SEALING

2023

Overview

Rotary Shaft Seals

AST Sealing Solutions

About AST Sealing

As AST Sealing, we have been providing OEM service on sealing elements since 1998.

Our business partnerships with the world's leading Industrial and Hydraulic equipment manufacturers; We offer sustainable quality products with our R&D engineers. It is one of the world's leading suppliers of sealing solutions specific to 16 sectors, especially automotive, construction machinery, agriculture, and industrial sectors.

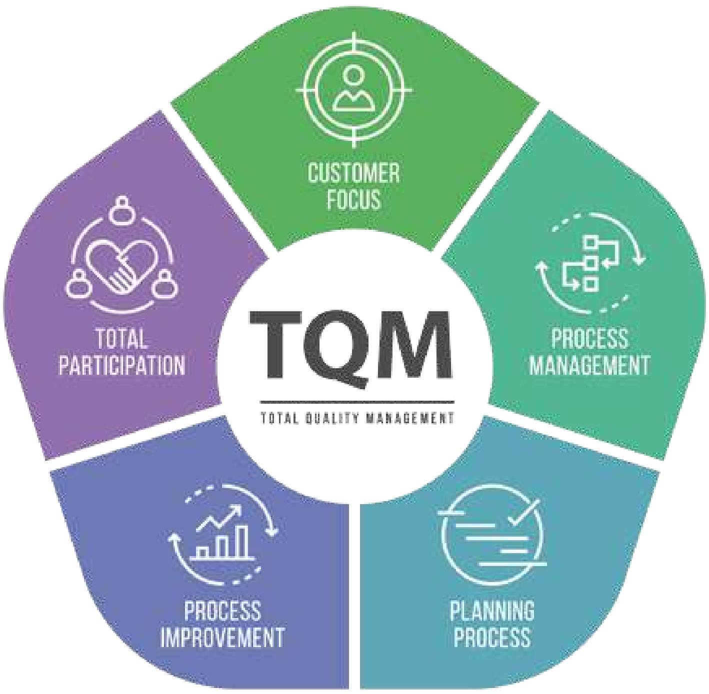
- 11 factories in 6 countries
- Export to 35 countries
- 1200+ employees
- Possibility to ship anywhere in the world

Supplied Product

1.325,022

18

Global Brands



Products

Static Seals

Rotary Shaft Seals

O-Rings

Seal Kits

Hydraulic Accumulators

Hydraulic Seals

Bushing

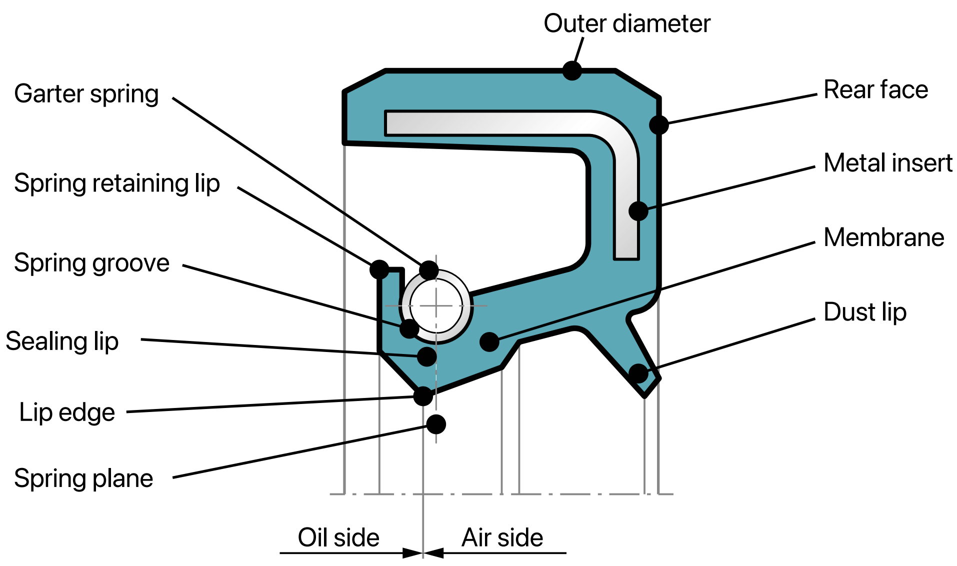
General Information

What is a Rotary Shaft Seal?

A rotary shaft seal is an essential component that provides a seal between the rotating shaft and the housing, preventing oil and other fluids from leaking out. With a wide range of applications, such as in the automotive industry and industrial machinery and equipment, rotary shaft seals also prevent dust, dirt, and other foreign materials from entering the system, offering long-lasting use.

Advantages of Rotary Shaft Sealst

- High sealing performance
- Long-lasting and durable structure
- Wide range of applications
- Reliable operation even at high speeds and pressures
- Low friction and heat generation



Designation for rotary shaft lip seals (extract from ISO 6194)

Application Areas

- Automotive industry (engine, transmission, and differential systems)
- Industrial machinery and equipment
- Agricultural and construction machinery
- Hydraulic and pneumatic systems
- Wind energy and other renewable energy systems

Working Principle of Rotary Shaft Seals

Rotary shaft seals consist of a flexible outer ring and a special sealing element on the inner surface. As the shaft rotates, the sealing element creates a tight connection by rubbing against the shaft surface. This prevents oil and other fluids from leaking out and stops foreign materials like dust and dirt from entering the system.

