

Rotary Seal

General description	1
Introduction	7
Working parameters	7
Environment	9
Quality	11
Storage and shelf life	11
Design instructions	13
Radial oil seal	16
The seal	16
Shaft and housing design	25
Standard types of rotary seals	27
Busak+Shamban type TRA and STEFA type CB (DIN 3760 type A)	28
Busak+Shamban type TRE and STEFA type CC (DIN 3760 type AS)	48
Busak+Shamban type TRC and STEFA type BB (DIN 3761 type B)	59
Busak+Shamban type TRD and STEFA type BC (DIN 3761 type BS)	65
Busak+Shamban type TRB and STEFA type DB (DIN 3761 type C)	70
Busak+Shamban type TRF and STEFA type DC (DIN 3761 type CS)	77
Special types of rotary seals	80
Busak+Shamban types TRD_A / TRD_B and STEFA type 1B/CC / 2B/CC	81
Busak+Shamban type TRU - medium pressure oil seal	83
Busak+Shamban type TRP and STEFA type 6CC - medium pressure oil seal	87
STEFA type 12CC - medium - high pressure oil seal	90
Busak+Shamban type TRK and STEFA type CD	92
Busak+Shamban type TRG and STEFA type BD	96
Rotary and axial seal combination	100
Product description	102
Combined rotary shaft seals	103
STEFA standard APJ types	104
STEFA 1B/APJ and 2B/APJ types - housing as per DIN 3760-3761	106
End cover	108
Busak+Shamban type YJ 38 and STEFA type VK	108
Busak+Shamban type YJ 39	112
Shaft repair kit	114
Installation recommendation, metric sizes	116
Installation recommendation, imperial sizes	118
Cassette seal	122
General	122
STEFA System 500	122
STEFA System 3000	123
STEFA System 5000	123
Material	126
Application	127
Installation	130

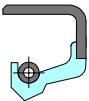
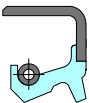
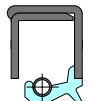
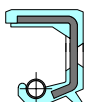
Rotary Seal

V-Ring	132
General	132
Materials	133
Installation	136
Dimension table, V-Ring type A	139
Dimension table, V-Ring type S	142
Dimension table, V-Ring type L / LX	144
Dimension table, V-Ring type RM / RME	146
Dimension table, V-Ring type AX	150
GAMMA seal	152
GAMMA seal type TBP/RB	156
GAMMA seal type TBR/9RB	159
Axial shaft seal	161
General	161
Applications	163
Materials	164
Installation recommendation, type I, internal sealing, for oil and grease	166
Installation Recommendation, type A, external sealing, for grease only	170
Varilip® - Turcon® shaft seals	173
Description	173
Varilip®, type A	173
Varilip®, type B	173
Varilip®, type C	174
Varilip®, type D	174
Materials	177
Design instructions	178
Installation recommendation	179
PDR™ - PTFE shaft seals	185
Technical data	187
Materials	193
Turcon® rotary seals - elastomer energized	197
Turcon® Roto Glyd Ring®	197
Installation of Turcon® Roto Glyd Ring®	200
Installation recommendation - external sealing	204
Installation recommendation - internal sealing	207
Special solutions for rotary applications	210
Turcon® rotary seals - spring energized	211
Turcon® Roto Variseal®	211
Installation of Turcon® Roto Variseal®	213
Installation recommendation	215

Rotary Seal

GENERAL DESCRIPTION

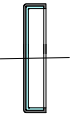
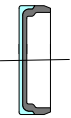
Table I Rotary seals selection criteria - Radial oil seals

Family	Seal					Installation	Outer cover		Dust lip		Technical data*	
	Profile	Page	B+S type	Forsheda/ STEFA Type	Standard (Characteristics)	Size range mm	Rubber Coated	Metal	With	Without	Speed m/s	Pressure MPa max.
Radial Oil Seals 		28	TRA	CB	ISO 6194/1 DIN 3760 Type A	4 - 500	X			X	30	0.05
		48	TRE	CC	ISO 6194/0 DIN 3761 Type AS	6 - 380	X		X		30	0.05
		59	TRC	BB	ISO 6194/1 DIN 3761 Type B	6 - 550		X		X	30	0.05
		65	TRD	BC	ISO 6194/1 DIN 3761 Type BS	15 - 400		X	X		30	0.05
		70	TRB	DB	ISO 6194/1 DIN 3761 Type C	20 - 760		X		X	30	0.05
		77	TRF	DC	ISO 6194/1 DIN 3761 Type CS	35 - 600		X	X		30	0.05
		81	TRD_A	1B/CC	Combined seal Rubber at backface	On demand	Half	Half	X		30	0.05
		81	TRD_B	2B/CC	Combined seal Rubber at frontface	On demand	Half	Half	X		30	0.05
		83	TRU	-	Pressure seal	8 - 120	X		X		15	0.5

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

Rotary Seal

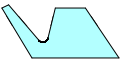
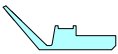
Radial oil seals - End covers - Shaft repair kit - Cassette seals

Family	Seal					Installation	Outer cover		Dust lip		Technical data*	
	Profile	Page	B+S type	Forsheda/ STEFA Type	Standard (Characteristics)	Size range mm	Rubber Coated	Metal	With	Without	Speed m/s	Pressure MPa max.
Radial Oil Seals 		87	TRP	6CC	Pressure seal	11 - 365	X		X		15	0.5
		90	TRQ_D	12CC	Pressure seal	15 - 55	X		X		15	1.0
		92	TRK	CD	Low friction, no spring	4 - 70	X			X	10	Without
		96	TRG	BD	Low friction, no spring	4 - 70		X		X	10	Without
End Covers 		108	YJ38	VK	End cover	16 - 230	X					0.02
		112	YJ39	-	End cover	22 - 270	Half	Half				0.5
Shaft Repair Kit 		114	TS	-	Sleeve	12 - 200		X				-
Cassette Seals 		122	TC5	System 500 1HH	System 500	90 - 320		X			10	0.05
		123	TC3	System 3000 1HHD	System 3000	130 - 150		X	X		4	0.05
		123	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	Retention/Clamping possibilities		Technical data*	
	Profile	Page	B+S designation	Forsheda-type	Standard (characteristics)	Size range mm	With clamping band	With axial retention	Speed m/s	Pressure MPa max.
V-Ring		139	VA	A	V-Ring Standard	2.7 - 2010		X	10	Without
		142	VS	S	V-Ring Extended body	4.5 - 210		X	10	Without
		144	VL	L	V-Ring Small profile	105 - 2025		X	10	Without
		144	LX	LX	V-Ring Large diameter rigid lip	135 - 2025		X	10	Without
		146	RM	RM	V-Ring Standard with clamping band, extended body	300 - 2010	X		10	Without
		146	VB	RME	V-Ring Standard with clamping band	300 - 2010	X		10	Without
		150	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	B+S type	STEFA type	Standard (Characteristics)	Size range mm	Speed m/s	Pressure MPa max.
GAMMA Seals 		152	TBP	RB	GAMMA Seal standard	10 - 225	20	Without
		152	TBR	9RB	GAMMA Seal with labyrinth	15 - 108	20	Without
Axial Shaft Seals 		161	I	-	Axial shaft seal inside sealing	10 - 100	30	0.01
		161	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

Varilip® - Turcon® shaft seals

Family	Seal		Application	Standard	Size range	Function		Technical data*			Material	Shaft
	Type	Page				Single acting	Double acting	Temp.** range	Speed	Pres- sure		
			Field of application	ISO/DIN	mm			°C	m/s	MPa max.	Standard seal material	Mating surface hardness
Varilip® 	Varilip® Type A 	173	Pumps Separators Compressors Blowers Centrifuges	DIN 3760	6 - 170	X	-	-60 to +200	40	0.5	Turcon® T25	>55 HRc
				ISO 6194/1							Turcon® T78	> 170 HB
	Varilip® Type B 	173	Machine tools Gearboxes Mixers Blowers	DIN 3760	6 - 170	X	-	-60 to +200	20	0.5	Turcon® T25	>55 HRc
				ISO 6194/1							Turcon® T78	> 170 HB
	Varilip® Type C 	174	Pumps Machine tools Compressors	DIN 3760	6 - 170	X	-	-60 to +200	20	2	Turcon® T25	>55 HRc
				ISO 6194/1							Turcon® T78	> 170 HB
	Varilip® Type D 	174	Separators Hubs Bearings Mixers	DIN 3760	6 - 170	-	X	-60 to +200	20	0.1	Turcon® T25	>55 HRc
				ISO 6194/1							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.

Rotary Seal

PDR™ - PTFE shaft seals

Family	Seal		Application	Standard	Size range	Function		Technical Data*			Material	Shaft
	Type	Page				Field of application	Temp.** range	Speed	Pres- sure			
			ISO/DIN	mm	Single acting					Double acting	°C	m/s
PDR™ 		185	Compressors Vacuum pumps Crankshaft seals Gearboxes Grease retainers Pumps	Special	3 - 1500	X	X	-100 to +260	90	1.5	Various PTFE materials	>20 HRc

* 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.

Turcon® rotary seals

Family	Seal		Application	Standard	Size range	Function		Technical Data*			Material	Shaft
	Type	Page				Field of application	Single acting	Double acting	Temp.** range	Speed		
			ISO/DIN	mm	°C				m/s	MPa max.	Standard seal material	Mating surface hardness
Turcon® seals Elastomer energized 	Turcon® Roto Glyd Ring® O.D. 	197	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. 	197	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® 	211	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, B+S 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 B+S 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 B+S 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 B+S 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

Rotary Seal

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.

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 I.

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 I.

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 Busak+Shamban 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. Busak+Shamban recommend a minimum hardness of 55 HRC on minimum 0.3mm 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.

■ 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 1 the resistance of elastomeric materials are given to “bio-oils”. They are, however, provided with a number of comments.

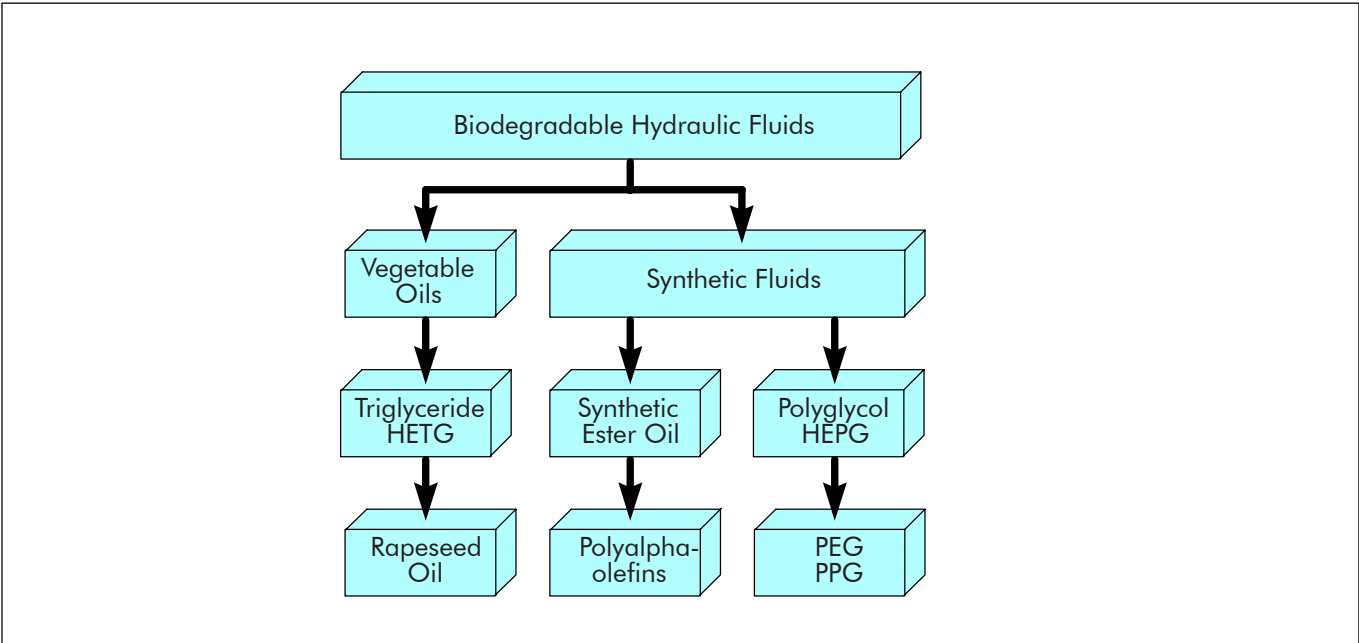


Figure 1 Biodegradable hydraulic fluids

Rotary Seal

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.

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

Oil Temperature	< 60°C	< 80°C	< 100°C	< 120°C
ISO VG Oil Type	32 - 68	32 - 68	32 - 68	32 - 68
HETG (Rapeseed)	AU1 NBR HNBR FKM	AU1 NBR HNBR FKM	--- --- --- ---	--- --- --- ---
HEES	AU1 NBR1 HNBR1 FKM1	AU1 NBR1 HNBR1 FKM	--- --- --- FKM	--- --- --- FKM
HEPG (PAG)	AU1 NBR1 HNBR1 FKM1	NBR HNBR FKM2	HNBR FKM2	HNBR FKM2
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

■ Quality criteria

The cost-effective use of seals and bearings is highly influenced by the quality criteria applied in production. Seals and bearings from Busak+Shamban 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 Busak+Shamban 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.

Rotary Seal

Radiation

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

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 tolerated 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
	$R_{\text{max.}}$	= 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.

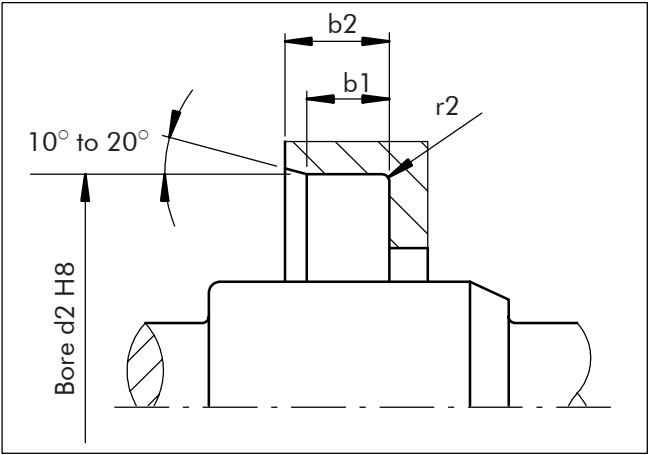


Figure 2 Installation depth and lead-in chamfer

Table III Housing dimensions

Ring Width b	b ₁ (0.85 × 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

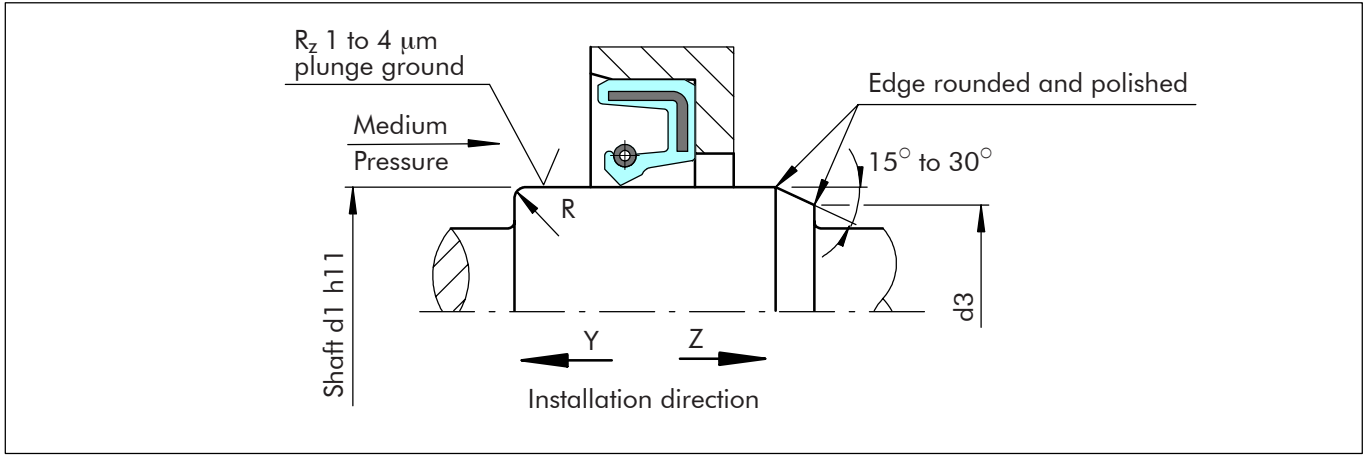


Figure 3 Installation of the Radial Oil Seal

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

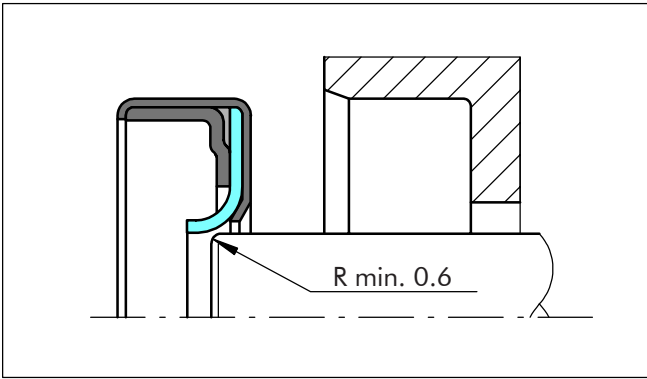


Figure 4 Installation of the sealing lip with the back to the shaft for pressurised application

Lead-in chamfers for Varilip® and PDR™

When installing Varilip® and PDR™ seals, careful handling is particularly important in order to avoid damaging the sealing lip. Several methods can be employed, depending on the design.

If the seal is installed from the back, radii or lead-in chamfers must be made on the ends of the shaft (Figure 4).

When installing the seal with the lip against the shaft end, a lead-in chamfer is required whose smallest diameter is smaller than the unstressed diameter of the sealing lip. Table V shows guide values for this. Preferable is the use of an installation tool (Figure 5).

Table V Lead-in chamfers

Shaft Dia. d_1	6 - 60	65 - 135	140 - 170
Cone Dia. d_3	$d_1 - 3$	$d_1 - 4$	$d_1 - 5.5$

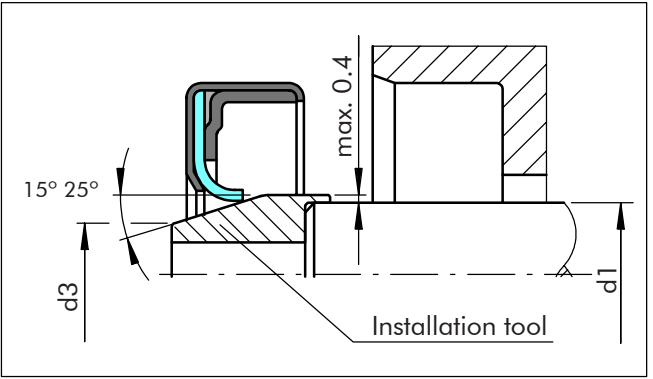


Figure 5 Fitting the sealing lip using an installation tool

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 or lubricated with system fluid for Varilip® and PDR™
- 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 6 shows various force fit situations of the rotary shaft lip seal with suitable installation tools or devices.

Rotary Seal

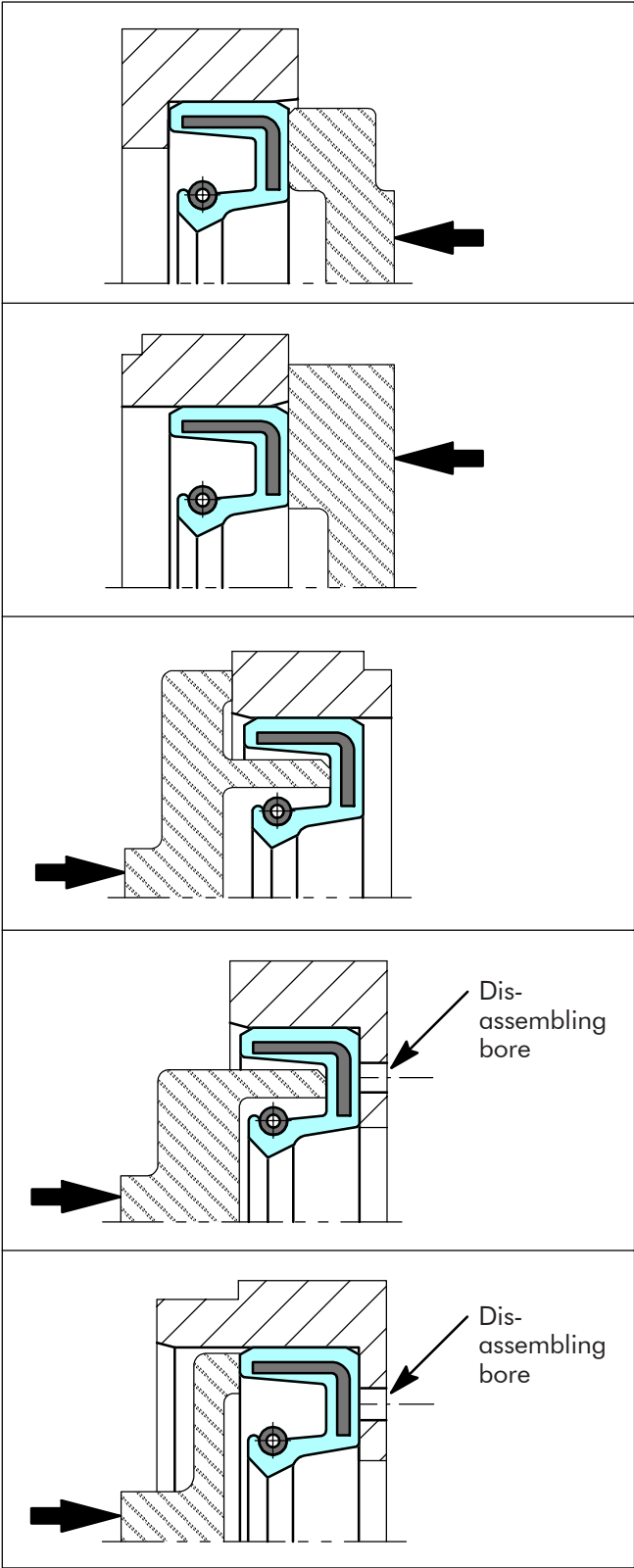


Figure 6 Installation aids for fitting rotary shaft lip seals

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 7. 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 7 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

■ 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.

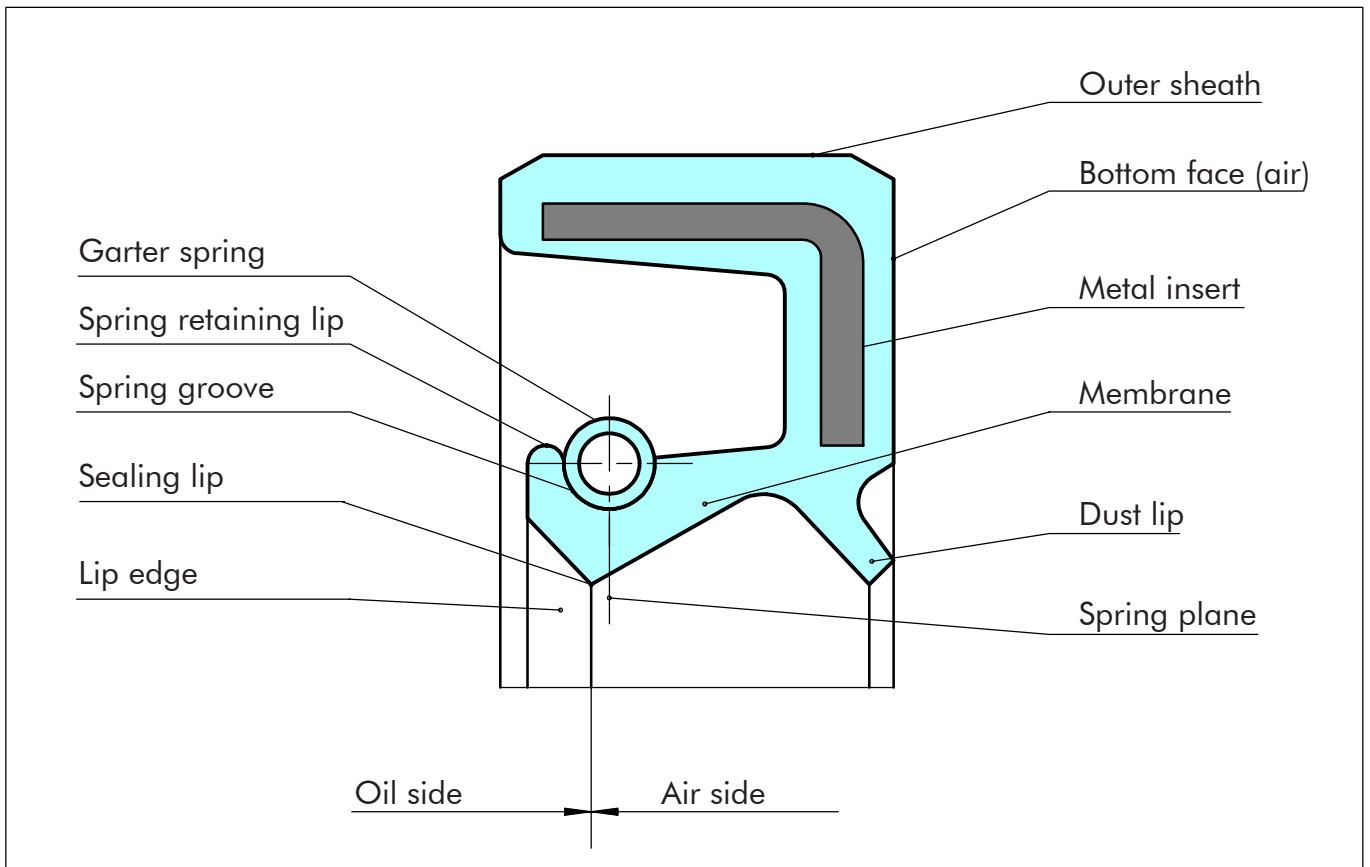


Figure 8 Designations for Rotary shaft lip seals (extract from ISO 6194)



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 VI 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
Flame retardant hydraulic fluids (VDMA 24317) (VDMA 24320)	Greases	90	- -	- -	- -	100
	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, gas	- -	- -	- -	- -	130



Description of rubber materials

Nitrile Rubber (NBR)

Advantages:

- Good oil resistance
- Good heat resistance up to 125°C in oil, 100°C in air, 80°C in water
- High tensile strength (special compounds over 20 MPa)
- High tear strength
- Low swelling in water

Limitations:

- Poor weather and ozone resistance
- Poor resistance against polar fluids (ester, ether, acetone and aniline)
- Poor resistance against chlorinated hydrocarbons (carbon tetrachloride, trichlorethylene)
- Poor resistance against aromatic fluids (bensine, 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, acetone 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
- Excellent weather and ozone resistance
- Excellent acid resistance
- Low swelling in steam and hot water

Limitations:

- Limited cold flexibility, to approx. -20°C to -25°C
- Limited tensile and tear strength, especially above 100°C
- Limited wear resistance
- 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 pure mineral oils and most grease types

Limitations:

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



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 9. 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 VI must thus be regarded as only approximate.

In case of doubt always contact your local B+S company.

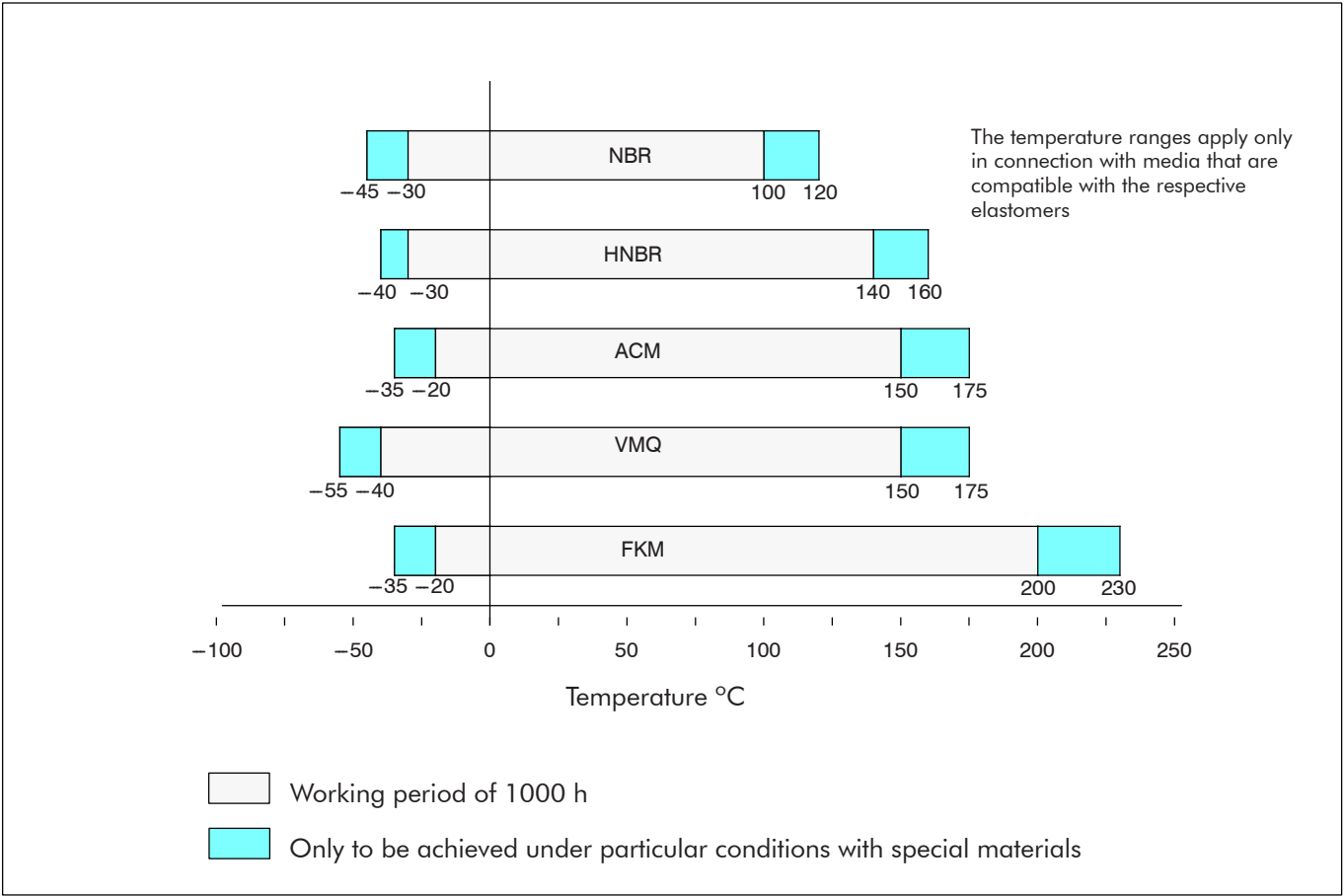


Figure 9 Temperature limits for some common types of rubber



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 10 and 11 show the change in the initial tension in stabilized and not-stabilised garter springs.

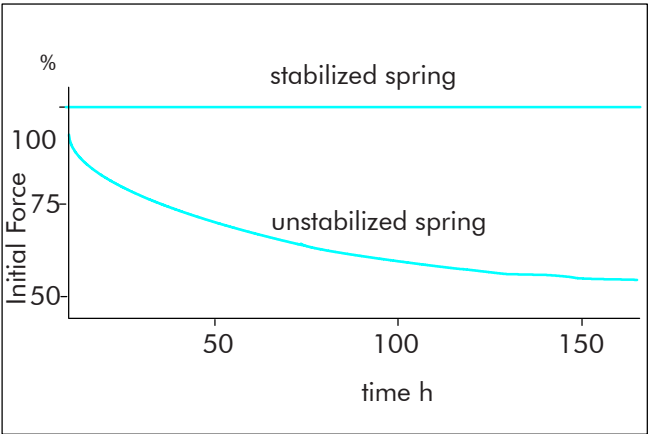


Figure 10 The change in the initial tension in stabilized and not-stabilised garter springs.

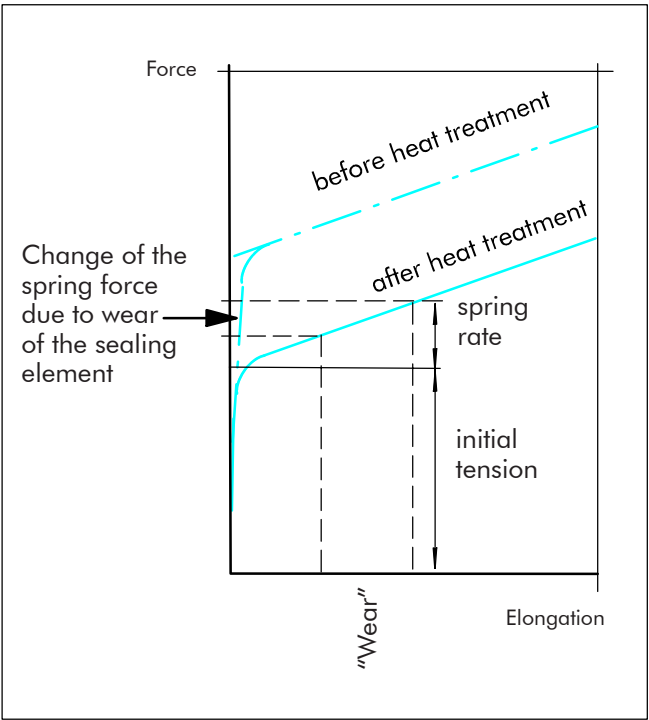


Figure 11 Spring force versus elongation

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.



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 12. However, the back-up ring requires much accurate fitting. Please ask your local B+S company for

suitable back-up ring drawing. The cases of seal type TRU are formed to support the sealing element. See Figure 12. 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.

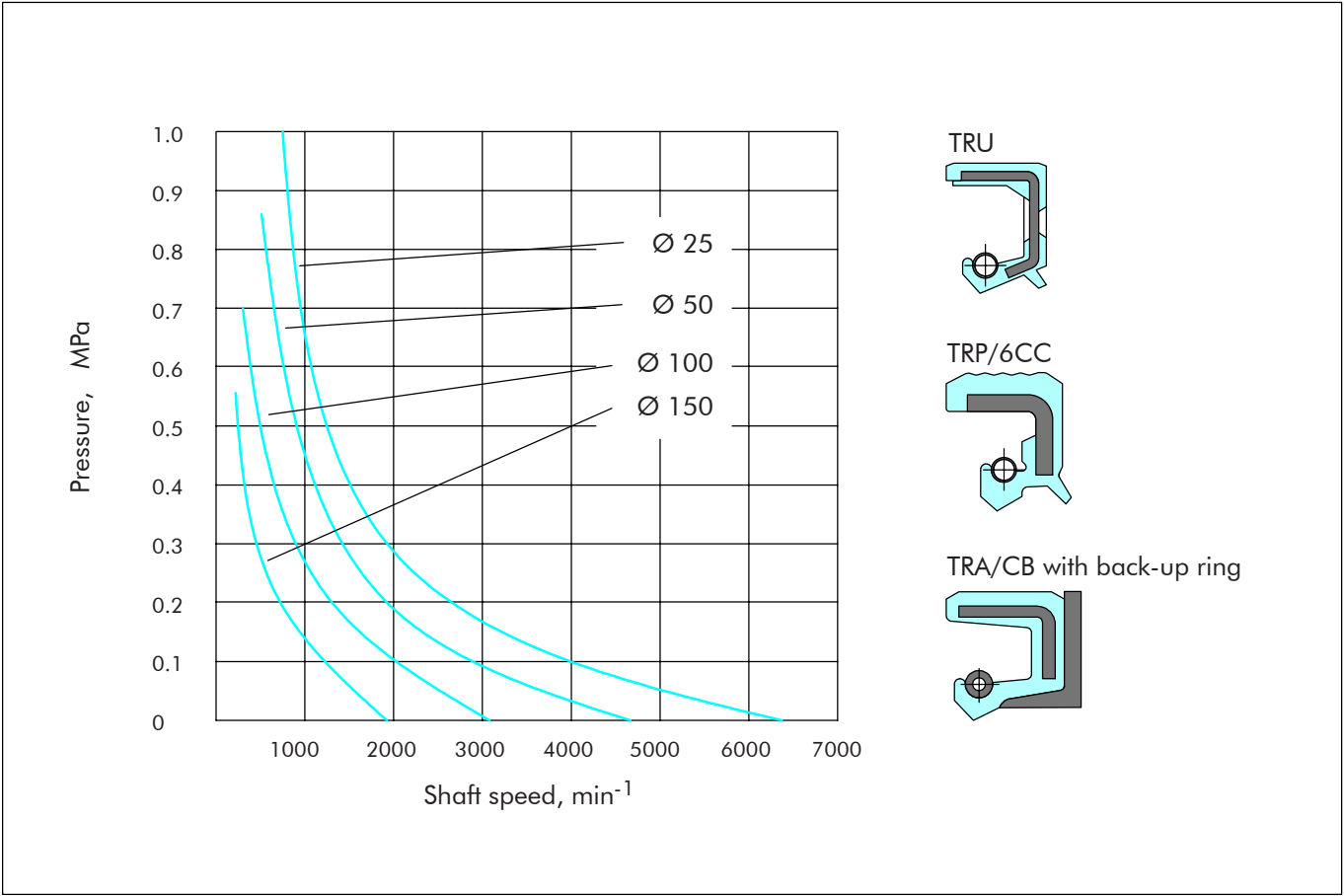


Figure 12 Permissible overpressure for supported lip seals and for pressure seals



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 13 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 VI 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.

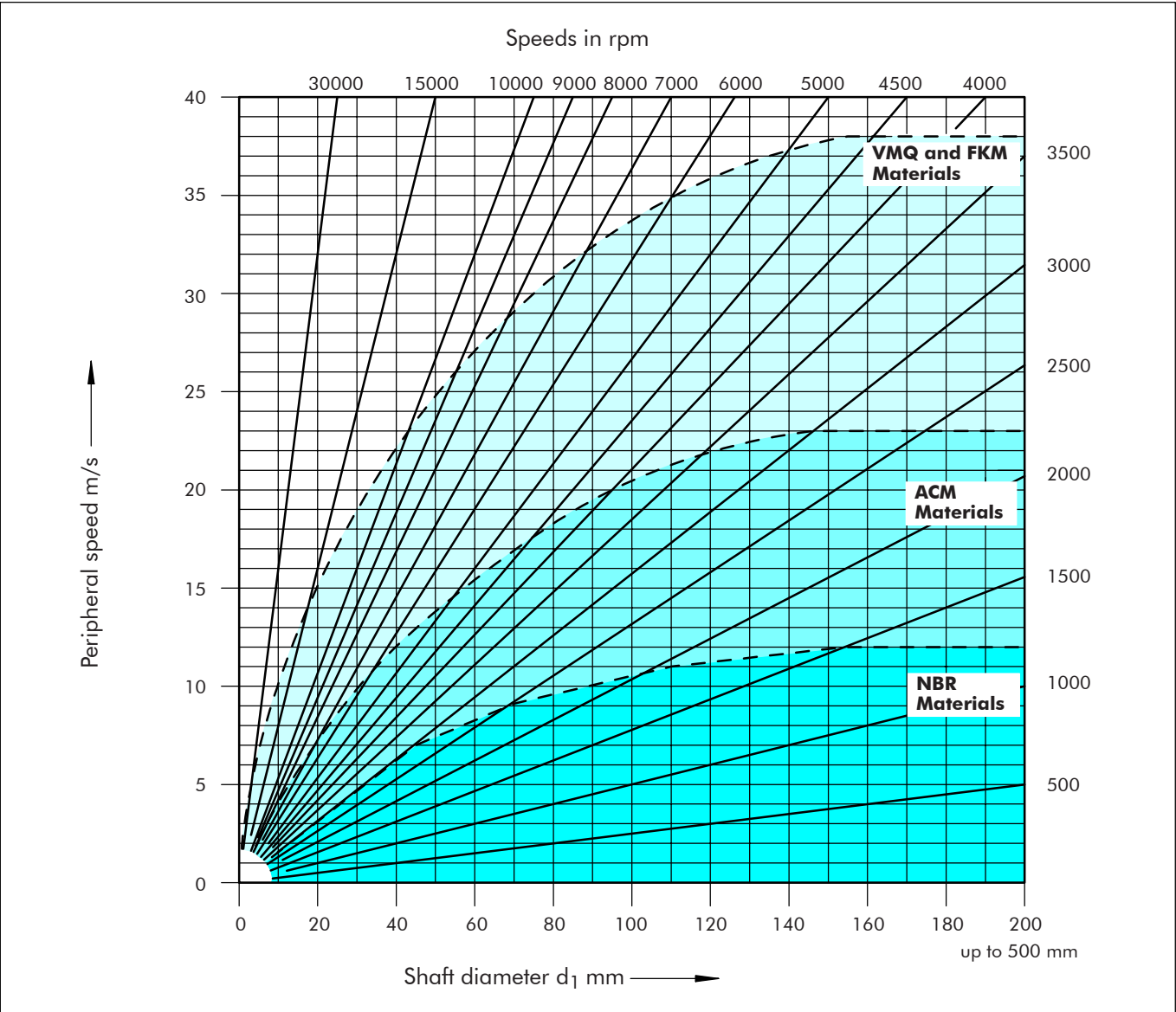


Figure 13 Permissible speeds in pressure-free state to DIN 3761



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 VI.

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 14 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.

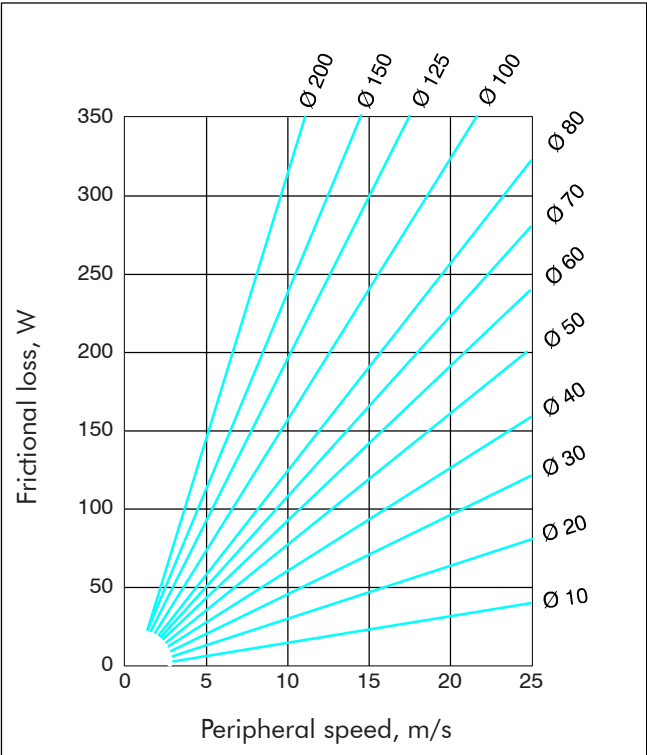


Figure 14 Frictional loss for TRA/CB type seal of nitrile rubber



■ 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 $R_t=1\text{ }\mu\text{m}$ to $4\text{ }\mu\text{m}$. Laboratory tests have however proved that the most suitable roughness is $R_t=2\text{ }\mu\text{m}$ ($R_a=0.3\text{ }\mu\text{m}$). Rougher as well as smoother surfaces generate higher friction, resulting in increased temperature and wear. We suggest a surface roughness of $R_t=2\text{--}3\text{ }\mu\text{m}$ ($R_a=0.3\text{--}0.8\text{ }\mu\text{m}$).

