 1452
 Material Code: 4N011

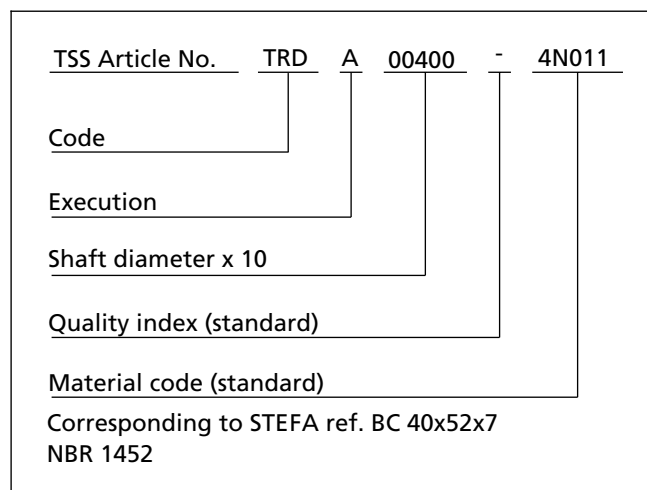


Table XIII Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | | | |
|----------------------|----------------------|----------|--------------|-------|-----------|-----------|----------|----------|---|--|
| d₁ | d₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV | | |
| 12 | 20 | 4 | TRD300120 | BC | X | | X | | | |
| 12 | 20 | 5 | TRD000120 | | | | | | | |
| 15 | 21 | 4 | TRD000150 | | | | | | X | |
| 15 | 24 | 7 | TRD100150 | BC | X | | X | | | |
| 15 | 26 | 4 | TRD200150 | | | | | | X | |
| 15 | 26 | 6 | TRD400150 | | | | | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 15 | 32 | 10 | TRD300150 | BC | X | | | |
| 17 | 28 | 5 | TRD000170 | BC | X | | | |
| 20 | 30 | 7 | TRDA00200 | | | | X | |
| 20 | 35 | 7 | TRDC00200 | | | | X | |
| 20 | 42 | 7 | TRD000200 | | | | X | |
| 22 | 40 | 7 | TRDC00220 | BC | X | | X | |
| 25 | 32 | 7 | TRD000250 | | | | X | |
| 25 | 35 | 6 | TRD200250 | BC | | X | | |
| 25 | 40 | 7 | TRDB00250 | | | | X | |
| 25 | 42 | 7 | TRDC00250 | BC | X | | | |
| 25 | 47 | 7 | TRDD00250 | BC | X | | | |
| 25 | 47 | 10 | TRD100250 | | | | X | |
| 25 | 52 | 7 | TRDE00250 | | | | X | |
| 26 | 40 | 7 | TRD000260 | | | | | X |
| 30 | 42 | 7 | TRDB00300 | BC | X | | | |
| 30 | 50 | 7 | TRD100300 | BC | X | | | |
| 30 | 50 | 10 | TRD200300 | BC | X | | | |
| 30 | 52 | 10 | TRD000300 | | | | X | |
| 35 | 47 | 7 | TRDA00350 | BC | X | | X | |
| 35 | 50 | 10 | TRD000350 | BC | X | | X | |
| 35 | 50 | 12 | TRD200350 | | | | X | |
| 35 | 52 | 7 | TRDC00350 | BC | X | | | |
| 35 | 62 | 12 | TRD100350 | | | | X | |
| 38 | 50 | 7 | TRD000380 | | | | X | |
| 38 | 52 | 7 | TRDA00380 | BC | X | | X | |
| 40 | 52 | 7 | TRDA00400 | BC | X | | X | |
| 40 | 54 | 5.5 | TRD400400 | BC | X | | | |
| 40 | 55 | 7 | TRDB00400 | | | | X | |
| 40 | 60 | 10 | TRD300400 | BC | X | | | |
| 40 | 62 | 7 | TRDC00400 | BC | | X | | |
| 40 | 90 | 10 | TRD200400 | BC | X | | | |
| 42 | 55 | 7 | TRD000420 | BC | X | | X | |
| 42 | 58 | 7 | TRD200420 | BC | X | | | |
| 42 | 62 | 7 | TRD100420 | BC | X | | | X |
| 45 | 62 | 7 | TRD100450 | BC | X | | | |
| 45 | 62 | 8 | TRDB00450 | BC | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 45 | 62 | 10 | TRD200450 | BC | X | | | |
| 45 | 65 | 5 | TRD300450 | BC | X | | | |
| 45 | 72 | 8 | TRDD00450 | BC | | X | X | |
| 45 | 72 | 12 | TRD000450 | | | | X | |
| 48 | 62 | 7 | TRD000480 | BC | X | | | |
| 48 | 65 | 12 | TRD100480 | BC | X | | | |
| 48 | 70 | 9 | TRD200480 | BC | X | | | |
| 50 | 65 | 8 | TRDA00500 | | | | X | |
| 50 | 70 | 8 | TRD100500 | BC | X | | | |
| 50 | 90 | 10 | TRD200500 | | | | X | |
| 50.8 | 66.6 | 7.92 | TRD000508 | BC | X | | | |
| 52 | 65 | 9 | TRD000520 | BC | X | | | |
| 53.98 | 69.83 | 9.52 | TRD000539 | BC | X | | | |
| 54 | 72.5 | 9 | TRD000540 | BC | X | | | |
| 54 | 74 | 8 | TRD100540 | BC | X | | | |
| 55 | 70 | 8 | TRDA00550 | | | | X | |
| 55 | 72 | 10 | TRD100550 | BC | X | | | |
| 55 | 80 | 8 | TRDC00550 | BC | X | | | |
| 55 | 90 | 10 | TRD000550 | | | | X | |
| 57 | 72 | 9 | TRD000570 | | | | X | |
| 58 | 72 | 8 | TRDA00580 | BC | X | | | |
| 58 | 75 | 15 | TRD000580 | | | | X | |
| 60 | 80 | 8 | TRDB00600 | BC | X | | X | |
| 60 | 80 | 10 | TRD200600 | BC | | X | | |
| 60 | 80 | 13 | TRD000600 | | | | X | |
| 60 | 82 | 12 | TRD100600 | | | | X | |
| 61 | 85 | 13 | TRD000610 | | | | X | |
| 65 | 90 | 13 | TRD100650 | BC | X | | | |
| 65 | 100 | 13 | TRD000650 | | | | X | |
| 68 | 90 | 13 | TRD000680 | BC | X | | | |
| 70 | 85 | 8 | TRD000700 | | | | X | |
| 70 | 90 | 10 | TRDA00700 | BC | X | | | |
| 70 | 90 | 13 | TRD200700 | BC | X | | | |
| 70 | 100 | 12 | TRD100700 | | | | X | |
| 74 | 90 | 10 | TRD000740 | | | | X | |
| 75 | 95 | 12 | TRD100750 | BC | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 75 | 95 | 13 | TRD200750 | BC | | X | | |
| 75 | 100 | 13 | TRD000750 | BC | X | | | X |
| 78 | 100 | 10 | TRDA00780 | | | | X | |
| 79 | 120 | 13 | TRD000790 | | | | X | |
| 80 | 100 | 12 | TRD100800 | | | | X | |
| 80 | 100 | 13 | TRD200800 | BC | X | | | |
| 80 | 105 | 13 | TRD000800 | | | | | X |
| 85 | 115 | 13 | TRD000850 | | | | X | |
| 90 | 110 | 13 | TRD000900 | | | | X | |
| 90 | 115 | 12 | TRD200900 | BC | | X | | |
| 100 | 130 | 12 | TRDC01000 | BC | | X | | |
| 100 | 130 | 13 | TRD001000 | | | | X | |
| 105 | 130 | 13 | TRD001050 | BC | X | | | |
| 120 | 140 | 13 | TRD001200 | | | | X | |
| 120 | 150 | 12 | TRDA01200 | BC | X | | | |
| 120 | 150 | 14 | TRD101200 | | | | X | |
| 125 | 150 | 13 | TRD001250 | BC | X | | X | |
| 130 | 160 | 13 | TRD101300 | BC | X | | | |
| 140 | 170 | 14 | TRD001400 | | | | X | |
| 140 | 170 | 15 | TRDA01400 | | | | X | |
| 145 | 170 | 13 | TRD001450 | BC | X | | | |
| 146 | 170 | 14 | TRD001460 | | | | X | |
| 148 | 170 | 14.5 | TRD001480 | BC | X | | | |
| 150 | 180 | 15 | TRDA01500 | BC | X | | | |
| 155 | 180 | 15 | TRD001550 | | | | X | |
| 160 | 180 | 10 | TRD001600 | BC | X | | | |
| 165 | 190 | 13 | TRD001650 | | | | | X |
| 170 | 200 | 15 | TRDA01700 | | | | X | |
| 180 | 200 | 15 | TRD001800 | | | | X | |
| 190 | 220 | 12 | TRD001900 | | | | | X |
| 200 | 240 | 20 | TRD002000 | | | | X | |
| 230 | 260 | 20 | TRD002300 | | | | X | |
| 265 | 290 | 16 | TRD002650 | | | | | X |
| 270 | 310 | 16 | TRD002700 | | | | X | |
| 280 | 310 | 16 | TRD202800 | | | | | X |
| 290 | 330 | 16 | TRD002900 | | | | X | |
| 400 | 440 | 20 | TRDA04000 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRB and STEFA type DB (DIN 3761 type C)

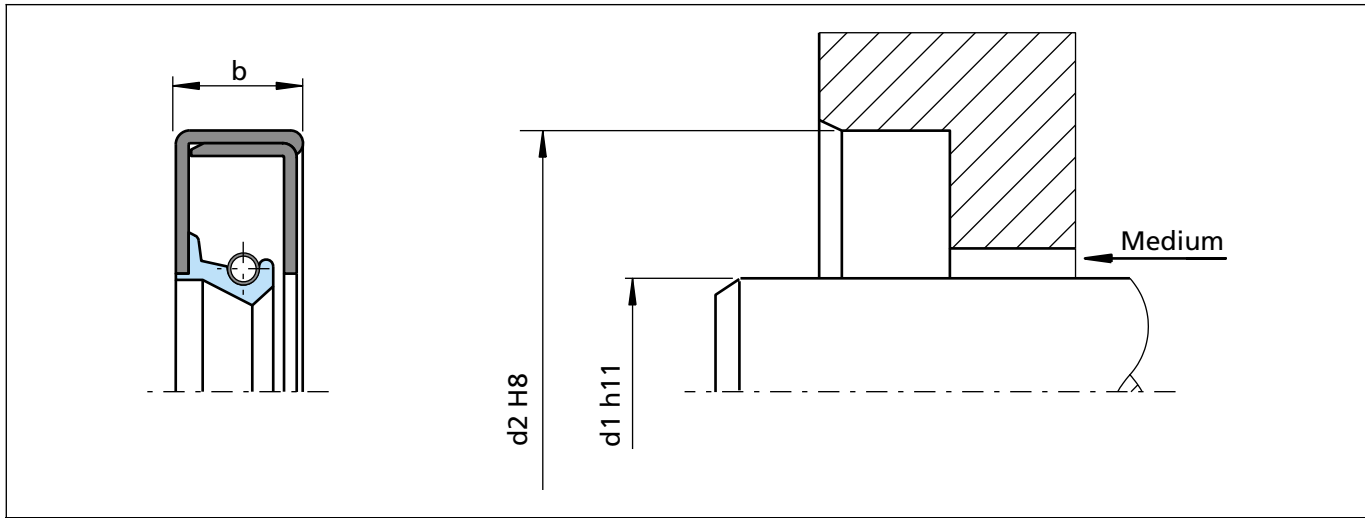


Figure 20 Installation drawing

General description

TSS type TRB and STEFA type DB are reinforced metal cased radial lip seals. The supplementary metal inner ring provides a superior stiffness. This type is not recommended for use in heavy polluted environments. As the static sealing between housing and metallic shell is limited, low viscosity media can "creep". Better performance can be achieved with epoxy based resin O. D. coating. This special treatment is on request.

Advantages

- Superior radial stiffness, especially for very large diameters
- Very good fitting stability avoiding pop-out of the seal
- Modern lip design provides low radial forces
- Cost effective for expensive elastomer materials
- Suitable for use in combination with axial seal (V-Ring and GAMMA-seal)

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)
- Heavy engineering applications (e.g. mills in steel industry)

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility test. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XIV Materials

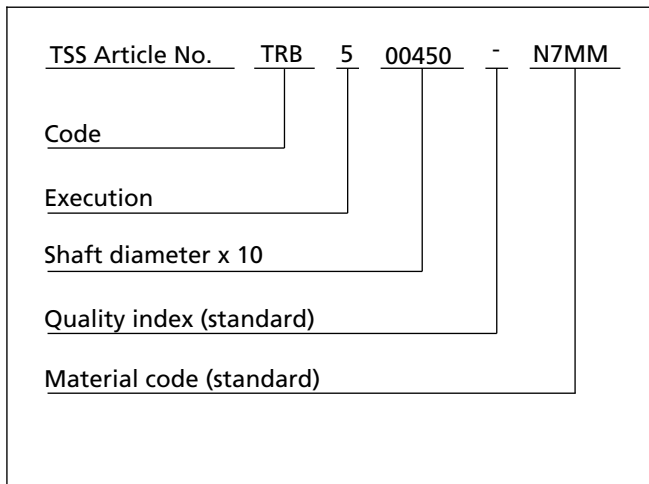
| Standard material* | TSS material Code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: B
 Code: TRB
 Dimensions: Shaft diameter 45 mm
 Housing diameter 60 mm
 Width 10 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA type: DB
 Code: TRB
 Dimensions: Shaft diameter 45 mm
 Housing diameter 60 mm
 Width 10 mm
 Material: NBR 1452
 Material Code: 4N011

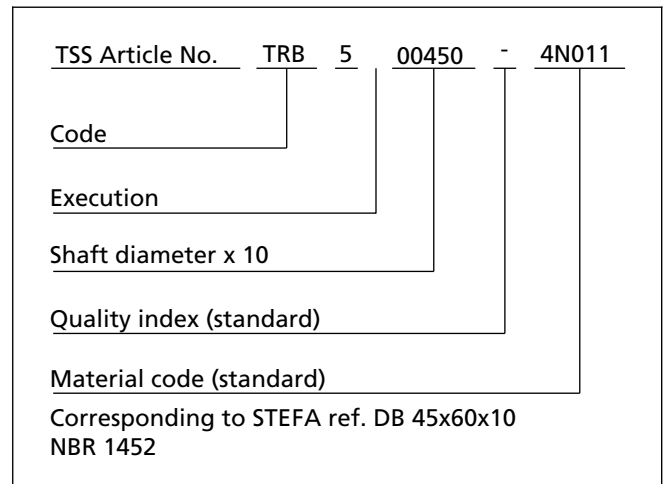


Table XV Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|----------|------------------|-------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 20 | 47 | 10 | TRB100200 | DB | X | | | |
| 22 | 40 | 9 | TRB200220 | DB | X | | | |
| 22 | 47 | 9 | TRB300220 | DB | X | | | |
| 22 | 47 | 10 | TRB000220 | | | | X | |
| 25 | 35 | 7 | TRBA00250 | | | | X | |
| 25 | 45 | 10 | TRB600250 | DB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.

() values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------------|----------------------|---------------|--------------|-------|--------------|--------------|-------------|-------------|
| d₁ | d₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 25 | 47 | 9 | TRB700250 | DB | X | | | |
| 25 | 50 | 10 | TRB800250 | DB | X | | | |
| 28 | 47 | 9 | TRB000280 | DB | X | | | |
| 30 | 47 | 9 | TRB800300 | DB | X | | | |
| 30 | 47 | 10 | TRB100300 | | | | X | |
| 30 | 50 | 10 | TRB300300 | | | | X | |
| 30 | 52 | 12 | TRB200300 | | | | X | |
| 35 | 50 | 9 | TRB000350 | DB | X | | | |
| 35 | 52 | 9 | TRBG00350 | DB | X | | | |
| 35 | 56 | 10 | TRB300350 | | | | | X |
| 35 | 62 | 9 | TRB600350 | | | | X | |
| 35 | 62 | 10 | TRB700350 | | | | X | |
| 35 | 72 | 12 | TRB800350 | | | | X | |
| 35 | 80 | 13 | TRBF00350 | | | | X | |
| 38 | 55 | 12 | TRB200380 | | | | X | |
| 40 | 60 | 10 | TRB200400 | | | | X | |
| 40 | 62 | 9 | TRB100400 | DB | X | | | |
| 40 | 62 | 10 | TRB300400 | | | | X | |
| 40 | 62 | 12 | TRB400400 | DB | X | | | |
| 40 | 68 | 10 | TRB700400 | DB | X | | | |
| 40 | 68 | 12 | TRB800400 | DB | X | X | | |
| 40 | 90 | 9 | TRB600400 | DB | X | | | |
| 45 | 60 | 10 | TRB500450 | DB | X | | X | |
| 45 | 62 | 10 | TRB100450 | DB | X | | X | |
| 45 | 65 | 10 | TRB200450 | DB | X | | | |
| 45 | 72 | 10 | TRB600450 | DB | X | | | |
| 45 | 72 | 12 | TRB000450 | | | | X | |
| 45 | 75 | 10 | TRBG00450 | DB | X | | | |
| 48 | 65 | 12 | TRB000480 | DB | X | | | |
| 50 | 68 | 10 | TRB200500 | | | | X | |
| 50 | 70 | 10 | TRB900500 | DB | X | | | |
| 50 | 72 | 10 | TRB600500 | DB | X | | | |
| 50 | 72 | 12 | TRB700500 | DB | X | | | |
| 50 | 80 | 10 | TRB800500 | DB | X | | | |
| 50.80 (2.00") | 73.10 (2.88") | 12.70 (0.50") | TRB000508 | DB | X | | | |
| 52 | 68 | 10 | TRB100520 | DB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---------------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 52 | 72 | 10 | TRB000520 | | | | X | |
| 52 | 72 | 12 | TRB200520 | DB | X | | | |
| 52 | 80 | 13 | TRB300520 | DB | X | | | |
| 54 | 80 | 10 | TRB000540 | | | | X | |
| 55 | 72 | 10 | TRB000550 | DB | X | | X | |
| 55 | 72 | 12 | TRB600550 | DB | X | | | |
| 55 | 80 | 10 | TRB200550 | DB | X | | | |
| 55 | 85 | 13 | TRB800550 | DB | X | | | |
| 55 | 100 | 13 | TRB500550 | | | | X | |
| 58 | 80 | 10 | TRB000580 | | | | X | |
| 60 | 75 | 8 | TRBA00600 | | | | X | |
| 60 | 80 | 10 | TRB000600 | DB | X | X | X | |
| 60 | 85 | 10 | TRB100600 | DB | X | | X | |
| 60 | 90 | 10 | TRB300600 | DB | X | | | X |
| 65 | 85 | 10 | TRBA00650 | DB | X | | X | |
| 65 | 85 | 12 | TRB000650 | | | | X | |
| 65 | 90 | 10 | TRBB00650 | DB | X | | | |
| 65 | 90 | 12 | TRB200650 | DB | X | | | |
| 65.10 (2.56") | 92.20 (3.63") | 12.70 (0.50") | TRB000651 | DB | X | | | |
| 66.70 (2.63") | 88.50 (3.48") | 12.70 (0.50") | TRB000667 | DB | X | | | |
| 66.70 (2.63") | 92.20 (3.63") | 12.70 (0.50") | TRB100667 | DB | X | | | |
| 68 | 90 | 10 | TRBA00680 | DB | X | X | | |
| 68 | 90 | 12 | TRB000680 | DB | X | | | |
| 69.85 (2.75") | 90.12 (3.55") | 12.70 (0.50") | TRB000698 | DB | X | | | |
| 70 | 90 | 10 | TRBA00700 | DB | X | | X | |
| 70 | 90 | 12 | TRB000700 | DB | X | X | | |
| 70 | 95 | 10 | TRB300700 | DB | X | | | |
| 70 | 100 | 12 | TRB200700 | DB | X | | | |
| 70 | 105 | 13 | TRB400700 | DB | X | | | |
| 73.02 (2.87") | 95.40 (3.76") | 12.70 (0.50") | TRB100730 | DB | X | | | |
| 74 | 90 | 10 | TRB000740 | DB | X | | | |
| 75 | 90 | 10 | TRB600750 | DB | | X | | |
| 75 | 95 | 12 | TRB500700 | DB | X | X | | |
| 75 | 100 | 10 | TRBB00750 | | | | X | |
| 75 | 100 | 12 | TRB400750 | DB | X | X | | |
| 75 | 110 | 13 | TRB200750 | DB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---------------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 75 | 115 | 13 | TRB300750 | | | | X | |
| 76.20 (3.00") | 95.40 (3.76") | 12.70 (0.50") | TRB000762 | DB | X | | | |
| 76.20 (3.00") | 98.60 (3.88") | 11.90 (0.47") | TRB100762 | DB | X | | | |
| 76.20 (3.00") | 101.80 (4.00") | 11.90 (0.47") | TRB200762 | DB | X | | | |
| 80 | 100 | 10 | TRBA00800 | DB | X | | X | |
| 80 | 100 | 12 | TRB000800 | DB | X | X | X | |
| 80 | 100 | 13 | TRB600800 | DB | X | | | |
| 80 | 105 | 13 | TRB100800 | DB | X | | X | |
| 80 | 110 | 12 | TRB200800 | DB | X | | | |
| 80 | 120 | 13 | TRB400800 | DB | X | | | |
| 85 | 105 | 13 | TRB500850 | DB | X | | | |
| 85 | 110 | 12 | TRBA00850 | DB | | X | | |
| 85 | 110 | 13 | TRB100850 | DB | X | X | | |
| 85 | 110 | 15 | TRB600850 | DB | X | | | |
| 85 | 115 | 13 | TRB200850 | | | | X | |
| 85 | 130 | 13 | TRB400850 | | | | X | |
| 85.72 (3.37") | 108.05 (4.25") | 12.70 (0.50") | TRB000857 | DB | X | | | |
| 90 | 110 | 8 | TRB000900 | DB | X | | | |
| 90 | 110 | 12 | TRBA00900 | | | | | X |
| 90 | 110 | 13 | TRB200900 | DB | X | | X | |
| 90 | 120 | 13 | TRB300900 | DB | X | | X | |
| 90 | 120 | 15 | TRB400900 | DB | X | | | |
| 90 | 130 | 13 | TRB500900 | DB | X | | X | |
| 90 | 140 | 13 | TRB600900 | | | | X | |
| 95 | 115 | 13 | TRB000950 | DB | X | | X | |
| 95 | 120 | 12 | TRBA00950 | | | | | X |
| 95 | 120 | 13 | TRB100950 | DB | X | X | X | |
| 95 | 120 | 15 | TRB500950 | DB | X | | | |
| 95 | 125 | 13 | TRB200950 | DB | X | | | |
| 95 | 125 | 15 | TRB600950 | DB | X | | | |
| 95 | 130 | 13 | TRB300950 | DB | X | | X | |
| 98.42 (3.87") | 120.81 (4.76") | 12.70 (0.50") | TRB000984 | DB | X | | | |
| 98.42 (3.87") | 127.10 (5.00") | 11.91 (0.47") | TRB100984 | DB | X | | | |
| 100 | 115 | 9 | TRB001000 | | | | | X |
| 100 | 120 | 12 | TRBA01000 | | | | | X |
| 100 | 120 | 13 | TRB101000 | DB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
() values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---------------|--------------|-------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 100 | 125 | 13 | TRB501000 | DB | X | | | |
| 100 | 130 | 13 | TRB201000 | DB | X | | X | |
| 100 | 140 | 13 | TRB601000 | DB | X | | | |
| 101.60 (4.00") | 127.10 (5.00") | 12.70 (0.50") | TRB101016 | DB | X | X | | |
| 105 | 125 | 13 | TRB001050 | DB | X | | | |
| 105 | 130 | 13 | TRB101050 | DB | X | | X | |
| 105 | 130 | 15 | TRB201050 | DB | X | | | |
| 105 | 140 | 15 | TRB501050 | DB | X | | | |
| 110 | 130 | 13 | TRB101100 | DB | X | | X | |
| 110 | 130 | 15 | TRB601100 | DB | X | | | |
| 110 | 140 | 13 | TRB501100 | DB | X | | | |
| 110 | 140 | 15 | TRB301100 | DB | X | | | |
| 110 | 145 | 15 | TRB701100 | DB | X | | | |
| 110 | 150 | 13 | TRB401100 | | | | X | |
| 110 | 150 | 15 | TRB001100 | DB | X | | | |
| 114.30 (4.50") | 139.85 (5.50") | 12.70 (0.50") | TRB001143 | DB | X | | | |
| 115 | 140 | 13 | TRB001150 | DB | X | | | |
| 115 | 140 | 15 | TRB101150 | DB | X | | | |
| 115 | 150 | 15 | TRB201150 | DB | X | | | |
| 120 | 140 | 13 | TRB001200 | DB | X | | X | |
| 120 | 145 | 14.5 | TRB501200 | DB | X | | | |
| 120 | 150 | 13 | TRB101200 | DB | X | | | |
| 120 | 150 | 15 | TRB201200 | DB | X | X | | |
| 120 | 160 | 13 | TRB301200 | | | | X | |
| 120 | 160 | 15 | TRB401200 | DB | X | X | | |
| 125 | 150 | 13 | TRB001250 | DB | X | | | |
| 125 | 150 | 15 | TRB301250 | DB | X | | | |
| 125 | 160 | 15 | TRB501250 | DB | X | | | |
| 127.00 (5.00") | 158.90 (6.25") | 12.70 (0.50") | TRB001270 | DB | X | | | |
| 130 | 160 | 13 | TRB101300 | DB | X | | X | |
| 130 | 160 | 15 | TRB401300 | DB | X | X | | |
| 130 | 170 | 15 | TRB501300 | DB | X | | | |
| 130 | 180 | 15 | TRB301300 | | | | X | |
| 135 | 160 | 13 | TRB001350 | DB | X | | | |
| 135 | 160 | 15 | TRB101350 | DB | X | | | |
| 135 | 170 | 15 | TRB201350 | DB | X | | | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
() values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---------------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 140 | 160 | 13 | TRB001400 | DB | X | | | |
| 140 | 165 | 12 | TRB401400 | DB | X | | | |
| 140 | 170 | 13 | TRB101400 | DB | X | | | |
| 140 | 170 | 15 | TRBA01400 | DB | X | X | X | |
| 140 | 180 | 15 | TRB201400 | | | | X | |
| 140 | 190 | 15 | TRB301400 | | | | X | |
| 145 | 165 | 13 | TRB001450 | DB | X | | X | |
| 145 | 170 | 13 | TRB101450 | DB | X | | X | |
| 145 | 170 | 15 | TRB201450 | DB | X | | | |
| 145 | 175 | 15 | TRBA01450 | | | | X | |
| 145 | 180 | 15 | TRB301450 | | | | X | |
| 150 | 170 | 15 | TRB201500 | DB | X | | | |
| 150 | 180 | 13 | TRB001500 | DB | X | | X | |
| 150 | 180 | 15 | TRBA01500 | DB | X | X | X | |
| 155 | 180 | 15 | TRB001550 | DB | X | | | |
| 160 | 180 | 15 | TRB001600 | DB | X | | X | |
| 160 | 185 | 10 | TRB101600 | | | | X | |
| 160 | 190 | 15 | TRBA01600 | DB | X | X | | X |
| 165 | 190 | 13 | TRB001650 | | | | X | |
| 165 | 190 | 15 | TRB101650 | DB | X | | | |
| 165.10 (6.50") | 193.88 (7.63") | 15.75 (0.62") | TRB001651 | DB | X | | | |
| 170 | 190 | 15 | TRB101700 | DB | X | | | |
| 170 | 200 | 15 | TRBA01700 | DB | X | X | X | X |
| 174.60 (6.87") | 200.23 (7.88") | 15.90 (0.63") | TRB001746 | DB | X | | | |
| 175 | 200 | 15 | TRB001750 | DB | X | | X | |
| 175 | 205 | 15 | TRB101750 | | | | X | |
| 180 | 210 | 15 | TRBA01800 | DB | X | | | |
| 180 | 220 | 16 | TRB001800 | | | | X | |
| 190 | 215 | 16 | TRB001900 | DB | X | | | |
| 190 | 220 | 15 | TRBA01900 | DB | X | | X | |
| 200 | 230 | 15 | TRBA02000 | DB | X | X | | |
| 200 | 230 | 16 | TRB102000 | | | | X | |
| 200 | 250 | 15 | TRB002000 | | | | X | |
| 210 | 240 | 15 | TRBA02100 | DB | X | X | | |
| 220 | 250 | 15 | TRB002200 | DB | X | | X | |
| 230 | 260 | 15 | TRBA02300 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
() values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|-----------------|-----------------|---------------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 240 | 270 | 15 | TRBA02400 | DB | X | | X | X |
| 250 | 280 | 15 | TRBA02500 | DB | X | | | |
| 260 | 290 | 16 | TRB002600 | DB | X | X | X | X |
| 260 | 300 | 20 | TRBA02600 | DB | X | X | | |
| 280 | 310 | 16 | TRB002800 | DB | X | X | X | X |
| 280 | 320 | 20 | TRBA02800 | DB | X | X | | |
| 290 | 330 | 18 | TRB202900 | DB | X | | | |
| 300 | 332 | 16 | TRB003000 | DB | X | | X | |
| 300 | 340 | 20 | TRBA03000 | DB | X | X | X | |
| 310 | 350 | 18 | TRB003100 | DB | X | | | X |
| 320 | 350 | 18 | TRB003200 | DB | X | | | |
| 320 | 360 | 18 | TRB103200 | DB | X | | | |
| 320 | 360 | 20 | TRBA03200 | DB | X | | X | |
| 330 | 370 | 18 | TRB003300 | | | | X | |
| 340 | 372 | 16 | TRB003400 | DB | X | | | |
| 340 | 380 | 20 | TRBA03400 | DB | X | X | X | X |
| 350 | 390 | 18 | TRB003500 | DB | X | | | |
| 360 | 400 | 18 | TRB003600 | DB | X | | X | |
| 360 | 400 | 20 | TRBA03600 | DB | X | X | | |
| 365 | 405 | 18 | TRB003650 | | | | X | |
| 374.65 (14.75") | 419.00 (16.50") | 22.20 (0.87") | TRB003746 | DB | X | | | |
| 380 | 420 | 20 | TRBA03800 | DB | X | X | X | |
| 390 | 430 | 18 | TRB003900 | DB | X | | | |
| 400 | 440 | 20 | TRBA04000 | DB | X | X | | |
| 420 | 460 | 20 | TRBA04200 | DB | X | | | |
| 440 | 470 | 20 | TRB004400 | DB | X | | | |
| 440 | 480 | 20 | TRBA04400 | DB | X | | | X |
| 460 | 500 | 20 | TRBA04600 | DB | X | | | |
| 480 | 520 | 20 | TRBA04800 | | | | X | |
| 500 | 540 | 20 | TRBA05000 | DB | X | | X | |
| 560 | 610 | 20 | TRB005600 | | | | | X |
| 600 | 640 | 20 | TRB006000 | | | | | X |
| 700 | 750 | 25 | TRB007000 | | | | X | |
| 760 | 800 | 20 | TRB107600 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
() values in brackets are inch sizes.



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRF and STEFA type DC (DIN 3761 type CS)

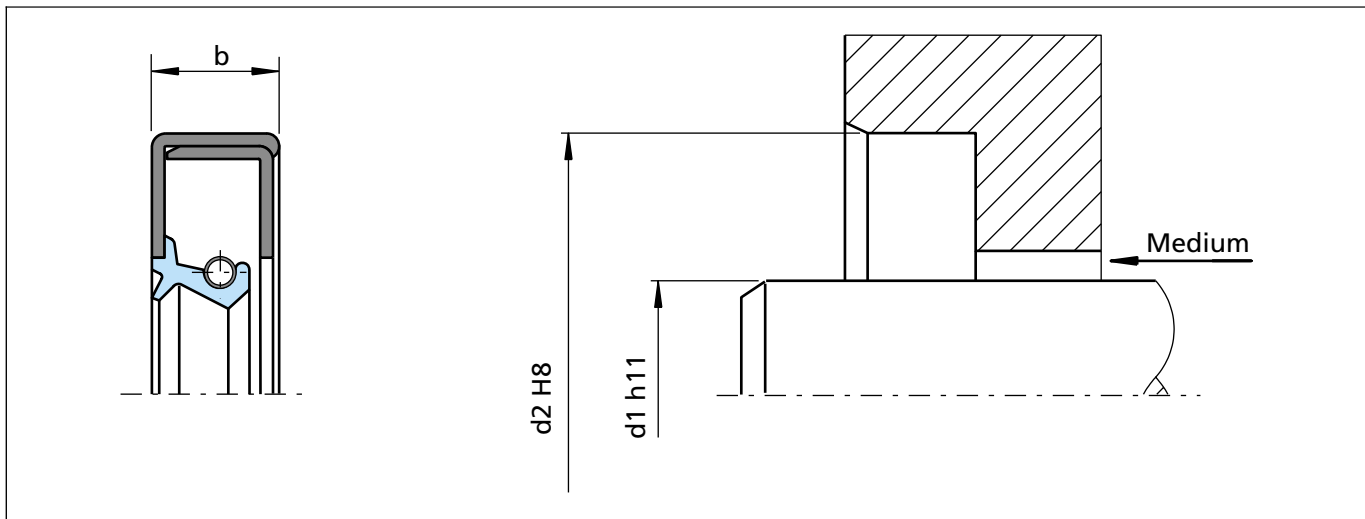


Figure 21 Installation drawing

General description

TSS type TRF and STEFA type DC are reinforced metal cased radial lip seals with dust lip. The supplementary metal inner ring provides a superior stiffness. This type is recommended for use in heavy polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied. As the static sealing between housing and metallic shell is limited, low viscosity media can "creep". Better performance can be achieved with epoxy based resin O.D. coating. This special treatment is on request.

Advantages

- Superior radial stiffness, especially for very large diameters
- Very good fitting stability avoiding pop-out of the seal
- Modern lip design provides low radial forces
- Cost effective for expensive elastomer materials
- Suitable for use in combination with axial seal (V-Ring and GAMMA-seal)

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)
- Heavy engineering applications (e.g. mills in steel industry)

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility test. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XVI Materials

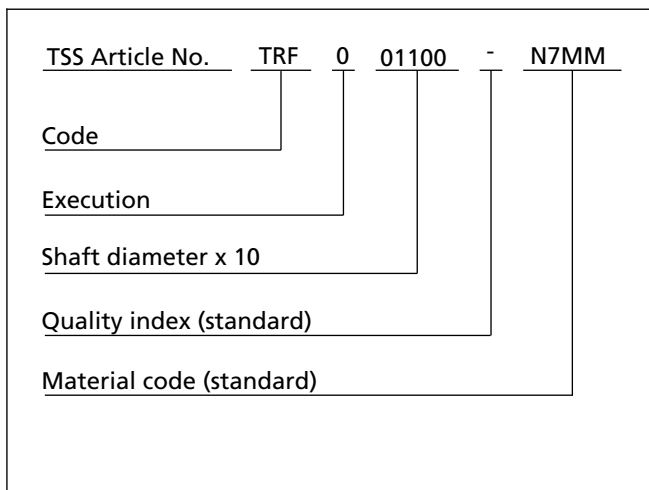
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: F
 Code: TRF
 Dimensions: Shaft diameter 110 mm
 Housing diameter 140 mm
 Width 13 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA type: DC
 Code: TRF
 Dimensions: Shaft diameter 110 mm
 Housing diameter 140 mm
 Width 13 mm
 Material: NBR 1452
 Material Code: 4N011

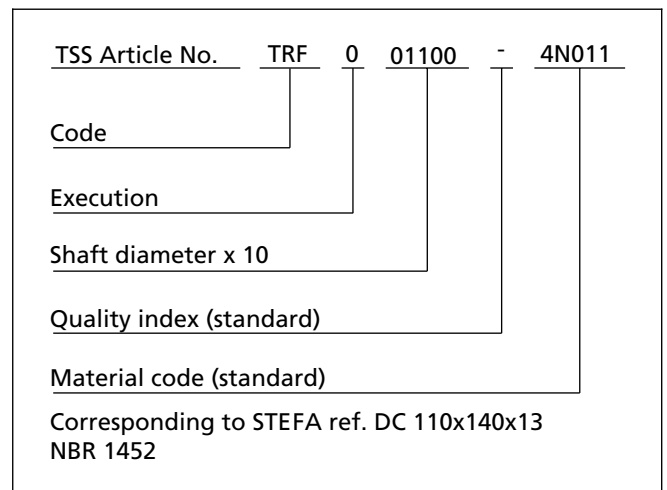


Table XVII Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---------------|------------------|-------|-----------|-----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 35 | 52 | 9 | TRF000350 | | | | X | |
| 45 | 62 | 10 | TRF100450 | | | | X | |
| 45 | 62 | 12 | TRF000450 | | | | X | |
| 50.80 (2.00") | 73.13 (2.88") | 12.70 (0.50") | TRF000508 | DC | X | | | |
| 58 | 80 | 13 | TRF000580 | | | | X | |
| 60 | 80 | 8 | TRFB00600 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-----------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 60 | 80 | 10 | TRF100600 | DC | X | | | |
| 60 | 80 | 12 | TRF000600 | | | | X | |
| 60 | 90 | 10 | TRF200600 | DC | X | | | |
| 66.7 | 98.5 | 11.9 | TRF000667 | DC | X | | | |
| 70 | 90 | 12 | TRF000700 | | | | X | |
| 80 | 100 | 10 | TRFA00800 | | | | | X |
| 80 | 100 | 12 | TRF000800 | | | | X | |
| 90 | 120 | 13 | TRF000900 | | | | X | |
| 90 | 130 | 13 | TRF100900 | | | | X | |
| 95 | 120 | 13 | TRF100950 | DC | X | | | |
| 100 | 125 | 13 | TRF001000 | | | | X | |
| 100 | 130 | 13 | TRF101000 | | | | | X |
| 105 | 140 | 13 | TRF001050 | | | | X | |
| 110 | 140 | 13 | TRF001100 | DC | X | | X | X |
| 115 | 140 | 11 | TRF001150 | | | | X | |
| 120 | 140 | 13 | TRF001200 | | | | | X |
| 120 | 150 | 15 | TRF101200 | DC | X | | | |
| 125 | 150 | 12 | TRFA01250 | | | | | X |
| 130 | 155 | 10 | TRF001300 | | | | X | |
| 130 | 170 | 15 | TRF101300 | | | | X | |
| 132 | 160 | 13 | TRF001320 | | | | X | |
| 140 | 170 | 15 | TRFA01400 | DC | X | | X | |
| 148 | 170 | 15 | TRF001480 | | | | X | |
| 150 | 180 | 15 | TRFA01500 | DC | X | | X | |
| 160 | 190 | 15 | TRFA01600 | DC | X | | | |
| 170 | 200 | 15 | TRFA01700 | DC | X | | | |
| 175 | 200 | 15 | TRF001750 | | | | X | |
| 180 | 210 | 15 | TRFA01800 | | | | | X |
| 180 | 215 | 15 | TRF001800 | | | | X | |
| 200 | 225 | 15 | TRF102000 | | | | X | |
| 240 | 270 | 15 | TRFA02400 | | | | X | X |
| 250 | 275 | 15 | TRF002500 | | | | X | |
| 275 | 300 | 15 | TRF002750 | | | | X | |
| 275 | 310 | 16 | TRF102750 | | | | | X |
| 280 | 310 | 16 | TRF002800 | | | | X | X |
| 280 | 320 | 20 | TRFA02800 | | | | X | |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----------|------------------|-------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 350 | 390 | 18 | TRF003500 | | | | X | |
| 380 | 420 | 20 | TRF003800 | | | | X | X |
| 390 | 425 | 18 | TRF003900 | | | | X | |
| 460 | 500 | 20 | TRFA04600 | | | | X | |
| 600 | 640 | 20 | TRF006000 | | | | | X |

The dimensions printed in **bold** type correspond to the recommendations in DIN 3760, draft September 1996.
 () values in brackets are inch sizes.



Special types of rotary seals

When the seals designed according to the standard of Figure 15, are not able to satisfy the application's specification, special seals are available. The selection guide in Table II

shows the range of seals suitable to fulfill the majority of industrial applications and meeting DIN 3760/3761 requirements as well. Special seals include:

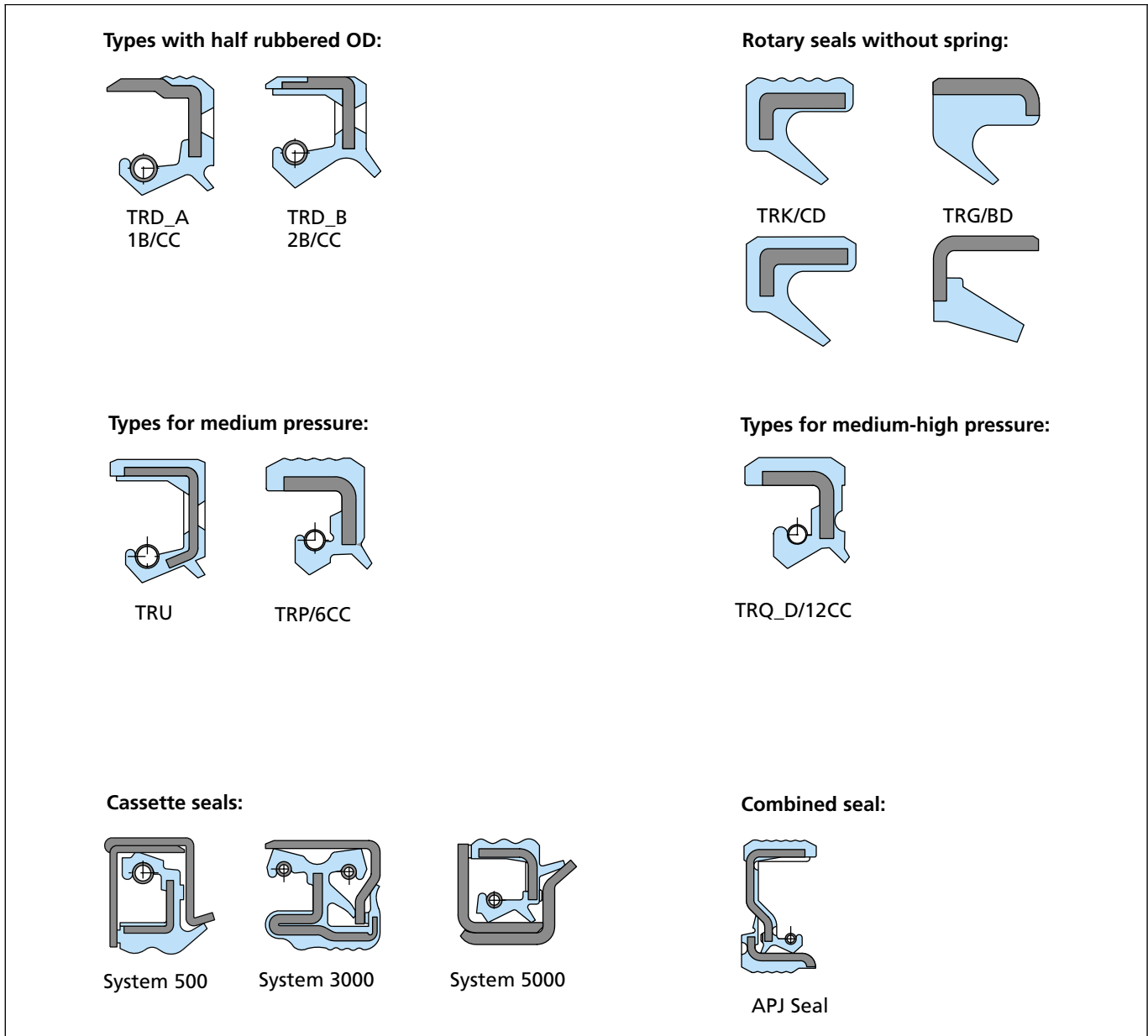


Figure 22 Selection of special radial seals



■ Trelleborg Sealing Solutions types TRD_A / TRD_B and STEFA type 1 B/CC / 2B/CC

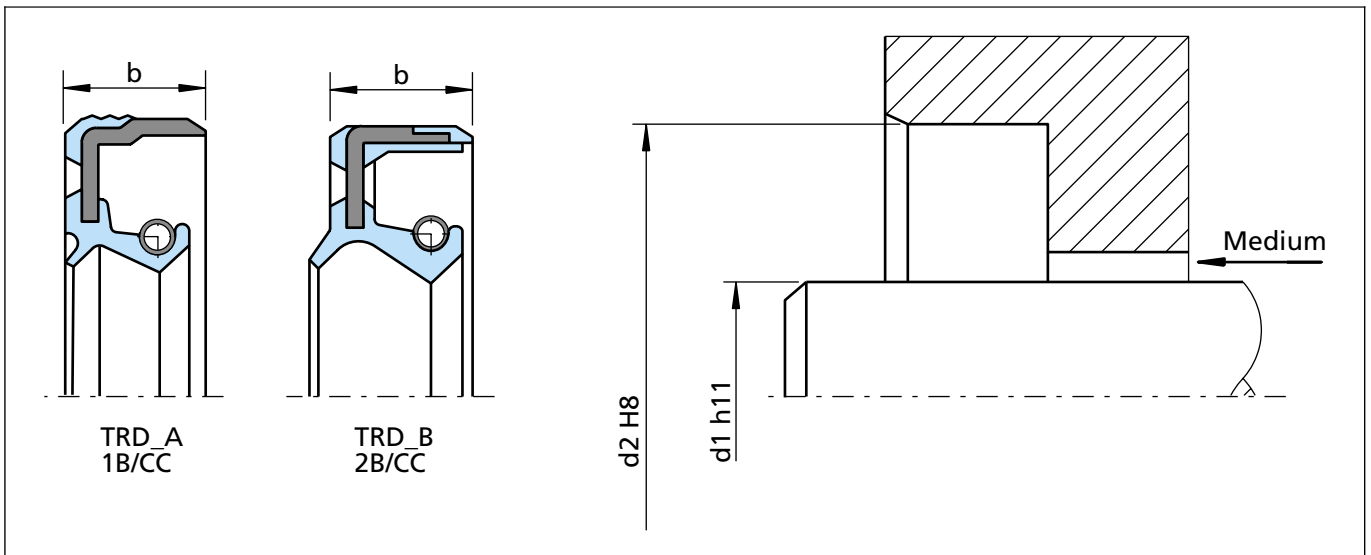


Figure 23 Installation drawing

General description

TSS types TRD_A / TRD_B and STEFA type 1B/CC and 2B/CC are seals with partially rubber covered Outer Diameter. These seals are designed to assure a high assembly stiffness and a good static sealing together with a good heat transfer. The additional dust lip protects the main sealing lip against dust and other fine solid contaminants, therefore these types are recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied.

Please note that this O.D. design (half & half design) can be delivered on request also for different sealing lip types (e.g. type TRA/CB, TRP/6CC, etc.)

Advantages

- Good static sealing and stiffness (No pop-out effect)
- Good thermal expansion compensation
- Good heat transfer
- Effective protection against air side contaminants

Application examples

- Automotive "Power-train" and "Drive-train"
- Automotive servo-pumps
- High speed transmission
- Machine tools

Technical data

| | |
|--------------|--|
| Pressure: | up to 0.05 MPa for standard lip profiles |
| Temperature: | -40 °C to +200 °C (depending on material) |
| Speed: | up to 30 m/s (depending on material) |
| Media: | mineral and synthetic oils (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Radial Oil Seal

Table XVIII Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Remark: These seals are customer tailored products.

For more details please contact your local TSS company.



■ Trelleborg Sealing Solutions type TRU - medium pressure oil seal

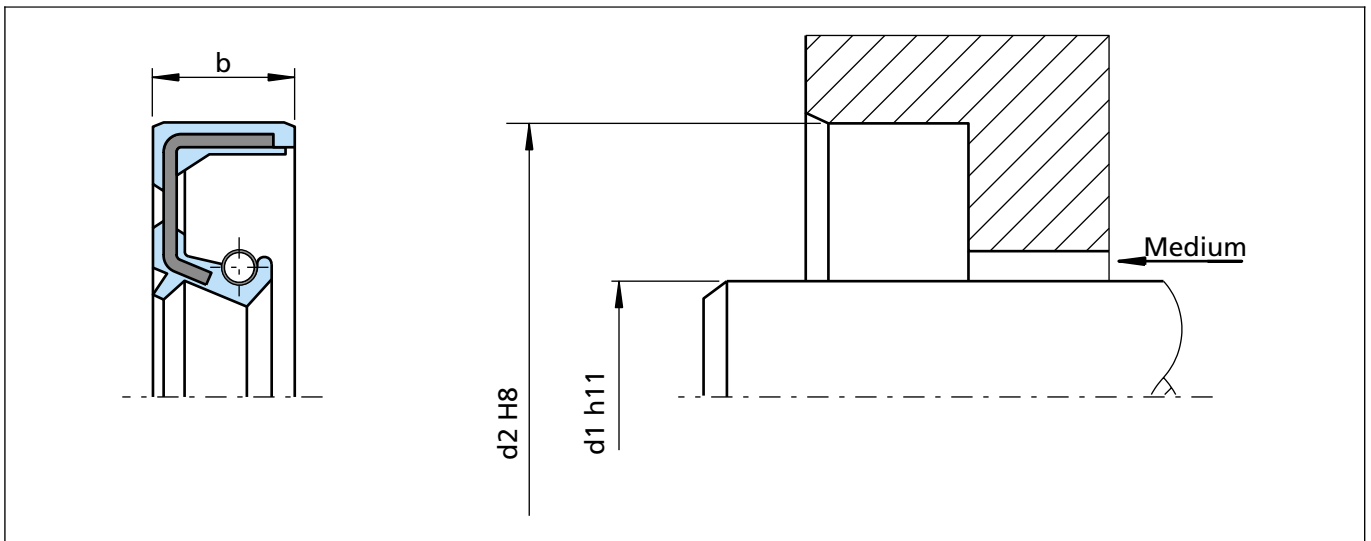


Figure 24 Installation drawing

General description

TSS type TRU is a seal with completely rubber covered outer diameter. This type of seal is designed with an extended metallic support of the diaphragm that allows pressures up to 0.5 MPa. In order to avoid a "pop-out" of the seal, we suggest to fit an axial retainer (e.g. circlip, shoulder, etc.). The additional dust lip protects the main sealing lip against dust and other fine solid contaminants and therefore this type is recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Reduced risk of fretting corrosion
- Up to 0.5 MPa pressure at moderate peripheral speed
- Effective protection against air side contaminants
- No need of back-up ring

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Hydraulic motors
- Machinery industry

Technical data

- Pressure: up to 0.5 MPa
- Temperature: -40°C to +200°C (depending on material)
- Speed: up to 10 m/s (depending on pressure and material)
- Media: mineral and synthetic lubricants (CLP, HLP, APGL etc.)

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Radial Oil Seal

Table XIX Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.
 ** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: U
 Code: TRU
 Dimensions: Shaft diameter 40 mm
 Housing diameter 52 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM

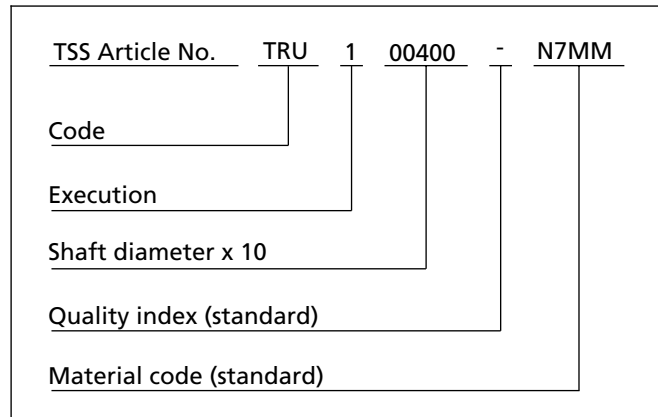


Table XX Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | TSS | |
|----------------|----------------|---|--------------|----------|----------|
| d ₁ | d ₂ | b | | NBR N7MM | FKM VCBV |
| 8 | 22 | 7 | TRU000080 | X | |
| 12 | 22 | 6 | TRU200120 | X | |
| 12 | 22 | 7 | TRU000120 | X | |
| 15 | 25 | 6 | TRU100150 | | X |
| 16 | 28 | 6 | TRU000160 | | X |
| 17 | 28 | 6 | TRU000170 | X | |
| 20 | 30 | 7 | TRU200200 | X | |
| 20 | 35 | 6 | TRU300200 | X | |
| 20 | 35 | 7 | TRU100200 | X | |
| 20 | 40 | 6 | TRU000200 | X | |
| 22 | 32 | 7 | TRU100220 | X | |
| 22 | 42 | 7 | TRU200220 | X | |
| 22 | 47 | 7 | TRU000220 | X | X |
| 23 | 40 | 6 | TRU000230 | | X |
| 25 | 40 | 7 | TRU000250 | X | X |
| 28 | 40 | 6 | TRU000280 | | X |
| 28 | 47 | 7 | TRU100280 | X | |
| 29 | 40 | 6 | TRU000290 | | X |

Radial Oil Seal



| Dimension | | | TSS Part No. | TSS | |
|----------------|----------------|-----|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | NBR N7MM | FKM VCBV |
| 30 | 42 | 6 | TRU000300 | X | X |
| 30 | 47 | 7 | TRU200300 | X | |
| 30 | 47 | 8 | TRU100300 | X | |
| 35 | 47 | 7 | TRU000350 | | X |
| 35 | 50 | 7.5 | TRU300350 | X | |
| 35 | 52 | 6 | TRU100350 | X | X |
| 35 | 56 | 12 | TRU200350 | X | |
| 37 | 47 | 6 | TRU000370 | | X |
| 40 | 52 | 5 | TRU000400 | X | X |
| 40 | 52 | 7 | TRU100400 | X | |
| 40 | 55 | 7 | TRUB00400 | | X |
| 40 | 55 | 8 | TRU200400 | X | |
| 40 | 56 | 6 | TRU300400 | X | X |
| 42 | 62 | 7 | TRU000420 | X | |
| 45 | 62 | 7 | TRU000450 | | X |
| 45 | 65 | 7 | TRU200450 | X | |
| 45 | 65 | 8 | TRU100450 | X | |
| 46 | 60 | 6 | TRU000460 | | X |
| 47 | 62 | 7 | TRU000470 | X | |
| 50 | 65 | 8 | TRU200500 | X | |
| 50 | 68 | 8 | TRU000500 | X | |
| 50 | 72 | 7 | TRU100500 | X | X |
| 55 | 72 | 7 | TRU000550 | | X |
| 55 | 72 | 8 | TRU200550 | X | |
| 55 | 75 | 7 | TRU100550 | | X |
| 58 | 80 | 10 | TRU000580 | | X |
| 60 | 75 | 8 | TRU100600 | | X |
| 60 | 80 | 7 | TRU000600 | X | X |
| 65 | 85 | 10 | TRU000650 | X | |
| 70 | 90 | 7 | TRU100700 | X | |
| 70 | 90 | 10 | TRU000700 | | X |
| 80 | 100 | 7 | TRU000800 | X | |
| 85 | 105 | 12 | TRU000850 | X | |
| 90 | 110 | 7.5 | TRU000900 | | X |
| 90 | 110 | 12 | TRU200900 | X | |
| 90 | 125 | 12 | TRU100900 | X | |



Radial Oil Seal

| Dimension | | | TSS Part No. | TSS | |
|----------------|----------------|-----|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | NBR N7MM | FKM VCBV |
| 95 | 120 | 12 | TRU000950 | X | |
| 100 | 120 | 12 | TRU001000 | X | |
| 120 | 140 | 13 | TRU001200 | X | |
| 120 | 150 | 12 | TRU101200 | X | |
| 135 | 165 | 15 | TRU001350 | X | |
| 140 | 170 | 12 | TRU001400 | X | |
| 140 | 170 | 15 | TRU101400 | X | |
| 160 | 185 | 8.5 | TRU101600 | X | |
| 160 | 190 | 15 | TRU001600 | X | |
| 190 | 213 | 8 | TRU001900 | | X |
| 200 | 230 | 15 | TRU002000 | X | |



■ Trelleborg Sealing Solutions type TRP and STEFA type 6CC - medium pressure oil seal

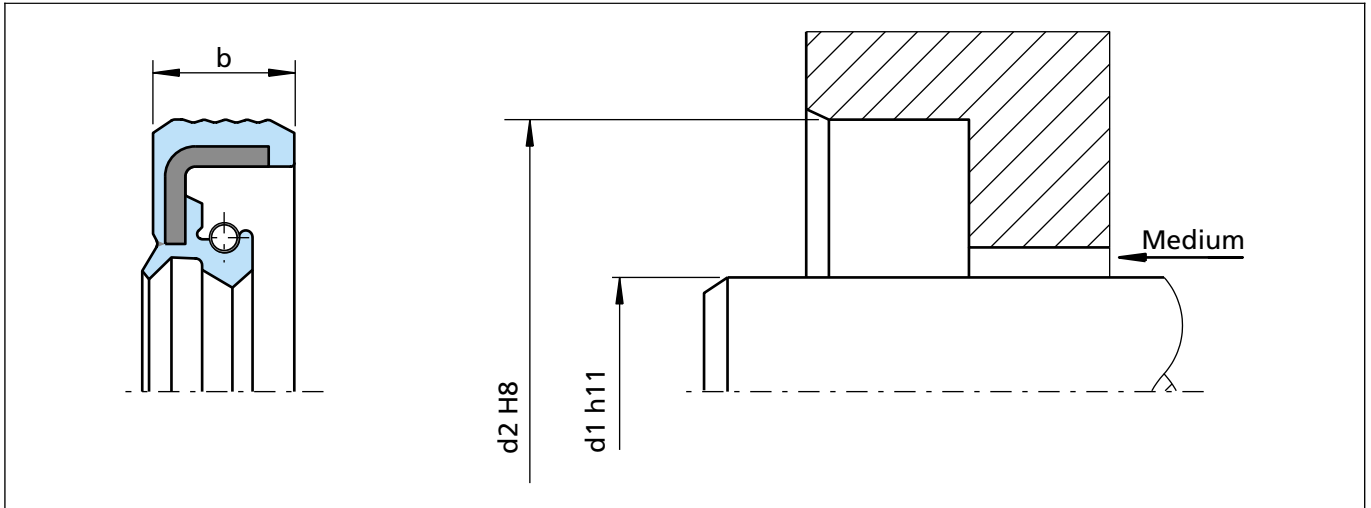


Figure 25 Installation drawing

General description

TSS type TRP and STEFA type 6CC are seals with completely rubber covered Outer Diameter. This type of seal is designed for pressures up to 0.5 MPa. In order to avoid a "pop-out" of the seal, we suggest to fit an axial retainer (e.g. circlip, shoulder, etc.) The additional dust lip protects the main sealing lip against dust and other fine solid contaminants and therefore this type is recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Reduced risk of fretting corrosion
- Up to 0.5 MPa pressure at moderate peripheral speed
- Low lip and shaft wear at low pressure run
- Effective protection against air side contaminants
- No need of back-up ring

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Hydraulic motors
- Machinery industry

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.5 MPa |
| Temperature: | -40 °C to +200 °C (depending on material) |
| Speed: | up to 10 m/s (depending on pressure and material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Radial Oil Seal

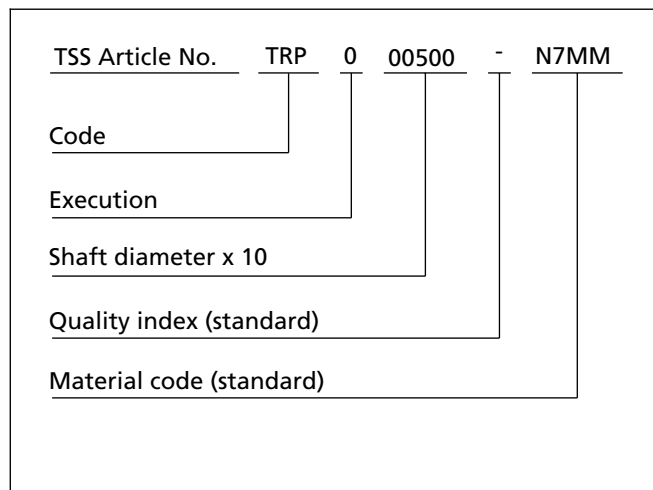
Table XXI Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel | Carbon steel |
| NBR (75 Shore A) | 4N011 | 1452 | | |
| FKM (75 Shore A) | VCBV | - | Carbon steel | Stainless steel |
| FKM (75 Shore A) | 4V012 | 5466 | | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.
 ** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: P
 Code: TRP
 Dimensions: Shaft diameter 50 mm
 Housing diameter 72 mm
 Width 7 mm
 Material: NBR
 Material Code: N7MM



Ordering example oil seal STEFA type

STEFA type: 6CC
 Code: TRP
 Dimensions: Shaft diameter 50 mm
 Housing diameter 72 mm
 Width 7 mm
 Material: NBR 1452
 Material Code: 4N011

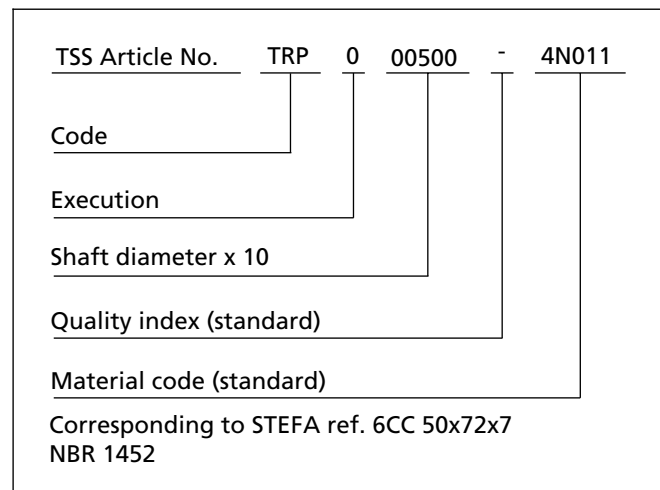


Table XXII Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | | | |
|----------------|----------------|---|--------------|-------|-----------|-----------|----------|----------|---|---|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV | | |
| 10 | 22 | 7 | TRP000100 | 6CC | X | | X | | | |
| 11 | 22 | 7 | TRPA00110 | | | | | | | |
| 12 | 22 | 6 | TRP000120 | | | | | | X | X |
| 13 | 22 | 5 | TRP000130 | | | | | X | | |
| 17 | 28 | 7 | TRP100170 | | | | X | | | |
| 17 | 30 | 7 | TRP000170 | | | | | X | | |

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|-----|--------------|-------|--------------|--------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 | NBR N7MM | FKM VCBV |
| 19 | 27 | 5 | TRP000190 | | | | X | |
| 19 | 32 | 6 | TRP100190 | 6CC | | X | | |
| 20 | 35 | 6 | TRP100200 | 6CC | X | | | |
| 20 | 40 | 7 | TRP000200 | | | | | X |
| 20 | 45 | 6 | TRP200200 | 6CC | X | | | |
| 22 | 32 | 6 | TRP100220 | 6CC | X | X | | |
| 22 | 40 | 6 | TRP000220 | | | | | X |
| 24 | 40 | 7 | TRPC00240 | 6CC | X | X | | |
| 25 | 35 | 6 | TRP100250 | 6CC | X | X | | |
| 25 | 37 | 6 | TRP200250 | 6CC | X | X | | |
| 25 | 40 | 7 | TRP000250 | | | | | X |
| 28 | 40 | 6 | TRP000280 | 6CC | | X | | |
| 30 | 42 | 6 | TRP000300 | 6CC | X | X | | |
| 33 | 45 | 5 | TRP000330 | | | | | X |
| 35 | 47 | 6 | TRP100350 | 6CC | X | X | | |
| 35 | 52 | 6 | TRP000350 | 6CC | X | X | X | X |
| 36 | 48 | 5.5 | TRP000360 | | | | X | |
| 40 | 55 | 7 | TRPB00400 | 6CC | X | X | | |
| 40 | 62 | 6 | TRP100400 | 6CC | X | | | |
| 40 | 67 | 7 | TRP000400 | | | | | X |
| 42 | 62 | 7 | TRP000420 | 6CC | | X | | |
| 45 | 62 | 7 | TRP000450 | 6CC | X | | | |
| 50 | 72 | 7 | TRP000500 | 6CC | X | X | | X |
| 52 | 68 | 10 | TRP000520 | 6CC | | X | | |
| 55 | 70 | 7 | TRP000550 | 6CC | X | | | |
| 55 | 72 | 7 | TRP100550 | 6CC | X | | | |
| 60 | 80 | 7 | TRP000600 | 6CC | X | X | X | X |
| 70 | 90 | 7 | TRP000700 | 6CC | X | X | | |
| 80 | 100 | 7 | TRP000800 | | | | | X |
| 85 | 105 | 7.5 | TRP000850 | | | | X | |
| 100 | 118 | 7.5 | TRP001000 | 6CC | X | | | |
| 105 | 125 | 13 | TRP001050 | 6CC | | X | | |
| 155 | 174 | 12 | TRP001550 | 6CC | | X | | |
| 190 | 220 | 12 | TRP001900 | | | | X | |
| 280 | 320 | 16 | TRP002800 | 6CC | X | | | |
| 365 | 400 | 12 | TRP003650 | 6CC | X | | | |
| 365 | 405 | 15 | TRP103650 | 6CC | X | | | |
| 460 | 490 | 12 | TRP004600 | 6CC | | X | | |



Radial Oil Seal

■ STEFA type 12CC - medium - high pressure oil seal

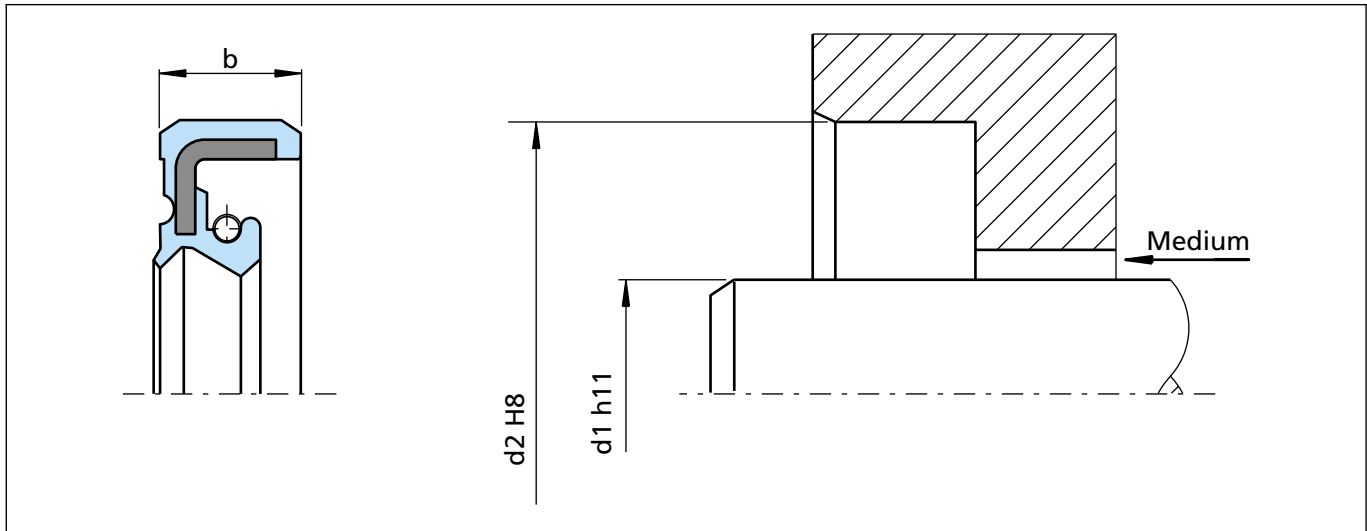


Figure 26 Installation drawing

General description

STEFA type 12 CC (TRQ_D) is a seal with completely rubber covered Outer Diameter. This type of seal is designed for pressures up to 1 MPa. In order to avoid a "pop-out" of the seal, we suggest to fit an axial retainer (e.g. circlip, shoulder, etc.). The additional dust lip protects the main sealing lip against dust and other fine solid contaminants and therefore this type is recommended for use in polluted environments. To achieve a long lifetime a suitable lubricant between the two sealing lips should be applied.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Reduced risk of fretting corrosion
- Up to 1 MPa pressure at low peripheral speed
- Effective protection against air side contaminants
- No need of back-up ring.

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Hydraulic motors
- Machinery industry

Technical data

| | |
|--------------|---|
| Pressure: | up to 1 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 5 m/s (depending on pressure and material) |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXIII Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** | Standard spring** |
|--------------------|-------------------|--------------------------|-------------------------|-------------------|
| NBR (75 Shore A) | 4N011 | 1452 | Carbon steel | Carbon steel |
| FKM (75 Shore A) | 4V012 | 5466 | Carbon steel | Stainless steel |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Ordering example oil seal STEFA type

STEFA type: 12CC
 Code: TRQ_D
 Dimensions: Shaft diameter 24 mm
 Housing diameter 40 mm
 Width 6 mm
 Material: NBR 1452
 Material Code: 4N011

| | | | | |
|--|-------|-------|---|-------|
| TSS Article No. | TRQ0D | 00240 | - | 4N011 |
| Type | | | | |
| Shaft diameter x 10 | | | | |
| Quality Index (Standard) | | | | |
| Material Code (Standard) | | | | |
| Corresponding to STEFA ref. 12CC 24x40x6/6.5 NBR 1452 | | | | |

Table XXIV Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | |
|----------------|----------------|---|--------------|-------|-----------|-----------|
| d ₁ | d ₂ | b | | Type | NBR 4N011 | FKM 4V012 |
| 15 | 25 | 6 | TRQ0D0150 | 12CC | X | |
| 19.5 | 30 | 6 | TRQ0D0195 | 12CC | | X |
| 24 | 40 | 6 | TRQ0D0240 | 12CC | X | |
| 25 | 35 | 6 | TRQ0D0250 | 12CC | | X |
| 27 | 44 | 7 | TRQ0D0270 | 12CC | X | |
| 32 | 47 | 6 | TRQ0D0320 | 12CC | | X |
| 32 | 48 | 7 | TRQ1D0320 | 12CC | X | |
| 35 | 52 | 6 | TRQ1D0350 | 12CC | | X |
| 35 | 54 | 6 | TRQ0D0350 | 12CC | | X |
| 40 | 55 | 7 | TRQBD0400 | 12CC | | X |
| 45 | 62 | 7 | TRQ0D0450 | 12CC | | X |
| 47 | 62 | 7 | TRQ0D0470 | 12CC | X | |
| 50 | 72 | 7 | TRQ0D0500 | 12CC | | X |
| 55 | 70 | 7 | TRQ0D0550 | 12CC | | X |
| 55 | 83 | 7 | TRQ1D0550 | 12CC | X | |
| 60 | 80 | 7 | TRQ0D0600 | 12CC | | X |
| 70 | 90 | 7 | TRQ0D0700 | 12CC | | X |



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRK and STEFA type CD

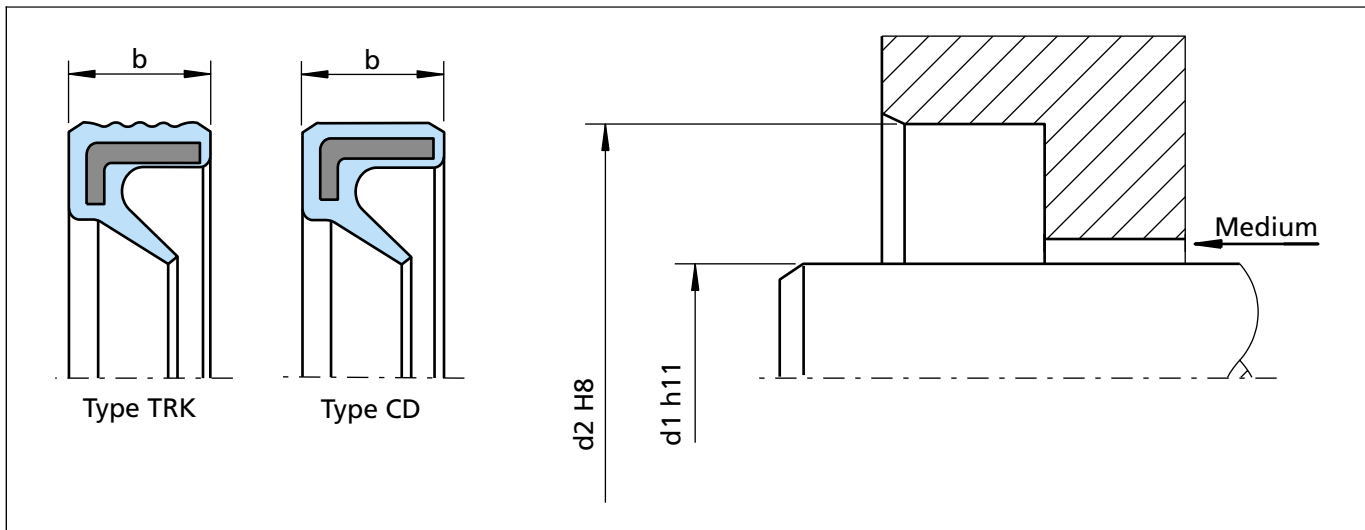


Figure 27 Installation drawing

General description

The TSS type TRK and STEFA type CD are specially designed radial oil seals reinforced with a metal insert but without spring energised sealing lip. The TSS type TRK has a wavy rubber covered outer diameter. STEFA CD type are available with flat rubber covered O.D. These types are not recommended for use in heavy polluted environments.

Advantages

- Good static sealing and thermal expansion compensation
- Low friction and low heat generation
- Extremely compact design
- Low radial force provides a low brake-out torque
- Suitable for scraper applications

Application examples

- Roller bearings
- Tooling fixtures (e.g. drilling machines)
- Sealing against viscous media (e.g. grease)
- Supplementary excluders (shaft ends)
- Axle King Pin seals

Technical data

Pressure: Without pressure

Temperature: -40°C to $+200^{\circ}\text{C}$
(depending on material)

Speed: up to 10 m/s

Media: mineral and synthetic base greases

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXV Materials

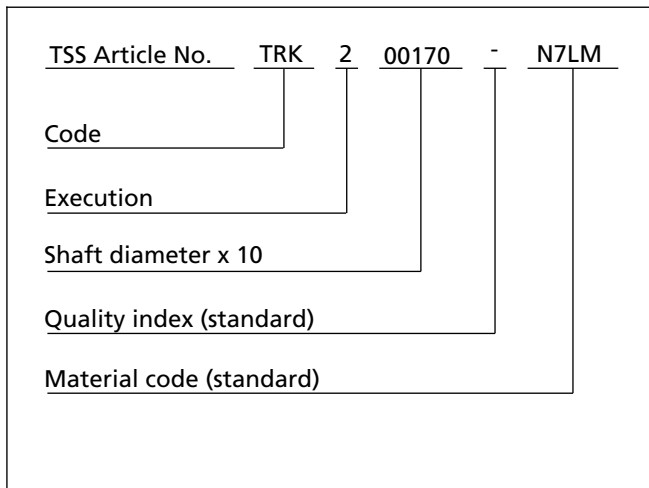
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** |
|--------------------|-------------------|--------------------------|-------------------------|
| NBR (70 Shore A) | N7LM | - | Carbon steel |
| NBR (75 Shore A) | 4N01 | 1452 | |
| FKM (75 Shore A) | VCBM | - | Carbon steel |
| FKM (75 Shore A) | 4V01 | 5466 | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: K
 Code: TRK
 Dimensions: Shaft diameter 17 mm
 Housing diameter 23 mm
 Width 3 mm
 Material: NBR
 Material Code: N7LM



Ordering example oil seal STEFA type

STEFA type: CD
 Code: TRK
 Dimensions: Shaft diameter 17 mm
 Housing diameter 23 mm
 Width 3 mm
 Material: NBR 1452
 Material Code: 4N01

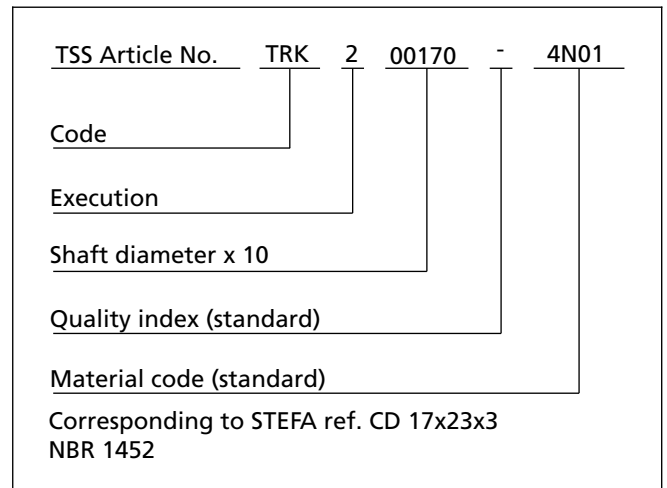


Table XXVI Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part no. | STEFA | | | TSS | |
|----------------|----------------|---|--------------|-------|----------|----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 4 | 8 | 2 | TRK000040 | | | | X | |
| 5 | 9 | 2 | TRK000050 | | | | X | X |
| 5 | 10 | 2 | TRK100050 | | | | X | X |
| 6 | 10 | 2 | TRK000060 | | | | | X |
| 6 | 15 | 4 | TRK200060 | | | | X | X |
| 7 | 14 | 2 | TRK100070 | | | | X | X |



Radial Oil Seal

| Dimension | | | TSS Part no. | STEFA | | | TSS | |
|----------------|----------------|-----|--------------|-------|-------------|-------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 8 | 12 | 3 | TRK000080 | | | | X | |
| 8 | 15 | 3 | TRK200080 | | | | X | X |
| 9 | 13 | 3 | TRK000090 | | | | X | |
| 9 | 16 | 3 | TRK200090 | | | | X | |
| 10 | 14 | 3 | TRK000100 | | | | X | X |
| 10 | 16 | 4 | TRK500100 | CD | X | | | |
| 10 | 17 | 3 | TRK100100 | | | | X | |
| 10 | 19 | 3 | TRK200100 | | | | X | |
| 10 | 21 | 4 | TRK300100 | | | | X | |
| 10 | 26 | 4 | TRK400100 | | | | X | |
| 11 | 15 | 3 | TRK000110 | | | | X | |
| 12 | 16 | 3 | TRK000120 | | | | X | |
| 12 | 18 | 3 | TRK100120 | | | | X | X |
| 12 | 19 | 3 | TRK200120 | | | | X | X |
| 12 | 20 | 4 | TRK300120 | CD | X | X | | |
| 13 | 19 | 3 | TRK000130 | CD | X | | X | |
| 14 | 20 | 3 | TRK000140 | | | | X | X |
| 15 | 21 | 3 | TRK000150 | | | | X | X |
| 15 | 23 | 3 | TRK100150 | | | | X | |
| 16 | 22 | 3 | TRK000160 | | | | X | X |
| 16 | 24 | 3 | TRK200160 | | | | X | |
| 17 | 23 | 3 | TRK000170 | CD | X | | X | |
| 17 | 23.5 | 3.4 | TRK200170 | | | | X | |
| 17 | 25 | 3 | TRK100170 | | | | X | |
| 18 | 24 | 3 | TRK000180 | | | | X | |
| 18 | 24 | 4 | TRK100180 | CD | X | | | |
| 19 | 26 | 4 | TRK100190 | | | | X | |
| 19 | 27 | 4 | TRK000190 | | | | X | |
| 20 | 26 | 3 | TRK000200 | | | | X | X |
| 20 | 26 | 4 | TRK100200 | | | | X | |
| 20 | 28 | 4 | TRK200200 | | | | X | X |
| 22 | 28 | 4 | TRK000220 | | | | X | |
| 22 | 30 | 4 | TRK100220 | | | | X | X |
| 24 | 32 | 4 | TRK000240 | | | | X | |
| 25 | 32 | 4 | TRK000250 | | | | X | |
| 25 | 33 | 4 | TRK100250 | | | | X | |

Radial Oil Seal



| Dimension | | | TSS Part no. | STEFA | | | TSS | |
|----------------|----------------|-----|--------------|-------|-------------|-------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 25 | 35 | 4 | TRK200250 | | | | X | X |
| 26 | 34 | 4 | TRK000260 | | | | X | |
| 28 | 35 | 4 | TRK000280 | | | | X | |
| 28 | 38 | 6.5 | TRK200280 | CD | X | | | |
| 28 | 40 | 6.5 | TRK300280 | CD | X | | | |
| 30 | 37 | 4 | TRK000300 | | | | X | X |
| 30 | 40 | 4 | TRK100300 | | | | X | X |
| 30 | 40 | 6.5 | TRK300300 | CD | X | | | |
| 32 | 42 | 4 | TRK000320 | | | | X | |
| 32 | 45 | 6.5 | TRK200320 | CD | X | | | |
| 33 | 40 | 3 | TRK100330 | | | | X | |
| 33 | 40 | 4 | TRK000330 | | | | X | |
| 35 | 41 | 4 | TRK000350 | | | | X | X |
| 35 | 42 | 4 | TRK100350 | | | | X | |
| 35 | 45 | 4 | TRK200350 | | | | X | |
| 38 | 48 | 4 | TRK000380 | | | | X | |
| 40 | 47 | 4 | TRK000400 | | | | X | |
| 40 | 50 | 4 | TRK200400 | | | | X | |
| 40 | 56 | 8.5 | TRK400400 | CD | X | | | |
| 42 | 52 | 4 | TRK000420 | | | | X | |
| 45 | 52 | 4 | TRK000450 | | | | X | |
| 45 | 55 | 4 | TRK100450 | | | | X | |
| 45 | 62 | 8 | TRKB00450 | CD | X | | | |
| 48 | 58 | 4 | TRK000480 | CD | X | | | |
| 50 | 58 | 4 | TRK000500 | | | | X | X |
| 50 | 60 | 6 | TRK100500 | | | | X | |
| 50 | 62 | 5 | TRK200500 | CD | X | | | |
| 50 | 68 | 8.5 | TRK300500 | CD | X | | | |
| 55 | 63 | 5 | TRK000550 | | | | X | |
| 55 | 73 | 8.5 | TRK100550 | CD | X | | | |
| 60 | 72 | 4 | TRK000600 | | | | X | |
| 70 | 78 | 5 | TRK000700 | | | | X | X |
| 75 | 95 | 7 | TRK000750 | | | | X | |
| 90 | 100 | 6 | TRK000900 | | | | X | |



Radial Oil Seal

■ Trelleborg Sealing Solutions type TRG and STEFA type BD

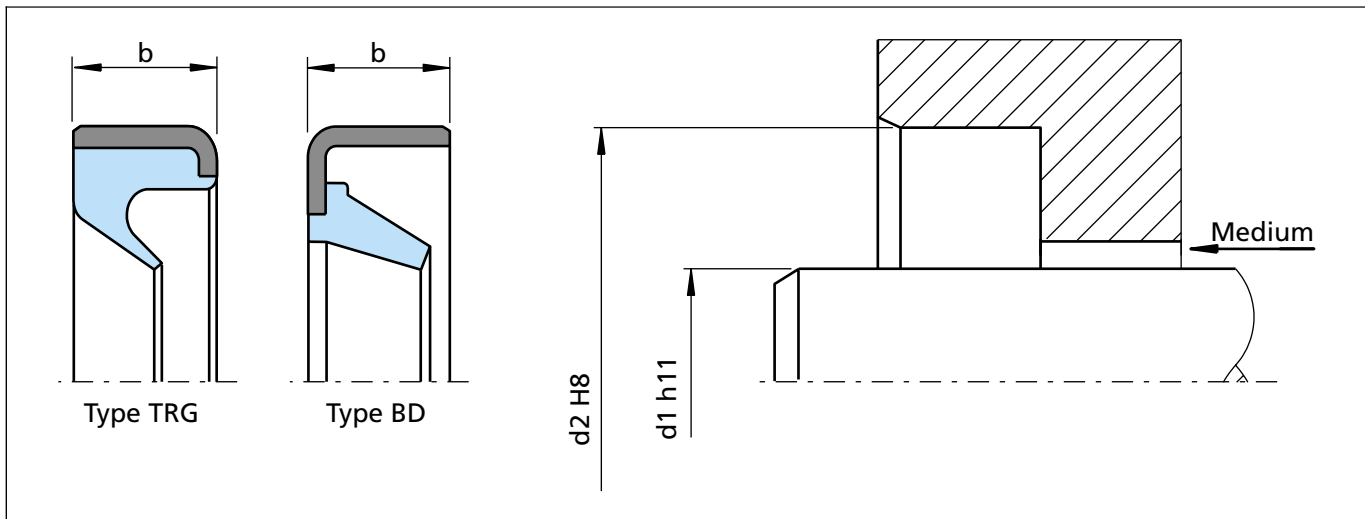


Figure 28 Installation drawing

General description

The TSS type TRG and STEFA type BD are special metal cased radial oil seals without spring energised sealing lip. These types are not recommended for use in heavy polluted environments. As the static sealing between housing and metallic shell is limited, low viscosity media can "creep". Better performance can be achieved with Epoxy based resin O.D. coating. This special treatment is on request.

Advantages

- Good radial stiffness
- Good fitting stability avoiding pop-out of the seal
- Low friction and low heat generation
- Extremely compact design
- Low radial force provides a low brake-out torque
- Suitable for scraper applications

Application examples

- Roller bearings
- Tooling fixtures (e.g. drilling machines)
- Sealing against viscous media (e.g. grease)
- Supplementary excluders (shaft ends)
- Axle King Pin seals

Technical data

| | |
|--------------|--|
| Pressure: | without pressure |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 10 m/s |
| Media: | mineral and synthetic base greases |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXVII Materials

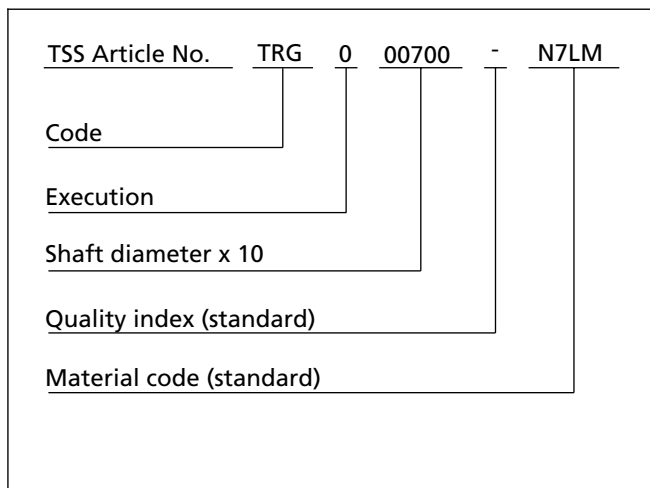
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** |
|--------------------|-------------------|--------------------------|-------------------------|
| NBR (70 Shore A) | N7LM | - | Carbon steel |
| NBR (75 Shore A) | 4N01 | 1452 | |
| FKM (75 Shore A) | VCBM | - | Carbon steel |
| FKM (75 Shore A) | 4V01 | 5466 | |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert can be supplied in different materials on request.

Ordering example oil seal TSS type

TSS type: G
 Code: TRG
 Dimensions: Shaft diameter 70 mm
 Housing diameter 78 mm
 Width 5 mm
 Material: NBR
 Material Code: N7LM



Ordering example oil seal STEFA type

STEFA type: BD
 Code: TRG
 Dimensions: Shaft diameter 70 mm
 Housing diameter 78 mm
 Width 5 mm
 Material: NBR 1452
 Material Code: 4N01

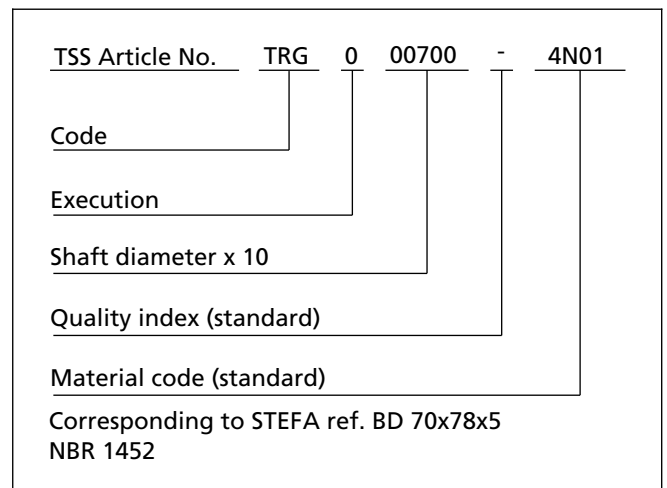


Table XXVIII Preferred series / Dimension, TSS part numbers

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|---|--------------|-------|----------|----------|----------|----------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 3 | 8 | 2 | TRG000030 | | | | X | |
| 4 | 8 | 2 | TRG000040 | | | | X | X |
| 5 | 9 | 2 | TRG000050 | | | | X | |
| 6 | 10 | 2 | TRG000060 | | | | X | X |
| 6 | 12 | 2 | TRG100060 | | | | X | |
| 7 | 11 | 2 | TRG000070 | | | | X | X |

() values in brackets are inch sizes.



Radial Oil Seal

| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|------|--------------|-------|-------------|-------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 8 | 14 | 2 | TRG100080 | | | | X | |
| 8 | 15 | 3 | TRG200080 | | | | X | |
| 9 | 13 | 3 | TRG000090 | | | | X | |
| 10 | 14 | 3 | TRG000100 | | | | X | |
| 10 | 15 | 3 | TRG200100 | BD | X | | | |
| 10 | 16 | 4 | TRG300100 | BD | X | X | | |
| 10 | 17 | 3 | TRG100100 | | | | X | |
| 12 | 16 | 3 | TRG000120 | | | | X | X |
| 12 | 18 | 3 | TRG100120 | | | | X | X |
| 12 | 19 | 3 | TRG200120 | | | | X | |
| 14 | 22 | 3 | TRG200140 | | | | X | |
| 15 | 21 | 3 | TRG000150 | | | | X | |
| 15 | 23 | 3 | TRG100150 | | | | X | |
| 16 | 24 | 3 | TRG200160 | | | | X | |
| 17 | 23 | 3 | TRG000170 | | | | X | |
| 18 | 24 | 3 | TRG000180 | | | | X | X |
| 20 | 26 | 4 | TRG100200 | | | | X | |
| 20 | 28 | 4 | TRG200200 | | | | X | X |
| 21 | 29 | 4 | TRG000210 | | | | X | |
| 22 | 28 | 4 | TRG000220 | | | | X | |
| 24 | 32 | 4 | TRG000240 | | | | X | |
| 25 | 32 | 4 | TRG000250 | BD | | X | X | X |
| 25 | 32 | 5 | TRG300250 | BD | X | | | |
| 25 | 33 | 4 | TRG100250 | | | | X | |
| 25 | 35 | 4 | TRG200250 | | | | X | |
| 27 | 40 | 10 | TRG000270 | BD | X | | | |
| 28 | 35 | 6 | TRG300280 | | | | X | |
| 28 | 37 | 4 | TRG100280 | | | | X | |
| 30 | 37 | 4 | TRG000300 | | | | X | |
| 30 | 40 | 4 | TRG100300 | | | | X | |
| 32 | 42 | 4 | TRG000320 | | | | X | |
| 35 | 42 | 4 | TRG000350 | | | | X | X |
| 35 | 42 | 4.46 | TRG300350 | BD | | X | | |
| 36 | 42 | 4 | TRG000360 | | | | X | |
| 37 | 47 | 4 | TRG000370 | | | | X | |
| 37 | 48 | 4 | TRG100370 | | | | X | |

() values in brackets are inch sizes.

Radial Oil Seal



| Dimension | | | TSS Part No. | STEFA | | | TSS | |
|----------------|----------------|--------------|--------------|-------|-------------|-------------|-------------|-------------|
| d ₁ | d ₂ | b | | Type | NBR 4N01 | FKM 4V01 | NBR N7LM | FKM VCBM |
| 38 | 48 | 4 | TRG000380 | | | | X | |
| 38.1 | 47.1 | 6.4 | TRG000381 | BD | X | | | |
| 39.69 (1.56") | 52.48 (2.07") | 4.80 (0.19") | TRG000396 | BD | X | | | |
| 40 | 47 | 4 | TRG000400 | | | | X | |
| 40 | 48 | 4 | TRG100400 | | | | X | |
| 40 | 50 | 4 | TRG200400 | | | | X | |
| 40 | 52 | 5 | TRG300400 | | | | X | |
| 40 | 62 | 4.76 | TRG400400 | BD | X | | | |
| 42 | 52 | 4 | TRG000420 | | | | X | |
| 43 | 53 | 4 | TRG000430 | | | | X | |
| 44 | 54 | 5 | TRG000440 | BD | X | | | |
| 45 | 52 | 4 | TRG000450 | | | | X | |
| 45 | 55 | 4 | TRG100450 | | | | X | X |
| 50 | 58 | 4 | TRG000500 | | | | X | |
| 52 | 68 | 6 | TRG000520 | BD | X | | | |
| 55 | 63 | 5 | TRG000550 | | | | X | X |
| 61.6 | 74 | 5 | TRG000616 | BD | X | | | |
| 67 | 75.5 | 4.3 | TRG000670 | BD | X | | | |
| 70 | 78 | 5 | TRG000700 | BD | X | | X | |
| 77 | 85.5 | 4.8 | TRG000770 | BD | X | | | |

() values in brackets are inch sizes.



■ Rotary and axial seal combination

General Description

In many applications rotary shaft lip seals are used to seal against various mediums.

An important failure mechanism for lip seals is the destruction of the lubricant film, resulting in rapid wear, due to the ingress of dirt, dust, moisture etc. The use of shaft seals having one or more auxiliary sealing lips (dust lips) provides a limited improvement, is not always sufficient. In order to meet the constantly increasing requirements as to sealability - not the least considering the environmental protection -and long service life the STEFA COMBI - seal is a simple solution, which has proved to be particularly well suited even in critical applications with heavy contamination. The COMBI-seal consists of a GAMMA seal and a rotary shaft lip seal working together. The lip seal provides the counterface for the GAMMA seal being fixed to the shaft by press fit. See Figure 29 and 30.

Years of successful experiences show that another frequently used alternative consists in the combination of a V-Ring seal with a standard seal selected inside the type list: TRC/BB; TRD/BC; TRB/DB; TRF/DC.

The rotary shaft seal should be ordered **"Without Markings"** on the air side.

Radial Oil Seal + GAMMA seal

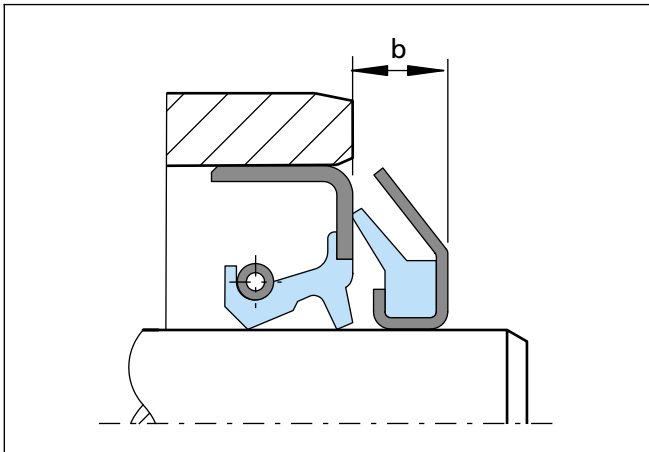


Figure 29 GAMMA seal fitted on the shaft end

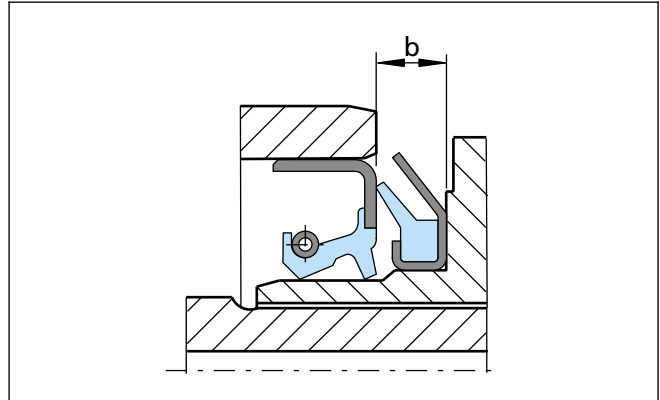


Figure 30 GAMMA seal fitted on the shaft boss

Radial Oil Seal + V-Ring

The function of the rotary axial seal is to prevent by centrifugation the intrusion of particles and water drops.

In other words, adds it's original protection capacity to the radial seal functionality. The necessary condition to allow the application is the space availability on the shaft to host the axial seal width. (See Figure 31).

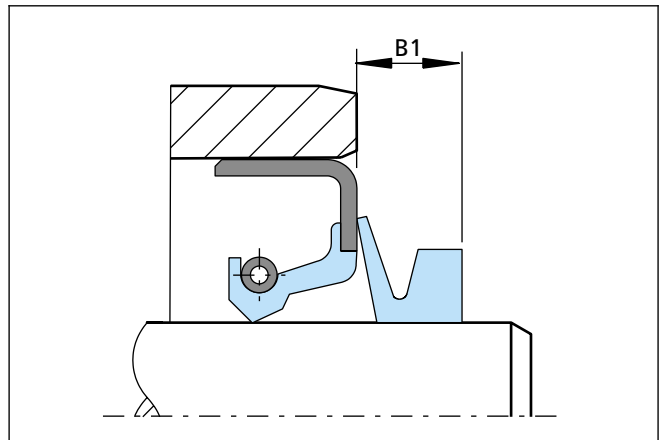


Figure 31 V-Ring fitted on the shaft end

Housing and shaft design

The radial lip seal needs to be assembled in the housing according to usual fitting instructions. Both V-Ring and GAMMA seal is assembled later on the shaft. The shaft design requires to be adapted by an elongation corresponding at least to B1 (b) dimension. In case of very high peripheral speeds, the V-Ring body should be radially supported. See also the instructions reported in the specific catalogue chapter.



The GAMMA seal can be fitted according above sequence but sometimes the shaft surface must be slightly changed in order to avoid scratches at assembly that can negatively influence the radial seal functionality (See Figure 29 and 30). See also the instructions reported into specific catalogue chapters.

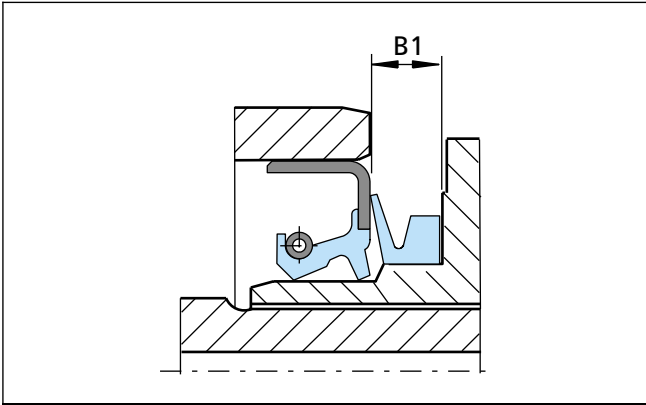


Figure 32 V-Ring type A fitted on the shaft boss

In the examples the V-Ring “type A” is represented, but any other type of V-Ring is usable in accordance with space available and application requirements.

In special application conditions, with consequent design alterations in the housing, is also possible the use of TRB type (labyrinth formed by metal shell and housing).



Radial Oil Seal

■ Product description

The combination of Radial shaft seal with V-Ring or GAMMA seals is recommended for use in heavy polluted environments.

Both the radial shaft seal and the GAMMA seal housing may also be manufactured with different metal shell as well as different rubber types for sealing members. See specific paragraphs.

Advantages

- Longer service life and high function reliability
- Good IP protection for electrical motors (VDE-Norm 0470-1)
- Good protection against water splash and welding sparks
- Simple handling
- Superior total economy
- Friction loss decreases with increasing shaft speed

Application examples

Typical applications are all equipment working in contaminated environments where dust, foreign matter and liquid splatter are present.

Some examples:

- gear motors
- journal and gear transmissions
- bearing housings
- power saws
- utility vehicles
- agricultural machinery and equipment
- wheel hubs
- propeller shafts
- pumps
- hydraulic motors
- tool machinery
- equipments for steel manufacture
- metal working machinery

Technical data

| | |
|--------------|---|
| Pressure: | see radial seal data |
| Temperature: | -40 °C to +200 °C (depending on material) |
| Speed: | up to 20 m/s (depending on material) |
| Mediums: | Mineral and synthetic oils (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.

Materials

See data reported in the specific chapters.

Ordering example

Order components separately as per data reported into specific chapters. Please consider to order the radial oil seals "**without marking**".



■ Combined rotary shaft seal

General description

The combined rotary shaft lip seal is an assembly which includes a supplementary protection of the radial sealing members with an axial rotary sealing lip integrated into a wear sleeve. The rubberised wear sleeve and radial seal are designed to satisfy either customer's and DIN 3760 (3761) specifications.

Sealing lips design

The sealing lips design corresponds to the latest state of development based on many years of laboratory and field tests. The main radial sealing edge can either be ready moulded (when equipped with TURBO ribs) or trimmed by mechanical cutting. The total radial force of the sealing lip is extremely low thanks to the miniaturisation of the lip profile and the application of smallest possible Garter spring. The above miniaturisation is made in order to reduce as much as possible the metal sleeve wear, the friction loss and relevant heat generation.

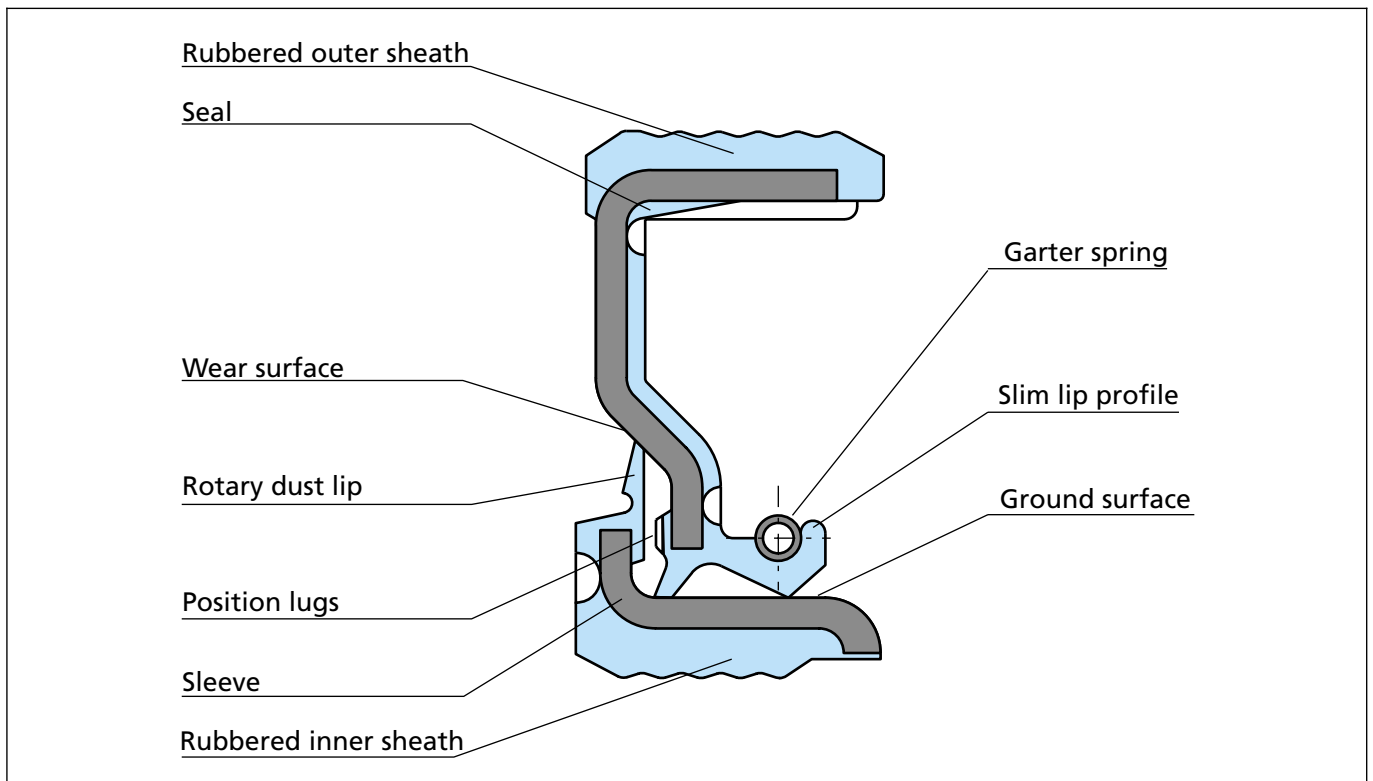


Figure 33 APJ seal details



■ STEFA standard APJ type

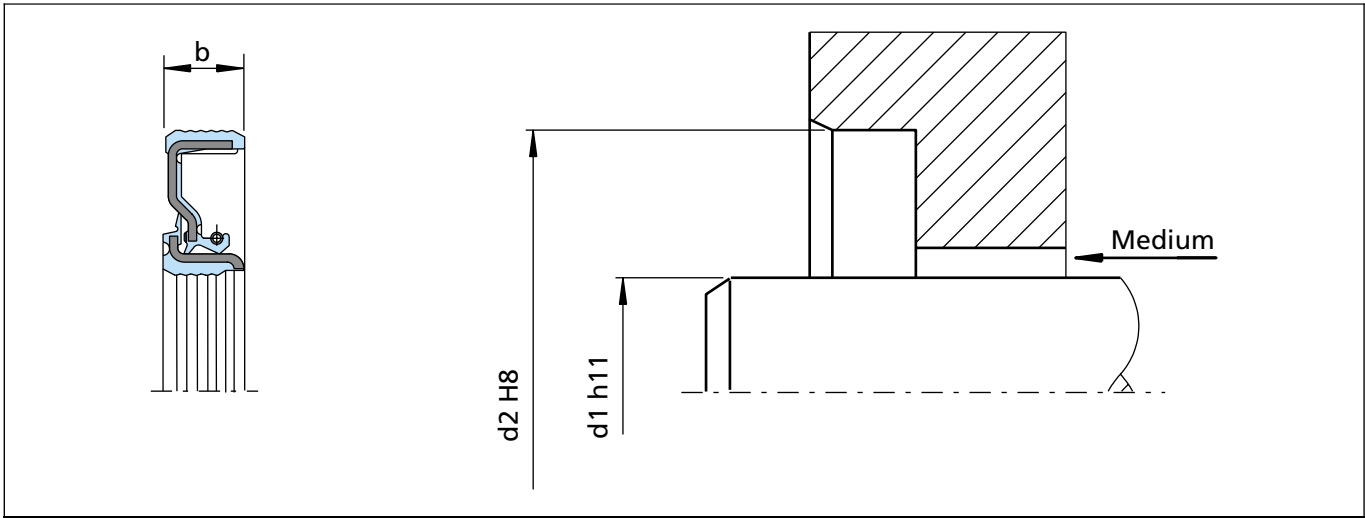


Figure 34 Installation drawing

Product description

STEFA standard APJ is a seal with completely rubber covered outer diameter. Two different O.D designs are available: Flat rubber sheath as well as wavy, both correctly fitting into H8 bores.

APJ seal is recommended for use in heavy polluted environments.

Both the seal and the sleeve may also be manufactured with different metal insert material as well as different rubber types.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- No risk of fretting corrosion
- Higher bore surface roughness is allowed
- Do not require shaft hardening
- Do not require shaft grinding
- Modern lip design provides low power loss

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Washing machines
- Machinery for Industry (e.g. tool machines)
- Axles for heavy-duty applications

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40 °C to +200 °C (depending on material) |
| Speed: | up to 10 m/s (depending on material) |
| Media: | mineral and synthetic oils (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility test. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXIX Materials

| Standard material* | TSS material code | STEFA material code | Standard metal insert** | Standard spring** |
|---------------------------|--------------------------|----------------------------|--------------------------------|--------------------------|
| NBR (75 Shore A) | 4N011 | 1452 | Carbon steel | Carbon steel |
| FKM (75 Shore A) | 4V012 | 5466 | Carbon steel | Stainless steel |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Remark: These seals are customer tailored products.

For more details please contact your local TSS company.



Radial Oil Seal

■ STEFA 1B/APJ and 2B/APJ types - housing as per DIN 3760-3761

The design of the radial seal corresponds to STEFA Type 1B/CC and 2B/CC.

The sleeve remains the same for all kind of radial seal design.

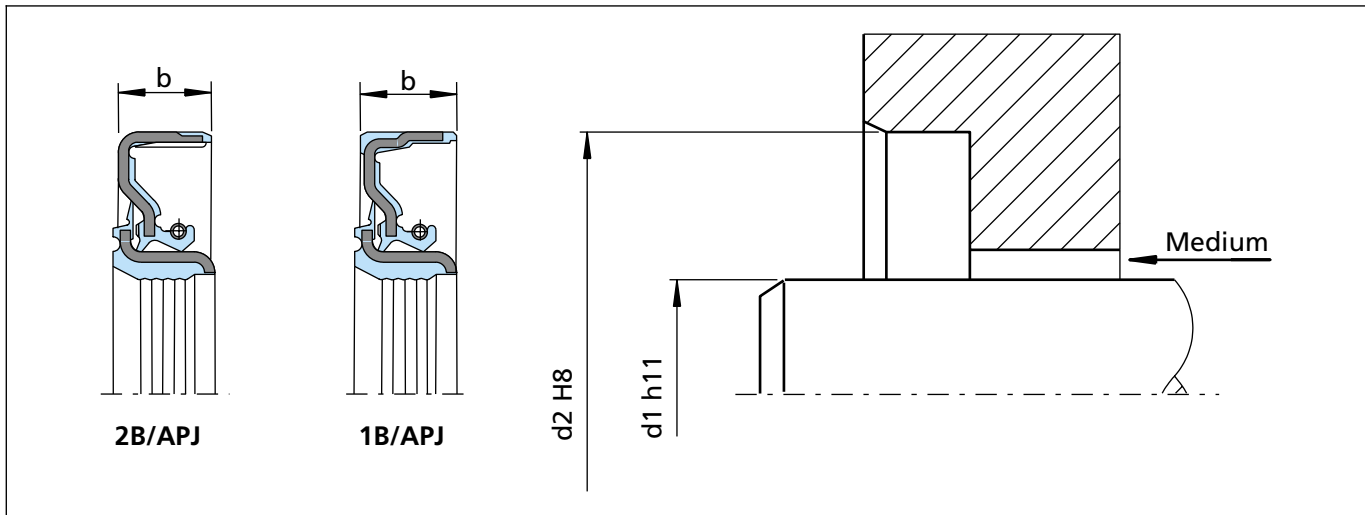


Figure 35 Installation drawing

Product description

STEFA 1B/APJ and 2B/APJ types are radial lip seals with partially rubber covered outer diameter.