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 15.

Eccentricity

Eccentricity between shaft and housing bore centers should be avoided in order to eliminate unilateral load of the lip. See Figure 16.

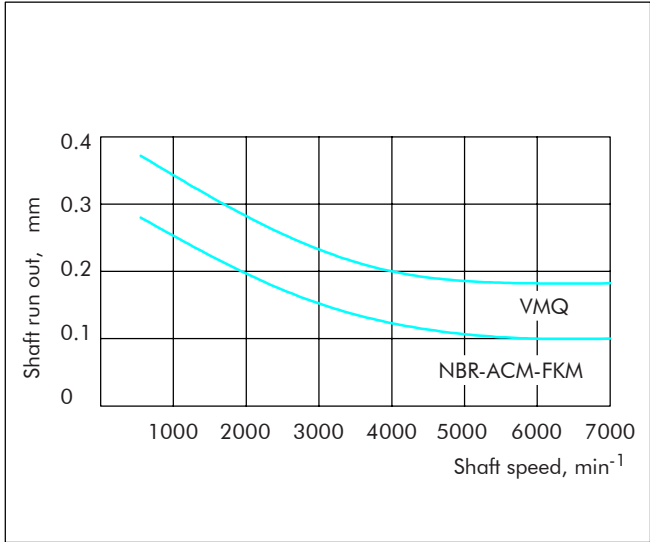


Figure 15 Shaft run out

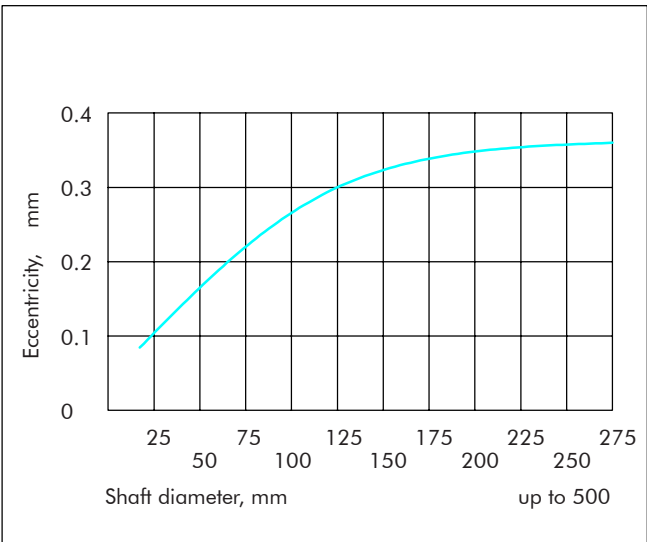


Figure 16 Eccentricity



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 "General description".

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.

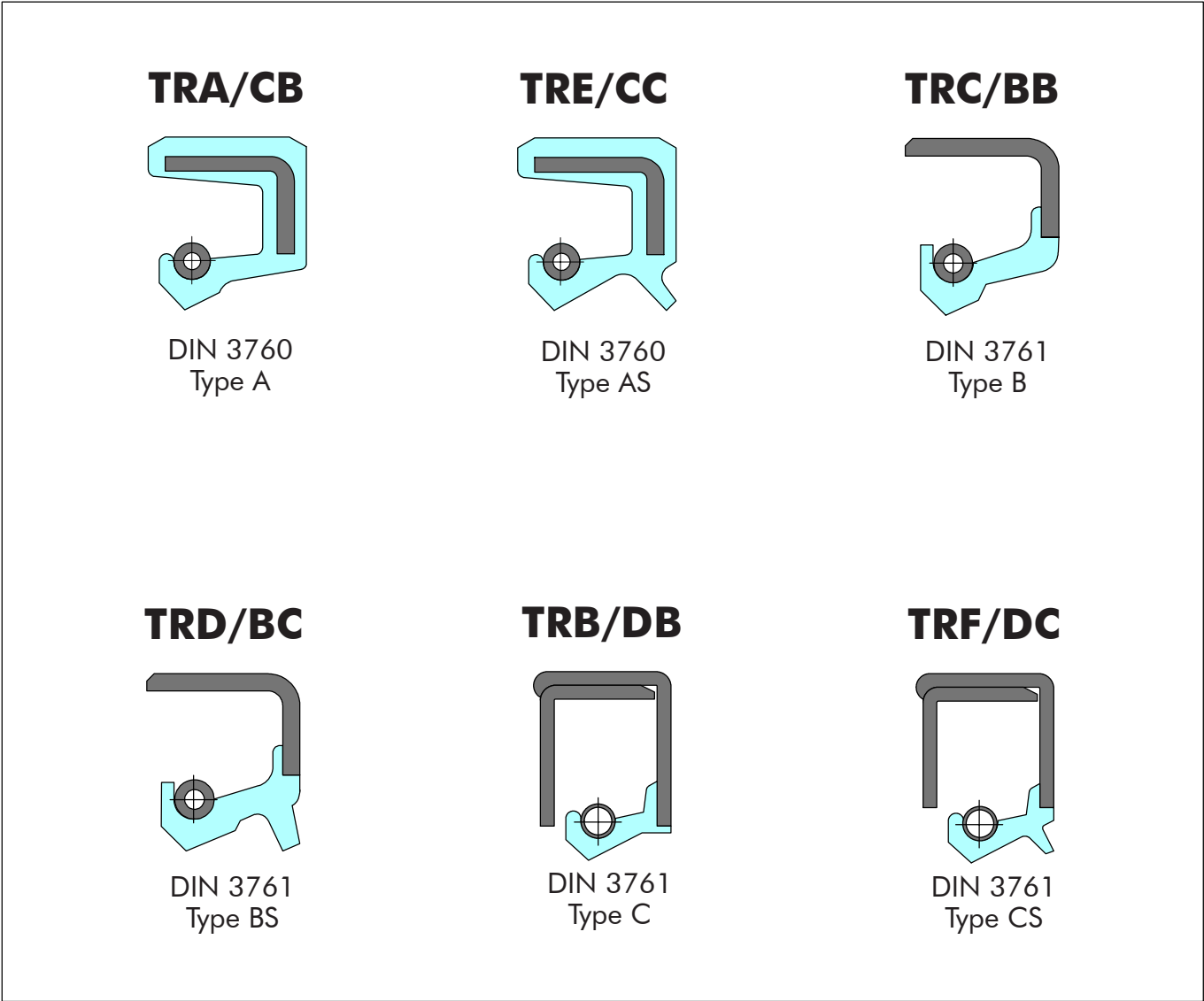


Figure 17 Standard types



■ Busak+Shamban type TRA and STEFA type CB (DIN 3760 type A)

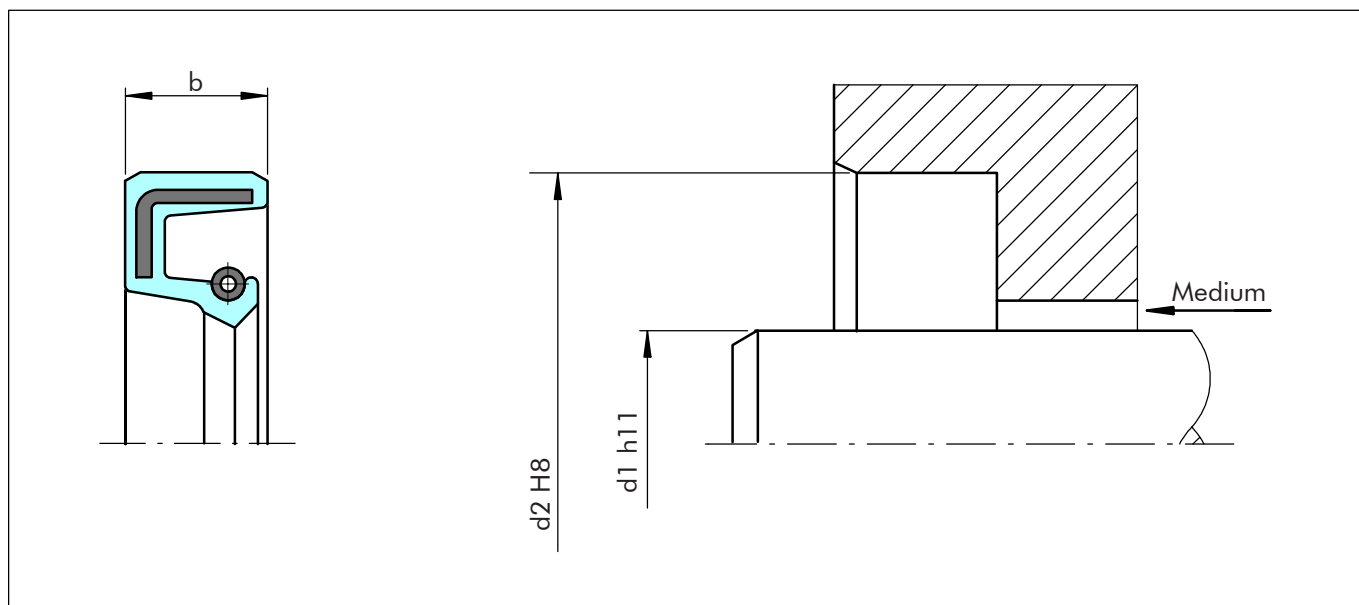


Figure 18 Installation drawing

General description

B+S 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
- No 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.)

B+S/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 VII Materials

Standard material*	B+S 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.

Table VIII Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
4	11	5	TRA200040			X	X	X
4	12	6	TRA100040					X
5	15	6	TRA000050					X
6	12	5.5	TRA400060	CB	X	X	X	
6	15	4	TRA000060					
6	16	5	TRA100060					
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	CB	X	X	X	X
8	16	5	TRA100080					
8	16	7	TRA200080					
8	18	5	TRA300080	CB	X	X	X	X
8	22	4	TRA500080					
8	22	7	TRAA00080					
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					
10	18	6	TRA300100					
10	19	7	TRA400100	CB	X	X	X	
10	22	7	TRAA00100	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			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
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

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

Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
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	TRAK00200					X
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			

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
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

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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		
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

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
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	TRAA00360	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			

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
37	80	12	TRA400370				X	
38	50	7	TRA000380	CB	X		X	
38	52	7	TRAA00380	CB	X	X	X	
38	52	8	TRAF00380	CB	X			
38	52	10	TRAL00380	CB	X			
38	54	6.5	TRA900380				X	X
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
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	
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			

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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
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	

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
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			

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
70	100	13	TRAH00700	CB	X		X	X
70	105	13	TRAN00700	CB	X			
70	110	8	TRA900700	CB	X		X	
70	110	12	TRAG00700	CB	X	X		
70	110	13	TRAH00700	CB	X	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	100	13	TRAB00750	CB	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		

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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	TRAI00850	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		

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
95	145	13	TRA700950				X	
95	150.5	13	TRAF00950	CB	X			
95	180.5	13	TRAG00950	CB	X	X		
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	
120	140	12	TRA101200				X	
120	140	13	TRA201200	CB	X	X	X	X
120	145	15	TRAF01200	CB	X			

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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		
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	200	7.5	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
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	

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
280	310	15	TRA202800	CB	X			X
280	320	20	TRAA02800				X	
300	340	16	TRA003000				X	
300	340	18	TRA10300	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	

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Ordering example oil seal B+S type

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

Order no.	TRA	B	00250	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality Index (Standard)					
Material Code (Standard)					

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

Order no.	TRA	B	00250	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality Index (Standard)					
Material Code (Standard)					

Corresponding to STEFA ref. CB 25x40x7
NBR 1452



■ Busak+Shamban type TRE and STEFA type CC (DIN 3760 type AS)

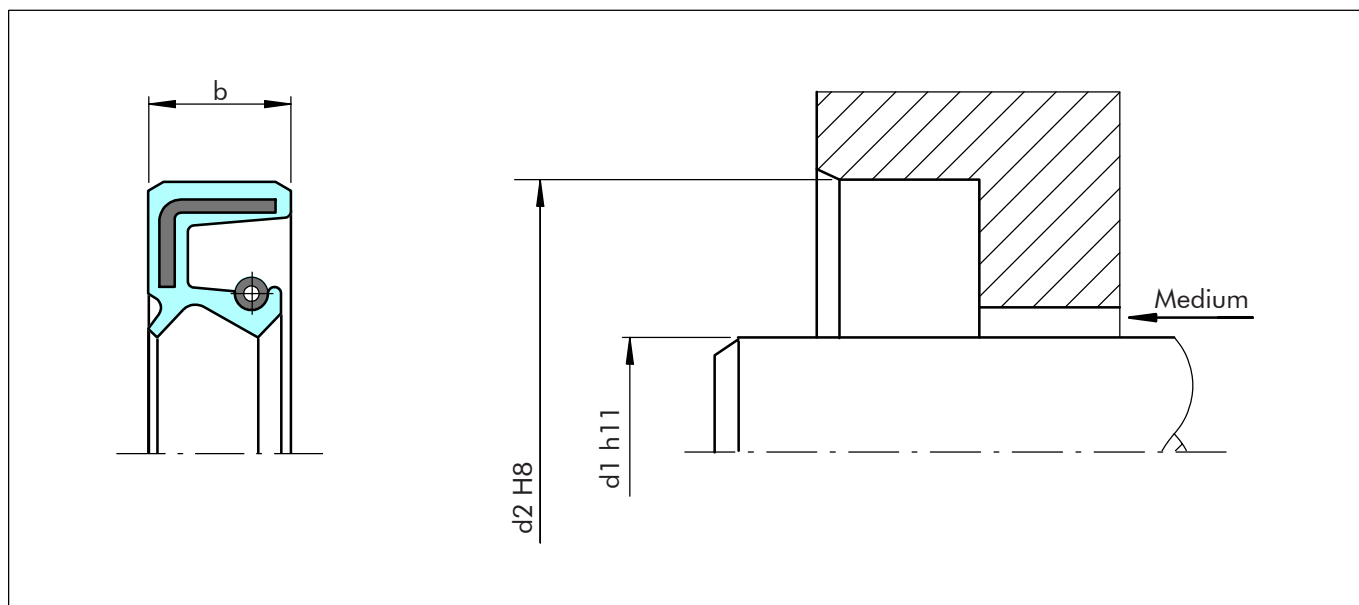


Figure 19 Installation drawing

General description

B+S 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
- No 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.)

B+S/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 IX Materials

Standard material *	B+S 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.

Table X Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
8	16	7	TRE000080	CC	X		X	
8	20	6	TRE500080					
10	18	6	TRE100100				X	
10	19	7	TRE200100	CC	X		X	
10	20	5	TRE300100	CC	X	X	X	
10	22	7	TREA00100				X	
10	26	7	TREC00100				X	
11	17	4	TRE000110				X	
12	19	5	TRE000120				X	
12	20	5	TRE400120	CC	X	X	X	
12	22	6	TRE200120				X	
12	22	7	TREA00120				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	CC	X	X	X	
15	30	7	TREB00150				X	X
15	32	7	TREC00150				X	
15	35	7	TRED00150	CC	X	X	X	X
16	28	7	TREA00160	CC	X		X	X
16	29	4	TRE400160	CC	X		X	
17	28	7	TREA00170				X	
17	30	7	TREB00170				X	
17	37	7	TRE400170	CC	X	X	X	
17	40	7	TREE00170	CC	X			
17.8	26.2	3.5	TRE000178	CC				

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



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
18	28	7	TRE000180				X	
18	30	7	TREA00180				X	
18	32	7	TREB00180	CC	X		X	
18	35	7	TREC00180	CC	X		X	
19	32	7	TRE300190	CC		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			
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	TRER00250					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	

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

Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
28	47	10	TRE400280	CC	X	X	X	X
28	52	7	TREC00280				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	
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	

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
35	72	12	TRE800350	CC	X	X	X	
35	80	10	TRE900350				X	
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	CC				X
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

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	TREOP0470	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	
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		

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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
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	

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
65	85	13	TRE300650	CC	X	X	X	X
65	90	10	TREB00650				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	
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	CC	X	X	X	X
75	95	12	TREF00750					
75	100	10	TREB00750				X	X
75	100	12	TRE100750	CC	X		X	
75	100	13	TRE200750				X	
75	110	13	TRE500750				X	
75	115	10	TRE800750	CC	X		X	
75	115	12	TRE900750					
75	120	12	TRE300750				X	
79	120	13	TRE000790	CC	X	X	X	
80	100	7	TRE000800				X	
80	100	10	TREA00800				X	X
80	100	12	TRE500800	CC	X			
80	105	13	TRE200800				X	
80	110	10	TREB00800	CC	X	X	X	X

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Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
80	115	10	TRE300800	CC	X		X	
80	120	13	TRE400800				X	
80	140	13	TRE900800					
80	140	15	TRE600800				X	
85	100	13	TRE900850				X	
85	105	10	TRE100850				X	
85	105	12	TRE800850	CC	X			X
85	110	12	TREA00850				X	X
85	120	10	TRE300850				X	
85	120	12	TREB00850	CC	X	X		X
85	130	10	TRE400850				X	
85	130	12	TRE700850					
85	130	13	TRE500850	CC	X			X
85	140	12	TREG00850					
85	150	12	TRE600850				X	
90	110	8	TRE600900	CC		X		X
90	110	12	TREA00900	CC	X	X	X	X
90	110	13	TRE000900					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	CC	X	X	X	
95	115	13	TRE100950					
95	120	12	TREA00950				X	
95	120	13	TRE200950	CC	X	X	X	
95	125	12	TREB00950				X	
95	130	13	TRE300950				X	
100	120	10	TRE001000	CC	X		X	
100	120	12	TREA01000				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	CC		X	X	
105	120	7	TRE001050				X	
105	125	13	TRE101050				X	
105	130	12	TREA01050	CC	X	X	X	
105	140	12	TREB01050					
105	140	13	TRE401050					

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Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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			

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



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
190	220	12	TRE001900				X	
190	220	15	TREA01900	CC	X	X	X	
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.

Ordering example oil seal B+S type

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

Order no.	TRE	B	00150	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TRE	B	00150	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. CC 15x30x7 NBR 1452					



■ Busak+Shamban type TRC and STEFA type BB (DIN 3761 type B)

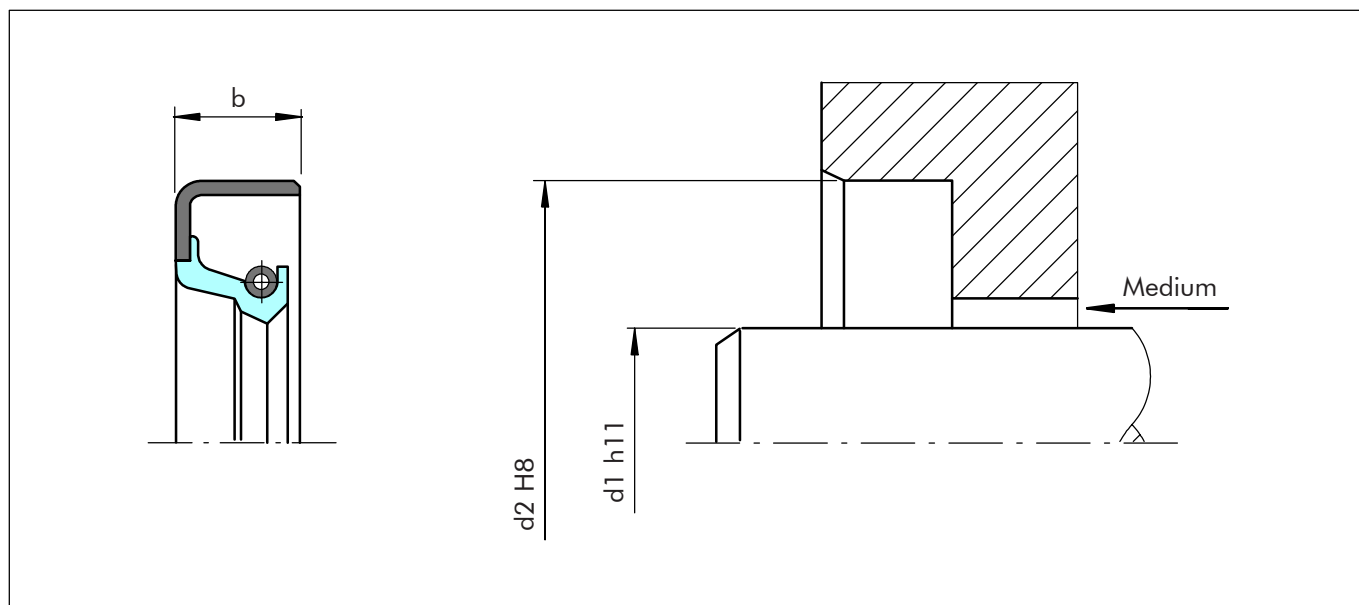


Figure 20 Installation drawing

General description

B+S 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.)

B+S/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 XI Materials

Standard material *	B+S 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.

Table XII Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
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	
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	

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			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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	

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



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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.

Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
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		
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	

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



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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.

Ordering example oil seal B+S type

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

Order no.	TRC	C	00200	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TRC	C	00200	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Corresponding to STEFA ref. BB 20x35x7
NBR 1452



■ Busak+Shamban type TRD and STEFA type BC (DIN 3761 type BS)

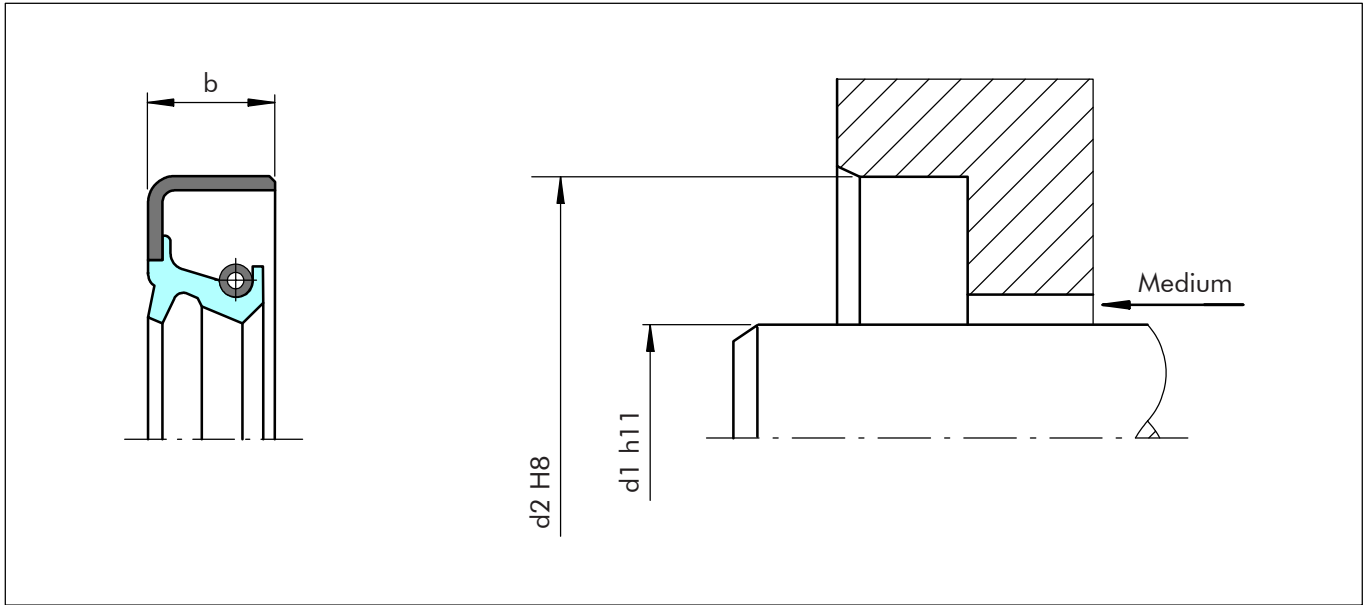


Figure 21 Installation drawing

General description

B+S 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.)

B+S/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 XIII Materials

Standard material *	B+S 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.

Table XIV Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	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					
15	32	10	TRD300150	BC	X			
17	28	5	TRD000170	BC	X			
20	30	7	TRDA00200				X	
20	35	7	TRDC00200	BC	X		X	
20	42	7	TRD000200				X	
22	40	7	TRDC00220				X	
25	32	7	TRD000250	BC		X	X	
25	35	6	TRD200250					
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	BC	X		X	
26	40	7	TRD000260					X
30	42	7	TRDB00300					
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	

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

Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	56	10	TRD200400	BC	X			
40	60	10	TRD300400	BC	X			
40	62	7	TRDC00400	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			
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			

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



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
70	85	8	TRD000700	BC	X		X	
70	90	10	TRDA00700		X			
70	90	13	TRD200700	BC	X			
70	100	12	TRD100700	BC	X		X	
74	90	10	TRD000740				X	
75	95	12	TRD100750					
75	95	13	TRD200750	BC		X		
75	100	13	TRD000750	BC	X			X
78	100	10	TRDA00780				X	
79	120	13	TRD000790	BC	X		X	
80	100	12	TRD100800				X	
80	100	13	TRD200800					
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	BC	X		X	
120	150	12	TRDA01200					
120	150	14	TRD101200	BC	X		X	
125	150	13	TRD001250				X	
130	160	13	TRD101300					
140	170	14	TRD001400	BC	X		X	
140	170	15	TRDA01400				X	
145	170	13	TRD001450					
146	170	14	TRD001460	BC	X		X	
148	170	14.5	TRD001480					
150	180	15	TRDA01500					
155	180	15	TRD001550	BC	X		X	
160	180	10	TRD001600					
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	

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

Radial Oil Seal



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
400	440	20	TRDA04000				X	

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

Ordering example oil seal B+S type

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

Order no.	TRD	A	00400	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TRD	A	00400	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. BC 40x52x7 NBR 1452					



■ Busak+Shamban type TRB and STEFA type DB (DIN 3761 type C)

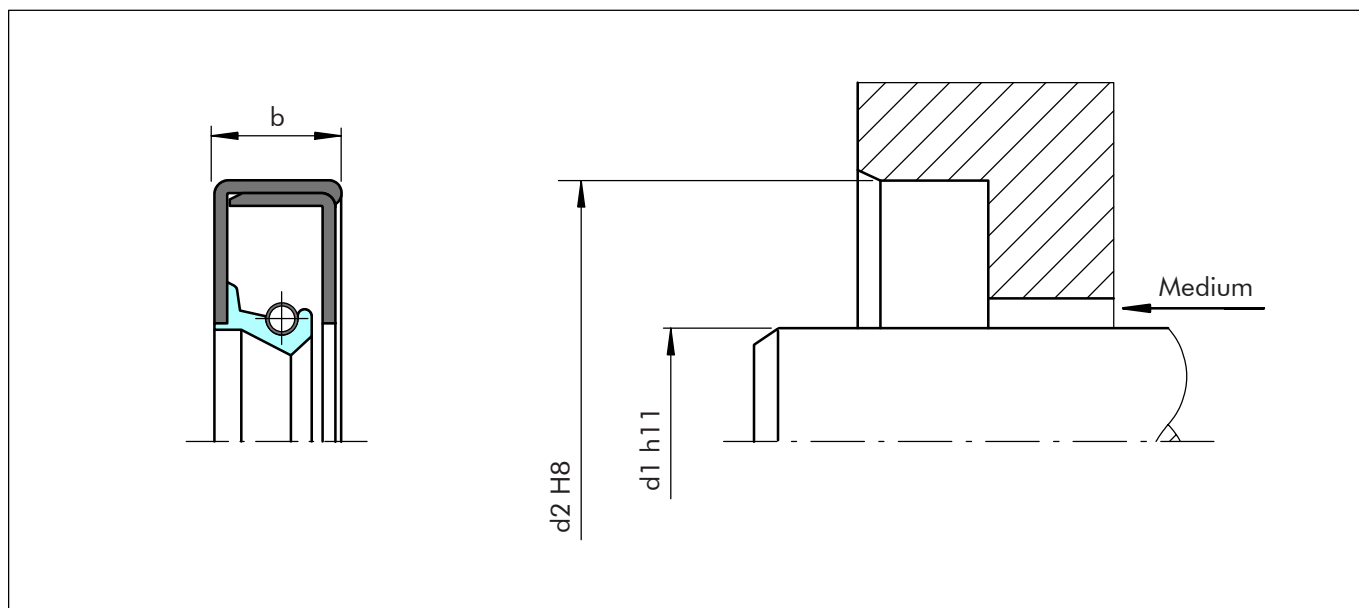


Figure 22 Installation drawing

General description

B+S 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.)

B+S/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 XV Materials

Standard material *	B+S 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.

Table XVI Preferred series / Dimension, part numbers

Dimension			Part No	STEFA			B+S	
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			
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	

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			Part No	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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			

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			Part No	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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			
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			Part No	STEFA			B+S	
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			
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	

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			Part No	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	TRBA02000	DB	X	X		
220	250	15	TRB002200	DB	X		X	
230	260	15	TRBA02300				X	
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			

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			Part No	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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.

Ordering example oil seal B+S type

B+S type: B
Code: TRB
Dimensions: Shaft diameter 45 mm
Housing diameter 60mm
Width 10 mm

Material: NBR
Material Code: N7MM

Order no.	TRB	5	00450	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Ordering example oil seal STEFA type

STEFA type: DB
Code: TRB
Dimensions: Shaft diameter 45 mm
Housing diameter 60 mm
Width 10mm

Material: NBR 1452
Material Code: 4N011

Order no.	TRB	5	00450	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. DB 45x60x10 NBR 1452					



■ Busak+Shamban type TRF and STEFA type DC (DIN 3761 type CS)

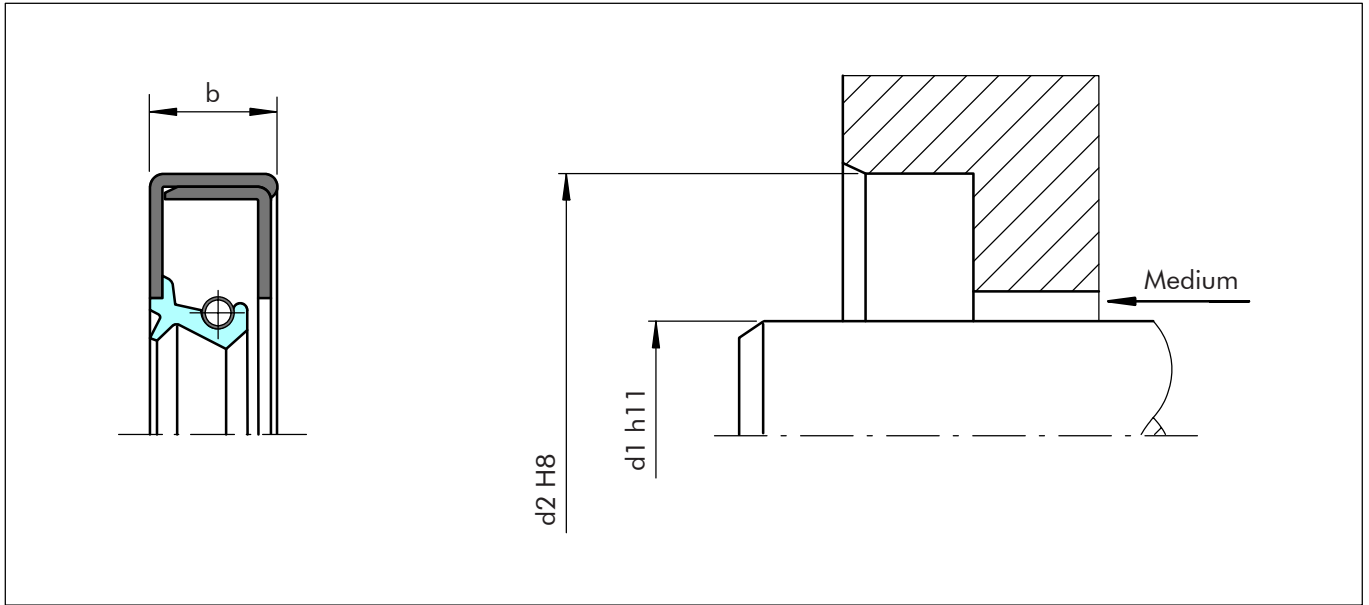


Figure 23 Installation drawing

General description

B+S 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.)

B+S/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.



Radial Oil Seal

Table XVII Materials

Standard material *	B+S 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.

Table XVIII Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
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	
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	

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

() values in brackets are inch sizes.



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	
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.

Ordering example oil seal B+S type

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

Order no.	TRF	0	01100	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Ordering example oil seal STEFA type

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

Order no.	TRF	0	01100	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. DC 110x140x13 NBR 1452					

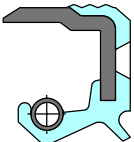


Special types of rotary seals

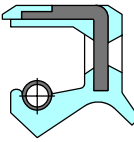
When the seals designed according the standard of Figure 17, are not able to satisfy the application’s specification, special seals are available. The selection guide in Table I

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

Types with half rubbered OD:

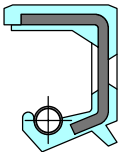


TRD_A
1B/CC

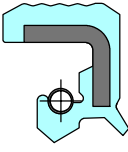


TRD_B
2B/CC

Types for medium pressure:

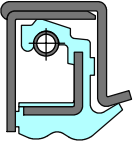


TRU

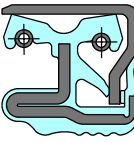


TRP/6CC

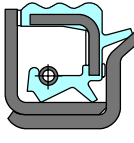
Cassette seals:



System 500

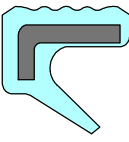


System 3000

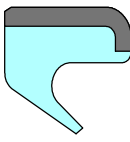


System 5000

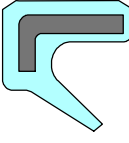
Rotary seals without spring:

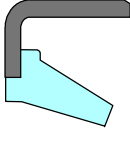


TRK/CD

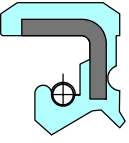


TRG/BD



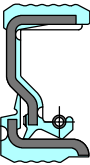


Types for medium-high pressure:



TRQ_D/12CC

Combined seal:



APJ Seal

Figure 24 Selection of special radial seals



■ Busak+Shamban types TRD_A / TRD_B and STEFA type 1B/CC / 2B/CC

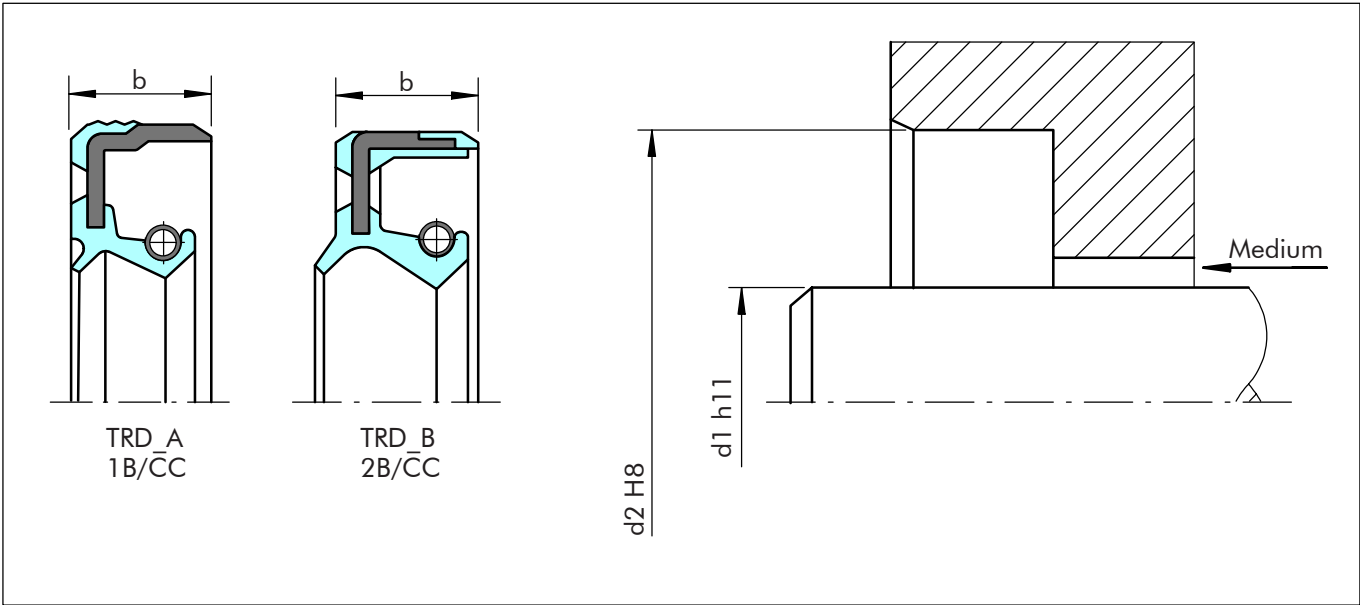


Figure 25 Installation drawing

General description

B+S 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.)

B+S/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 *	B+S 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 B+S company.



■ Busak+Shamban type TRU - medium pressure oil seal

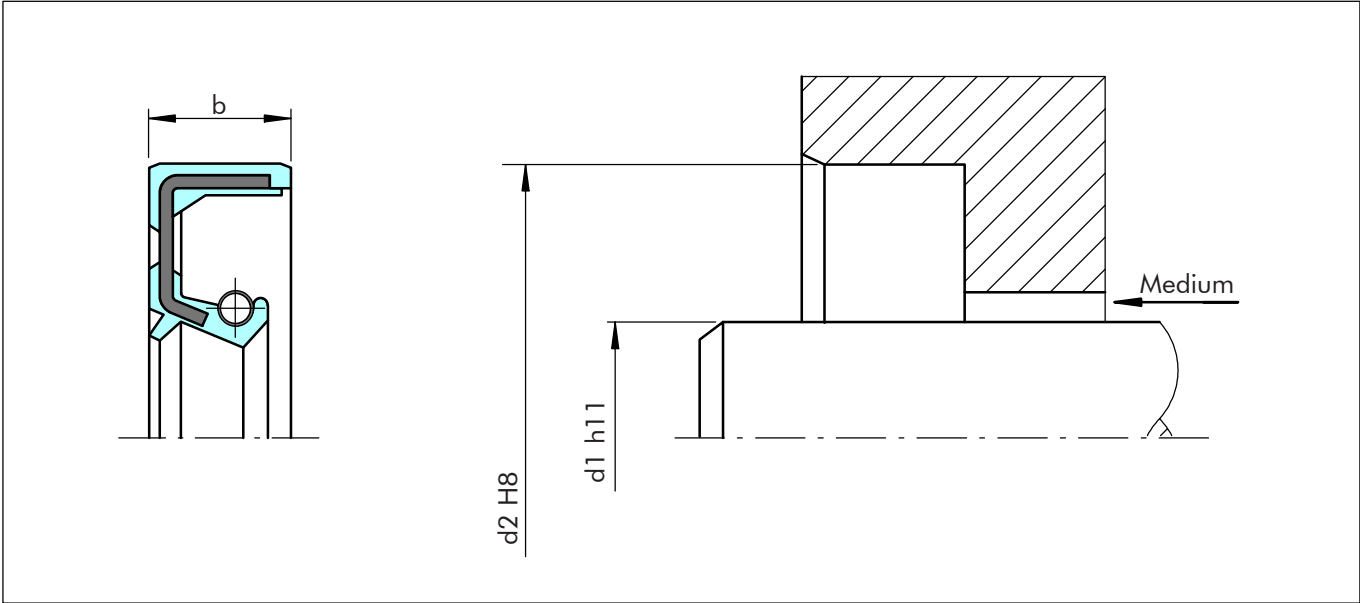


Figure 26 Installation drawing

General description

B+S 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
- No 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.)

B+S/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 XX Materials

Standard material*	B+S 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.

Table XXI Preferred series / Dimension, part numbers

Dimension			Part no.	B+S	
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
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

Radial Oil Seal



Dimension			Part no.	B+S	
d ₁	d ₂	b		NBR N7MM	FKM VCBV
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	12	TRU200900	X	
90	125	12	TRU100900	X	
90	110	7.5	TRU000900		X
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	



Ordering example oil seal B+S type

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

Order no.	TRU	1	00400	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					



■ Busak+Shamban type TRP and STEFA type 6CC - medium pressure oil seal

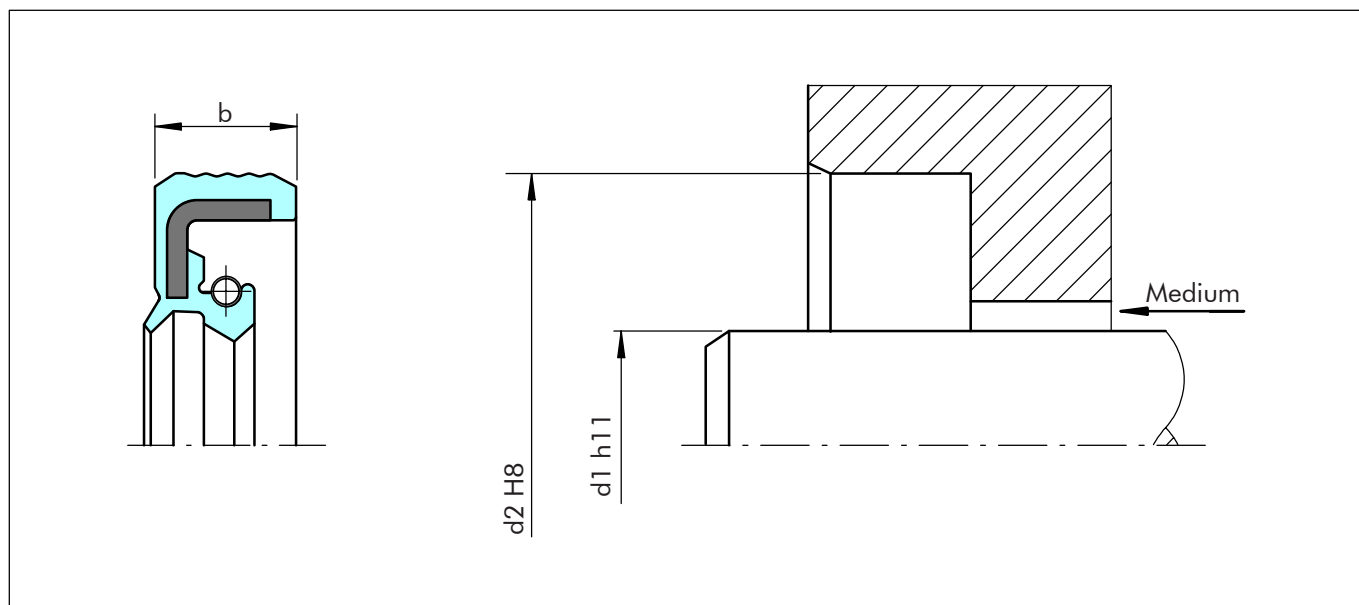


Figure 27 Installation drawing

General description

B+S 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
- No 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.)