1B/APJ type recommended for use in heavy polluted environments and where a good axial retention force is required with a good heat transfer as well. The type 2B/APJ is recommended for aluminium or soft metal housings that may be scratched at assembly by metal frame of the seal.

Advantages

- Good static sealing
- Compensation of different thermal expansion
- Higher bore surface roughness is allowed
- Do not require shaft treatment (hardening and grinding)
- Modern lip design provides low power loss
- Good heat transfer to outside
- Quick servicing (No shaft rework required)

Applications examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Machinery industry (e.g. tool machines weaving machinery)
- Axle Hubs and axle for heavy-duty applications

Technical data

| | |
|--------------|---|
| Pressure: | up to 0.05 MPa |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 10 m/s (depending on material) |
| Media: | mineral and synthetic oils (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXX Materials

| Standard material* | TSS material code | STEFA material code | Standard metal insert** | Standard spring** |
|---------------------------|--------------------------|----------------------------|--------------------------------|--------------------------|
| NBR (75 Shore A) | 4N011 | 1452 | Carbon steel | Carbon steel |
| FKM (75 Shore A) | 4V012 | 5466 | Carbon steel | Stainless steel |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert, and spring as well, can be supplied in different materials on request.

Remark: These seals are customer tailored products.

For more details please contact your local TSS company.



■ END COVER

General description

End covers are components to be fitted in the housing bores where no input/output shaft is located. Moreover they are used to plug and seal service bores.

Standard end covers are manufactured in accordance with bore tolerances recommended by DIN 3760 and ISO 6194/1 for radial oil seals.

Two different types of end covers are available as described in the following chapters. The type YJ38 is fully rubber covered and the type YJ39 has a "half-half" design.

■ Trelleborg Sealing Solutions type YJ 38 and STEFA type VK

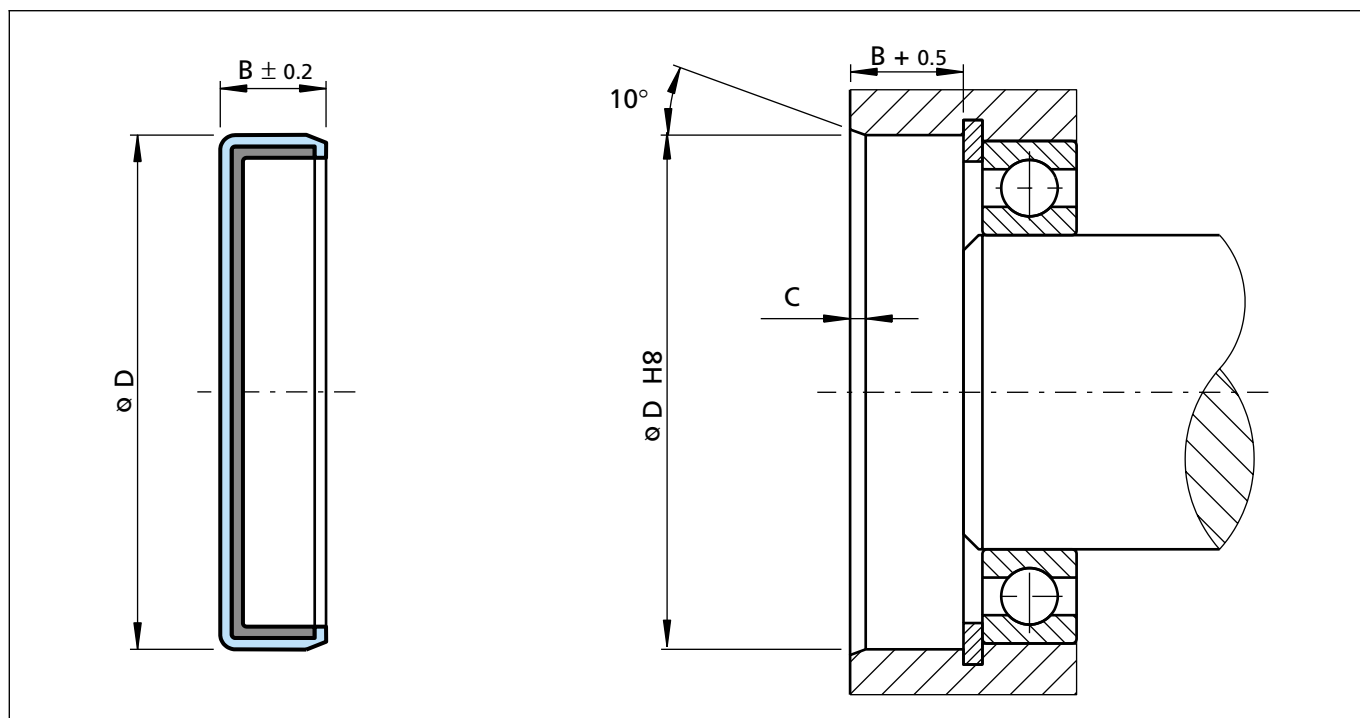


Figure 36 Installation drawing

Advantages

- Good static sealing
- Compensation of different thermal expansion
- No risk of fretting corrosion
- Effective protection against air side contaminants
- Higher bore surface roughness is allowed
- Mounting in split-housings

Application examples

- Transmission systems (e.g. gearboxes)
- Machine tool



Technical data

Pressure: up to 0.05 MPa

Temperature: -40°C to +200°C
(depending on material)

Media: mineral and synthetic lubricants
(CLP, HLP, APGL etc.)

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.

Table XXXI Materials

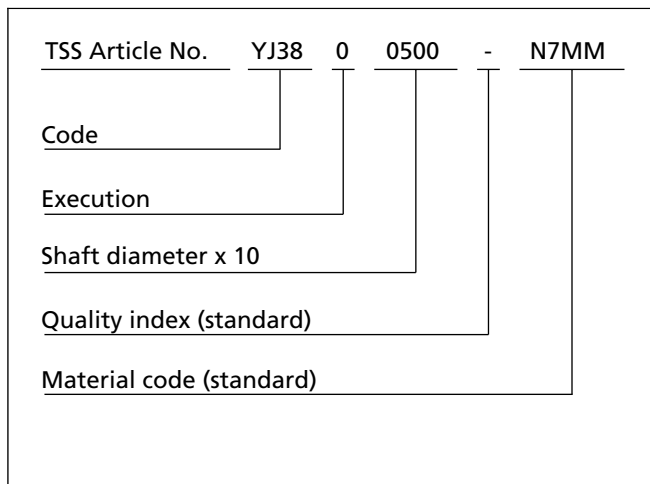
| Standard material* | TSS material code | STEFA material reference | Standard metal insert** |
|--------------------|-------------------|--------------------------|-------------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel |
| NBR (75 Shore A) | 4N01 | 1452 | Carbon steel |
| FKM (75 Shore A) | VCBV | - | Carbon steel |
| FKM (75 Shore A) | 4V01 | 5466 | Carbon steel |

* Special grades and other materials (ACM, EACM, EPDM, HNBR, VMQ) on request.

** Metal insert can also be supplied in different materials on request.

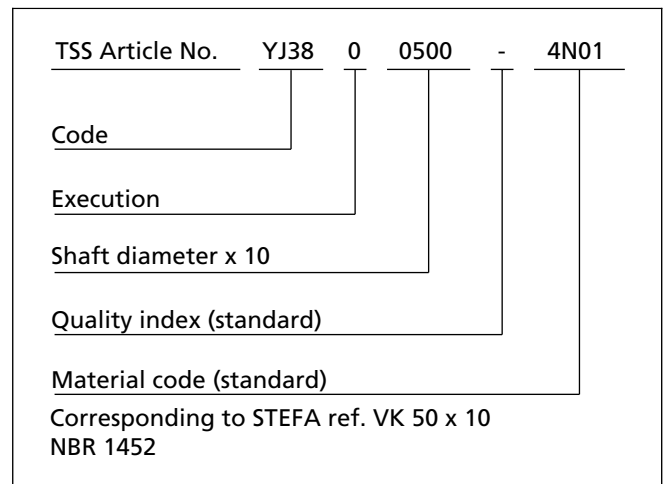
Ordering example end cover TSS type

TSS type: YJ
Code: YJ38
Dimensions: Housing diameter 50 mm
Width 10 mm
Material: NBR
Material Code: N7MM



Ordering example end cover STEFA type

STEFA type: VK
Code: YJ38
Dimensions: Housing diameter 50 mm
Width 10 mm
Material: NBR 1452
Material Code: 4N01





End Cover

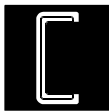
Table XXXII Preferred series/ Dimension, TSS part numbers

| Bore D H8 | Width B | Chamfer C | TSS Part No. | STEFA | | | TSS | |
|--------------|------------|--------------|--------------|-------|-------------|-------------|-------------|-------------|
| | | | | Type | NBR 4N01 | FKM 4V01 | NBR N7MM | FKM VCBV |
| 16 | 4 | 1.0 | YJ3800160 | | | | X | |
| 19 | 6 | 1.3 | YJ3810190 | VK | X | | X | |
| 20 | 4 | 1.0 | YJ3800200 | VK | | | X | |
| 22 | 7 | 1.3 | YJ3800220 | VK | X | | X | |
| 25 | 7 | 1.3 | YJ3800250 | | | | X | |
| 26 | 6.5 | 1.3 | YJ3800260 | VK | X | | X | |
| 28 | 7 | 1.3 | YJ3800280 | VK | X | X | X | |
| 28 | 9 | 1.5 | YJ3810280 | | | | X | |
| 30 | 6 | 1.3 | YJ3810300 | VK | X | | X | |
| 30 | 8 | 1.5 | YJ3800300 | VK | X | | X | |
| 32 | 5 | 1.0 | YJ3820320 | VK | X | | | |
| 32 | 7 | 1.3 | YJ3810320 | | | | X | |
| 32 | 9.5 | 1.5 | YJ3800320 | VK | X | | X | |
| 35 | 8 | 1.5 | YJ3800350 | VK | X | | X | |
| 37 | 5 | 1.0 | YJ3810370 | VK | X | | | |
| 37 | 10 | 1.8 | YJ3800370 | VK | X | | X | |
| 40 | 7 | 1.3 | YJ3800400 | VK | X | | X | |
| 42 | 7 | 1.3 | YJ3810420 | | | | X | |
| 42 | 9.5 | 1.5 | YJ3800420 | VK | X | | X | |
| 47 | 6.5 | 1.3 | YJ3800470 | VK | X | X | X | X |
| 47 | 7 | 1.3 | YJ3830470 | | | | X | |
| 47 | 8 | 1.5 | YJ3810470 | | | | X | |
| 47 | 10 | 1.8 | YJ3820470 | VK | X | X | X | |
| 50 | 10 | 1.8 | YJ3800500 | VK | X | X | X | |
| 52 | 6.5 | 1.3 | YJ3800520 | VK | X | | X | |
| 52 | 10 | 1.8 | YJ3810520 | VK | X | | X | |
| 55 | 6 | 1.3 | YJ3820550 | VK | X | | | |
| 55 | 9 | 1.5 | YJ3800550 | | | | X | |
| 55 | 10 | 1.8 | YJ3810550 | VK | X | | X | |
| 60 | 10 | 1.8 | YJ3800600 | | | | X | |
| 62 | 7 | 1.3 | YJ3820620 | VK | X | | | |
| 62 | 8 | 1.5 | YJ3800620 | VK | X | | X | X |
| 65 | 10 | 1.8 | YJ3800650 | VK | X | | X | |
| 68 | 8 | 1.5 | YJ3800680 | VK | X | | X | |
| 70 | 10 | 1.8 | YJ3800700 | VK | X | | | |
| 72 | 9 | 1.5 | YJ3800720 | VK | X | X | X | |

End Cover



| Bore D H8 | Width B | Chamfer C | TSS Part No. | STEFA | | | TSS | |
|--------------|------------|--------------|--------------|-------|-------------|-------------|-------------|-------------|
| | | | | Type | NBR 4N01 | FKM 4V01 | NBR N7MM | FKM VCBV |
| 75 | 7 | 1.3 | YJ3800750 | VK | X | | X | |
| 75 | 10 | 1.8 | YJ3810750 | | | | X | |
| 75 | 12 | 2.0 | YJ3820750 | VK | X | X | | |
| 80 | 8 | 1.5 | YJ3800800 | | | | X | |
| 80 | 10 | 1.8 | YJ3820800 | VK | X | | | |
| 80 | 12 | 2.0 | YJ3830800 | VK | X | | X | |
| 85 | 10 | 1.8 | YJ3810850 | | | | X | |
| 85 | 12 | 2.0 | YJ3800850 | VK | X | | X | |
| 90 | 8 | 1.5 | YJ3800900 | VK | X | | X | |
| 90 | 12 | 2.0 | YJ3810900 | VK | X | | X | |
| 95 | 10 | 1.8 | YJ3800950 | VK | X | | X | |
| 95 | 12 | 2.0 | YJ3810950 | VK | X | | | |
| 100 | 10 | 1.8 | YJ3811000 | VK | X | X | X | |
| 100 | 12 | 2.0 | YJ3801000 | VK | X | X | X | |
| 110 | 8 | 1.5 | YJ3811100 | | | | X | |
| 110 | 12 | 2.0 | YJ3801100 | VK | X | | X | |
| 115 | 12 | 2.0 | YJ3801150 | | | | X | |
| 120 | 12 | 2.0 | YJ3801200 | VK | X | | X | |
| 125 | 12 | 2.0 | YJ3801250 | VK | X | | X | |
| 130 | 10 | 1.8 | YJ3811300 | | | | X | |
| 130 | 12 | 2.0 | YJ3801300 | VK | X | | X | |
| 140 | 15 | 2.0 | YJ3801400 | VK | X | | X | |
| 150 | 15 | 2.0 | YJ3801500 | VK | X | | X | |
| 160 | 15 | 2.0 | YJ3801600 | VK | X | | X | |
| 165 | 8 | 1.5 | YJ3801650 | VK | | X | | |
| 168 | 11 | 1.8 | YJ3801680 | | | | X | |
| 168 | 12 | 2.0 | YJ3811680 | VK | X | | | |
| 170 | 15 | 2.0 | YJ3801700 | VK | X | | X | |
| 180 | 12 | 2.0 | YJ3801800 | VK | X | | X | |
| 190 | 12 | 2.0 | YJ3801900 | VK | X | | X | |
| 200 | 13 | 2.0 | YJ3802000 | VK | X | | X | |
| 210 | 15 | 2.0 | YJ3802100 | | | | X | |
| 230 | 14 | 2.0 | YJ3802300 | VK | X | | X | |



■ Trelleborg Sealing Solutions type YJ 39

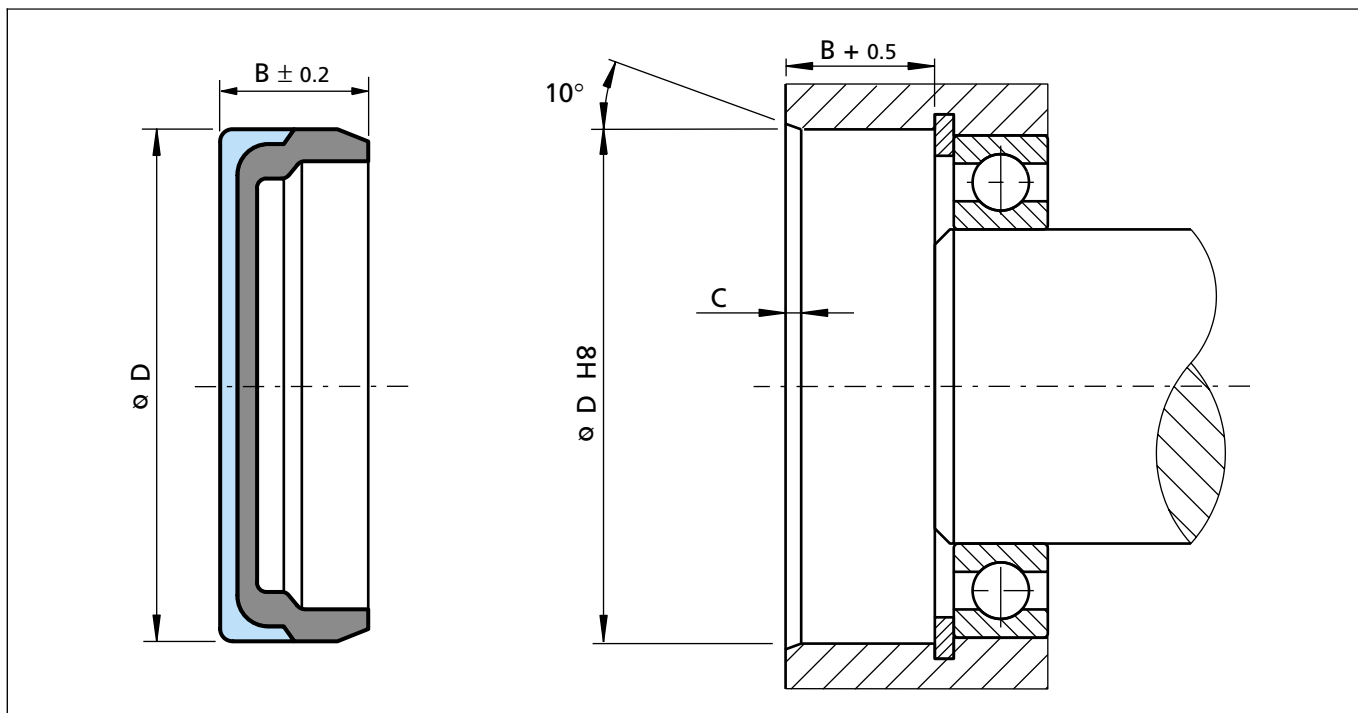


Figure 37 Installation drawing

Advantages

- Good static sealing and stiffness (no pop-out effect)
- Compensation of different thermal expansion
- No risk of fretting corrosion
- Effective protection against air side contaminants
- Higher bore surface roughness is allowed
- Mounting in split-housings
- Good heat transfer

Application examples

- Transmission systems (e.g. gearboxes)
- Machine tools

Technical data

Pressure: up to 0.5 MPa

Temperature: -40°C to +200°C
(depending on material)

Media: mineral and synthetic lubricants
(CLP, HLP, APGL etc.)

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XXXIII Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal insert** |
|--------------------|-------------------|--------------------------|-------------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel |

* Special grades and other materials (FKM, ACM, EACM EPDM, HNBR, VMQ) on request.

** Metal insert can be supplied in different materials on request.

Ordering example end cover TSS type

TSS type: YJ
 Code: YJ39
 Dimensions: Housing diameter 52 mm
 Width 6 mm
 Material: NBR
 Material Code: N7MM

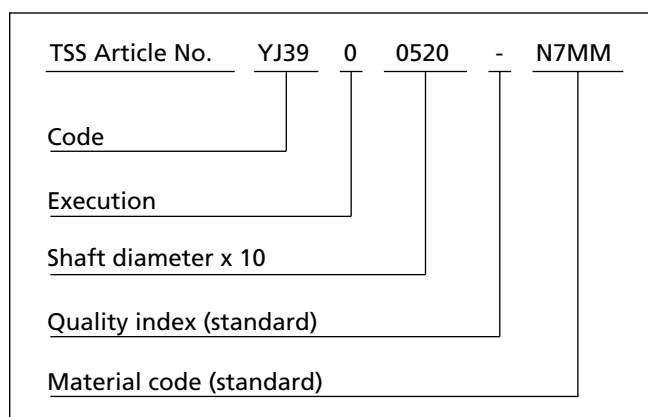


Table XXXIV Preferred series / Dimension, TSS part numbers

| Bore D H8 | Width B | Chamfer C | TSS Part No. | TSS |
|--------------|------------|--------------|--------------|-------------|
| | | | | NBR N7MM |
| 22 | 7 | 1.3 | YJ3900220 | X |
| 28 | 7 | 1.3 | YJ3900280 | X |
| 35 | 7 | 1.3 | YJ3900350 | X |
| 40 | 7 | 1.3 | YJ3900400 | X |
| 42 | 7 | 1.3 | YJ3900420 | X |
| 47 | 7 | 1.3 | YJ3900470 | X |
| 52 | 6 | 1.3 | YJ3900520 | X |
| 65 | 10 | 1.8 | YJ3900650 | X |
| 72 | 9 | 1.5 | YJ3900720 | X |
| 75 | 8 | 1.5 | YJ3900750 | X |
| 80 | 8 | 1.5 | YJ3900800 | X |
| 90 | 10 | 1.8 | YJ3900900 | X |
| 100 | 10 | 1.8 | YJ3901000 | X |
| 115 | 12 | 2.0 | YJ3901150 | X |
| 140 | 15 | 2.0 | YJ3901400 | X |
| 145 | 12 | 2.0 | YJ3901450 | X |
| 210 | 15 | 2.0 | YJ3902100 | X |



■ SHAFT REPAIR KIT

General description

The shaft repair kit serves as a running surface for rotary shaft lip seals. It consists of a thin-walled cylindrical tube with a mounting flange (see Figure 38). The flange has a design breaking point and can – if it is an obstacle – be removed.

The shaft repair kit has a wall thickness of approx. 0.254 mm and a spiral free ground surface. It is ideally suited as a counter face for rotary shaft lip seals.

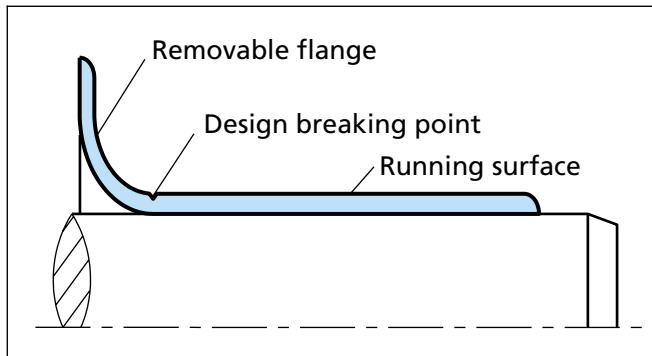


Figure 38 Design of the shaft repair kit

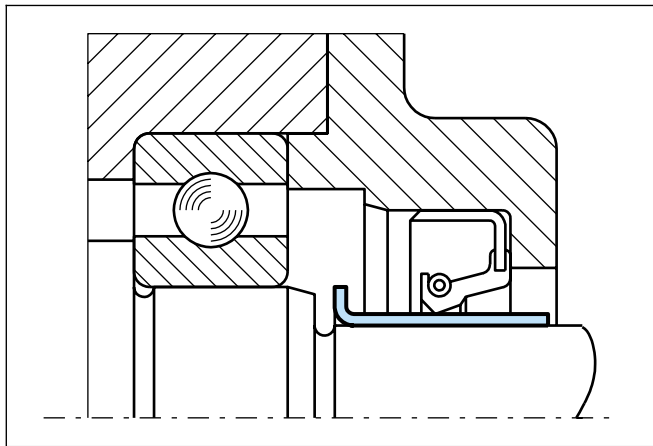


Figure 39 Running surface with shaft repair kit

Advantages

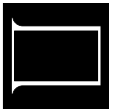
- Inexpensive replacement of worn shaft surfaces
- Simple and quick installation with supplied assembly tool
- No alterations to the seal dimensions
- Wear-resistant surface for long service life
- Secure seating due to a force fit

Application examples

- Repair of worn shaft surfaces
- Used in new designs to save costs for surface treatment

Technical data

| | |
|-----------------|---|
| Material: | Stainless steel, AISI 304 (1.4301) |
| Material Code: | 900V |
| Wall thickness: | 0.254 mm |
| Surface: | Ground spiral-free, ($R_a = 0.25 \dots 0.5 \mu\text{m}$) |
| Hardness: | 95 HRB |



Installation instructions

The shaft repair kit is fitted using the installation tool supplied. The raised mounting flange and the tool supplied ensure an exact fit.

Together they prevent tilting during installation and thus damage to the sealing surface.

Observe the following points before installation:

- Remove dust, dirt, rust, etc. from the damaged running surface
- Repair deep running scores with filling compound, e.g. metal-filled synthetic resin
- Check that the shaft has a lead-in chamfer

Installation sequence

- Check the nominal diameter of the shaft. The oversize to the nominal dimension of the shaft must be taken into consideration
- Place the shaft repair kit with the mounting flange facing forward onto the shaft.
- Push on the installation tool.
- Push on the shaft repair kit by striking the installation tool with a hammer or use a press.
- If necessary, cut the mounting flange using side cutters up to the design breaking point and break off the flange at the line.
- Grease the shaft repair kit before fitting the seal

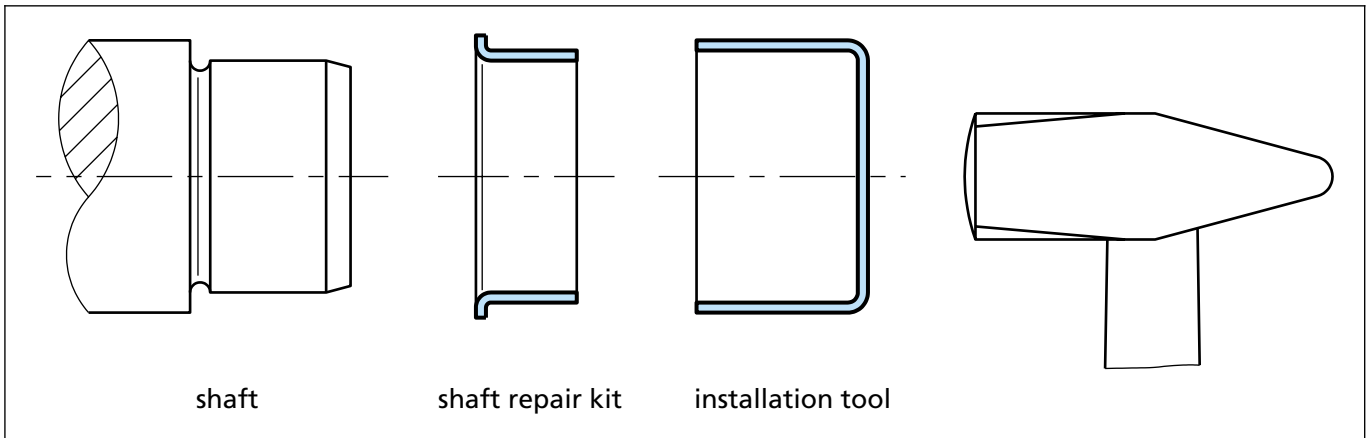


Figure 40 Installation sequence



Shaft Repair Kit

■ Installation recommendation, metric sizes

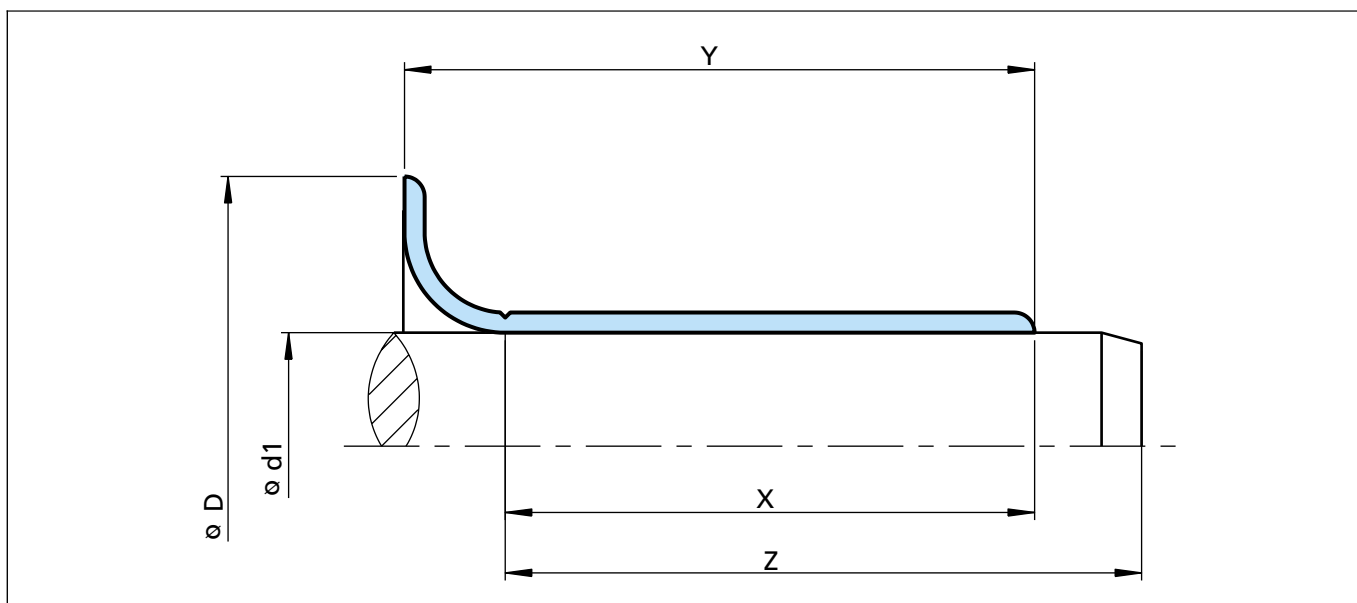


Figure 41 Installation drawing

Table XXXV Installation dimension / TSS part no.

| Shaft diameter metric sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-----------------------------|-------|-------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.8$ | $Y \pm 0.8$ | $D \pm 1.6$ | Z | |
| 12.0 | 11.93 | 12.07 | 6.0 | 8.4 | 20.0 | 12.0 | TS0099049-900V |
| 15.0 | 14.96 | 15.06 | 5.0 | 9.0 | 19.1 | 11.0 | TS0099059-900V |
| 17.0 | 16.94 | 17.04 | 8.0 | 11.0 | 22.2 | 51.0 | TS0099068-900V |
| 18.0 | 17.89 | 18.00 | 8.0 | 11.0 | 27.0 | 46.0 | TS0099082-900V |
| 20.0 | 19.94 | 20.04 | 8.0 | 11.0 | 23.6 | 51.0 | TS0099078-900V |
| 22.0 | 21.87 | 22.00 | 8.0 | 12.0 | 30.2 | 46.0 | TS0099085-900V |
| 25.0 | 24.94 | 25.04 | 8.0 | 11.0 | 33.0 | 51.0 | TS0099098-900V |
| 26.0 | 25.87 | 26.00 | 8.0 | 12.0 | 33.3 | 46.0 | TS0099103-900V |
| 28.0 | 27.94 | 28.04 | 9.5 | 12.7 | 34.9 | 71.0 | TS0099111-900V |
| 30.0 | 29.95 | 30.07 | 8.0 | 11.0 | 35.6 | 17.0 | TS0099114-900V |
| 32.0 | 31.93 | 32.08 | 8.0 | 11.1 | 38.0 | 18.0 | TS0099128-900V |
| 35.0 | 34.93 | 35.08 | 13.0 | 16.0 | 41.6 | 20.0 | TS0099139-900V |
| 36.0 | 35.84 | 36.00 | 13.0 | 17.0 | 42.9 | 25.0 | TS0099146-900V |
| 38.0 | 37.84 | 38.00 | 13.0 | 17.0 | 45.2 | 25.0 | TS0099147-900V |
| 40.0 | 39.93 | 40.08 | 13.0 | 16.0 | 47.0 | 26.0 | TS0099157-900V |

Shaft Repair Kit



| Shaft diameter metric sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-----------------------------|--------|--------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.8$ | $Y \pm 0.8$ | $D \pm 1.6$ | Z | |
| 42.0 | 41.86 | 42.00 | 14.3 | 17.5 | 53.0 | 21.0 | TS0099169-900V |
| 45.0 | 44.93 | 45.09 | 14.0 | 17.0 | 53.0 | 21.0 | TS0099177-900V |
| 48.0 | 47.92 | 48.08 | 14.0 | 17.0 | 56.0 | 25.0 | TS0099189-900V |
| 50.0 | 49.91 | 50.06 | 14.0 | 17.0 | 57.0 | 25.0 | TS0099196-900V |
| 55.0 | 54.91 | 55.07 | 20.0 | 23.0 | 62.0 | 32.0 | TS0099215-900V |
| 60.0 | 59.92 | 60.07 | 20.0 | 23.0 | 70.7 | 35.0 | TS0099235-900V |
| 62.0 | 61.85 | 62.00 | 12.7 | 15.9 | 71.8 | 36.0 | TS0099242-900V |
| 65.0 | 64.92 | 65.07 | 20.0 | 23.0 | 72.4 | 35.0 | TS0099254-900V |
| 70.0 | 69.85 | 70.00 | 10.3 | 14.3 | 79.4 | 31.0 | TS0099272-900V |
| 70.0 | 69.93 | 70.08 | 20.0 | 24.0 | 79.4 | 32.0 | TS0099276-900V |
| 75.0 | 74.93 | 75.08 | 22.0 | 26.0 | 84.0 | 33.0 | TS0099294-900V |
| 80.0 | 79.81 | 80.01 | 19.1 | 22.5 | 89.9 | 35.0 | TS0099313-900V |
| 80.0 | 79.91 | 80.09 | 21.0 | 24.0 | 90.0 | 35.0 | TS0099315-900V |
| 85.0 | 84.78 | 85.00 | 21.0 | 25.0 | 94.0 | 35.0 | TS0099333-900V |
| 90.0 | 89.92 | 90.07 | 23.0 | 28.0 | 101.6 | 44.0 | TS0099354-900V |
| 95.0 | 94.92 | 95.07 | 21.0 | 24.0 | 102.2 | 44.0 | TS0099369-900V |
| 100.0 | 99.85 | 100.10 | 20.6 | 25.4 | 110.0 | 52.0 | TS0099393-900V |
| 105.0 | 104.90 | 105.11 | 20.0 | 23.0 | 113.5 | 35.0 | TS0099413-900V |
| 110.0 | 109.90 | 110.10 | 12.9 | 16.5 | 125.0 | 31.0 | TS0099435-900V |
| 115.0 | 114.88 | 115.09 | 20.6 | 23.8 | 127.0 | 32.0 | TS0099452-900V |
| 120.0 | 119.89 | 120.09 | 20.0 | 25.0 | 129.8 | 32.0 | TS0099473-900V |
| 125.0 | 124.89 | 125.10 | 26.0 | 32.0 | 137.2 | 37.0 | TS0099492-900V |
| 130.0 | 129.98 | 130.18 | 22.0 | 25.3 | 139.5 | 33.0 | TS0099491-900V |
| 135.0 | 134.79 | 135.00 | 20.5 | 25.4 | 149.2 | 32.0 | TS0099533-900V |
| 140.0 | 139.90 | 140.11 | 20.5 | 25.5 | 151.0 | 32.0 | TS0099552-900V |
| 150.0 | 149.75 | 150.00 | 26.0 | 30.0 | 159.0 | 34.0 | TS0099595-900V |
| 155.0 | 154.75 | 155.00 | 26.0 | 30.0 | 167.0 | 33.0 | TS0099606-900V |
| 160.0 | 159.97 | 160.23 | 25.4 | 31.8 | 177.8 | 46.0 | TS0099630-900V |
| 165.0 | 164.97 | 165.23 | 25.4 | 31.8 | 177.8 | 44.0 | TS0099650-900V |
| 170.0 | 169.75 | 170.00 | 31.8 | 38.0 | 182.6 | 55.0 | TS0099640-900V |
| 175.0 | 174.75 | 175.00 | 28.0 | 32.0 | 187.0 | 35.0 | TS0099687-900V |
| 180.0 | 179.76 | 180.00 | 33.0 | 38.0 | 190.5 | 45.0 | TS0099721-900V |
| 185.0 | 184.73 | 185.00 | 32.0 | 38.0 | 199.0 | 55.0 | TS0099726-900V |
| 200.0 | 199.87 | 200.13 | 34.5 | 38.1 | 212.7 | 44.0 | TS0099787-900V |



Shaft Repair Kit

■ Installation recommendation, imperial sizes

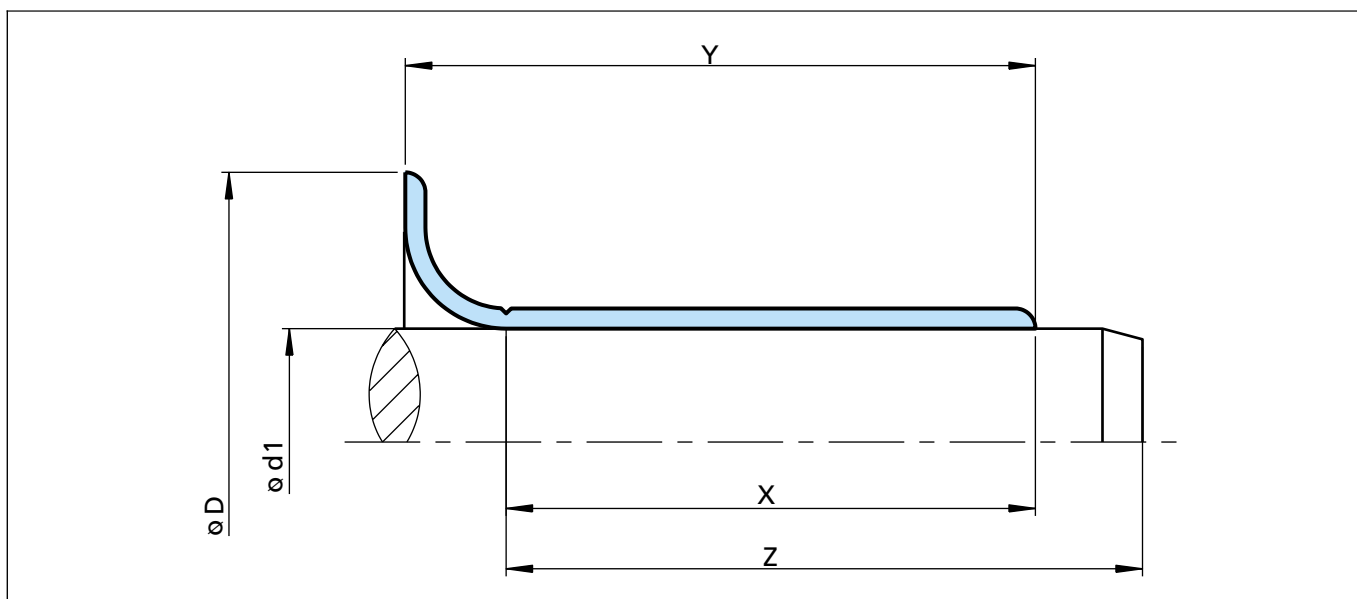


Figure 42 Installation drawing

Table XXXVI Installation Dimensions in Inches

| Shaft diameter imperial sizes | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-------------------------------|---------------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | |
| d_1 | min. max. | $X \pm 0.031$ | $Y \pm 0.031$ | $D \pm 0.063$ | Z | |
| 0.500 | 0.498 0.502 | 0.250 | 0.344 | 0.610 | 2.000 | TS0099050-900V |
| 0.563 | 0.560 0.566 | 0.250 | 0.391 | 0.750 | 1.831 | TS0099056-900V |
| 0.625 | 0.623 0.627 | 0.313 | 0.406 | 0.750 | 2.000 | TS0099062-900V |
| 0.750 | 0.748 0.752 | 0.313 | 0.438 | 0.945 | 2.000 | TS0099076-900V |
| 0.781 | 0.780 0.784 | 0.313 | 0.438 | 0.935 | 2.000 | TS0099080-900V |
| 0.859 | 0.857 0.861 | 0.250 | 0.373 | 1.155 | 2.000 | TS0099086-900V |
| 0.875 | 0.873 0.877 | 0.313 | 0.438 | 1.094 | 2.000 | TS0099087-900V |
| 0.969 | 0.966 0.970 | 0.313 | 0.438 | 1.130 | 2.000 | TS0099094-900V |
| 0.969 | 0.966 0.970 | 0.625 | 0.719 | 1.130 | 2.000 | TS0099096-900V |
| 1.000 | 0.998 1.002 | 0.313 | 0.438 | 1.219 | 2.000 | TS0099100-900V |
| 1.063 | 1.060 1.064 | 0.313 | 0.438 | 1.320 | 2.813 | TS0099106-900V |
| 1.125 | 1.123 1.127 | 0.313 | 0.438 | 1.500 | 0.688 | TS0099112-900V |
| 1.156 | 1.154 1.158 | 0.375 | 0.500 | 1.350 | 0.688 | TS0099120-900V |
| 1.188 | 1.185 1.190 | 0.313 | 0.438 | 1.400 | 0.688 | TS0099118-900V |
| 1.240 | 1.237 1.243 | 0.315 | 0.438 | 1.540 | 0.688 | TS0099141-900V |
| 1.250 | 1.247 1.253 | 0.313 | 0.438 | 1.500 | 0.688 | TS0099125-900V |
| 1.313 | 1.308 1.314 | 0.250 | 0.375 | 1.600 | 0.813 | TS0099129-900V |
| 1.313 | 1.310 1.316 | 0.500 | 0.625 | 1.594 | 1.813 | TS0099131-900V |

Shaft Repair Kit



| Shaft diameter imperial sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-------------------------------|-------|-------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.031$ | $Y \pm 0.031$ | $D \pm 0.063$ | Z | |
| 1.375 | 1.371 | 1.377 | 0.313 | 0.438 | 1.638 | 0.813 | TS0099133-900V |
| 1.375 | 1.371 | 1.377 | 0.500 | 0.625 | 1.638 | 0.813 | TS0099138-900V |
| 1.438 | 1.432 | 1.438 | 0.563 | 0.688 | 1.690 | 1.016 | TS0099143-900V |
| 1.438 | 1.435 | 1.441 | 0.375 | 0.500 | 1.781 | 1.016 | TS0099144-900V |
| 1.500 | 1.497 | 1.503 | 0.563 | 0.688 | 1.781 | 1.016 | TS0099149-900V |
| 1.500 | 1.497 | 1.503 | 0.375 | 0.500 | 1.781 | 1.016 | TS0099150-900V |
| 1.563 | 1.559 | 1.565 | 0.563 | 0.688 | 1.859 | 1.016 | TS0099156-900V |
| 1.625 | 1.622 | 1.628 | 0.313 | 0.438 | 1.875 | 1.016 | TS0099161-900V |
| 1.625 | 1.623 | 1.628 | 0.563 | 0.688 | 1.875 | 0.813 | TS0099162-900V |
| 1.688 | 1.685 | 1.691 | 0.313 | 0.438 | 1.906 | 0.875 | TS0099167-900V |
| 1.688 | 1.684 | 1.690 | 0.563 | 0.688 | 1.906 | 0.875 | TS0099168-900V |
| 1.719 | 1.715 | 1.721 | 0.563 | 0.688 | 2.031 | 0.813 | TS0099171-900V |
| 1.750 | 1.747 | 1.753 | 0.375 | 0.500 | 2.055 | 0.813 | TS0099172-900V |
| 1.750 | 1.747 | 1.753 | 0.563 | 0.688 | 2.063 | 0.813 | TS0099174-900V |
| 1.750 | 1.747 | 1.753 | 0.750 | 0.875 | 2.063 | 0.813 | TS0099175-900V |
| 1.750 | 1.747 | 1.753 | 0.531 | 0.625 | 2.063 | 0.812 | TS0099180-900V |
| 1.781 | 1.778 | 1.784 | 0.664 | 0.800 | 2.125 | 1.125 | TS0099179-900V |
| 1.875 | 1.872 | 1.878 | 0.375 | 0.516 | 2.203 | 1.050 | TS0099184-900V |
| 1.875 | 1.872 | 1.878 | 0.563 | 0.688 | 2.203 | 1.000 | TS0099187-900V |
| 1.875 | 1.872 | 1.878 | 0.295 | 0.415 | 2.203 | 0.744 | TS0099188-900V |
| 1.875 | 1.872 | 1.878 | 0.175 | 0.295 | 2.203 | 0.744 | TS0099190-900V |
| 1.938 | 1.934 | 1.940 | 0.563 | 0.688 | 2.219 | 1.000 | TS0099193-900V |
| 1.969 | 1.965 | 1.971 | 0.551 | 0.688 | 2.244 | 0.984 | TS0099196-900V |
| 2.000 | 1.997 | 2.003 | 0.563 | 0.688 | 2.406 | 1.050 | TS0099199-900V |
| 2.000 | 1.997 | 2.003 | 0.875 | 1.000 | 2.406 | 1.000 | TS0099200-900V |
| 2.063 | 2.057 | 2.063 | 0.781 | 0.938 | 2.469 | 1.375 | TS0099205-900V |
| 2.125 | 2.123 | 2.128 | 0.500 | 0.750 | 2.422 | 1.281 | TS0099210-900V |
| 2.125 | 2.124 | 2.130 | 0.781 | 0.938 | 2.422 | 1.375 | TS0099212-900V |
| 2.188 | 2.186 | 2.192 | 0.781 | 0.938 | 2.500 | 1.313 | TS0099218-900V |
| 2.250 | 2.249 | 2.255 | 0.781 | 0.938 | 2.531 | 1.313 | TS0099225-900V |
| 2.250 | 2.249 | 2.255 | 0.313 | 0.438 | 2.531 | 1.313 | TS0099227-900V |
| 2.313 | 2.309 | 3.315 | 0.781 | 0.938 | 2.688 | 1.375 | TS0099231-900V |
| 2.375 | 2.369 | 2.375 | 0.781 | 0.938 | 2.750 | 1.375 | TS0099236-900V |
| 2.375 | 2.374 | 2.380 | 0.781 | 0.938 | 2.750 | 1.375 | TS0099237-900V |
| 2.375 | 2.372 | 2.378 | 0.594 | 0.750 | 2.750 | 1.375 | TS0099238-900V |
| 2.375 | 2.374 | 2.380 | 0.526 | 0.683 | 2.750 | 1.375 | TS0099240-900V |



Shaft Repair Kit

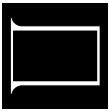
| Shaft diameter imperial sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-------------------------------|-------|-------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.031$ | $Y \pm 0.031$ | $D \pm 0.063$ | Z | |
| 2.438 | 2.435 | 2.441 | 0.500 | 0.625 | 2.828 | 1.425 | TS0099242-900V |
| 2.438 | 2.434 | 2.440 | 0.781 | 0.938 | 2.828 | 1.375 | TS0099243-900V |
| 2.500 | 2.500 | 2.506 | 0.500 | 0.656 | 2.828 | 1.393 | TS0099248-900V |
| 2.500 | 2.500 | 2.506 | 0.781 | 0.938 | 2.820 | 1.375 | TS0099250-900V |
| 2.563 | 2.560 | 2.566 | 0.781 | 0.938 | 2.850 | 1.375 | TS0099256-900V |
| 2.625 | 2.622 | 2.628 | 0.500 | 0.625 | 3.047 | 1.375 | TS0099260-900V |
| 2.625 | 2.621 | 2.627 | 0.781 | 0.938 | 3.047 | 1.375 | TS0099262-900V |
| 2.625 | 2.621 | 2.627 | 0.781 | 0.906 | 3.047 | 1.562 | TS0099264-900V |
| 2.750 | 2.747 | 2.753 | 1.438 | 1.625 | 3.075 | 1.625 | TS0099267-900V |
| 2.750 | 2.750 | 2.756 | 1.125 | 1.250 | 3.125 | 1.313 | TS0099269-900V |
| 2.750 | 2.747 | 2.753 | 0.781 | 0.906 | 3.125 | 1.250 | TS0099270-900V |
| 2.750 | 2.750 | 2.756 | 0.406 | 0.563 | 3.125 | 1.250 | TS0099272-900V |
| 2.750 | 2.745 | 2.751 | 0.781 | 0.938 | 3.125 | 1.250 | TS0099274-900V |
| 2.750 | 2.750 | 2.756 | 0.781 | 0.938 | 3.125 | 1.250 | TS0099275-900V |
| 2.813 | 2.809 | 2.815 | 0.594 | 0.688 | 3.188 | 1.250 | TS0099281-900V |
| 2.875 | 2.873 | 2.879 | 0.781 | 0.938 | 3.219 | 1.250 | TS0099287-900V |
| 2.938 | 2.937 | 2.943 | 0.781 | 0.938 | 3.344 | 1.250 | TS0099293-900V |
| 3.000 | 2.997 | 3.003 | 0.813 | 0.938 | 3.240 | 1.375 | TS0099296-900V |
| 3.000 | 3.000 | 3.006 | 0.813 | 1.000 | 3.235 | 1.281 | TS0099300-900V |
| 3.000 | 3.000 | 3.006 | 0.625 | 0.813 | 3.345 | 1.063 | TS0099303-900V |
| 3.125 | 3.124 | 3.132 | 0.551 | 0.709 | 3.525 | 2.031 | TS0099307-900V |
| 3.125 | 3.120 | 3.126 | 0.688 | 0.813 | 3.531 | 2.000 | TS0099311-900V |
| 3.125 | 3.120 | 3.126 | 0.813 | 1.000 | 3.531 | 2.000 | TS0099312-900V |
| 3.250 | 3.247 | 3.253 | 0.813 | 1.000 | 3.594 | 1.375 | TS0099322-900V |
| 3.250 | 3.250 | 3.256 | 0.595 | 0.719 | 3.575 | 1.375 | TS0099324-900V |
| 3.250 | 3.250 | 3.256 | 0.813 | 1.000 | 3.585 | 1.375 | TS0099325-900V |
| 3.375 | 3.373 | 3.379 | 0.813 | 1.000 | 3.695 | 1.375 | TS0099337-900V |
| 3.375 | 3.373 | 3.379 | 0.375 | 0.500 | 3.688 | 1.410 | TS0099338-900V |
| 3.438 | 3.435 | 3.441 | 0.781 | 0.906 | 3.844 | 1.406 | TS0099339-900V |
| 3.500 | 3.500 | 3.506 | 0.313 | 0.500 | 3.825 | 1.347 | TS0099347-900V |
| 3.500 | 3.500 | 3.506 | 0.813 | 1.000 | 3.844 | 1.347 | TS0099350-900V |
| 3.563 | 3.560 | 3.566 | 0.813 | 1.000 | 3.900 | 1.750 | TS0099356-900V |
| 3.625 | 3.623 | 3.629 | 0.813 | 1.000 | 4.031 | 1.750 | TS0099362-900V |
| 3.625 | 3.623 | 3.629 | 0.500 | 0.625 | 4.025 | 1.750 | TS0099363-900V |
| 3.688 | 3.685 | 3.691 | 0.813 | 0.938 | 4.025 | 1.750 | TS0099365-900V |
| 3.688 | 3.684 | 3.690 | 0.313 | 0.438 | 3.830 | 0.875 | TS0099368-900V |



Shaft Repair Kit



| Shaft diameter imperial sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-------------------------------|-------|-------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.031$ | $Y \pm 0.031$ | $D \pm 0.063$ | Z | |
| 3.750 | 3.750 | 3.756 | 0.344 | 0.500 | 4.025 | 1.750 | TS0099367-900V |
| 3.750 | 3.750 | 3.756 | 0.688 | 0.875 | 4.020 | 1.875 | TS0099372-900V |
| 3.750 | 3.746 | 3.752 | 0.563 | 0.688 | 4.025 | 1.750 | TS0099376-900V |
| 3.875 | 3.873 | 3.879 | 0.813 | 1.000 | 4.219 | 1.875 | TS0099387-900V |
| 4.000 | 3.398 | 4.006 | 0.600 | 0.725 | 4.375 | 2.050 | TS0099395-900V |
| 4.000 | 3.398 | 4.006 | 0.813 | 1.000 | 4.375 | 2.050 | TS0099399-900V |
| 4.000 | 3.398 | 4.006 | 0.650 | 0.775 | 4.375 | 1.375 | TS0099400-900V |
| 4.000 | 3.398 | 4.006 | 0.500 | 0.625 | 4.375 | 1.375 | TS0099401-900V |
| 4.125 | 4.122 | 4.130 | 0.813 | 1.000 | 4.420 | 1.375 | TS0099412-900V |
| 4.188 | 4.183 | 4.191 | 0.813 | 1.000 | 4.500 | 1.375 | TS0099418-900V |
| 4.234 | 4.226 | 4.234 | 0.781 | 0.906 | 4.610 | 1.438 | TS0099423-900V |
| 4.250 | 4.248 | 4.256 | 0.813 | 1.000 | 4.610 | 1.438 | TS0099424-900V |
| 4.328 | 4.327 | 4.335 | 0.509 | 0.650 | 4.921 | 1.250 | TS0099435-900V |
| 4.375 | 4.370 | 4.378 | 0.813 | 1.000 | 4.750 | 1.650 | TS0099437-900V |
| 4.406 | 4.401 | 4.409 | 0.748 | 0.886 | 4.750 | 1.063 | TS0099438-900V |
| 4.438 | 4.434 | 4.442 | 1.000 | 1.142 | 4.813 | 1.313 | TS0099439-900V |
| 4.500 | 4.496 | 4.504 | 0.813 | 1.000 | 4.900 | 1.250 | TS0099450-900V |
| 4.625 | 4.621 | 4.629 | 1.000 | 1.250 | 5.063 | 1.375 | TS0099463-900V |
| 4.625 | 4.621 | 4.628 | 0.438 | 0.625 | 4.875 | 1.375 | TS0099465-900V |
| 4.688 | 4.685 | 4.693 | 0.813 | 1.000 | 5.063 | 1.375 | TS0099468-900V |
| 4.750 | 4.746 | 4.754 | 0.500 | 0.750 | 5.000 | 1.500 | TS0099475-900V |
| 4.875 | 4.871 | 4.879 | 0.625 | 0.750 | 5.250 | 1.438 | TS0099487-900V |
| 5.125 | 5.117 | 5.125 | 0.866 | 0.996 | 5.493 | 1.280 | TS0099491-900V |
| 5.125 | 5.120 | 5.128 | 0.813 | 1.000 | 5.500 | 1.250 | TS0099513-900V |
| 5.250 | 5.246 | 5.254 | 0.813 | 1.000 | 5.560 | 1.250 | TS0099525-900V |
| 5.313 | 5.307 | 5.315 | 0.807 | 1.000 | 5.875 | 1.250 | TS0099533-900V |
| 5.375 | 5.371 | 5.379 | 0.813 | 1.000 | 5.875 | 1.250 | TS0099537-900V |
| 5.438 | 5.434 | 5.442 | 1.500 | 1.688 | 5.750 | 1.875 | TS0099548-900V |
| 5.500 | 5.498 | 5.506 | 0.813 | 1.000 | 5.938 | 1.250 | TS0099549-900V |
| 5.750 | 5.746 | 5.754 | 0.813 | 1.000 | 6.180 | 1.750 | TS0099575-900V |
| 6.000 | 5.995 | 6.003 | 1.000 | 1.250 | 6.375 | 1.750 | TS0099599-900V |
| 6.000 | 5.995 | 6.003 | 0.500 | 0.750 | 6.360 | 1.750 | TS0099601-900V |
| 6.063 | 6.058 | 6.068 | 1.024 | 1.181 | 6.375 | 1.299 | TS0099605-900V |
| 6.203 | 6.198 | 6.208 | 0.813 | 1.063 | 6.625 | 1.750 | TS0099620-900V |
| 6.250 | 6.245 | 6.255 | 1.031 | 1.250 | 6.625 | 1.750 | TS0099625-900V |
| 6.500 | 6.495 | 6.505 | 1.000 | 1.250 | 7.000 | 1.750 | TS0099650-900V |



Shaft Repair Kit

| Shaft diameter imperial sizes | | | Length without flange | Overall length | Flange diameter | Max. installation depth | TSS Article no. |
|-------------------------------|-------|-------|-----------------------|----------------|-----------------|-------------------------|-----------------|
| Nominal dia. | Range | | | | | | |
| d_1 | min. | max. | $X \pm 0.031$ | $Y \pm 0.031$ | $D \pm 0.063$ | Z | |
| 6.688 | 6.683 | 6.693 | 1.250 | 1.496 | 7.188 | 2.175 | TS0099640-900V |
| 6.750 | 6.745 | 6.755 | 0.813 | 1.063 | 7.175 | 1.750 | TS0099675-900V |
| 7.000 | 6.995 | 7.005 | 1.000 | 1.250 | 7.475 | 1.688 | TS0099700-900V |
| 7.250 | 7.244 | 7.254 | 1.250 | 1.500 | 7.760 | 2.175 | TS0099725-900V |
| 7.500 | 7.495 | 7.505 | 0.813 | 1.000 | 7.875 | 1.250 | TS0099750-900V |
| 7.750 | 7.745 | 7.755 | 1.000 | 1.313 | 8.270 | 1.875 | TS0099775-900V |
| 7.875 | 7.869 | 7.879 | 1.359 | 1.500 | 8.375 | 1.750 | TS0099787-900V |
| 8.000 | 7.795 | 8.005 | 1.000 | 1.250 | 8.375 | 1.750 | TS0099800-900V |



■ CASSETTE SEAL

■ General

The Cassette Seal has been developed to meet the ever-increasing requirements of long service life, high functional reliability, environmental safety, simple handling and superior total economy.