B+S/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 XXII Materials

Standard material*	B+S 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.

Table XXIII Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
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	X
17	28	7	TRP100170					
17	30	7	TRP000170					X
19	27	5	TRP000190	6CC		X	X	
19	32	6	TRP100190					
20	32	6	TRP000200					
20	35	6	TRP100200	6CC	X			
20	45	6	TRP200200	6CC	X			
22	32	6	TRP100220	6CC	X	X		
22	40	6	TRP000220	6CC	X	X		X
24	40	7	TRPC00240					
25	35	6	TRP100250					
25	37	6	TRP200250	6CC	X	X		X
25	40	7	TRP000250					
28	40	6	TRP000280					
30	42	6	TRP000300	6CC	X	X		X
33	45	5	TRP000330					
35	47	6	TRP100350					
35	52	6	TRP000350	6CC	X	X	X	X
36	48	5.5	TRP000360					
40	55	7	TRPB00400					
40	62	6	TRP100400	6CC	X			X
40	67	7	TRP000400					
42	62	7	TRP000420			X		
45	62	7	TRP000450	6CC	X	X		X
50	72	7	TRP000500					
52	68	10	TRP000520			X		



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N011	FKM 4V012	NBR N7MM	FKM VCBV
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	TRP003650	6CC	X			
460	490	12	TRP004600	6CC		X		

Ordering example oil seal B+S type

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

Order no.	TRP	0	00500	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TRP	0	00500	-	4N011
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Corresponding to STEFA ref. 6CC 50x72x7
NBR 1452



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

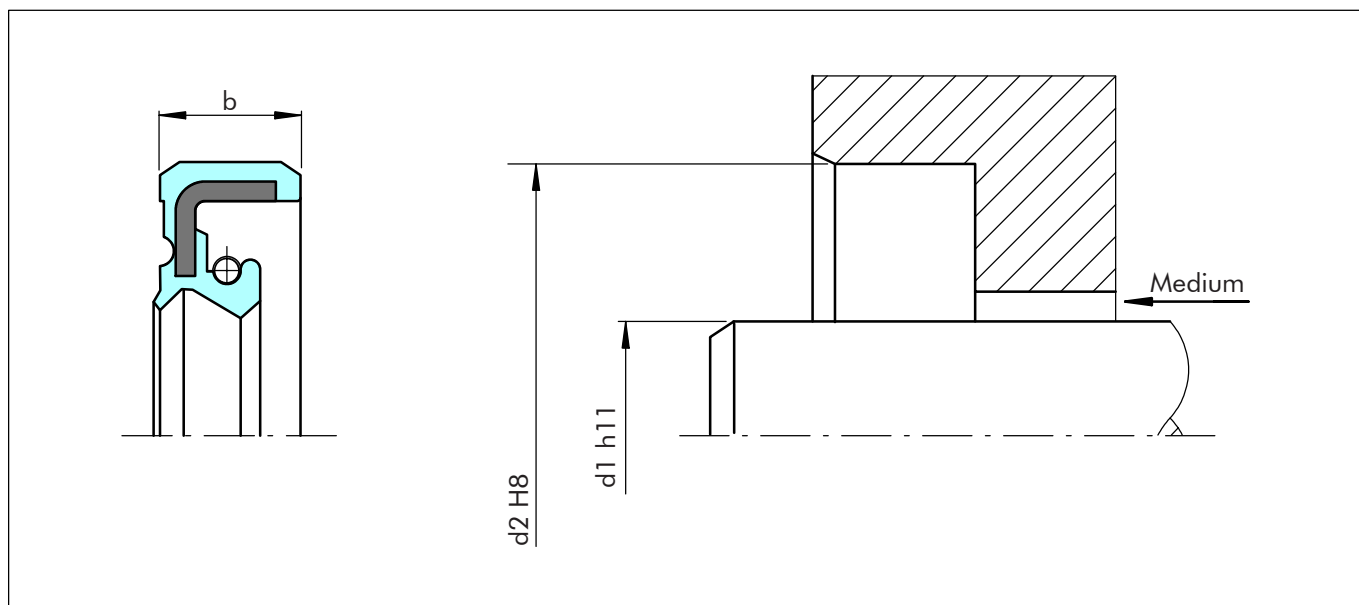


Figure 28 Installation drawing

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
- No 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.)

B+S/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 XXIV Materials

Standard material*	B+S 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.

Table XXV Preferred series / Dimension, part numbers

Dimension			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

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

Order 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



■ Busak+Shamban type TRK and STEFA type CD

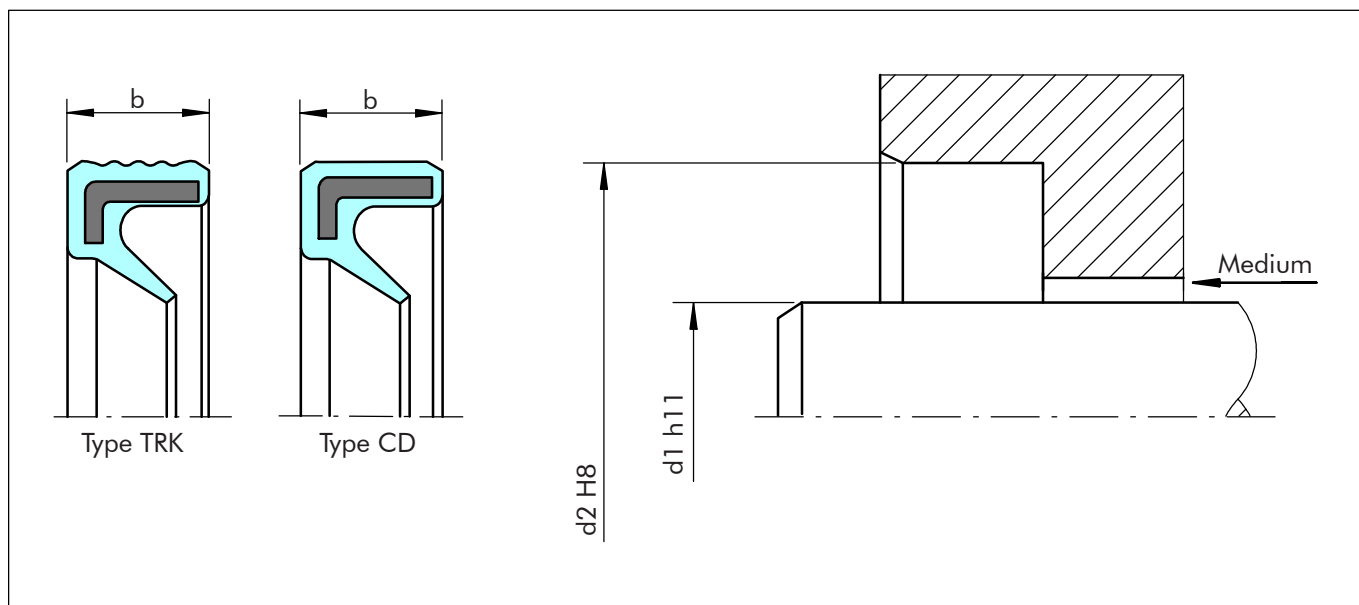


Figure 29 Installation drawing

General description

The B+S type TRK and STEFA type CD are specially designed radial oil seals reinforced with a metal insert but without spring energised sealing lip. The B+S 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°C (depending on material)
Speed:	up to 10 m/s
Media:	mineral and synthetic base greases

B+S/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 XXVI Materials

Standard material*	B+S 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.

Table XXVII Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
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
8	12	3	TRK000080				X	
8	15	3	TRK200080				X	X
9	13	3	TRK000090				X	
9	16	3	TRK200090	CD	X		X	
10	14	3	TRK000100				X	X
10	16	4	TRK500100					
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	CD	X	X	X	X
12	19	3	TRK200120				X	X
12	20	4	TRK300120					
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	



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N01	FKM 4V01	NBR N7LM	FKM VCBM
18	24	3	TRK000180	CD	X		X	
18	24	4	TRK100180					
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	
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	CD	X		X	X
30	40	6.5	TRK300300					
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	CD	X		X	
45	62	8	TRKB00450					
48	58	4	TRK000480					
50	58	4	TRK000500	CD	X		X	X
50	60	6	TRK100500				X	
50	62	5	TRK200500					
50	68	8.5	TRK300500	CD	X			
55	63	5	TRK000550				X	
55	73	8.5	TRK100550					



Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N01	FKM 4V01	NBR N7LM	FKM VCBM
60	72	4	TRK000600				X	
70	78	5	TRK000700				X	X
75	95	7	TRK000750				X	
90	10	6	TRK000900				X	

Ordering example oil seal B+S type

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

Order no.	TRK	2	00170	-	N7LM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TRK	2	00170	-	4N01
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. CD 17x23x3 NBR 1452					



■ Busak+Shamban type TRG and STEFA type BD

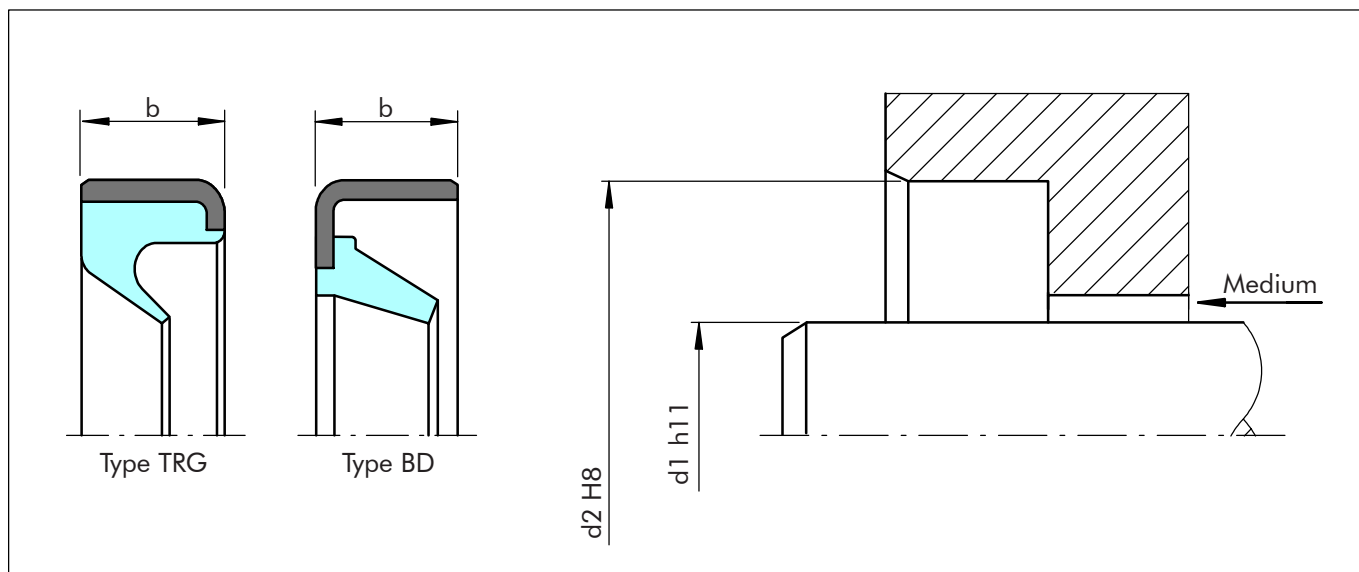


Figure 30 Installation drawing

General description

The B+S 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

B+S/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 XXVIII Materials

Standard material*	B+S 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.

Table XXIX Preferred series / Dimension, part numbers

Dimension			Part no.	STEFA			B+S	
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
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	



Radial Oil Seal

Dimension			Part no.	STEFA			B+S	
d ₁	d ₂	b		Type	NBR 4N01	FKM 4V01	NBR N7LM	FKM VCBM
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	
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.

Ordering example oil seal B+S type

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

Order no.	TRG	0	00700	-	N7LM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					



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

Order no.	TRG	0	00700	-	4N01
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. BD 70x78x5 NBR 1452					



■ 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 31 and 32.

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

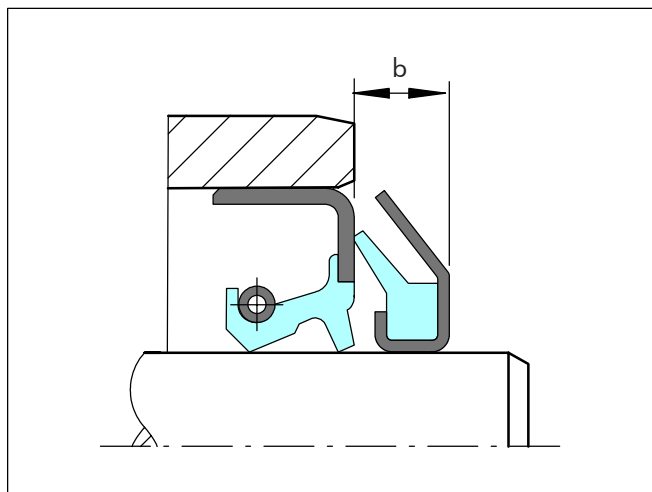


Figure 31 GAMMA seal fitted on the shaft end

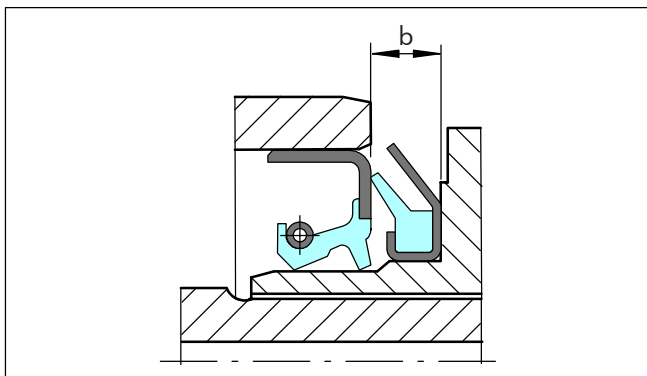


Figure 32 GAMMA seal fitted on the shaft boss

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 33).

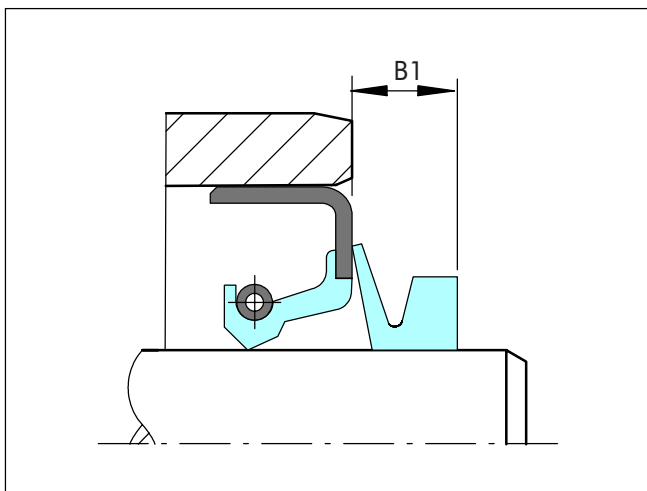


Figure 33 V-Ring fitted on the shaft end

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 31 and 32). See also the instructions reported into specific catalogue chapters.

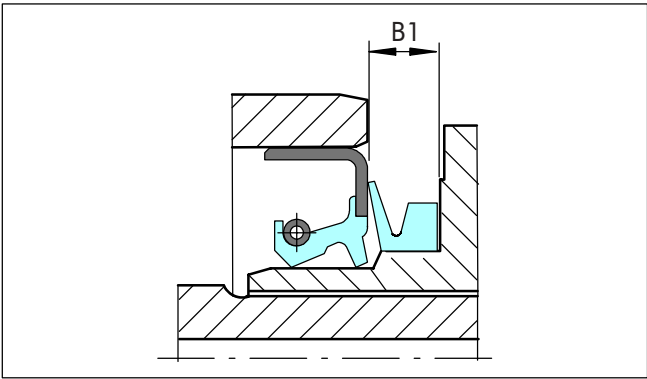


Figure 34 V-Ring type A fitted on the shaft boss

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).



■ 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 EP protection for electrical motors
- 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 12 m/s (depending on material)
Mediums:	Mineral and synthetic oils (CLP, HLP, APGL etc.)

B+S/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.

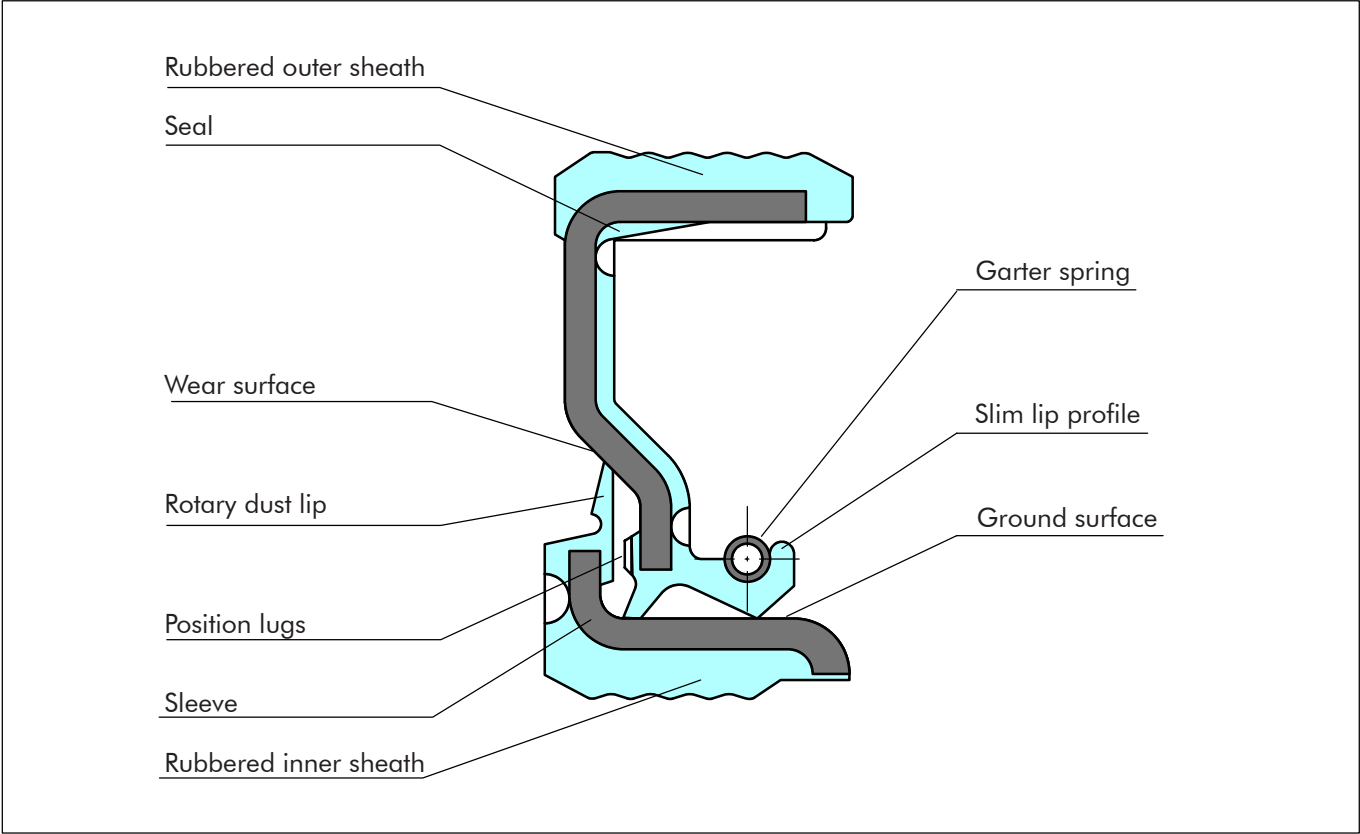


Figure 35 APJ seal details



■ STEFA standard APJ type

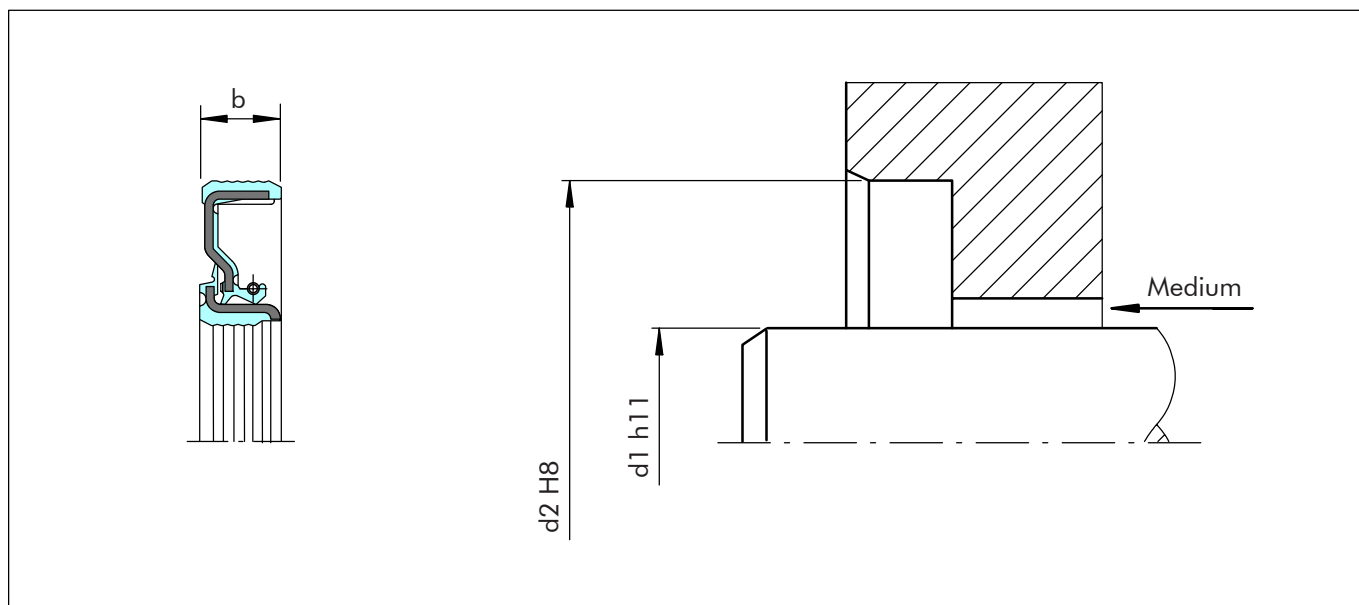


Figure 36 Installation drawing

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.)

B+S/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 XXX Materials

Standard material*	B+S 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 B+S company.



■ 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.

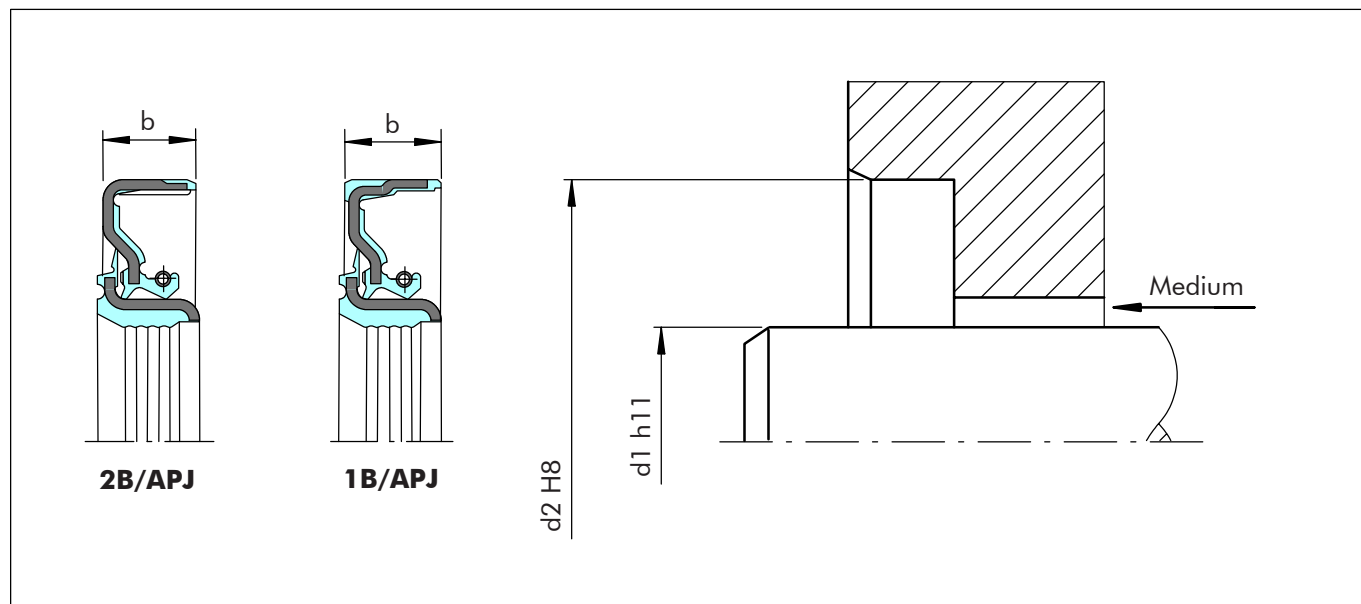


Figure 37 Installation drawing

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.)

B+S/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.



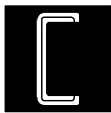
Table XXXI Materials

Standard material*	B+S 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 B+S 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.

■ Busak+Shamban type YJ 38 and STEFA type VK

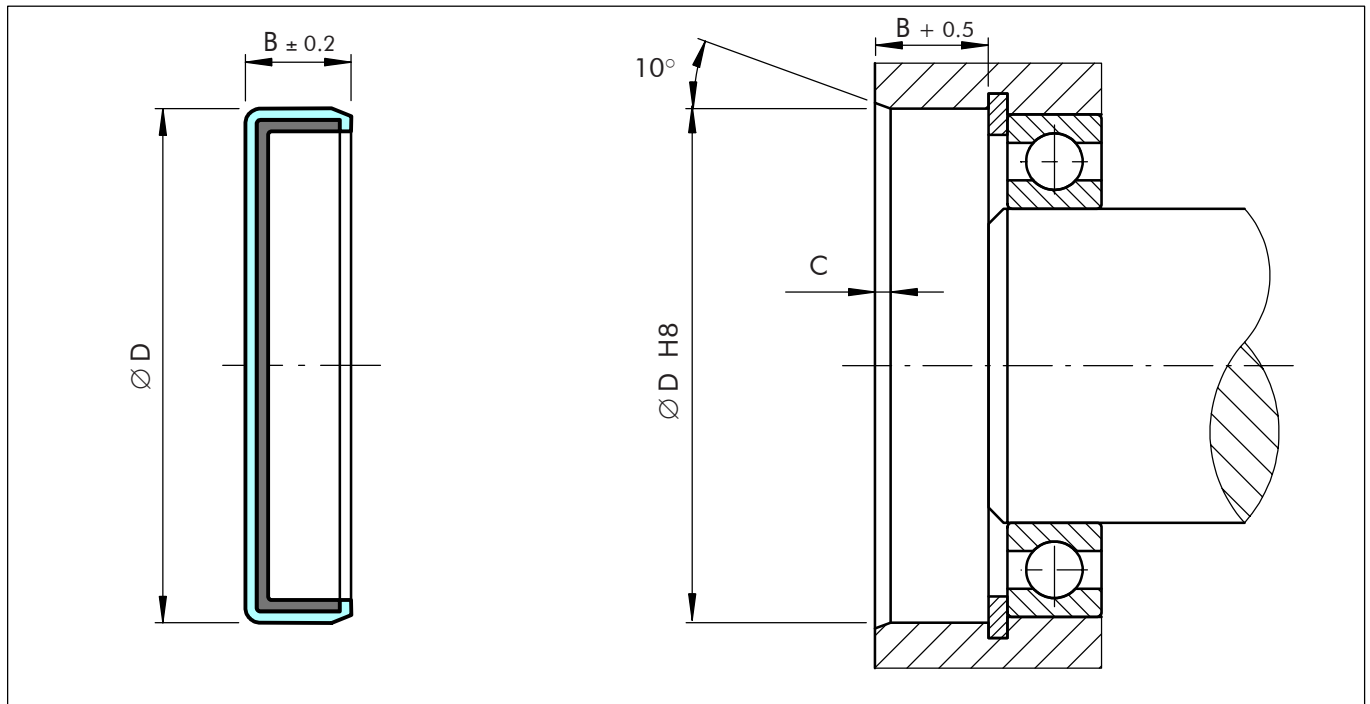


Figure 38 Installation drawing

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.)
- B+S/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 pressure depends on material type and temperature.



Table XXXII Materials

Standard material*	B+S 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.

Table XXXIII Preferred series / Dimension, part numbers

Bore D H8	Width B	Chamfer C	Part no.	STEFA			B+S	
				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		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	YJ3810320	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	



End Cover

Bore D H8	Width B	Chamfer C	Part no.	STEFA			B+S	
				Type	NBR 4N01	FKM 4V01	NBR N7MM	FKM VCBV
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	
75	7	1.3	YJ3820750	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	



Ordering example end cover B+S type

B+S type: YJ
Code: YJ38
Dimensions: Housing diameter 50 mm
Width 10 mm
Material: NBR
Material Code: N7MM

Order no.	YJ38	0	0500	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	YJ38	0	0500	-	4N01
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Corresponding to STEFA ref. VK 50 x 10
NBR 1452



■ Busak+Shamban type YJ 39

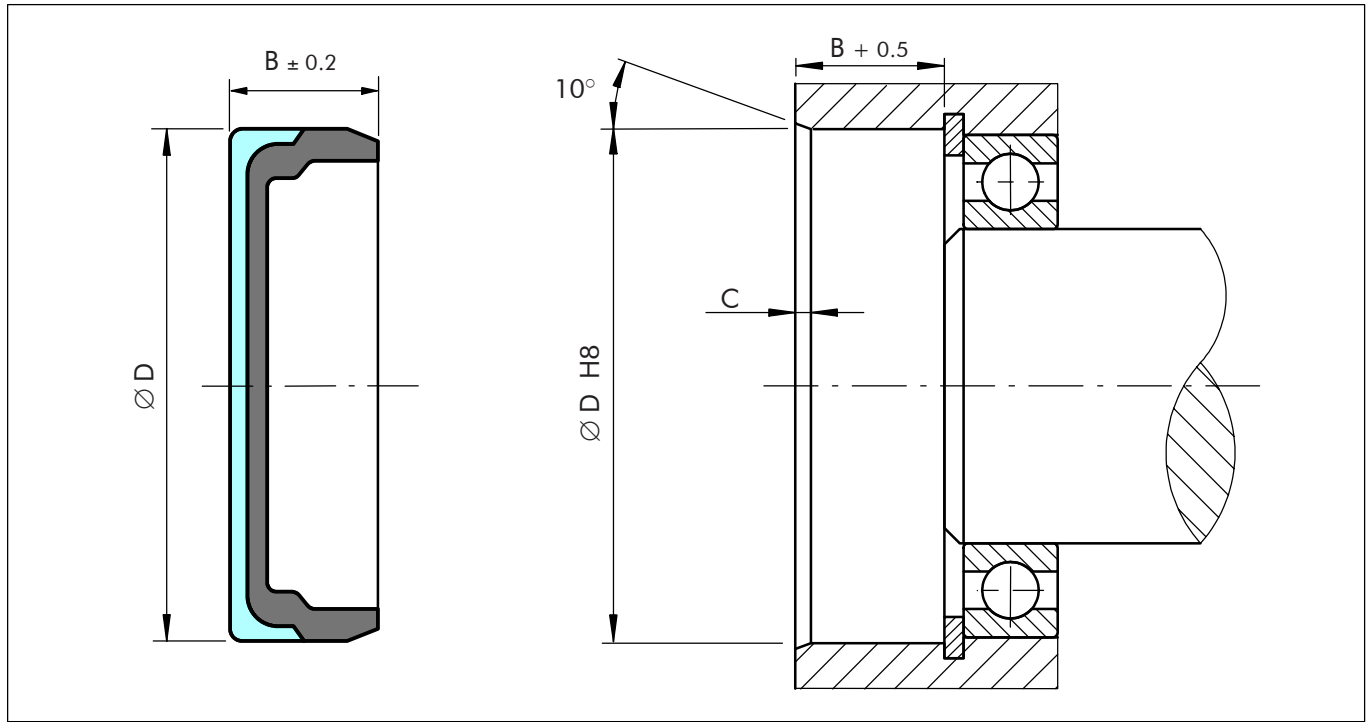


Figure 39 Installation drawing

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.)

B+S/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 pressure depends on material type and temperature.



Table XXXIV Materials

Standard material*	B+S 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.

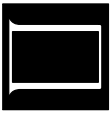
Table XXXV Preferred series / Dimension, part numbers

Bore	Width	Chamfer	Part no.	B+S
D H8	B	C		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

Ordering example end cover B+S type

B+S type: YJ
Code: YJ39
Dimensions: Housing diameter 52 mm
Width 6 mm
Material: NBR
Material Code: N7MM

Order no.	YJ39	0	0520	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					



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 40). 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.

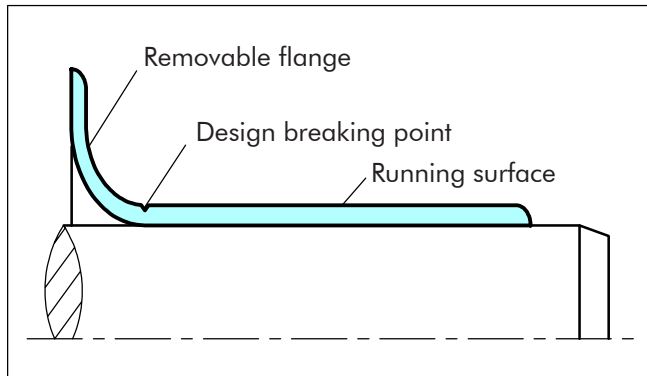


Figure 40 Design of the shaft repair kit

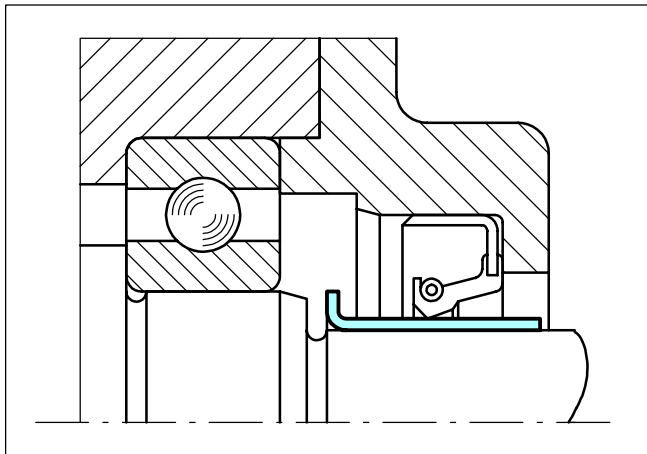


Figure 41 Running surface with shaft repair kit

Advantages

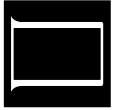
- Inexpensive replacement of worn shaft surfaces
- Simple and quick installation with supplied assembly tool
- No alterations to the seal dimensions
- Wear-resistant surface for long service life
- Secure seating due to a force fit

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, ($R_a = 0.25 \dots 0.5 \mu m$)
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

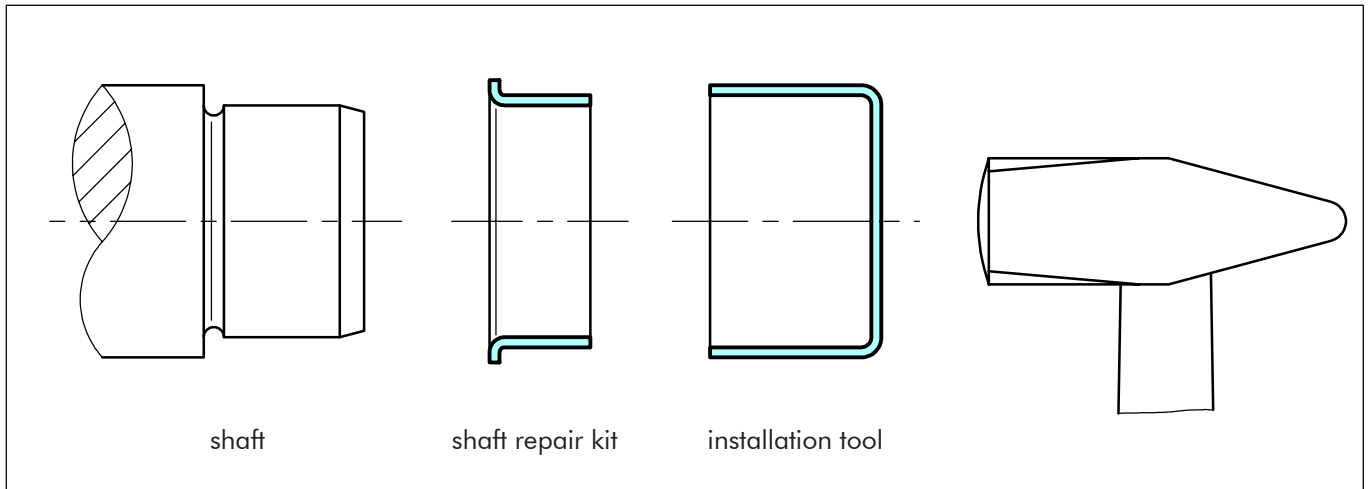
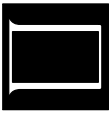


Figure 42 Installation sequence



■ Installation recommendation, metric sizes

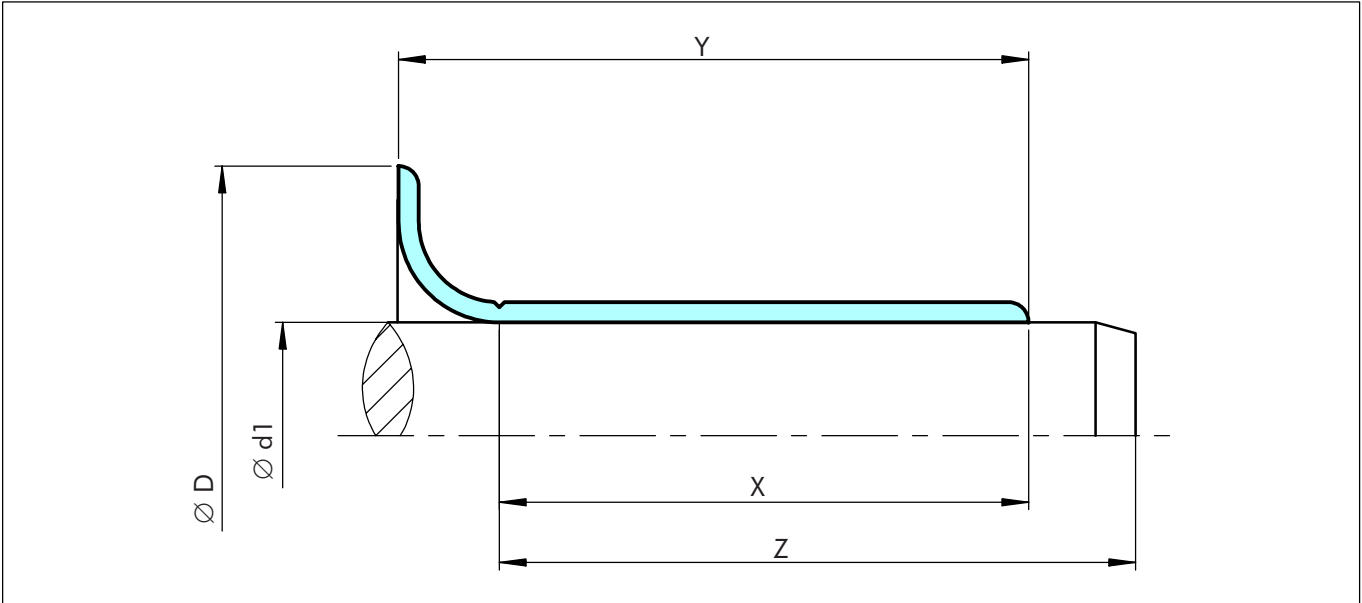
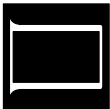


Figure 43 Installation drawing

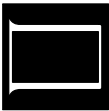
Table XXXVI Installation dimensions / part no.

Shaft diameter metric sizes			Length without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominel dia.	Range						
d ₁	min.	max.	X ± 0.8	Y ± 0.8	D ± 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
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



Shaft diameter metric sizes			Length without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominel dia.	Range						
d ₁	min.	max.	X ± 0.8	Y ± 0.8	D ± 1.6	Z	
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

Special versions up to a diameter of 1150 mm are available on request.



■ Installation recommendation, imperial sizes

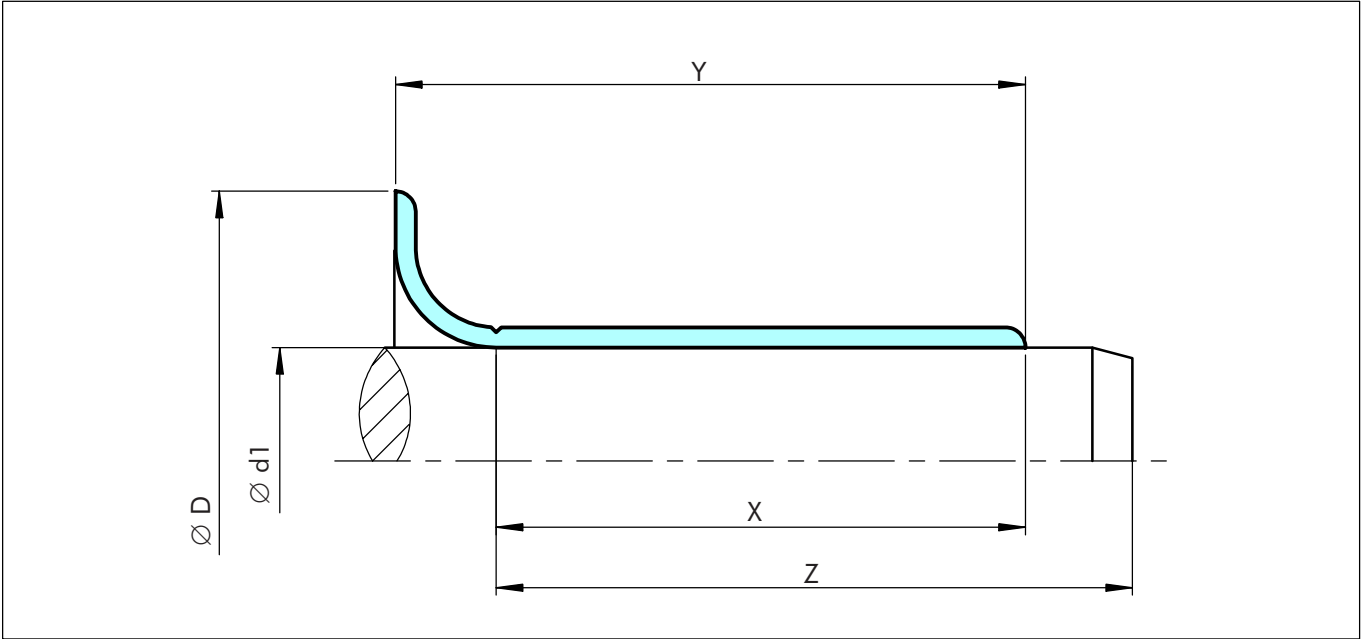
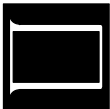


Figure 44 Installation drawing

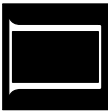
Table XXXVII Installation Dimensions in Inches

Shaft diameter imperial sizes			Lenght without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominal dia.	Range						
d ₁	min.	max.	X ± 0.031	Y ± 0.031	D ± 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



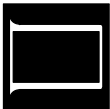
Shaft diameter imperial sizes			Lenght without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominal dia.	Range						
d ₁	min.	max.	X ± 0.031	Y ± 0.031	D ± 0.063	Z	
1.375	1.371	1.377	0.500	0.625	1.638	0.813	TS0099138-900V
1.375	1.371	1.377	0.313	0.438	1.638	0.813	TS0099133-900V
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	0.375	0.500	1.781	1.016	TS0099150-900V
1.500	1.497	1.503	0.563	0.688	1.781	1.016	TS0099149-900V
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
2.438	2.434	2.440	0.781	0.938	2.828	1.375	TS0099243-900V
2.438	2.435	2.441	0.500	0.625	2.828	1.425	TS0099242-900V
2.500	2.500	2.506	0.500	0.656	2.828	1.393	TS0099248-900V



Shaft Repair Kit

Shaft diameter imperial sizes			Lenght without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominal dia.	Range						
d ₁	min.	max.					
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	3.250	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
3.250	3.247	3.253	0.813	1.000	3.594	1.375	TS0099322-900V
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
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

Shaft Repair Kit



Shaft diameter imperial sizes			Lenght without flange	Overall length	Flange diameter	Max. installation depth	Order no.
Nominal dia.	Range						
d ₁	min.	max.	X ± 0.031	Y ± 0.031	D ± 0.063	Z	
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
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

Special versions up to 45" (dia. of 1150 mm) are available on request.