Cassette Seals are fully enclosed seals with an integrated sealing system, that performs the function of oil seal, wear sleeve and dust protection in one unit. No extra components such as shaft sleeves or dirt protection are needed.

Unique to all the TSS Cassette seals is that the sealing lip is fixed on the stationary part of the hardware. Because of this the sealing force is constant, independent of the rotary speed.

Cassette seals consist of several individual features working together, built into one unit and for this reason they are called "Systems".

The TSS Cassette Seals were originally designed at FORSHEDA AB in Sweden and sold under the trade name STEFA.

■ System 500

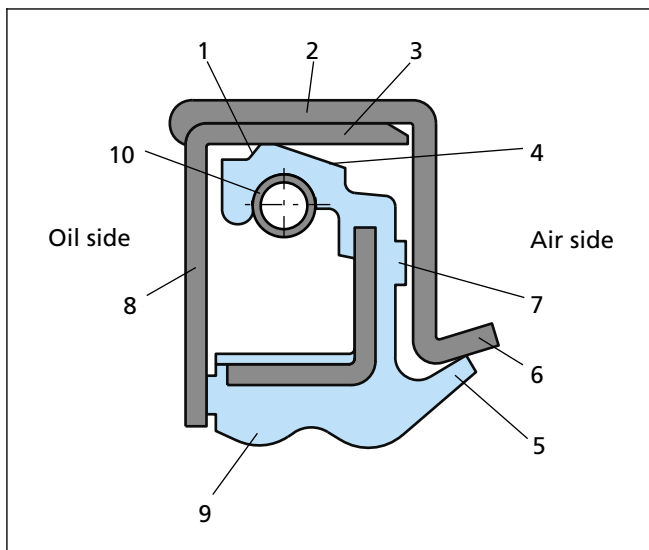


Figure 43 System 500

System 500, the original Unitized Wheel Hub Seal for heavy-duty vehicles, is designed for rotating hubs.

The inner section of the System 500 is secured against the shaft. The outer section, press fitted into the wheel hub, rotates together with the hub around the inner section, creating a completely enclosed seal. Dirt and water, the

major enemies of hub seals, are effectively kept at distance, whilst the lubrication of the rubber lip remains intact. This decreases friction and increases seal life accordingly.

The main features of the System 500 are:

- The sealing (1) element is non-rotating, which means that the radial force is kept unchanged at various speeds.
- The sealing surface (2) is in close contact with the wheel hub, which gives an excellent heat transfer.
- The structure of the sealing counterface (3) has been chosen after several thousands of test hours. The position of the sealing lip ensures best lubrication.
- The sealing lip (4) normally has bi-directional TURBO-pattern (see page 134).
- Integral prelubricated dust-sealing (5) functions.
- The protruding conical part (6) of the case deflects heavier particles due to the centrifugal force.
- The excluding lip (5) protects against water splash and finer particles.
- Moulded distance lugs (7) automatically locate the sealing element in the right position.
- The lugs (7) are spaced and dimensioned to ensure the sealing lip has adequate lubrication.
- The inner case (8) also protects the sealing lip from direct oil spray caused by taper roller bearings.

The robust ribs (9) give:

- a firm seat on the shaft
- a smooth sliding during installation
- a positive static seal even if one of the ribs is located on a defective shaft surface
- The compression spring (10) maintains the radial force. The initial force exerted by the sealing element will in some applications reduce due to ageing of the rubber exposed to heat, load or chemical action.
- For such applications where the seal is exposed to dirty environment, i.e. off road use, the System 500 can be equipped with an additional specially developed dirt protection, the HRV seal.
- In cases where the space does not allow the use of the HRV seal, the System 500HD, a derivative of System 500, can be used. It has the same outside dimensions, but an extra dust lip inside. Since the casing is identical to System 500 it is readily available in the same sizes. Please contact you local TSS office for more details.



Cassette Seal

■ System 3000

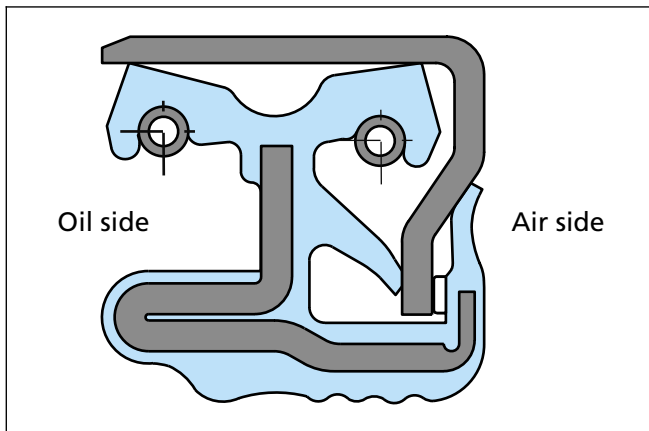


Figure 44 System 3000

System 3000 is specifically designed for rotating hubs on off-road machines in heavy duty applications, i.e. wet rice fields. The design offers significant improvements in providing improved ability to exclude water, dirt and dust for much longer time. Its ability to sustain eccentricities, over-pressure and shaft misalignments are equal to Radial Seals.

The System 3000, while based on System 500, features two sealing lips, equipped with compression springs, to provide excellent sealing performance and an additional dust lip. Mudbox-tests are showing more than doubled lifetime performance compared with the other system seals.

■ System 5000

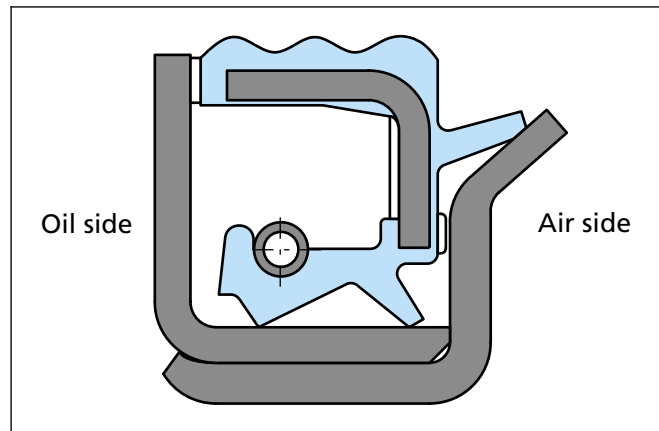


Figure 45 System 5000

The System 5000 is, like System 500 and System 3000, a fully enclosed seal however designed for rotating shafts. The System 5000 has the same features but the design has been inverted, i.e. the sealing element is fixed in the stationary housing and the casing components rotates with the shaft.

The System 5000 is used to prevent oil from leaking out of a bearing housing, i.e. a differential pinion housing for rear axles on trucks, and at the same time preventing road dirt, salt and water splash to enter.

The design is compact and integrates the necessary shaft counterface as well as the dirt exclusion. The dirt exclusion function consists of two rubber lips, one axial and one radial, the space between these filled with grease, and the rotating seal case, which acts as an effective deflector due to the centrifugal force.

TURBO-pattern - Hydrodynamic sealing aids

TURBO is the TSS designation of a range of hydrodynamic sealing aids supporting the sealing function. The hydrodynamic sealing aids are located on the air side of main sealing lip in form of ribs or other geometrical figures of a variety of shapes. Optimum sealing conditions are attained when a thin film of lubricant is formed so that the lip does not come in contact with the sealing counterface. Such conditions are created by the TURBO-pattern, which brings about a pumping effect. The pumping effect starts at relatively low shaft speed, and is understood as the capacity of the seal lip to pump the medium to be sealed back from the air side to the medium side.



In order to avoid leakage at standstill or low speed, the TURBO-pattern includes a static edge, which provides continuous contact line against the shaft. The frictional loss of the seals provided with TURBO-pattern is significantly lower than that caused by seals without hydrodynamic sealing aids. A lower friction does also allow higher shaft speeds, or provide longer service life.

The Turbo pattern is available in three versions: Bi-directional, left hand or right hand rotation. The standard is bi-directional as most applications have alternating movement of the hub or shaft. If an application have rotation in one direction only, the corresponding left or right hand type can be specified. The direction of rotation is always defined as seen from the air side.

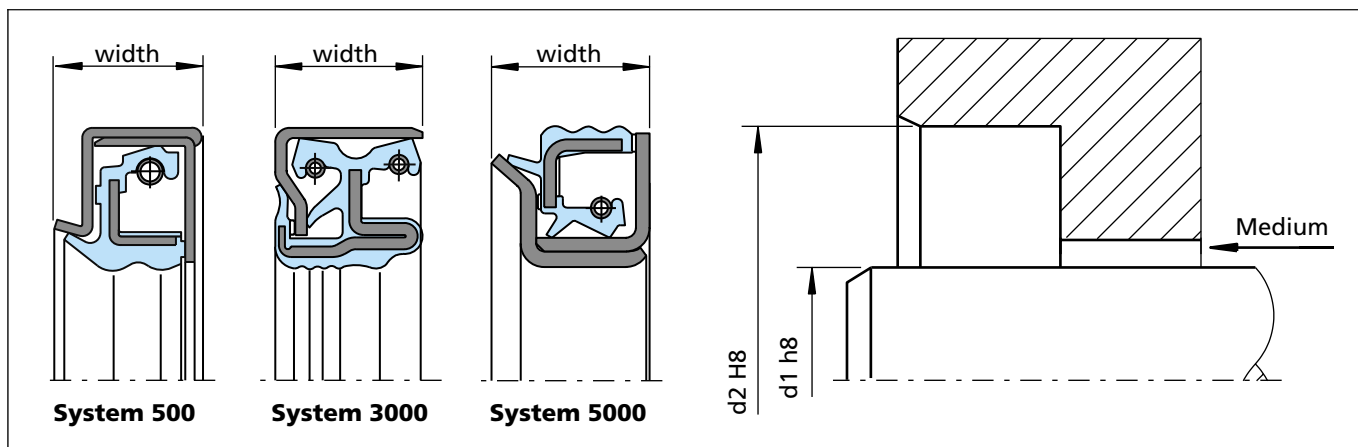


Figure 46 Installation drawing

Table XXXVII Standard dimensions

| ID d_1 | OD d_2 | Width | System 500 (TC 5) | | | System 3000 (TC 3) | | | System 5000 (TC 0) | | |
|-------------|-------------|-------|----------------------|------|-----|-----------------------|------|-----|-----------------------|------|-----|
| | | | NBR | HNBR | FKM | NBR | HNBR | FKM | NBR | HNBR | FKM |
| 85 | 140 | 17 | | | | | | | X | X | X |
| 90 | 130 | 17 | X | X | X | | | | | | |
| 100 | 130 | 17 | X | X | | | | | | | |
| 100 | 140 | 17 | X | X | X | | | | | | |
| 110 | 140 | 17 | X | X | X | | | | | | |
| 111 | 146 | 17 | X | X | X | | | | | | |
| 120 | 160 | 17 | X | X | X | | | | | | |
| 125 | 160 | 17 | X | X | X | | | | | | |
| 128 | 164 | 17 | X | X | X | | | | | | |
| 130 | 160 | 17 | X | X | X | X | X | X | | | |
| 130 | 170 | 17 | X | X | X | | | | | | |
| 135 | 165 | 17 | X | X | X | | | | | | |
| 140 | 170 | 17 | X | X | X | | | | | | |
| 143.3 | 190.5 | 16 | X | X | | | | | | | |
| 145 | 175 | 17 | X | X | X | | | | | | |
| 149.9 | 176 | 16 | X | X | | | | | | | |
| 150 | 180 | 17 | | | | X | X | X | | | |
| 155 | 190 | 17 | X | X | X | | | | | | |
| 160 | 196 | 17 | X | X | | | | | | | |



Cassette Seal

| ID d ₁ | OD d ₂ | Width | System 500 (TC 5) | | | System 3000 (TC 3) | | | System 5000 (TC 0) | | |
|----------------------|----------------------|-------|----------------------|------|-----|-----------------------|------|-----|-----------------------|------|-----|
| | | | NBR | HNBR | FKM | NBR | HNBR | FKM | NBR | HNBR | FKM |
| 178 | 205 | 17 | X | X | X | | | | | | |
| 187 | 230 | 17 | X | X | X | | | | | | |
| 190 | 230 | 17 | X | X | X | | | | | | |
| 320 | 360 | 19 | X | X | | | | | | | |

Table XXXVIII Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal case | Standard spring |
|--------------------|-------------------|--------------------------|---------------------|-----------------|
| NBR (75 Shore A) | 4N063 | 1452 | Carbon steel | Carbon steel |
| HNBR (75 Shore A) | 4H063 | 1614 | | |
| FKM (75 Shore A) | 4V063 | 5466 | Carbon steel | Carbon steel |

* Special grades and other materials (ACM, EACM, VQM) on request.

Ordering example

Due to various combinations (HRV-additional dirt seal + coating), please contact your TSS company for ordering cassette seals.



■ Material

Metal case

The cases are normally stamped of cold rolled steel sheet, EN 10 130 - Fe P04. The high demands on the metal cases; high surface finish, free from scratches etc., calls for production in special tools.

Compression spring

For the spring, spring steel SS14 1774 - DIN 17223 - is normally employed. If resistance to corrosion is required, stainless steel SS 14 2331 - DIN 1.4301 - is used.

Sealing element

The material of the sealing element must be selected according to the working conditions of the seal and the environmental conditions.

Some of the requirements associated with environmental considerations are:

- good chemical resistance
- good resistance to heat and low temperature
- good resistance to ozone and weathering

The functional demands include:

- high resistance to wear
- low friction
- low compression set
- good elasticity

In addition, cost considerations make good processability a desirable feature.

No material is available today, which satisfies all these requirements. The choice of material is therefore always a compromise between the relative significance of the factors involved.

However, FORSHEDA has succeeded in developing a Nitrile Rubber compound (NBR), which exhibits good all-round properties, and for this reason it is the compound most commonly used.

The materials normally used for the sealing element are:

Nitrile Rubber (NBR), Hydrogenated Nitrile Rubber (HNBR) and Fluorinated Elastomers (FKM).

The additional dirt seal is normally made of Nitrile Rubber.

Nitrile Rubber is the basis material for cassette seals, as it covers most standard application requirements for general oil- and grease resistance. It is from function and cost aspects the best choice when temperature is not excessively high.

Nitrile can be used up to 125°C in non-aggressive oils. However for long time use, or in aggressive oils, service temperature is reduced to 80°C.

Nitrile generally has good mechanical properties and the material used for cassette seals is optimised for best heat and abrasion resistance.

Hydrogenated Nitrile Rubber is a further development of NBR, where the chemical double bonds in the polymer molecules are saturated with hydrogen. Since the double bonds of NBR are sensitive to heat and ozone, the HNBR will be superior to NBR in heat, ozone and weather resistance. It can generally be used up to 150°C in non-aggressive media, however for long time use maximum service temperature is 120°C.

The HNBR for the cassette seal is fully saturated and thus well suited for use in aggressive oils. The temperature should however be limited at 120°C. As saturated HNBR cannot be vulcanised with sulphur, the material has resistance to most hypoid oils up to about 120°C for long time use.

Low friction and high abrasion resistance are additional typical features.

Fluorinated Elastomers represents peak performance regarding heat and chemical resistance. They can be used up to 200°C for long time, and are generally very resistant to oil, grease and fuels. Ozone and weather resistance is outstanding.

Mechanical and low temperature properties are however lower compared to Nitrile. Thus Fluor elastomers should be considered only when the material properties are fully used. Some oil additives like amines and high pH-values may damage Fluoroelastomers, when used at high temperatures.

Temperature resistance

Increasing temperature accelerates the ageing of rubber, the elongation decreases, and the compression set increases and finally the material becomes hard and brittle. Cracks at the sealing edge are a typical indication that the seal has been exposed to excessively high temperature. The ageing of the rubber has appreciable significance on the useful life of the seal. It can generally be said that a temperature increase of 10°C (in air) will half the theoretical useful life of the rubber. Low temperatures are generally not a big problem since the seals themselves generate heat by friction when rubbing against another surface. If the seal has been chilled down, its original properties will return as soon as it is warmed up again. Some leakage may however arise during the start-up phase, before rubber material is softened by friction heat.



Cassette Seal

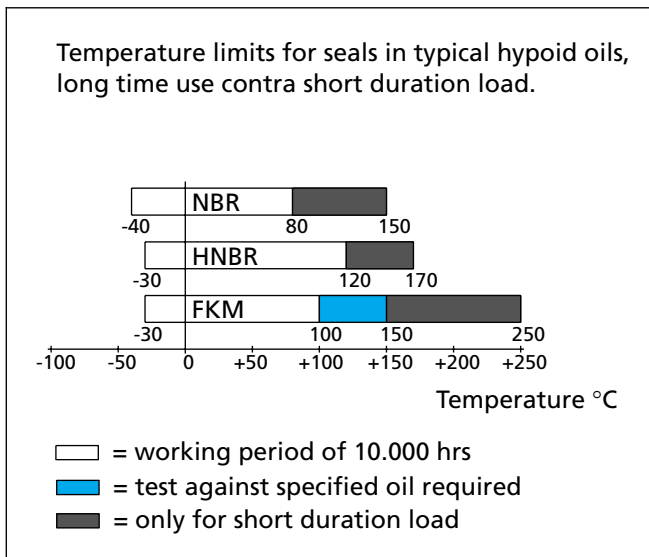


Figure 47 Temperature recommendations in typical hypoid oils

The temperature limits for the standard materials in hypoid oils are illustrated in figure above. They should only be regarded as approximate, since the oil type and the time of exposure also affect the materials. The temperature ranges within the shaded areas in the illustrations are temperatures that can be allowed only for certain periods of time. The higher the temperature, the shorter the period of time. At low temperatures, time has no influence on ageing.

However, seals are not often working in air as only medium, but they are also affected by other media. Temperature limits in combination with other oils and media can be obtained from your local sales office.

Oil resistance

Innumerable types of oils are available on the market and each of these has a different effect on the rubber. In addition, a given type of oil from different manufactures may have a different influence.

The additives in the oil generally affect the rubber. This is the case with hypoid oil, which contains sulphur. Since sulphur is used as vulcanizing agent for Nitrile rubber, the

sulphur additive in the oil acts as a vulcanizing agent at temperatures above +80°C. As a result of this secondary curing, Nitrile rubber will rapidly become hard and brittle. Hydrogenated Nitrile and Fluorinated rubbers, which are not vulcanised with sulphur, can therefore be used for this type of oil, even though the operating temperature may not require these.

Oxidised oils represent another example illustrating the difficulty of tabulating the oil resistance of rubber materials. These oils are oxidised during operation and their properties will therefore change substantially.

Due to the above stated, no detailed information is given about resistance to certain types of oils. In case of questions or doubt, it is advisable to contact the local TSS office who have access to the many years of in-house testing made by FORSHEDA AB. Additional testing can be carried out in specific oil types provided a sufficient sample is available.

Chemical resistance

Since the Cassette seals are normally exposed to oil or grease, and not other chemicals, tables for chemical resistance to different media are not included. For guidelines about chemical resistance, please look under "Radial Oil Seals" or contact your local sales office.

Application

System 500, 3000 and 5000

For the System 500, 3000 and 5000, requirements on the shaft finish and hardness are less stringent in comparison with traditional radial shaft seals. A simple fine turning operation gives an adequate surface on the shaft as well as for the housing bore. Diameter tolerances and finish values are shown in Figure 49 and 48.

As the sealing elements have built in counterfaces of their own, no wear on the shaft itself will occur and consequently no hardening of the shaft is necessary.

Suitable lead in chamfers facilitates the installation of the seal.

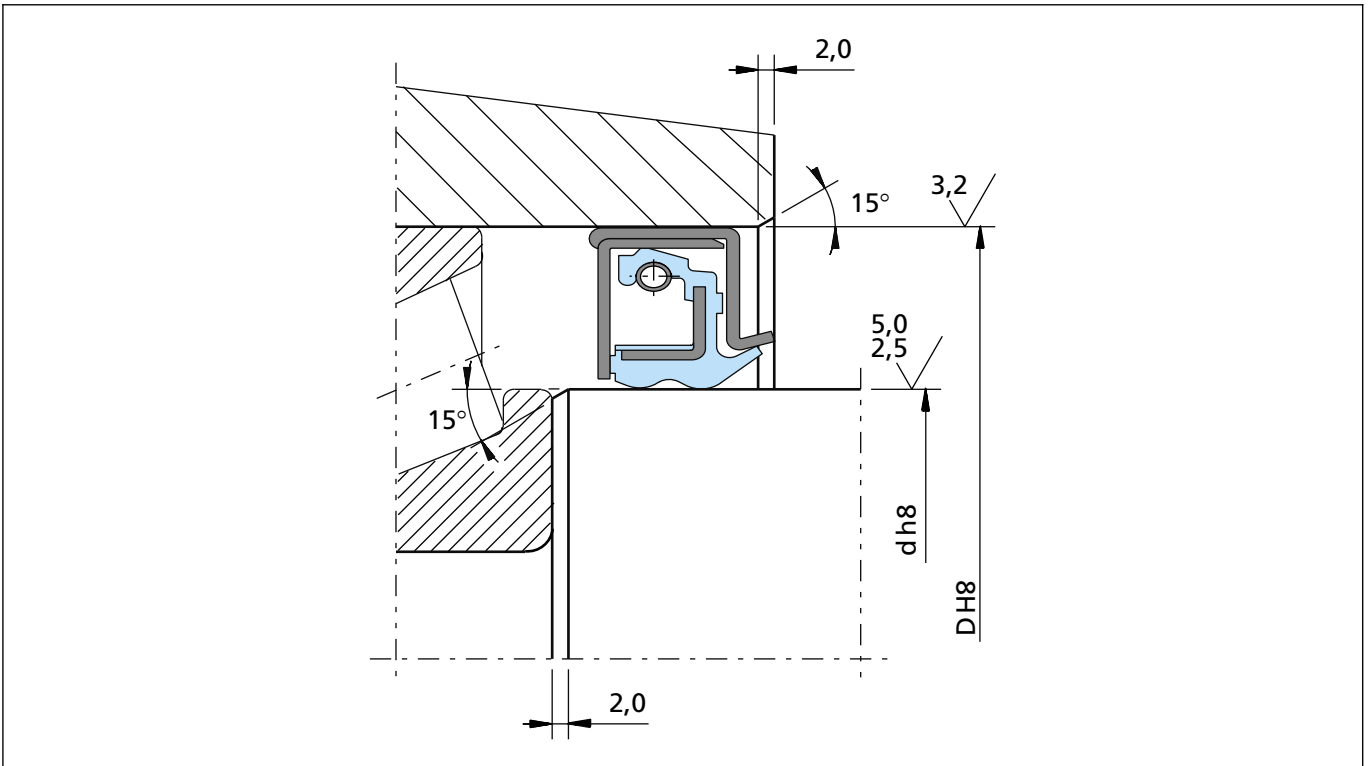


Figure 48 System 500 in wheel hub application

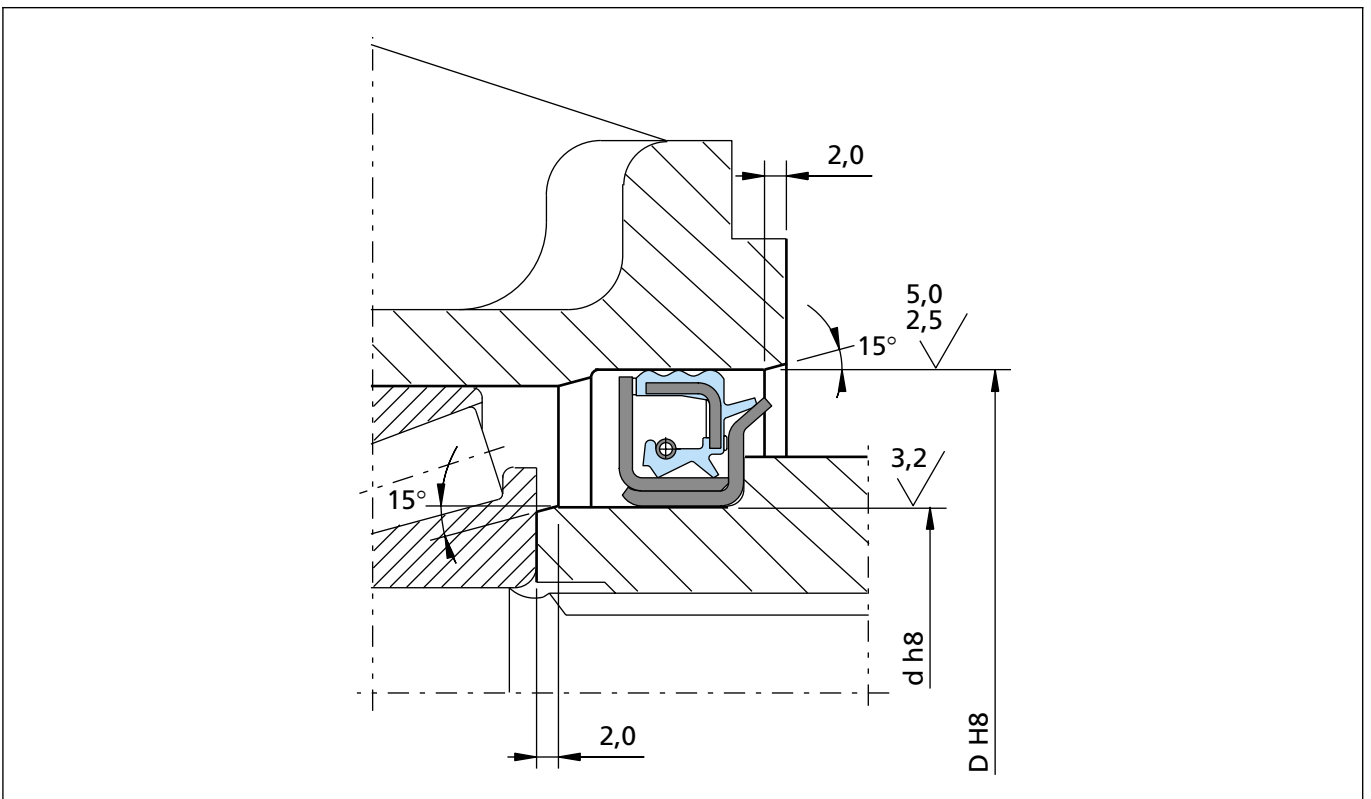


Figure 49 System 5000 in pinion application



Cassette Seal

Shaft run out

Shaft run out should as far as possible be avoided or kept within a minimum. At higher speeds there is a risk that the inertia of the sealing lip prevents it from following the shaft movement. The seal must be located next to the bearing and the bearing play is maintained at the lowest possible value.

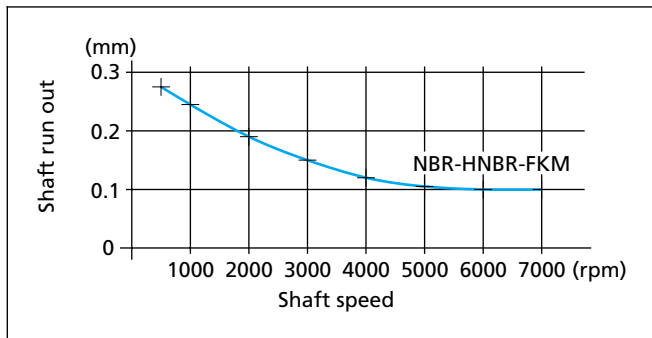


Figure 50 Permissible run out of the shaft

Eccentricity

Eccentricity between shaft and housing bore centres should be avoided in order to eliminate unilateral load of the lip.

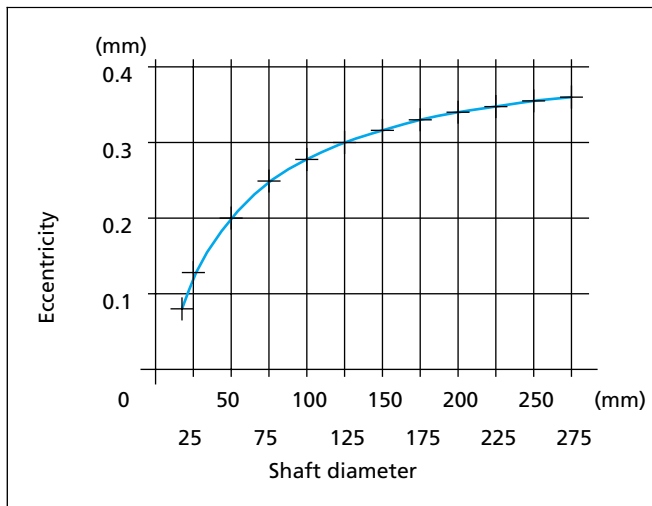


Figure 51 Permissible eccentricity

Shaft misalignment

Shaft misalignment should as far as possible be avoided or kept at a minimum, max. 0.25 mm.

Axial movement

Axial movement, inclusive what can be considered as normal bearing play, should be within ± 0.1 mm. The Cassette seal will function at larger movements, however this may cause a larger wear on support lugs and in the end shorter lifetime.

Pressure

Any difference in pressure from one side of the seal to the other should be avoided. Since the seal is developed for ventilated applications, a pressure difference will in the end lead to a decreased lifetime or leakage.

In some applications, a pressure difference up to 0.05 MPa could be accepted, but tests should be carried out for each case.

Speed

The permissible speed of rotation at sealing point for the various seal designs stated below, assumes normal running conditions, e.g. oil retention and no pressure differential across the seal.

| Type of Seal | max. Surface Speed (m/s) |
|--------------|--------------------------|
| System 500 | 10 |
| System 3000 | 4 |
| System 5000 | 15 |

Start-/Operating torque

Due to transferred assembly forces inside the Cassette seal, the Cassette seal absorbs higher torque than a standard radial seal. See also the Installation part.

HRV - Additional dirt seal

The HRV seal is an all-rubber seal. It is designed for use as complementary seal for the System 500, in dirty applications such as off-road. The main sealing is against small particles such as dust, but also dirt and splash. Since the sealing action is axially, it can absorb some axial displacement.

The HRV seal is bonded directly to the outer case of the System 500. The design is similar to the FORSHEDA V-ring with a body and a flexible conical shaped sealing lip with an integral resilient "hinge".

The HRV seal rotates, due to the outer case being press fitted into the bore, and seals axially against a stationary counter face. During rotation the sealing lip rubs against the counterface under a contact pressure calculated to achieve a sealing function. The HRV seal also operates as a deflector ring, and its centrifugal action contributes to a good sealing function. Due to the centrifugal force, the contact pressure of the lip decreases with increase in speed. The contact pressure also varies with the fitted width.



The counterface for the HRV seal can consist of a suitable surface on the existing hardware or a steel casing adapted to suit the specification for the seal counterface.

The HRV seal:

- seals against outer medium like dirt and dust
- has a deflecting function due to the centrifugal force

The requirements on the counterface against which the sealing lip works are rather low. The requirements are more or less determined by the medium to be sealed. A finish-turned, polished surface with a surface roughness of Ra 1.6 to 2.0 μm is normally adequate. For sealing against liquid and dirt, Ra 0.8 to 1.6 μm is recommended. However, the character of the surface is of greater importance than the actual surface roughness value. For turned surfaces, it is recommended to buff the surface with fine emery cloth to remove any sharp peaks, which could tear the rubber surface apart and destroy the sealing function and shorten seal life time.

It is also necessary to ensure that the counterface is perpendicular to the shaft, flat and free from scratch marks and other damage within the sealing area. This is especially important when sealing fluids and fine particles.

To achieve the full effect of the deflector action, the HRV seal should be designed in a relatively open space.

The fitted width dimension will be stated on the corresponding product drawing.

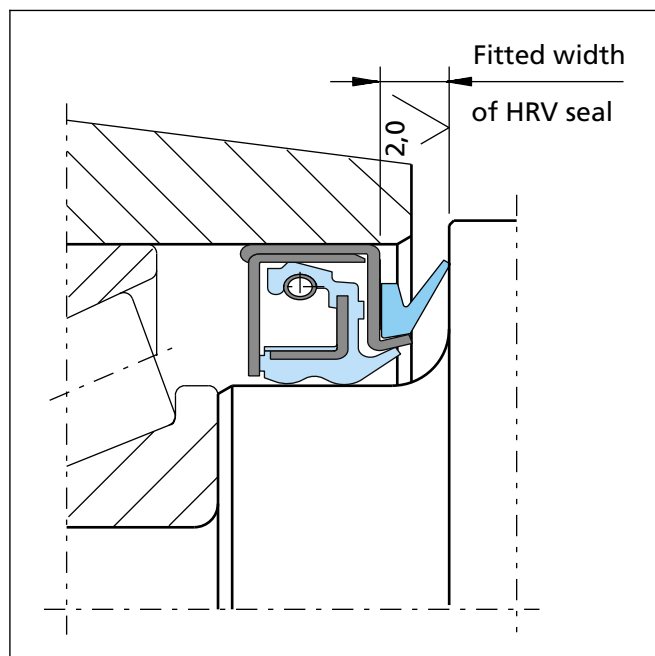


Figure 52 System 500 with HRV seal

■ Installation

As the Cassette seal incorporate all functions as seal, shaft counterface and dust protection, there is no need for extra components as exchangeable shaft sleeves or dirt protection.

This means fewer parts to stock and handle.

When handling and fitting traditional shaft seals there is always a risk for damaging the shaft surface or sealing lips and for improper installation. As the Cassette seal is fully enclosed the vital sealing components cannot be touched or damaged during the installation.

System 500 and System 3000

When the bearing has been installed the seal is simply pressed into the hub bore. The seal shall be oriented with the side marked "oil side" facing the interior of the hub. It is recommended to oil the inside rubber covered surface of the seal and also the shaft, to decrease the force necessary for assembly. If the Cassette seal is equipped with the additional dirt protection this shall be greased prior to fitting. The complete hub is then entered over the axle spindle. Normally the locking nuts for the bearing are used to drive the hub home. The Cassette seal automatically takes the right position on the shaft and no axial support is required provided no over pressure will be built up during operation.

During the start-up phase, some leakage of grease as well as smoke formation may occur. This is a result of the generation of frictional heat between the metal cases and support lugs, and does not influence the function and service life of the seal.

If, on the other hand, the seal has been misaligned during installation, or jammed against the bore, this may lead to that the support lugs are in too close contact with the metal cases, and may be worn out or torn away at the start-up phase. The seal must in these cases always be replaced before start-up. When repairing of the wheel hub becomes necessary, a new seal shall always be installed.



Cassette Seal

System 5000

The System 5000 seal must be installed onto a shaft or a sleeve by a special assembly tool. The seal shall be oriented with the side marked "oil side" facing the inside of the gearbox. The shaft must then be assembled so the oil side of the seal is entering the housing bore.

If the shaft is hollow, the assembly tool should be designed with a guiding column.

For pinion applications on trucks, when a separate end carrier is used, the seal is simply pressed onto the end carrier in a first step of assembling. The end carrier is then entering the splines on the pinion shaft and then a locking nut is used to drive the end carrier and the seal into the right position.

The force required to assemble a System 5000 seal onto the shaft is between 20 to 50 kN, while assembly into the housing bore requires about 1.0 kN. The value of assembly force depends on surface structure for shaft resp. housing bore as well as the tolerances. It is recommended to oil the outer rubber covered surface of the seal and also the housing bore, to decrease the force necessary for assembly.

During the start-up phase, eventually some leakage of grease and smoke formation may occur. This is a result of the generation of frictional heat between the metal cases and the support lugs of rubber, and does not influence on the function and service life of the seal.

If the seal is jammed or damaged in some way during installation, the seal must be replaced before start up.

If the construction is disassembled for any reason, a new seal should be installed.

Further instructions for assembling can be found on separate assembly instruction sheets available from your local TSS office.

Dismantling and replacement

As all the necessary functions are integrated in the Cassette seal the complete sealing arrangement is re-newed. The shaft to be sealed is unaffected by wear and once it has been cleaned and possible corrosion and dirt have been removed a new seal can be fitted again.

The Cassette Seal may be provided with a sealant on the metal casing when it is installed into the housing. Take care that the sealant do not flow into the seal or is smeared onto the rubber surface as this may impede the function of the seal. The sealant can reduce the risk of static leakage due to small imperfections on the surface.

Storage

As the service life of bearings and other machine parts depends on how well the seals perform, seals should be handled with caution. Unfavourable storage conditions or improper handling will most likely lead to a change of their physical properties. This can lead to a shortening of life, or failure, for example as a result of hardening or softening, cracking or other surface damages. These changes can be the result of one particular factor or a combination of factors, like oxygen, ozone, heat, light, moisture, solvents etc. Storing the seals under load can lead to permanent deformation of the elastomer. On the other hand, properly stored elastomer products retain their properties for several years.

As the sensitive sealing lips and counter faces are well protected inside the Cassette seal casing, there is less risk of mechanical damages and influence of dirt and dust in comparison to many other seal types.

Cleaning

If cleaning of Cassette seals is necessary, use a damp duster and allow the seals to dry off at room temperature.

Solvents, sharp-edged objects and abrasives should not be used.



■ V-RING

■ General

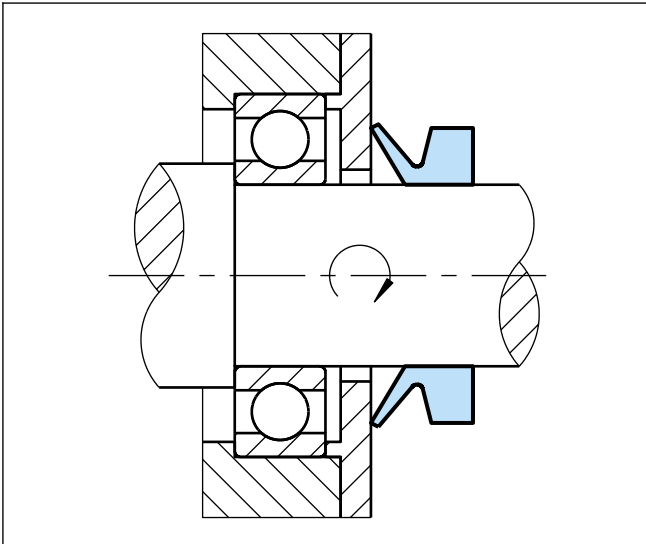


Figure 53 Method of operation of the V-Ring

The V-RING is a unique all-rubber seal for rotary shafts. Developed in the 1960's by FORSHEDA AB, it has been used successfully by OEMs and on the replacement market world wide in a broad range of applications.

The V-Ring is the perfect seal to prevent the ingress of dirt, dust, water or combinations of these media while positively retaining grease. With its unique design and performance the V-Ring can be used with a wide range of bearing types. It can also be used as a secondary seal to protect primary seals that do not perform well in hostile environments.

Description and advantages

The V-Ring is normally stretched and mounted directly on the shaft, where it is held in position by the inherent tension of the rubber body. It rotates with the shaft and seals axially against a stationary counterface, perpendicular to the shaft. The counterface can be the side wall of a bearing or a washer, stamping, bearing housing, or even the metal case of an oil seal. The sealing lip is flexible and applies only a relatively light contact pressure against the counter-face and yet is still sufficient to maintain the sealing function. The low contact pressure (that varies with the fitted width) allows the seal to run dry in many applications.

Due to influence of the centrifugal force, the contact pressure of the lip decreases with increased speed. This means that frictional losses and heat are kept to a

minimum, resulting in excellent wear characteristics and extended seal life. Once breakaway friction is overcome, the friction reduces steadily until around the 10 - 15 m/s range, when it reduces quite quickly. In the 15 - 20 m/s range the friction reduces to zero. The V-Ring then serves as a clearance seal and deflector. The power loss due to seal friction develops as shown in Fig. 54.

The flexible lip and hinge allow the V-Ring to function even in the presence of a certain amount of run-out, eccentricity and shaft misalignment. Contact our local TSS company for advice on these and other application issues.

V-Rings are made entirely of rubber without fabric or sheet metal reinforcement. They are, therefore, particularly easy to install. V-Rings can be stretched and, depending on size, installed over flanges, pulleys and bearing housings without costly dismantling. For larger sizes they can even be supplied as cut rings and joined by vulcanisation on site.

Design

V-Rings are available in seven standard cross-sections to meet various space and application requirements.

The cross-sections of profiles A and S increase with the shaft diameter, whilst the other types have the same cross-section for the whole diameter range.

Profile A is the most common and available for shaft diameters from 2.7 to 2020 mm, inclusive.

Profile S is wide and tapered, which provides a very firm hold on the shaft. The rings are available for shaft diameters from 4.5 to 210 mm.

Profiles L and LX have narrow axial cross sections making them suitable for compact arrangements and are often used in combination with labyrinth seals. Available for shaft diameters from 105 (135 for LX) to 2025 mm.

Profiles RME, RM and AX are heavy duty V-Rings that are designed primarily for large high speed bearing arrangements, i. e. rolling mill and papermaking machine applications. Additionally they can be used as secondary seals for heavy duty applications where the primary seal has to be protected against water and or particulate contamination. The RME, RM and AX types can be axially and radially located on the shaft with the especially designed clamping bands (see page 148). Available for shaft diameters from 300 mm and up.

Larger V-Ring sizes are available as spliced seals. For more details please contact your local TSS company.



V-Ring

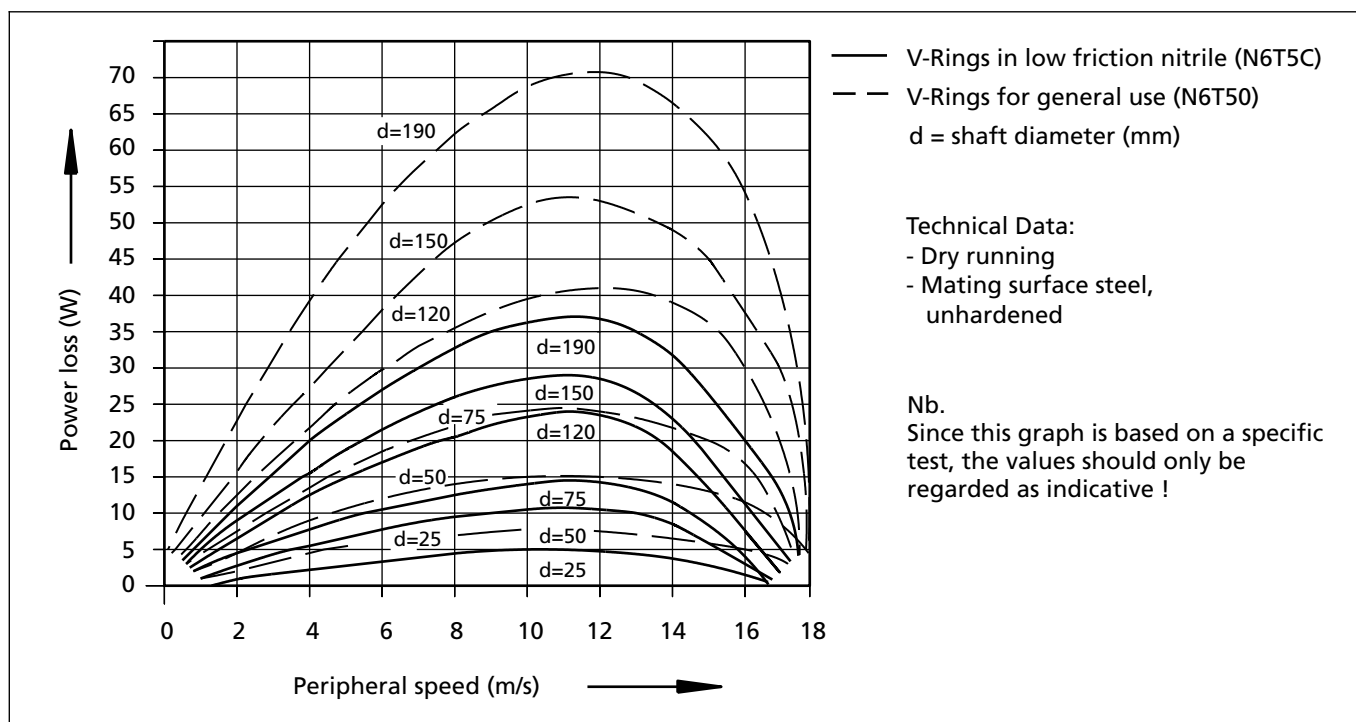


Figure 54 Power loss as a function of peripheral speed for various sizes

Materials

When selecting the correct rubber compound it is necessary to take the following requirements into account;

- good chemical resistance
- good resistance to high and low temperatures
- good resistance to ozone and weathering

It is also necessary to consider the need for the following attributes;

- high resistance to wear
- low friction
- low compression set
- good elasticity

Material types

The most frequently selected material is the purpose made Nitrile rubber N6T50 which has excellent allround properties.

For applications with temperatures above 100°C, or in chemically aggressive conditions, V-Rings made of fluorinated rubber (FKM) can be supplied. In fact a wide range of rubber compounds is available and some of these are listed below.

Table XXXIX Guide to selection of rubber material

| TSS code | Old (FORSHEDA) code | Type of rubber | Characteristics |
|----------|---------------------|----------------------|---|
| N6T50 | NBR 510 | Nitrile | For general use |
| N7T50 | NBR 555 | Nitrile | Heavy duty conditions. Good tear and abrasion resistance |
| N6T5C | NBR 562 | Nitrile | Low friction |
| H7T50 | HNBR 576 | Hydrogenated Nitrile | Hypoid oils at high temp. |
| CDT50 | CR 415 | Chloroprene | For applications in the presence of ozone |
| E7T50 | EPDM 762 | Ethylene-Propylene | Good weather and ozone resistance, used with special chemicals such as acetone, ammonium carbonate and benzaldehyde |
| VDT50 | FKM 900 | Fluorinated | Very high temperature and chemical resistance |



Temperature resistance

Exposure to higher temperatures accelerate the ageing of rubber, the elongation decreases, the compression set increases, and finally the material becomes hard and brittle. Cracks at the sealing edge are a typical indication that the seal has been exposed to excessively high temperature. The ageing of the rubber has an appreciable negative influence on the useful life of the seal.

The temperature limits for the principal materials are illustrated in Figure 55. They should only be regarded as approximate, since the media and time of exposure also affect the materials.

The temperature ranges within the shaded areas indicate temperatures that can be allowed for only certain periods of time. The higher the temperature, the shorter the service life. If the maximum temperature is exceeded, the elastomer may suffer permanent set or damage. Special elastomers are available for use in cold temperatures. If the elastomer is subjected to temperatures lower than the recommended values it will become hard and brittle, however it will regain its properties as soon as the temperature rises again.

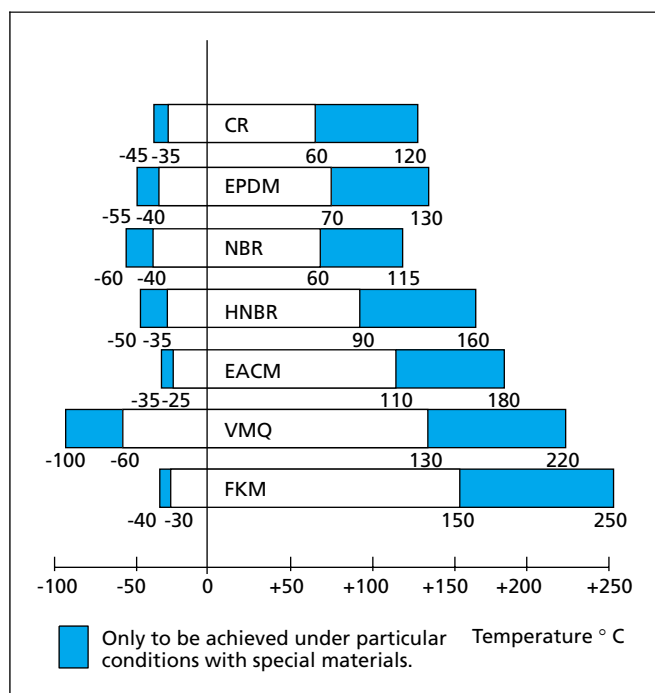


Figure 55 Temperature recommendations for V-Rings

Oil and solvent resistance

Since the V-Ring is used primarily for sealing grease lubricated bearings exposed to water splash, dirt, dust, scale etc. the normal choice of compound is Nitrile Rubber (N6T50) 510. However innumerable types of oil are available on the market and each of these has different effect on rubber. In addition, a given type of oil from different manufacturers may have different influence.

It is the additives in the oil that may affect the rubber. Especially so for hypoid oils, that contain sulphur. Since sulphur is used as the vulcanising agent for nitrile rubber it will initiate a secondary curing at temperatures above +80° C. As a result of that, nitrile rubber will become hard and brittle. Hydrogenated Nitrile and Fluorinated rubbers, which are not vulcanised with sulphur, may therefore be considered for use with this type of oil. Oxidised oils represent another example illustrating the difficulty of tabulating the oil resistance of rubber materials. These oils are oxidised during operation and their properties will therefore change substantially. Such oils break down silicone rubber. Solvents could generally cause deterioration or swelling of the rubber however mixtures of different solvents may cause considerably more damage than a single solvent. An example of this is mixing methanol and hydrocarbons.

For further information on oil and solvent resistance we recommend you to be in contact with your local TSS company.

Application instructions

The V-RING is normally fully exposed to the medium to be sealed. The requirements on the shaft and the counterface are mainly dependent on the medium and the peripheral speed.

Shaft design

The V-Ring is in most cases fitted on a rotating shaft. The requirements regarding diameter tolerances and surface roughness of the shaft are fairly moderate. As the V-Ring is an all-rubber seal it can be stretched to a varying degree and be used for a wide range of shaft diameters.

In applications where low power loss and long lifetime are important it is recommended that the V-Ring size is selected, so that the shaft diameter falls between the minimum and nominal values within the recommended range. This is because the contact pressure of the sealing lip increases with the shaft diameter, due to the stretch of the V-Ring. At a higher stretch, a harder contact pressure is generated, causing an accelerated wear of the sealing lip. In order to prevent the V-Ring from sliding along the shaft, and to ensure the correct installation width, it is always recommended to arrange an axial support, especially for small cross-section profiles and larger shaft sizes, for example V-Ring type A, L and LX.



V-Ring

The surface roughness of the shaft should in general not exceed Ra 6.3 µm. For sealing fluids and fine particles, a maximum of Ra 3.2 µm is recommended. Sharp edges and burrs, which can damage the V-Ring must be avoided.

Counter-face design

The condition of the counter-face has a great influence on the sealing function. The medium to be sealed and the peripheral speed of the shaft determine the requirements regarding surface roughness and material of the counter-face. It is important that it is smooth and flat without any sharp edges. To achieve the full effect of the flinger action, the V-Ring should always be designed in a relatively open space. Equally important is to keep the gap between the shaft and the counter-face as small as possible, in order to prevent entry of the V-Ring lip during the installation. Recommended application dimensions are given in the dimension tables.

Material and material hardness

Cold rolled steel sheet, stainless steel or zinc plated sheet are excellent materials for the counter-face. However, the choice of material is highly dependent on the medium to be sealed.

For normal running conditions, conventional mild steel with a hardness of min. 125 HB is sufficient. For sealing against grease, oil and dry particles no further surface treatment is required. With an increase in speed and the presence of abrasive particles the hardness of the counter-face must also be increased.

The following materials are normally used :

| Material | Hardness HB | Medium |
|---------------------------------------|-------------|------------------------------|
| Mild Steel | 125-150 | Water splash, sand, dust |
| Grey Cast Iron | 190-270 | Water splash, sand, dust |
| Sinter Bronze | 100-160 | Water, dust |
| Stainless Steel (Cr/Ni 18-8, C 0.1%) | 150-200 | Water |
| Stainless Steel (Cr/Ni 18-8, C 0.15%) | 350 | Water and abrasive particles |
| Work-hardened | | |
| Acid Proof Steel | 180-200 | Chemicals |
| Tungsten Carbide | 350-500 | Water and scale |
| Forged Steel | 200-255 | Water and scale |
| Die-cast Aluminium | 90-160 | Water splash |

Surface treatment

When the counter-face is exposed to water or other corrosive media, it must be protected accordingly.

Mild steel surfaces should either be zinc-plated and chromated, chromium plated, treated with an anticorrosion spray, or painted. The choice of treatment will depend on the overall running conditions.

Where the seal is immersed in water, stainless steel is recommended. However, due to the poor thermal conductivity stainless steel should not be used in dry running conditions unless the speed is slow (<1 m/s).

Surface finish

The rate of abrasion of the V-Ring is influenced by a number of factors, one of which is the surface finish of the counter-face. The choice of surface finish will depend on the medium to be sealed and the shaft speed as well. It is not only the surface finish value as such that is important, but also the surface character. For turned surfaces, it is recommended to buff the surface with fine emery cloth to remove any sharp peaks arising from the turning operation.

Surfaces with too fine finish, e.g. certain cold rolled steel surfaces, may cause a suction effect between the V-Ring lip and the counter-face resulting in noise problems and uneven running (so-called stick-slip effect).

The counterface surface must be free from scratch marks and other surface damages within the sealing area. This is important when sealing fluids and fine particles are present.

Guide to recommended surface finish

| Surface finish µm Ra | Speed m/s | Medium |
|----------------------|-----------|-----------------------------------|
| 0.4-0.8 | > 10 | Oil, water, scale, fibre |
| 0.8-1.6 | 5-10 | Oil splash, grease, water splash |
| 1.6-2.0 | 1-5 | Grease, dust, water splash, scale |
| 2.0-2.5 | <1 | Grease, dust |

The surface finish should not be lower than Ra 0.05 µm.

Flatness

The flatness of the counter-face is of importance, especially at higher shaft speeds.

The maximum permissible flatness deviation is normally defined as 0.4 mm per 100 mm.



■ Installation

Axial support

When used to retain oil and grease, an axial support for the V-Ring is always required. For applications with a lower degree of stretch than recommended in the dimension tables (e.g. for ease of assembly) or with a shaft speed exceeding 6-8 m/s (depending on the rubber compound selected) an axial support is also necessary.

An axial support can ensure that the correct installation width relative to the counter-face is maintained for blind assemblies.

The V-Ring must always be supported over its entire base. The axial support should be designed in accordance with Figure 56. The dimensions A, c, d₁, d₃ and B₁ are shown in the dimension tables.

Calculation of the axial support diameter d₅ is as follows;

| V-Ring type | Diameter d ₅ |
|-------------|--------------------------|
| A, S | d ₁ + 0.5 x c |
| L, LX | d ₁ + 3 mm |
| RM, RME | d ₁ + 10 mm |
| AX | d ₁ + 9 mm |

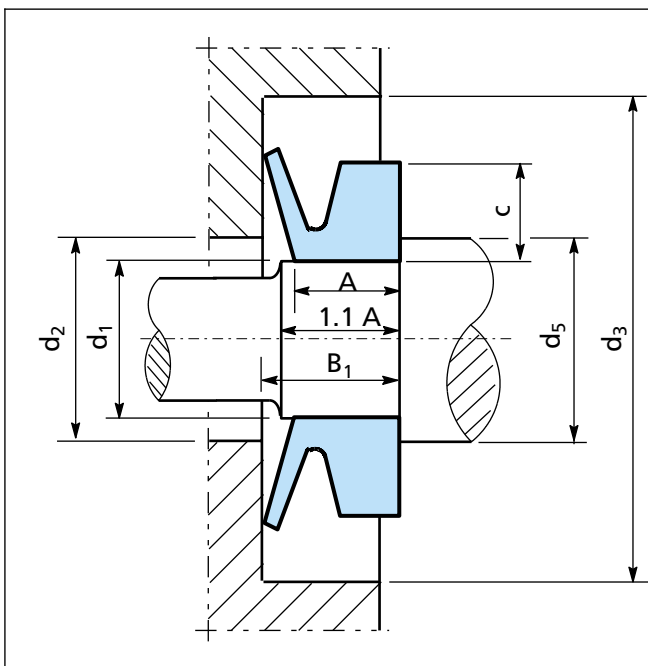


Figure 56 Axial support

Radial retention

When the V-Ring is fitted on the shaft, the body of the V-Ring is subject to a centrifugal force and tends to move or even lift off from the shaft at a certain speed.

At shaft speeds over 10-12 m/s, depending on the V-Ring material, the V-Ring in general requires radial retention.

The speed when radial retention is required is also dependent on the degree of stretch of the V-Ring. V-Rings larger than 2000 mm should always be fitted with radial retention, irrespective of the operating speed.

The radial retention can be designed as a recess, in which the V-Ring body fits, or consist of a number of separate clamping segments. Please contact your local TSS company for further guidance.

The clamping band type A or RM are other useful alternatives. See page 148.

Stationary assembly

In cases where the peripheral speed of the shaft exceeds 10-12 m/s an alternative method to radial clamping is to mount the V-Ring on a stationary component in the unit. The contact pressure of the lip will remain constant, as there will be no centrifugal force acting upon the lip.

In comparison to a rotating V-Ring, friction and power loss will be higher resulting in somewhat shorter service life. In order to compensate for this the following steps should be taken:

Counter-face surface finish:
machine to max. 0.8 μm Ra

V-Ring stretch:
maximum 4-6%

Axial interference:
keep to the minimum requirements for compensation of the axial movement within the assembly.

At higher peripheral speed adequate lubrication and heat transfer from the counter-face are required.

Torque

The torque, and consequently the power loss due to the friction of the seal, is often of such a magnitude that it should be taken into consideration when deciding seal type. This applies particularly in the case of small electrical motors, conveyor rollers or any unit where low friction is an important requirement.

The power losses are influenced by many factors such as the seal design and compound, surface finish of the counter-face, fitted width and stretch, speed, medium, lubricant, temperature etc.



For this reason it is difficult to give exact torque values for all running conditions.

Generally speaking, the power losses resulting from a V-Ring are always lower than a corresponding radial oil seal.

Grease lubrication gives higher power losses than oil lubrication or dry running.

By applying a suitable low friction dry film lubricant on the counter-face surface the friction and the heat generated can be reduced.

An increase of the fitted width of the V-Ring, giving a reduced lip pressure, will also lower the friction. However, the total axial movement in the assembly must be considered in order not to exceed the tolerances shown in the dimension tables.

Whenever detailed information about power losses is required, consult your local TSS company.

Installation guidelines

When the V-Ring is used as a grease seal/contaminant excluder, the V-Ring is normally mounted on the outside of a bearing housing, with or without, axial support.

General rules:

1. The V-Ring, the counter-face and the shaft should be clean.
2. The shaft should preferably be dry and free from grease or oil, particularly when the V-Ring is mounted without axial support.
3. The lip of the V-Ring should be lubricated with a thin film of grease or silicone oil.
4. In cases when friction must be reduced to a minimum, coat the counter-face with a low friction agent, and do not apply grease to the lip.
5. Ensure that the V-Ring is mounted with a uniform stretch around the shaft.

When the V-Ring is mounted on the shaft the outer diameter of the lip is reduced. Unless the stretch is uniform this reduction will vary around the periphery. This may lead to partial entry of the lip in the bore of the counter-face when the seal is pushed into position.

In the case of large diameter seals a uniform stretch can be achieved by inserting a blunt screwdriver or a piece of string under the V-Ring body and running it around the shaft twice. Take care not to damage seal or shaft.

The most convenient method of assembling large diameter V-Ring's, to ensure uniform stretch, is to mark off the body of the V-Ring and the shaft or seating with six equidistant marks. The marks should then be matched together when the V-Ring is fitted in position.

For more detailed installation instructions, contact your local TSS company.

Clamping band

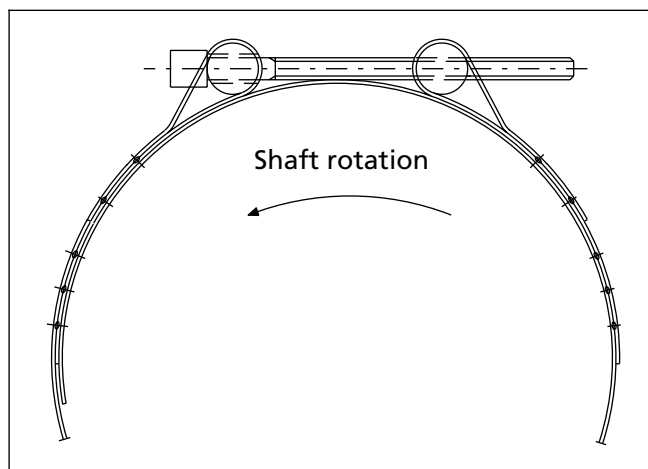


Figure 57 Clamping band RM

FORSHEDA Clamping Band RM

For clamping large diameter V-Rings of the RM and RME types, the FORSHEDA Clamping Band RM is recommended.

Together with Clamping Band RM a special series of "low stretch" V-Rings can be used for shaft diameters larger than 1500 mm. This will reduce torque and facilitate the fitting of the V-Ring.

When ordering the Clamping Band RM, simply state the shaft diameter for which the clamping band is intended. Each clamping band comprises a set of standard lengths measuring 1000 mm and 1500 mm depending on the size, standard attachments and, if necessary, an adjustable length and two set of rivets. When the parts are assembled, the clamping band will fit the specific V-Ring.

All parts are made of acid-proof steel with the exception of the pop rivets, which are made of conventional stainless steel. If operation conditions dictate the use of acid-proof steel, the conventional rivets must be used in conjunction with the adjustable length.



Fitting the clamping band RM

Trim the adjustable clamping band to the right length by using a pair of shears. Rivet the adjustable length and the end attachment together by using a standard pop riveter and the three pop rivets.

Locate the V-Ring in correct position relative to the counterface, i.e. the predetermined B₁-dimension.

Smear the V-Ring with a thin film of grease in the groove designed for the clamping band.

Using the attachments supplied with the band sections, join them together and position the complete band in the body groove with the screw heads facing the direction of shaft rotation. Turn the attachment screws a few turns one by one until the band is tight.

Check that the entire band fits snugly in the body groove.

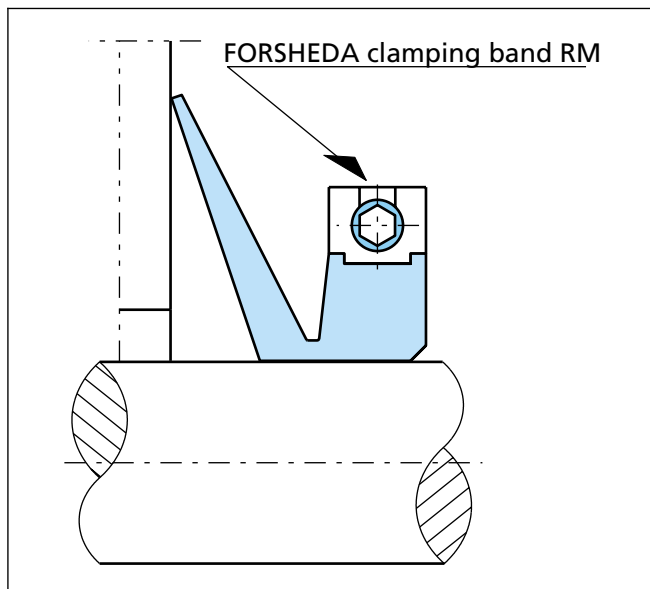


Figure 58 FORSHEDA clamping band RM

Clamping band for V-Ring type A and AX

The clamping band A/AX is meant to be used with V-rings type A and AX on shaft diameters from 200 mm and larger. The clamping band keeps the V-ring in position both axially and radially and can be re-used several times. The clamping band is supplied in 5 m lengths. Screw joints to connect the clamping band as well as the buckle are ordered on separate article number. The band is made of stainless steel AISI 301, the screw joint is made of AISI 304 with galvanized screw.

To order the right size and for the correct installation, please ask for the "TECH INFO".

TSS part numbers for clamping band A:

| | |
|---------------|------------|
| Band | XZYDFAE002 |
| Screw joint | XZYDF00022 |
| Buckles A(AX) | XZYDFAR001 |

Splicing by vulcanisation

To avoid unnecessary downtime and difficult dismantling when carrying out preventive maintenance of process machinery, it is possible to split the V-Ring, fold it around the shaft and splice it.

The V-Ring can be supplied either as a complete ring and cut on site, or supplied in the split condition from the factory. For V-Rings types RM and RME it is preferable to split the seals at the factory due to the size of the section.

The best method of splicing a V-Ring is by vulcanising. Portable vulcanising tools for the different V-Rings profiles, vulcanising cement and detailed instructions are available from your local TSS company.



Dimension table - V-Ring type A

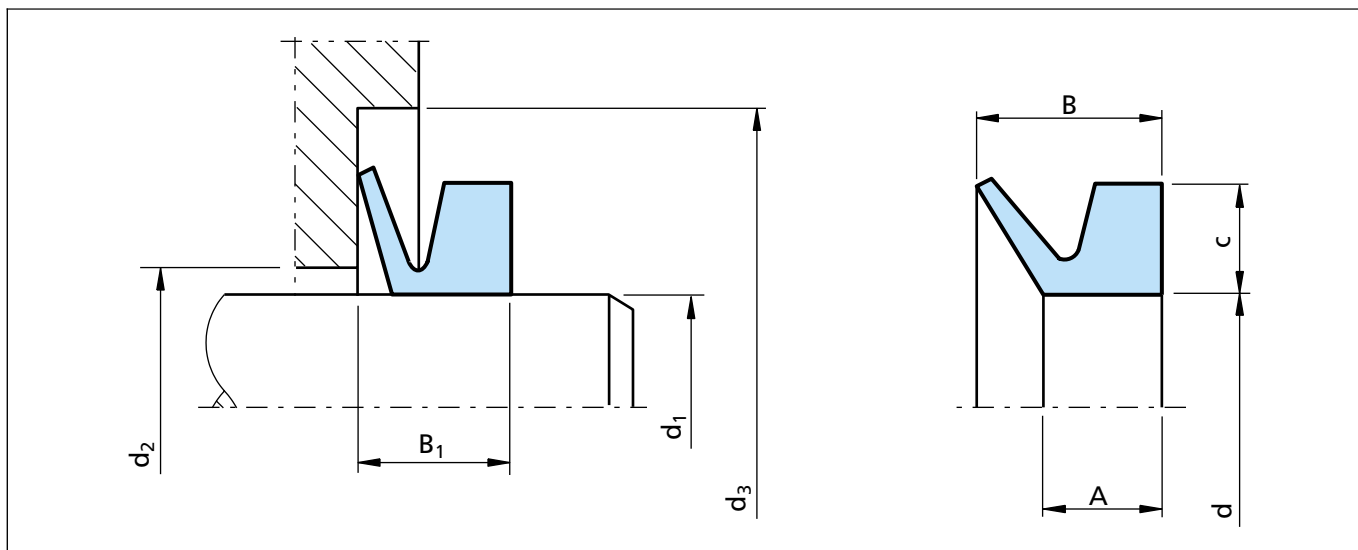


Figure 59 Installation drawing

When the shaft diameter d_1 is on the boundary between two sizes of V-Ring, select the larger V-Ring.
All dimensions in mm.

Ordering example

V-Ring, type A
for shaft diameter = 30.0 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|---|-----------|---|-------|
| TSS Article No. | TWVA00300 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-30A NBR510 | | | |

Table XL Profile dimensions - assembly dimensions

| For shaft diameter d_1 | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d_2 | Minimum d_3 | Fitted width B_1 | V-Ring FORSHEDA Ref. | TSS Part number |
|--------------------------|-----------------|-----------------------------|---------------|----------------|---------------|---------------|--------------------|----------------------|-----------------|
| 2.7 - 3.5 | 2.5 | 1.5 | 2.1 | 3.0 | $d_1 + 1$ | $d_1 + 4$ | 2.5 ± 0.3 | V-3A | TWVA00030 |
| 3.5 - 4.5 | 3.2 | 2 | 2.4 | 3.7 | $d_1 + 1$ | $d_1 + 6$ | 3.0 ± 0.4 | V-4A | TWVA00040 |
| 4.5 - 5.5 | 4 | 2 | 2.4 | 3.7 | $d_1 + 1$ | $d_1 + 6$ | 3.0 ± 0.4 | V-5A | TWVA00050 |
| 5.5 - 6.5 | 5 | 2 | 2.4 | 3.7 | $d_1 + 1$ | $d_1 + 6$ | 3.0 ± 0.4 | V-6A | TWVA00060 |

V-Ring



| For shaft diameter d_1 | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d_2 | Minimum d_3 | Fitted width B_1 | V-Ring FORSHEDA Ref. | TSS Part number |
|--------------------------|-----------------|-----------------------------|---------------|----------------|---------------|---------------|--------------------|----------------------|-----------------|
| 6.5 - 8.0 | 6 | 2 | 2.4 | 3.7 | $d_1 + 1$ | $d_1 + 6$ | 3.0 ± 0.4 | V-7A | TWVA00070 |
| 8.0 - 9.5 | 7 | 2 | 2.4 | 3.7 | $d_1 + 1$ | $d_1 + 6$ | 3.0 ± 0.4 | V-8A | TWVA00080 |
| 9.5 - 11.5 | 9 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-10A | TWVA00100 |
| 11.5 - 12.5 | 10.5 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-12A | TWVA00120 |
| 12.5 - 13.5 | 11.7 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-13A | TWVA00130 |
| 13.5 - 15.5 | 12.5 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-14A | TWVA00140 |
| 15.5 - 17 | 14 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-16A | TWVA00160 |
| 17.5 - 19 | 16 | 3 | 3.4 | 5.5 | $d_1 + 1$ | $d_1 + 9$ | 4.5 ± 0.6 | V-18A | TWVA00180 |
| 19 - 21 | 18 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-20A | TWVA00200 |
| 21 - 24 | 20 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-22A | TWVA00220 |
| 24 - 27 | 22 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-25A | TWVA00250 |
| 27 - 29 | 25 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-28A | TWVA00280 |
| 29 - 31 | 27 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-30A | TWVA00300 |
| 31 - 33 | 29 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-32A | TWVA00320 |
| 33 - 36 | 31 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-35A | TWVA00350 |
| 36 - 38 | 34 | 4 | 4.7 | 7.5 | $d_1 + 2$ | $d_1 + 12$ | 6.0 ± 0.8 | V-38A | TWVA00380 |
| 38 - 43 | 36 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-40A | TWVA00400 |
| 43 - 48 | 40 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-45A | TWVA00450 |
| 48 - 53 | 45 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-50A | TWVA00500 |
| 53 - 58 | 49 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-55A | TWVA00550 |
| 58 - 63 | 54 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-60A | TWVA00600 |
| 63 - 68 | 58 | 5 | 5.5 | 9.0 | $d_1 + 2$ | $d_1 + 15$ | 7.0 ± 1.0 | V-65A | TWVA00650 |
| 68 - 73 | 63 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-70A | TWVA00700 |
| 73 - 78 | 67 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-75A | TWVA00750 |
| 78 - 83 | 72 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-80A | TWVA00800 |
| 83 - 88 | 76 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-85A | TWVA00850 |
| 88 - 93 | 81 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-90A | TWVA00900 |
| 93 - 98 | 85 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-95A | TWVA00950 |
| 98 - 105 | 90 | 6 | 6.8 | 11.0 | $d_1 + 3$ | $d_1 + 18$ | 9.0 ± 1.2 | V-100A | TWVA01000 |
| 105 - 115 | 99 | 7 | 7.9 | 12.8 | $d_1 + 4$ | $d_1 + 21$ | 10.5 ± 1.5 | V-110A | TWVA01100 |
| 115 - 125 | 108 | 7 | 7.9 | 12.8 | $d_1 + 4$ | $d_1 + 21$ | 10.5 ± 1.5 | V-120A | TWVA01200 |
| 125 - 135 | 117 | 7 | 7.9 | 12.8 | $d_1 + 4$ | $d_1 + 21$ | 10.5 ± 1.5 | V-130A | TWVA01300 |
| 135 - 145 | 126 | 7 | 7.9 | 12.8 | $d_1 + 4$ | $d_1 + 21$ | 10.5 ± 1.5 | V-140A | TWVA01400 |



V-Ring

| For shaft diameter d_1 | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d_2 | Minimum d_3 | Fitted width B_1 | V-Ring FORSHEDA Ref. | TSS Part number |
|--------------------------|-----------------|-----------------------------|---------------|----------------|---------------|---------------|--------------------|----------------------|-----------------|
| 145 - 155 | 135 | 7 | 7.9 | 12.8 | $d_1 + 4$ | $d_1 + 21$ | 10.5 ± 1.5 | V-150A | TWVA01500 |
| 155 - 165 | 144 | 8 | 9.0 | 14.5 | $d_1 + 4$ | $d_1 + 24$ | 12.0 ± 1.8 | V-160A | TWVA01600 |
| 165 - 175 | 153 | 8 | 9.0 | 14.5 | $d_1 + 4$ | $d_1 + 24$ | 12.0 ± 1.8 | V-170A | TWVA01700 |
| 175 - 185 | 162 | 8 | 9.0 | 14.5 | $d_1 + 4$ | $d_1 + 24$ | 12.0 ± 1.8 | V-180A | TWVA01800 |
| 185 - 195 | 171 | 8 | 9.0 | 14.5 | $d_1 + 4$ | $d_1 + 24$ | 12.0 ± 1.8 | V-190A | TWVA01900 |
| 195 - 210 | 180 | 8 | 9.0 | 14.5 | $d_1 + 4$ | $d_1 + 24$ | 12.0 ± 1.8 | V-199A | TWVA01990 |
| 190 - 210 | 180 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-200A | TWVA02000 |
| 210 - 235 | 198 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-220A | TWVA02200 |
| 235 - 265 | 225 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-250A | TWVA02500 |
| 265 - 290 | 247 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-275A | TWVA02750 |
| 290 - 310 | 270 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-300A | TWVA03000 |
| 310 - 335 | 292 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-325A | TWVA03250 |
| 335 - 365 | 315 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-350A | TWVA03500 |
| 365 - 390 | 337 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-375A | TWVA03750 |
| 390 - 430 | 360 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-400A | TWVA04000 |
| 430 - 480 | 405 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-450A | TWVA04500 |
| 480 - 530 | 450 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-500A | TWVA05000 |
| 530 - 580 | 495 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-550A | TWVA05500 |
| 580 - 630 | 540 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-600A | TWVA06000 |
| 630 - 665 | 600 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-650A | TWVA06500 |
| 665 - 705 | 630 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-700A | TWVA07000 |
| 705 - 745 | 670 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-725A | TWVA07250 |
| 745 - 785 | 705 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-750A | TWVA07500 |
| 785 - 830 | 745 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-800A | TWVA08000 |
| 830 - 875 | 785 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-850A | TWVA08500 |
| 875 - 920 | 825 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-900A | TWVA09000 |
| 920 - 965 | 865 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-950A | TWVA09500 |
| 965 - 1015 | 910 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1000A | TWVAX1000 |
| 1015 - 1065 | 955 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1050A | TWVAX1050 |
| 1065 - 1115 | 1000 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1100A | TWVAW1100 |
| 1115 - 1165 | 1045 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1150A | TWVAW1150 |
| 1165 - 1215 | 1090 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1200A | TWVAW1200 |
| 1215 - 1270 | 1135 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1250A | TWVAW1250 |
| 1270 - 1320 | 1180 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1300A | TWVAW1300 |
| 1320 - 1370 | 1225 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1350A | TWVAW1350 |
| 1370 - 1420 | 1270 | 15 | 14.3 | 25.0 | $d_1 + 10$ | $d_1 + 45$ | 20.0 ± 4.0 | V-1400A | TWVAW1400 |

V-Ring



| For shaft diameter d_1 | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d_2 | Minimum d_3 | Fitted width B_1 | V-Ring FORSHEDA Ref. | TSS Part number |
|--------------------------|-----------------|-----------------------------|---------------|----------------|---------------|---------------|--------------------|----------------------|-----------------|
| 1420 - 1470 | 1315 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1450A | TWVAW1450 |
| 1470 - 1520 | 1360 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1500A | TWVAW1500 |
| 1520 - 1570 | 1405 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1550A | TWVAW1550 |
| 1570 - 1620 | 1450 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1600A | TWVAW1600 |
| 1620 - 1670 | 1495 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1650A | TWVAW1650 |
| 1670 - 1720 | 1540 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1700A | TWVAW1700 |
| 1720 - 1770 | 1585 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1750A | TWVAW1750 |
| 1770 - 1820 | 1630 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1800A | TWVAW1800 |
| 1820 - 1870 | 1675 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1850A | TWVAW1850 |
| 1870 - 1920 | 1720 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1900A | TWVAW1900 |
| 1920 - 1970 | 1765 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-1950A | TWVAW1950 |
| 1970 - 2020 | 1810 | 15 | 14.3 | 25.0 | $d1 + 10$ | $d1 + 45$ | 20.0 ± 4.0 | V-2000A | TWVAW2000 |



V-Ring

Dimension table - V-Ring type S

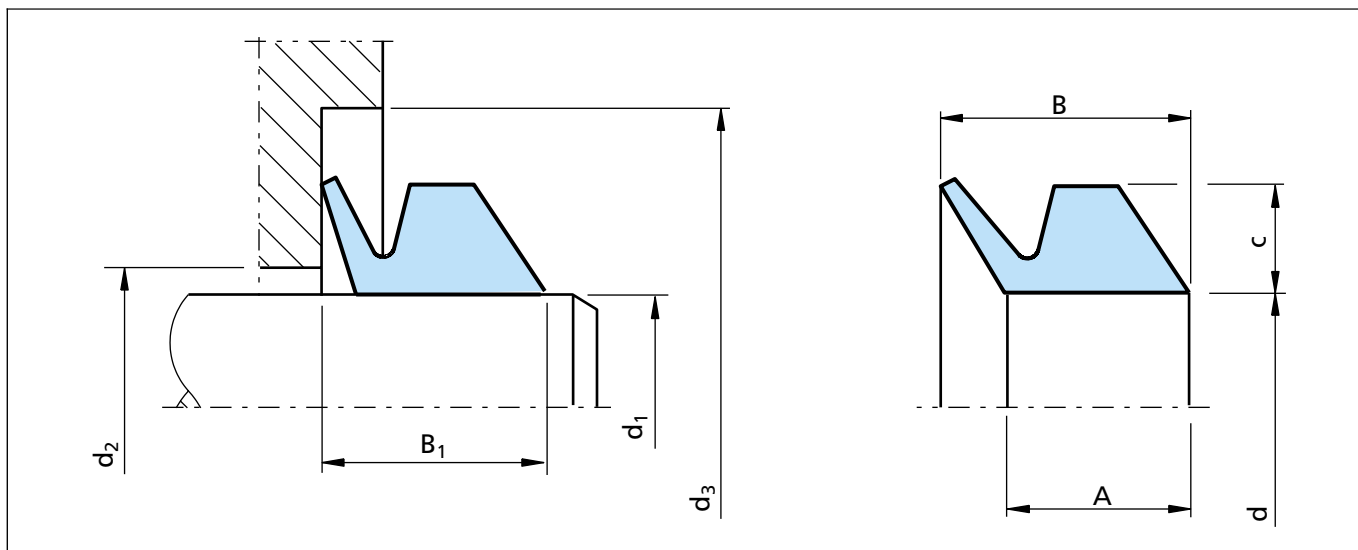


Figure 60 Installation drawing

When the dimension d_1 is on the boundary between two sizes of V-Ring, select the larger V-Ring. All dimensions in mm.

Ordering example

V-Ring, Type S
for shaft diameter = 30.0 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|---|-----------|---|-------|
| TSS Article No. | TWVS00300 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-30S NBR510 | | | |

Table XLI Profile dimensions - assembly dimensions

| For shaft diameter d_1 | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d_2 | Minimum d_3 | Fitted width B_1 | V-Ring FORSHEDA Ref. | TSS Part No. |
|--------------------------|-----------------|-----------------------------|-------------|--------------|---------------|---------------|--------------------|----------------------|--------------|
| 4.5 - 5.5 | 4 | 2 | 3.9 | 5.2 | $d_1 + 1$ | $d_1 + 6$ | 4.5 ± 0.4 | V-5S | TWVS00050 |
| 5.5 - 6.5 | 5 | 2 | 3.9 | 5.2 | $d_1 + 1$ | $d_1 + 6$ | 4.5 ± 0.4 | V-6S | TWVS00060 |
| 6.5 - 8.0 | 6 | 2 | 3.9 | 5.2 | $d_1 + 1$ | $d_1 + 6$ | 4.5 ± 0.4 | V-7S | TWVS00070 |
| 8.0 - 9.5 | 7 | 2 | 3.9 | 5.2 | $d_1 + 1$ | $d_1 + 6$ | 4.5 ± 0.4 | V-8S | TWVS00080 |
| 9.5 - 11.5 | 9 | 3 | 5.6 | 7.7 | $d_1 + 1$ | $d_1 + 9$ | 6.7 ± 0.6 | V-10S | TWVS00100 |
| 11.5 - 13.5 | 10.5 | 3 | 5.6 | 7.7 | $d_1 + 1$ | $d_1 + 9$ | 6.7 ± 0.6 | V-12S | TWVS00120 |
| 13.5 - 15.5 | 12.5 | 3 | 5.6 | 7.7 | $d_1 + 1$ | $d_1 + 9$ | 6.7 ± 0.6 | V-14S | TWVS00140 |

V-Ring



| For shaft diameter d ₁ | Inside dia. d | Height of cross-section c | Dimension A | Free width B | Maximum d ₂ | Minimum d ₃ | Fitted width B ₁ | V-Ring FORSHEDA Ref. | TSS Part No. |
|-----------------------------------|---------------|---------------------------|-------------|--------------|------------------------|------------------------|-----------------------------|----------------------|--------------|
| 15.5 - 17.5 | 14 | 3 | 5.6 | 7.7 | d1 + 1 | d1 + 9 | 6.7 ±0.6 | V-16S | TWVS00160 |
| 17.5 - 19 | 16 | 3 | 5.6 | 7.7 | d1 + 1 | d1 + 9 | 6.7 ±0.6 | V-18S | TWVS00180 |
| 19 - 21 | 18 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-20S | TWVS00200 |
| 21 - 24 | 20 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-22S | TWVS00220 |
| 24 - 27 | 22 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-25S | TWVS00250 |
| 27 - 29 | 25 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-28S | TWVS00280 |
| 29 - 31 | 27 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-30S | TWVS00300 |
| 31 - 33 | 29 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-32S | TWVS00320 |
| 33 - 36 | 31 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-35S | TWVS00350 |
| 36 - 38 | 34 | 4 | 7.9 | 10.5 | d1 + 2 | d1 + 12 | 9.0 ±0.8 | V-38S | TWVS00380 |
| 38 - 43 | 36 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-40S | TWVS00400 |
| 43 - 48 | 40 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-45S | TWVS00450 |
| 48 - 53 | 45 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-50S | TWVS00500 |
| 53 - 58 | 49 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-55S | TWVS00550 |
| 58 - 63 | 54 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-60S | TWVS00600 |
| 63 - 68 | 58 | 5 | 9.5 | 13.0 | d1 + 2 | d1 + 15 | 11.0 ±1.0 | V-65S | TWVS00650 |
| 68 - 73 | 63 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-70S | TWVS00700 |
| 73 - 78 | 67 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-75S | TWVS00750 |
| 78 - 83 | 72 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-80S | TWVS00800 |
| 83 - 88 | 76 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-85S | TWVS00850 |
| 88 - 93 | 81 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-90S | TWVS00900 |
| 93 - 98 | 85 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-95S | TWVS00950 |
| 98 - 105 | 90 | 6 | 11.3 | 15.5 | d1 + 3 | d1 + 18 | 13.5 ±1.2 | V-100S | TWVS01000 |
| 105 - 115 | 99 | 7 | 13.1 | 18.0 | d1 + 4 | d1 + 21 | 15.5 ±1.5 | V-110S | TWVS01100 |
| 115 - 125 | 108 | 7 | 13.1 | 18.0 | d1 + 4 | d1 + 21 | 15.5 ±1.5 | V-120S | TWVS01200 |
| 125 - 135 | 117 | 7 | 13.1 | 18.0 | d1 + 4 | d1 + 21 | 15.5 ±1.5 | V-130S | TWVS01300 |
| 135 - 145 | 126 | 7 | 13.1 | 18.0 | d1 + 4 | d1 + 21 | 15.5 ±1.5 | V-140S | TWVS01400 |
| 145 - 155 | 135 | 7 | 13.1 | 18.0 | d1 + 4 | d1 + 21 | 15.5 ±1.5 | V-150S | TWVS01500 |
| 155 - 165 | 144 | 8 | 15.0 | 20.5 | d1 + 4 | d1 + 24 | 18.0 ±1.8 | V-160S | TWVS01600 |
| 165 - 175 | 153 | 8 | 15.0 | 20.5 | d1 + 4 | d1 + 24 | 18.0 ±1.8 | V-170S | TWVS01700 |
| 175 - 185 | 162 | 8 | 15.0 | 20.5 | d1 + 4 | d1 + 24 | 18.0 ±1.8 | V-180S | TWVS01800 |
| 185 - 195 | 171 | 8 | 15.0 | 20.5 | d1 + 4 | d1 + 24 | 18.0 ±1.8 | V-190S | TWVS01900 |
| 195 - 210 | 180 | 8 | 15.0 | 20.5 | d1 + 4 | d1 + 24 | 18.0 ±1.8 | V-199S | TWVS01990 |



V-Ring

Dimension table - V-Ring type L / LX

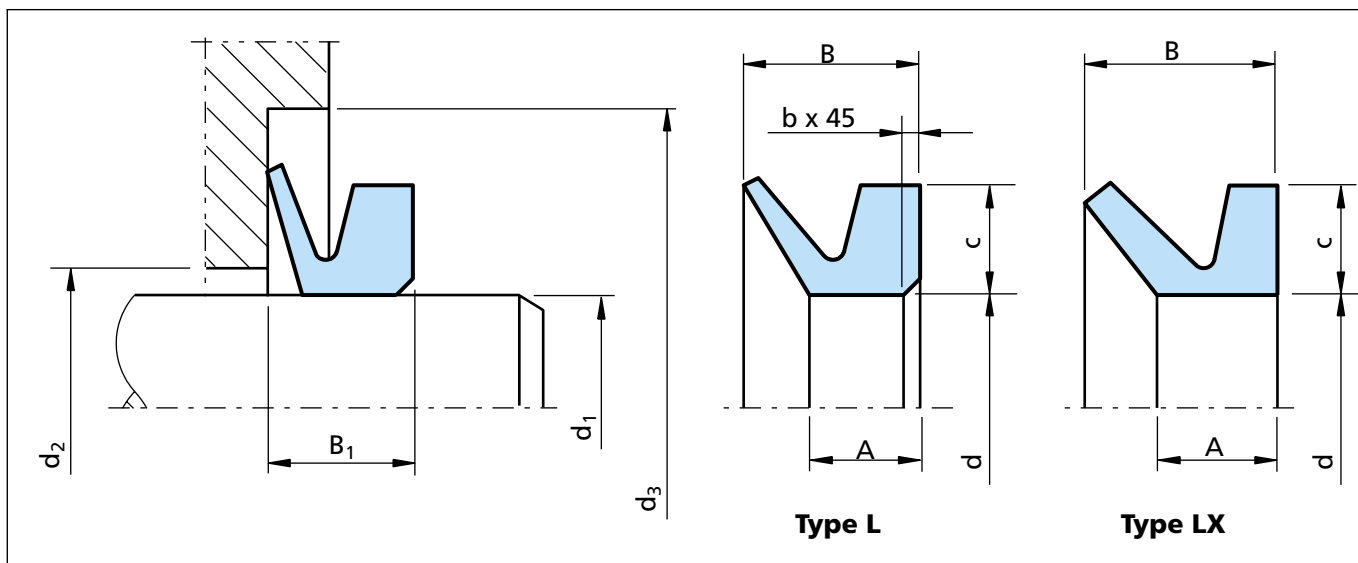


Figure 61 Installation drawing

When the dimension d_1 is on the boundary between two sizes of V-Ring, select the larger V-Ring. All dimensions in mm.

Table XLII Installation dimensions

| Type | c | A | B | b | B ₁ | d ₃ min | d ₂ max |
|------|-----|-----|------|---|----------------|---------------------|--------------------|
| L | 6.5 | 6 | 10.5 | 1 | 8 ± 1.5 | d ₁ + 20 | d ₁ + 5 |
| LX | 5 | 5.4 | 8.5 | 0 | 6.8 ± 1.1 | d ₁ + 15 | d ₁ + 4 |

Ordering example

V-Ring, Type L
for shaft diameter = 205 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|--|-----------|---|-------|
| TSS Article No. | TWVL02000 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-200L NBR510 | | | |

Ordering example

V-Ring, Type LX
for shaft diameter = 205 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|---|-----------|---|-------|
| TSS Article No. | TWLXV2000 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-200LX NBR510 | | | |



Table XLIII Profile dimensions - assembly dimensions

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. Type L | TSS Part No. Type LX |
|-----------------------------|------------------------|-------------------------|------------------------|-------------------------|
| 105 - 115 | 99 | V-110L | TWVL01100 | |
| 115 - 125 | 108 | V-120L | TWVL01200 | |
| 125 - 135 | 117 | V-130L | TWVL01300 | |
| 135 - 145 | 126 | V-140L/LX | TWVL01400 | TWLX01400 |
| 145 - 155 | 135 | V-150L/LX | TWVL01500 | TWLX01500 |
| 155 - 165 | 144 | V-160L/LX | TWVL01600 | TWLXV1600 |
| 165 - 175 | 153 | V-170L/LX | TWVL01700 | TWLXV1700 |
| 175 - 185 | 162 | V-180L/LX | TWVL01800 | TWLXV1800 |
| 185 - 195 | 171 | V-190L/LX | TWVL01900 | TWLXV1900 |
| 195 - 210 | 182 | V-200L/LX | TWVL02000 | TWLXV2000 |
| 210 - 233 | 198 | V-220L/LX | TWVL02200 | TWLXV2200 |
| 233 - 260 | 225 | V-250L/LX | TWVL02500 | TWLXV2500 |
| 260 - 285 | 247 | V-275L/LX | TWVL02750 | TWLXV2750 |
| 285 - 310 | 270 | V-300L/LX | TWVL03000 | TWLXV3000 |
| 310 - 335 | 292 | V-325L/LX | TWVL03250 | TWLXV3250 |
| 335 - 365 | 315 | V-350L/LX | TWVL03500 | TWLXV3500 |
| 365 - 385 | 337 | V-375L/LX | TWVL03750 | TWLXV3750 |
| 385 - 410 | 360 | V-400L/LX | TWVL04000 | TWLXV4000 |
| 410 - 440 | 382 | V-425L/LX | TWVLV4250 | TWLXV4250 |
| 440 - 475 | 405 | V-450L/LX | TWVL04500 | TWLXV4500 |
| 475 - 510 | 450 | V-500L/LX | TWVLV5000 | TWLXV5000 |
| 510 - 540 | 472 | V-525L/LX | TWVLV5250 | TWLXV5250 |
| 540 - 575 | 495 | V-550L/LX | TWVLV5500 | TWLXV5500 |
| 575 - 625 | 540 | V-600L/LX | TWVLV6000 | TWLXV6000 |
| 625 - 675 | 600 | V-650L/LX | TWVLV6500 | TWLXV6500 |
| 675 - 710 | 630 | V-700L/LX | TWVLV7000 | TWLXV7000 |
| 710 - 740 | 670 | V-725L/LX | TWVLV7250 | TWLXV7250 |
| 740 - 775 | 705 | V-750L/LX | TWVLV7500 | TWLXV7500 |
| 775 - 825 | 745 | V-800L/LX | TWVL08000 | TWLXV8000 |
| 825 - 875 | 785 | V-850L/LX | TWVLV8500 | TWLXV8500 |
| 875 - 925 | 825 | V-900L/LX | TWVLV9000 | TWLXV9000 |
| 925 - 975 | 865 | V-950L/LX | TWVLV9500 | TWLXV9500 |
| 975 - 1025 | 910 | V-1000L/LX | TWVLW1000 | TWLXW1000 |
| 1025 - 1075 | 955 | V-1050L/LX | TWVLW1050 | TWLXW1050 |
| 1075 - 1125 | 1000 | V-1100L/LX | TWVLW1100 | TWLXW1100 |
| 1125 - 1175 | 1045 | V-1150L/LX | TWVLW1150 | TWLXW1150 |



V-Ring

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. Type L | TSS Part No. Type LX |
|-----------------------------|------------------------|-------------------------|------------------------|-------------------------|
| 1175 - 1225 | 1090 | V-1200L/LX | TWVLW1200 | TWLXW1200 |
| 1225 - 1275 | 1135 | V-1250L/LX | TWVLW1250 | TWLXW1250 |
| 1275 - 1325 | 1180 | V-1300L/LX | TWVLW1300 | TWLXW1300 |
| 1325 - 1375 | 1225 | V-1350L/LX | TWVLW1350 | TWLXW1350 |
| 1375 - 1425 | 1270 | V-1400L/LX | TWVLW1400 | TWLXW1400 |
| 1425 - 1475 | 1315 | V-1450L/LX | TWVLW1450 | TWLXW1450 |
| 1475 - 1525 | 1360 | V-1500L/LX | TWVLW1500 | TWLXW1500 |
| 1525 - 1575 | 1405 | V-1550L/LX | TWVLW1550 | TWLXW1550 |
| 1575 - 1625 | 1450 | V-1600L/LX | TWVLW1600 | TWLXW1600 |
| 1625 - 1675 | 1495 | V-1650L/LX | TWVLW1650 | TWLXW1650 |
| 1675 - 1725 | 1540 | V-1700L/LX | TWVLW1700 | TWLXW1700 |
| 1725 - 1775 | 1585 | V-1750L/LX | TWVLW1750 | TWLXW1750 |
| 1775 - 1825 | 1630 | V-1800L/LX | TWVLW1800 | TWLXW1800 |
| 1825 - 1875 | 1675 | V-1850L/LX | TWVLW1850 | TWLXW1850 |
| 1875 - 1925 | 1720 | V-1900L/LX | TWVLW1900 | TWLXW1900 |
| 1925 - 1975 | 1765 | V-1950L/LX | TWVLW1950 | TWLXW1950 |
| 1975 - 2025 | 1810 | V-2000L/LX | TWVLW2000 | TWLXW2000 |

V-Ring L or LX larger than 2000 made to special order



■ Dimension table - V-Ring type RM / RME

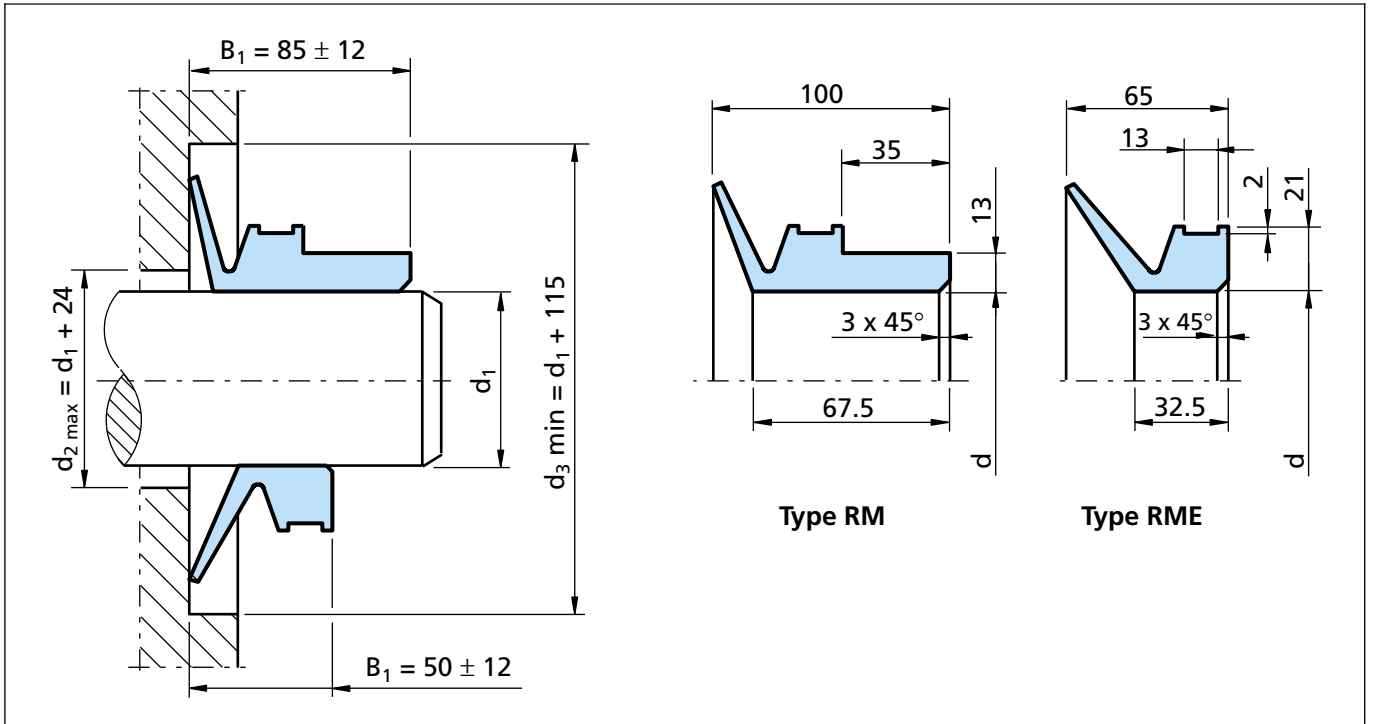


Figure 62 Installation drawing

When the dimension d1 is on the boundary between two sizes of V-Ring, select the larger V-Ring. All dimensions in mm.

Ordering example

V-Ring, Type RME, for clamping band, butt-vulcanised for shaft diameter = 500.0 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|--|-----------|---|-------|
| TSS Article No. | TWVBV5000 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-500RME NBR510 | | | |

Ordering example

V-Ring, Type RM, for clamping band, butt-vulcanised for shaft diameter = 500.0 mm
Material: N6T50 (Nitrile Elastomer)

| | | | |
|---|-----------|---|-------|
| TSS Article No. | TWRMV5000 | - | N6T50 |
| TSS Part No. | | | |
| Quality index (standard) | | | |
| Material no. (standard) | | | |
| Corresponding to FORSHEDA ref. V-500RM NBR510 | | | |



V-Ring

Table XLIV Profile dimensions - assembly dimensions

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. type RM | TSS Part No. type RME |
|--------------------------|---------------------|----------------------|----------------------|-----------------------|
| 300 - 305 | 294 | V-300RM/RME | TWRMV3000 | TWVBV3000 |
| 305 - 310 | 299 | V-305RM/RME | TWRMV3050 | TWVBV3050 |
| 310 - 315 | 304 | V-310RM/RME | TWRMV3100 | TWVBV3100 |
| 315 - 320 | 309 | V-315RM/RME | TWRMV3150 | TWVBV3150 |
| 320 - 325 | 314 | V-320RM/RME | TWRMV3200 | TWVBV3200 |
| 325 - 330 | 319 | V-325RM/RME | TWRMV3250 | TWVBV3250 |
| 330 - 335 | 323 | V-330RM/RME | TWRMV3300 | TWVBV3300 |
| 335 - 340 | 328 | V-335RM/RME | TWRMV3350 | TWVBV3350 |
| 345 - 350 | 338 | V-345RM/RME | TWRMV3450 | TWVBV3450 |
| 350 - 355 | 343 | V-350RM/RME | TWRMV3500 | TWVBV3500 |
| 355 - 360 | 347 | V-355RM/RME | TWRMV3550 | TWVBV3550 |
| 360 - 365 | 352 | V-360RM/RME | TWRMV3600 | TWVBV3600 |
| 365 - 370 | 357 | V-365RM/RME | TWRMV3650 | TWVBV3650 |
| 370 - 375 | 362 | V-370RM/RME | TWRMV3700 | TWVBV3700 |
| 375 - 380 | 367 | V-375RM/RME | TWRMV3750 | TWVBV3750 |
| 380 - 385 | 371 | V-380RM/RME | TWRMV3800 | TWVBV3800 |
| 385 - 390 | 376 | V-385RM/RME | TWRMV3850 | TWVBV3850 |
| 390 - 395 | 381 | V-390RM/RME | TWRMV3900 | TWVBV3900 |
| 395 - 400 | 386 | V-395RM/RME | TWRMV3950 | TWVBV3950 |
| 400 - 405 | 391 | V-400RM/RME | TWRMV4000 | TWVBV4000 |
| 405 - 410 | 396 | V-405RM/RME | TWRMV4050 | TWVBV4050 |
| 410 - 415 | 401 | V-410RM/RME | TWRMV4100 | TWVBV4100 |
| 415 - 420 | 405 | V-415RM/RME | TWRMV4150 | TWVBV4150 |
| 420 - 425 | 410 | V-420RM/RME | TWRMV4200 | TWVBV4200 |
| 425 - 430 | 415 | V-425RM/RME | TWRMV4250 | TWVBV4250 |
| 430 - 435 | 420 | V-430RM/RME | TWRMV4300 | TWVBV4300 |
| 435 - 440 | 425 | V-435RM/RME | TWRMV4350 | TWVBV4350 |
| 440 - 445 | 429 | V-440RM/RME | TWRMV4400 | TWVBV4400 |
| 445 - 450 | 434 | V-445RM/RME | TWRMV4450 | TWVBV4450 |
| 450 - 455 | 439 | V-450RM/RME | TWRMV4500 | TWVBV4500 |
| 455 - 460 | 444 | V-455RM/RME | TWRMV4550 | TWVBV4550 |
| 460 - 465 | 448 | V-460RM/RME | TWRMV4600 | TWVBV4600 |
| 465 - 470 | 453 | V-465RM/RME | TWRMV4650 | TWVBV4650 |
| 470 - 475 | 458 | V-470RM/RME | TWRMV4700 | TWVBV4700 |
| 475 - 480 | 463 | V-475RM/RME | TWRMV4750 | TWVBV4750 |



| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. type RM | TSS Part No. type RME |
|-----------------------------|------------------------|-------------------------|-------------------------|--------------------------|
| 480 - 485 | 468 | V-480RM/RME | TWRMV4800 | TWVBV4800 |
| 485 - 490 | 473 | V-485RM/RME | TWRMV4850 | TWVBV4850 |
| 490 - 495 | 478 | V-490RM/RME | TWRMV4900 | TWVBV4900 |
| 495 - 500 | 483 | V-495RM/RME | TWRMV4950 | TWVBV4950 |
| 500 - 505 | 488 | V-500RM/RME | TWRMV5000 | TWVBV5000 |
| 505 - 510 | 493 | V-505RM/RME | TWRMV5050 | TWVBV5050 |
| 510 - 515 | 497 | V-510RM/RME | TWRMV5100 | TWVBV5100 |
| 515 - 520 | 502 | V-515RM/RME | TWRMV5150 | TWVBV5150 |
| 520 - 525 | 507 | V-520RM/RME | TWRMV5200 | TWVBV5200 |
| 525 - 530 | 512 | V-525RM/RME | TWRMV5250 | TWVBV5250 |
| 530 - 535 | 517 | V-530RM/RME | TWRMV5300 | TWVBV5300 |
| 535 - 540 | 521 | V-535RM/RME | TWRMV5350 | TWVBV5350 |
| 540 - 545 | 526 | V-540RM/RME | TWRMV5400 | TWVBV5400 |
| 545 - 550 | 531 | V-545RM/RME | TWRMV5450 | TWVBV5450 |
| 550 - 555 | 536 | V-550RM/RME | TWRMV5500 | TWVBV5500 |
| 555 - 560 | 541 | V-555RM/RME | TWRMV5550 | TWVBV5550 |
| 560 - 565 | 546 | V-560RM/RME | TWRM05600 | TWVB05600 |
| 565 - 570 | 550 | V-565RM/RME | TWRMV5650 | TWVBV5650 |
| 570 - 575 | 555 | V-570RM/RME | TWRMV5700 | TWVBV5700 |
| 575 - 580 | 560 | V-575RM/RME | TWRMV5750 | TWVBV5750 |
| 580 - 585 | 565 | V-580RM/RME | TWRMV5800 | TWVBV5800 |
| 585 - 590 | 570 | V-585RM/RME | TWRMV5850 | TWVBV5850 |
| 590 - 600 | 575 | V-590RM/RME | TWRMV5900 | TWVBV5900 |
| 600 - 610 | 582 | V-600RM/RME | TWRMV6000 | TWVBV6000 |
| 610 - 620 | 592 | V-610RM/RME | TWRMV6100 | TWVBV6100 |
| 620 - 630 | 602 | V-620RM/RME | TWRMV6200 | TWVBV6200 |
| 630 - 640 | 612 | V-630RM/RME | TWRMV6300 | TWVBV6300 |
| 640 - 650 | 621 | V-640RM/RME | TWRMV6400 | TWVBV6400 |
| 650 - 660 | 631 | V-650RM/RME | TWRMV6500 | TWVBV6500 |
| 660 - 670 | 640 | V-660RM/RME | TWRMV6600 | TWVBV6600 |
| 670 - 680 | 650 | V-670RM/RME | TWRMV6700 | TWVBV6700 |
| 680 - 690 | 660 | V-680RM/RME | TWRMV6800 | TWVBV6800 |
| 690 - 700 | 670 | V-690RM/RME | TWRMV6900 | TWVBV6900 |
| 700 - 710 | 680 | V-700RM/RME | TWRMV7000 | TWVBV7000 |
| 710 - 720 | 689 | V-710RM/RME | TWRMV7100 | TWVBV7100 |



V-Ring

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. type RM | TSS Part No. type RME |
|-----------------------------|------------------------|-------------------------|-------------------------|--------------------------|
| 720 - 730 | 699 | V-720RM/RME | TWRMV7200 | TWVBV7200 |
| 730 - 740 | 709 | V-730RM/RME | TWRMV7300 | TWVBV7300 |
| 740 - 750 | 718 | V-740RM/RME | TWRMV7400 | TWVBV7400 |
| 750 - 758 | 728 | V-750RM/RME | TWRMV7500 | TWVBV7500 |
| 758 - 766 | 735 | V-760RM/RME | TWRMV7600 | TWVBV7600 |
| 766 - 774 | 743 | V-770RM/RME | TWRMV7700 | TWVBV7700 |
| 774 - 783 | 751 | V-780RM/RME | TWRMV7800 | TWVBV7800 |
| 783 - 792 | 759 | V-790RM/RME | TWRMV7900 | TWVBV7900 |
| 792 - 801 | 768 | V-800RM/RME | TWRMV8000 | TWVBV8000 |
| 801 - 810 | 777 | V-810RM/RME | TWRMV8100 | TWVBV8100 |
| 810 - 821 | 786 | V-820RM/RME | TWRMV8200 | TWVBV8200 |
| 821 - 831 | 796 | V-830RM/RME | TWRMV8300 | TWVBV8300 |
| 831 - 841 | 805 | V-840RM/RME | TWRMV8400 | TWVBV8400 |
| 841 - 851 | 814 | V-850RM/RME | TWRMV8500 | TWVBV8500 |
| 851 - 861 | 824 | V-860RM/RME | TWRMV8600 | TWVBV8600 |
| 861 - 871 | 833 | V-870RM/RME | TWRMV8700 | TWVBV8700 |
| 871 - 882 | 843 | V-880RM/RME | TWRMV8800 | TWVBV8800 |
| 882 - 892 | 853 | V-890RM/RME | TWRMV8900 | TWVBV8900 |
| 892 - 912 | 871 | V-900RM/RME | TWRMV9000 | TWVBV9000 |
| 912 - 922 | 880 | V-920RM/RME | TWRMV9200 | TWVBV9200 |
| 922 - 933 | 890 | V-930RM/RME | TWRMV9300 | TWVBV9300 |
| 933 - 944 | 900 | V-940RM/RME | TWRMV9400 | TWVBV9400 |
| 944 - 955 | 911 | V-950RM/RME | TWRMV9500 | TWVBV9500 |
| 955 - 966 | 921 | V-960RM/RME | TWRMV9600 | TWVBV9600 |
| 966 - 977 | 932 | V-970RM/RME | TWRMV9700 | TWVBV9700 |
| 977 - 988 | 942 | V-980RM/RME | TWRMV9800 | TWVBV9800 |
| 988 - 999 | 953 | V-990RM/RME | TWRMV9900 | TWVBV9900 |
| 999 - 1010 | 963 | V-1000RM/RME | TWRMW1000 | TWVBW1000 |
| 1010 - 1025 | 973 | V-1020RM/RME | TWRMW1020 | TWVBW1020 |
| 1025 - 1045 | 990 | V-1040RM/RME | TWRMW1040 | TWVBW1040 |
| 1045 - 1065 | 1008 | V-1060RM/RME | TWRMW1060 | TWVBW1060 |
| 1065 - 1085 | 1027 | V-1080RM/RME | TWRMW1080 | TWVBW1080 |
| 1085 - 1105 | 1045 | V-1100RM/RME | TWRM01100 | TWVB01100 |
| 1105 - 1125 | 1065 | V-1120RM/RME | TWRMW1120 | TWVBW1120 |
| 1125 - 1145 | 1084 | V-1140RM/RME | TWRMW1140 | TWVBW1140 |



| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. type RM | TSS Part No. type RME |
|-----------------------------|------------------------|-------------------------|-------------------------|--------------------------|
| 1145 - 1165 | 1103 | V-1160RM/RME | TWRMW1160 | TWVBW1160 |
| 1165 - 1185 | 1121 | V-1180RM/RME | TWRMW1180 | TWVBW1180 |
| 1185 - 1205 | 1139 | V-1200RM/RME | TWRMW1200 | TWVBW1200 |
| 1205 - 1225 | 1157 | V-1220RM/RME | TWRMW1220 | TWVBW1220 |
| 1225 - 1245 | 1176 | V-1240RM/RME | TWRMW1240 | TWVBW1240 |
| 1245 - 1270 | 1195 | V-1260RM/RME | TWRMW1260 | TWVBW1260 |
| 1270 - 1295 | 1218 | V-1280RM/RME | TWRMW1280 | TWVBW1280 |
| 1295 - 1315 | 1240 | V-1300RM/RME | TWRMW1300 | TWVBW1300 |
| 1315 - 1340 | 1259 | V-1325RM/RME | TWRMW1325 | TWVBW1325 |
| 1340 - 1365 | 1281 | V-1350RM/RME | TWRMW1350 | TWVBW1350 |
| 1365 - 1390 | 1305 | V-1375RM/RME | TWRMW1375 | TWVBW1375 |
| 1390 - 1415 | 1328 | V-1400RM/RME | TWRMW1400 | TWVBW1400 |
| 1415 - 1440 | 1350 | V-1425RM/RME | TWRMW1425 | TWVBW1425 |
| 1440 - 1465 | 1374 | V-1450RM/RME | TWRMW1450 | TWVBW1450 |
| 1465 - 1490 | 1397 | V-1475RM/RME | TWRMW1475 | TWVBW1475 |
| 1490 - 1515 | 1419 | V-1500RM/RME | TWRMW1500 | TWVBW1500 |
| 1515 - 1540 | 1443 | V-1525RM/RME | TWRMW1525 | TWVBW1525 |
| 1540 - 1570 | 1467 | V-1550RM/RME | TWRMW1550 | TWVBW1550 |
| 1570 - 1600 | 1495 | V-1575RM/RME | TWRMW1575 | TWVBW1575 |
| 1600 - 1640 | 1524 | V-1600RM/RME | TWRMW1600 | TWVBW1600 |
| 1640 - 1680 | 1559 | V-1650RM/RME | TWRMW1650 | TWVBW1650 |
| 1680 - 1720 | 1596 | V-1700RM/RME | TWRMW1700 | TWVBW1700 |
| 1720 - 1765 | 1632 | V-1750RM/RME | TWRMW1750 | TWVBW1750 |
| 1765 - 1810 | 1671 | V-1800RM/RME | TWRMW1800 | TWVBW1800 |
| 1810 - 1855 | 1714 | V-1850RM/RME | TWRMW1850 | TWVBW1850 |
| 1855 - 1905 | 1753 | V-1900RM/RME | TWRMW1900 | TWVBW1900 |
| 1905 - 1955 | 1794 | V-1950RM/RME | TWRMW1950 | TWVBW1950 |
| 1955 - 2010 | 1844 | V-2000RM/RME | TWRMW2000 | TWVBW2000 |

V-Ring RM or RME larger than 2000 made to special order.