Cassette Seal

CASSETTE SEAL

■ General

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

The STEFA System seals, fully enclosed seals with an integrated sealing system, 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.

The STEFA name on the outside is your guarantee of Forsheda quality on the inside.

■ STEFA System 500

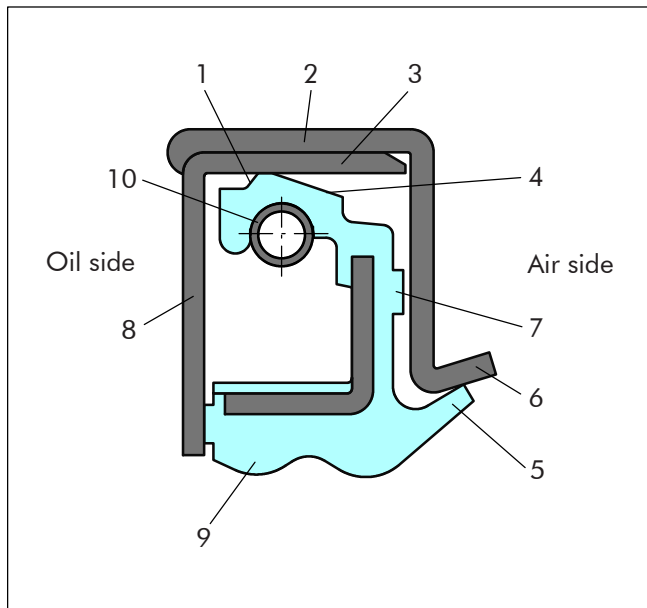


Figure 45 System 500

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

The inner section of the STEFA System 500 is secured against the shaft. The outer section, press fitted in 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.

For such applications where the seal is exposed to dirty environment, i.e. off road use, the STEFA System 500 can be equipped with an additional specially developed dirt protection, the HRV seal.

- 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 the STEFA bi-directional TURBO-pattern.
 - Integral prelubricated dust-sealing (5) functions.
 - The protruding conical part (6) of the case deflects heavier particles due to the centrifugal force.
 - The sealing element (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) serves as puller for the inner ring of bearings having a clearance fit on the shaft.
 - 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.



■ STEFA System 3000

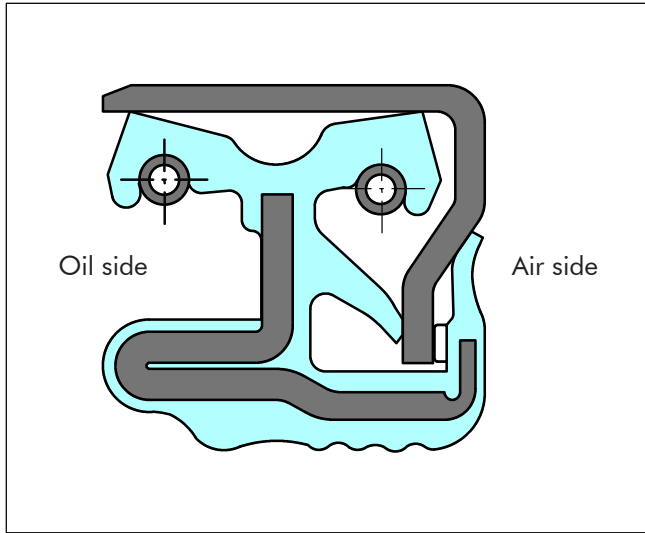


Figure 46 System 3000

STEFA System 3000 is specifically designed for 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 STEFA System 3000, based on System 500, features two sealing lips, equipped with compression springs, to provide excellent sealing performance and two complementary dust lips. Mudbox-tests are showing more than doubled lifetime performance compared with the other system seals.

■ STEFA System 5000

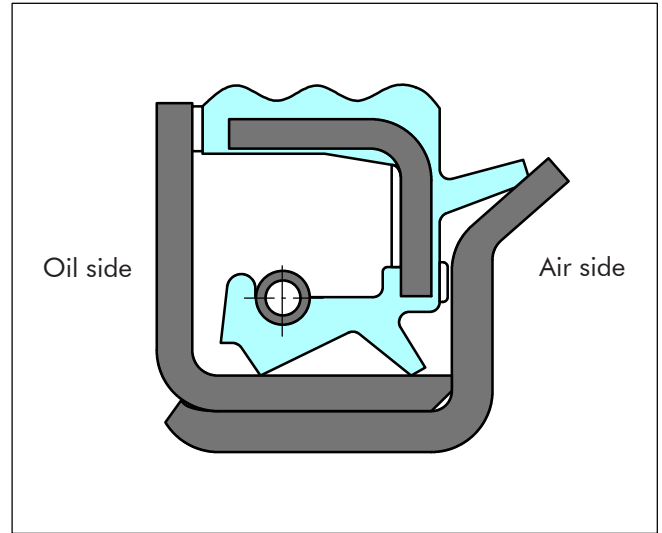


Figure 47 System 5000

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

The STEFA 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 STEFA 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



Cassette Seal

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 providing longer service lives.

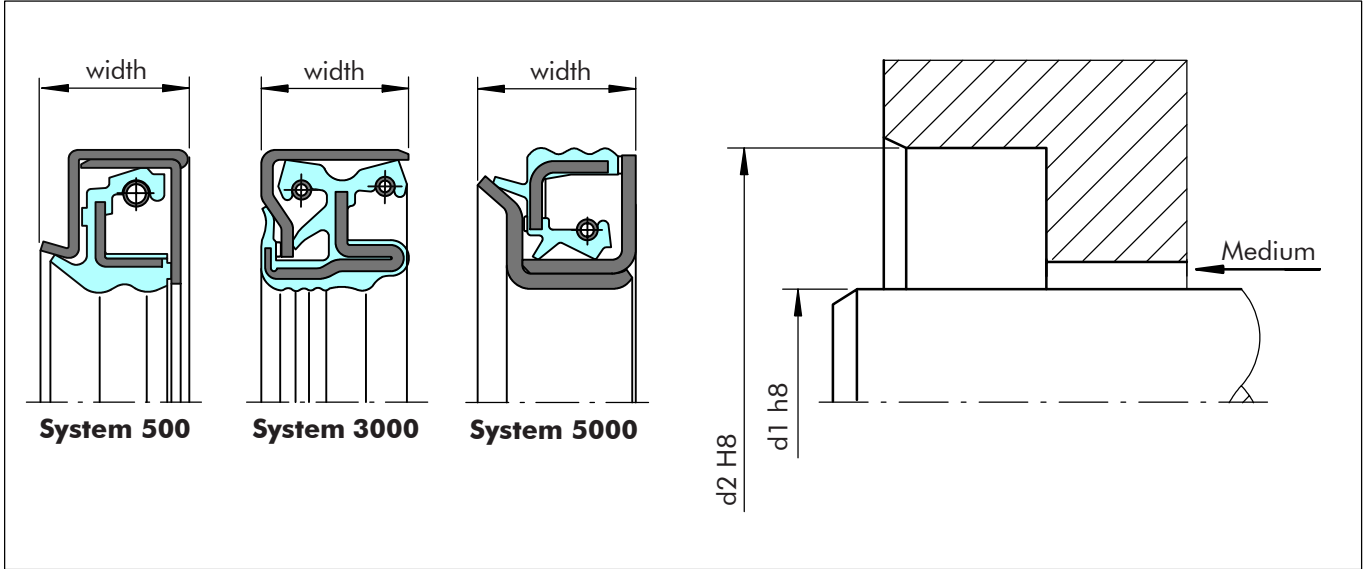


Figure 48 Installation drawing

Table XXXVIII 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						
158	188	17	X	X	X						



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
160	196	17	X	X							
178	205	17	X	X	X						
187	230	17	X	X	X						
190	230	17	X	X	X						
320	360	19	X	X							

Table XXXIX Materials

Standard material*	B+S 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	Stainless steel

* Special grades and other materials (ACM, EACM, VQM) on request.
** Metal case and spring as well, can be supplied in different materials on request.

Ordering example

Due to various combinations (HRV-additional dirt seal + coating), please contact your local B+S 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 demands 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 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, which exhibits 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.

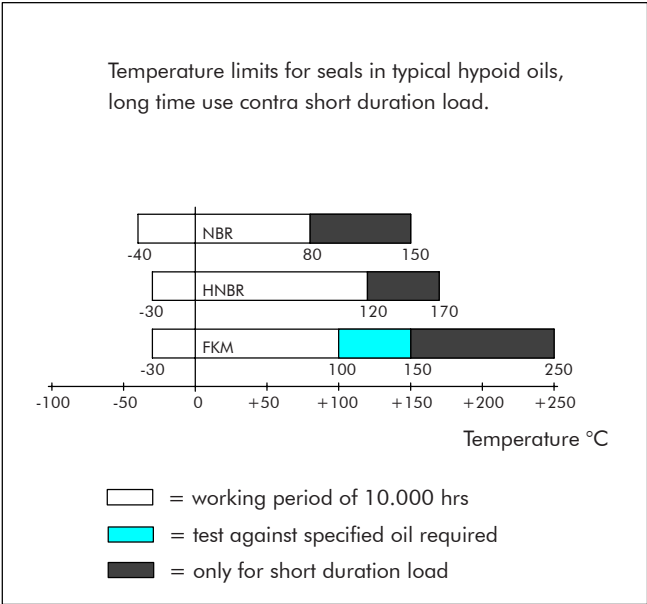


Figure 49 Temperature recommendations in typical hypoid oils

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 technical department for shaft seals at Forsheda AB, who have access to many years of in-house testing, for advice.

Chemical resistance

Since the Cassette seals are normally exposed to oil or grease, and not other chemicals, tables about 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 STEFA 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 51 and 50.

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.



Cassette Seal

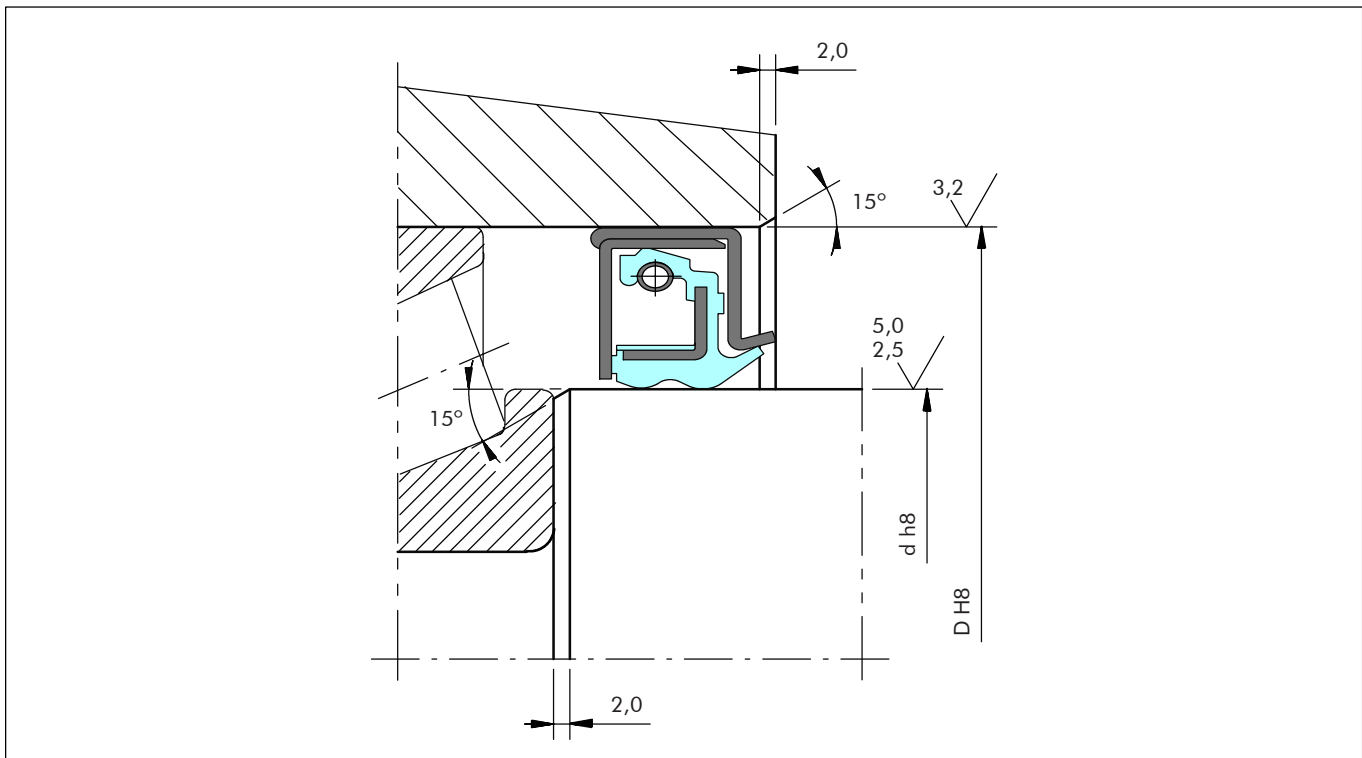


Figure 50 System 500 in wheel hub application

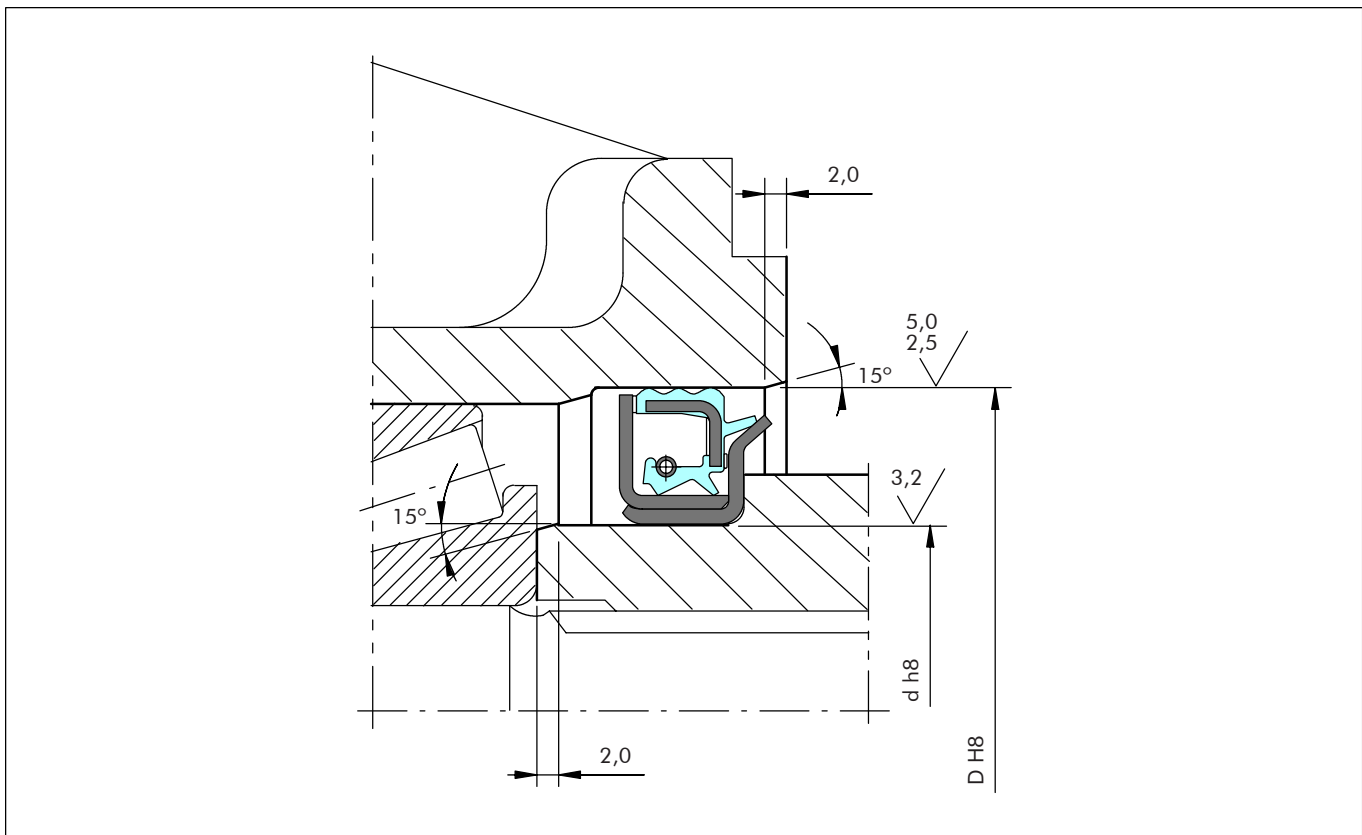


Figure 51 System 5000 in pinion application



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 minimum value possible.

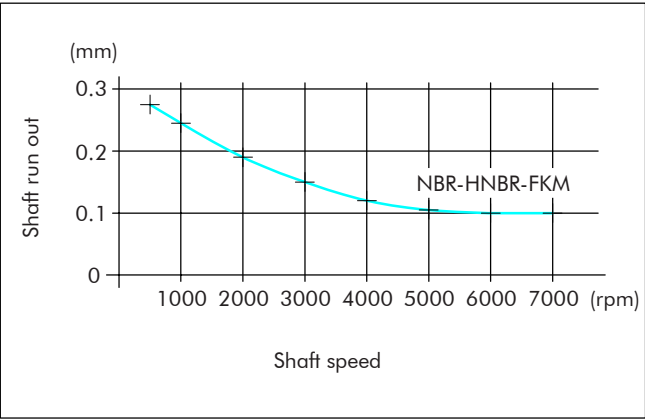


Figure 52 Permissible run out of the shaft

Eccentricity

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

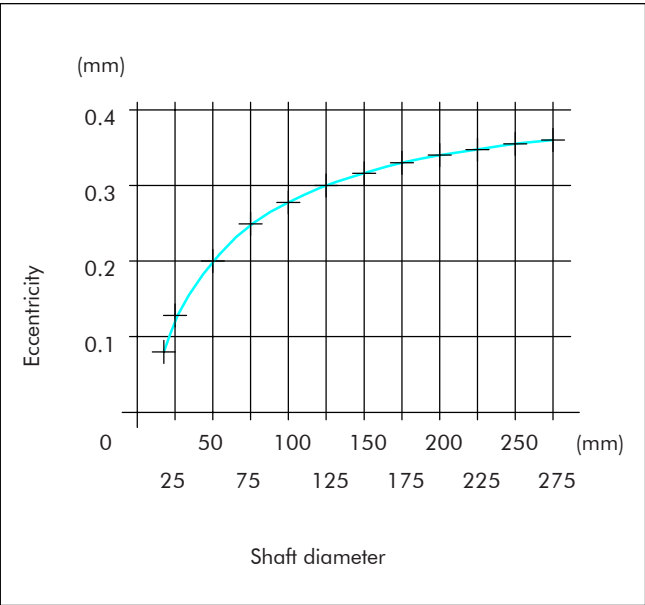


Figure 53 Permissible eccentricity

Shaft misalignment

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

Axial movement

Axial movement, inclusive what can be considered as normal bearing play, should be within ± 0.1 mm. The STEFA System seals can function properly at larger movements, but 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 STEFA System 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 rotations speed 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 STEFA System 500 seal, in dirty applications such as off-road. The main sealing area 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 being bonded directly to the outer case of the STEFA 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.



Cassette Seal

The counterface for the HRV seal can consist either of a surrounding component or a steel shell adequately adapted to the seal.

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 R_a 1.6 to 2.0 μm is normally adequate. For sealing against liquid and dirt, R_a 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 measure for fitted width can be obtained from the product drawing of the dimension.

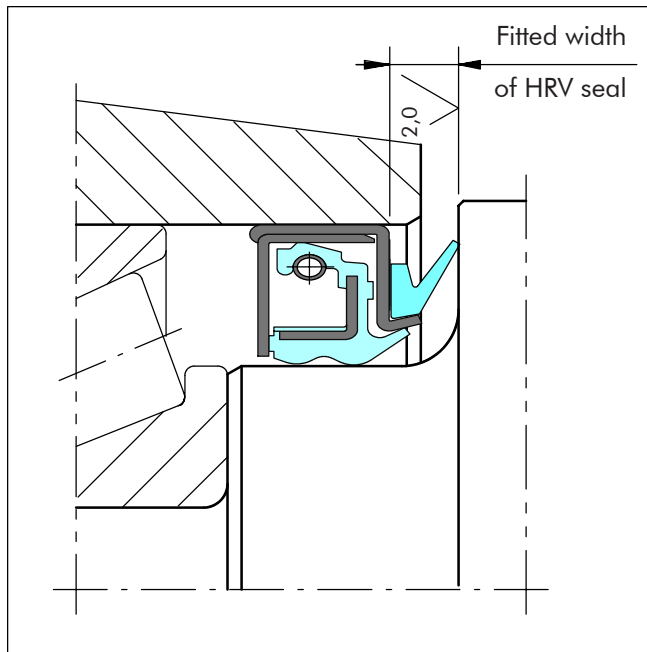


Figure 54 System 500 with HRV seal

■ Installation

As the STEFA System seals 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 STEFA System seals are 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 STEFA System 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 STEFA System 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, 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 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.



System 5000

The STEFA 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 to the oil side of the seal is entering the housing bore.

The seal can of course enter the housing bore at the same time as the seal is assembled on the shaft.

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 in right position.

The force required to assemble a STEFA 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 together with utilization of 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 live of the seal.

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

When repairing of the application is necessary, a new seal shall always be installed.

Further instructions for assembling can be found on separate assembly instruction sheet.

Dismantling and replacement

As all the necessary functions are integrated in the STEFA System seals 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 STEFA System seals may be provided with a sealant on surface for interference fit. The sealant may reduce the risk for static leakage due to small imperfections on surfaces involved at replacement.

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 unserviceable, 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. or by storing the seals under load. On the other hand, properly stored elastomer products may retain their properties for several years.

As the sensitive sealing lips and counter faces are incorporated into the Cassette seals, there is a less risk for mechanical damages and influence of dirt and dust in comparison to many other seal types.

Cleaning

If cleaning of Cassette seals are 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.

Testing

To be a leading company of seal production demands development and testing. The way from idea to ready product is long. An important tool on that way is test equipment, for testing from first prototype to verification of the customer's production tools. In testing equipment you are able to regulate parameters such as speed, temperature, eccentricity, shaft run out and over pressure. When working with new designs of cassette seals, the ability to withstand the outer environment is a determining factor. Therefore tests are often run until the seal is showing out leakage of oil, or in leakage of water or dirt particles.

To make it able to perform testing in water and mud, Forsheda has constructed special testing equipment. In that equipment we are able to perform own standard tests, as well as customer specific testing. We can imitate rice fields, where most part of the wheel hub is immersed in a mix of clay and water, or make the desert sand of Sahara whirl round in the wheel hub.

In testing equipment you can secure a comparable value, like for example length of life for a standard radial seal to be compared to a cassette seal. To get a broader base, many customers are choosing to supplement with field tests in real environment.



V-RING

■ General

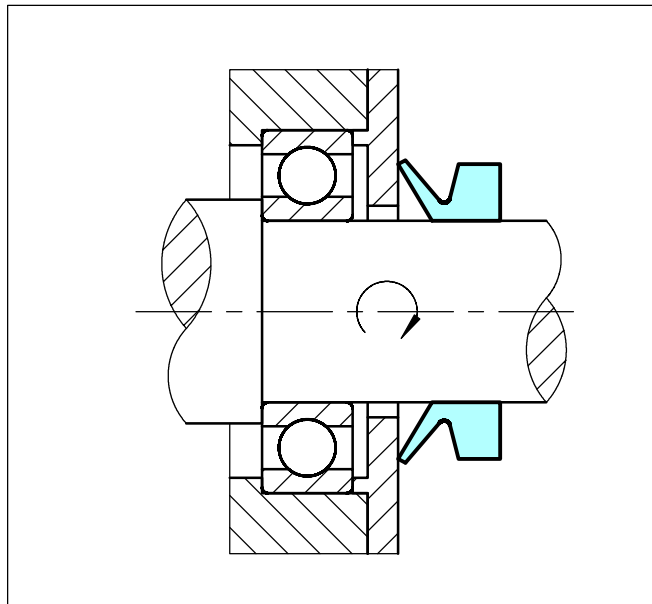


Figure 55 Method of operation of the V-Ring

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

The V-Ring provides a perfect solution 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 protects 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 positioned by the inherent tension of the rubber body. It rotates with the shaft and seals axially against a stationary counterface, at right angles to the shaft. The counterface can be the end face of a bearing or a washer, stamping, bearing housing, or even the metal case of 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 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 torque is overcome, the power losses reduce steadily until around the 10 -15 m/s band when they reduce quite quickly. In the 15 - 20 m/s band the losses reduce to zero and the V-Ring then serves as clearance seal and deflector.

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 B+S 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.

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 vary 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 has 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.

Additionally, profiles RME, RM and AX are all designed as secondary seals for heavy-duty applications where the primary seal has to be protected against water and / or particulate contamination. RME and RM can be axially located on the shaft using the RM clamping band specially designed by Forsheda. These heavy-duty V-Rings are designed primarily for large, high-speed bearing arrangements, i.e. rolling mill and papermaking machine applications. Available for shaft diameters from 300 to 2010 mm.

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

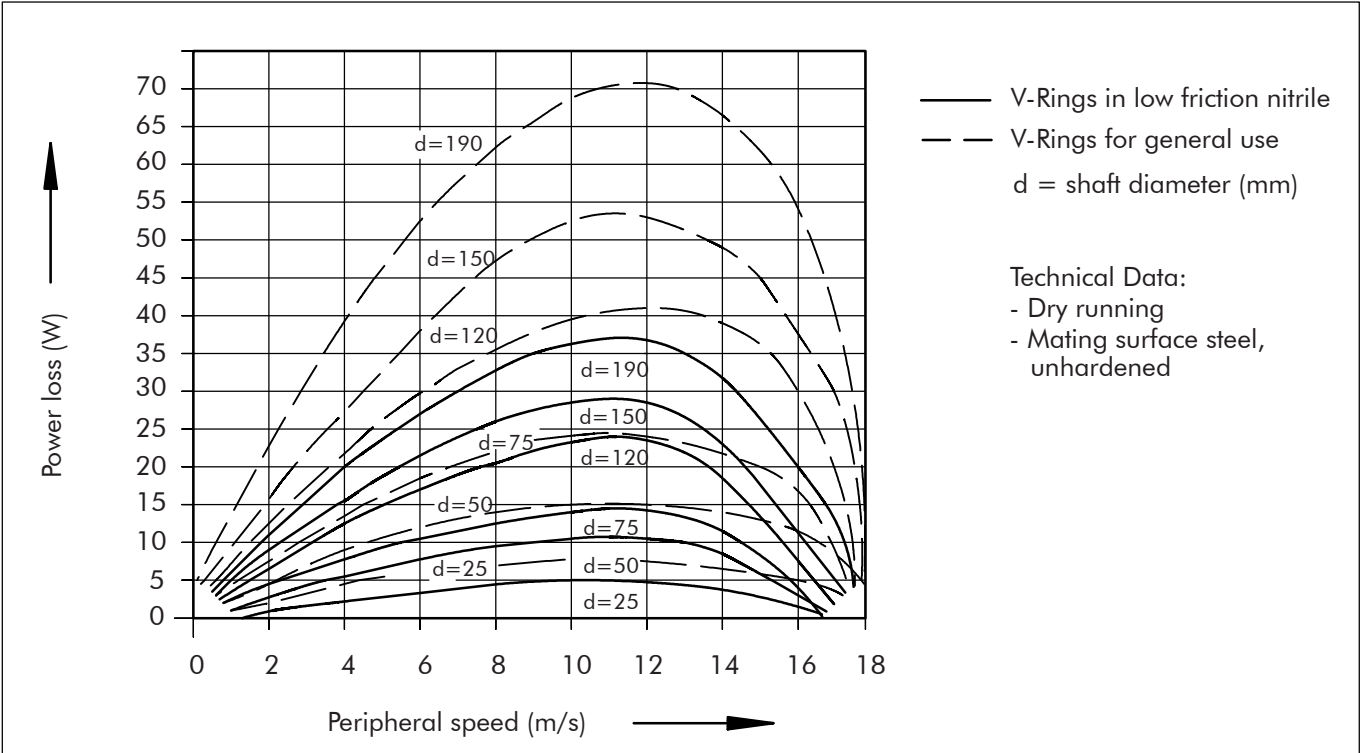


Figure 56 Power loss as a function of peripheral speed for various sizes

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 commonly selected material is Forsheda’s specially developed general purpose nitrile rubber, NBR510 (N6T50). Subjected to continuous improvement over many years, NBR510 (N6T50) is a highly evolved and highly successful material.

In applications at high 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 these are listed below.

Table XL Guide to selection of rubber material

Forsheda code	B+S code	Type of rubber	Characteristics
NBR 510	N6T50	Nitrile	For general use
NBR 555	N7T50	Nitrile	Heavy duty conditions. Good tear and abrasion resistance
NBR 562	N6T52	Nitrile	Low friction
HNBR 576	H7T50	Hydrogenated Nitrile	Hypoid oils at high temp.
CR 415	CDT50	Chloroprene	For applications in the presence of ozone
EPDM 762	E7T50	Ethylene-Propylene	Good weather and ozone resitence, used with special chemicals such as acetone, ammonium carbonate and benzaldehyde
FKM 900	VDT50	Fluorinated	Very high temperature and chemical resistance



Temperature resistance

Exposure to increasing temperature accelerates 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 significance on the useful life of the seal.

The temperature limits for the principal materials are illustrated in Figure 57. 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 period of time. On the cold side, the lower temperatures normally require special compounds.

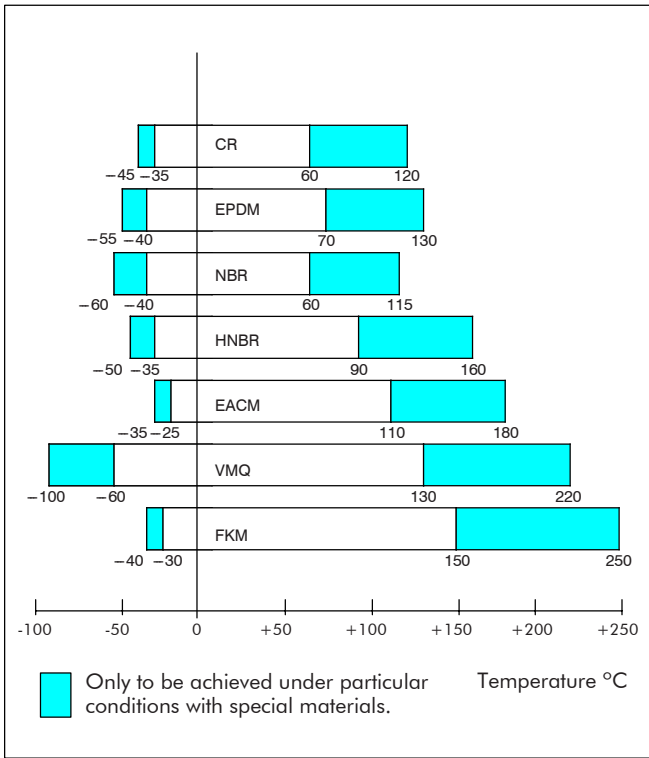


Figure 57 Temperature recommendations for V-Rings

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 Forsheda grade Nitrile Rubber 510 (N6T50) 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 B+S company.

Application instructions

The FORSHEDA V-RING is normally located in 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.



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	150-200	Water
(Cr/Ni 18-8, C 0.1%)		
Stainless Steel	350	Water and abrasive particles
(Cr/Ni 18-8, C 0.15%)		
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 such as Molycote 106, 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

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 58. 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 d5
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

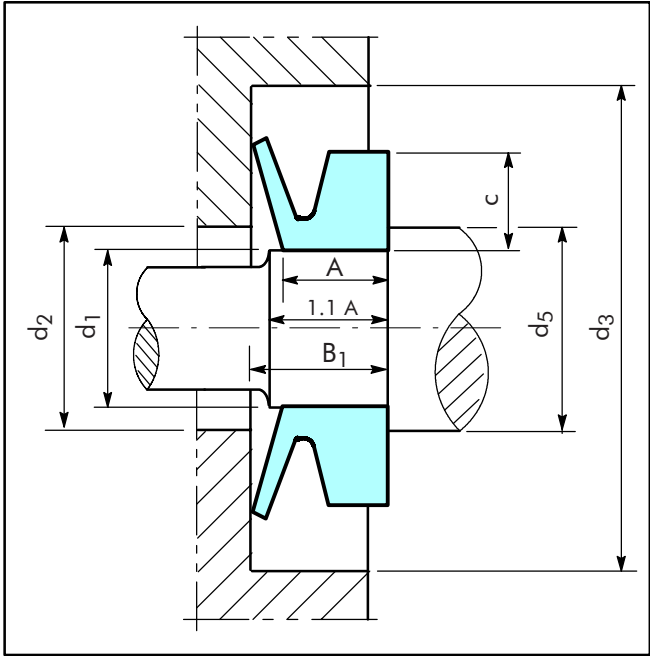


Figure 58 Axial support

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 B+S company for further guidance.

The FORSHEDA clamping band type RM is another useful alternative. See separate chapter.

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 optimum 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 such as Molykote 7409 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 loss. 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 B+S 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, such as Molykote 7409, 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 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 B+S company.

Clamping band

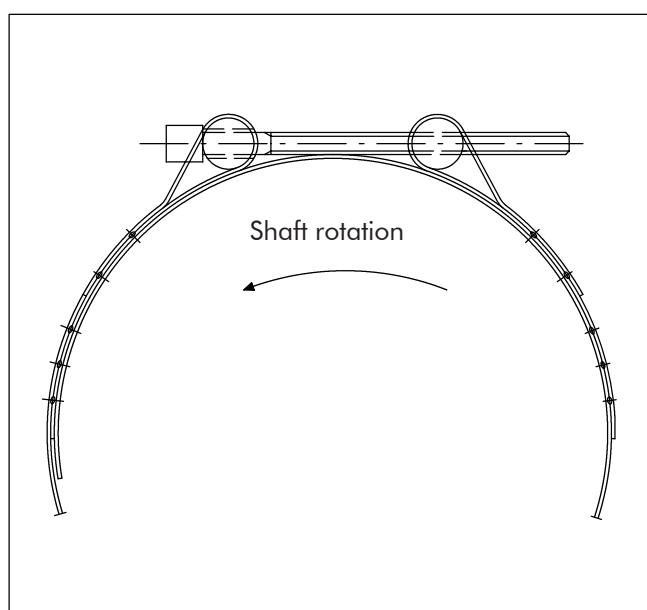


Figure 59 Clamping band RM

FORSHEDA Clamping Band RM

For clamping large diameter V-Rings, the Forsheda Clamping Band RM, especially designed for V-Ring type RM and RME, 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 connected together, the clamping band will fit the specific V-Ring.



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 either a standard pop riveter and the three pop rivets or, by using the three conventional rivets supplied.

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 bands, join the bands 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.

Clamping band for V-Ring type A

For clamping V-Ring type A, >V-200 A, a conventional jubilee type band can be supplied.

Such a band is wrapped twice around the V-Ring body and is kept in place with supporting buckles.

Consult your local B+S company for further information.

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 B+S company.

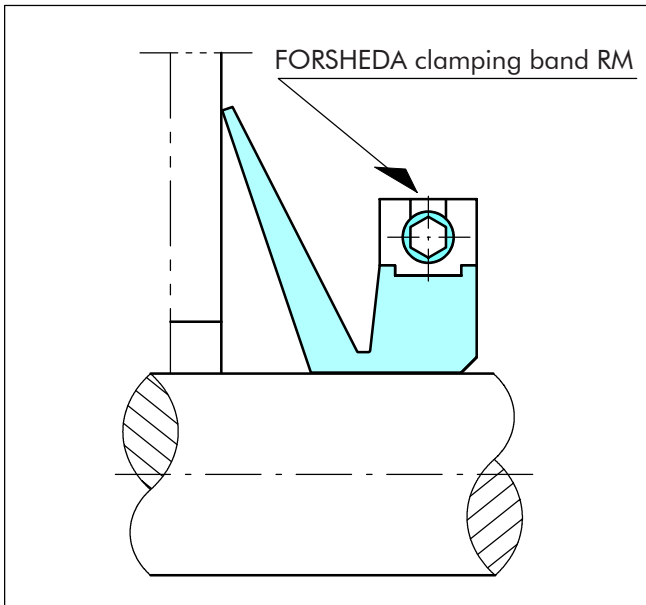


Figure 60 FORSHEDA clamping band RM

Detailed information how to splice and assemble the Clamping Band RM is supplied together with the bands.



■ Dimension table - V-Ring type A

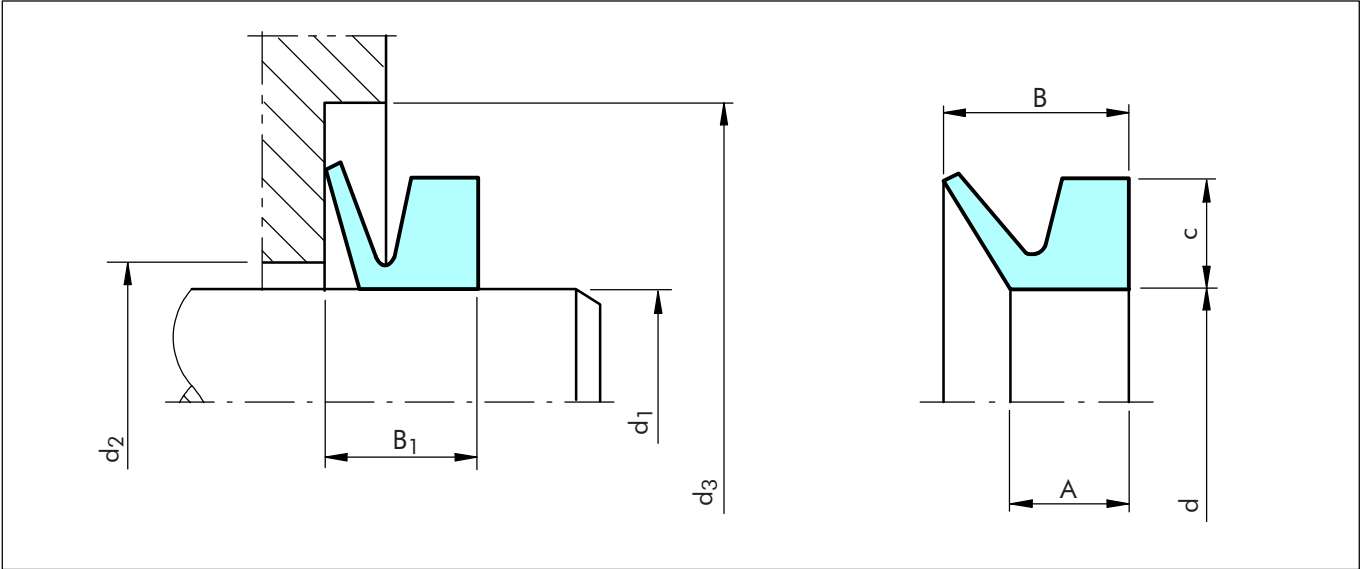


Figure 61 Installation drawing

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.

Table XLI Profile dimensions - assembly dimensions

For shaft diameter d_1	Inside diameter 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.	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
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



V-Ring

For shaft diameter d_1	Inside diameter 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.	Part number
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
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
1420 - 1470	1315	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1450A	TWVAW1450
1470 - 1520	1360	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1500A	TWVAW1500
1520 - 1570	1405	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1550A	TWVAW1550
1570 - 1620	1450	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1600A	TWVAW1600
1620 - 1670	1495	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1650A	TWVAW1650
1670 - 1720	1540	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1700A	TWVAW1700
1720 - 1770	1585	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1750A	TWVAW1750
1770 - 1820	1630	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1800A	TWVAW1800
1820 - 1870	1675	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1850A	TWVAW1850
1870 - 1920	1720	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1900A	TWVAW1900
1920 - 1970	1765	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-1950A	TWVAW1950
1970 - 2020	1810	15	14.3	25.0	$d_1 + 10$	$d_1 + 45$	20.0 ± 4.0	V-2000A	TWVAW2000



Ordering example

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

Order no.	TWVA00300	-	N6T50
Part no.			
Quality index (standard)			
Material no. (standard)			
Corresponding to Forsheda ref. V-30A NBR510			



V-Ring

■ Dimension table - V-Ring type S

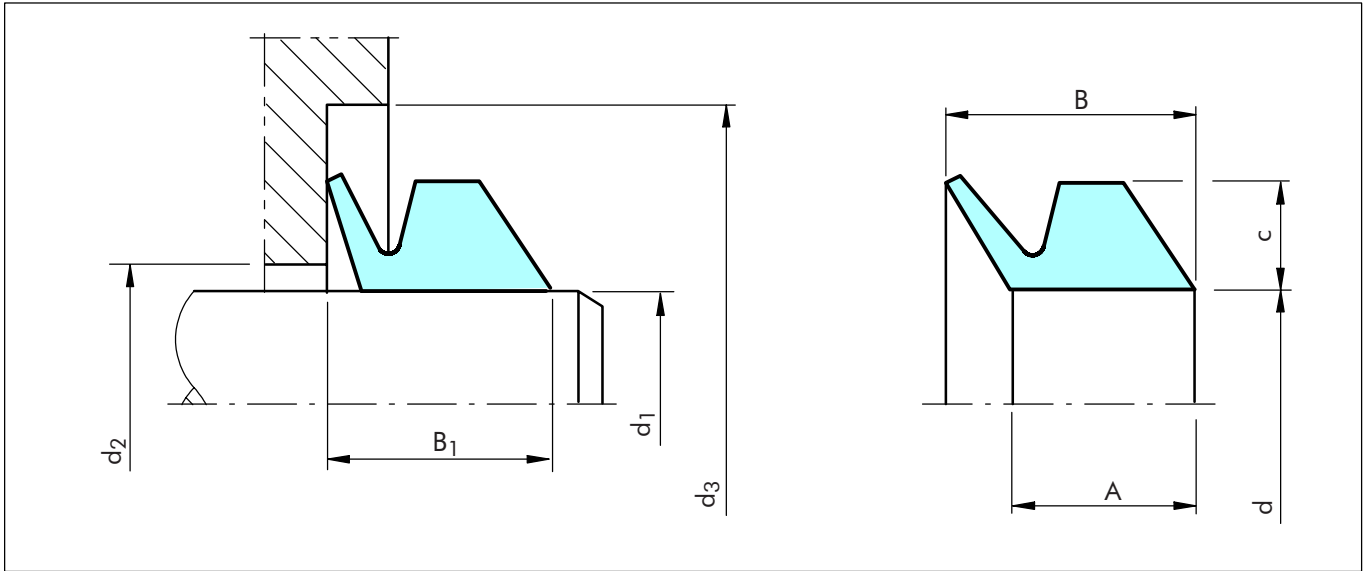


Figure 62 Installation drawing

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 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.	Part number
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	3.7	$d_1 + 1$	$d_1 + 6$	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
15.5 – 17.5	14	3	5.6	7.7	$d_1 + 1$	$d_1 + 9$	6.7 ± 0.6	V-16S	TWVS00160
17.5 – 19	16	3	5.6	7.7	$d_1 + 1$	$d_1 + 9$	6.7 ± 0.6	V-18S	TWVS00180
19 – 21	18	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-20S	TWVS00200
21 – 24	20	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-22S	TWVS00220
24 – 27	22	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-25S	TWVS00250
27 – 29	25	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-28S	TWVS00280
29 – 31	27	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-30S	TWVS00300
31 – 33	29	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-32S	TWVS00320
33 – 36	31	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-35S	TWVS00350
36 – 38	34	4	7.9	10.5	$d_1 + 2$	$d_1 + 12$	9.0 ± 0.8	V-38S	TWVS00380
38 – 43	36	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-40S	TWVS00400
43 – 48	40	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-45S	TWVS00450
48 – 53	45	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-50S	TWVS00500
53 – 58	49	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-55S	TWVS00550
58 – 63	54	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-60S	TWVS00600
63 – 68	58	5	9.5	13.0	$d_1 + 2$	$d_1 + 15$	11.0 ± 1.0	V-65S	TWVS00650



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.	Part number
68 – 73	63	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-70S	TWVS00700
73 – 78	67	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-75S	TWVS00750
78 – 83	72	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-80S	TWVS00800
83 – 88	76	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-85S	TWVS00850
88 – 93	81	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-90S	TWVS00900
93 – 98	85	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-95S	TWVS00950
98 – 105	90	6	11.3	15.5	d ₁ + 3	d ₁ + 18	13.5 ±1.2	V-100S	TWVS01000
105 – 115	99	7	13.1	18.0	d ₁ + 4	d ₁ + 21	15.5 ±1.5	V-110S	TWVS01100
115 – 125	108	7	13.1	18.0	d ₁ + 4	d ₁ + 21	15.5 ±1.5	V-120S	TWVS01200
125 – 135	117	7	13.1	18.0	d ₁ + 4	d ₁ + 21	15.5 ±1.5	V-130S	TWVS01300
135 – 145	126	7	13.1	18.0	d ₁ + 4	d ₁ + 21	15.5 ±1.5	V-140S	TWVS01400
145 – 155	135	7	13.1	18.0	d ₁ + 4	d ₁ + 21	15.5 ±1.5	V-150S	TWVS01500
155 – 165	144	8	15.0	20.5	d ₁ + 4	d ₁ + 24	18.0 ±1.8	V-160S	TWVS01600
165 – 175	153	8	15.0	20.5	d ₁ + 4	d ₁ + 24	18.0 ±1.8	V-170S	TWVS01700
175 – 185	162	8	15.0	20.5	d ₁ + 4	d ₁ + 24	18.0 ±1.8	V-180S	TWVS01800
185 – 195	171	8	15.0	20.5	d ₁ + 4	d ₁ + 24	18.0 ±1.8	V-190S	TWVS01900
195 – 210	180	8	15.0	20.5	d ₁ + 4	d ₁ + 24	18.0 ±1.8	V-199S	TWVS01990

Ordering example

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

Order no.

Part no.

Quality index (standard)

Material no. (standard)

Corresponding to Forsheda ref. V-30S NBR510

TWVS00300

-

N6T50



V-Ring

■ Dimension table - V-Ring type L/LX

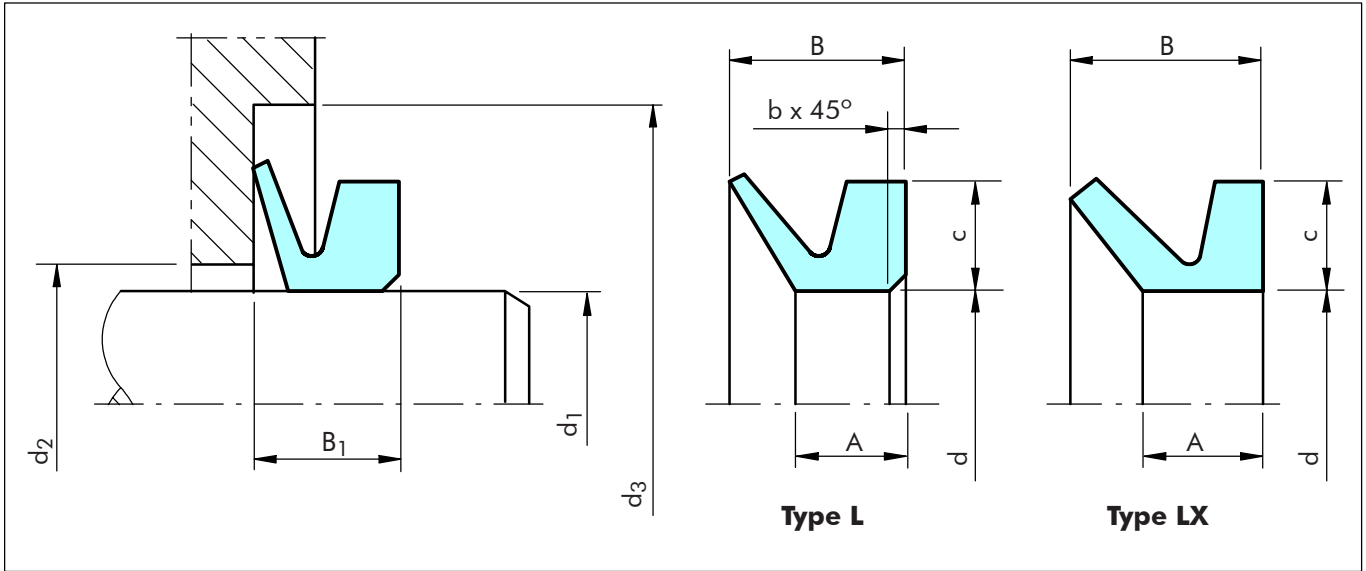


Figure 63 Installation drawing

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

Table XLIII 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

Table XLIV Profile dimensions - assembly dimensions

For shaft diameter d ₁	Inside diameter d	V-Ring Forsheda Ref.	Part number Type L	Part number 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



For shaft diameter d ₁	Inside diameter d	V-Ring Forsheda Ref.	Part number Type L	Part number Type LX
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
1035 – 1075	955	V-1050L/LX	TWVLW1050	TWLXW1050
1075 – 1125	1000	V-1100L/LX	TWVLW1100	TWLXW1100
1125 – 1175	1045	V-1150L/LX	TWVLW1150	TWLXW1150
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.

Ordering example

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

Order no.

TWVL02000

-

N6T50

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)

Order no.

TWLXV2000

-

N6T50

Part no.

Quality index (standard)

Material no. (standard)

Corresponding to Forsheda ref. V-200LX VBR510



V-Ring

■ Dimension table - V-Ring type RM/RME

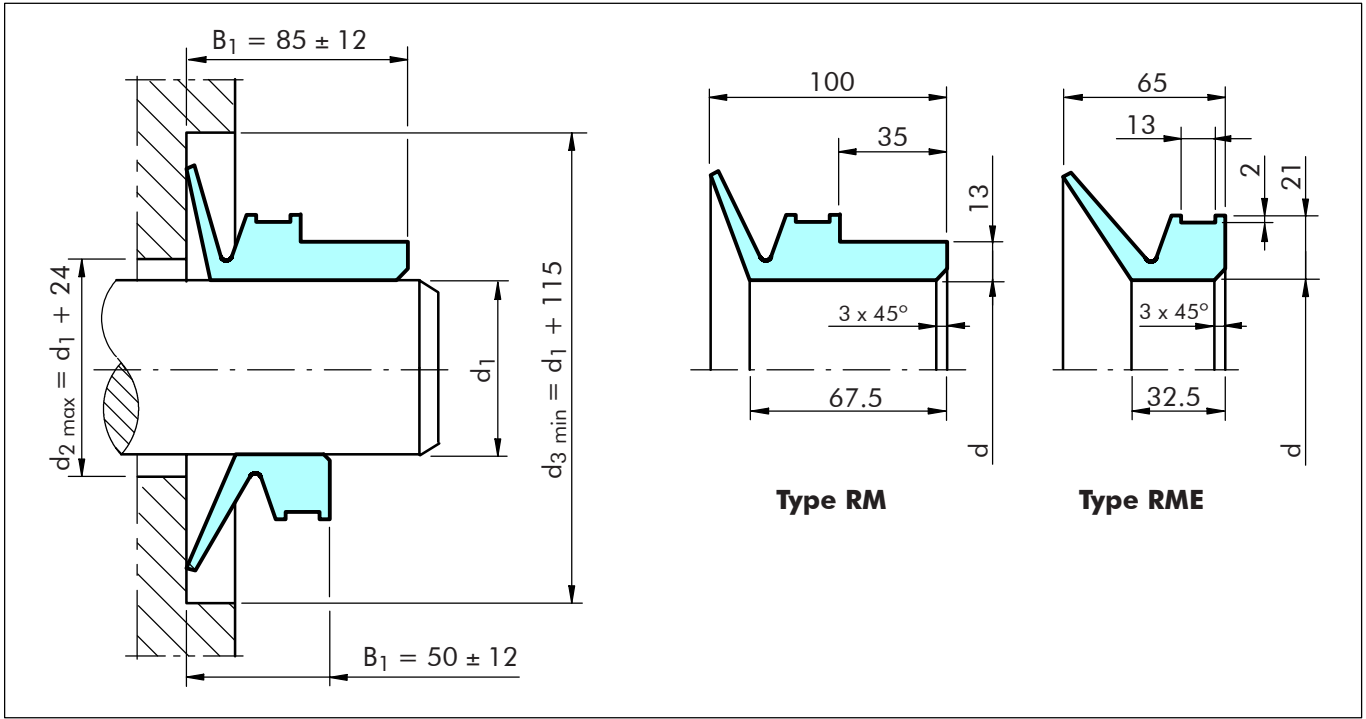


Figure 64 Installation drawing

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

Table XLV Profile dimensions - assembly dimensions

For shaft diameter d ₁	Inside diam. d	V-Ring Forsheda Ref.	Part number type RM	Part number 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
340 – 345	333	V-340RM/RME	TWRMV3400	TWVBV3400
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



For shaft diameter d ₁	Inside diam. d	V-Ring Forsheda Ref.	Part number type RM	Part number type RME
400 – 405	391	V-400RM/RME	TWRMV3400	TWVBV3400
405 – 410	396	V-405RM/RME	TWRMV3405	TWVBV3405
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
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



V-Ring

For shaft diameter d ₁	Inside diam. d	V-Ring Forsheda Ref.	Part number type RM	Part number type RME
710 – 720	689	V-710RM/RME	TWRMV7100	TWVBV7100
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	413	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
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



For shaft diameter d ₁	Inside diam. d	V-Ring Forsheda Ref.	Part number type RM	Part number type RME
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.

Ordering example

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

Ordering example

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

Order no.

TWVBV5000

-

N6T50

Part no.

Quality index (standard)

Material no. (standard)

Corresponding to Forsheda ref. V-500RME NBR510

Order no.

TWRMV5000

-

N6T50

Part no.

Quality index (standard)

Material no. (standard)

Corresponding to Forsheda ref. V-500RM NBR510



V-Ring

■ Dimension table - V-Ring type AX

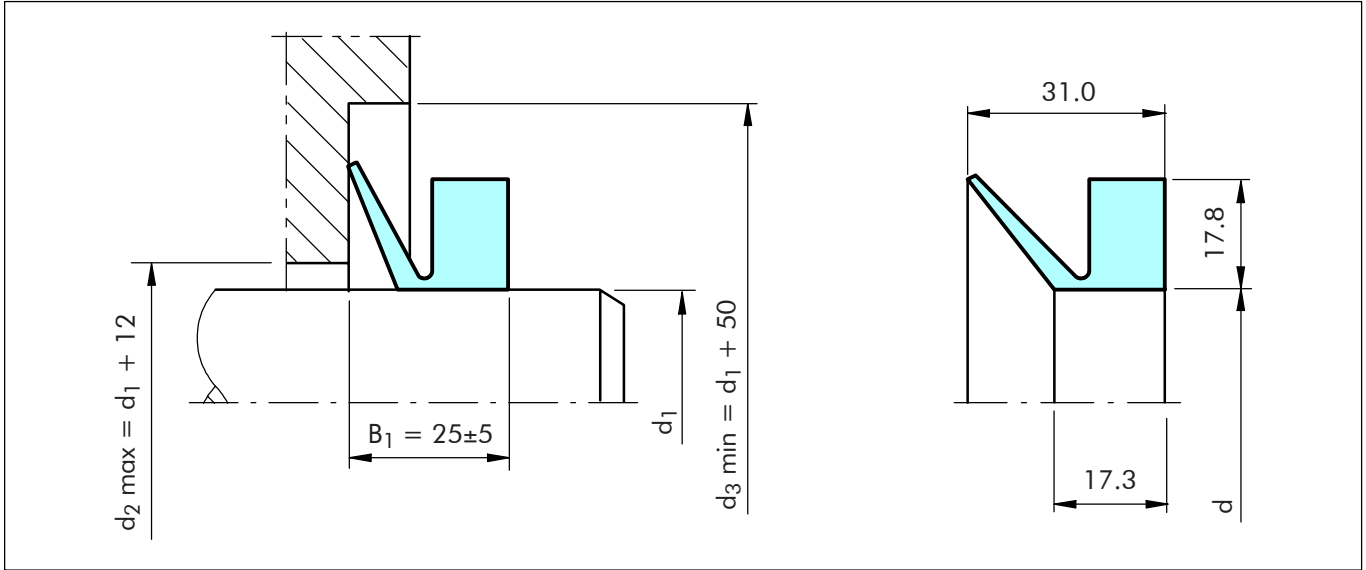


Figure 65 Installation drawing

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

Table XLVI Profile dimensions - assembly dimensions

For shaft diameter d ₁	Inside diameter d	V-Ring Forsheda Ref.	Part number
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
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



For shaft diameter d ₁	Inside diameter d	V-Ring Forsheda Ref.	Part number
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
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.

Ordering example

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

Order no. TWAXW1200 - N6T50

Part no.

Quality index (standard)

Material no. (standard)

Corresponding to Forsheda
ref. V-1200AX NBR510



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 66 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 67). 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 66). 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.

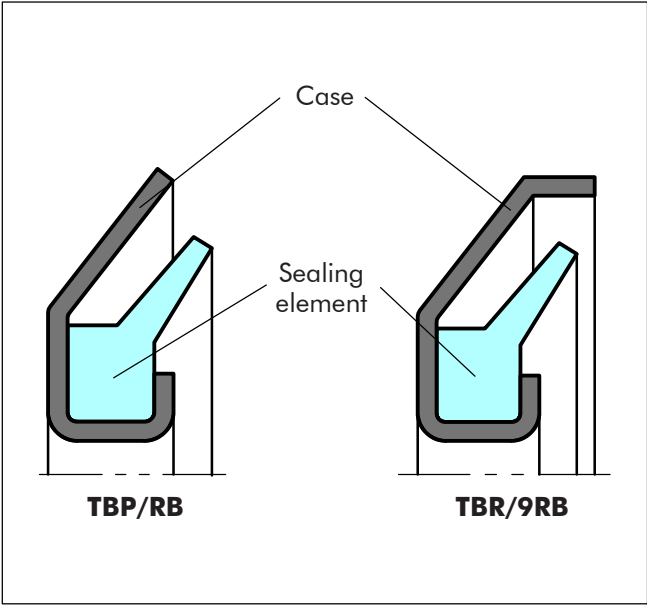


Figure 66 GAMMA seal types

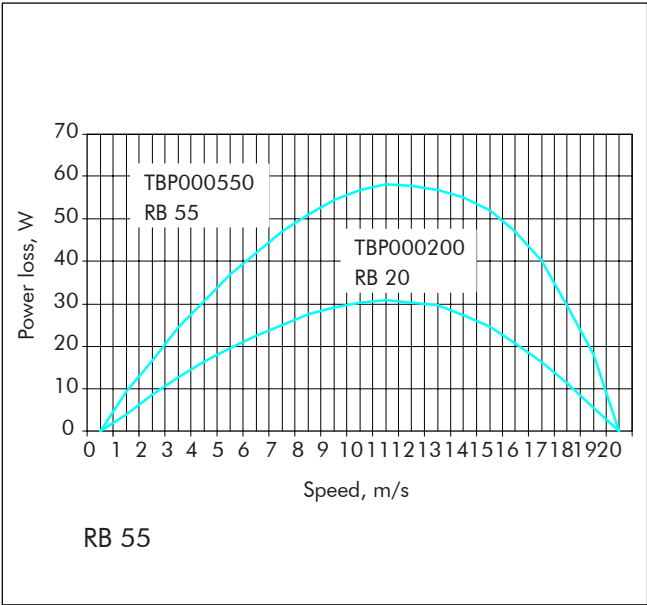


Figure 67 Power loss as a function of peripheral speed (Counterface 1.5-2 μm Ra not lubricated seal)

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 XLVII. 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 TPB should normally be installed as shown in Figure 69, i.e. with the seal located in the medium which is to seal against. As shown in Figure 73 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 68 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.

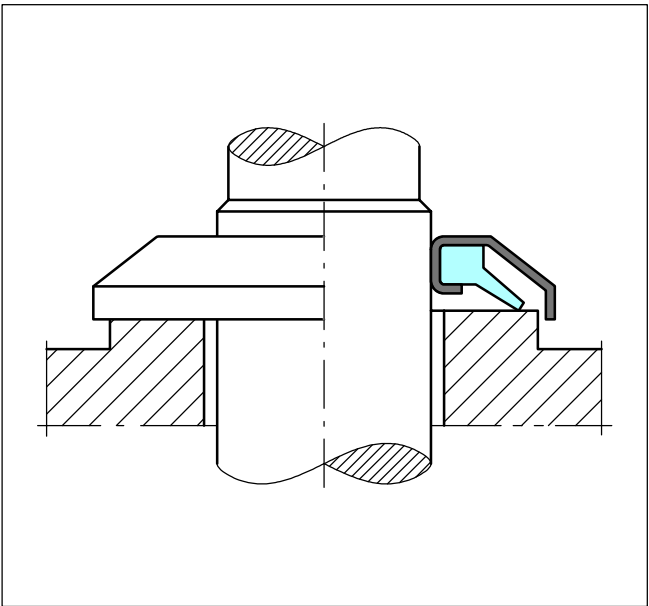


Figure 68 Vertical installation

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

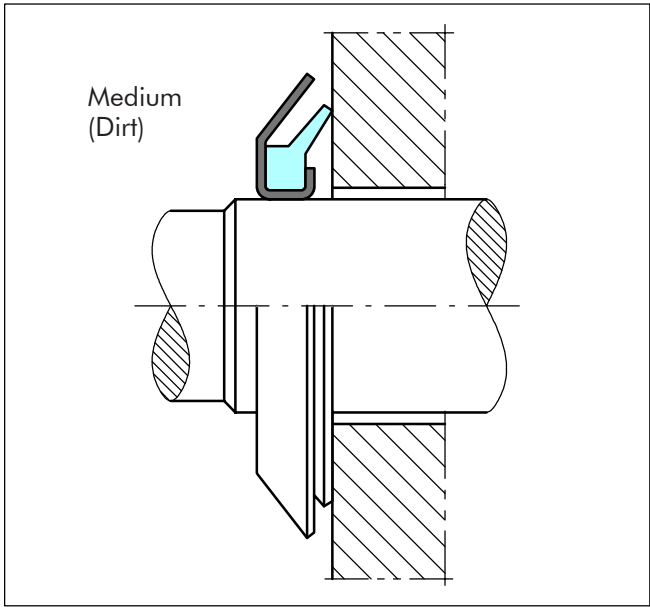


Figure 69 Installation drawing

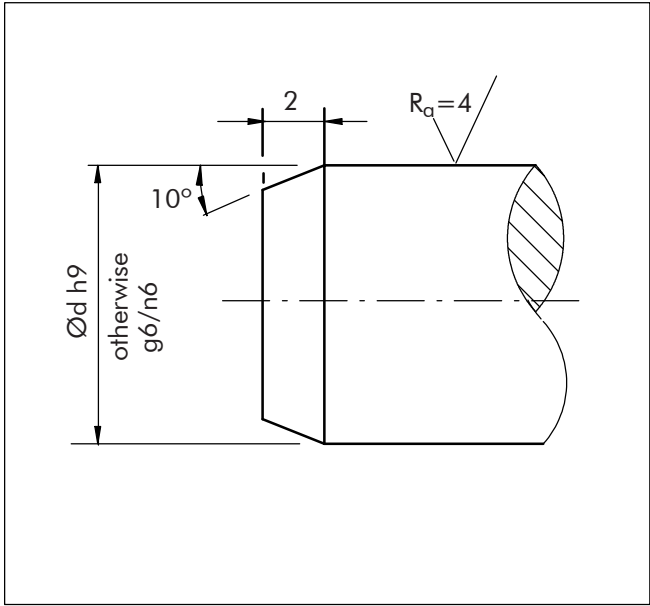


Figure 70 Tolerance of the shaft, surface roughness and chamfer of the shaft

The surface roughness of the shaft should not exceed 4µm Ra. In addition, the shaft should be provided with a chamfer as per Figure 70. Sharp edges or burrs are not permitted. In the case of width b, a variation of +0.5mm is permissible.

Table XLVII 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 be 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 71, 72 and 73). 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 71 and 73 in order to obtain the installation width b as per the dimension tables.

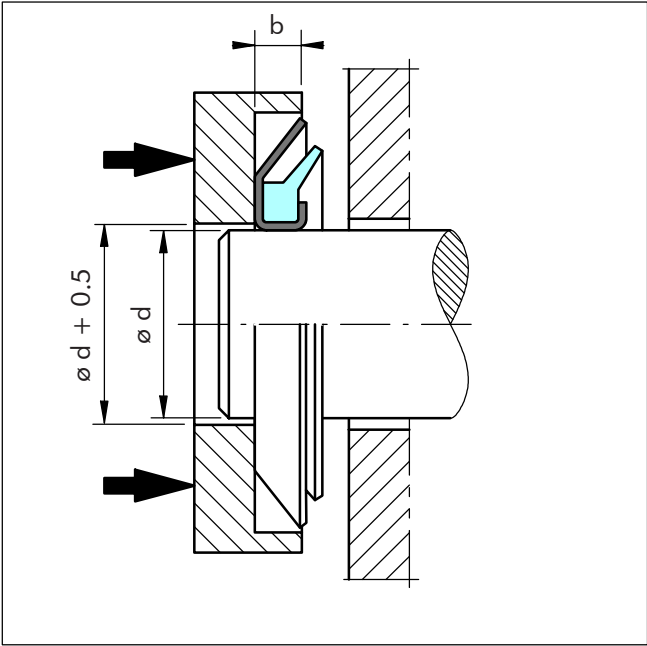


Figure 71 Assembly tool for TBP/RB

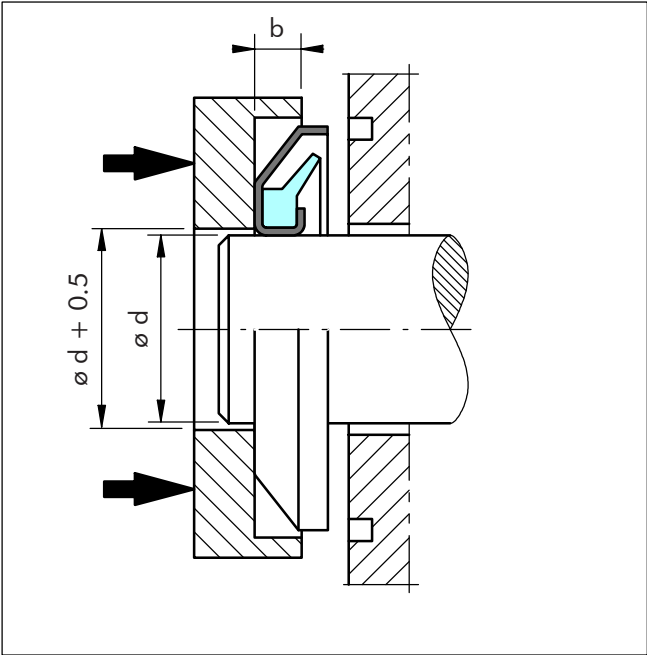


Figure 73 Assembly tool TBR/9RB

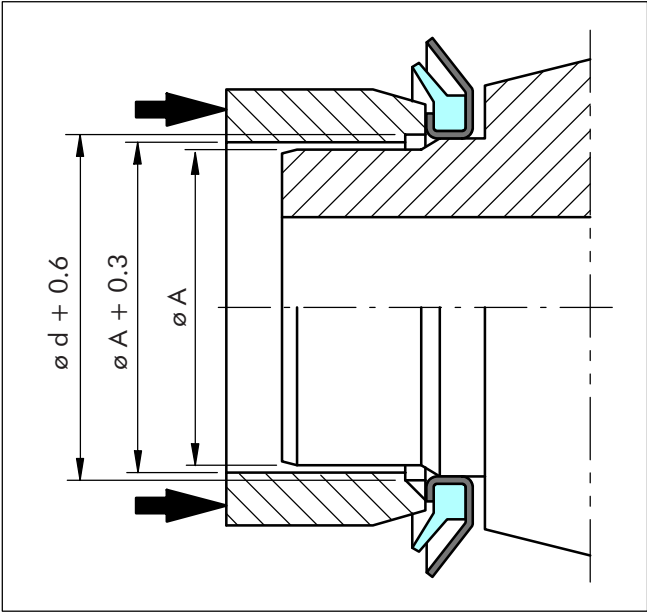


Figure 72 Assembly tool. When positioning the GAMMA seal against a shoulder it is important not to deform the case by pressing with too high load



■ GAMMA seal type TBP/RB

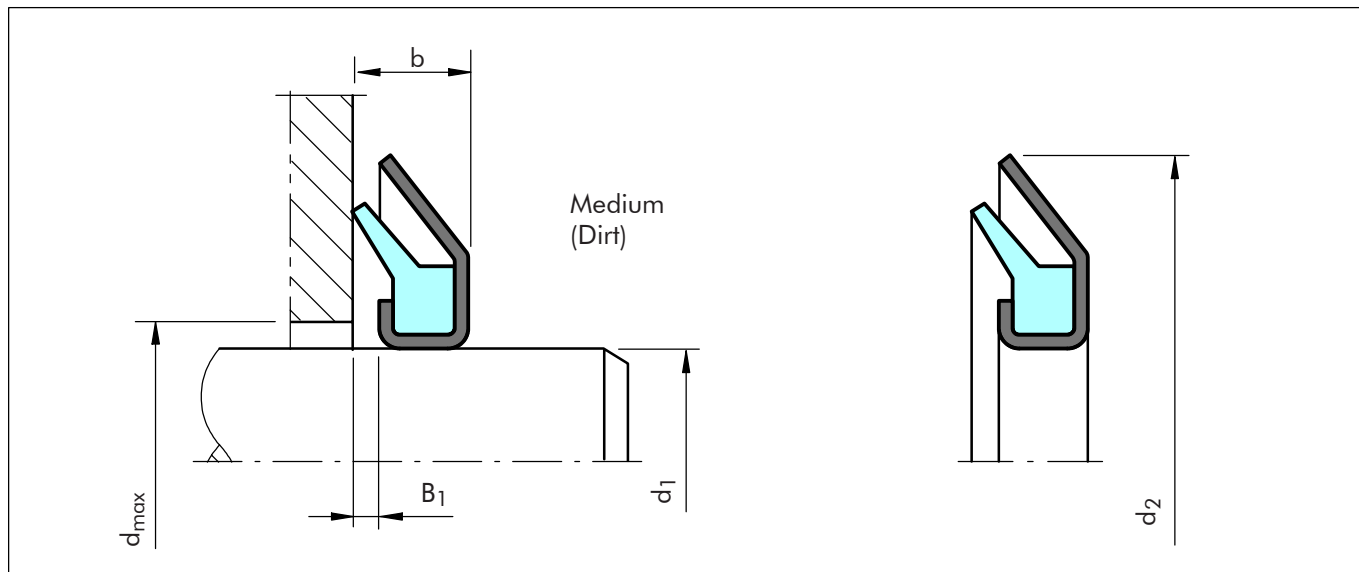


Figure 74 Installation drawing

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 (EP spec.s)
- 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.)
B+S/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.



Table XLVIII Materials

Standard material*	B+S 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.

Table XLIX Preferred series / Dimension, part numbers

Dimension					Part no	STEFA			B+S
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
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



GAMMA Seal

Dimension					Part no	STEFA			B+S
d ₁	d ₂	b	B ₁	d _{max}		Type	NBR 4N04	FKM 4V04	NBR N7MM
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	

Ordering example GAMMA seal B+S type

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

Order no.	TBP	0	00250	-	N7MM
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

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

Order no.	TBP	0	00250	-	4N04
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					

Corresponding to STEFA ref. RB25
NBR 1452



■ GAMMA-seal type TBR/9RB

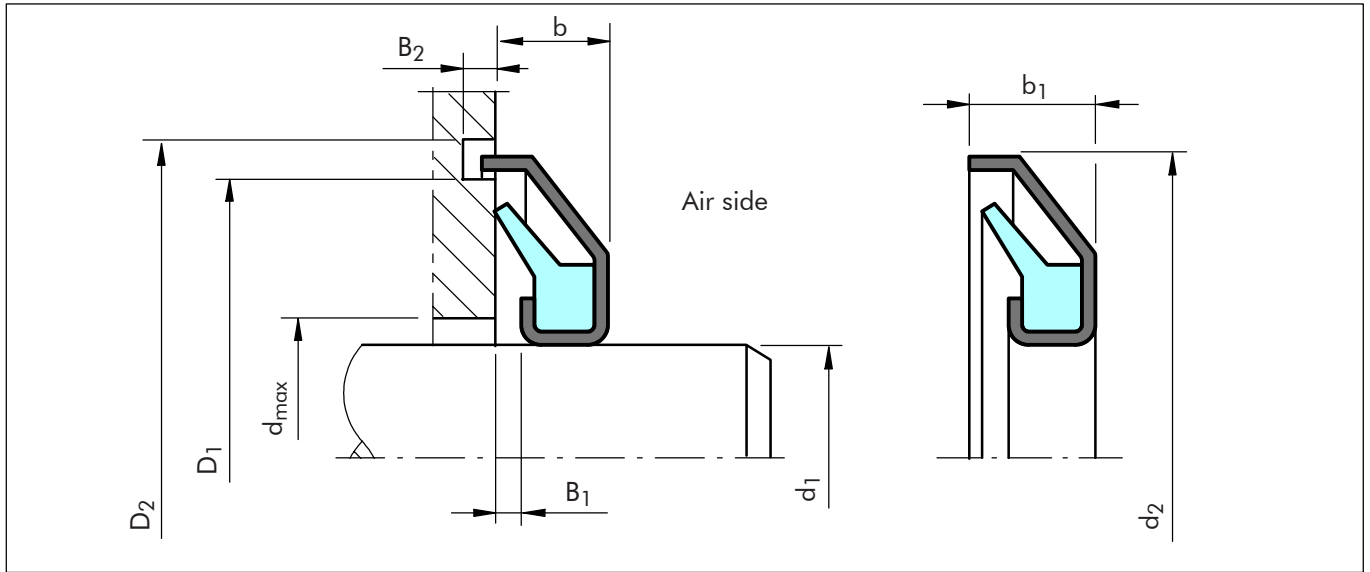


Figure 75 GAMMA-seal with labyrinth

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 (EP spec.s)
- 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.)
B+S/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.



GAMMA Seal

Table L Materials

Standard material*	B+S 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.

Table LI Preferred series / Dimension, part numbers

Dimension									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
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

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

Order no.	TBR	0	00250	-	4N04
Code					
Execution					
Shaft diameter x 10					
Quality index (standard)					
Material code (standard)					
Corresponding to STEFA ref. 9RB25 NBR 1452					



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 76).

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

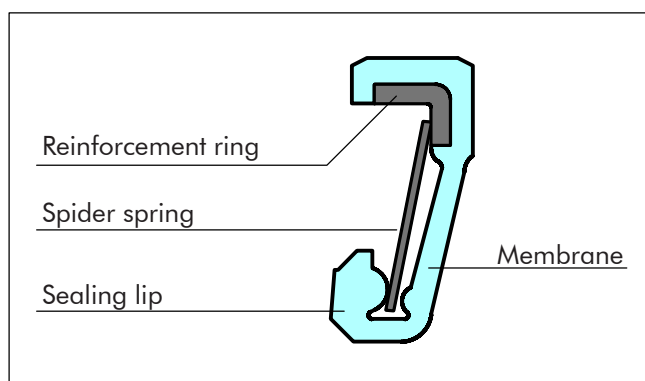


Figure 76 Axial shaft seal



Axial Shaft Seal

Standard versions

Type I

Axial shaft seal with internal sealing lip, primarily for sealing of fluids (Figure 77).

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 LIII, and Table LIV.

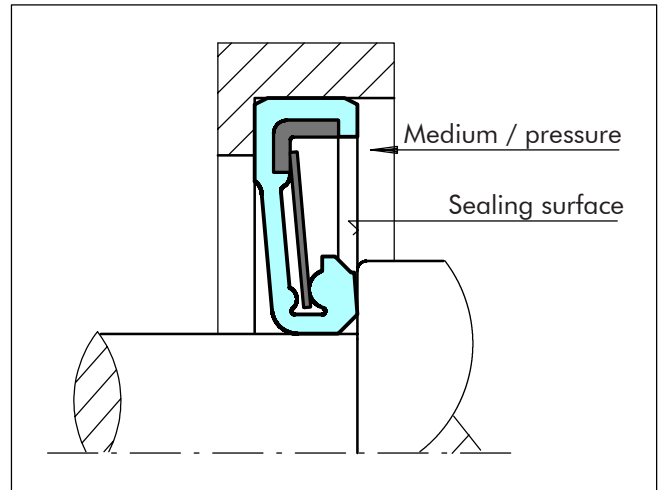


Figure 77 Type I, internal sealing

Type A

Axial shaft seal with external sealing lip for sealing against grease (Figure 78).

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 LV, pages and Table LVI.

For fluid sealing, the maximum permissible speed is reduced to one-third of the value shown in the tables.

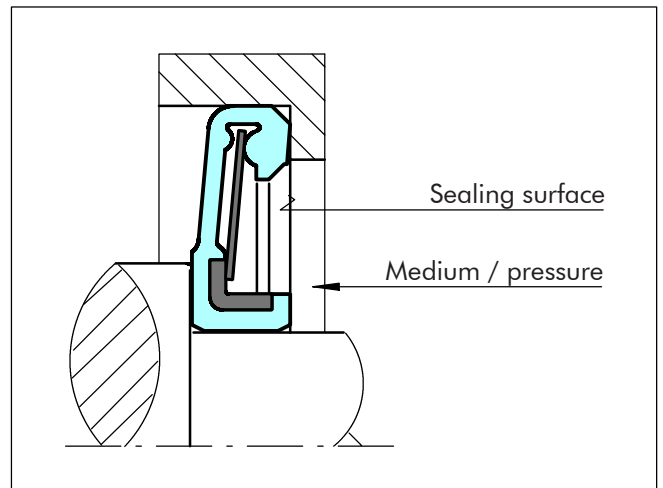


Figure 78 Type A, external sealing



■ 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 +250°C, depending on elastomer material see Table LII.

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 79 shows the maximum speed n as a function of the average sealing lip diameter d_m for the elastomer material Acrylonitrile Butadiene Elastomer (NBR).

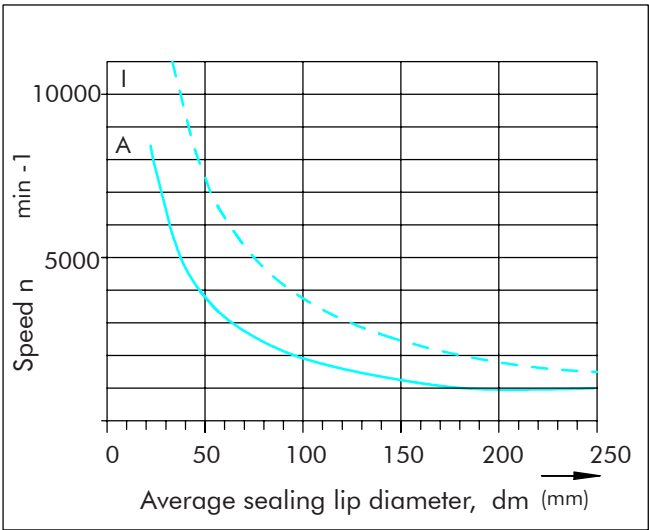


Figure 79 Maximum revolutions n as a function of sealing lip diameter d_m



Materials

Table LII shows the available standard materials. Materials for elastomer and metal parts are selected according to the requirements for temperature and fluid resistance.

Table LII 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 + 250° 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 77 and 78.

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 80).

Optimal seal performance is obtained when the seal or mating face is positioned in line with the front end of the seal.

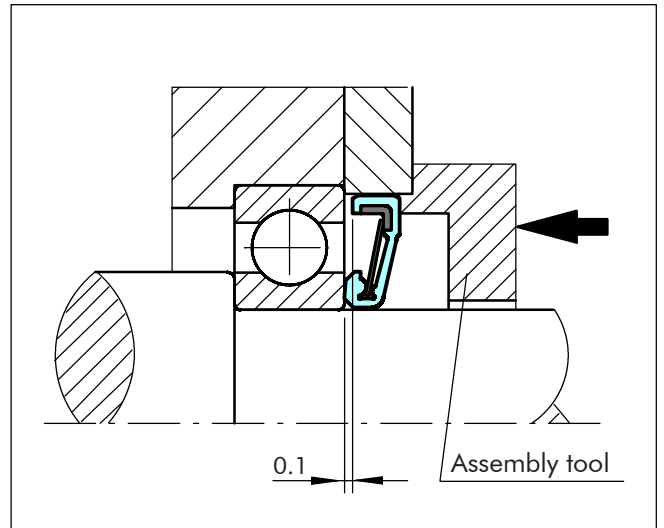


Figure 80 Installation of the axial shaft seal using an assembly tool.