V-Ring

Dimension table - V-Ring type AX

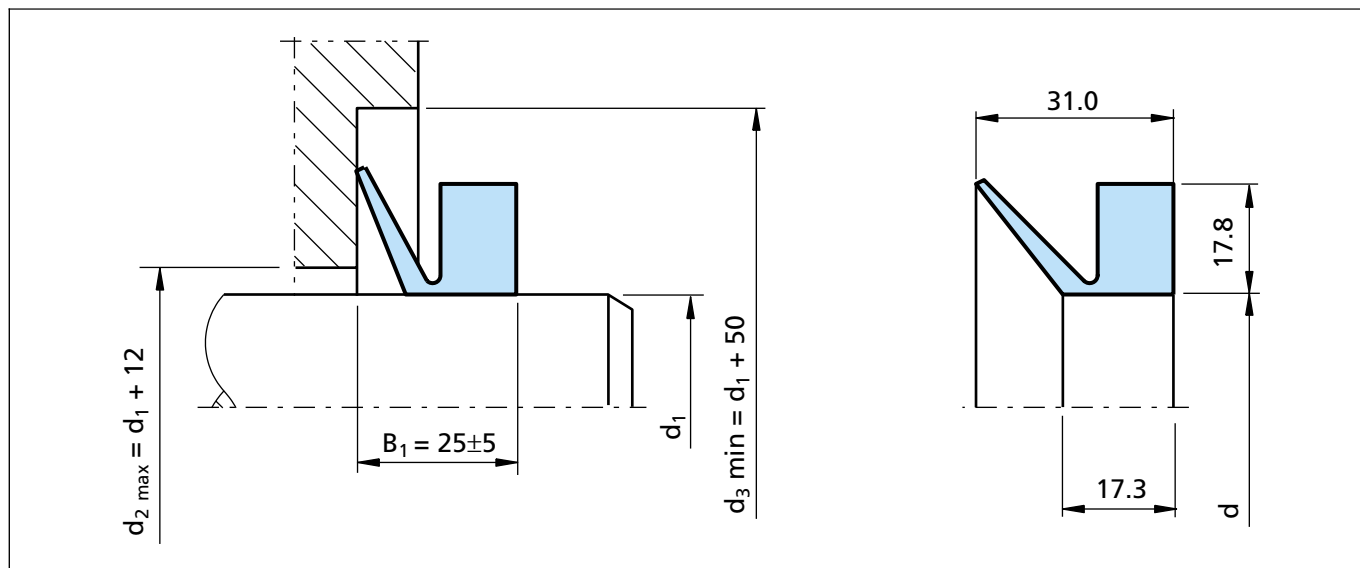


Figure 63 Installation drawing

When the dimension d_1 is on the boundary between two sizes of V-Ring, select the larger V-Ring. All dimensions in mm.

Ordering example

V-Ring, Type AX
for shaft diameter = 1190 mm
Material: N6T50 (Nitrile Elastomer)

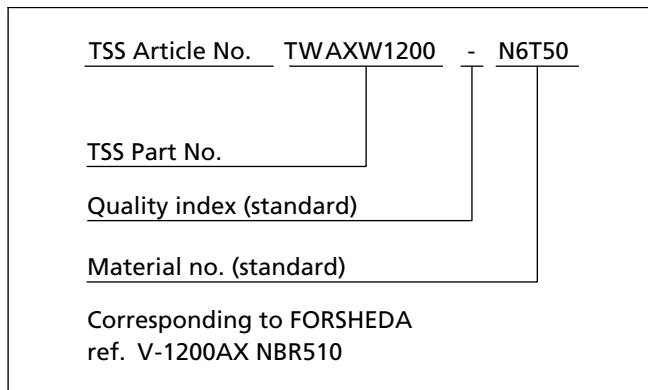


Table XLV Profile dimensions - assembly dimensions

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. |
|--------------------------|---------------------|----------------------|--------------|
| 200 - 205 | 192 | V-200AX | TWAXV2000 |
| 205 - 210 | 196 | V-205AX | TWAXV2050 |
| 210 - 215 | 200 | V-210AX | TWAXV2100 |
| 215 - 219 | 204 | V-215AX | TWAXV2150 |
| 219 - 224 | 207 | V-220AX | TWAXV2200 |
| 224 - 228 | 211 | V-225AX | TWAXV2250 |



| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. |
|-----------------------------|------------------------|-------------------------|--------------|
| 228 - 232 | 215 | V-230AX | TWAXV2300 |
| 232 - 236 | 219 | V-235AX | TWAXV2350 |
| 236 - 240 | 223 | V-240AX | TWAXV2400 |
| 240 - 250 | 227 | V-250AX | TWAXV2500 |
| 250 - 260 | 236 | V-260AX | TWAXV2600 |
| 260 - 270 | 245 | V-270AX | TWAXV2700 |
| 270 - 281 | 255 | V-280AX | TWAXV2800 |
| 281 - 292 | 265 | V-290AX | TWAXV2900 |
| 292 - 303 | 275 | V-300AX | TWAXV3000 |
| 303 - 313 | 285 | V-310AX | TWAXV3100 |
| 313 - 325 | 295 | V-320AX | TWAXV3200 |
| 325 - 335 | 305 | V-330AX | TWAXV3300 |
| 335 - 345 | 315 | V-340AX | TWAXV3400 |
| 345 - 355 | 322 | V-350AX | TWAXV3500 |
| 355 - 372 | 328 | V-360AX | TWAXV3600 |
| 372 - 390 | 344 | V-380AX | TWAXV3800 |
| 390 - 415 | 360 | V-400AX | TWAXV4000 |
| 415 - 443 | 385 | V-425AX | TWAX04250 |
| 443 - 480 | 410 | V-450AX | TWAXV4500 |
| 480 - 530 | 450 | V-500AX | TWAXV5000 |
| 530 - 580 | 495 | V-550AX | TWAXV5500 |
| 580 - 630 | 540 | V-600AX | TWAXV6000 |
| 630 - 665 | 600 | V-650AX | TWAX06500 |
| 665 - 705 | 630 | V-700AX | TWAXV7000 |
| 705 - 745 | 670 | V-725AX | TWAXV7250 |
| 745 - 785 | 705 | V-750AX | TWAXV7500 |
| 785 - 830 | 745 | V-800AX | TWAXV8000 |
| 830 - 875 | 785 | V-850AX | TWAXV8500 |
| 875 - 920 | 825 | V-900AX | TWAXV9000 |
| 920 - 965 | 865 | V-950AX | TWAXV9500 |
| 965 - 1015 | 910 | V-1000AX | TWAXW1000 |
| 1015 - 1065 | 955 | V-1050AX | TWAXX1050 |
| 1065 - 1115 | 1000 | V-1100AX | TWAXW1100 |
| 1115 - 1165 | 1045 | V-1150AX | TWAXW1150 |
| 1165 - 1215 | 1090 | V-1200AX | TWAXW1200 |
| 1215 - 1270 | 1135 | V-1250AX | TWAXW1250 |
| 1270 - 1320 | 1180 | V-1300AX | TWAXW1300 |
| 1320 - 1370 | 1225 | V-1350AX | TWAXW1350 |
| 1370 - 1420 | 1270 | V-1400AX | TWAXW1400 |



V-Ring

| For shaft diameter d_1 | Inside diameter d | V-Ring FORSHEDA Ref. | TSS Part No. |
|-----------------------------|------------------------|-------------------------|--------------|
| 1420 - 1470 | 1315 | V-1450AX | TWAXW1450 |
| 1470 - 1520 | 1360 | V-1500AX | TWAXW1500 |
| 1520 - 1570 | 1405 | V-1550AX | TWAXW1550 |
| 1570 - 1620 | 1450 | V-1600AX | TWAXW1600 |
| 1620 - 1670 | 1495 | V-1650AX | TWAXW1650 |
| 1670 - 1720 | 1540 | V-1700AX | TWAXW1700 |
| 1720 - 1770 | 1585 | V-1750AX | TWAXW1750 |
| 1770 - 1820 | 1630 | V-1800AX | TWAXW1800 |
| 1820 - 1870 | 1675 | V-1850AX | TWAXW1850 |
| 1870 - 1920 | 1720 | V-1900AX | TWAXW1900 |
| 1920 - 1970 | 1765 | V-1950AX | TWAXW1950 |
| 1970 - 2020 | 1810 | V-2000AX | TWAXW2000 |

V-Ring AX larger than 2000 made to special order.
Profile and axial fitted width the same as for the standard
V-Ring AX.



■ GAMMA SEAL

General description

The GAMMA seal is the result of a large-scale development project covering many years of attempts to combining the capacity of conventional mechanical seals to operate at high speeds with the simplicity of the Rotary Shaft Lip Seal. Figure 64 shows the different types, which are characterised by simple design. The basic design consists of two parts, sealing member and metal case. The GAMMA seal is designed to be fixed to the shaft at a pre-determined distance from the sealing surface, which is positioned perpendicularly to the shaft, for example the end wall of a bearing housing. During rotation, the sealing lip rubs against the counter face under a contact pressure calculated to achieve a sealing function. The seal also operates as a deflector ring, and its centrifugal action contributes to good sealing function. Due to the effect of centrifugal force, the sealing lip tends to reduce its contact pressure with increasing speed. As a result, the curve for power loss is very favourable (see Figure 65). At a peripheral speed of around 12 m/s, friction losses begin to diminish and cease completely at about 20 m/s, when the sealing lip has completely lifted free of counter faces. The GAMMA seal then functions as a combined deflector ring and clearance seal.

The GAMMA seal is primarily intended for sealing against foreign matter, liquid splatter, grease.

The foremost features of the GAMMA seal are:

- very narrow installation width
- friction diminishes with increasing rotational speed
- centrifugal action contributes to good sealing
- lower demands on surface smoothness, surface hardness and tolerances
- mechanical protection
- easy to fit

General design parameters

The GAMMA seal permits simple installation design and the requirements on the surface against which the sealing lip works are low. A finish-turned, polished surface with a roughness of 3-5 $\mu\text{m Ra}$ is normally adequate. However, the character of the surface is of greater importance than the action surface roughness value. Surface profiles with sharp peaks must be avoided. Injection-moulded light-metal alloys can be used in counter faces without further machining. It is necessary to ensure, however, that the part of the mould that produces the counter face is absolutely flawless.

Cold-rolled steel sheet, stainless or zinc plated sheet are excellent materials for counter faces for GAMMA-seal. In comparison to other types of seals, the GAMMA-seal can better absorb a certain amount of shaft misalignment. It is also relatively insensitive to shaft-to-bore eccentricity and shaft run-out.

Directions of shaft design and fitting are provided in the following sections on GAMMA seal types TBP/RB and TBR/9RB.

GAMMA seal type TBP/RB and TBR/9RB

GAMMA seal type TPB/RB and TBR/9RB consists of an elastic sealing member and a metal case (see Figure 64). The case serves as a holder, support and protection for the sealing member and constitutes a very effective deflector. The components are not bonded to each other, the rubber-sealing member is stretched and held in the case by its elasticity.

Type TBP/RB and TBR/9RB provides a very narrow installation width, which has proved to be very advantageous in certain applications and has permitted this seal to be used in assemblies where other seals could not previously be installed due to lack of space. The seal is press fitted on the shaft, and no other means of fixing is required.



GAMMA Seal

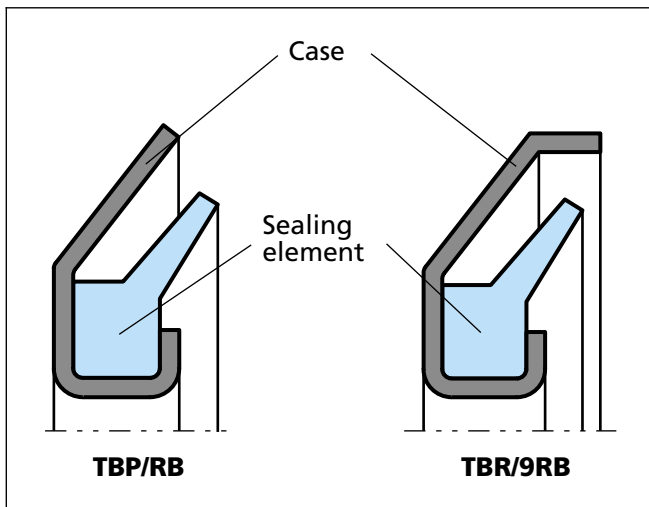


Figure 64 GAMMA seal types

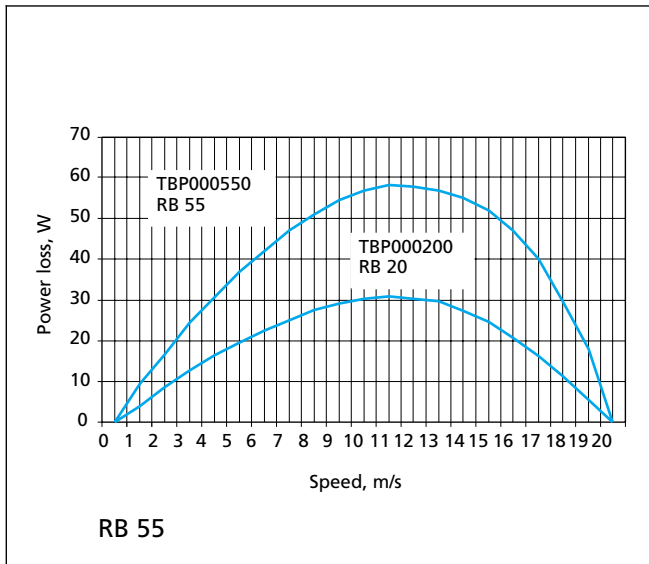


Figure 65 Power loss as a function of peripheral speed (Counterface 1.5-2 $\mu\text{m Ra}$ not lubricated seal)

Manufacture materials

The sealing member is moulded and is normally made of Nitrile rubber with a hardness of 75 ± 5 IRHD. Other compounds can be supplied on request. The case is stamped of cold-rolled steel sheet. In order to ensure a good seal and a tight grip on the shaft, the inside diameter is machined to dimensions which ensure a suitable press fit. The tolerances for the inside diameter of the case are given in Table XLVI. The case is normally zinc plated. The case can also be made out of other materials, e.g. in stainless steel.

Installation design

GAMMA seal type TBP should normally be installed as shown in Figure 67, i.e. with the seal located in the medium which is to seal against. As shown in Figure 71 the counter face for type TBR against which the sealing lip works should be designed with a groove for the case extension in order to create the clearance seal. For vertical shafts a design in accordance with Figure 66 is preferred, which effectively will reject impurities and liquid splatter. Shaft tolerance ISO h9 provides a suitable press fit. The shaft tolerances normally used for ball and roller bearings, ISO g6 to n6, can also be used. The seal does not require any other axial fixation other than that which is obtained by the press fit between the case and the shaft.

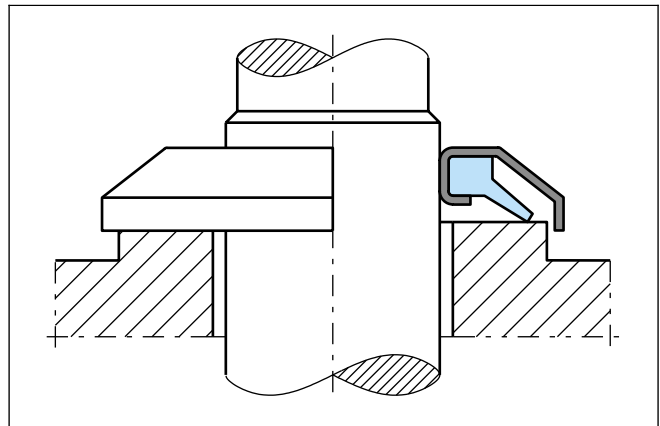


Figure 66 Vertical installation

However, providing a shoulder or a circlip to position the ring may facilitate fitting. The installation dimensions are given in the dimension table.

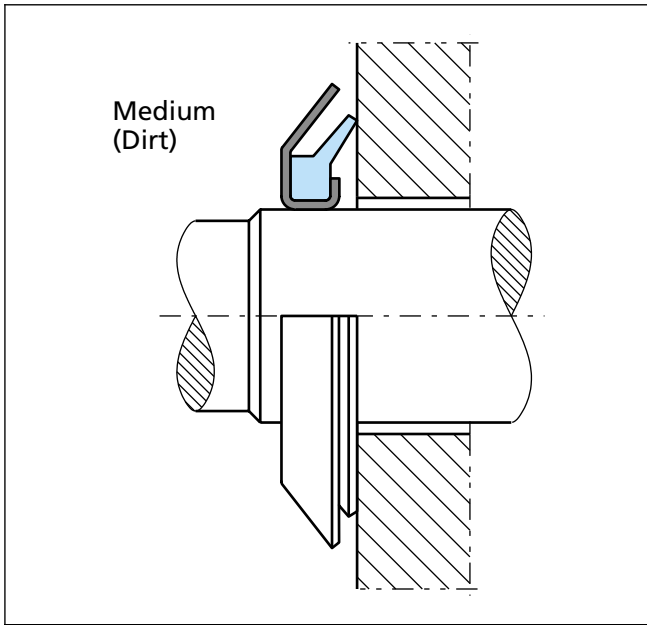


Figure 67 Installation drawing

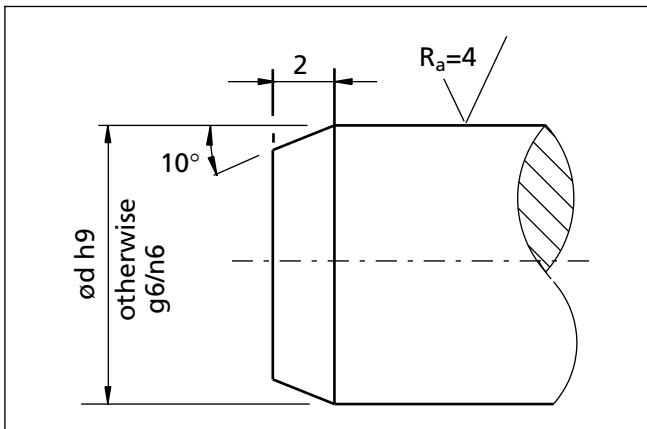


Figure 68 Tolerance of the shaft, surface roughness and chamfer of the shaft

The surface roughness of the shaft should not exceed $4 \mu m$ R_a . In addition, the shaft should be provided with a chamfer as per Figure 68. Sharp edges or burrs are not permitted. In the case of width b , a variation of $+0.5$ mm is permissible.

Table XLVI Lead-in chamfers

| Inside diameter mm | Chamfer mm | Tolerance mm |
|--------------------|------------|----------------|
| 0 - 35 | 2 | -0.15 -0.25 |
| 36 - 50 | 2 | -0.18 -0.28 |
| 51 - 135 | 2 | -0.20 -0.30 |
| 136 - 200 | 2 | -0.25 -0.35 |

Fitting

Prior to being fitted, the sealing member shall be greased, but not between the sealing member and the case. It is important that the seal is fitted with adequate precision. The seal shall be pressed onto the shaft with a uniform and even pressure.

The case must not be tapped directly with the hammer. The seal should therefore be pressed to the right position by means of a suitable assembly tool (see Figures 69, 70 and 71). Since facial fixation beyond the press fit between the seal and the shaft is not provided, the assembly tool should be of a design as shown in Figures 69 and 71 in order to obtain the installation width b as per the dimension tables.



GAMMA Seal

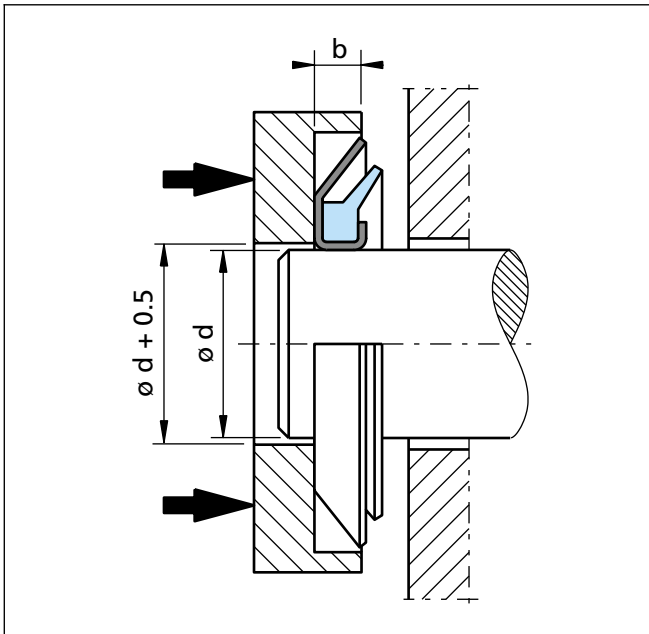


Figure 69 Assembly tool for TBP/RB

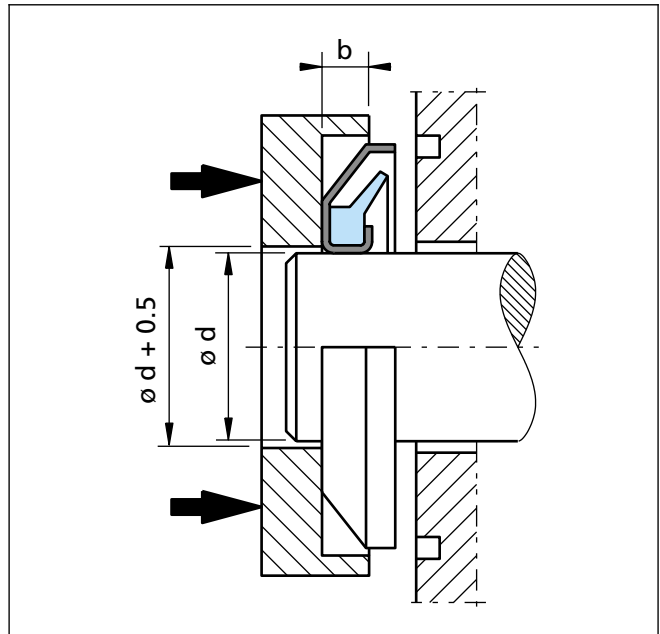


Figure 71 Assembly tool TBR/9RB

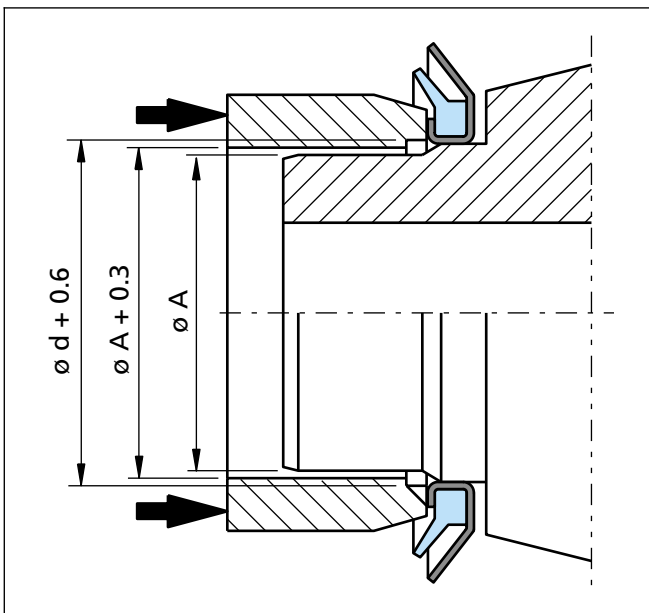


Figure 70 Assembly tool. When positioning the GAMMA seal against a shoulder it is important not to deform the case by pressing with too high load.



■ GAMMA-seal type TBP/RB

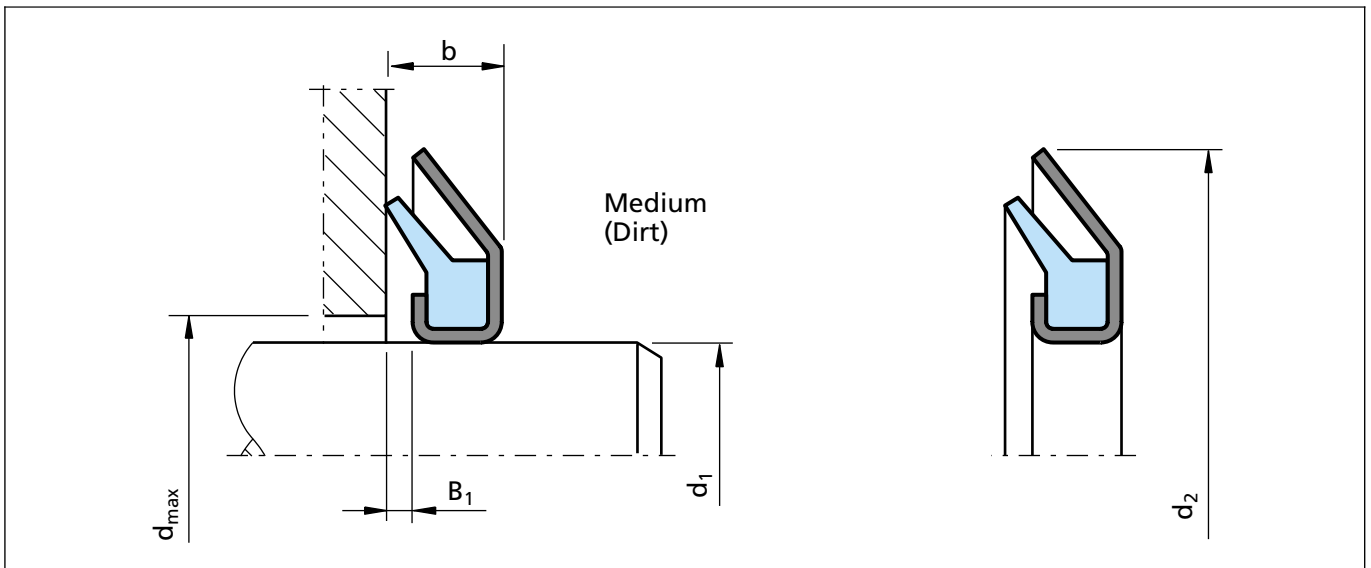


Figure 72 Installation drawing

General description

The design of mainly used GAMMA seal TBP/RB is based on many years of experience in such applications. The total axial force of the sealing lip is given by elastomer pre-stretching together with lip deformation force which depends on the elasticity of the rubber material, geometry of the sealing lip and assembly positioning against the counter-face. The metal shell is protecting the seal from solids and contributes to exclude other pollution media by centrifugation, allowing a good drainage after immersion in liquids.

Advantages

- Good dynamic sealing
- Very good protection against solid pollution particles
- Modern lip design provides low axial forces (low power loss)
- Small fitting width
- No supplementary retention's needed

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps
- Electrical motors
- Machinery industry (e.g. tool machines)
- Wheels and heavy-duty axles

Technical data

| | |
|--------------|---|
| Pressure: | No pressure |
| Temperature: | -40°C to +200°C (depending on material) |
| Speed: | up to 20 m/s |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility tests. Please ask for details.

| | |
|-----------|---|
| Housing : | Carbon steel - chromate treated (N7MM) or zinc plated (4N04, 4V04) |
| | Stainless and acid-proof steel on request |

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



GAMMA Seal

Table XLVII Materials

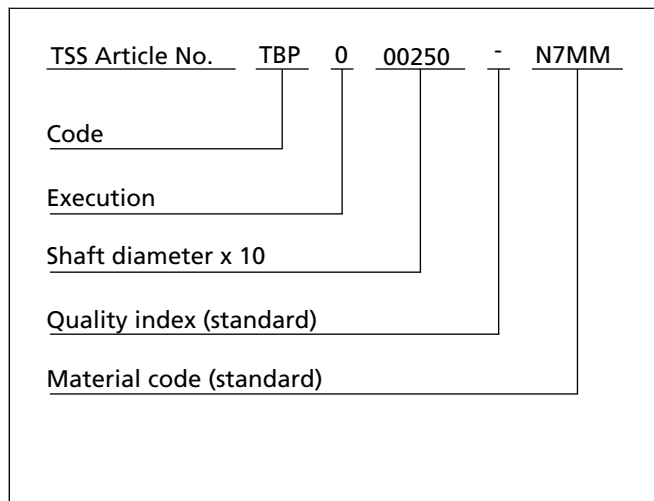
| Standard material* | TSS material code | STEFA material reference | Standard metal shell** |
|--------------------|-------------------|--------------------------|----------------------------|
| NBR (70 Shore A) | N7MM | - | Carbon steel (chromated) |
| NBR (75 Shore A) | 4N04 | 1452 | Carbon steel (zinc plated) |
| FKM (75 Shore A) | 4V04 | 5466 | Carbon steel (zinc plated) |

* Special grades and other materials (HNBR, ACM, VMQ) on request.

** Metal shell can be supplied in different material or treatment on request.

Ordering example GAMMA seal TSS type

TSS type: BP
 Code: TBP
 Dimensions: Shaft diameter 25 mm
 Housing diameter 40 mm
 Width 4 mm
 Material: NBR
 Material Code: N7MM



Ordering example GAMMA seal STEFA type

STEFA type: RB
 Code: TBP
 Dimensions: Shaft diameter 25 mm
 Housing diameter 40 mm
 Width 4 mm
 Material: NBR 1452
 Material Code: 4N04

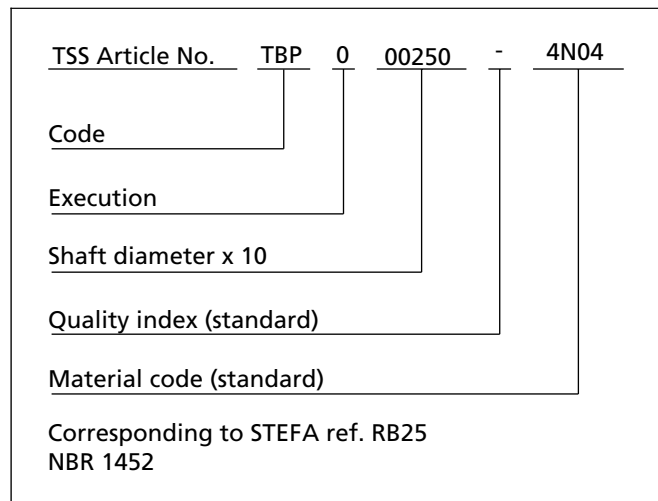


Table XLVIII Preferred series / Dimension, TSS part numbers

| Dimension | | | | | TSS Part No. | STEFA | | | TSS |
|----------------|----------------|-----|----------------|------------------|--------------|-------|----------|----------|----------|
| d ₁ | d ₂ | b | B ₁ | d _{max} | | Type | NBR 4N04 | FKM 4V04 | NBR N7MM |
| 10 | 24 | 3.5 | 1.0 | 15 | TBP000100 | RB10 | X | X | |
| 12 | 26 | 3.5 | 1.0 | 17 | TBP000120 | RB12 | X | X | |
| 15 | 30 | 4 | 1.0 | 21 | TBP000150 | RB15 | X | X | X |
| 16 | 32 | 4 | 1.0 | 23 | TBP000160 | RB16 | X | X | X |
| 17 | 32 | 4 | 1.0 | 23 | TBP000170 | RB17 | X | X | X |
| 18 | 33 | 4 | 1.0 | 24 | TBP000180 | RB18 | X | X | X |
| 20 | 35 | 4 | 1.0 | 26 | TBP000200 | RB20 | X | X | X |
| 22 | 40 | 4 | 1.0 | 28 | TBP000220 | RB22 | X | X | X |
| 24 | 40 | 4 | 1.0 | 30 | TBP000240 | RB24 | X | X | X |



| Dimension | | | | | TSS Part No. | STEFA | | | TSS |
|----------------|----------------|-----|----------------|------------------|--------------|-------|----------|----------|----------|
| d ₁ | d ₂ | b | B ₁ | d _{max} | | Type | NBR 4N04 | FKM 4V04 | NBR N7MM |
| 25 | 40 | 4 | 1.0 | 31 | TBP000250 | RB25 | X | X | X |
| 26 | 40 | 4 | 1.0 | 32 | TBP000260 | RB26 | X | X | |
| 28 | 43 | 4 | 1.0 | 34 | TBP000280 | RB28 | X | X | X |
| 30 | 47 | 4.5 | 1.0 | 37 | TBP000300 | RB30 | X | X | X |
| 32 | 49 | 4.5 | 1.0 | 39 | TBP000320 | RB32 | X | X | |
| 35 | 52 | 4.5 | 1.0 | 42 | TBP000350 | RB35 | X | X | X |
| 40 | 57 | 4.5 | 1.0 | 47 | TBP000400 | RB40 | X | X | X |
| 45 | 62 | 4.5 | 1.0 | 52 | TBP000450 | RB45 | X | X | X |
| 48 | 65 | 4.5 | 1.0 | 55 | TBP000480 | RB48 | X | X | |
| 50 | 70 | 5.5 | 1.0 | 58 | TBP000500 | RB50 | X | X | X |
| 52 | 72 | 5.5 | 1.0 | 60 | TBP000520 | RB52 | X | X | |
| 53 | 73 | 5.5 | 1.0 | 61 | TBP000530 | RB53 | X | X | |
| 55 | 75 | 5.5 | 1.0 | 63 | TBP000550 | RB55 | X | X | X |
| 58 | 78 | 5.5 | 1.0 | 66 | TBP000580 | RB58 | X | X | |
| 60 | 80 | 5.5 | 1.0 | 68 | TBP000600 | RB60 | X | X | X |
| 62 | 82 | 5.5 | 1.0 | 70 | TBP000620 | RB62 | X | X | |
| 65 | 85 | 5.5 | 1.0 | 73 | TBP000650 | RB65 | X | X | X |
| 68 | 88 | 5.5 | 1.0 | 76 | TBP000680 | RB68 | X | X | |
| 70 | 90 | 5.5 | 1.0 | 78 | TBP000700 | RB70 | X | X | X |
| 72 | 92 | 5.5 | 1.0 | 80 | TBP000720 | RB72 | X | X | |
| 75 | 95 | 5.5 | 1.0 | 83 | TBP000750 | RB75 | X | X | X |
| 78 | 98 | 5.5 | 1.0 | 86 | TBP000780 | RB78 | X | X | |
| 80 | 100 | 5.5 | 1.0 | 88 | TBP000800 | RB80 | X | X | X |
| 85 | 105 | 5.5 | 1.0 | 93 | TBP000850 | RB85 | X | X | X |
| 90 | 110 | 5.5 | 1.0 | 98 | TBP000900 | RB90 | X | X | |
| 95 | 115 | 5.5 | 1.0 | 103 | TBP000950 | RB95 | X | X | |
| 100 | 120 | 5.5 | 1.0 | 108 | TBP001000 | RB100 | X | X | X |
| 105 | 125 | 5.5 | 1.0 | 113 | TBP001050 | RB105 | X | X | |
| 125 | 148 | 6.5 | 1.0 | 133 | TBP001250 | RB125 | X | X | |
| 135 | 159 | 6.5 | 1.0 | 145 | TBP001350 | RB135 | X | X | |



■ GAMMA-seal type TBR/9RB

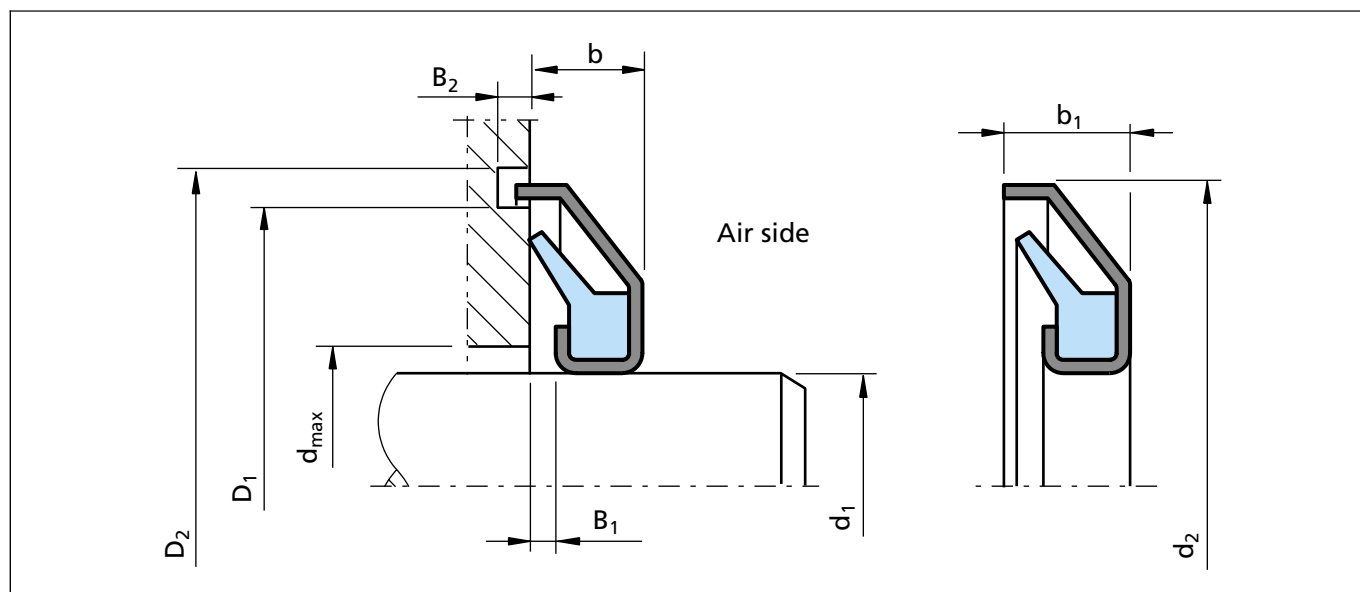


Figure 73 GAMMA-seal with labyrinth

General description

The design of the GAMMA seal TBR/9RB is based on many years of experience in such applications. The total axial force of the sealing lip is given by elastomer pre-stretching together with lip deformation force which depends on the elasticity of the rubber material, geometry of the sealing lip and assembly positioning against the counterface. The metal shell is protecting the seal from solids and contributes to exclude other pollution media by centrifugation, allowing a good drainage after immersion in liquids. The shape of the metal shell allows a supplementary barrier via the labyrinth in the housing groove which is very effective for heavy-duty applications.

Advantages

- Good dynamic sealing
- Very good protection against solid pollution particles
- Modern lip design provides low axial forces (low power loss)
- Small fitting width
- No supplementary retention's needed
- Very effective supplementary labyrinth protection

Application examples

- Transmission systems (e.g. gearboxes)
- Pumps

- Electrical motors - mixers
- Machinery industry (e.g. tool machines)
- Wheels and heavy-duty axles

Technical data

| | |
|--------------|---|
| Pressure: | No pressure |
| Temperature: | -40 °C to +200 °C (depending on material) |
| Speed: | up to 20 m/s |
| Media: | mineral and synthetic lubricants (CLP, HLP, APGL etc.) |

TSS/STEFA have carried out several thousand compatibility test. Please ask for details.

| | |
|-----------|--|
| Housing : | Carbon steel - zinc plated |
| | Stainless and acid-proof steel on request |

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Table XLIX Materials

| Standard material* | TSS material code | STEFA material reference | Standard metal shell** |
|--------------------|-------------------|--------------------------|----------------------------|
| NBR (75 Shore A) | 4N04 | 1452 | Carbon Steel (zinc plated) |
| FKM (75 Shore A) | 4V04 | 5466 | Carbon Steel (zinc plated) |

* Special grades and other compounds (HNBR, ACM, VMQ) on request.
 ** Metal shell can be supplied in different material or treatment on request.

Ordering example GAMMA seal STEFA type

STEFA type: 9RB
 Code: TBR
 Dimensions: Shaft diameter 25 mm
 Housing diameter 42 mm
 Width 4 mm
 Material: NBR 1452
 Material Code: 4N04

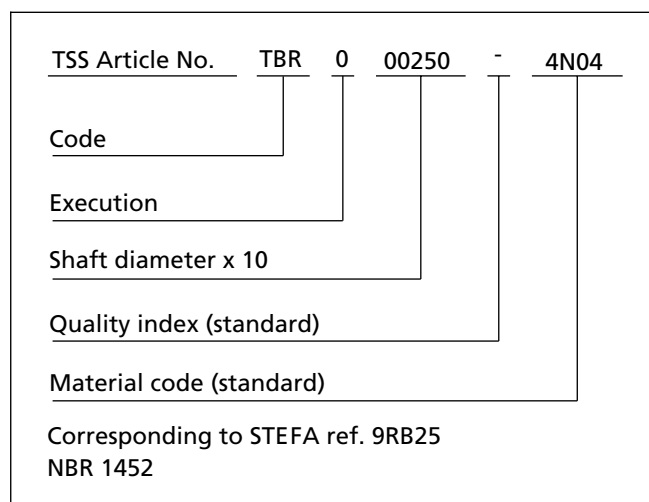


Table L Preferred series / Dimension, TSS part numbers

| Dimension | | | | | | | | | TSS Part No. | STEFA | | |
|----------------|----------------|-----|----------------|----------------|----------------|------------------|----------------|----------------|--------------|-------|----------|----------|
| d ₁ | d ₂ | b | B ₁ | b ₁ | B ₂ | d _{max} | D ₁ | D ₂ | | Type | NBR 4N04 | FKM 4V04 |
| 15 | 32 | 4 | 1.0 | 6.0 | 3 | 21 | 29 | 34 | TBR000150 | 9RB15 | X | X |
| 17 | 34 | 4 | 1.0 | 6.0 | 3 | 23 | 31 | 36 | TBR000170 | 9RB17 | X | X |
| 20 | 37 | 4 | 1.0 | 6.0 | 3 | 26 | 34 | 39 | TBR000200 | 9RB20 | X | X |
| 25 | 42 | 4 | 1.0 | 6.0 | 3 | 31 | 39 | 44 | TBR000250 | 9RB25 | X | X |
| 30 | 48 | 4.5 | 1.0 | 6.5 | 3 | 37 | 45 | 50 | TBR000300 | 9RB30 | X | X |
| 35 | 53 | 4.5 | 1.0 | 6.5 | 3 | 42 | 50 | 55 | TBR000350 | 9RB35 | X | X |
| 40 | 58 | 4.5 | 1.0 | 6.5 | 3 | 47 | 55 | 60 | TBR000400 | 9RB40 | X | X |
| 45 | 63 | 4.5 | 1.0 | 6.5 | 3 | 52 | 60 | 65 | TBR000450 | 9RB45 | X | X |
| 50 | 72 | 5.5 | 1.0 | 7.5 | 3 | 58 | 68.5 | 74 | TBR000500 | 9RB50 | X | X |
| 55 | 77 | 5.5 | 1.0 | 7.5 | 3 | 63 | 73.5 | 79 | TBR000550 | 9RB55 | X | X |
| 60 | 82 | 5.5 | 1.0 | 7.5 | 3 | 68 | 78.5 | 84 | TBR000600 | 9RB60 | X | X |
| 65 | 87 | 5.5 | 1.0 | 7.5 | 3 | 73 | 83.5 | 89 | TBR000650 | 9RB65 | X | X |
| 70 | 92 | 5.5 | 1.0 | 7.5 | 3 | 78 | 88.5 | 94 | TBR000700 | 9RB70 | X | X |
| 80 | 102 | 5.5 | 1.0 | 7.5 | 3 | 88 | 98.5 | 104 | TBR000800 | 9RB80 | X | X |
| 85 | 107 | 5.5 | 1.0 | 7.5 | 3 | 93 | 103.5 | 109 | TBR000850 | 9RB85 | X | X |



GAMMA Seal

| Dimension | | | | | | | | | TSS Part No. | STEFA | | |
|----------------|----------------|-----|----------------|----------------|----------------|------------------|----------------|----------------|--------------|--------|-------------|-------------|
| d ₁ | d ₂ | b | B ₁ | b ₁ | B ₂ | d _{max} | D ₁ | D ₂ | | Type | NBR 4N04 | FKM 4V04 |
| 90 | 112 | 5.5 | 1.0 | 7.5 | 3 | 98 | 108.5 | 114 | TBR000900 | 9RB90 | X | X |
| 95 | 117 | 5.5 | 1.0 | 7.5 | 3 | 103 | 113.5 | 119 | TBR000950 | 9RB95 | X | X |
| 100 | 122 | 5.5 | 1.0 | 7.5 | 3 | 108 | 118.5 | 124 | TBR001000 | 9RB100 | X | X |



■ AXIAL SHAFT SEAL

Axial shaft seals are used primarily as a protective seal for roller bearings. Their sizes are matched to those of roller bearings. If fluids are to be prevented from escaping, a design with an internal seal lip, is to be preferred.

The design with external sealing lip is suitable for sealing grease and for protection against dirt entering from the outside.

In both types of construction the elastomer seal lip is axially spring-loaded against the opposite mating face by a spider spring. The linear compressive force is lower than with an oil seal (about one third), but constant in operation. There is no reduction in contact force due to thermal expansion as with oil seals, and the larger diameter of the sliding seal edge has an unessential influence on the friction effect.

■ General

Axial shaft seals are ready-to-install seal elements for sealing shafts, axles and bearings.

The Axial shaft seal consists of an elastomer-elastic membrane with a vulcanised metallic reinforcement ring. The membrane has an axial sealing lip. The sealing lip is designed in a conical form to obtain a minimum contact area, thus considerably reducing friction, heat and wear. The sturdy form ensures a proper fit with the shaft or housing. A metallic spider spring is used to energize the seal lip (Figure 74).

Characteristics

Axial shaft seals have axial spring load against the mating surface. The seal requires very little mounting space and can be effectively used where space is limited.

Method of Operation

The sealing lip is pressed axially against the mating surface which must be perpendicular to the axis of the shaft. The seal membrane and the spider spring pressing against the back of the sealing lip ensure a uniform and vibration-free contact pressure.

The centrifugal force of fluid accelerated by the shaft reinforces the sealing effect.

Static sealing against the shaft (Type A) or in the housing bore (Type I) is ensured by interference fit with the shaft or housing.

Advantages

- Low friction, minimum heat generation
- No shaft wear
- Minimum installation space requirement
- Simple installation
- High heat resistance
- High sliding speed
- Suitable for a wide range of roller bearing series
- Long service life

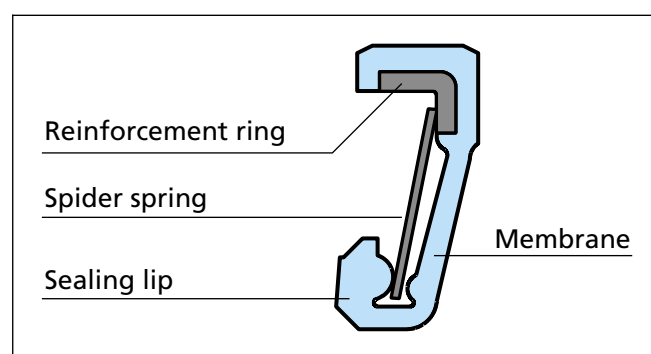


Figure 74 Axial shaft seal



Axial Shaft Seal

Standard versions

Type I

Axial shaft seal with internal sealing lip, primarily for sealing of fluids (Figure 75).

The seal is generally pressfitted in the housing with the sealing lip against the rotating shaft. The seal should always be installed so that the sealing lip is flushed by the fluid. Dry running must be avoided.

The limits for speed, pressure and contact force of the sealing lip can be found in Table LII, and Table LIII.

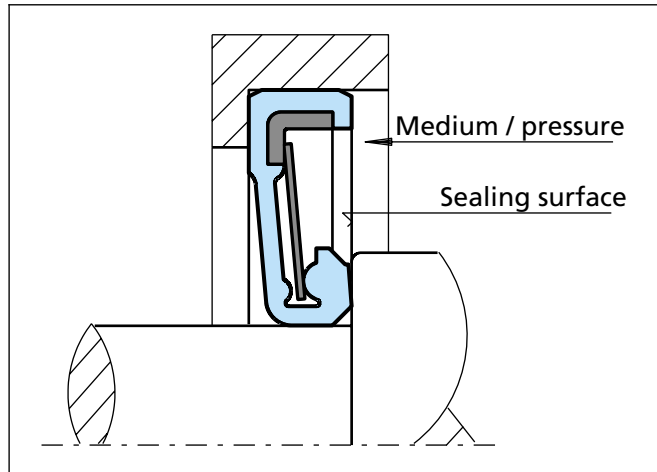


Figure 75 Type I, internal sealing

Type A

Axial shaft seal with external sealing lip for sealing against grease (Figure 76).

At low speeds and with a very good, preferably ground or lapped contact surface, it can also be used for sealing against fluids.

The limits for speed, pressure and contact force of the sealing lip can be found in Table LIV and Table LV.

For fluid sealing, the maximum permissible speed is reduced to one-third of the value shown in the tables.

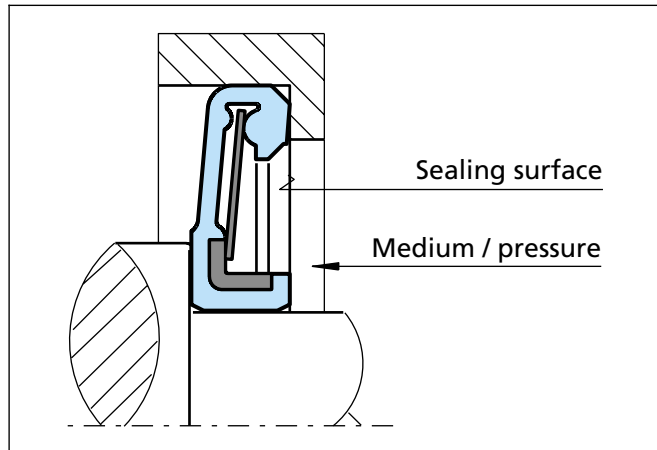


Figure 76 Type A, external sealing



■ Applications

Fields of application

Axial shaft seals are used for sealing shafts, axles and bearings. Their function is to prevent the ingress of dust, dirt, splash water, etc., and to prevent the escape of fluid or lubricant from the sealed chamber.

The fields of application of the individual types differ widely and are predominantly dependent on the type of lubricant and the operating conditions.

Technical data

| | |
|---------------------|--|
| Operating pressure: | pressureless |
| Speed: | Up to 30 m/s, depending on type and elastomer material |
| Temperature: | -30°C to +200°C, depending on elastomer material see Table LI. |

We offer special materials down to -40°C on request.

Media:

Mineral and synthetic oils and greases, water, hydrocarbons, acids, lyes, etc. (depending on elastomer material).

Peripheral speed and rotational speed

To maintain acceptable heat generation and wear of the sealing lip, the peripheral speed must be limited according to the elastomer grade used. The peripheral speed at the sealing lip must not exceed the following values:

| | | |
|---------|----------|--------|
| Type I: | with NBR | 20 m/s |
| | with FKM | 30 m/s |
| Type A: | with NBR | 10 m/s |
| | with FKM | 15 m/s |

These values apply with adequate lubrication and heat dissipation at the seal surface. If these conditions are not satisfied, the above limits must be reduced according to the application.

Figure 77 shows the maximum speed n as a function of the average sealing lip diameter d_m for the elastomer material Acrylonitrile Butadiene Elastomer (NBR).

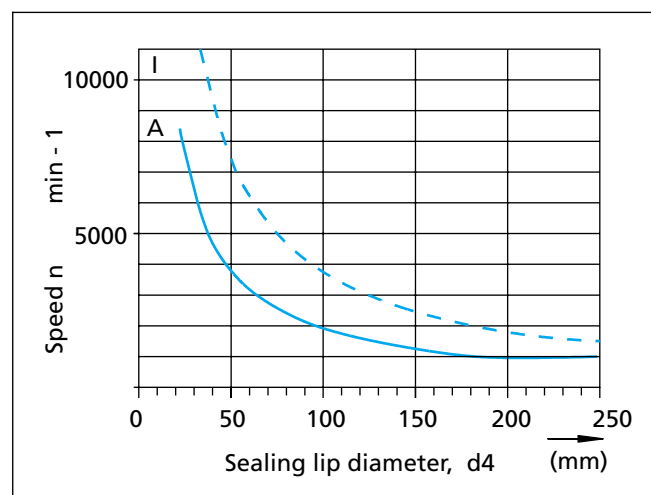


Figure 77 Maximum revolutions n as a function of sealing lip diameter d_4



Axial Shaft Seal

■ Materials

Table LI shows the available standard materials. Materials for elastomer and metal parts are selected according to the requirements for temperature and fluid resistance.