Axial Shaft Seal

■ Installation recommendation, type I, internal sealing, for oil and grease

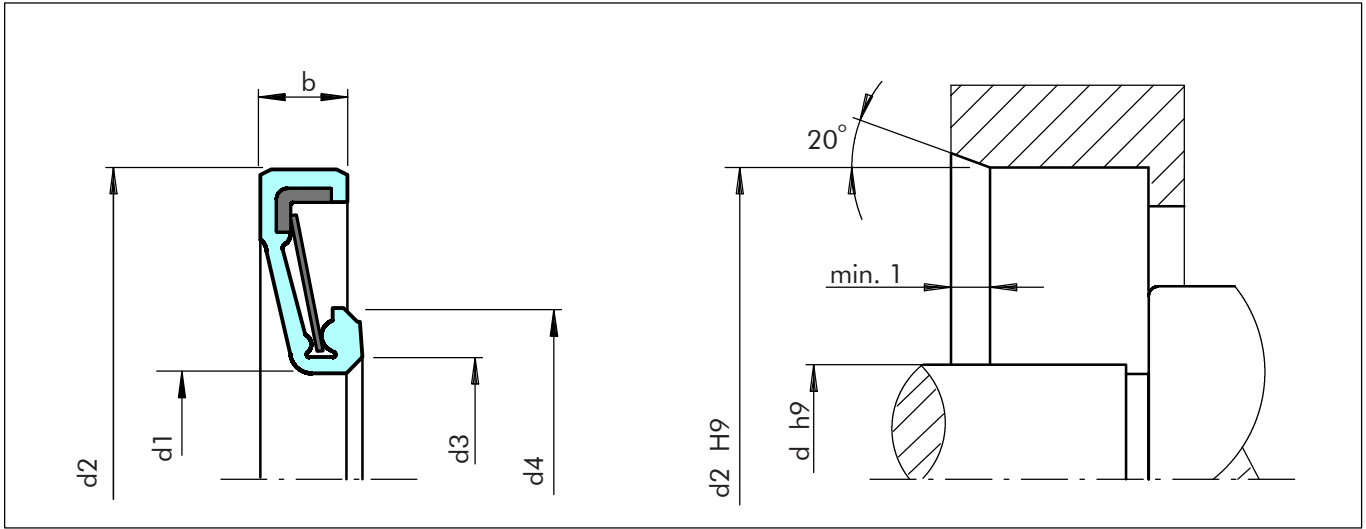


Figure 81 Installation drawing

Table LIII Preferred series

Shaft	Dimensions					Max. speed [min ⁻¹]		Fa*	Max. press.	Correspondence to the roller bearing series					Part No.
d	d ₁	d ₂	d ₃	d ₄	b	NBR	FKM	[N]	[Pa]	6000	6300	6400	4200	4300	
10	11	24	12.0	13.0	4.0	25400	38000	1.8	9000	6000	6300	-	-	-	TAI 000 100
12	13	26	14.0	16.0	4.0	23800	35700	2.0	9400	6001	-	-	4200	-	TAI 000 101
15	16	30	17.0	20.0	4.5	19200	28800	2.5	9500	6002	-	-	-	4301	TAI 000 102
17	18	33	19.0	22.0	4.5	17500	26200	3.0	8800	6003	6302	-	-	-	TAI 000 103
20	22	39	23.0	26.0	4.5	14700	22000	3.5	6900	6004	6304	6403	-	-	TAI 000 104
25	27	44	27.5	31.0	4.5	13000	19500	3.8	6150	6005	-	6404	-	-	TAI 000 105
30	32	50	33.0	36.0	5.0	10600	15900	4.0	5800	6006	-	6405	-	-	TAI 000 106
35	37	56	38.0	41.0	5.0	9300	13900	4.5	6100	6007	6306	6406	4206	-	TAI 000 107
40	42	62	44.0	47.0	5.5	8100	12000	5.5	6550	6008	6307	6407	4207	-	TAI 000 108
45	47	70	49.0	53.0	5.5	7200	10800	6.5	5200	6009	6308	6408	4208	-	TAI 000 109
50	52	75	55.5	59.0	6.0	6600	9900	7.0	4750	6010	6309	6409	4209	-	TAI 000 110
55	58	83	61.5	65.5	6.0	6000	9000	7.5	4450	6011	6310	-	4210	-	TAI 000 111
60	61	89	65.0	69.0	6.5	5500	8200	8.0	3800	6012	6311	6410	4211	-	TAI 000 112
65	67	94	70.0	74.0	7.0	5200	7800	9.0	4600	6013	6312	6411	4212	-	TAI 000 113
70	73	104	74.0	78.0	7.5	4800	7200	11.0	3800	6014	6313	6412	4213	-	TAI 000 114
75	78	109	80.0	84.0	7.5	4500	6700	12.0	4350	6015	6314	6413	4214	-	TAI 000 115
80	84	119	85.0	89.0	8.0	4300	6400	13.0	2900	6016	6315	6414	4215	-	TAI 000 116
85	87	124	90.0	94.0	8.0	4000	6000	14.5	3500	6017	6316	6414	4216	-	TAI 000 117
90	93	132	96.0	101.0	8.5	3800	5700	16.0	3050	6018	6317	6415/16	4217	-	TAI 000 118
95	98	137	100.0	104.5	8.5	3600	5400	17.0	3250	6019	6318	6415/16	-	-	TAI 000 119
100	101	142	105.0	110.0	8.5	3400	5100	18.0	3400	6020	6319	6416	4218/19	-	TAI 000 120

* Fa = Contact force of the sealing lip

Axial Shaft Seal



Shaft	Dimensions					Max. speed [min ⁻¹]		Fa*	Max. press.	Correspondence to the roller bearing series					Part No.
d	d ₁	d ₂	d ₃	d ₄	b	NBR	FKM	[N]	[Pa]	6200	6300	6400	4200	4300	
10	11	26	13.0	15.5	4.5	24600	36900	1.8	9700	6200	-	-	-	-	TAI 000 200
12	13	28	15.0	17.5	4.5	22200	33300	2.0	10700	6201	6300/01	-	4201	4300	TAI 000 201
15	16	31	18.0	21.0	4.5	18200	27300	3.0	12800	6202	6302	-	4202	-	TAI 000 202
17	18	36	21.0	23.0	5.0	16600	24900	3.8	8100	6203	6303	-	4203	4302	TAI 000 203
20	21	41	23.0	26.0	5.5	14700	22000	4.2	7400	6204	6304	6403	4204	4303	TAI 000 204
25	26	46	28.0	30.0	5.5	12700	19000	4.3	6400	6205	-	6403	-	4304	TAI 000 205
30	32	56	34.5	37.5	6.0	10300	15400	4.6	4900	6206	-	6405	-	4305	TAI 000 206
35	37	65	41.0	44.0	6.5	8900	13300	5.0	3300	6207	6306/07	6405/06	-	4306	TAI 000 207
40	42	73	46.5	50.0	6.5	7600	11400	6.0	3200	6208	6308	6407	-	4307	TAI 000 208
45	47	78	51.5	56.0	6.5	7000	10500	6.5	3000	6209	6308/09	6407/08	-	4308	TAI 000 209
50	53	83	56.5	59.5	6.5	6400	9600	7.0	3000	6210	6309	6408/09	-	4309	TAI 000 210
55	58	90	61.0	65.0	7.0	5900	8800	7.5	2750	6211	6310	6409/10	-	4310	TAI 000 211
60	63	100	65.5	69.0	8.0	5500	8200	8.0	2100	6212	6311	6410/11	-	4311	TAI 000 212
65	68	110	72.0	77.0	8.5	5000	7500	9.0	2000	6213	6312	6411/12	-	-	TAI 000 213
70	72	115	74.0	79.0	8.5	4800	7200	10.5	2000	6214	6313	6411/12	-	4312	TAI 000 214
75	78	120	83.0	88.0	8.5	4400	6600	11.0	2100	6215	6313/14	6413/14	-	4313	TAI 000 215
80	84	128	90.0	94.0	9.0	4100	6100	13.0	2400	6216	6314/15	6414	-	4314	TAI 000 216
85	87	138	91.0	96.0	9.5	3900	5800	14.5	2100	6217	6315/16	6414/15	-	4315	TAI 000 217
90	94	148	96.5	101.5	10.0	3700	5500	16.5	2000	6218	6316	6415/16	-	-	TAI 000 218
95	98	158	103.0	108.0	10.0	3500	5200	17.0	2000	6219	6317/18	6415/16	-	4316/17	TAI 000 219
100	104	168	109.0	114.0	10.5	3300	4900	19.0	2100	6220	6318/19	6416	-	4318/19	TAI 000 220

* Fa = Contact force of the sealing lip



Axial Shaft Seal

Table LIV Special sizes for type I

Shaft	Dimensions					Max. speed [min ⁻¹]		Fa*	Max. pressure	Part No.
d	d ₁	d ₂	d ₃	d ₄	b	NBR	FKM	[N]	[Pa]	
6	6,5	17	7,5	9,0	3,5	45000	67000	5,0	43500	TAI 000 006
7	7,5	17	8,5	10,6	3,5	40000	60000	4,5	48000	TAI 000 007
8	8,5	20	9,5	11,2	4,0	35000	52000	4,0	35600	TAI 000 008
9	9,6	22	11,0	13,0	4,0	30000	45000	4,5	27700	TAI 000 009
23	24,5	44	24,5	31,0	4,5	13500	20000	5,0	9300	TAI 100 105
26	28,0	52	28,5	32,5	5,5	12000	18000	9,0	13000	TAI 200 205
30	32,0	63	35,5	38,5	5,5	9800	14700	16,0	13000	TAI 100 306
35	37,0	56	37,0	42,0	5,0	9500	14000	5,0	8000	TAI 100 107
45	46,5	83	50,0	54,0	6,0	7100	10600	11,0	4300	TAI 100 309
70	72,0	115	75,0	80,0	8,5	4700	7000	12,0	2800	TAI 100 214
72	75,5	128	78,5	83,5	9,0	4500	6700	17,0	2800	TAI 100 314
75	77,5	125	81,0	86,0	8,5	4400	6600	12,0	2500	TAI 100 215
80	83,0	130	84,0	90,0	9,0	4200	6300	13,0	2900	TAI 100 216
93	98,0	150	100,0	106,0	10,0	3600	5400	17,0	2350	TAI 100 218
105	108,0	150	114,0	119,0	9,0	3300	5000	12,0	2000	TAI 100 121
110	114,0	160	120,0	125,0	9,0	3100	4600	15,0	2000	TAI 100 122
110	113,0	190	121,0	126,0	9,5	3000	4500	38,0	5600	TAI 100 320
110	117,0	190	124,0	129,0	9,5	2900	4300	20,0	1300	TAI 100 221
120	125,0	170	129,0	134,0	9,0	2900	4300	20,0	3050	TAI 100 124
130	134,0	190	140,0	146,0	9,5	2600	3900	19,0	1750	TAI 100 126
130	135,0	200	140,0	146,0	9,5	2600	3900	35,0	4800	TAI 100 324
140	143,0	200	148,0	154,0	9,5	2500	3700	32,0	2850	TAI 100 128
150	154,0	215	160,0	166,0	10,0	2300	3400	26,0	2000	TAI 100 130
150	155,0	270	160,0	167,0	11,0	2200	3300	30,0	2500	TAI 100 328
160	164,0	230	175,0	181,0	10,0	2100	3100	40,0	2700	TAI 100 132
170	176,0	250	180,0	186,0	11,0	2050	3000	37,0	1900	TAI 100 134
220	226,0	328	230,0	240,0	13,0	1550	2300	35,0	2200	TAI 100 144
240	247,0	348	249,0	257,0	13,0	1500	2250	38,0	1000	TAI 100 148
285	290,0	360	294,0	298,0	13,0	1300	1950	33,0	1350	TAI 100 156
330	336,0	420	338,0	344,0	13,0	1100	1650	32,0	1000	TAI 100 166
380	385,0	460	390,0	398,0	13,0	950	1400	30,0	1100	TAI 100 176

* Fa = Contact force of the sealing lip



Ordering example

Axial shaft seal, Type I
Shaft diameter d = 50.0 mm
Suitable for roller bearing No. 6010

Materials: From Table LII, page 164:
Membrane and sealing lip: NBR
Material code: NCM
Reinforcement ring 1.0338
+ spider spring 1.0605
Material code: M

Order no.	TAI000110	-	NCM	M
Part no.				
Quality Index (Standard)				
Material No. (elastomer)				
Material No. (metal parts)				

Part no. and dimensions see Table LIV.
Materials see Table LII.



Axial Shaft Seal

■ Installation recommendation, type A, external sealing, for grease only

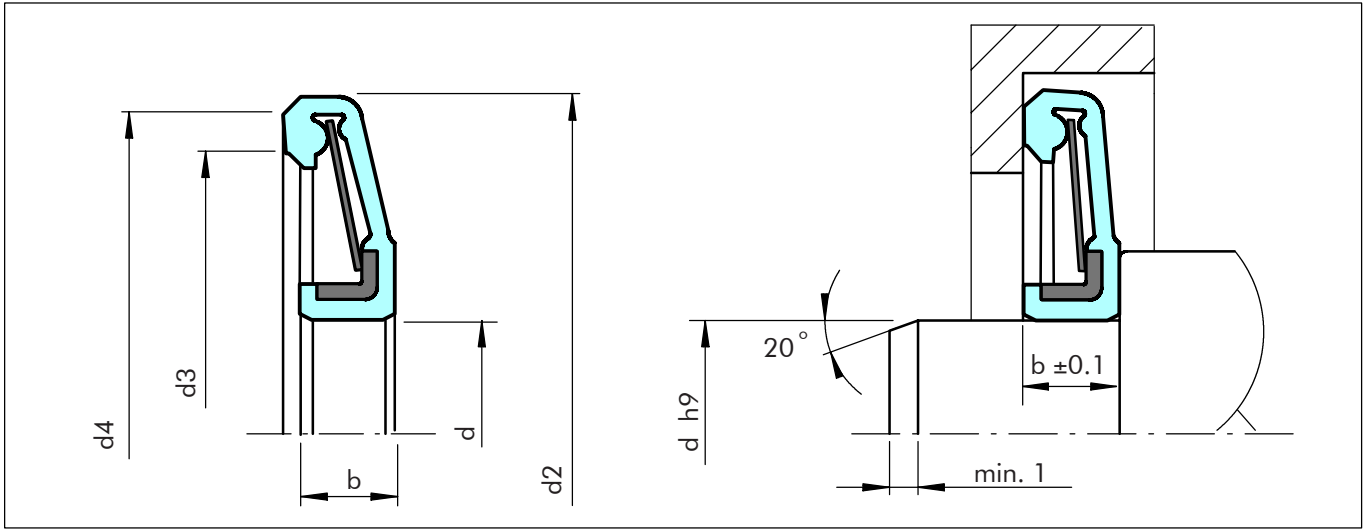


Figure 82 Installation drawing

Table LV Preferred series

Shaft d	Dimensions				Max. speed [min ⁻¹]		Fa * [N]	Max. press. [Pa]	Correspondence to the roller bearing series					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	-	-	-	-	TAA 000 100
14	27.0	24.0	26.5	3.5	7300	11000	2.0	7500	6001	-	-	-	-	TAA 000 101
17	31.0	27.5	30.0	4.0	6300	9400	3.0	10000	6002	-	-	-	-	TAA 000 102
19	35.0	30.0	33.0	4.0	5900	8800	3.5	10000	6003	6300	-	-	-	TAA 000 103
23	40.5	30.5	38.5	4.5	4900	7300	4.0	6600	6004	6302	-	-	-	TAA 000 104
28	45.5	41.5	44.0	4.5	4300	6400	4.5	5750	6005	-	-	-	-	TAA 000 105
35	53.0	47.5	50.5	4.5	3800	5700	5.0	5400	6006	-	-	-	-	TAA 000 106
40	61.0	54.0	58.0	4.5	3300	4900	5.5	4400	6007	6305	-	-	-	TAA 000 107
45	68.5	59.5	63.5	5.0	3000	4500	6.0	4000	6008	-	6404	-	-	TAA 000 108
50	74.0	66.5	70.5	5.0	2700	4000	6.5	3400	6009	6307	6405	-	-	TAA 000 109
55	77.0	71.0	75.0	5.5	2500	3700	7.0	3650	6010	-	-	-	-	TAA 000 110
61	87.0	80.5	84.5	6.0	2250	3400	8.0	3100	6011	6309	6407	-	-	TAA 000 111
66	93.0	85.0	89.0	6.0	2150	3200	9.0	3300	6012	-	-	-	-	TAA 000 112
71	97.0	90.5	94.5	6.0	2000	3000	10.0	3200	6013	-	6408	-	-	TAA 000 113
76	106.0	99.0	103.0	6.5	1800	2700	11.0	3000	6014	6310	-	-	-	TAA 000 114
81	112.0	103.0	108.0	7.0	1700	2550	12.5	3700	6015	6311	6409	-	-	TAA 000 115
86	122.0	112.0	117.0	7.5	1600	2400	14.0	2950	6016	6312	6410	-	-	TAA 000 116
91	127.0	118.0	123.0	7.5	1550	2300	15.0	2900	6017	-	6411	-	-	TAA 000 117
98	137.0	128.0	133.0	8.0	1450	2150	16.0	2750	6018	6314	6412	-	-	TAA 000 118
103	142.0	132.0	137.0	7.5	1400	2100	18.0	2850	6019	6314	6412	-	-	TAA 000 119
108	147.0	137.0	142.0	8.5	1350	2000	19.0	2900	6020	6315	6413	-	-	TAA 000 120

* Fa = Contact force of the sealing lip

Axial Shaft Seal



Shaft d	Dimensions				Max. speed [min ⁻¹]		Fa *	Max. press.	Correspondence to the roller bearing series					Part No.
	d ₂	d ₃	d ₄	b	NBR	FKM	[N]	[Pa]	6200	6300	6400	4200	4300	
14	29.5	25.0	28.5	4.0	7000	10500	2.0	6000	6200	-	-	4200	-	TAA 000 200
16	31.5	26.0	29.0	4.0	6500	9700	2.0	4700	6201	-	-	4201	4300	TAA 000 201
19	33.0	29.5	32.0	4.0	6400	9600	3.0	8150	6202	6300	-	4202	4301	TAA 000 202
21	38.5	34.5	37.0	4.0	4900	7300	3.5	5950	6203	-	-	4203	4302	TAA 000 203
25	46.5	40.0	43.0	4.5	4400	6600	4.0	4450	6204	6303	-	4204	4303	TAA 000 204
31	50.5	45.5	48.5	5.0	3900	5800	4.5	4500	6205	6304	-	4205	-	TAA 000 205
36	60.0	54.0	58.0	5.5	3300	4900	5.0	3400	6206	6305	6404	4206	4305	TAA 000 206
42	68.0	61.5	65.5	6.0	2900	4300	5.5	2700	6207	6306	-	4207	4306	TAA 000 207
47	77.0	69.5	73.5	6.0	2600	3900	6.0	2200	6208	6307	6405	4208	4307	TAA 000 208
52	82.0	74.5	78.5	6.5	2400	3600	6.5	2450	6209	6308	6406	4209	4308	TAA 000 209
57	86.0	79.0	83.0	7.0	2300	3400	7.0	2450	6210	-	6407	4210	-	TAA 000 210
64	97.0	88.0	92.0	7.5	2100	3100	8.0	2300	6211	6309	6408	4211	4309	TAA 000 211
69	106.0	98.0	102.0	8.0	1800	2700	9.0	1900	6212	6310	6409	4212	4310	TAA 000 212
74	116.0	105.0	110.0	8.5	1700	2550	10.0	1700	6213	6311	6410	4213	4311	TAA 000 213
80	120.5	109.0	114.0	8.5	1650	2450	11.0	2000	6214	6312	-	4214	4312	TAA 000 214
85	126.0	115.0	120.0	9.0	1600	2400	12.5	2100	6215	6312	-	4215	4313	TAA 000 215
92	136.0	125.0	130.0	9.0	1450	2150	14.0	2050	6216	6313	6411	4216	4314	TAA 000 216
97	145.0	134.0	139.0	9.0	1350	2000	15.0	2100	6217	6314	6412	4217	4315	TAA 000 217
102	156.0	144.0	149.0	9.5	1250	1850	16.0	1600	6218	6315	6413	4218	4316	TAA 000 218
108	166.0	154.5	159.0	9.5	1200	1800	18.0	1600	6219	6316	6415	4219	4317	TAA 000 219
114	175.0	164.0	169.0	10.0	1100	1650	18.5	1500	6220	6317	6416	4220	43181.2.	TAA 000 220

* Fa = Contact force of the sealing lip

Table LVI Special sizes for type A

Shaft d	Dimensions				Max. Speed [min ⁻¹]		Fa*	Max. pressure	Part No.
	d ₂	d ₃	d ₄	b	NBR	FKM	[N]	[Pa]	
50	90	83,5	87,5	6,5	2200	3300	6	1500	TAA 100 209
66	93	85,0	93,0	6,0	2000	3000	15	7000	TAA 100 112
85	111	103,0	108,0	7,0	1700	2550	16	7000	TAA 100 115
85	142	134,0	140,0	8,0	1300	1950	10	1000	TAA 100 215
110	155	144,0	149,0	9,0	1200	1800	17	2800	TAA 100 220
120	165	153,0	158,0	9,0	1200	1800	16	2000	TAA 100 122
130	160	151,0	157,0	7,0	1200	1800	12	3100	TAA 100 124
130	172	162,0	168,0	9,0	1100	1650	40	5300	TAA 300 124
130	175	165,0	170,0	9,0	1100	1650	16	2000	TAA 200 124
150	208	195,0	200,0	10,0	950	1400	63	4400	TAA 100 128
160	252	236,0	243,0	10,0	750	1100	32	1000	TAA 100 130
160	253	245,0	250,0	8,0	750	1100	36	1500	TAA 300 130
162	184	177,0	181,0	6,0	1500	1500	52	8300	TAA 100 162
180	214	209,0	213,0	6,0	900	1350	30	4000	TAA 100 134
252	348	332,0	340,0	13,0	550	800	32	1000	TAA 100 148

* Fa = Contact force of the sealing lip



Ordering example

Axial shaft seal, Type A
Shaft diameter d = 50.0 mm
Suitable for roller bearing No. 6009

Materials: From Table LII, page 164:
Membrane and sealing lip: NBR
Material code: NCM
Reinforcement ring 1.0338
+ spider spring 1.0605
Material code: M

Order no.	TAA000109	-	NCM	M
Part no.				
Quality index (standard)				
Material no. (elastomer)				
Material no. (metal parts)				

Part no. and dimensions see Table LV and Table LVI.
Materials see Table LII.



VARILIP® - TURCON® SHAFT SEALS

■ Description

Standard radial shaft seals have only a limited application range with respect to pressure, temperature and media loads due to their elastomer sealing lip. Furthermore they only have a limited suitability for applications with inadequate lubrication.

Varilip® shaft seals from Busak+Shamban extend this application range by using modern Turcon® materials developed specially for rotational applications.

They are characterised in particular by the low friction and their stick-slip-free running, thus reducing the heat development and permitting higher peripheral speeds.

The Varilip® shaft seal fits into grooves according to ISO/DIS 16589 and is dimensionally interchangeable with the shaft seals to DIN 3760 and ISO 6194/1.

The minimal groove size required for Varilip® allows its use as a pressurised seal where the installation of a mechanical shaft seal would not be possible due to constructional reasons.

In contrast to the conventional shaft seals, the Varilip® seal requires no metallic energising spring.

As can be seen from Figure 83, dynamic sealing is effected by the radial load of the sealing lip against the shaft. Static sealing is effected on the one hand by a press fit of the metallic casing in the housing bore and, on the other, by an elastomeric flat gasket between metallic housing and Turcon® sealing lip.

■ Varilip®, type A

Type A is a one-lip seal suitable for use in standard industrial applications up to $p_{max} = 0.5 \text{ MPa}$ where a radial shaft seal would be unable to withstand the temperature, friction, medium or poor lubrication. Type A allows high-speed shafts with peripheral speeds of up to 40 m/s to be sealed.

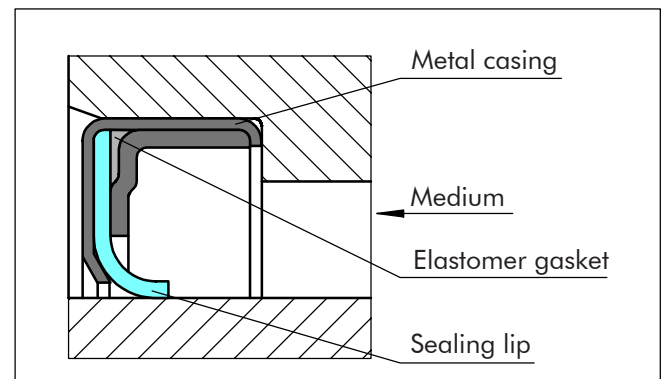


Figure 83 Type A

■ Varilip®, type B

Type B is the preferred choice for applications in which a high sealability is demanded or where contaminated media are to be sealed. This two-lip type offers greater safety than the Type A.

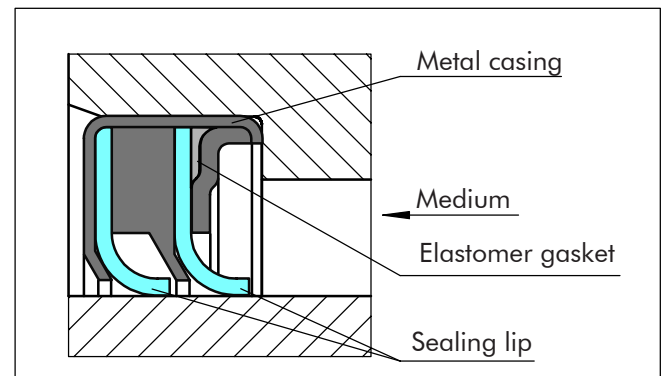


Figure 84 Type B



■ Varilip®, type C

The Varilip® Type C can be used for applications involving higher pressures for which a simple elastomer radial shaft seal can no longer be considered. Due to a reinforcement of the sealing lip, pressures of up to 2 MPa are possible, e.g. as pump, shaft or rotor seals.

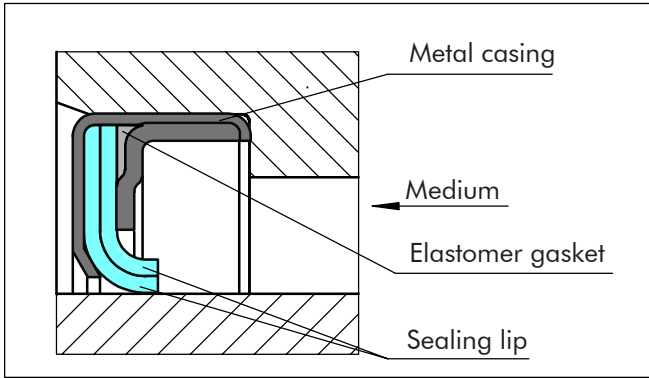


Figure 85 Type C

■ Varilip®, type D

Whilst Types A to C can be used to seal against pressures from only one side, Type D can be subjected to pressure from both sides. Pressures of up to 0.1 MPa are permissible. The separation of two different media using a single seal is possible. The second lip can also take on the function of a wiper or dust lip.

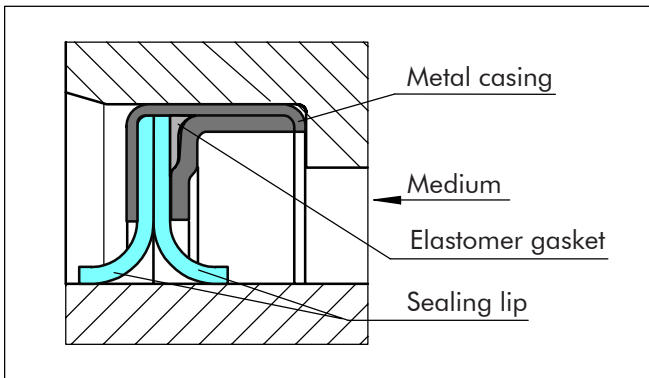


Figure 86 Type D

Table I summarises the important technical data and selection criteria for the different Varilip® types. Furthermore it gives an overview of the most significant applications in which the various Varilip® types have already proven themselves in practice.

This table is intended to allow the designer a quick preselection of the most favourable seal type and the optimum material for his specific application.

Advantages

- Low friction seal material
- Stick-slip free running
- Low and high temperature range (-60 to +200 °C)
- High pressure capability (2 MPa)
- High speed ability (40 m/s)
- Wide media compatibility
- Not affected by chemicals
- Fits standard oil seal installation groove

Technical data

Coaxiality tolerance

In order to achieve a uniform radial load of the sealing lip on the surface of the shaft, the best possible coaxiality should exist between shaft and housing bore.

The maximum permissible coaxial deviation as a function of shaft diameter is shown in Figure 87.

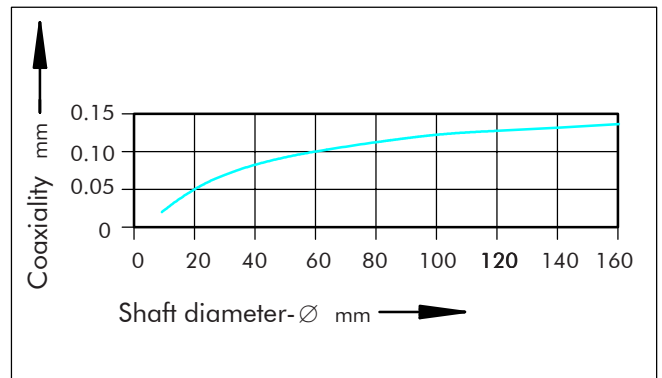


Figure 87 Coaxiality tolerance



Shaft runout tolerance

In order to maintain the sealing function, the shaft eccentricity as a function of the speed must be limited as shown in Figure 88.

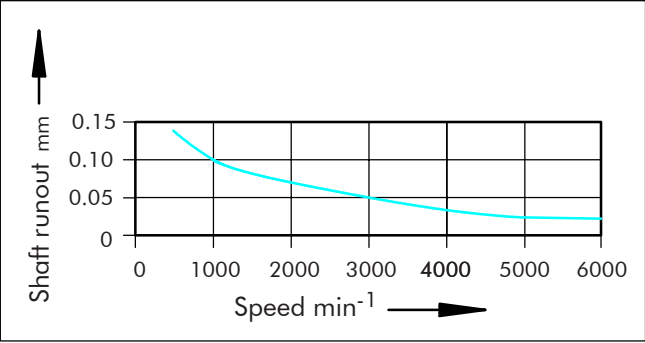


Figure 88 Max. shaft runout

Power consumption, dry running

Guide values for the frictional power consumption can be determined from the curve in Figure 89. It is plotted as a function of surface speed and operating pressure for a shaft diameter of 50 mm for a Varilip® type A and lip material T25.

Guide values for other shaft diameters can be calculated from the formula

$$p \approx p_{50} \times \left(\frac{d}{50 \text{ mm}}\right)^2 \text{ [W]}$$

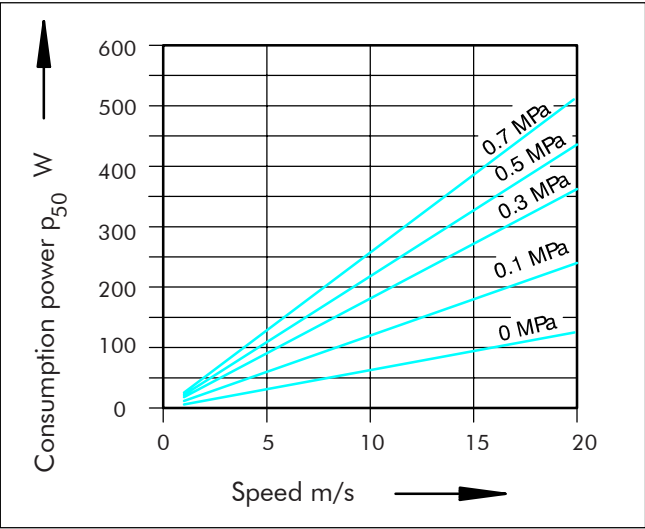


Figure 89 Power consumption on a 50 mm shaft-Ø

Torque

Figure 90 shows the torque as a function of the operating pressure for various Varilip® types and Turcon® materials for a shaft diameter of 50 mm. The torque for other shaft diameters can be roughly calculated from the formula

$$M \approx M_{50} \times \left(\frac{d}{50 \text{ mm}}\right)^2 \text{ [Nm]}$$

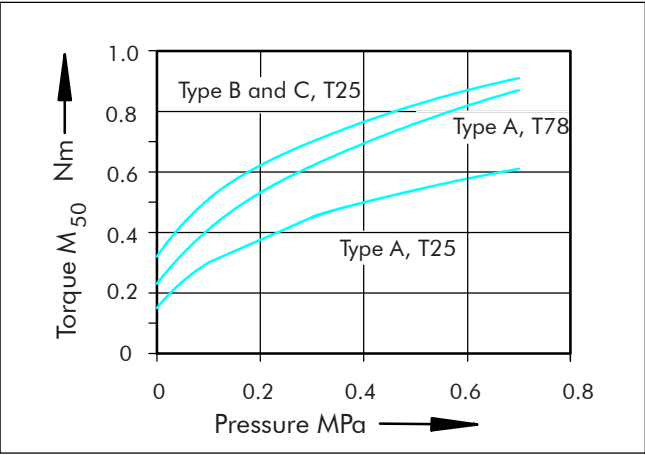


Figure 90 Torque on a 50 mm shaft-Ø



Application examples

Varilip® is preferably used as a single acting seal for rotating hydraulic and pneumatic equipment in sectors such as:

- Pumps
- Separators
- Blowers
- Centrifuges
- Gearboxes
- Machine tools
- Hubs
- Mixers
- Bearings
- Marine

Application Limits

The limits for temperature, pressure and speed given in this catalogue cannot be fully exploited at the same time.

Furthermore, the lubrication properties, the media, the heat dissipation and the condition of the shaft surface affects the application limits.

The following $p \times v$ values can be used as general guidelines:

For shaft diameter from 30 mm to 170 mm:

- up to 1.5 (MPa x m/s) with poor lubrication
- up to 3.0 (MPa x m/s) with good lubrication
- up to 10.0 (MPa x m/s) with very good cooling

For smaller shaft diameters, the values must be reduced.





Materials

An important factor for the proper function of rotational seals is the material. For this reason, Busak+Shamban has developed a range of specially modified materials for rotational applications on the basis of the proven Turcon® materials. Particular importance was attached to the optimisation of friction and wear properties, even at high peripheral speeds.

Figure 91 shows the standard materials used for Varilip® seals.

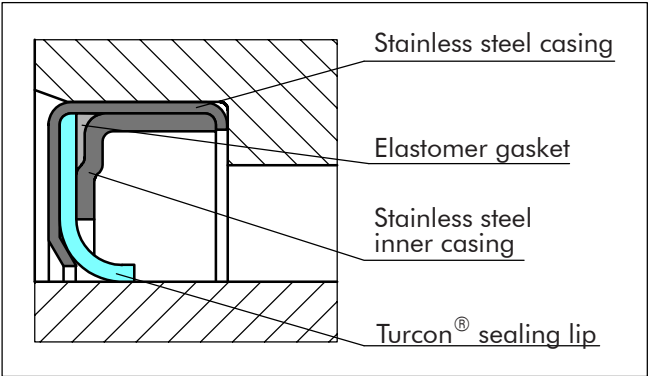


Figure 91 Materials for Varilip® seals

Table LVII Turcon® materials for Varilip®

Material, Applications, Properties	Code	Operating temp. °C	Mating surface hardness	MPa max.
Turcon® T25 Standard material with exceptional wear and friction characteristics. For lubricated or dry running. Glass fiber, lubricant Colour: Grey	T25	-60 to +200	Min. 55 HRC At low pressure and speeds up to 4 m/s, a hardness of 45 HRC is acceptable	2
Turcon® T40 For all lubricating and non-lubricating fluids. Used for medium hard shafts in applications where a risk for shaft wear exist. Carbon fiber Colour: Grey	T40	-60 to +200	Min. 30 HRC	2
Turcon® T78 Characterized by particular good running behaviour. This permits use in dry running applications, applications with poor lubrication and in conjunction with soft shaft surfaces e.g. in applications where stainless steel is standard, like food stuff, pharmaceutical and chemical industries. Aromatic polymer Colour: Tan to dark brown	T78	-60 to +200	Min. 170 HB	0.2

Other Turcon® lip materials are available, simply by using the relevant Turcon® material code when ordering.

Highlighted materials are standard.

Table LVIII Casing materials

Medium	Material	Material Code
Oils, greases, air/gases, water, vapour, solvents, foodstuffs	Stainless steel Material No. 1.4301 AISI 304	1
Acids, caustics, seawater	Acid-resistant stainless steel Material No. 1.4436 AISI 316	2
	Acid-resistant stainless steel Material No. 1.4571 AISI 316 Ti	3*)

*) Only for type **A, C** and **D** up to max. 90 mm outside diameter.

Table LIX Materials for gasket elastomers

Medium	Temperature	Material	Code
Air, water, oils, greases	Nitrile-Elastomer - 30 to + 110°C	NBR	N
Air, water, vapour, foodstuffs, alcohols	Ethylene-propylene-elastomer - 60 to + 150°C	EPDM	E
Air, water, oils, greases, solvents, acids, caustics	Fluoroelastomer - 20 to + 200°C	FKM	V



■ Design Instructions

Groove design

Varilip® shaft seals in Table LXI fit into grooves according to ISO/DIS 16589 and also to DIN 3760 or ISO 6194/1.

Table LX Surface roughness

Surface roughness µm		
	Shaft surface	Housing bore
R _{max}	1.00 - 4.00	< 10.0
R _z	0.63 - 2.50	< 6.3
R _a	0.10 - 0.40	< 1.6

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 c_{ref}. 5%.



■ Installation recommendation

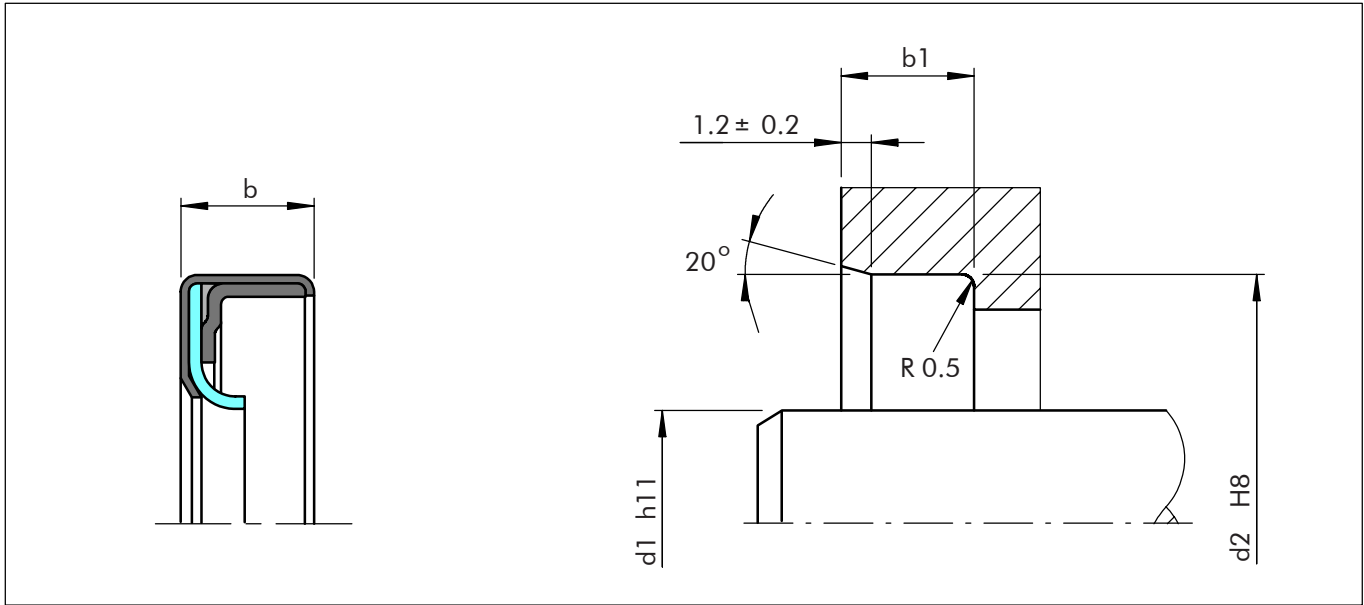


Figure 92 Installation drawing for pressure up to 0.2 MPa

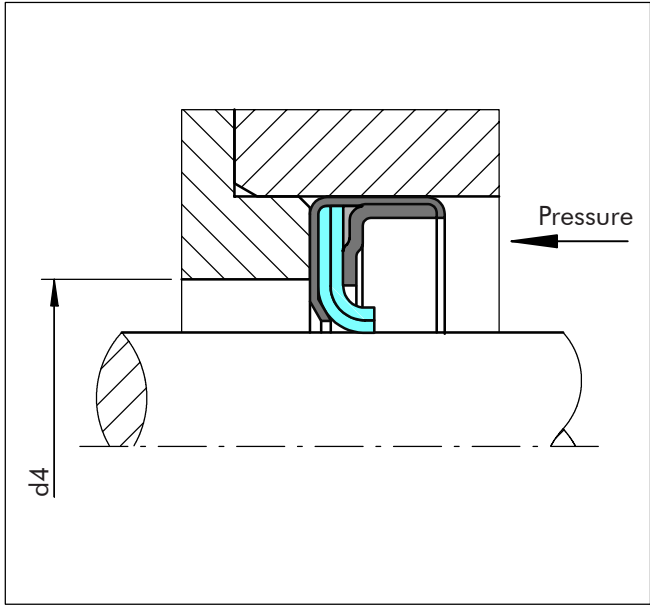


Figure 93 Installation for pressure from 0.2 MPa up to 2 MPa

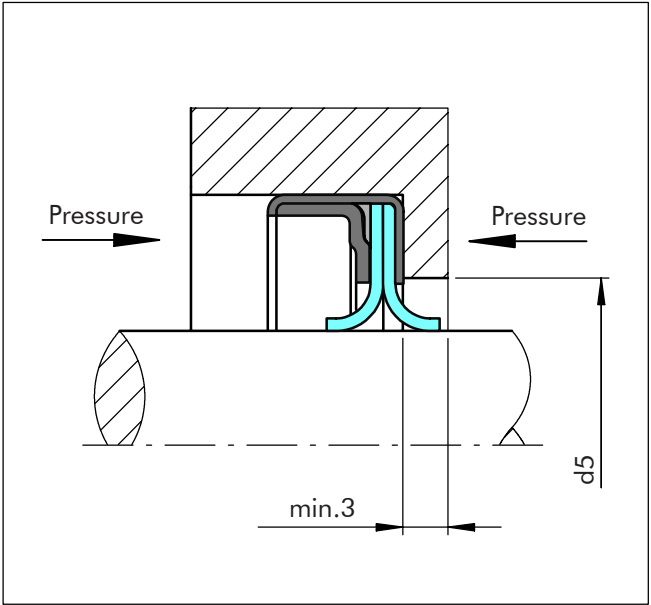


Figure 94 Installation type D

Remark: The installation for Varilip® follows the same rules as for oil seals. See Fig. 6, page 15.



Table LXI Standard sizes

Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
6	16	7	TP_100060	7.3	10	9.6
6	22	7	TP_200060	7.3	10	9.6
7	22	7	TP_100070	7.3	11	10.6
8	22	7	TP_100080	7.3	12	11.6
8	24	7	TP_200080	7.3	12	11.6
9	22	7	TP_100090	7.3	13	12.6
9	24	7	TP_200090	7.3	13	12.6
9	26	7	TP_300090	7.3	13	12.6
10	22	7	TP_100100	7.3	14	13.6
10	24	7	TP_200100	7.3	14	13.6
10	25	7	TP_300100	7.3	14	13.6
10	26	7	TP_400100	7.3	14	13.6
11	22	7	TP_100110	7.3	15	14.6
11	26	7	TP_200110	7.3	15	14.6
12	22	7	TP_100120	7.3	16	15.6
12	24	7	TP_200120	7.3	16	15.6
12	25	7	TP_300120	7.3	16	15.6
12	28	7	TP_400120	7.3	16	15.6
12	30	7	TP_500120	7.3	16	15.6
14	24	7	TP_100140	7.3	18	17.6
14	28	7	TP_200140	7.3	18	17.6
14	30	7	TP_300140	7.3	18	17.6
14	35	7	TP_400140	7.3	18	17.6
15	26	7	TP_100150	7.3	19	18.6
15	30	7	TP_200150	7.3	19	18.6
15	32	7	TP_300150	7.3	19	18.6
15	35	7	TP_400150	7.3	19	18.6
16	28	7	TP_100160	7.3	20	19.6
16	30	7	TP_200160	7.3	20	19.6
16	32	7	TP_300160	7.3	20	19.6
16	35	7	TP_400160	7.3	20	19.6
17	28	7	TP_100170	7.3	21	20.6
17	30	7	TP_200170	7.3	21	20.6
17	32	7	TP_300170	7.3	21	20.6
17	35	7	TP_400170	7.3	21	20.6
17	40	7	TP_500170	7.3	21	20.6
18	30	7	TP_100180	7.3	22	21.6
18	32	7	TP_200180	7.3	22	21.6
18	35	7	TP_300180	7.3	22	21.6
18	40	7	TP_400180	7.3	22	21.6

The sizes printed in bold type should be preferred. Other sizes are available on request.



Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
20	30	7	TP_100200	7.3	24	23.6
20	32	7	TP_200200	7.3	24	23.6
20	35	7	TP_300200	7.3	24	23.6
20	40	7	TP_400200	7.3	24	23.6
20	47	7	TP_500200	7.3	24	23.6
22	32	7	TP_100220	7.3	26	25.6
22	35	7	TP_200220	7.3	26	25.6
22	40	7	TP_300220	7.3	26	25.6
22	47	7	TP_400220	7.3	26	25.6
24	35	7	TP_100240	7.3	28	27.6
24	37	7	TP_200240	7.3	28	27.6
24	40	7	TP_300240	7.3	28	27.6
24	47	7	TP_400240	7.3	28	27.6
25	35	7	TP_100250	7.3	29	28.6
25	40	7	TP_200250	7.3	29	28.6
25	42	7	TP_300250	7.3	29	28.6
25	47	7	TP_400250	7.3	29	28.6
25	52	7	TP_500250	7.3	29	28.6
26	37	7	TP_100260	7.3	30	29.6
26	42	7	TP_200260	7.3	30	29.6
26	47	7	TP_300260	7.3	30	29.6
28	40	7	TP_100280	7.3	32	31.6
28	47	7	TP_200280	7.3	32	31.6
28	52	7	TP_300280	7.3	32	31.6
30	40	7	TP_100300	7.3	34	33.6
30	42	7	TP_200300	7.3	34	33.6
30	47	7	TP_300300	7.3	34	33.6
30	52	7	TP_400300	7.3	34	33.6
30	62	7	TP_500300	7.3	34	33.6
32	45	7	TP_100320	7.3	36	35.6
32	45	8	TP_200320	8.3	36	35.6
32	47	7	TP_300320	7.3	36	35.6
32	47	8	TP_400320	8.3	36	35.6
32	52	7	TP_500320	7.3	36	35.6
32	52	8	TP_600320	8.3	36	35.6
35	47	7	TP_100350	7.3	39	38.6
35	50	7	TP_200350	7.3	39	38.6
35	50	8	TP_300350	8.3	39	38.6
35	52	7	TP_400350	7.3	39	38.6
35	52	8	TP_500350	8.3	39	38.6
35	55	8	TP_600350	8.3	39	38.6
35	62	7	TP_700350	7.3	39	38.6

The sizes printed in bold type should be preferred. Other sizes are available on request.