Table LI Materials

| | Standard Materials | Material code |
|---|--|----------------------|
| Elastomers Membrane and sealing lip | Acrylonitrile Butadiene Elastomer (NBR) 75 Shore A Colour: black/anthracite Temperature range: - 30 °C to + 120 °C | NCM_ |
| | Fluoroelastomer (FKM) 75 Shore A Colour: anthracite (Identification mark: yellow dot) Temperature range: - 25° C to + 200° C | VCM_ |
| Metal parts Reinforcement ring + spider spring | Reinforcement ring: Steel 1.0338/St 14.03 Star-type spring: Spring steel 1.0605/C75 | _ _ _ M |

Special materials are available on request.



Design instructions

The design of the sealing area should be made according to the information on the individual types given in Figure 75 and 76.

Suitable mating faces for the sealing lip can be achieved in various ways, f.i. by using the hardened end face of a Roller bearing. The bearing must not have identification marks on the side used as a mating face. Other design possibilities are shaft collars, back-up washers, etc.

The mating face can be of steel, brass, bronze, aluminium alloys and ceramic materials. The mating surface must be clean and smooth without spiral grooves or scratches. Recommended surface hardness for steel is HRC > 40, for other materials lower hardness can be employed.

Surface roughnesses:

Contact surface: with oil lubrication
 $R_{\max} < 2.5 \mu\text{m}$
($R_a \leq 1.0 \mu\text{m}$, $R_z < 1.6 \mu\text{m}$)

 with grease lubrication
 $R_{\max} < 6.3 \mu\text{m}$
($R_a \leq 2.5 \mu\text{m}$, $R_z < 4.0 \mu\text{m}$)

Radial runout of the shaft has very little influence on seal efficiency.

The axial runout - at the maximum permissible rotational speed - must not exceed 0.03 mm when sealing against oil and 0.05 mm when sealing against grease.

Installation recommendation

Before installation of the seal, the sealing surface should be cleaned and greased lightly to minimize wear during the run-in phase.

Installation is, in most cases, performed "blind", i.e. uniform contact between the sealing lip and the mating face cannot be checked visually. During installation the sealing lip must not be damaged or deformed, and the seal must be installed parallel to the mating face. This is best ensured if the seal is installed against a seat in the housing with an assembly tool (Figure 78).

Optimal seal performance is obtained when the seal or mating face is positioned in line with the front end of the seal.

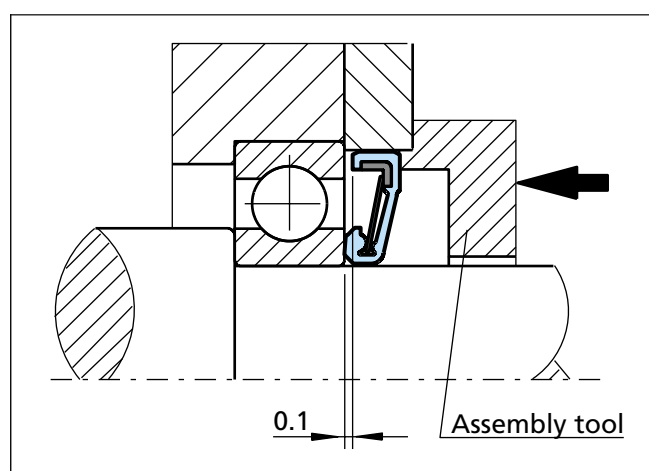


Figure 78 Installation of the axial shaft seal using an assembly tool.



Axial Shaft Seal

■ Installation recommendation, type I, internal sealing, for oil and grease

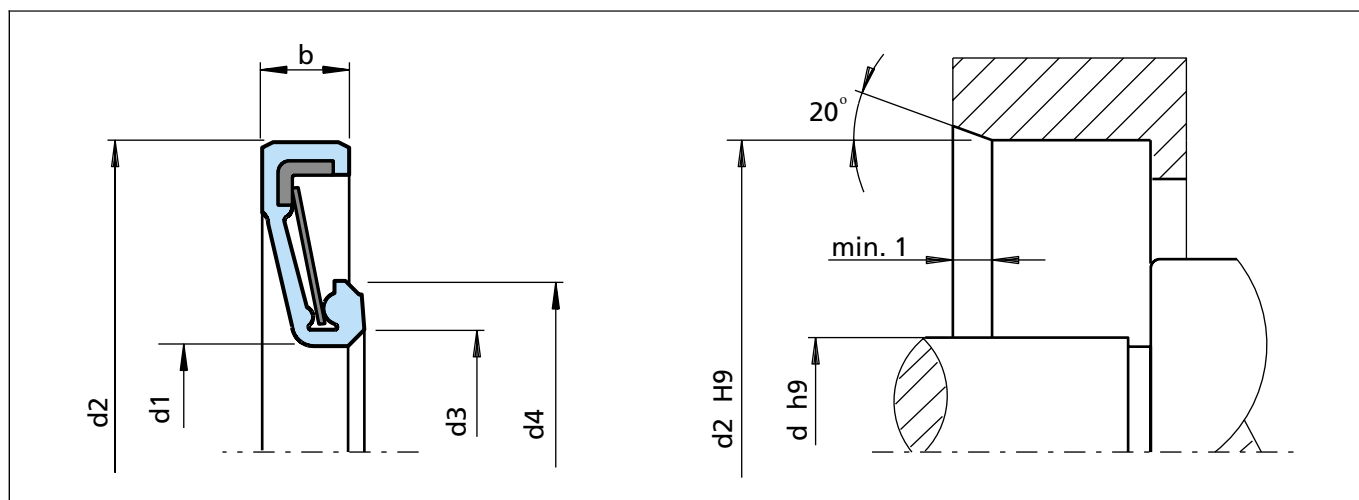


Figure 79 Installation drawing

Ordering example

Axial shaft seal, Type I
 Shaft diameter $d = 50.0$ mm
 Suitable for roller bearing No. 6010

Materials: From Table LI, page 180:
 Membrane and sealing lip: NBR
 Material code: NCM
 Reinforcement ring: 1.0338
 + spider spring: 1.0605
 Material code: M

TSS Part No. and dimensions see Table LII and Table LIII.
 Materials see Table LI.

| | | | | |
|----------------------------|-----------|---|-----|---|
| TSS Article No. | TAI000110 | - | NCM | M |
| TSS Part No. | | | | |
| Quality Index (Standard) | | | | |
| Material No. (elastomer) | | | | |
| Material No. (metal parts) | | | | |

Table LII Preferred series

| Shaft d | Dimensions | | | | | Max. speed [min ⁻¹] | | Fa* [N] | Max. press. [Pa] | Correspondance to the roller bearing series | | | | | TSS Part No. |
|-------------------|----------------|----------------|----------------|----------------|-----|------------------------------------|-------|------------|------------------------|--|------|------|------|------|-----------------|
| | d ₁ | d ₂ | d ₃ | d ₄ | b | NBR | FKM | | | 6000 | 6300 | 6400 | 4200 | 4300 | |
| 10 | 11 | 24 | 12.0 | 13.0 | 4.0 | 25400 | 38000 | 1.8 | 9000 | 6000 | 6300 | - | - | - | TAI000100 |
| 12 | 13 | 26 | 14.0 | 16.0 | 4.0 | 23800 | 35700 | 2.0 | 9400 | 6001 | - | - | 4200 | - | TAI000101 |
| 15 | 16 | 30 | 17.0 | 20.0 | 4.5 | 19200 | 28800 | 2.5 | 9500 | 6002 | - | - | - | 4301 | TAI000102 |
| 17 | 18 | 33 | 19.0 | 22.0 | 4.5 | 17500 | 26200 | 3.0 | 8800 | 6003 | 6302 | - | - | - | TAI000103 |
| 20 | 22 | 39 | 23.0 | 26.0 | 4.5 | 14700 | 22000 | 3.5 | 6900 | 6004 | 6304 | 6403 | - | - | TAI000104 |
| 25 | 27 | 44 | 27.5 | 31.0 | 4.5 | 13000 | 19500 | 3.8 | 6150 | 6005 | - | 6404 | - | - | TAI000105 |
| 30 | 32 | 50 | 33.0 | 36.0 | 5.0 | 10600 | 15900 | 4.0 | 5800 | 6006 | - | 6405 | - | - | TAI000106 |
| 35 | 37 | 56 | 38.0 | 41.0 | 5.0 | 9300 | 13900 | 4.5 | 6100 | 6007 | 6306 | 6406 | 4206 | - | TAI000107 |
| 40 | 42 | 62 | 44.0 | 47.0 | 5.5 | 8100 | 12000 | 5.5 | 6550 | 6008 | 6307 | 6407 | 4207 | - | TAI000108 |

* Fa = Contact force of the sealing lip

Axial Shaft Seal



| Shaft | Dimensions | | | | | Max. speed [min ⁻¹] | | Fa* [N] | Max. press. [Pa] | Correspondance to the roller bearing series | | | | | TSS Part No. |
|-------|------------|----------------|----------------|----------------|----------------|------------------------------------|-------|------------|------------------------|--|---------|---------|---------|--------|-----------------|
| | d | d ₁ | d ₂ | d ₃ | d ₄ | b | NBR | | | FKM | 6000 | 6300 | 6400 | 4200 | |
| 45 | 47 | 70 | 49.0 | 53.0 | 5.5 | 7200 | 10800 | 6.5 | 5200 | 6009 | 6308 | 6408 | 4208 | - | TAI000109 |
| 50 | 52 | 75 | 55.5 | 59.0 | 6.0 | 6600 | 9900 | 7.0 | 4750 | 6010 | 6309 | 6409 | 4209 | - | TAI000110 |
| 55 | 58 | 83 | 61.5 | 65.5 | 6.0 | 6000 | 9000 | 7.5 | 4450 | 6011 | 6310 | - | 4210 | - | TAI000111 |
| 60 | 61 | 89 | 65.0 | 69.0 | 6.5 | 5500 | 8200 | 8.0 | 3800 | 6012 | 6311 | 6410 | 4211 | - | TAI000112 |
| 65 | 67 | 94 | 70.0 | 74.0 | 7.0 | 5200 | 7800 | 9.0 | 4600 | 6013 | 6312 | 6411 | 4212 | - | TAI000113 |
| 70 | 73 | 104 | 74.0 | 78.0 | 7.5 | 4800 | 7200 | 11.0 | 3800 | 6014 | 6313 | 6412 | 4213 | - | TAI000114 |
| 75 | 78 | 109 | 80.0 | 84.0 | 7.5 | 4500 | 6700 | 12.0 | 4350 | 6015 | 6314 | 6413 | 4214 | - | TAI000115 |
| 80 | 84 | 119 | 85.0 | 89.0 | 8.0 | 4300 | 6400 | 13.0 | 2900 | 6016 | 6315 | 6414 | 4215 | - | TAI000116 |
| 85 | 87 | 124 | 90.0 | 94.0 | 8.0 | 4000 | 6000 | 14.5 | 3500 | 6017 | 6316 | 6414 | 4216 | - | TAI000117 |
| 90 | 93 | 132 | 96.0 | 101.0 | 8.5 | 3800 | 5700 | 16.0 | 3050 | 6018 | 6317 | 6415/16 | 4217 | - | TAI000118 |
| 95 | 98 | 137 | 100.0 | 104.5 | 8.5 | 3600 | 5400 | 17.0 | 3250 | 6019 | 6318 | 6415/16 | - | - | TAI000119 |
| 100 | 101 | 142 | 105.0 | 110.0 | 8.5 | 3400 | 5100 | 18.0 | 3400 | 6020 | 6319 | 6416 | 4218/19 | - | TAI000120 |
| 10 | 11 | 26 | 13.0 | 15.5 | 4.5 | 24600 | 36900 | 1.8 | 9700 | 6200 | - | - | - | - | TAI000200 |
| 12 | 13 | 28 | 15.0 | 17.5 | 4.5 | 22200 | 33300 | 2.0 | 10700 | 6201 | 6300/01 | - | 4201 | 4300 | TAI000201 |
| 15 | 16 | 31 | 18.0 | 21.0 | 4.5 | 18200 | 27300 | 3.0 | 12800 | 6202 | 6302 | - | 4202 | - | TAI000202 |
| 17 | 18 | 36 | 21.0 | 23.0 | 5.0 | 16600 | 24900 | 3.8 | 8100 | 6203 | 6303 | - | 4203 | 4302.0 | TAI000203 |
| 20 | 21 | 41 | 23.0 | 26.0 | 5.5 | 14700 | 22000 | 4.2 | 7400 | 6204 | 6304 | 6403 | 4204 | 4303 | TAI000204 |
| 25 | 26 | 46 | 28.0 | 30.0 | 5.5 | 12700 | 19000 | 4.3 | 6400 | 6205 | - | 6403 | - | 4304 | TAI000205 |
| 30 | 32 | 56 | 34.5 | 37.5 | 6.0 | 10300 | 15400 | 4.6 | 4900 | 6206 | - | 6405 | - | 4305 | TAI000206 |
| 35 | 37 | 65 | 41.0 | 44.0 | 6.5 | 8900 | 13300 | 5.0 | 3300 | 6207 | 6306/07 | 6405/06 | - | 4306 | TAI000207 |
| 40 | 42 | 73 | 46.5 | 50.0 | 6.5 | 7600 | 11400 | 6.0 | 3200 | 6208 | 6308 | 6407 | - | 4307 | TAI000208 |
| 45 | 47 | 78 | 51.5 | 56.0 | 6.5 | 7000 | 10500 | 6.5 | 3000 | 6209 | 6308/09 | 6407/08 | - | 4308 | TAI000209 |
| 50 | 53 | 83 | 56.5 | 59.5 | 6.5 | 6400 | 9600 | 7.0 | 3000 | 6210 | 6309 | 6408/9 | - | 4309 | TAI000210 |
| 55 | 58 | 90 | 61.0 | 65.0 | 7.0 | 5900 | 8800 | 7.5 | 2750 | 6211 | 6310 | 6409/10 | - | 4310 | TAI000211 |
| 60 | 63 | 100 | 65.5 | 69.0 | 8.0 | 5500 | 8200 | 8.0 | 2100 | 6212 | 6311 | 6410/11 | - | 4311 | TAI000212 |
| 65 | 68 | 110 | 72.0 | 77.0 | 8.5 | 5000 | 7500 | 9.0 | 2000 | 6213 | 6312 | 6411/12 | - | - | TAI000213 |
| 70 | 72 | 115 | 74.0 | 79.0 | 8.5 | 4800 | 7200 | 10.5 | 2000 | 6214 | 6313 | 6411/12 | - | 4312 | TAI000214 |
| 75 | 78 | 120 | 83.0 | 88.0 | 8.5 | 4400 | 6600 | 11.0 | 2100 | 6215 | 6313/14 | 6413/14 | - | 4313 | TAI000215 |
| 80 | 84 | 128 | 90.0 | 94.0 | 9.0 | 4100 | 6100 | 13.0 | 2400 | 6216 | 6314/15 | 6414 | - | 4314 | TAI000216 |
| 85 | 87 | 138 | 91.0 | 96.0 | 9.5 | 3900 | 5800 | 14.5 | 2100 | 6217 | 6315/16 | 6414/15 | - | 4315 | TAI000217 |
| 90 | 94 | 148 | 96.5 | 101.5 | 10.0 | 3700 | 5500 | 16.5 | 2000 | 6218 | 6316 | 6415/16 | - | - | TAI000218 |
| 95 | 98 | 158 | 103.0 | 108.0 | 10.0 | 3500 | 5200 | 17.0 | 2000 | 6219 | 6317/18 | 6415/16 | - | 4316 | TAI000219 |
| 100 | 104 | 168 | 109.0 | 114.0 | 10.5 | 3300 | 4900 | 19.0 | 2100 | 6220 | 6318 | 6416 | - | 4318 | TAI000220 |

* Fa = Contact force of the sealing lip



Axial Shaft Seal

Table LIII Special sizes for type I

| Shaft | Dimensions | | | | | Max. speed [min ⁻¹] | | Fa* | Max. pressure | TSS Part No. |
|-------|------------|----------------|----------------|----------------|----------------|------------------------------------|-------|------|------------------|--------------|
| | d | d ₁ | d ₂ | d ₃ | d ₄ | b | NBR | FKM | [N] | |
| 6 | 6,5 | 17 | 7,5 | 9,0 | 3,5 | 45000 | 67000 | 5,0 | 43500 | TAI000006 |
| 7 | 7,5 | 17 | 8,5 | 10,6 | 3,5 | 40000 | 60000 | 4,5 | 48000 | TAI000007 |
| 8 | 8,5 | 20 | 9,5 | 11,2 | 4,0 | 35000 | 52000 | 4,0 | 35600 | TAI000008 |
| 9 | 9,6 | 22 | 11,0 | 13,0 | 4,0 | 30000 | 45000 | 4,5 | 27700 | TAI000009 |
| 23 | 24,5 | 44 | 24,5 | 31,0 | 4,5 | 13500 | 20000 | 5,0 | 9300 | TAI100105 |
| 26 | 28,0 | 52 | 28,5 | 32,5 | 5,5 | 12000 | 18000 | 9,0 | 13000 | TAI200205 |
| 30 | 32,0 | 63 | 35,5 | 38,5 | 5,5 | 9800 | 14700 | 16,0 | 13000 | TAI100306 |
| 35 | 37,0 | 56 | 37,0 | 42,0 | 5,0 | 9500 | 14000 | 5,0 | 8000 | TAI100107 |
| 45 | 46,5 | 83 | 50,0 | 54,0 | 6,0 | 7100 | 10600 | 11,0 | 4300 | TAI100309 |
| 70 | 72,0 | 115 | 75,0 | 80,0 | 8,5 | 4700 | 7000 | 12,0 | 2800 | TAI100214 |
| 72 | 75,5 | 128 | 78,5 | 83,5 | 9,0 | 4500 | 6700 | 17,0 | 2800 | TAI100314 |
| 75 | 77,5 | 125 | 81,0 | 86,0 | 8,5 | 4400 | 6600 | 12,0 | 2500 | TAI100215 |
| 80 | 83,0 | 130 | 84,0 | 90,0 | 9,0 | 4200 | 6300 | 13,0 | 2900 | TAI100216 |
| 93 | 98,0 | 150 | 100,0 | 106,0 | 10,0 | 3600 | 5400 | 17,0 | 2350 | TAI100218 |
| 105 | 108,0 | 150 | 114,0 | 119,0 | 9,0 | 3300 | 5000 | 12,0 | 2000 | TAI100121 |
| 110 | 114,0 | 160 | 120,0 | 125,0 | 9,0 | 3100 | 4600 | 15,0 | 2000 | TAI100122 |
| 110 | 113,0 | 190 | 121,0 | 126,0 | 9,5 | 3000 | 4500 | 38,0 | 5600 | TAI100320 |
| 110 | 117,0 | 190 | 124,0 | 129,0 | 9,5 | 2900 | 4300 | 20,0 | 1300 | TAI100221 |
| 120 | 125,0 | 170 | 129,0 | 134,0 | 9,0 | 2900 | 4300 | 20,0 | 3050 | TAI100124 |
| 130 | 135,0 | 200 | 140,0 | 146,0 | 9,5 | 2600 | 3900 | 35,0 | 4800 | TAI100324 |
| 130 | 134,0 | 190 | 140,0 | 146,0 | 9,5 | 2600 | 3900 | 19,0 | 1750 | TAI100126 |
| 140 | 143,0 | 200 | 148,0 | 154,0 | 9,5 | 2500 | 3700 | 32,0 | 2850 | TAI100128 |
| 150 | 155,0 | 270 | 160,0 | 167,0 | 11,0 | 2200 | 3300 | 30,0 | 2500 | TAI100328 |
| 150 | 154,0 | 215 | 160,0 | 166,0 | 10,0 | 2300 | 3400 | 26,0 | 2000 | TAI100130 |
| 160 | 164,0 | 230 | 175,0 | 181,0 | 10,0 | 2100 | 3100 | 40,0 | 2700 | TAI100132 |
| 170 | 176,0 | 250 | 180,0 | 186,0 | 11,0 | 2050 | 3000 | 37,0 | 1900 | TAI100134 |
| 220 | 226,0 | 328 | 230,0 | 240,0 | 13,0 | 1550 | 2300 | 35,0 | 2200 | TAI100144 |
| 240 | 247,0 | 348 | 249,0 | 257,0 | 13,0 | 1500 | 2250 | 38,0 | 1000 | TAI100148 |
| 285 | 290,0 | 360 | 294,0 | 298,0 | 13,0 | 1300 | 1950 | 33,0 | 1350 | TAI100156 |
| 330 | 336,0 | 420 | 338,0 | 344,0 | 13,0 | 1100 | 1650 | 32,0 | 1000 | TAI100166 |
| 380 | 385,0 | 460 | 390,0 | 398,0 | 13,0 | 950 | 1400 | 30,0 | 1100 | TAI100176 |

* Fa = Contact force of the sealing lip



■ Installation recommendation, type A, external sealing, for grease only

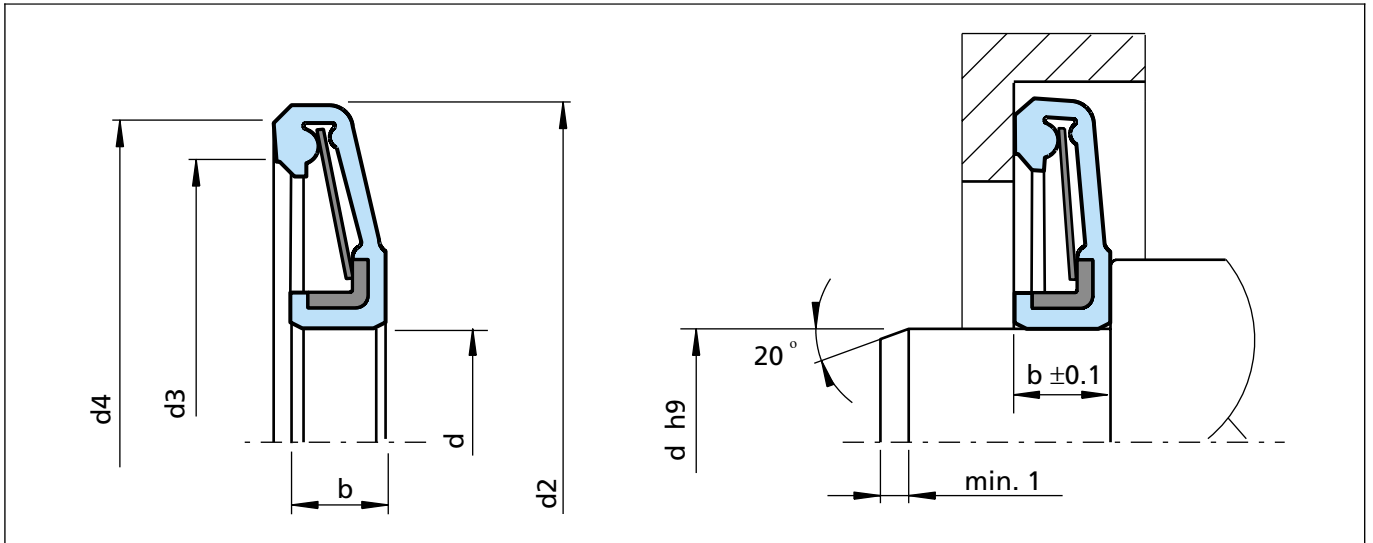


Figure 80 Installation drawing

Ordering example

Axial shaft seal, Type A
 Shaft diameter $d = 50.0$ mm
 Suitable for roller bearing No. 6009

Materials: From Table LI, page 180:
 Membrane and sealing lip: NBR
 Material code: NCM
 Reinforcement ring: 1.0338
 + spider spring: 1.0605
 Material code: M

TSS Part No. and dimensions see Table LIV and Table LV.
 Materials see Table LI.

| | | | | |
|----------------------------|-----------|---|-----|---|
| TSS Article No. | TAA000109 | - | NCM | M |
| TSS Part No. | | | | |
| Quality index (standard) | | | | |
| Material no. (elastomer) | | | | |
| Material no. (metal parts) | | | | |

Table LIV Preferred series

| Shaft d | Dimensions | | | | Max. speed [min ⁻¹] | | Fa* [N] | Max. press. [Pa] | Correspondance to the roller bearing series | | | | | TSS Part No. |
|-------------------|----------------|----------------|----------------|-----|------------------------------------|-------|------------|------------------------|--|------|------|------|------|--------------|
| | d ₂ | d ₃ | d ₄ | b | NBR | FKM | | | 6000 | 6300 | 6400 | 4200 | 4300 | |
| 12 | 25.0 | 22.0 | 24.5 | 3.5 | 7900 | 11800 | 2.0 | 10000 | 6000 | - | - | - | - | TAA000100 |
| 14 | 27.0 | 24.0 | 26.5 | 3.5 | 7300 | 11000 | 2.0 | 7500 | 6001 | - | - | - | - | TAA000101 |
| 17 | 31.0 | 27.5 | 30.0 | 4.0 | 6300 | 9400 | 3.0 | 10000 | 6002 | - | - | - | - | TAA000102 |
| 19 | 35.0 | 30.0 | 33.0 | 4.0 | 5900 | 8800 | 3.5 | 10000 | 6003 | 6300 | - | - | - | TAA000103 |
| 23 | 40.5 | 30.5 | 38.5 | 4.5 | 4900 | 7300 | 4.0 | 6600 | 6004 | 6302 | - | - | - | TAA000104 |
| 28 | 45.5 | 41.5 | 44.0 | 4.5 | 4300 | 6400 | 4.5 | 5750 | 6005 | - | - | - | - | TAA000105 |
| 35 | 53.0 | 47.5 | 50.5 | 4.5 | 3800 | 5700 | 5.0 | 5400 | 6006 | - | - | - | - | TAA000106 |
| 40 | 61.0 | 54.0 | 58.0 | 4.5 | 3300 | 4900 | 5.5 | 4400 | 6007 | 6305 | - | - | - | TAA000107 |
| 45 | 68.5 | 59.5 | 63.5 | 5.0 | 3000 | 4500 | 6.0 | 4000 | 6008 | - | 6404 | - | - | TAA000108 |

* Fa = Contact force of the sealing lip



Axial Shaft Seal

| Shaft | Dimensions | | | | Max. speed [min ⁻¹] | | Fa* | Max. press. | Correspondance to the roller bearing series | | | | | TSS Part No. |
|-------|------------|----------------|----------------|----------------|------------------------------------|-------|------|----------------|--|------|------|------|--------|--------------|
| | d | d ₂ | d ₃ | d ₄ | b | NBR | FKM | [N] | [Pa] | 6000 | 6300 | 6400 | 4200 | |
| 50 | 74.0 | 66.5 | 70.5 | 5.0 | 2700 | 4000 | 6.5 | 3400 | 6009 | 6307 | 6405 | - | - | TAA000109 |
| 55 | 77.0 | 71.0 | 75.0 | 5.5 | 2500 | 3700 | 7.0 | 3650 | 6010 | - | - | - | - | TAA000110 |
| 61 | 87.0 | 80.5 | 84.5 | 6.0 | 2250 | 3400 | 8.0 | 3100 | 6011 | 6309 | 6407 | - | - | TAA000111 |
| 66 | 93.0 | 85.0 | 89.0 | 6.0 | 2150 | 3200 | 9.0 | 3300 | 6012 | - | - | - | - | TAA000112 |
| 71 | 97.0 | 90.5 | 94.5 | 6.0 | 2000 | 3000 | 10.0 | 3200 | 6013 | - | 6408 | - | - | TAA000113 |
| 76 | 106.0 | 99.0 | 103.0 | 6.5 | 1800 | 2700 | 11.0 | 3000 | 6014 | 6310 | - | - | - | TAA000114 |
| 81 | 112.0 | 103.0 | 108.0 | 7.0 | 1700 | 2550 | 12.5 | 3700 | 6015 | 6311 | 6409 | - | - | TAA000115 |
| 86 | 122.0 | 112.0 | 117.0 | 7.5 | 1600 | 2400 | 14.0 | 2950 | 6016 | 6312 | 6410 | - | - | TAA000116 |
| 91 | 127.0 | 118.0 | 123.0 | 7.5 | 1550 | 2300 | 15.0 | 2900 | 6017 | - | 6411 | - | - | TAA000117 |
| 98 | 137.0 | 128.0 | 133.0 | 8.0 | 1450 | 2150 | 16.0 | 2750 | 6018 | 6314 | 6412 | - | - | TAA000118 |
| 103 | 142.0 | 132.0 | 137.0 | 7.5 | 1400 | 2100 | 18.0 | 2850 | 6019 | 6314 | 6412 | - | - | TAA000119 |
| 108 | 147.0 | 137.0 | 142.0 | 8.5 | 1350 | 2000 | 19.0 | 2900 | 6020 | 6315 | 6413 | - | - | TAA000120 |
| 14 | 29.5 | 25.0 | 28.5 | 4.0 | 7000 | 10500 | 2.0 | 6000 | 6200 | - | - | 4200 | - | TAA000200 |
| 16 | 31.5 | 26.0 | 29.0 | 4.0 | 6500 | 9700 | 2.0 | 4700 | 6201 | - | - | 4201 | 4300 | TAA000201 |
| 19 | 33.0 | 29.5 | 32.0 | 4.0 | 6400 | 9600 | 3.0 | 8150 | 6202 | 6300 | - | 4202 | 4301.0 | TAA000202 |
| 21 | 38.5 | 34.5 | 37.0 | 4.0 | 4900 | 7300 | 3.5 | 5950 | 6203 | - | - | 4203 | 4302 | TAA000203 |
| 25 | 46.5 | 40.0 | 43.0 | 4.5 | 4400 | 6600 | 4.0 | 4450 | 6204 | 6303 | - | 4204 | 4303 | TAA000204 |
| 31 | 50.5 | 45.5 | 48.5 | 5.0 | 3900 | 5800 | 4.5 | 4500 | 6205 | 6304 | - | 4205 | - | TAA000205 |
| 36 | 60.0 | 54.0 | 58.0 | 5.5 | 3300 | 4900 | 5.0 | 3400 | 6206 | 6305 | 6404 | 4206 | 4305 | TAA000206 |
| 42 | 68.0 | 61.5 | 65.5 | 6.0 | 2900 | 4300 | 5.5 | 2700 | 6207 | 6306 | - | 4207 | 4306 | TAA000207 |
| 47 | 77.0 | 69.5 | 73.5 | 6.0 | 2600 | 3900 | 6.0 | 2200 | 6208 | 6307 | 6405 | 4208 | 4307 | TAA000208 |
| 52 | 82.0 | 74.5 | 78.5 | 6.5 | 2400 | 3600 | 6.5 | 2450 | 6209 | 6308 | 6406 | 4209 | 4308 | TAA000209 |
| 57 | 86.0 | 79.0 | 83.0 | 7.0 | 2300 | 3400 | 7.0 | 2450 | 6210 | - | 6407 | 4210 | - | TAA000210 |
| 64 | 97.0 | 88.0 | 92.0 | 7.5 | 2100 | 3100 | 8.0 | 2300 | 6211 | 6309 | 6408 | 4211 | 4309 | TAA000211 |
| 69 | 106.0 | 98.0 | 102.0 | 8.0 | 1800 | 2700 | 9.0 | 1900 | 6212 | 6310 | 6409 | 4212 | 4310 | TAA000212 |
| 74 | 116.0 | 105.0 | 110.0 | 8.5 | 1700 | 2550 | 10.0 | 1700 | 6213 | 6311 | 6410 | 4213 | 4311 | TAA000213 |
| 80 | 120.5 | 109.0 | 114.0 | 8.5 | 1650 | 2450 | 11.0 | 2000 | 6214 | 6312 | - | 4214 | 4312 | TAA000214 |
| 85 | 126.0 | 115.0 | 120.0 | 9.0 | 1600 | 2400 | 12.5 | 2100 | 6215 | 6312 | - | 4215 | 4313 | TAA000215 |
| 92 | 136.0 | 125.0 | 130.0 | 9.0 | 1450 | 2150 | 14.0 | 2050 | 6216 | 6313 | 6411 | 4216 | 4314 | TAA000216 |
| 97 | 145.0 | 134.0 | 139.0 | 9.0 | 1350 | 2000 | 15.0 | 2100 | 6217 | 6314 | 6412 | 4217 | 4315 | TAA000217 |
| 102 | 156.0 | 144.0 | 149.0 | 9.5 | 1250 | 1850 | 16.0 | 1600 | 6218 | 6315 | 6413 | 4218 | 4316 | TAA000218 |
| 108 | 166.0 | 154.5 | 159.0 | 9.5 | 1200 | 1800 | 18.0 | 1600 | 6219 | 6316 | 6415 | 4219 | 4317 | TAA000219 |
| 114 | 175.0 | 164.0 | 169.0 | 10.0 | 1100 | 1650 | 18.5 | 1500 | 6220 | 6317 | 6416 | 4220 | 4318 | TAA000220 |

* Fa = Contact force of the sealing lip



Table LV Special sizes for type A

| Shaft | Dimensions | | | | Max. speed [min ⁻¹] | | Fa* [N] | Max. pressure [Pa] | TSS Part No. |
|-------|------------|----------------|----------------|----------------|------------------------------------|------|------------|--------------------------|--------------|
| | d | d ₂ | d ₃ | d ₄ | b | NBR | | | |
| 50 | 90 | 83,5 | 87,5 | 6,5 | 2200 | 3300 | 6.0 | 1500 | TAA100209 |
| 66 | 93 | 85,0 | 93,0 | 6,0 | 2000 | 3000 | 15.0 | 7000 | TAA100112 |
| 85 | 142 | 134,0 | 140,0 | 8,0 | 1300 | 1950 | 10.0 | 1000 | TAA100215 |
| 85 | 111 | 103,0 | 108,0 | 7,0 | 1700 | 2550 | 16.0 | 7000 | TAA100115 |
| 110 | 155 | 144,0 | 149,0 | 9,0 | 1200 | 1800 | 17.0 | 2800 | TAA100220 |
| 120 | 165 | 153,0 | 158,0 | 9,0 | 1200 | 1800 | 16.0 | 2000 | TAA100122 |
| 130 | 175 | 165,0 | 170,0 | 9,0 | 1100 | 1650 | 16.0 | 2000 | TAA200124 |
| 130 | 172 | 162,0 | 168,0 | 9,0 | 1100 | 1650 | 40.0 | 5300 | TAA300124 |
| 130 | 160 | 151,0 | 157,0 | 7,0 | 1200 | 1800 | 12.0 | 3100 | TAA100124 |
| 150 | 208 | 195,0 | 200,0 | 10,0 | 950 | 1400 | 63.0 | 4400 | TAA100128 |
| 160 | 253 | 245,0 | 250,0 | 8,0 | 750 | 1100 | 36.0 | 1500 | TAA300130 |
| 160 | 252 | 236,0 | 243,0 | 10,0 | 750 | 1100 | 32.0 | 1000 | TAA100130 |
| 162 | 184 | 177,0 | 181,0 | 6,0 | 1500 | 1500 | 52.0 | 8300 | TAA100162 |
| 180 | 214 | 209,0 | 213,0 | 6,0 | 900 | 1350 | 30.0 | 4000 | TAA100134 |
| 252 | 348 | 332,0 | 340,0 | 13,0 | 550 | 800 | 32.0 | 1000 | TAA100148 |

* Fa = Contact force of the sealing lip



■ TURCON® ROTARY SEALS - ELASTOMER ENERGIZED

■ Turcon® Roto Glyd Ring®

Description

The Turcon® Roto Glyd Ring® is used to seal rods, shafts, axles, bores, rotary transmission leadthroughs, journals, swivels etc. with rotary or oscillating movement.

The seal is double-acting and can be exposed to pressure from one, or from both sides.

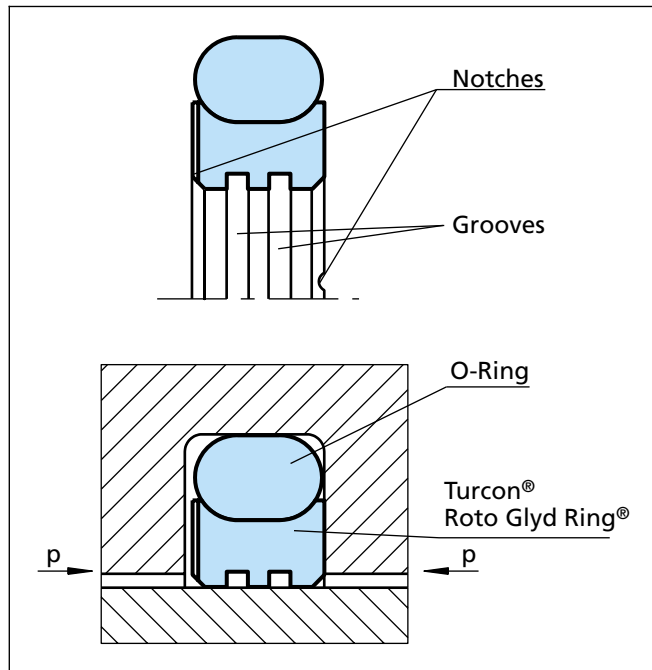


Figure 81 Turcon® Roto Glyd Ring®

It consists of a seal ring of Turcon® material and is activated by an O-Ring as an elastic energising element.

The contact surface profile of the seal ring is specially designed for use under high pressures and at low sliding speeds.

Depending on the profile cross-section of the seal, the contact surface has one or two continuous machined grooves. These have the following functions:

- Improved seal efficiency by increasing the specific surface load pressure against the sealed surface
- Formation of lubricant reservoir and reduction in friction.

In order to improve the pressure activation of the O-Ring, the Roto Glyd Ring® has notched end faces as standard.

The rear face which holds the O-Ring has a concave form. This increases the contact surface and shall prevent the seal from turning with the rotating surface.

A standard diameter range for each profile size is assigned to the series numbers in Table LXII and LX. This recommendation applies to all new constructions. Different dimensions are available on request.

Advantages

- Available for internal and external sealing applications
- Low friction
- Stick-slip-free starting, no sticking
- High abrasion resistance and dimensional stability
- Simple groove design, small groove dimensions
- Lubricant reservoir
- Available in all sizes up to 2700 mm diameter (to 2600 mm for rod seals)

Technical data

Operating pressure: Up to 30 MPa

Speed: Up to 2 m/s

Temperature: - 45°C to + 200 °C *) (depending on O-Ring material)

Media: Mineral oil-based hydraulic fluids, flame retardant hydraulic fluids, environmentally safe hydraulic fluids (bio-oils), water, air and others, depending on O-Ring material.

Note: For continuous operation at temperatures over +60 °C, pressure and speed must be limited.

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.

*) Important Note:

In the case of unpressurized applications in temperatures below 0°C please contact our application engineers for assistance!



Frictional power

Guide values for the frictional power can be determined from the graph in Figure 82. They are shown as a function of the sliding speed and operating pressure for a shaft diameter of 50 mm with an oil temperature of 60° C. At higher temperatures, these application limits must be reduced.

Guide values for other shaft diameters can be calculated using the formula:

$$P \approx P_{50} \times \left(\frac{d}{50 \text{ mm}} \right) \text{ [W]}$$

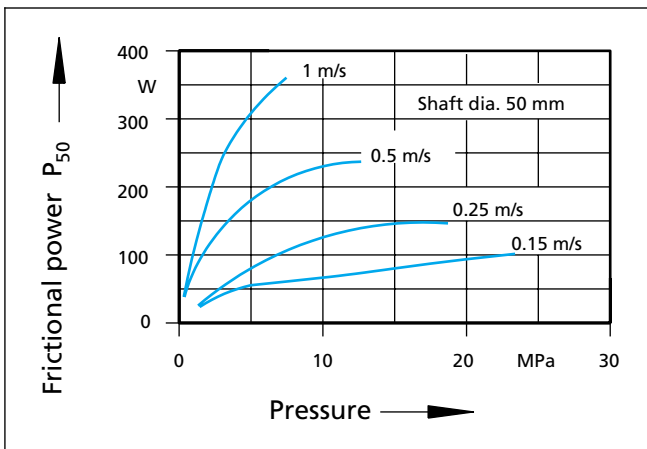


Figure 82 Frictional power for Turcon® Roto Glyd Ring®

The guide values apply for constant operating conditions. Changes in operating conditions such as pressure fluctuations or alternating directions of shaft rotation can result in considerably higher friction values.

Application examples

The Turcon® Roto Glyd Ring® is preferably used as a double acting rotary seal for hydraulic and pneumatic equipment in sectors such as:

- Rotary distributors
- High pressure valve stems
- Manipulators
- Pivoting motors in mobile hydraulic and machine tools
- Hydraulic motors

Application limits

The maximum application data for temperature, pressure and speed given in this catalogue have a mutual effect on one another and can thus not be exploited simultaneously.

Seal performance is further influenced by such factors as lubrication capability of the sealed medium and heat dissipation in the hardware, it follows that testing should always be made.

With good lubrication, the following pv value can be assumed as guide:

Turcon® Roto Glyd Ring®: up to $p_v = 2.5 \text{ MPa} \cdot \text{m/s}$

The value must be reduced for diameters < 50 mm.

Lead-in chamfers

In order to avoid damage during installation, lead-in chamfers and rounded edges must be provided on the housing and on the rod (Figures 83 and 84). If this is not possible for design reasons, a separate installation tool is recommended.

The minimum length of the lead-in chamfer depends on the profile size of the seal and can be seen from the following tables. If concentricity between the parts is not ensured during installation the lead-in chamfers must be increased correspondingly.

For the surface quality of the lead-in chamfer, the same recommendations apply as given for the sealing surfaces in Table LIX.



Turcon[®] Roto Glyd Ring[®]

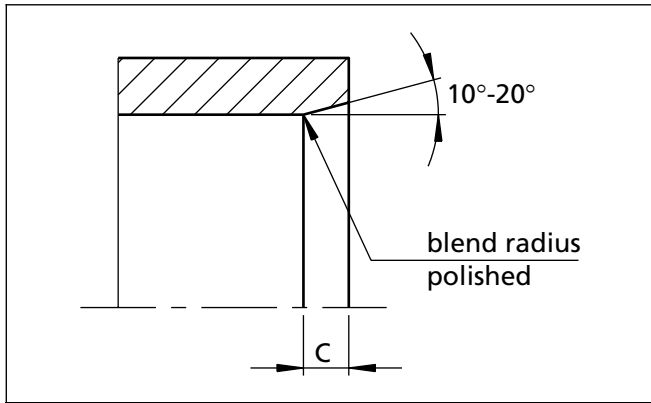


Figure 83 Lead-in chamfer on bore

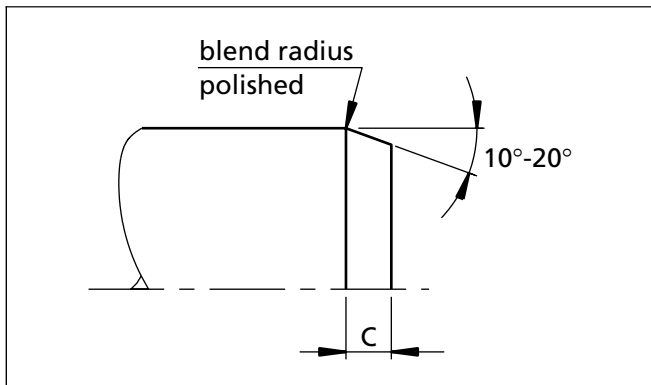


Figure 84 Lead-in chamfer on rod

Table LVI Lead-in chamfers for Turcon[®] Roto Glyd Ring[®]

| Series No. | | Lead-in chamfers length C min. |
|------------|------|--------------------------------|
| Bore | Rod | |
| TG40 | TG30 | 2.0 |
| TG41 | TG31 | 2.5 |
| TG42 | TG32 | 3.5 |
| TG43 | TG33 | 5.0 |
| TG44 | TG34 | 6.5 |
| TG45 | TG35 | 7.5 |

Table LVII Surface roughness

| Surface roughness μm | | |
|---------------------------------|-------------------------------|----------------|
| Parameter | Mating surface | Groove surface |
| | Turcon [®] materials | |
| R_{max} | 0.63 - 2.50 | < 16.0 |
| $R_{\text{z DIN}}$ | 0.40 - 1.60 | < 10.0 |
| R_{a} | 0.05 - 0.20 | < 1.6 |

The material contact area R_{mr} should be approx. 50 to 70%, determined at a cut depth $c = 0.25 \times R_{\text{z}}$, relative to a reference line of C_{ref} . 5%.

For ceramic coated surfaces, like plasma sprayed, additional focus on surface texture is necessary. Peaks and sharp edges from pores have to be polished away (e.g. with diamond paste on soft "pad") to avoid premature seal wear.

Closed grooves

Turcon[®] Roto Glyd Ring[®] for external and internal sealing can be installed in closed grooves at diameters from $\varnothing 15$ and $\varnothing 12$ respectively. Seal cross sections used outside of their recommended diameter range require split grooves according to Table LVIII below.

Table LVIII Groove type - closed or split

| Series | Series | Split grooves required below | |
|--------|--------|------------------------------|--------------------------|
| | | Turcite [®] T40 | Turcite [®] T10 |
| Bore | Rod | | |
| TG40 | - | $\varnothing 15$ | $\varnothing 25$ |
| TG41 | - | $\varnothing 25$ | $\varnothing 38$ |
| TG42 | - | $\varnothing 32$ | $\varnothing 50$ |
| TG43 | - | $\varnothing 50$ | $\varnothing 75$ |
| - | TG30 | $\varnothing 20$ | |
| - | TG31 | $\varnothing 30$ | |
| - | TG32 | $\varnothing 40$ | |
| - | TG33 | $\varnothing 60$ | |



■ Installation of Turcon® Roto Glyd Ring®

Installation instructions

The following points should be observed before installation of the seals:

- Check whether housing or rod has a lead-in chamfer; if not, use an installation sleeve
- Deburr and chamfer or round sharp edges, cover the tips of any screw threads
- Remove machining residues such as chips, dirt and other foreign particles and carefully clean all parts
- The seals can be installed more easily if they are greased or oiled. Attention must be paid to the compatibility of the seal materials with these lubricants. Use only grease without solid additives (e.g. molybdenum disulphide or zinc sulphide)
- Do not use installation tools with sharp edges

Installation of Turcon® Roto Glyd Ring® in split grooves

“Internal and external sealing”

Installation in split grooves is simple. During final assembly - insertion of the rod - the Turcon® Roto Glyd Ring® must be sized. The rod itself can be used for this purpose, provided it has a long lead-in chamfer. Alternatively a corresponding mandrel can be used.

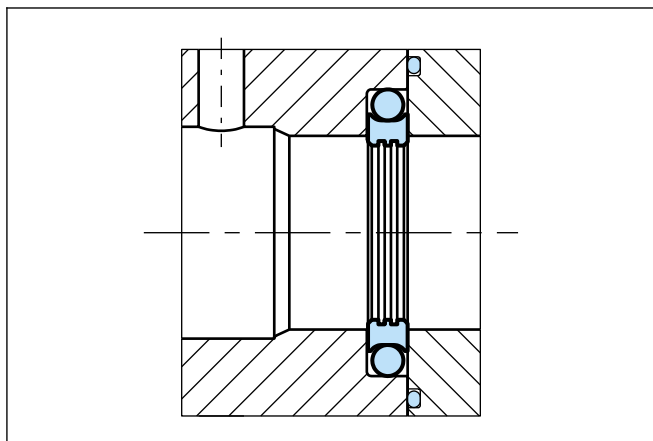


Figure 85 Installation in a split groove

The following installation sequence is recommended:

- Pull the O-Ring onto the Roto Glyd Ring®
- Press the seal element into the groove. The O-Ring must not be allowed to twist

Installation of Turcon® Roto Glyd Ring® in closed grooves

“Internal sealing”

The installation of our seal elements is unproblematical.

- Place the O-Ring into the groove (avoid twisting the ring!)
- Compress the Turcon® Roto Glyd Ring® into a kidney shape. The seal must have no sharp bends

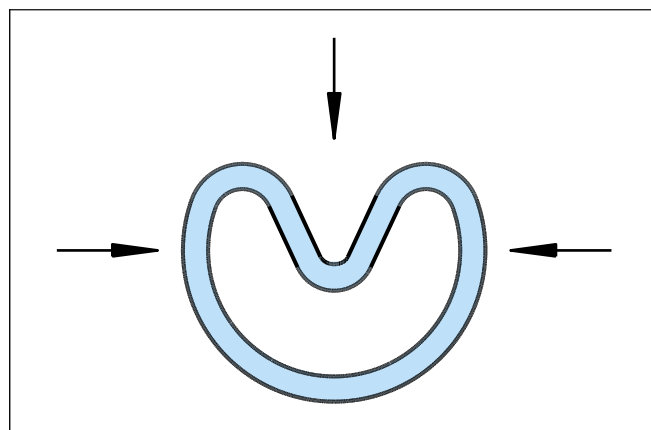


Figure 86 Kidney-shaped deformation of the seal ring

- Place the seal ring in compressed form into the groove and push against the O-Ring in the direction of the arrow (Figure 87)

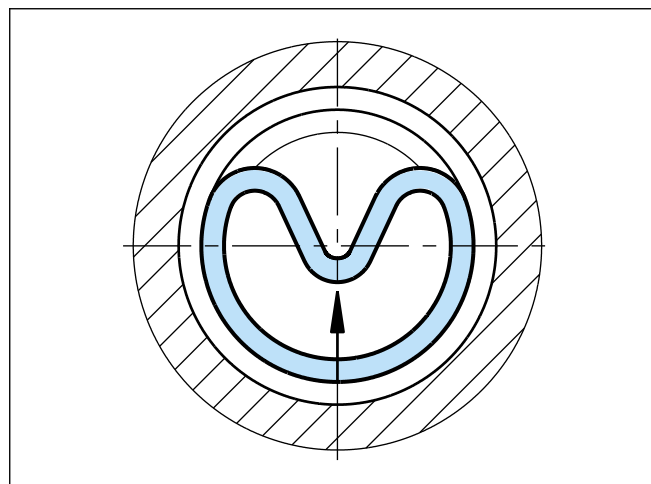


Figure 87 Inserting the seal ring into the closed groove

- Finally size the seal ring using a mandrel which should have a chamfer of 10° to 15° over a length of approx. 30 mm

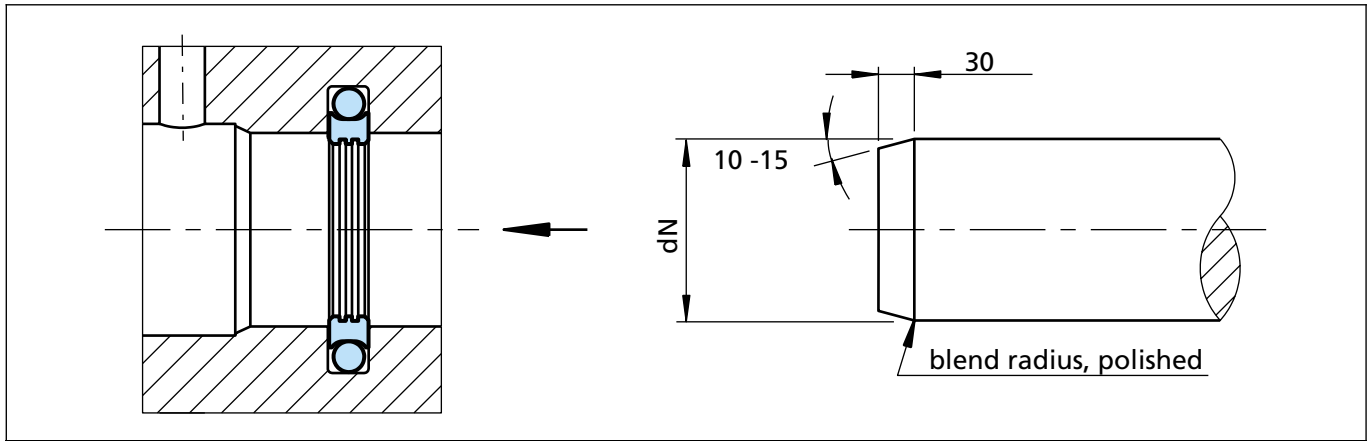


Figure 88 Sizing of the installed seal

The rod itself can also be used for sizing, provided that it has a sufficiently long lead-in chamfer as per our recommendations in Table LVI.

Sizing mandrels should be made from a polymer material (e.g. polyamide). In order to avoid damage to the seals, a smooth surface with rounded and polished lead-in chamfer is necessary.

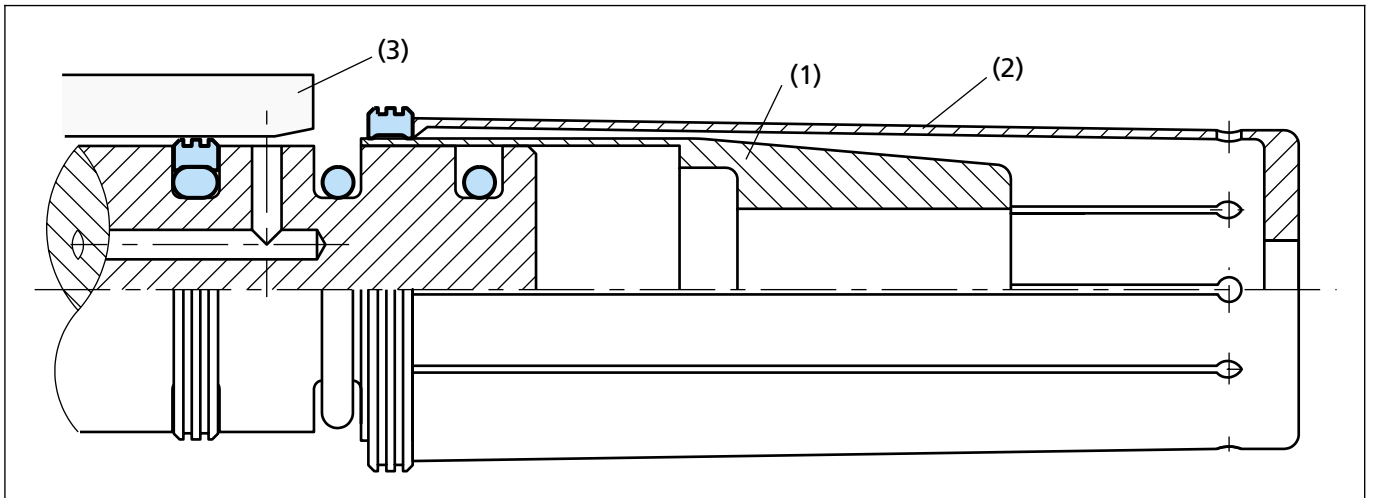
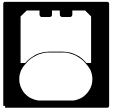


Figure 89 Expanding the Turcon® Roto Glyd Ring® over the installation sleeve using an expanding sleeve

Installation with installation tools (external sealing)

Use of a three-piece installation tool is recommended for series production installation of the Turcon® Roto Glyd Ring®.

The tool consists of:

- Installation sleeve (1)
- Expanding sleeve (2)
- Sizing sleeve (3).

All parts should be made of a polymer material (e.g. polyamide) with a good surface finish to avoid damage to the seals.

The O-Ring should be pulled over the piston into the groove (take care not to burst the O-Ring).

The Roto Glyd Ring® element should be expanded over the Installation sleeve using the Expanding sleeve using a fast but smooth movement.

After installation the Roto Glyd Ring® element should be sized using the Sizing sleeve.

In view of the large number of sizes and the application-specific installation conditions, this installation tool cannot be supplied as standard by TSS.

Drawings for installation tools are available on request.

Installation without installation tools (external sealing)

If installation has to be performed without installation tools, however, the following points should be observed:

- The Roto Glyd Ring® can be installed more easily by heating in oil, water or using a hot air fan to approx. 80° C to 100° C (expanding and then sizing)
- Use no sharp edged tools to expand the seal rings
- Installation should be performed as quickly as possible so that an optimum snap-back of the seal element is assured
- Sizing of the seal ring can be carried out in the corresponding housing, provided that it has a long lead-in chamfer as per Table LVI. Otherwise use a sizing sleeve.



Turcon® Roto Glyd Ring®

Materials

Standard materials:

Turcon® seal ring: Turcon® T10 and Turcon® T40
 O-Ring: NBR, 70 Shore A

For specific applications, other material combinations as listed in Table LIX.

Table LIX Standard Turcon® materials for Turcon® Roto Glyd Ring®

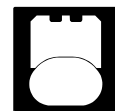
| Material, applications, properties | Code | O-Ring material | Code | O-Ring operating temp.* °C | Mating surface material | MPa max. |
|--|------|----------------------------|------|----------------------------|--|----------|
| Turcon® T10 Hydraulics and pneumatics for all lubricating and non-lubricating fluids, high extrusion resistance, good chemical resistance, BAM. Carbon, graphite filled Colour: Black | T10 | NBR - 70 Shore A | N | -30 to +100 | Steel Steel, chromeplated Stainless steel | 30 |
| | | NBR - Low temp. 70 Shore A | T | -45 to +80 | | |
| | | FKM - 70 Shore A | V | -10 to +200 | | |
| | | EPDM-70 Shore A | E** | -45 to +145 | | |
| Turcon® T40 For all lubricating and non-lubricating hydraulic fluids, water hydraulics, soft mating surfaces. Carbon fibre filled Colour: Grey | T40 | NBR - 70 Shore A | N | -30 to +100 | Steel Steel, chromeplated Cast iron Stainless steel, Aluminium Bronze Alloys | 20 |
| | | NBR - Low temp. 70 Shore A | T | -45 to +80 | | |
| | | FKM - 70 Shore A | V | -10 to +200 | | |
| | | EPDM-70 Shore A | E** | -45 to +145 | | |

* The O-Ring Operation Temperature is only valid in mineral hydraulic oil.

** Material not suitable for mineral oils.

BAM: Approved by "Bundes Anstalt Materialprüfung, Germany".

Highlighted materials are standard.



■ Installation recommendation - external sealing

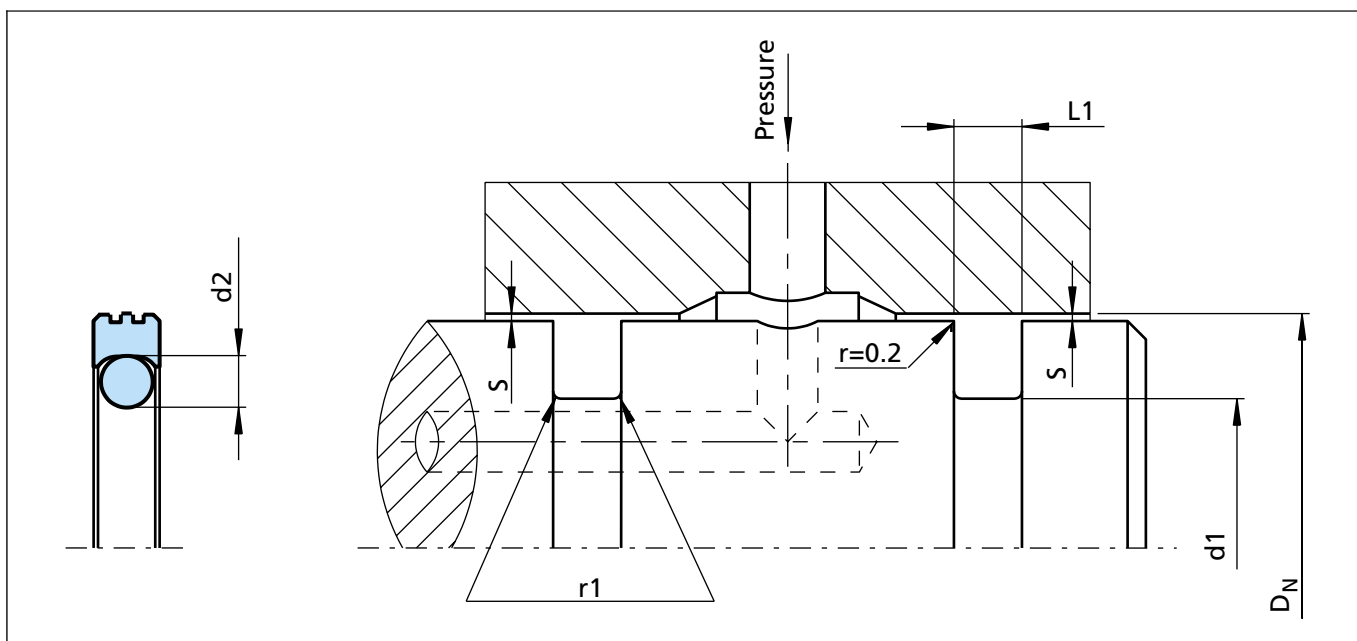


Figure 90 Installation drawing

Table LX Installation dimensions

| Series no. | Bore diameter D_N H9 | | Groove diameter d_1 h9 | Groove width $L_1 +0.2$ | Radial clearance S max. * | | Radius r_1 | O-Ring cross sec. d_2 | Number of grooves in the sealing surface |
|------------|---------------------------|-----------------|-----------------------------|----------------------------|--------------------------------|--------|-----------------|----------------------------|--|
| | Standard range | Available range | | | 10 MPa | 20 MPa | | | |
| TG40 | 8 - 39.9 | 8 - 135.0 | $D_N - 4.9$ | 2.20 | 0.15 | 0.10 | 0.40 | 1.78 | 0 |
| TG41 | 40 - 79.9 | 14 - 250.0 | $D_N - 7.5$ | 3.20 | 0.20 | 0.15 | 0.60 | 2.62 | 1 |
| TG42 | 80 - 132.9 | 22 - 460.0 | $D_N - 11.0$ | 4.20 | 0.25 | 0.20 | 1.00 | 3.53 | 1 |
| TG43 | 133 - 329.9 | 40 - 675.0 | $D_N - 15.5$ | 6.30 | 0.30 | 0.25 | 1.30 | 5.33 | 2 |
| TG44 | 330 - 669.9 | 133 - 690.0 | $D_N - 21.0$ | 8.10 | 0.30 | 0.25 | 1.80 | 7.00 | 2 |
| TG45 | 670 - 999.9 | 670 - 999.9 | $D_N - 28.0$ | 9.50 | 0.45 | 0.30 | 2.50 | 8.40 | 2 |

Provide split housing grooves according to diameter, see Table LVIII.

At pressures > **10 MPa** it is recommendable that for the cross section you choose the next larger profile according to the column "Available Range" i.e. for bore Ø80 mm: TG 43 00 800-.

* At pressures > **30 MPa**: Use diameter tolerance H8/f8 (bore / rod) in area of seal.



Turcon® Roto Glyd Ring®

Ordering Example

Turcon® Roto Glyd Ring®, complete with O-Ring, external sealing, series TG42 (from Table LX).

Bore diameter: $D_N = 80.0$ mm
 TSS Part No.: TG4200800 (from Table LXI)

Select the material from Table LIX. The corresponding code numbers are appended to the TSS Part No. (from Table LXI). Together they form the TSS Article No.

For all intermediate sizes not shown in Table LXI, the Order No. can be determined from the example opposite.

** For diameters ≥ 1000.0 mm multiply only by factor 1.
 Example: TG45 for diameter 1200.0 mm.
 TSS Article No.: TG45**X1200** - T40N.

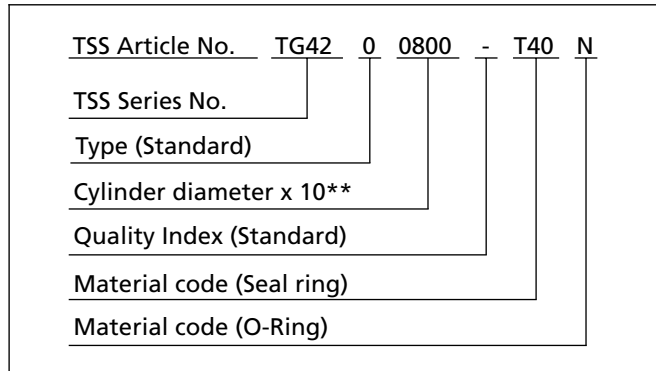


Table LXI Preferred Dimension / TSS Part No.

| Bore diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|---------------|-----------------|--------------|------------------|---------------------|
| D_N H9 | d_1 h9 | $L_1 +0.2$ | | |
| 8.0 | 3.1 | 2.2 | TG4000080 | 2.90 x 1.78 |
| 10.0 | 5.1 | 2.2 | TG4000100 | 4.80 x 1.8 |
| 12.0 | 7.1 | 2.2 | TG4000120 | 6.70 x 1.8 |
| 14.0 | 9.1 | 2.2 | TG4000140 | 8.75 x 1.8 |
| 15.0 | 10.1 | 2.2 | TG4000150 | 9.25 x 1.78 |
| 16.0 | 11.1 | 2.2 | TG4000160 | 10.82 x 1.78 |
| 18.0 | 13.1 | 2.2 | TG4000180 | 12.42 x 1.78 |
| 20.0 | 15.1 | 2.2 | TG4000200 | 14.00 x 1.78 |
| 22.0 | 17.1 | 2.2 | TG4000220 | 17.17 x 1.78 |
| 25.0 | 20.1 | 2.2 | TG4000250 | 18.77 x 1.78 |
| 28.0 | 23.1 | 2.2 | TG4000280 | 21.95 x 1.78 |
| 30.0 | 25.1 | 2.2 | TG4000300 | 25.12 x 1.78 |
| 32.0 | 27.1 | 2.2 | TG4000320 | 26.70 x 1.78 |
| 35.0 | 30.1 | 2.2 | TG4000350 | 29.87 x 1.78 |
| 40.0 | 32.5 | 3.2 | TG4100400 | 31.42 x 2.62 |
| 42.0 | 34.5 | 3.2 | TG4100420 | 32.99 x 2.62 |
| 45.0 | 37.5 | 3.2 | TG4100450 | 36.17 x 2.62 |
| 48.0 | 40.5 | 3.2 | TG4100480 | 39.34 x 2.62 |
| 50.0 | 42.5 | 3.2 | TG4100500 | 40.94 x 2.62 |
| 52.0 | 44.5 | 3.2 | TG4100520 | 44.12 x 2.62 |
| 55.0 | 47.5 | 3.2 | TG4100550 | 45.69 x 2.62 |

The bore diameters printed in **bold** type conform to the recommendations of ISO 3320.
 Other dimensions and all intermediate sizes up to 2.700 mm diameter including imperial (inch) sizes can be supplied.



| Bore diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|---------------|-----------------|--------------|------------------|----------------------|
| D_N H9 | d_1 h9 | $L_1 +0.2$ | | |
| 60.0 | 52.5 | 3.2 | TG4100600 | 52.07 x 2.62 |
| 63.0 | 55.5 | 3.2 | TG4100630 | 53.64 x 2.62 |
| 65.0 | 57.5 | 3.2 | TG4100650 | 56.82 x 2.62 |
| 70.0 | 62.5 | 3.2 | TG4100700 | 61.60 x 2.62 |
| 75.0 | 67.5 | 3.2 | TG4100750 | 66.34 x 2.62 |
| 80.0 | 69.0 | 4.2 | TG4200800 | 66.27 x 3.53 |
| 85.0 | 74.0 | 4.2 | TG4200850 | 72.62 x 3.53 |
| 90.0 | 79.0 | 4.2 | TG4200900 | 78.97 x 3.53 |
| 95.0 | 84.0 | 4.2 | TG4200950 | 82.14 x 3.53 |
| 100.0 | 89.0 | 4.2 | TG4201000 | 88.49 x 3.53 |
| 105.0 | 94.0 | 4.2 | TG4201050 | 91.67 x 3.53 |
| 110.0 | 99.0 | 4.2 | TG4201100 | 98.02 x 3.53 |
| 115.0 | 104.0 | 4.2 | TG4201150 | 101.19 x 3.53 |
| 120.0 | 109.0 | 4.2 | TG4201200 | 107.54 x 3.53 |
| 125.0 | 114.0 | 4.2 | TG4201250 | 113.89 x 3.53 |
| 130.0 | 119.0 | 4.2 | TG4201300 | 117.07 x 3.53 |
| 135.0 | 119.5 | 6.3 | TG4301350 | 116.84 x 5.33 |
| 140.0 | 124.5 | 6.3 | TG4301400 | 123.19 x 5.33 |
| 150.0 | 134.5 | 6.3 | TG4301500 | 132.72 x 5.33 |
| 160.0 | 144.5 | 6.3 | TG4301600 | 142.24 x 5.33 |
| 170.0 | 154.5 | 6.3 | TG4301700 | 151.77 x 5.33 |
| 180.0 | 164.5 | 6.3 | TG4301800 | 164.47 x 5.33 |
| 190.0 | 174.5 | 6.3 | TG4301900 | 170.82 x 5.33 |
| 200.0 | 184.5 | 6.3 | TG4302000 | 183.52 x 5.33 |
| 210.0 | 194.5 | 6.3 | TG4302100 | 189.87 x 5.33 |
| 220.0 | 204.5 | 6.3 | TG4302200 | 202.57 x 5.33 |
| 230.0 | 214.5 | 6.3 | TG4302300 | 208.92 x 5.33 |
| 240.0 | 224.5 | 6.3 | TG4302400 | 221.62 x 5.33 |
| 250.0 | 234.5 | 6.3 | TG4302500 | 234.32 x 5.33 |
| 280.0 | 264.5 | 6.3 | TG4302800 | 266.07 x 5.33 |
| 300.0 | 284.5 | 6.3 | TG4303000 | 278.77 x 5.33 |
| 320.0 | 304.5 | 6.3 | TG4303200 | 304.17 x 5.33 |
| 350.0 | 329.0 | 8.1 | TG4403500 | 329.57 x 7.00 |
| 400.0 | 379.0 | 8.1 | TG4404000 | 267.67 x 7.00 |
| 420.0 | 399.0 | 8.1 | TG4404200 | 393.07 x 7.00 |
| 450.0 | 429.0 | 8.1 | TG4404500 | 417.96 x 7.00 |

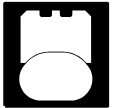
The bore diameters printed in **bold** type conform to the recommendations of ISO 3320.
Other dimensions and all intermediate sizes up to 2.700 mm diameter including imperial (inch) sizes can be supplied.



Turcon[®] Roto Glyd Ring[®]

| Bore diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|-------------------------|-------------------------|---------------------------|------------------|----------------------|
| D_N H9 | d₁ h9 | L₁ +0.2 | | |
| 480.0 | 459.0 | 8.1 | TG4404800 | 456.06 x 7.00 |
| 500.0 | 479.0 | 8.1 | TG4405000 | 468.76 x 7.00 |
| 600.0 | 579.0 | 8.1 | TG4406000 | 582.68 x 7.00 |
| 700.0 | 672.0 | 9.5 | TG4507000 | 670.00 x 8.40 |

The bore diameters printed in **bold** type conform to the recommendations of ISO 3320.
Other dimensions and all intermediate sizes up to 2.700 mm diameter including imperial (inch) sizes can be supplied.



■ Installation recommendation - internal sealing

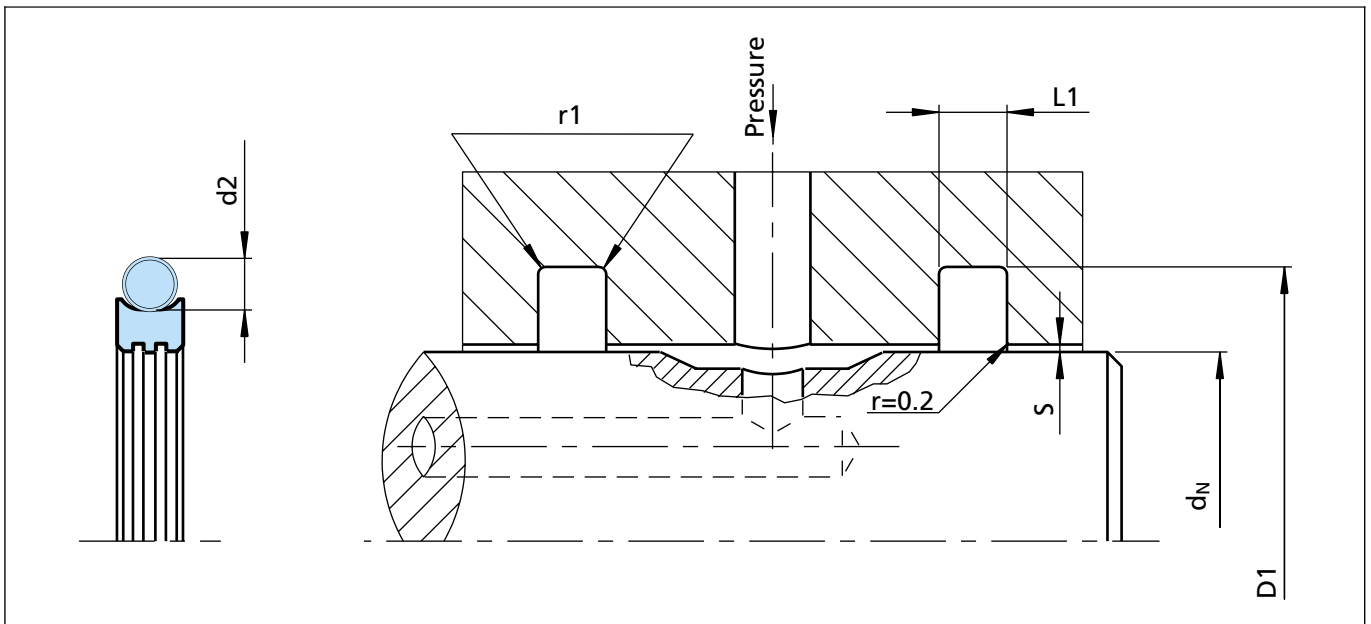


Figure 91 Installation drawing

Table LXII Installation dimensions

| Series no. | Rod diameter d_N f8/h9 | | Groove diameter D_1 H9 | Groove width $L_1 + 0.2$ | Radial clearance S max. * | | Radius r_1 | O-Ring cross sec. d_2 | Number of grooves in the sealing surface |
|------------|-----------------------------|-------------------------------|-----------------------------|-----------------------------|--------------------------------|--------|-----------------|----------------------------|--|
| | Standard range | Available ¹⁾ range | | | 10 MPa | 20 MPa | | | |
| TG30 | 6 - 18.9 | 6 - 130.0 | $d_{N+} 4.9$ | 2.20 | 0.15 | 0.10 | 0.40 | 1.78 | 0 |
| TG31 | 19 - 37.9 | 10 - 245.0 | $d_{N+} 7.5$ | 3.20 | 0.20 | 0.15 | 0.60 | 2.62 | 1 |
| TG32 | 38 - 199.9 | 19 - 455.0 | $d_{N+} 11.0$ | 4.20 | 0.25 | 0.20 | 1.00 | 3.53 | 1 |
| TG33 | 200 - 255.9 | 38 - 655.0 | $d_{N+} 15.5$ | 6.30 | 0.30 | 0.25 | 1.30 | 5.33 | 2 |
| TG34 | 256 - 649.9 | 120 - 655.0 | $d_{N+} 21.0$ | 8.10 | 0.30 | 0.25 | 1.80 | 7.00 | 2 |
| TG35 | 650 - 999.9 | 650 - 999.9 | $d_{N+} 28.0$ | 9.50 | 0.45 | 0.30 | 2.50 | 8.40 | 2 |

Provide split housing grooves according to diameter, see Table LVIII.

At pressures > **10 MPa** it is recommendable that for the cross section you choose the next larger profile according to the column "Available range" i.e. for shaft Ø80 mm: TG 33 00 800-.

* At pressures > **30 MPa**: Use diameter tolerance H8/f8 (bore / rod) in area of seal.



Turcon® Roto Glyd Ring®

Ordering example

Turcon® Roto Glyd Ring®, complete with O-Ring, internal sealing, series TG32 (from Table LXII).

Rod diameter: $d_N = 80.0$ mm
TSS Part No.: TG3200800 (from Table LXIII)

Select the material from Table LIX. The corresponding code numbers are appended to the TSS Part No. Together they form the TSS Article No.

For all intermediate sizes not shown in Table LXII, the TSS Article No. can be determined from the example below.

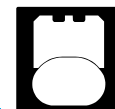
** For diameters ≥ 1000.0 mm multiply only by factor 1.
Example: TG35 for diameter 1200.0 mm.
TSS Article No.: TG35**X1200** - T40N.

| | | | | | | |
|---------------------------|------|---|------|---|-----|---|
| TSS Article No. | TG32 | 0 | 0800 | - | T40 | N |
| TSS Series No. | | | | | | |
| Type (Standard) | | | | | | |
| Rod diameter x 10** | | | | | | |
| Quality Index (Standard) | | | | | | |
| Material code (Seal ring) | | | | | | |
| Material code (O-Ring) | | | | | | |

Table LXIII Preferred Dimension / TSS Part No.

| Rod diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|--------------|-----------------|--------------|------------------|---------------------|
| d_N f8/h9 | D_1 H9 | L_1 +0.2 | | |
| 6.0 | 10.9 | 2.2 | TG3000060 | 7.65 x 1.78 |
| 8.0 | 12.9 | 2.2 | TG3000080 | 9.5 x 1.8 |
| 10.0 | 14.9 | 2.2 | TG3000100 | 11.8 x 1.8 |
| 12.0 | 16.9 | 2.2 | TG3000120 | 14.00 x 1.78 |
| 14.0 | 18.9 | 2.2 | TG3000140 | 15.60 x 1.78 |
| 15.0 | 19.9 | 2.2 | TG3000150 | 17.17 x 1.78 |
| 16.0 | 20.9 | 2.2 | TG3000160 | 17.17 x 1.78 |
| 18.0 | 22.9 | 2.2 | TG3000180 | 18.77 x 1.78 |
| 20.0 | 27.5 | 3.2 | TG3100200 | 21.89 x 2.62 |
| 22.0 | 29.5 | 3.2 | TG3100220 | 25.07 x 2.62 |
| 25.0 | 32.5 | 3.2 | TG3100250 | 28.24 x 2.62 |
| 28.0 | 35.5 | 3.2 | TG3100280 | 31.42 x 2.62 |
| 30.0 | 37.5 | 3.2 | TG3100300 | 32.99 x 2.62 |
| 32.0 | 39.5 | 3.2 | TG3100320 | 34.59 x 2.62 |
| 35.0 | 42.5 | 3.2 | TG3100350 | 37.77 x 2.62 |
| 36.0 | 43.5 | 3.2 | TG3100360 | 39.34 x 2.62 |
| 40.0 | 51.0 | 4.2 | TG3200400 | 44.04 x 3.53 |
| 42.0 | 53.0 | 4.2 | TG3200420 | 47.22 x 3.53 |
| 45.0 | 56.0 | 4.2 | TG3200450 | 50.39 x 3.53 |
| 48.0 | 59.0 | 4.2 | TG3200480 | 53.57 x 3.53 |
| 50.0 | 61.0 | 4.2 | TG3200500 | 53.57 x 3.53 |

The rod diameters printed in **bold** type conform to the recommendations of ISO 3320.
Other dimensions and all intermediate sizes up to 2.600 mm diameter including imperial (inch) sizes can be supplied.



| Rod diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|--------------|-----------------|--------------|------------------|----------------------|
| d_N f8/h9 | D_1 H9 | L_1 +0.2 | | |
| 52.0 | 63.0 | 4.2 | TG3200520 | 56.74 x 3.53 |
| 55.0 | 66.0 | 4.2 | TG3200550 | 59.92 x 3.53 |
| 56.0 | 67.0 | 4.2 | TG3200560 | 59.92 x 3.53 |
| 60.0 | 71.0 | 4.2 | TG3200600 | 63.09 x 3.53 |
| 63.0 | 74.0 | 4.2 | TG3200630 | 66.27 x 3.53 |
| 65.0 | 76.0 | 4.2 | TG3200650 | 69.44 x 3.53 |
| 70.0 | 81.0 | 4.2 | TG3200700 | 75.79 x 3.53 |
| 75.0 | 86.0 | 4.2 | TG3200750 | 78.97 x 3.53 |
| 80.0 | 91.0 | 4.2 | TG3200800 | 85.32 x 3.53 |
| 85.0 | 96.0 | 4.2 | TG3200850 | 88.49 x 3.53 |
| 90.0 | 101.0 | 4.2 | TG3200900 | 94.84 x 3.53 |
| 95.0 | 106.0 | 4.2 | TG3200950 | 101.19 x 3.53 |
| 100.0 | 111.0 | 4.2 | TG3201000 | 104.37 x 3.53 |
| 105.0 | 116.0 | 4.2 | TG3201050 | 110.72 x 3.53 |
| 110.0 | 121.0 | 4.2 | TG3201100 | 113.89 x 3.53 |
| 115.0 | 126.0 | 4.2 | TG3201150 | 120.24 x 3.53 |
| 120.0 | 131.0 | 4.2 | TG3201200 | 123.42 x 3.53 |
| 125.0 | 136.0 | 4.2 | TG3201250 | 129.77 x 3.53 |
| 130.0 | 141.0 | 4.2 | TG3201300 | 136.12 x 3.53 |
| 135.0 | 146.0 | 4.2 | TG3201350 | 139.29 x 3.53 |
| 140.0 | 151.0 | 4.2 | TG3201400 | 145.64 x 3.53 |
| 150.0 | 161.0 | 4.2 | TG3201500 | 151.99 x 3.53 |
| 160.0 | 171.0 | 4.2 | TG3201600 | 164.69 x 3.53 |
| 170.0 | 181.0 | 4.2 | TG3201700 | 177.39 x 3.53 |
| 180.0 | 191.0 | 4.2 | TG3201800 | 183.74 x 3.53 |
| 190.0 | 201.0 | 4.2 | TG3201900 | 196.44 x 3.53 |
| 200.0 | 215.5 | 6.3 | TG3302000 | 208.92 x 5.33 |
| 210.0 | 225.5 | 6.3 | TG3302100 | 215.27 x 5.33 |
| 220.0 | 235.5 | 6.3 | TG3302200 | 227.97 x 5.33 |
| 240.0 | 255.5 | 6.3 | TG3302400 | 247.02 x 5.33 |
| 250.0 | 265.5 | 6.3 | TG3302500 | 253.37 x 5.33 |
| 280.0 | 301.0 | 8.1 | TG3402800 | 291.47 x 7.00 |
| 300.0 | 321.0 | 8.1 | TG3403000 | 304.17 x 7.00 |
| 320.0 | 341.0 | 8.1 | TG3403200 | 329.57 x 7.00 |
| 350.0 | 371.0 | 8.1 | TG3403500 | 354.97 x 7.00 |
| 360.0 | 381.0 | 8.1 | TG3403600 | 367.67 x 7.00 |

The rod diameters printed in **bold** type conform to the recommendations of ISO 3320.
Other dimensions and all intermediate sizes up to 2.600 mm diameter including imperial (inch) sizes can be supplied.

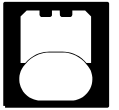


Turcon[®] Roto Glyd Ring[®]

| Rod diameter | Groove diameter | Groove width | TSS Part No. | O-Ring size |
|-------------------------------|----------------------------|------------------------------|---------------------|--------------------|
| d_N f8/h9 | D_1 H9 | $L_1 +0.2$ | | |
| 400.0 | 421.0 | 8.1 | TG3404000 | 405.26 x 7.00 |
| 420.0 | 441.0 | 8.1 | TG3404200 | 430.66 x 7.00 |
| 450.0 | 471.0 | 8.1 | TG3404500 | 456.06 x 7.00 |
| 480.0 | 501.0 | 8.1 | TG3404800 | 494.16 x 7.00 |
| 500.0 | 521.0 | 8.1 | TG3405000 | 506.86 x 7.00 |
| 600.0 | 621.0 | 8.1 | TG3406000 | 608.08 x 7.00 |
| 700.0 | 728.0 | 9.5 | TG3507000 | 713.00 x 8.40 |

The rod diameters printed in **bold** type conform to the recommendations of ISO 3320.

Other dimensions and all intermediate sizes up to 2.600 mm diameter including imperial (inch) sizes can be supplied.



■ Special solutions for rotary applications

The sealing of rotary movements in machine engineering and hydraulics often demands solutions which cannot be achieved using standard seal elements.

On request, we will be pleased to draw up specific seal proposals for your application.

Axial seals

Our extensive Turcon® seal range also permits solutions with modified standard seals.

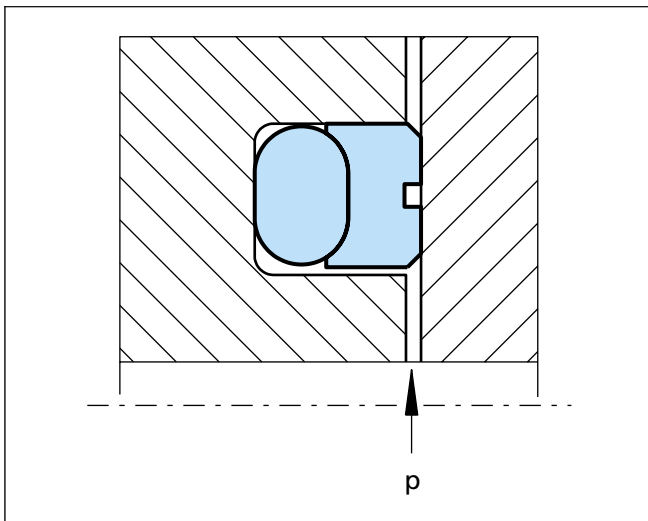


Figure 92 Axial acting Turcon® Roto Glyd Ring®

Figure 92 shows an axial acting Turcon® Roto Glyd Ring®. It is pressed axially against the mating surface by the O-Ring. In the same way, a Turcon® Stepseal® K can also be used here. The max. production diameter is 2700 mm.

The surface roughness of the mating surface must be as specified in Table LVII.

Special model with pressure relief

The Roto Glyd Ring® can also be supplied with pressure relief grooves. As can be seen in Figure 93 the continuous radial groove is linked on one side to the pressure chamber. The seal is thus relieved of pressure and can be used for higher pv values. The double-acting sealing function is maintained, but the relieved side should be installed on the side with the higher pressure.

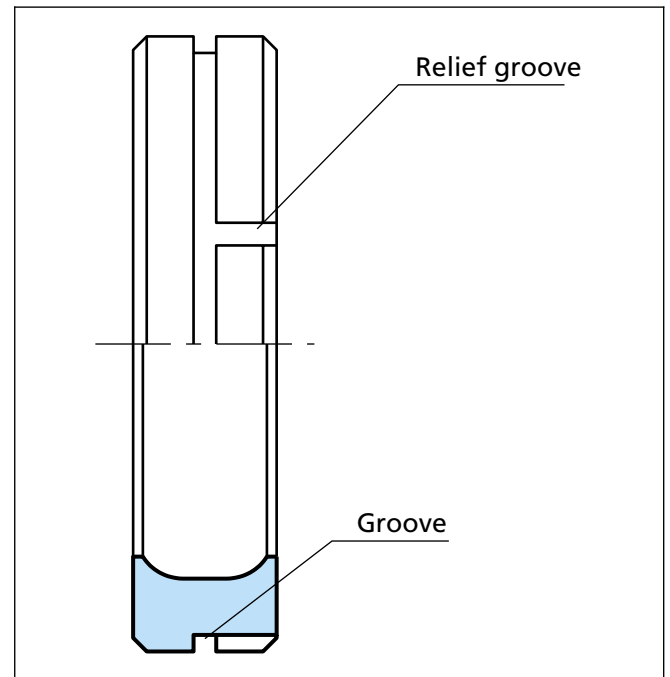


Figure 93 Turcon® Roto Glyd Ring® with pressure relief

The installation direction must be observed in this case. This version is identified in the article number by a "K" as the 5th digit.



■ TURCON[®] ROTARY SEALS - SPRING ENERGIZED

■ Turcon[®] Roto Variseal[®]

Description

The Turcon[®] Roto Variseal[®] is a single-acting seal consisting of a U-shaped seal jacket and a V-shaped corrosion resistant metal spring.

The characteristic of the Roto Variseal[®] is the flanged heel, which prevents the seal from rotating by clamping in the groove and the short and heavy dynamic lip offering reduced friction, long service life and a good scraping effect even in highly viscous media.

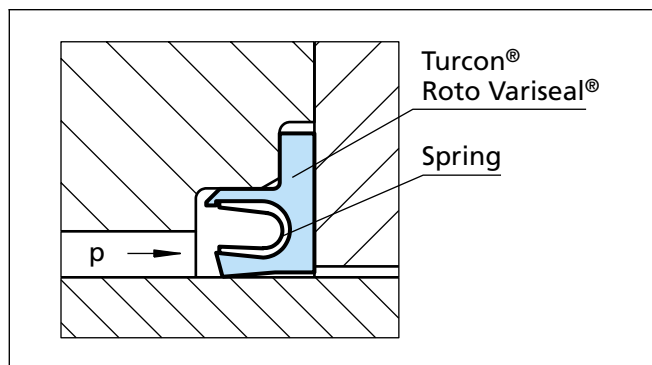


Figure 94 Turcon[®] Roto Variseal[®]

At low and zero pressure, the metal spring provides the primary sealing force. As the system pressure increases, the main sealing force is achieved by the system pressure and ensures a tight seal from zero to high pressure.

The possibility of matching suitable materials for the seal and the spring allows use in a wide range of applications going beyond the field of hydraulics, e.g. in the chemical, pharmaceutical and foodstuffs industry.

The Roto Variseal[®] can be sterilized and is available in a special Hi-Clean version where the spring cavity is filled with a Silicone elastomer preventing contaminants from being entrapped in the seal. This design also works well in applications involving mud, slurries or adhesives to keep grit from packing into the seal cavity and inhibiting the spring action.

Advantages

- Suitable for rotary, reciprocating and static applications
- Protects against mechanical torsion
- Low coefficient of friction
- Remains tight in groove even when subject to oscillating or helical movements
- Withstands rapid changes in temperature
- High abrasion resistance
- Excellent resistance to aging
- Good scraping ability
- Can be sterilized
- Available in Hi-Clean version

Technical data

| | |
|----------------------|---|
| Operating pressure: | For dynamic loads: 15 MPa For static loads: 25 MPa |
| Speed: | Rotating: Up to 2 m/s |
| Temperature: | -100 °C to +260 °C For specific applications at lower temperatures, please enquire |
| Media compatibility: | Virtually all fluids, chemicals and gases |

Important Note:

The above data are maximum values and cannot be used at the same time, e. g. the maximum operating speed depends on material type, pressure and temperature.



Frictional force

Indicative values for frictional force are included in Figure 95. Frictional force is given as a function of sliding speed and operating pressure for a shaft diameter of 50 mm (2 inches) at an oil temperature of 60 °C. The operating limits are lower at higher temperatures.

Indicative values for other shaft diameters can be calculated from the formula:

$$P \approx P_{50} \times \left(\frac{d}{50 \text{ mm}} \right) \text{ [W]}$$

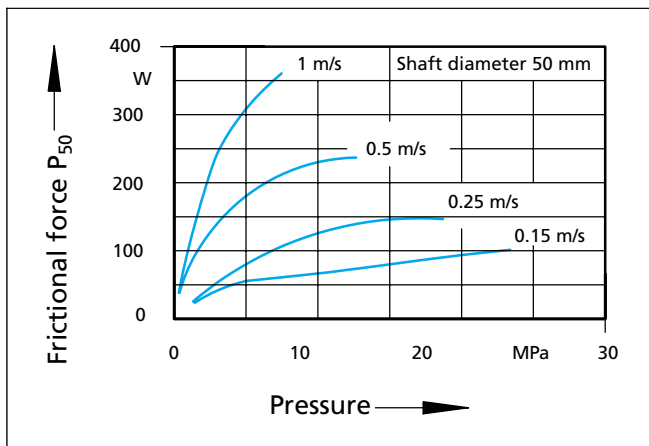


Figure 95 Frictional power for Turcon® Roto Variseal®

The indicative values apply for constant operating conditions. Changes in these, such as pressure fluctuations or direction of rotation can result in significantly higher frictional values.

Application examples

The Turcon® Roto Variseal® is used as a single acting rotary seal in sectors such as:

- Rotary injection units (injection moulding machines)
- Rotary distributors
- Pivoting motors in pharmacy, industry, machine tools, foodstuff and chemical

Application limits

The maximum operating limits for temperature, pressure and speed are dependent upon one another and therefore cannot all apply at the same time.

The lubrication properties of the media to be sealed and heat dissipation must also be taken into consideration.

The following pv values can be used as general guidelines:

- Poor lubrication up to pv = 2 MPa x m/s
- Good lubrication up to pv = 5 MPa x m/s
- Very good cooling up to pv = 8 MPa x m/s

These values are lower for diameters < 50 mm (2 inches). Tests of these characteristics are recommended to establish application limits.

Materials

All materials used are physiologically safe. They contain no odour or taste-affecting substances.

The following standard material combination has proved effective for most applications:

- Seal ring: Turcon® T40
- Spring: Stainless Steel Material No. AISI 301

For use in accordance with the demands of the "Food and Drug Administration", suitable materials are available on request.

Lead-in chamfers

In order to avoid damage during installation, lead-in chamfers and rounded edges must be provided on the housing and on the rod (Figure 96). If this is not possible for design reasons, a separate installation tool is recommended.

The minimum length of the lead-in chamfer depends on the profile size of the seal and can be seen from the following tables. If concentricity between the parts is not ensured during installation the lead-in chamfers must be increased correspondingly.

For the surface quality of the lead-in chamfer, the same recommendations apply as given for the sealing surfaces in Table LXVI.

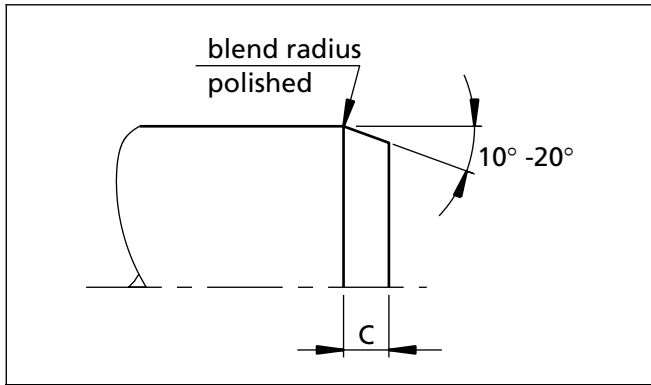


Figure 96 Lead-in chamfer on shaft

Table LXIV Lead-in chamfers for Turcon[®] Roto Variseal[®]

| Series | Lead-in Chamfers Length C min. |
|--------|--------------------------------|
| TVM1 | 4.5 |
| TVM2 | 5.0 |
| TVM3 | 8.0 |
| TVM4 | 12.0 |

Mating surface materials

Sealing of applications with rotating movements require very good mating surfaces. A minimum hardness 55 HRC is recommended to a hardening depth of at least 0.3 mm.

Particular attention must be paid to coated surfaces and good heat dissipation through the coating is required.

Shaft bearing/Radial clearance for bearing

In general the sealing elements should not take on any bearing tasks as this will reduce the functioning of the seals. Consequently we recommend to guide the components by means of a roller or slide bearing.

■ Installation of Turcon[®] Roto Variseal[®]

Installation instructions

The following points should be observed before installation of the seals:

- Check whether housing or rod has a lead-in chamfer; if not, use an installation sleeve
- Deburr and chamfer or round sharp edges, cover the tips of any screw threads
- Remove machining residues such as chips, dirt and other foreign particles and carefully clean all parts
- If the seals are installed with grease or oil, attention must be paid to the compatibility of the seal materials with these lubricants. Use only grease without solid additives (e.g. molybdenum disulphide or zinc sulphide)
- Do not use installation tools with sharp edges

Installation of Turcon[®] Roto Variseal[®]

Turcon[®] Roto Variseal[®] is installed in split grooves.

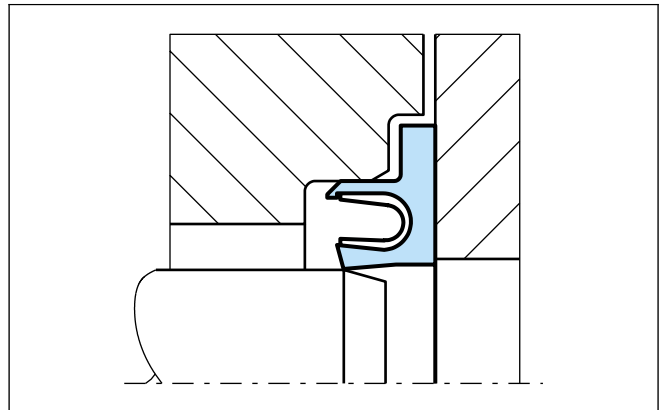


Figure 97 Turcon[®] Roto Variseal[®]

Installation should be performed in the following steps in order to ensure a concentric and strain-free fit:

- Place the seal ring in into the open groove
- Fit the cover loosely onto the housing
- Insert the shaft
- Tighten the cover



Table LXV Standard Turcon® materials for Roto Variseal®

| Material, Applications, Properties | Code | Spring material | Code | Operating temp. °C | Mating surface material | MPa max. |
|---|------|-----------------------------|------|--------------------|--|----------|
| Turcon® T40 For all lubricating and non-lubricating hydraulic fluids, water hydraulics, soft mating surfaces Carbon fibre filled Colour: Grey | T40 | Spring material AISI 301 | S | -100 to +260 | Steel Steel, chromeplated Cast iron Stainless steel, Aluminium Bronze Alloys | 15 |
| Turcon® T78 For all lubricated and non-lubricated applications, soft mating surfaces. Aromatic polymer Colour: Tan to dark brown | T78 | Spring material AISI 301 | S | -100 to +260 | Steel Steel, chromeplated Cast iron Stainless steel | 5 |

Highlighted materials are standard.

Trelleborg Sealing Solutions recommends that the following surface finishes be observed :

Table LXVI Surface roughness

| Recommended maximum surface roughness µm | | |
|--|--|---|
| Media | Shaft surface ¹⁾ | Static groove surface |
| Cryogenic and low molecular gases Hydrogen, Helium, Freon, Oxygen Nitrogen | R _{max} = 1.0 µm R _z = 0.63 µm R _a = 0.1 µm | R _{max} = 3.5 µm R _z = 2.2 µm R _a = 0.3 µm |
| Low viscosity fluids Water, Alcohols, Hydrazine, Gaseous nitrogen, Natural gas, Skydrol, air | R _{max} = 2.5 µm R _z = 1.6 µm R _a = 0.2 µm | R _{max} = 5.0 µm R _z = 3.5 µm R _a = 0.6 µm |
| High viscosity fluids Hydraulic oils, Crude oil, Gear oil, Sealants, Glue, Milkproducts | R _{max} = 2.5 µm R _z = 1.6 µm R _a = 0.2 µm | R _{max} = 6.5 µm R _z = 5.0 µm R _a = 0.8 µm |

¹⁾ The sealing surface must be free from spiral grooves.

The material contact area R_{mr} should be approx. 50 to 70%, determined at a cut depth c = 0.25 x R_z, relative to a reference line of C_{ref}. 5%.



■ Installation recommendation

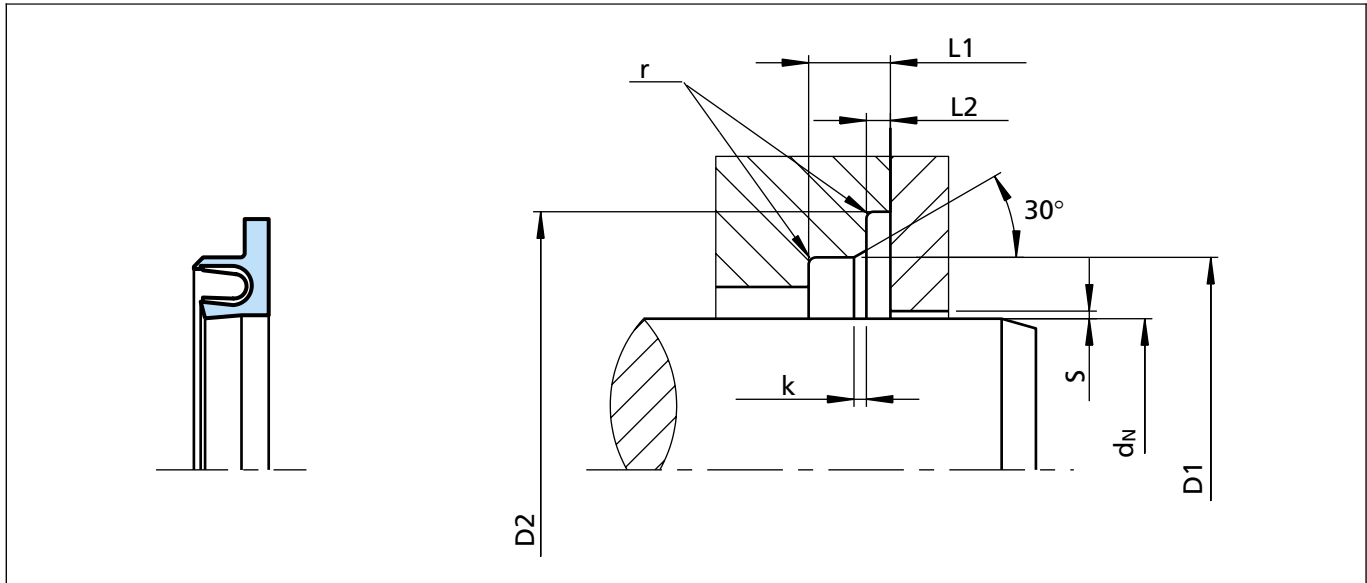


Figure 98 Installation drawing

Table LXVII Installation dimensions

| Series no. | Rod diameter | | Groove diameter | | Groove width | | Lead-in chamfer | Ra- dius | Radial clearance S max. | | |
|------------|-------------------------------|---|-----------------|--------------|--------------|-----------------|-----------------|-------------|----------------------------|------|---------|
| | Standard range d_N f8/h9 | Available ¹⁾ range d_N f8/h9 | D_1 H9 | D_2 H10 | L_1 min | L_2 | | | k | r | < 2 MPa |
| TVM1 | 5.0 - 19.9 | 5.0 - 200.0 | $d_N + 5.0$ | $d_N + 9.0$ | 3.6 | $0.85 +0 -0.1$ | 0.3 | 0.8 | 0.25 | 0.15 | 0.10 |
| TVM2 | 20.0 - 39.9 | 10.0 - 400.0 | $d_N + 7.0$ | $d_N + 12.5$ | 4.8 | $1.35 +0 -0.15$ | 0.4 | 1.1 | 0.35 | 0.20 | 0.15 |
| TVM3 | 40.0 - 399.9 | 20.0 - 700.0 | $d_N + 10.5$ | $d_N + 17.5$ | 7.1 | $1.80 +0 -0.20$ | 0.5 | 1.4 | 0.50 | 0.25 | 0.20 |
| TVM4 | 400.0 - 999.9 | 35.0 - 999.9 | $d_N + 14.0$ | $d_N + 22.0$ | 9.5 | $2.80 +0 -0.20$ | 0.5 | 1.6 | 0.60 | 0.30 | 0.25 |

¹⁾ Available on request. Application of a seal series outside of the standard range can impair seal performance and stability and should only be made after careful testing and evaluation.



Ordering example

Turcon® Roto Variseal®, series TVM3 (from Table LXVII).

Rod diameter: $d_N = 80.0$ mm

TSS Part No.: TVM300800 (from Table LXVIII)

Select the material from Table LXV. The corresponding code numbers are appended to the TSS Part No. (from Table LXVIII). Together they form the TSS Article No. For all intermediate sizes not shown in Table LXVII, the TSS Article No. can be determined from the example opposite.

* For diameters ≥ 1000.0 mm multiply only by factor 1.
Example: TVM4 for diameter 1200.0 mm.

TSS Article No.: TVM4X1200 - T40S.

** Roto Variseal® are available with the spring groove filled with high temperature silicone. The silicone prevents entrapment of biological contaminants in the seal making the seal easier to clean.

| | | | | | | | |
|---------------------------|------|---|------|---|-----|---|-----|
| TSS Article No. | TVM3 | 0 | 0800 | - | T40 | S | (D) |
| TSS Series No. | | | | | | | |
| Type (Standard) | | | | | | | |
| Rod Diameter x 10* | | | | | | | |
| Quality Index (Standard) | | | | | | | |
| Material code - Seal ring | | | | | | | |
| Material code - Spring | | | | | | | |
| Hi-Clean** - (option) | | | | | | | |

Table LXVIII Preferred dimension / TSS Part No.

| Rod diameter d_N f8/h9 | Groove diameter | | Groove width L_1 | TSS Part No. |
|-----------------------------|-----------------|-----------|-----------------------|------------------|
| | D_1 H9 | D_2 H10 | | |
| 5.0 | 10.0 | 14.0 | 3.6 | TVM100050 |
| 6.0 | 11.0 | 15.0 | 3.6 | TVM100060 |
| 8.0 | 13.0 | 17.0 | 3.6 | TVM100080 |
| 10.0 | 15.0 | 19.0 | 3.6 | TVM100100 |
| 12.0 | 17.0 | 21.0 | 3.6 | TVM100120 |
| 14.0 | 19.0 | 23.0 | 3.6 | TVM100140 |
| 15.0 | 20.0 | 24.0 | 3.6 | TVM100150 |
| 16.0 | 21.0 | 25.0 | 3.6 | TVM100160 |
| 18.0 | 23.0 | 27.0 | 3.6 | TVM100180 |
| 20.0 | 27.0 | 32.5 | 4.8 | TVM200200 |
| 22.0 | 29.0 | 34.5 | 4.8 | TVM200220 |
| 25.0 | 32.0 | 37.5 | 4.8 | TVM200250 |
| 28.0 | 35.0 | 40.5 | 4.8 | TVM200280 |
| 30.0 | 37.0 | 42.5 | 4.8 | TVM200300 |
| 32.0 | 39.0 | 44.5 | 4.8 | TVM200320 |
| 35.0 | 42.0 | 47.5 | 4.8 | TVM200350 |
| 36.0 | 43.0 | 48.5 | 4.8 | TVM200360 |
| 40.0 | 50.5 | 57.5 | 7.1 | TVM300400 |
| 42.0 | 52.5 | 59.5 | 7.1 | TVM300420 |
| 45.0 | 55.5 | 62.5 | 7.1 | TVM300450 |
| 48.0 | 58.5 | 65.5 | 7.1 | TVM300480 |
| 50.0 | 60.5 | 67.5 | 7.1 | TVM300500 |
| 52.0 | 62.5 | 69.5 | 7.1 | TVM300520 |
| 55.0 | 65.5 | 72.5 | 7.1 | TVM300550 |

| Rod diameter d_N f8/h9 | Groove diameter | | Groove width L_1 | TSS Part No. |
|-----------------------------|-----------------|-----------|-----------------------|------------------|
| | D_1 H9 | D_2 H10 | | |
| 56.0 | 66.5 | 73.5 | 7.1 | TVM300560 |
| 60.0 | 70.5 | 77.5 | 7.1 | TVM300600 |
| 63.0 | 73.5 | 80.5 | 7.1 | TVM300630 |
| 65.0 | 75.5 | 82.5 | 7.1 | TVM300650 |
| 70.0 | 80.5 | 87.5 | 7.1 | TVM300700 |
| 75.0 | 85.5 | 92.5 | 7.1 | TVM300750 |
| 80.0 | 90.5 | 97.5 | 7.1 | TVM300800 |
| 85.0 | 95.5 | 102.5 | 7.1 | TVM300850 |
| 90.0 | 100.5 | 107.5 | 7.1 | TVM300900 |
| 95.0 | 105.5 | 112.5 | 7.1 | TVM300950 |
| 100.0 | 110.5 | 117.5 | 7.1 | TVM301000 |
| 105.0 | 115.5 | 122.5 | 7.1 | TVM301050 |
| 110.0 | 120.5 | 127.5 | 7.1 | TVM301100 |
| 115.0 | 125.5 | 132.5 | 7.1 | TVM301150 |
| 120.0 | 130.5 | 137.5 | 7.1 | TVM301200 |
| 125.0 | 135.5 | 142.5 | 7.1 | TVM301250 |
| 130.0 | 140.5 | 147.5 | 7.1 | TVM301300 |
| 135.0 | 145.5 | 152.5 | 7.1 | TVM301350 |
| 140.0 | 150.5 | 157.5 | 7.1 | TVM301400 |
| 150.0 | 160.5 | 167.5 | 7.1 | TVM301500 |
| 160.0 | 170.5 | 177.5 | 7.1 | TVM301600 |
| 170.0 | 180.5 | 187.5 | 7.1 | TVM301700 |
| 180.0 | 190.5 | 197.5 | 7.1 | TVM301800 |
| 190.0 | 200.5 | 207.5 | 7.1 | TVM301900 |



| Rod diameter | Groove diameter | | Groove width | TSS Part No. |
|--------------|-----------------|--------------|--------------|------------------|
| | d_N f8/h9 | D_1 H9 | D_2 H10 | |
| 200.0 | 210.5 | 217.5 | 7.1 | TVM302000 |
| 210.0 | 220.5 | 227.5 | 7.1 | TVM302100 |
| 220.0 | 230.5 | 237.5 | 7.1 | TVM302200 |
| 230.0 | 240.5 | 247.5 | 7.1 | TVM302300 |
| 240.0 | 250.5 | 257.5 | 7.1 | TVM302400 |
| 250.0 | 260.5 | 267.5 | 7.1 | TVM302500 |
| 280.0 | 290.5 | 297.5 | 7.1 | TVM302800 |
| 300.0 | 310.5 | 317.5 | 7.1 | TVM303000 |
| 320.0 | 330.5 | 337.5 | 7.1 | TVM303200 |
| 350.0 | 360.5 | 367.5 | 7.1 | TVM303500 |
| 360.0 | 370.5 | 377.5 | 7.1 | TVM303600 |
| 400.0 | 410.5 | 417.5 | 7.1 | TVM304000 |
| 420.0 | 434.0 | 442.0 | 9.5 | TVM404200 |
| 450.0 | 464.0 | 472.0 | 9.5 | TVM404500 |
| 480.0 | 494.0 | 502.0 | 9.5 | TVM404800 |
| 500.0 | 514.0 | 522.0 | 9.5 | TVM405000 |
| 600.0 | 614.0 | 622.0 | 9.5 | TVM406000 |
| 700.0 | 714.0 | 722.0 | 9.5 | TVM407000 |

The rod diameters printed in **bold** type conform to the recommendations of ISO 3320.

Other dimensions and all intermediate sizes up to 2500 mm diameter including imperial (inch) sizes can be supplied.



Notes

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