Varilip® - Turcon® shaft seal

Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
36	47	7	TP_100360	7.3	40	39.6
36	50	7	TP_200360	7.3	40	39.6
36	52	7	TP_300360	7.3	40	39.6
36	62	7	TP_400360	7.3	40	39.6
38	52	7	TP_100380	7.3	42	41.6
38	55	7	TP_200380	7.3	42	41.6
38	55	8	TP_300380	8.3	42	41.6
38	58	8	TP_400380	8.3	42	41.6
38	62	7	TP_500380	7.3	42	41.6
38	62	8	TP_600380	8.3	42	41.6
40	52	7	TP_100400	7.3	44	43.6
40	55	7	TP_200400	7.3	44	43.6
40	55	8	TP_300400	8.3	44	43.6
40	62	7	TP_400400	7.3	44	43.6
40	62	8	TP_500400	8.3	44	43.6
40	72	7	TP_600400	7.3	44	43.6
42	55	8	TP_100420	8.3	46	45.6
42	62	8	TP_200420	8.3	46	45.6
42	72	8	TP_300420	8.3	46	45.6
45	60	8	TP_100450	8.3	49	48.6
45	62	8	TP_200450	8.3	49	48.6
45	65	8	TP_300450	8.3	49	48.6
45	72	8	TP_400450	8.3	49	48.6
48	62	8	TP_100480	8.3	52	51.6
48	72	8	TP_200480	8.3	52	51.6
50	65	8	TP_100500	8.3	54	53.6
50	68	8	TP_200500	8.3	54	53.6
50	72	8	TP_300500	8.3	54	53.6
50	80	8	TP_400500	8.3	54	53.6
52	68	8	TP_100520	8.3	56	55.6
52	72	8	TP_200520	8.3	56	55.6
55	70	8	TP_100550	8.3	59	58.6
55	72	8	TP_200550	8.3	59	58.6
55	80	8	TP_300550	8.3	59	58.6
55	85	8	TP_400550	8.3	59	58.6
56	70	8	TP_100560	8.3	60	59.6
56	72	8	TP_200560	8.3	60	59.6
56	80	8	TP_300560	8.3	60	59.6
56	85	8	TP_400560	8.3	60	59.6
58	72	8	TP_100580	8.3	62	61.6
58	80	8	TP_200580	8.3	62	61.6

The sizes printed in bold type should be preferred. Other sizes are available on request.



Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
60	75	8	TP_100600	8.3	64	63.6
60	80	8	TP_200600	8.3	64	63.6
60	85	8	TP_300600	8.3	64	63.6
60	90	8	TP_400600	8.3	64	63.6
62	85	10	TP_100620	10.3	68	66.4
62	90	10	TP_200620	10.3	68	66.4
63	85	10	TP_100630	10.3	69	67.4
63	90	10	TP_200630	10.3	69	67.4
65	85	10	TP_100650	10.3	71	69.4
65	90	10	TP_200650	10.3	71	69.4
65	100	10	TP_300650	10.3	71	69.4
68	90	10	TP_100680	10.3	74	72.4
68	100	10	TP_200680	10.3	74	72.4
70	90	10	TP_100700	10.3	76	74.4
70	95	10	TP_200700	10.3	76	74.4
70	100	10	TP_300700	10.3	76	74.4
72	95	10	TP_100720	10.3	78	76.4
72	100	10	TP_200720	10.3	78	76.4
75	95	10	TP_100750	10.3	81	79.4
75	100	10	TP_200750	10.3	81	79.4
78	100	10	TP_100780	10.3	84	82.4
80	100	10	TP_100800	10.3	86	84.4
80	110	10	TP_200800	10.3	86	84.4
85	110	12	TP_100850	12.4	91	89.4
85	120	12	TP_200850	12.4	91	89.4
90	110	12	TP_100900	12.4	96	94.4
90	120	12	TP_200900	12.4	96	94.4
95	120	12	TP_100950	12.4	101	99.4
95	125	12	TP_200950	12.4	101	99.4
100	120	12	TP_101000	12.4	106	104.4
100	125	12	TP_201000	12.4	106	104.4
100	130	12	TP_301000	12.4	106	104.4
105	130	12	TP_101050	12.4	111	109.4
105	140	12	TP_201050	12.4	111	109.4
110	130	12	TP_101100	12.4	116	114.4
110	140	12	TP_201100	12.4	116	114.4
115	140	12	TP_101150	12.4	121	119.4
115	150	12	TP_201150	12.4	121	119.4
120	150	12	TP_101200	12.4	126	124.4
120	160	12	TP_201200	12.4	126	124.4
125	150	12	TP_101250	12.4	131	129.4
125	160	12	TP_201250	12.4	131	129.4

The sizes printed in bold type should be preferred. Other sizes are available on request.



Varilip® - Turcon® shaft seal

Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
130	160	12	TP_101300	12.4	136	134.4
130	170	12	TP_201300	12.4	136	134.4
135	170	12	TP_101350	12.4	141	139.4
140	170	15	TP_101400	15.4	148	147.0
145	175	15	TP_101450	15.4	153	152.0
150	180	15	TP_101500	15.4	158	157.0
160	190	15	TP_101600	15.4	168	167.0
170	200	15	TP_101700	15.4	178	177.0

The sizes printed in bold type should be preferred. Other sizes are available on request.

Ordering example

Varilip®, type A
Shaft diameter d₁ = 30 mm
Outside diameter d₂ = 47 mm
Width b = 7 mm

Table LXI: Part no. TP_300300

The material is selected from Tables LVII to LIX.

The type is inserted as the 3rd digit.

Order-No.	TP	A	3	0	0300	-	T25	1	V
Type+cross sec.									
Type (Standard)									
Shaft-Ø x 10									
Quality Index (Standard)									
Material code - sealing lip									
Material code - casing									
Material code - gasket									

For other types by analogy:

Order no.: TP **B** 300300 - T 25 1V
TP **C** 300300 - T 25 1V
TP **D** 300300 - T 25 1V



PDR™ BUSAK+SHAMBAN PTFE SHAFT SEALS

Description

Standard elastomeric rotary shaft seals have a limited application range with respect to temperature, surface speed, media compatibility, pressure or a combination of these due to the inherent limitations of the various elastomer grades. In addition, their success is dependant upon satisfying certain lubrication and fitting criteria.

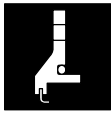
PDR™ (Performance, Durability, Reliability) shaft seals from B+S Rotary Seals extend the boundaries imposed by elastomer radial shaft seals, utilising advanced materials and design techniques to provide optimum sealing performance for each application, in terms of surface speed, temperature capability, fluid compatibility, endurance and design integration. The outcome is a superior sealing solution whilst retaining a compact seal envelope.

PTFE has the characteristic of inherent memory, whereby a distorted PTFE component will attempt to recover to the profile it had during the sintering cycle of its manufacturing process. PDR™ seals utilise this feature to provide the necessary radial loading of the sealing lip onto the shaft, therefore negating the requirement for the energising spring present in elastomeric seal designs. Where required, PDR™ seals employ hydrodynamic sealing which, in conjunction with mechanical retention of the PTFE in the seal body, gives exceptional seal performance. Combined with the unrivalled ability of B+S Rotary Seals to integrate the seal solution into the surrounding equipment, a rarely surpassed seal solution is cost effectively provided.

Advantages

PDR™ seals are specifically designed to satisfy the demands of the individual customer application, optimising the seal to provide the following features:

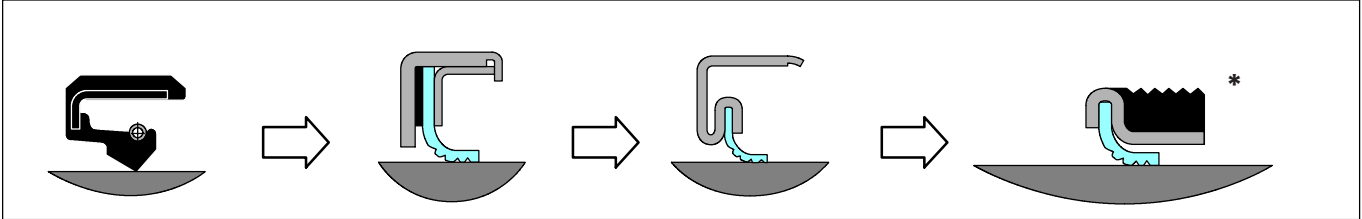
- Temperature Capability
PDR™ seals are capable of operation from -100 to +260 °C.
- Speed
PDR™ seals can operate at surface speeds in excess of 90 m/s.
- Fluid Compatibility
PDR™ seals have outstanding chemical resistance.
- Dry running ability
PDR™ seals are not adversely affected by periods of lubricant starvation.
- Endurance
PDR™ seals exhibit superior life capabilities.
- Friction
PDR™ seals can be designed to exhibit low levels of torque and power.
- Eccentricity
PDR™ seals can accommodate large levels of static and dynamic eccentricity.
- Shaft Wear
PDR™ seals can be designed to run on soft shafts with little resultant wear.
- Integration
PDR™ seals can be integrated into the surrounding hardware.
- Testing
PDR™ product testing facilities available.
- Finite Element Analysis
PDR™ seal lip design can be optimised using FEA techniques.



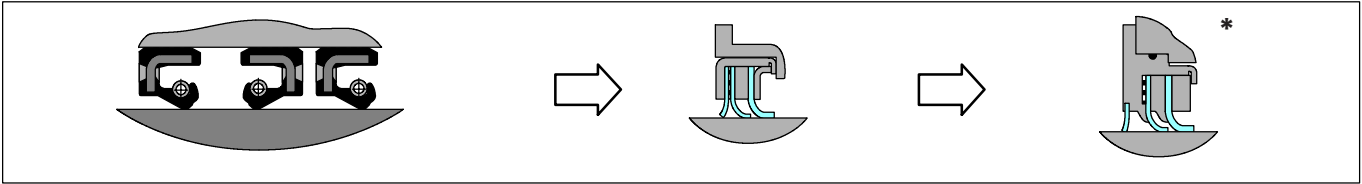
PDR™ - PTFE Shaft Seal

In addition to producing relatively simple designs to replace current elastomeric seals, the nature of the machined or pressed casings of PDR™ seals promotes the integration of the seal into the surrounding hardware. Some examples of this approach can be seen in Figure 95.

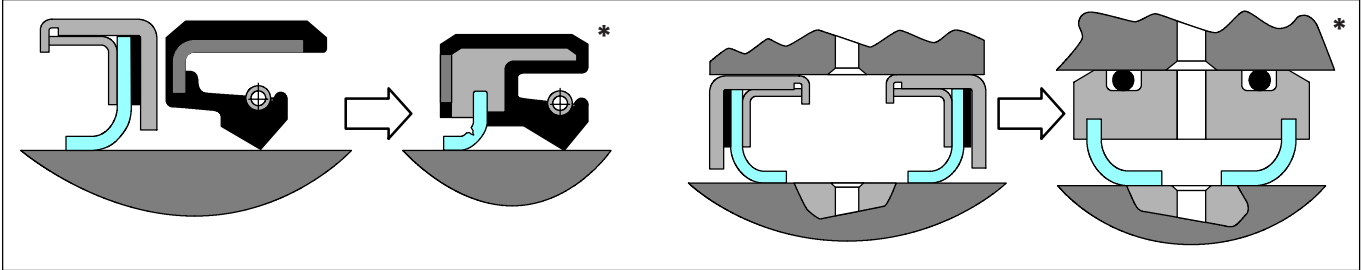
An important feature of our designs is that we mechanically retain the PTFE to provide a robust product which does not rely on bonding the PTFE to a metal or elastomer substrate, which is an environmentally unfriendly process.



Evolution from a rubber radial shaft seal (RSS) through clamped and single shell PDR™ to narrow radial section PDR™

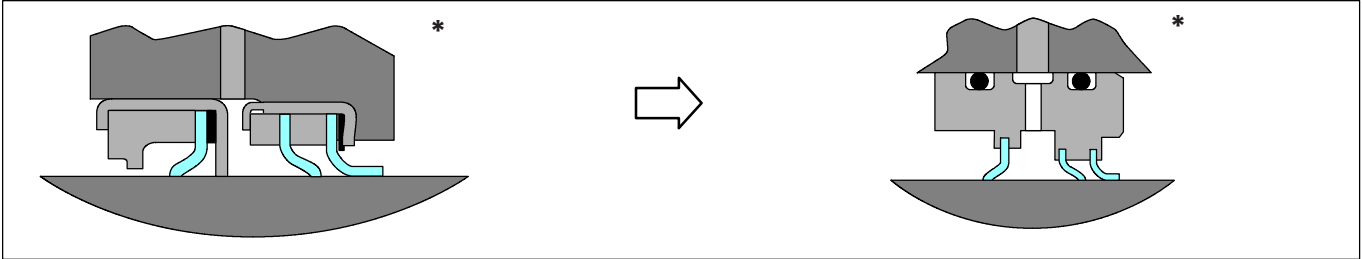


Three RSS's in tandem replaced by single PDR™ seal and subsequently by a PDR™ endplate seal

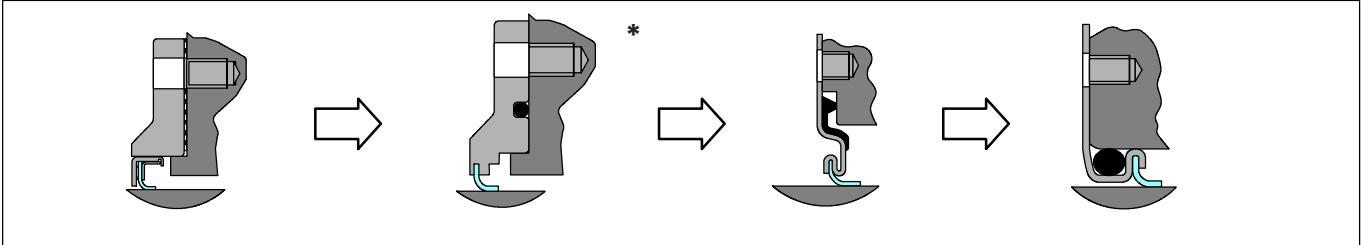


RSS protected by PDR™ dirt seal replaced by single hybrid PDR™ seal

Two separate seals incorporated as one piece



Two seals replaced by integrated seal assembly with improved seal lip retention



Seal pressed into separate carrier replaced by three variants of integrated design - the PDR™ Endplate

Designs marked * above are subject to international patents.

Figure 95 Examples of integration



Technical data

Surface speed

The graph in Figure 96 is based upon DIN 3760 and shows the limiting surface speed envelopes for various elastomeric shaft seals. Results obtained from testing PDR™ seals are superimposed. PDR™ seals are in production at running speeds of 90 m/s and have been successfully tested at 138 m/s, almost four times faster than the DIN recommendation for elastomeric seals. The actual limiting speed envelope for PTFE has yet to be determined. Recommended maximum surface speeds see graph, Figure 96.

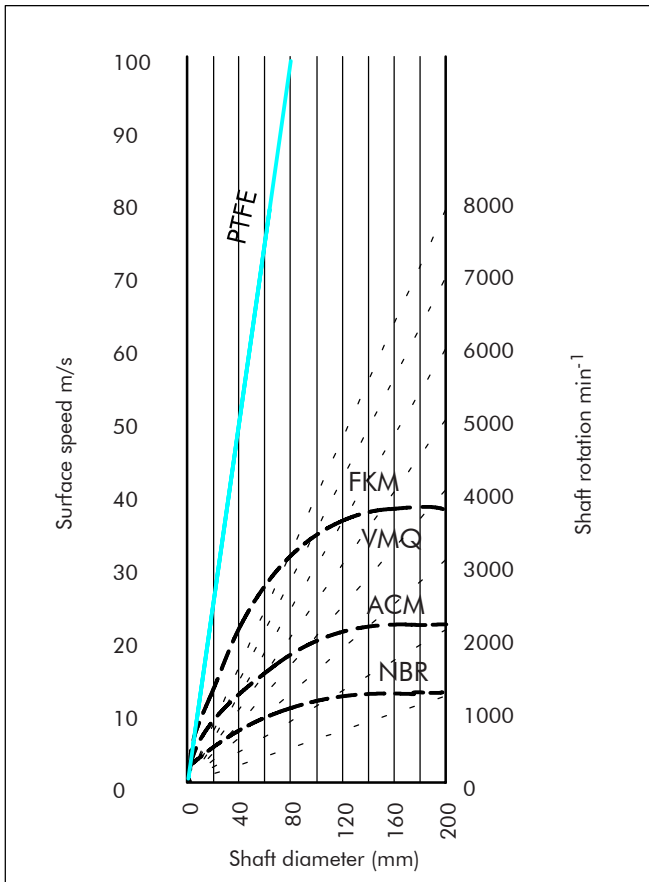


Figure 96 Surface speed

Temperature range

PDR™ seals are capable of outstanding high and, perhaps more importantly, low temperature performance compared to elastomeric materials, see Figure 97. The exceptional low temperature capability of PTFE rotary shaft seals makes them ideally suited to automotive and aerospace applications.

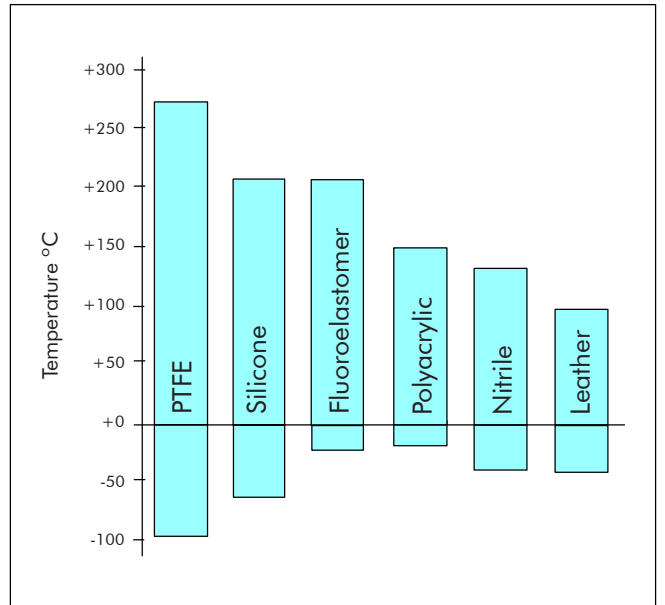


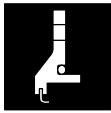
Figure 97 Temperature performance

N.B. The low temperatures specified above for elastomers are typical glass embrittlement points.

Endurance

The life of a PDR™ seal is very dependant upon the specific operating parameters, but the following examples clearly illustrate the superior life achievable with these seals:

- PDR™ engine crankshaft seals have completed over 1.75 million km without leakage, both the shafts and seals were in excellent condition after this length of service. This was a known endurance vehicle and many seals are likely to have significantly exceeded this result.
- PDR™ compressor seals have been run for 20000 hours without leakage and, more significantly for this particular application, have completed in excess of 320000 start/stop cycles before the test was terminated.
- PDR™ seals have been tested on aircraft flap actuators to a simulated 50000 take-off and landing cycles without leakage.



Pressure

Standard PDR™ seals are used for pressure differentials of up to 0.1 MPa. Higher pressures can be accommodated by utilising designs such as that shown in Figure 98. In certain applications, pressure up to 6 MPa have been sealed successfully. The combination of the remaining operating parameters, such as fluid type, shaft speed and surface finish, life requirement etc., will determine the limiting pressure capability.

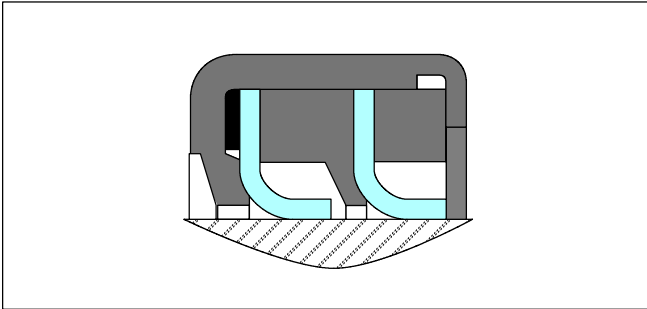


Figure 98 High pressure supported lips

Friction

Low friction can be achieved with PDR™ seals resulting in reduced heat generation, higher surface speed capability and reduced oil carbonisation.

Where elastomeric seals can suffer from stick-slip, a significant improvement in lip stability can be achieved with PTFE seals, which is particularly beneficial at low temperatures. The graphs, Figure 99 shows the comparison between PDR™ and fluorosilicone seals at -54 °C.

Eccentricity

Due to the wide contact band, PDR™ seals can accept severe eccentricity, both static and dynamic.

The graph, Figure 100 is reproduced from DIN 3760 and shows the maximum recommended operating envelope for nitrile, silicone, fluoroelastomer, and polyacrylic seals. One point has been superimposed representing a test on PDR™ at 3000 min⁻¹, 0.56mm TIR (total indicator reading) on a shaft of 67mm diameter (10.5 m/s) which ran successfully for 500 h.

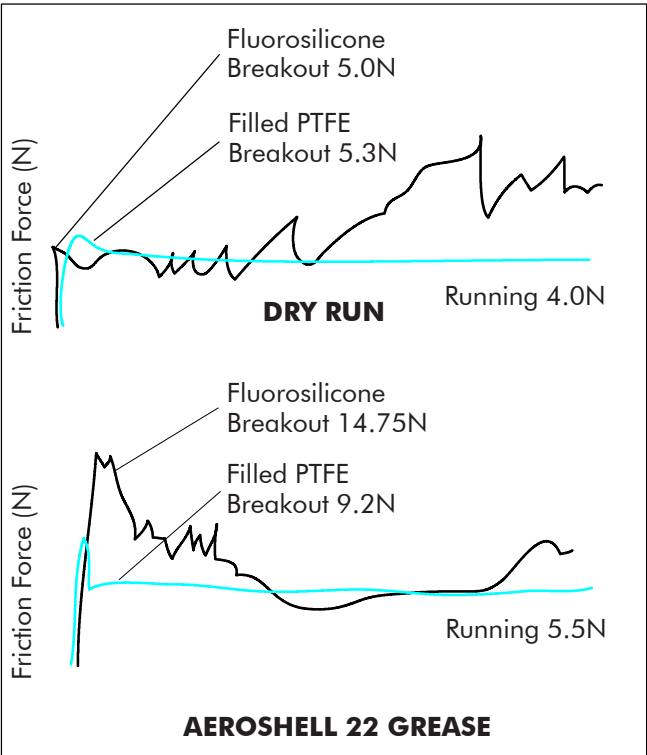


Figure 99 Friction

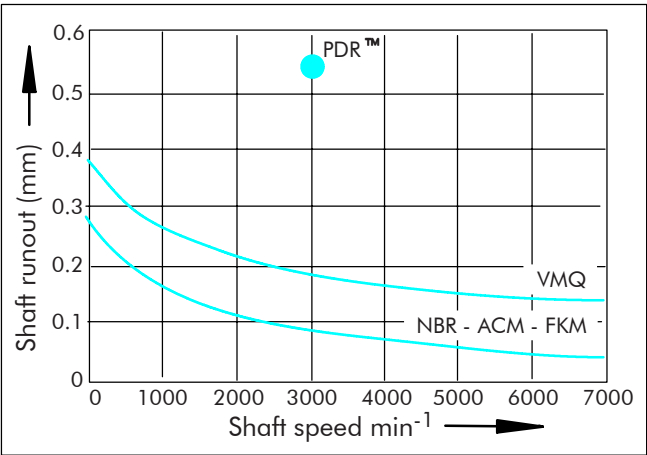


Figure 100 Dynamic eccentricity capability



Shaft wear

PTFE rotary shaft seals employ a "lay-down" lip sealing mechanism and therefore have a wider contact band on the shaft than conventional elastomeric shaft seals, see Figure 101. This results in a lower contact pressure on the shaft and hence a reduced wear rate. As a consequence, comparatively soft shafts can be accommodated with the appropriate seal design. As an example of the benefits of the "lay-down" sealing, PDR™ seals have been successfully retrofitted onto shafts that have previously been grooved by elastomeric seals.

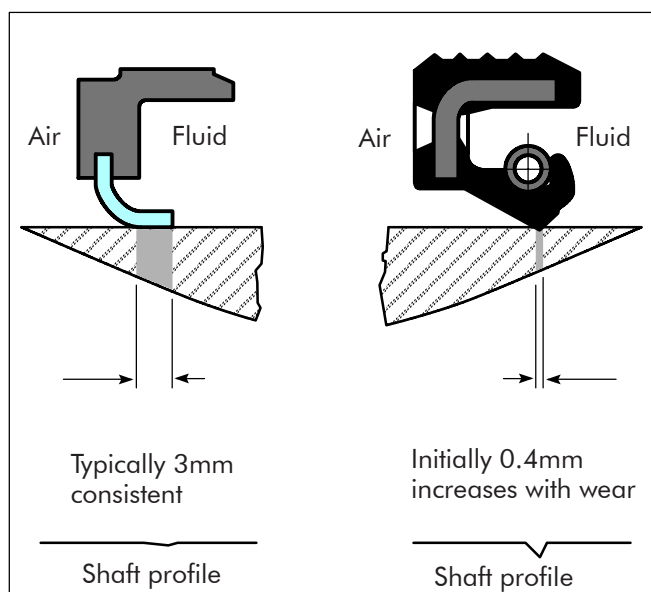


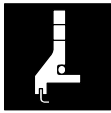
Figure 101 Shaft wear profile

Media

PDR™ seals are resistant to mineral oils, acids, bases, common organic fluids and solvents. PDR™ is unaffected by oxidation, ultraviolet radiation or ozone. PDR™ is ideally suited for use in the chemical industry and applications requiring exposure to the atmosphere. A particular benefit is resistance to Oil Additive Packages which have an adverse affect on elastomers. Using PDR™ allows the increased use of additives and hence a longer oil service life.

PDR™ has successfully sealed powders for 500 h with particle sizes ranging from 1 to 90 μm . Cement, talc and flour have all been successfully tested. This demonstrates the ability of PDR™ to be used as dirt excluders.

PDR™ seals can survive extended periods of lubricant starvation without detriment to the seal or shaft surface. PDR™ seals are in service in applications running for many thousands of hours unlubricated. Advances in filled PTFE compounds are continuously extending product performance.



Applications and design types

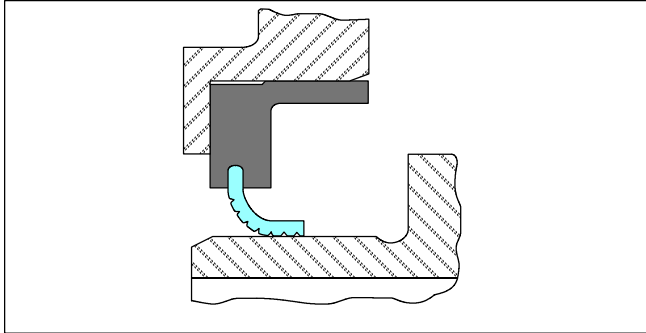


Figure 102 Common crimped design

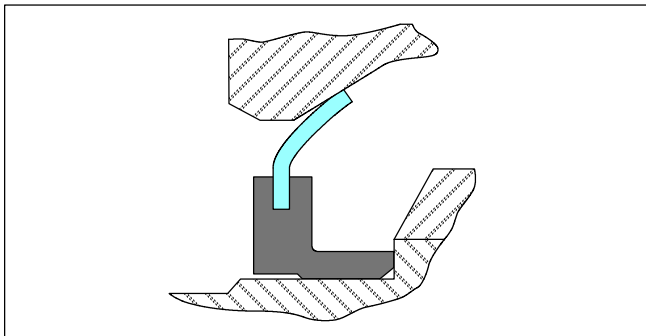


Figure 103 External rotating seal

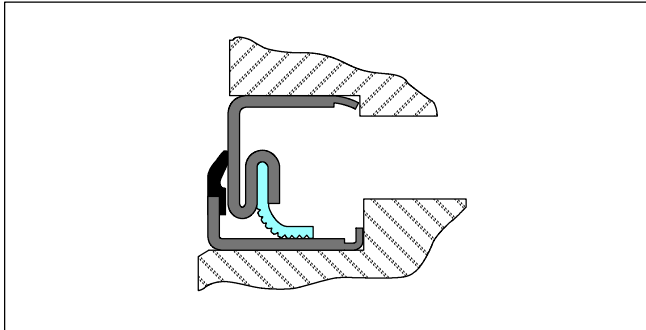


Figure 104 Unitised crankshaft seal

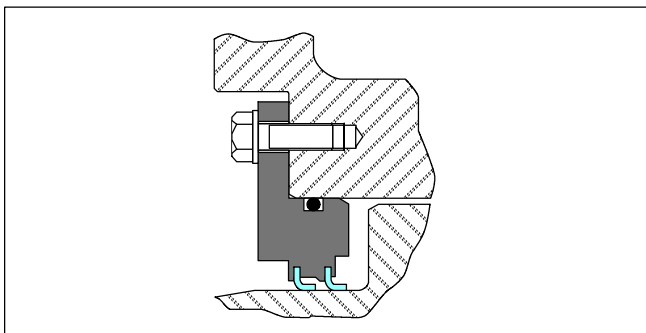


Figure 105 Double lip crimped

Simple single lip seal available with or without an O-ring on the outer diameter for convenient fitting in standard housing and shaft diameters used typically with elastomeric rotary shaft seals. Allows evaluation of PTFE seal in applications where elastomer seals may have been originally specified but found lacking in certain respects. Inclusion of a secondary lip for contaminant exclusion is straightforward. Figure 102.

An external seal whereby the PTFE sealing lip runs on the surface normally associated as the seal housing. Particularly useful where envelope or material considerations result in difficulty in fitting a standard shaft seal. This approach is also beneficial when heat dissipation through the housing is preferred to heat dissipation through the shaft. The minimal mass of the PTFE sealing element reduces the concerns over centrifugal forces increasing the lip loading and associated wear rate. Figure 103.

One example of a unitised or cassette seal whereby the PTFE sealing lip is pre-assembled onto the wear sleeve or running surface. Provision for contaminant exclusion is achieved via a moulded rubber face seal, which also acts to ensure correct assembly of the seal. The unitised design minimises the risk of damage to the PTFE sealing element during transit, storage or fitting and allows the specification for the shaft surface finish and hardness to be reduced. Figure 104.

Typical double lip seal with hydrodynamic sealing lip for running pressures of 0.1 to 0.3 MPa, with a second plain lip for static pressures or dynamic pressure spikes of up to 1.5 MPa. Integrally mounted in a one-piece endplate for fitting and servicing convenience. Figure 105.

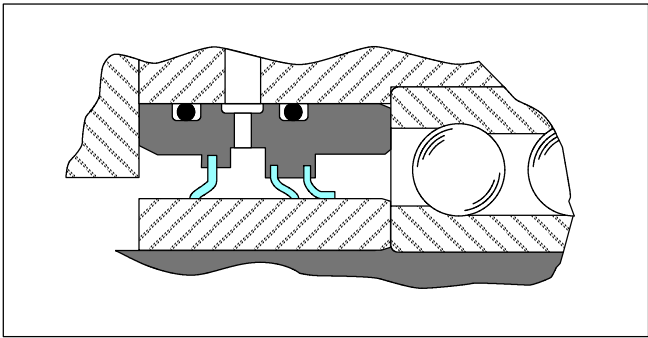


Figure 106 Seal with secondary gas purge control

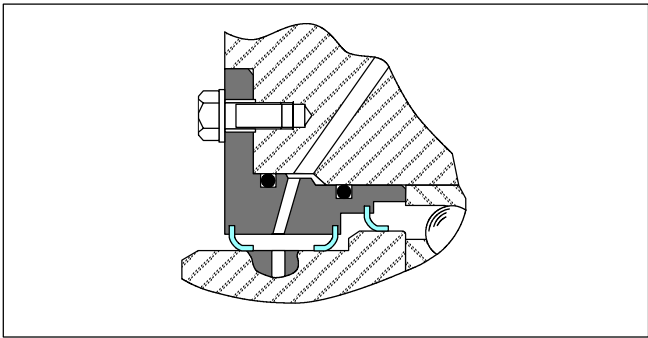


Figure 107 Fluid transfer seal into rotating shaft

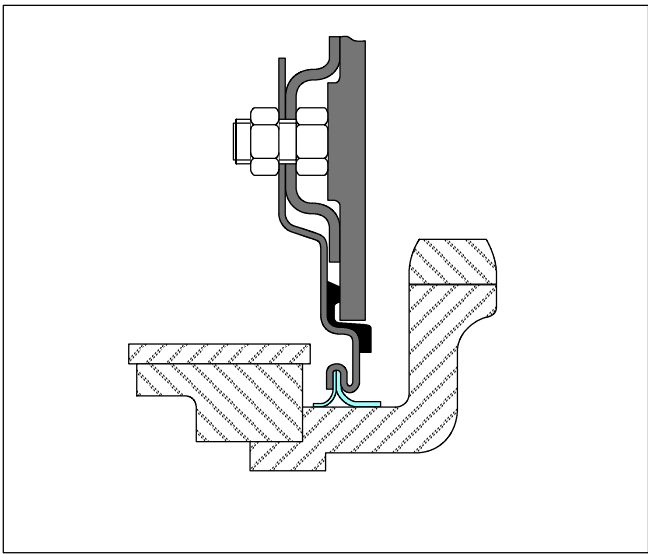


Figure 108 Single shell crankshaft seal with moulded static seal

Triple lip seal incorporating a single hydrodynamic oil sealing lip retaining oil within the gearbox or bearing cavity, accompanied by two opposing purge lips allowing the flow of a gas purge to clean process chemicals away from the oil sealing lip. Sealing lips mounted in a one piece body with O-rings fitted for sealing against the housing. Figure 106.

Typical fluid transfer seal with a single sealing lip for retaining grease or oil within the bearing or gearbox cavity, coupled with two opposing lips centred around drillings allowing a different fluid to be transferred from a feed in the housing through to the centre of the shaft or vice versa. Sealing lips mounted in an integral endplate incorporating O-ring sealing for ease of fitting. Figure 107.

Twin lip seal incorporating a pressed sheet metal endplate with integrally bonded elastomeric sealing bead to accomplish static sealing. Single hydrodynamic sealing lip to retain lubricant within a crank or gear drive casing with a second full contact contaminant exclusion lip to prevent damage to the sealing lip. Specifically designed to fit within narrow axial envelope. Figure 108.

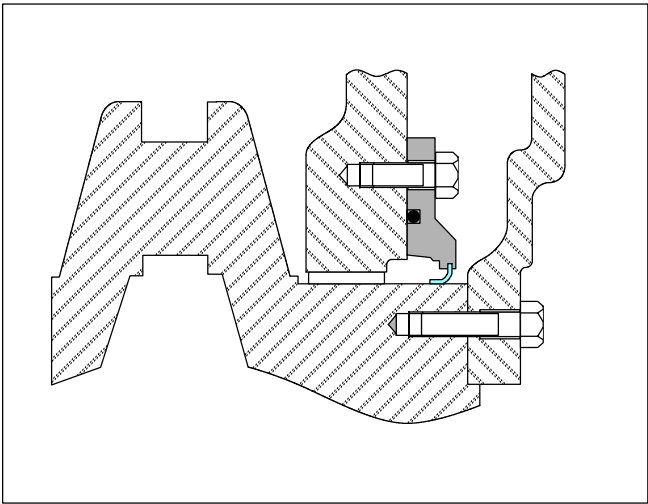


Figure 109 Crimped endplate crankshaft seal

Typical single lip oil seal, mounted in an endplate which could either be diecast with integral location dowels, or machined from solid, utilising a moulded seal or O-ring in a groove on the rear face for static sealing, resulting in a robust single piece part. Figure 109.

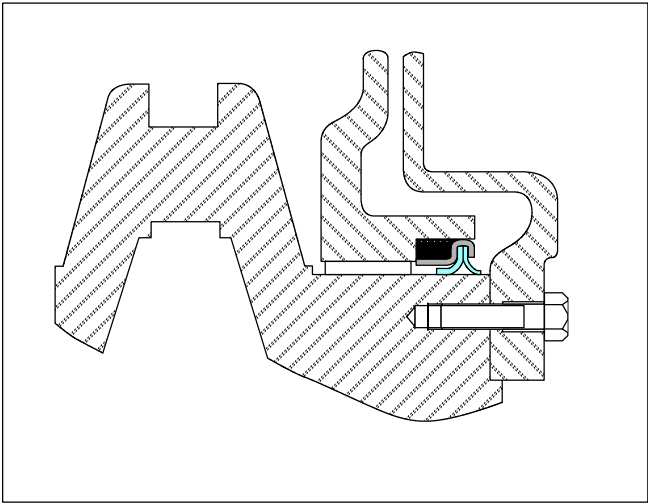


Figure 110 Narrow radial section (NRS) seal

An oil seal utilising a design with a very narrow radial section, allowing more flexible design of the surrounding equipment to minimise the overall package size. Figure 110.



Materials

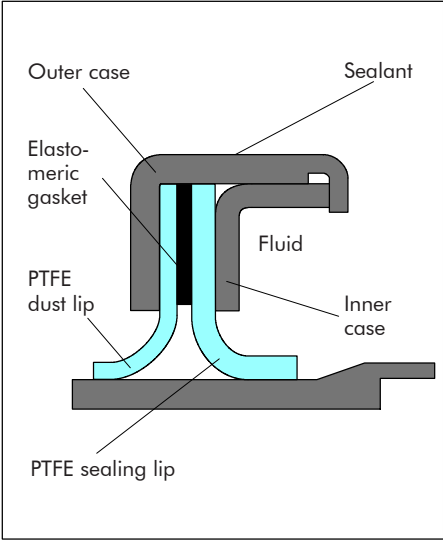


Figure 111 Clamped design

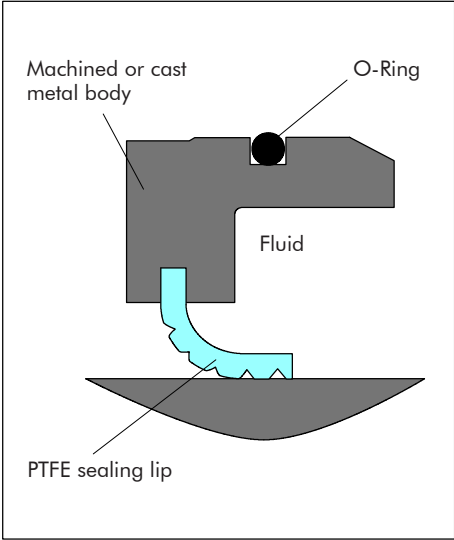


Figure 112 Crimped design

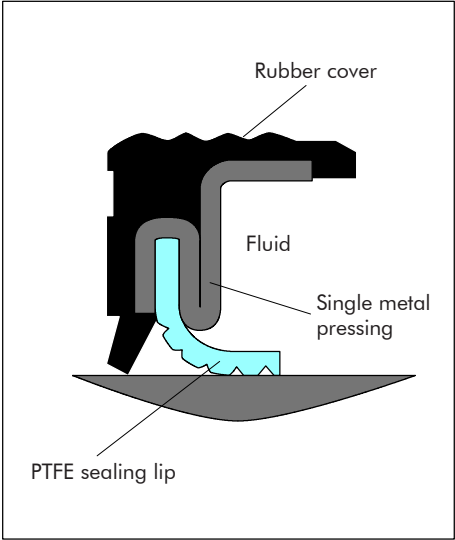


Figure 113 Single shell design

Metal case

Due to coefficients of linear expansion, where possible the seal body should be made from similar material to the housing into which the seal will be assembled. Currently produced parts include: Low Carbon Steel, Stainless Steel, Aluminium, Titanium, Phosphor Bronze and Brass

PTFE sealing elements

When used for sealing greases, a plain PTFE sealing lip is used. For liquids, B+S Rotary Seals employ a hydrodynamic spiral feature machined into the surface of the sealing element to provide a positive pumping action to drive fluid away from the air side of the seal. This feature is "open groove" (see Figure 114) allowing the maximum amount of clogging by carbonised oil or contamination before the pumping effect is destroyed. All PDR™ seals employ mechanical retention of the PTFE element which is a distinct benefit over bonded versions where the surface of the PTFE requires etching to achieve a bond, thereby modifying the seal surface.

Various different grades of filled PTFE are available and are chosen to suit the specific needs of the application. A small selection of the common materials used is given in Table LXII.

Table LXII Selection of common materials

Sealing requirement	PTFE material type
Oils and greases,	Glass filled
Non-contact lip	Virgin
Contacting dust lips	Glass/graphite-filled
Water	Glass-filled
Environmental	Polymeric filled

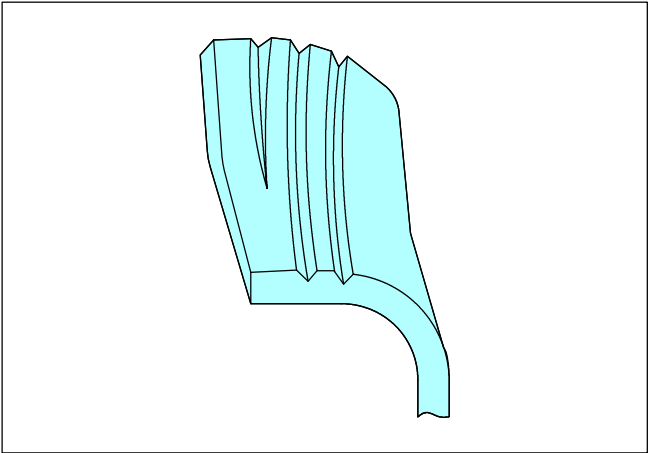


Figure 114 3D view of lip



Packaging

PDR™ seals are normally supplied on cardboard mandrels 280 mm in length. For smaller shaft sizes, the cardboard mandrel may be substituted by plastic or steel. If the seal is ultimately being supplied as part of a kit, PDR™ can be supplied on individual mandrels and/or individually packed. Alternatively, PDR™ seals can be supplied on individual plastic mandrels which can be adapted to aid handling and assembly of the seal. Ideal for both spares and production build, these sleeves negate the need for a separate fitting tool. As the sleeves are made to sizes specific to the application, an injection mould tool will be required. Where volume requirements are low, these sleeves can be provided as machined rather than moulded items. If required, PDR™ seals can be supplied in boxes without mandrels.

Hardware design instructions

Shaft

To the recommendations of ISO 6194/1 and draft ISO/DIS 16589, reproduced here for convenience. All dimensions given are in mm.

Diametral tolerances shall be h11 max.

Table LXIII Shaft installation data

Shaft diameter			Tolerance
Over		To	h11
3	—	6	+0 -.075
6	—	10	+0 -.090
10	—	18	+0 -.110
18	—	30	+0 -.130
30	—	50	+0 -.160
50	—	80	+0 -.190
80	—	120	+0 -.220
120	—	180	+0 -.250
180	—	250	+0 -.290
250	—	315	+0 -.320
315	—	400	+0 -.360

Lead-in chamfer: the shaft should be provided with a lead-in chamfer with a diametrical difference of d₁-d₂ and be free from burrs, sharp corners or rough machining marks.

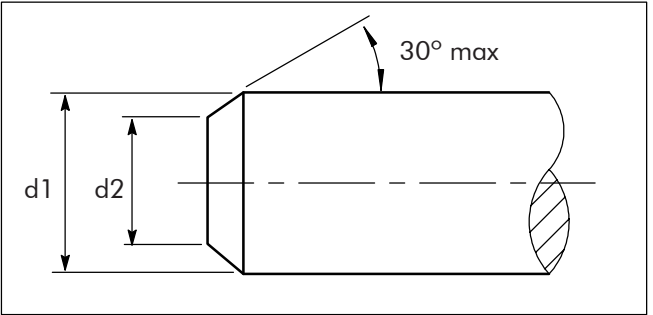


Figure 115 Shaft lead in chamfer

Table LXIV Shaft lead in chamfer

d ₁	d ₁ - d ₂
< 10	1.5
10 - 20	2.0
20 - 30	2.5
30 - 40	3.0
40 - 50	3.5
50 - 70	4.0
70 - 95	4.5
95 - 130	5.5
130 - 240	7.0
240 - 400	11.0

Surface roughness: the seal contact surface of a plunge ground shaft should be finished to a surface roughness of R_a 0.2 to 0.6 µm and R_{zi} 0.8 to 2.5 µm alternatively R_z 1.0 to 2.0 µm and be free from machining leads. Surface hardness: generally 40 HRC. PDR™ will operate successfully on much softer shafts including mild steels and SG iron depending upon application conditions. Similarly, applications with particularly high surface speeds or pressures may benefit from harder shaft surfaces.



Housing

To the recommendations of draft ISO 6194/1 and draft ISO/DIS 16589, reproduced here for convenience. All dimensions given are in mm.

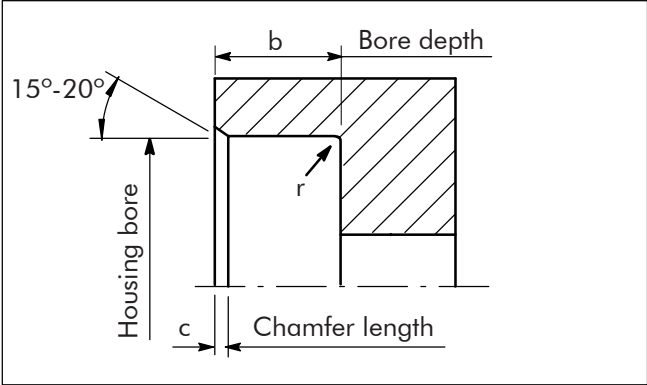


Figure 116 Housing design

Table LXV Housing installation data

Bore diameter			Tolerance
Over		To	H8
3	—	6	+0.018 -0
6	—	10	+0.022 -0
10	—	18	+0.027 -0
18	—	30	+0.033 -0
30	—	50	+0.039 -0
50	—	80	+0.046 -0
80	—	120	+0.054 -0
120	—	180	+0.063 -0
180	—	250	+0.072 -0
250	—	315	+0.081 -0
315	—	400	+0.089 -0

Diametral tolerances shall be H8 max.

Table LXVI Housing design data

Seal width	Up to 10	Over 10
Min. bore depth (b)	b + 0.9	b + 1.2
Chamfer length (c)	0.70 to 1.00	1.20 to 1.50
Max. corner rad. (r)	0.50	0.75

Surface roughness: the surface roughness of the housing bore should not exceed R_a 3.2 μm or R_{zi} 12.5 μm .

The lead-in chamfer should be free from burrs and sharp corners.

For tolerances for seals with larger diameters than specified above, please consult our technical staff.

Installation

When supplied on cardboard mandrels the seals should not be removed from the mandrel until immediately prior to fitting. An assembly cone may be required to expand the PTFE sealing lip onto the shaft, as shown in Figure 117.

When supplied on plastic transport assembly sleeves, the seal should not be removed from the sleeve prior to fitting.

To ensure correct, trouble free fitting, the following rules should always be observed:

- Assembly cones and fitting tools should be regularly checked for signs of damage.
- PDR™ seals should be kept on the mandrel until fitted.
- PDR™ seals should be fitted unlubricated.
- Care should be taken not to damage the outer diameter surface of the seal, whether this is coated in sealant, rubber covered or plain metal case.
- PDR™ seals should be pressed squarely into the housing.

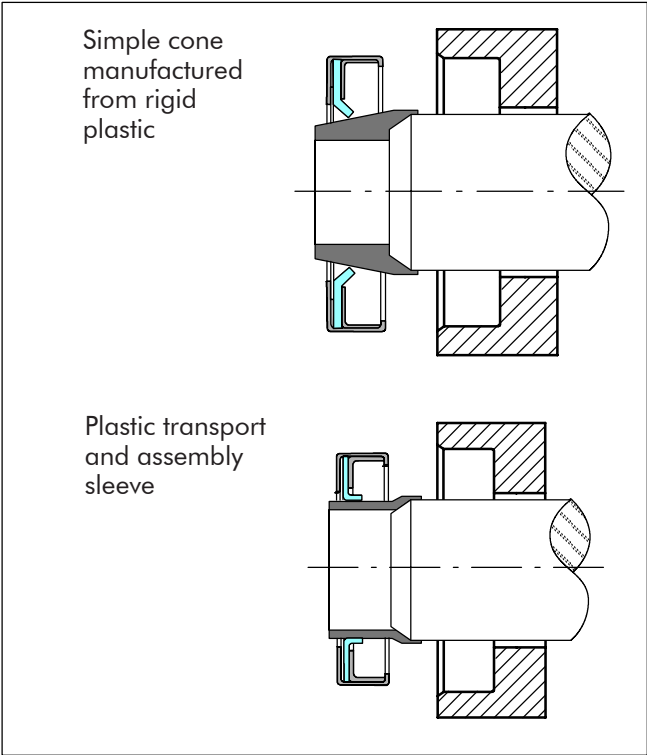
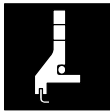


Figure 117 Assembly techniques

Ordering example

The PDR™ - B+S PTFE shaft seal are customer tailored products. On the next page you can find a technical and purchasing questionnaire. In case of an inquiry, please send the completely filled in questionnaire to your local B+S company.



PDR™ - PTFE Shaft Seal

PDR™ - PTFE shaft seals - Technical and purchasing questionnaire

Company name				
Address				
Company products				
Contacts	Name	Title	Telephone	Fax
Technical				
Purchasing				

Technical details Where available a sample or drawing of an existing seal is helpful but insufficient for a viable design to be produced unless accompanied by the following information include installation drawing or scheme wherever possible.

Shaft				
Diameter, with tolerances		mm		
Eccentricity	Static	mm TIR		
	Dynamic (Runout)	mm TIR		
Speed range	Normal	RPM	Maximum	RPM
Direction of rotation (viewed from air/low pressure side)	Clockwise ☐ Anti-clockwise ☐ Bi-directional ☐			
Surface roughness		µm Rz		µm Ra
Material and treatment				
Hardness	HRc			
Shaft type at sealing point	Solid ☐ Hollow ☐ Sleeve ☐ Thickness ☐ mm			
Axial movement and frequency		mm	Per	

Housing				
Diameter, with tolerances		mm		
Depth of recess		mm		
Speed range	Normal	RPM	Maximum	RPM
Direction of rotation (viewed from air/low pressure side)	Clockwise ☐ Anti-clockwise ☐ Bi-directional ☐			
Surface roughness		µm Rz	µm Rmax	µm Ra
Material and treatment				
Housing type	Axially split ☐ Homogeneous ☐ mm			
Axial movement and frequency		mm	Per	

Environment	
Type of fluid to be retained	
Fluid level relative to shaft centreline	
Shaft orientation during normal operation	Horizontal ☐ Vertical ☐
Any other media seal may contact	
Working temperature	°C
Maximum and minimum temperatures	°C
Maximum and minimum pressure differential	Bar Cycle Rate
Maximum test pressure	Bar
Is seal subject to pressure without shaft rotation	Yes ☐ No ☐

Purchasing details Note that this information will have an effect on the design solution offered. If actual data is unknown, please use estimations.

Drawing number (if available)			
Would a test programme be necessary	Yes ☐ No ☐		
Type of release	Aerospace ☐ Defence ☐ Industrial ☐	Specification	
Annual usage		Proporsion B+S could expect	
Rate of call off		Supply commencement date	
Prototype quantity		Date prototypes required	



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.

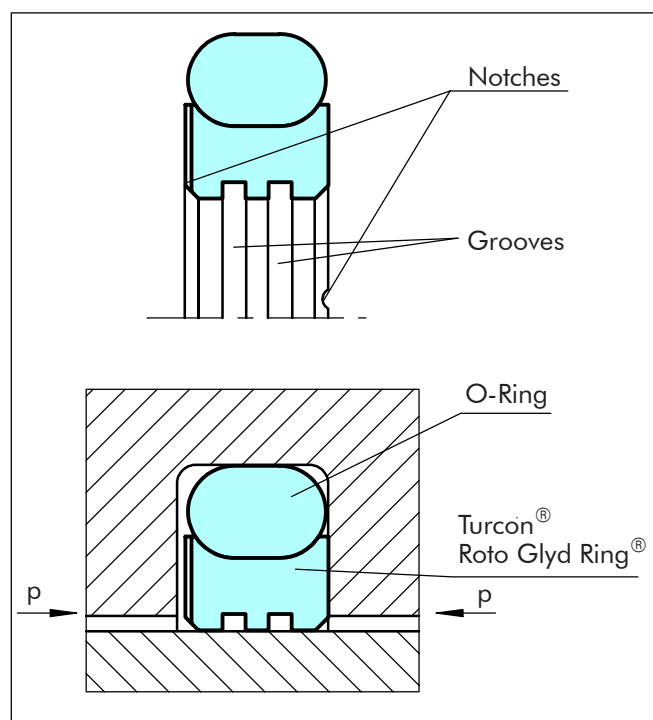


Figure 118 Turcon® Roto Glyd Ring®

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 LXXIII and LXXI. 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) (For applications at low temperatures below -30 °C, please contact B+S).
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.



Frictional power

Guide values for the frictional power can be determined from the graph in Figures 119. 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:

$$P \simeq P_{50} \times \left(\frac{d}{50 \text{ mm}} \right) \text{ [W]}$$

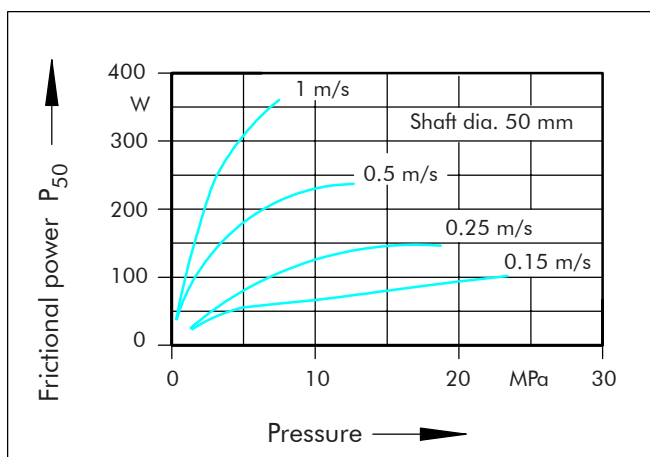


Figure 119 Frictional power for Turcon[®] Roto Glyd Ring[®]

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 the 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 120 and 121). 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 LXX.

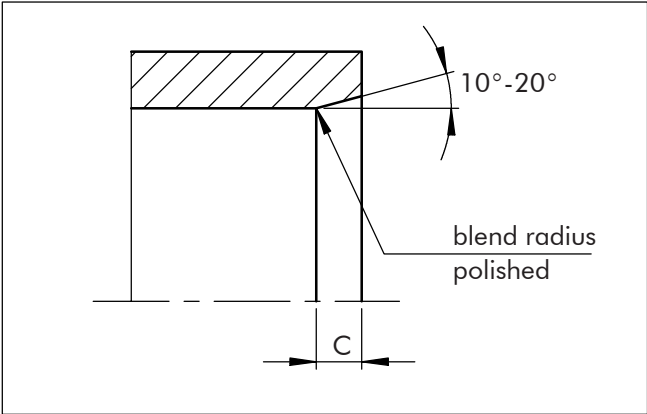


Figure 120 Lead-in chamfer on bore

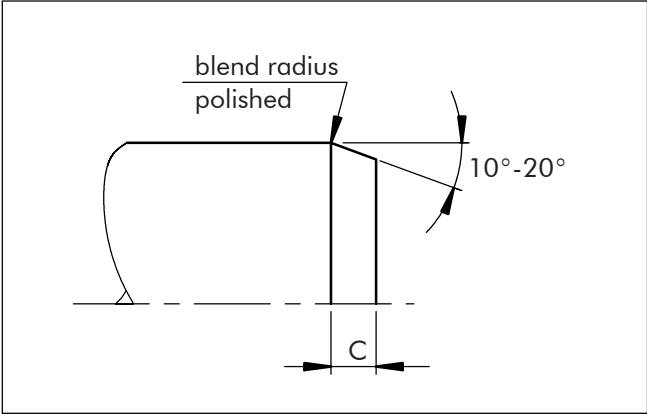


Figure 121 Lead-in chamfer on rod

Table LXVII Lead-in chamfers for Turcon® Roto Glyd Ring®

Series		Lead-in chamfers length C min.
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 LXVIII Surface roughness

Surface roughness μm		
Parameter	Mating surface	Groove surface
	Turcon® materials	
R_{max}	0.63 - 2.50	< 16.0
$R_z \text{ DIN}$	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 $c = 0.25 \times R_z$, relative to a reference line of C_{ref} . 5%.

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 LXIX below.

Table LXIX Groove type - closed or split

Series	Split grooves required below	
	Turcite® T40	Turcite® T10
TG40	$\varnothing 15$	$\varnothing 25$
TG41	$\varnothing 25$	$\varnothing 38$
TG42	$\varnothing 32$	$\varnothing 50$
TG43	$\varnothing 50$	$\varnothing 75$
TG30	$\varnothing 12$	
TG31	$\varnothing 18$	
TG32	$\varnothing 33$	
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.

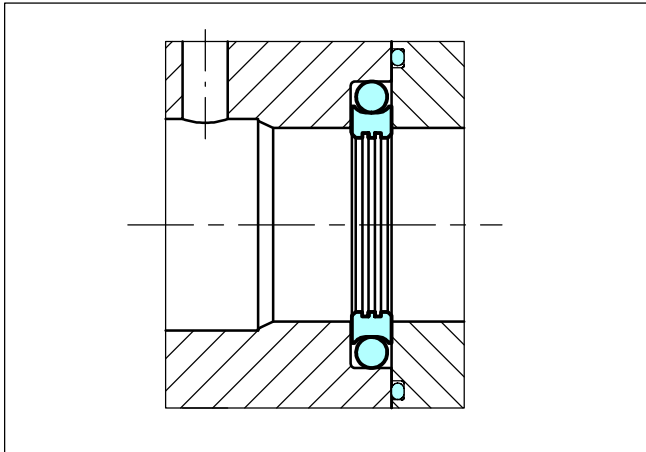


Figure 122 Installation in a split groove

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

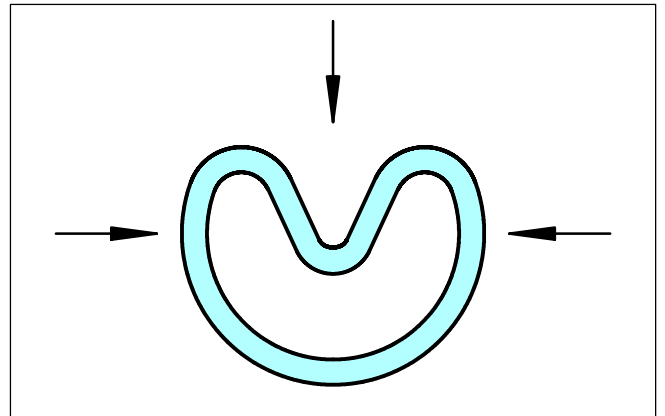


Figure 123 Kidney-shaped deformation of the seal ring

- Place the seal ring in compressed form into the groove and push against the O-Ring in the direction of the arrow (Figure 124)

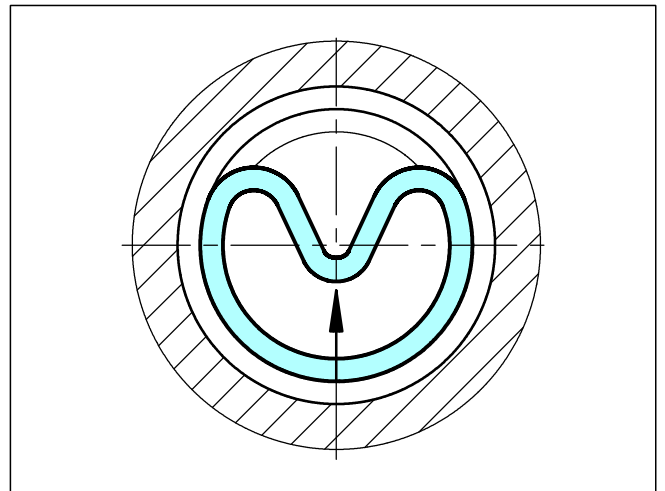


Figure 124 Inserting the seal ring into the closed groove

- Finally size the seal ring using a mandrel which should have a chamfer of 10° to 15° over a length of approx. 30 mm

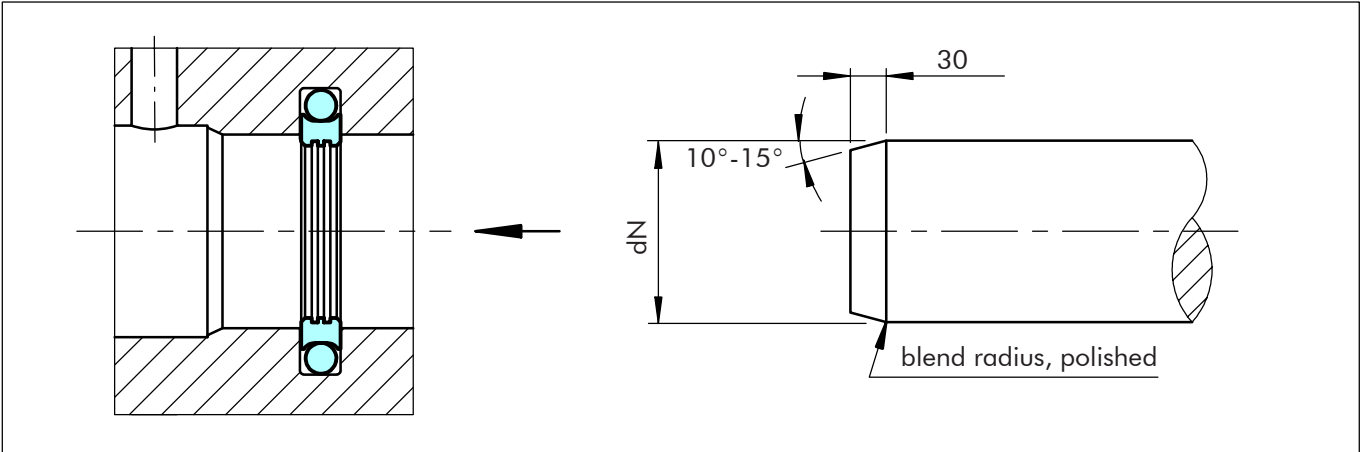


Figure 125 Sizing of the installed seal

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 LXVII.

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.

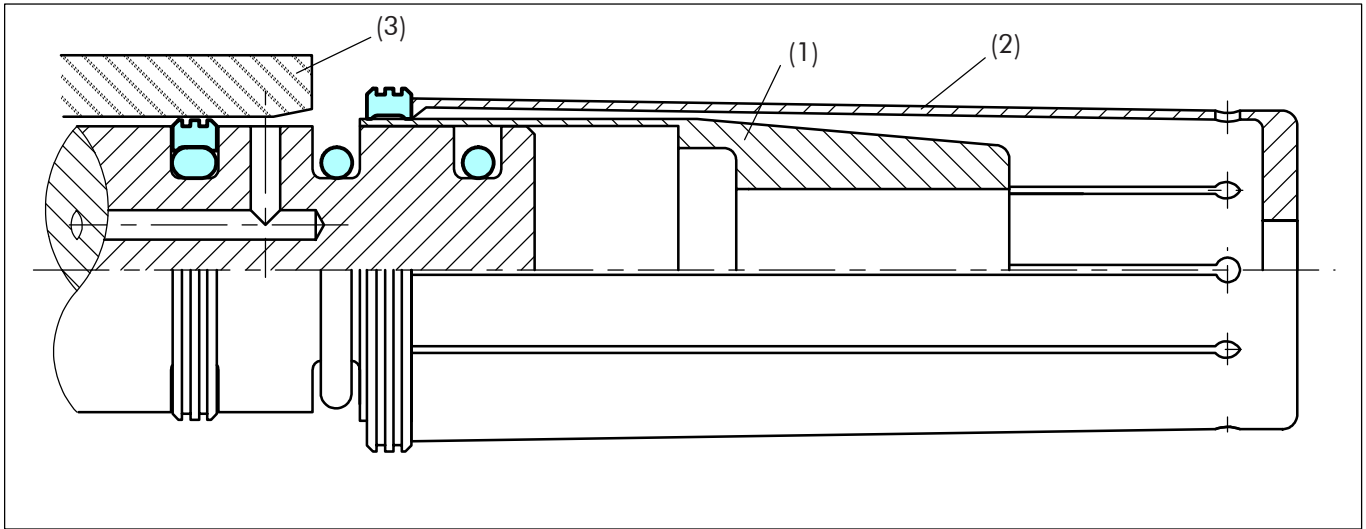


Figure 126 Expanding the Turcon® Roto Glyd Ring® over the installation sleeve using an expanding sleeve

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 B+S.

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 LXVII. Otherwise use a sizing sleeve.



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 LXX.

Table LXX 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

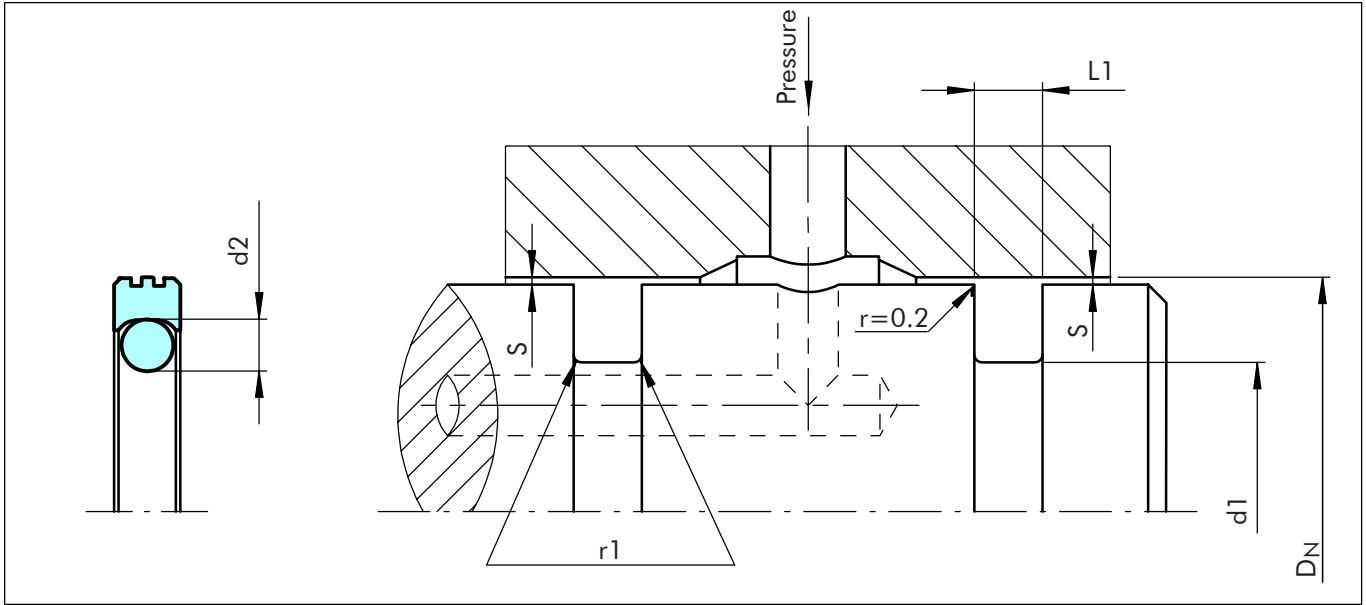


Figure 127 Installation drawing

Table LXXI Installation dimensions

Series no.	Bore diameter D _N H9		Groove diameter	Groove width	Radial clearance S max*		Radius	O-Ring cross sec.	Number of grooves in the sealing surface
	Standard range	Available range	d ₁ h9	L ₁ +0.2	10 MPa	20 MPa	r ₁	d ₂	
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 LXIX.
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.

Table LXXII Preferred Dimension / Part No.

Bore diameter	Groove diameter	Groove width	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

The bore diameters printed in bold type conform to the recommendations of ISO 3320.



Bore diameter	Groove diameter	Groove width	Part no.	O-Ring size
D _N H9	d ₁ h9	L ₁ +0.2		
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
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

The bore diameters printed in bold type conform to the recommendations of ISO 3320.



Bore diameter	Groove diameter	Groove width	Part no.	O-Ring size
D _N H9	d ₁ h9	L ₁ +0.2		
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
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.

Ordering Example

Turcon® Roto Glyd Ring®, complete with O-Ring, external sealing, series TG42 (from Table LXXI).
Bore diameter: D_N = 80.0 mm
Part No.: TG4200800 (from Table LXXII)

Select the material from Table LXX. The corresponding code numbers are appended to the Part No. (from Table LXXII). Together they form the Order No.
For all intermediate sizes not shown in Table LXXII, 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.
Order no.: TG45**X1200** - T40N.

Order No.	TG42	0	0800	-	T40	N
Series No.						
Type (Standard)						
Cylinder diameter x 10**						
Quality Index (Standard)						
Material code (Seal ring)						
Material code (O-Ring)						



■ Installation recommendation - internal sealing

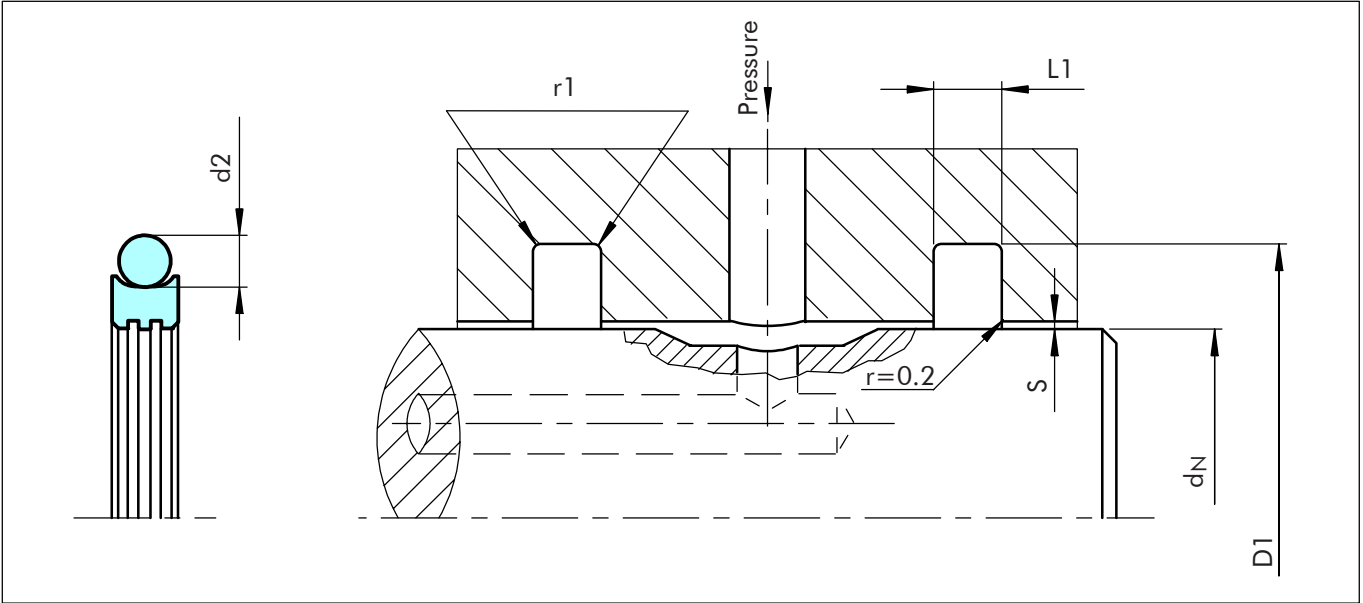


Figure 128 Installation drawing

Table LXXIII Installation dimensions

Series no.	Rod diameter d_N f8/h9		Groove diameter	Groove width	Radial clearance S max*		Radius	O-Ring cross sec.	Number of grooves in the sealing surface
	Standard range	Available ¹⁾ range	D_1 H9	$L_1 + 0.2$	10 MPa	20 MPa	r_1	d_2	
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 LXIX.
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.

Table LXXIV Preferred dimensions / Part No.

Rod diameter	Groove diameter	Groove width	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

The rod diameters printed in bold type conform to the recommendations of ISO 3320.



Turcon® Roto Glyd Ring®

Rod diameter	Groove diameter	Groove width	Part no.	O-Ring size
d _N f8/h9	D ₁ H9	L ₁ +0.2		
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
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

The rod diameters printed in bold type conform to the recommendations of ISO 3320.



Rod diameter	Groove diameter	Groove width	Part no.	O-Ring size
d _N f8/h9	D ₁ H9	L ₁ +0.2		
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
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.

Ordering example

Turcon® Roto Glyd Ring®, complete with O-Ring, internal sealing, series TG32 (from Table LXXIII).
Rod diameter: d_N = 80.0 mm
Part No.: TG3200800 (from Table LXXIV)

Select the material from Table LXX. The corresponding code numbers are appended to the Part No. Together they form the Order No.
For all intermediate sizes not shown in Table LXXIII, the Order 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.
Order no.: TG35**X1200** - T40N.

Order No.	TG32	0	0800	-	T40	N
Series No.						
Type (Standard)						
Rod diameter x 10**						
Quality Index (Standard)						
Material code (Seal ring)						
Material code (O-Ring)						



■ 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.

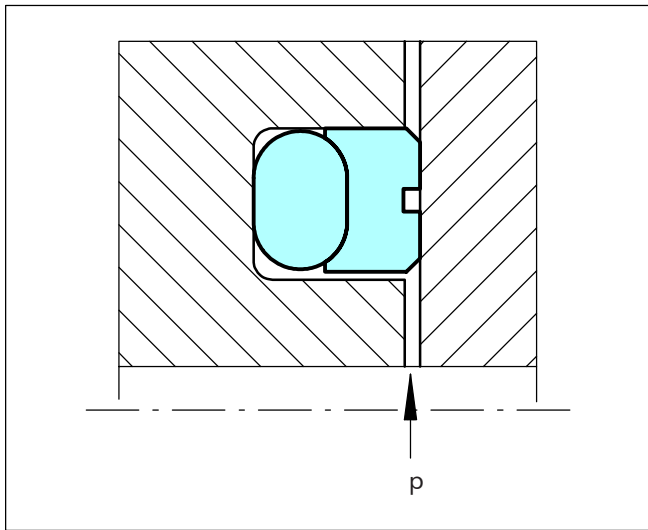


Figure 129 Axial acting Turcon® Roto Glyd Ring®

Figure 129 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 LXVIII.

Special model with pressure relief

The Roto Glyd Ring® can also be supplied with pressure relief grooves. As can be seen in Figure 130 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.

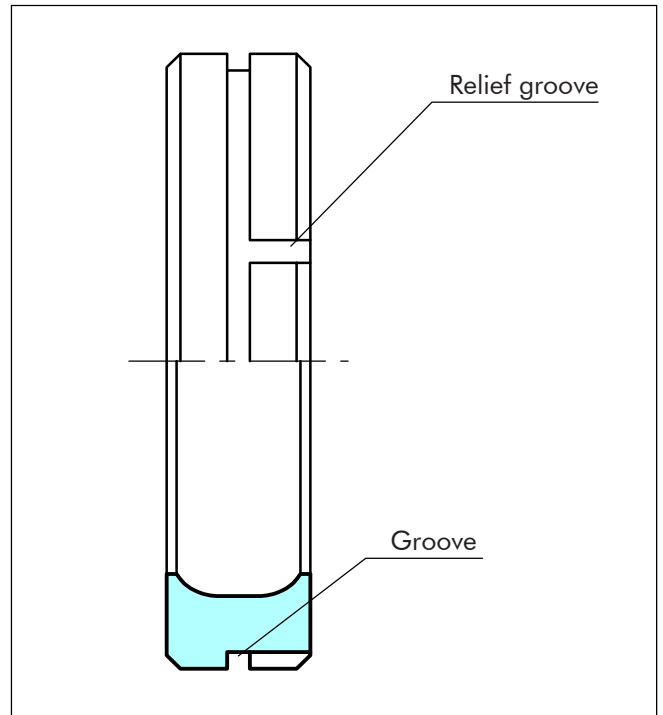


Figure 130 Turcon® Roto Glyd Ring® with pressure relief

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.

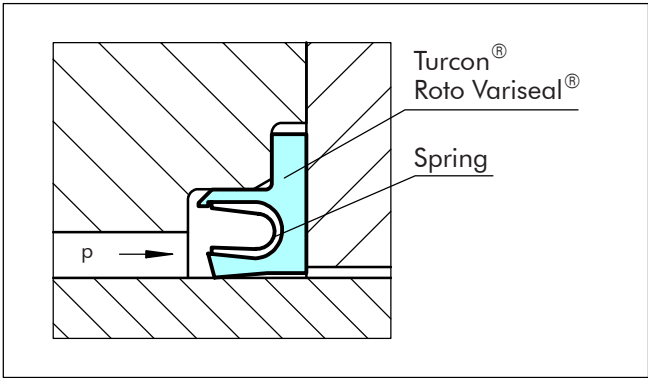


Figure 131 Turcon® Roto Variseal®

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

- Rotary, reciprocating and static service
- Good scraping effect
- Stick-slip-free operating for precise control
- High abrasion resistance and dimensional stability
- Can handle rapid changes in temperature
- No contamination in contact with foodstuffs, pharmaceutical and medicinal fluids
- Sterilisable
- Unlimited shelf life.

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: Practically 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 power

Guide values for the frictional power can be determined from the graphs in Figure 132. 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:

$$P \simeq P_{50} \times \left(\frac{d}{50 \text{ mm}} \right) \text{ [W]}$$

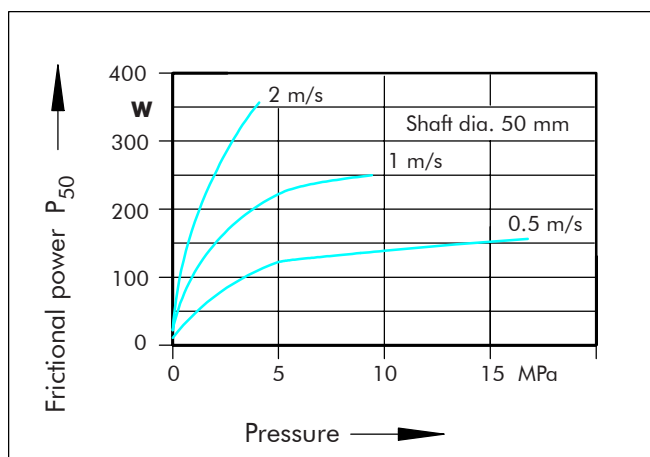


Figure 132 Frictional power for Turcon[®] Roto Variseal[®]

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 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 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 Variseal[®]: up to $p_v = 5 \text{ MPa} \cdot \text{m/s}$

The value must be reduced for diameters < 50 mm.

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 133). 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 LXXVII.

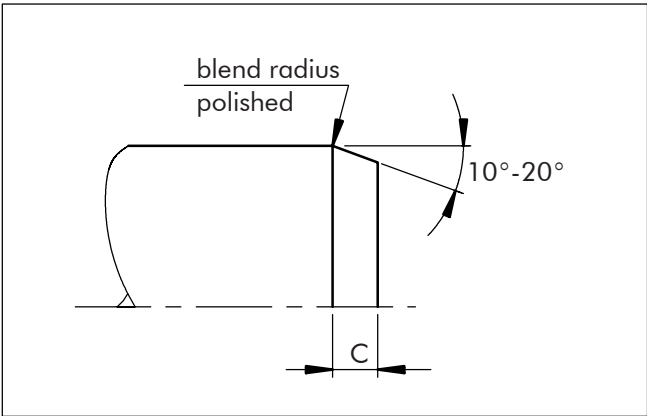


Figure 133 Lead-in chamfer on shaft

Table LXXV 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

The sealing of rotating movements makes particular demands on the mating surface. We recommend a hardness of min. 55 HRC. The hardening depth should be at least 0.3 mm.

Coated surfaces must be finished with particular care:

- Chrome platings must not peel off in service.
- Good heat dissipation must be assured by the coating.

Unhardened mating surfaces should have a Brinell hardness of at least 170 HB.

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.

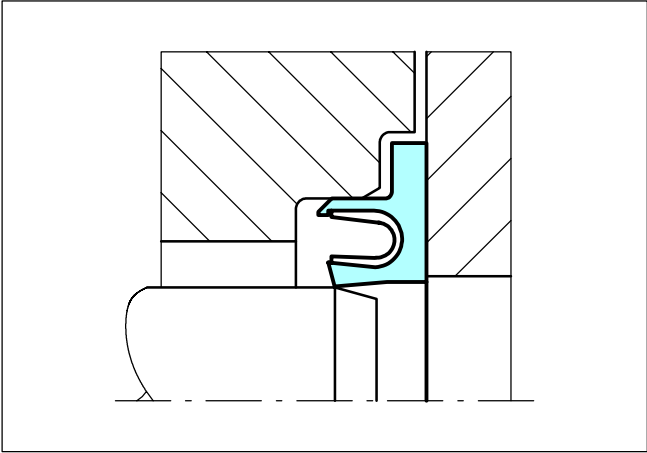


Figure 134 Turcon® Roto Variseal®

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 LXXVI 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.

Busak+Shamban recommends that the following surface finishes be observed :

Table LXXVII 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

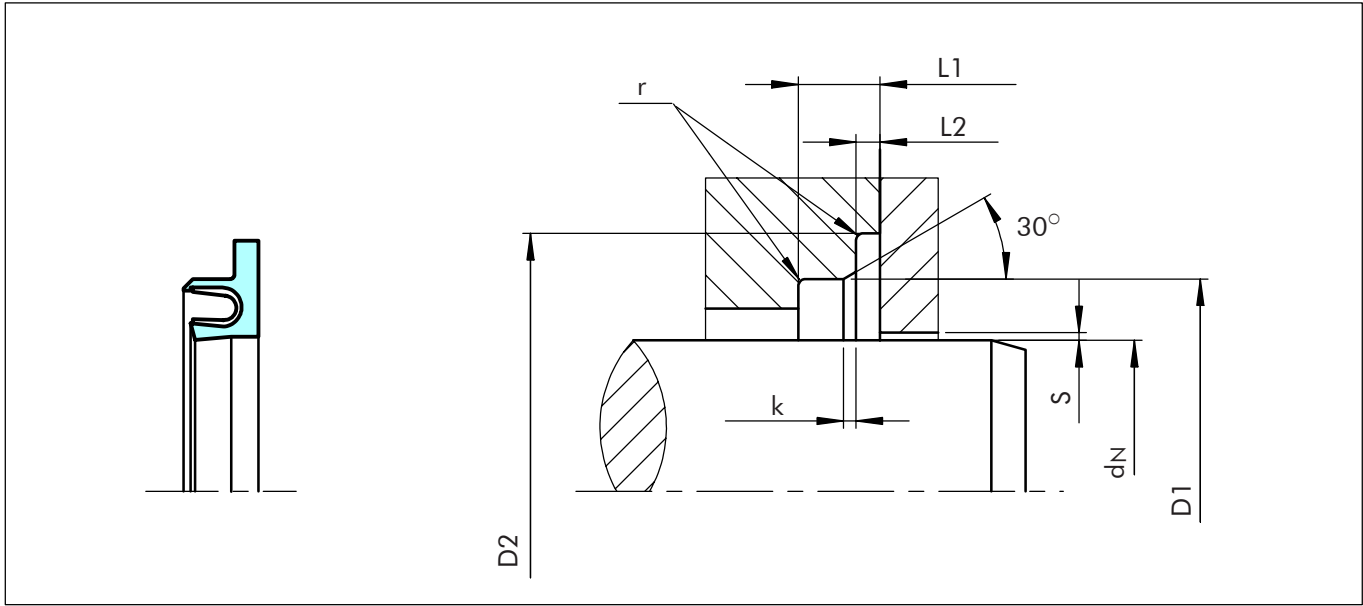


Figure 135 Installation drawing

Table LXXVIII Installation dimensions

Series no.	Rod diameter		Groove diameter		Groove width		Lead-in chamfer	Radius	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	<10 MPa	<20 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	0.8	0.3	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	1.1	0.4	0.35	0.20	0.15
TVM3	40.0 - 400.9	20.0 - 700.0	d _N + 10.5	d _N + 17.5	7.1	1.80 +0 -0.20	1.4	0.5	0.50	0.25	0.20
TVM4	401.0 - 999.9	35.0 - 999.9	d _N + 14.0	d _N + 22.0	9.5	2.80 +0 -0.20	1.6	0.5	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 LXXVIII).
Rod diameter: d_N = 80.0 mm
Part No.: TVM300800 (from Table LXXIX)

Select the material from Table LXXVI. The corresponding code numbers are appended to the Part No. (from Table LXXIX). Together they form the Order No. For all intermediate sizes not shown in Table LXXVIII, the Order 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.
Order no.: TVM4**X1200** - 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.

Order-No..	TVM3	0	0800	-	T40	S	(D)
Series No.							
Type (Standard)							
Rod Diameter x 10*							
Quality Index (Standard)							
Material code - Seal ring							
Material code - Spring							
Hi-Clean** - (option)							



Table LXXIX Preferred dimension / Part no.

Rod diameter d_N f8/h9	Groove diameter		Groove width	Part no.
	D_1 H9	D_2 H10	L_1	
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
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

Rod diameter d_N f8/h9	Groove diameter		Groove width	Part no.
	D_1 H9	D_2 H10	L_1	
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
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.