Rotary shaft seals can be made from different materials and structures. This allows the use of specially designed rotary shaft seals for various industrial applications.

The working principle of rotary shaft seals provides high performance and durability, enabling more efficient and reliable operation of systems. This helps reduce maintenance costs and extend the service life of equipment and machinery.

For detailed and current information about our Rotary Shaft Seal products, please scan the QR code.

General Information

Metal Case

The metal case is normally made out of formed, cold-rolled steel sheet in accordance with DIN EN 10139. Another material, such as stainless steel or brass, may be used depending on application requirements. If the metal case is rubber-covered, the outside diameter may be either smooth or ribbed. In all cases, the seal outer diameter tolerance is in accordance with ISO 6194-1 and the bore tolerance is in accordance with ISO H8.

Nominal Outside Diameter	Diametral Tolerance	
d_2	Metal Cased	Rubber Covered
$d_2 \leqslant 50$	+0.20 / +0.08	+0.30 / +0.15
$50 < d_2 \leqslant 80$	+0.23 / +0.09	+0.35 / +0.20
$80 < d_2 \leqslant 120$	+0.25 / +0.10	+0.35 / +0.20
$120 < d_2 \leqslant 180$	+0.28 / +0.12	+0.45 / +0.25
$180 < d_2 \leqslant 300$	+0.35 / +0.15	+0.45 / +0.25
$300 < d_2 \leqslant 530$	+0.45 / +0.20	+0.55 / +0.30

Not: Ribbed O.D tolerances on request.

Garter Springt

Function

When rubber is exposed to heat, pressure or chemical attack, it will gradually lose its original properties. The rubber is then said to have aged, causing the original radial force exerted by the sealing element to diminish. The function of the garter spring is to maintain the radial force during this period.

Experiments have shown that the radial force must vary with the size and type of seal. They have also clearly indicated the significance of maintaining 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 closely wound and carries an initial tension. The total force exerted by the spring 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 ensures that, as the sealing element wears, the total radial force from the initial tension will not change.

Material

Spring steel is normally used. If resistance to corrosion is required, stainless steel can be substituted. Garter springs of bronze or similar materials are not recommended, since they tend to fatigue after long service life, or as a result of exposure to high temperatures. In special cases, the garter spring can be protected against damage by means of a thin rubber cover.

General Information

Design Instructions: Shaft Surface Finish, Hardness and Machining Methods

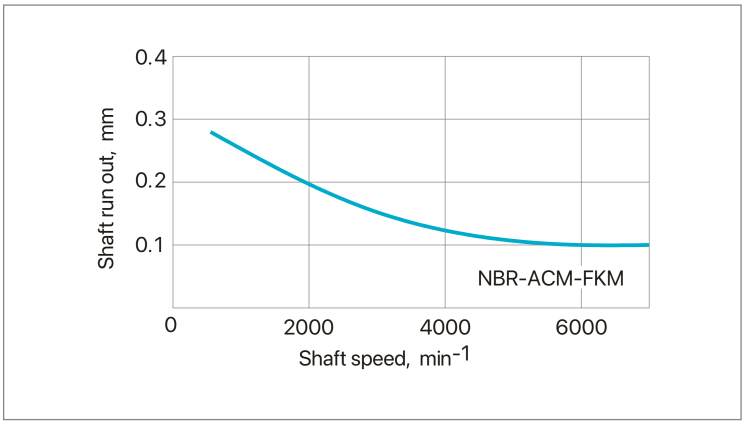
The shaft design is vital for sealing performance and ensures maximum service life for the seal (see Figure 4). As a basic principle, the hardness of the shaft should be higher as peripheral speeds increase. DIN 3760 specifies that the shaft must be hardened to at least 45 HRC.

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 suitable hardness is dependent not only on the peripheral speed but also on factors such as lubrication and the presence of abrasive particles. Poor lubrication and difficult environmental conditions require a higher shaft hardness. DIN 3760 specifies a surface roughness of Ra 0.2 - Ra 0.8 µm. Laboratory tests have however proved that the most suitable roughness is Rt = 2 µm (Ra = 0.3 µm). Both rougher and smoother surfaces generate higher friction, resulting in increased temperature and wear. AST Sealing suggest a surface roughness of Ra 0.2 - 0.5 µm

Ölçümler, sürtünme ve sıcaklık açısından şaftın öğütülmesinin en iyi işleme yöntemi olduğunu göstermiştir. Ancak, spiral öğütme izleri bir pompa etkisi yaratabilir. Bu nedenle, düşey öğütme kullanılmalı ve öğütme tekerleği hızı ile iş parçası arasında dengeli bir oran sağlanmamalıdır. Şaft yüzeyinin bir parlatma bezi ile cilalanması, düşey öğütme ile karşılaştırıldığında daha yüksek sürtünme ve ısı üretimi neden olacak bir yüzey oluşturur. Bazı durumlarda, şaft için gerekli sertlik, yüzey pürüzlülüğü ve korozyon direncini sağlamak mümkün olmayabilir. Bu sorun, ayrı bir manşonun şafta takılmasıyla çözülebilir. Aşınma oluşması durumunda, sadece manşonun değiştirilmesi gerekmektedir.

Shaft Run Out

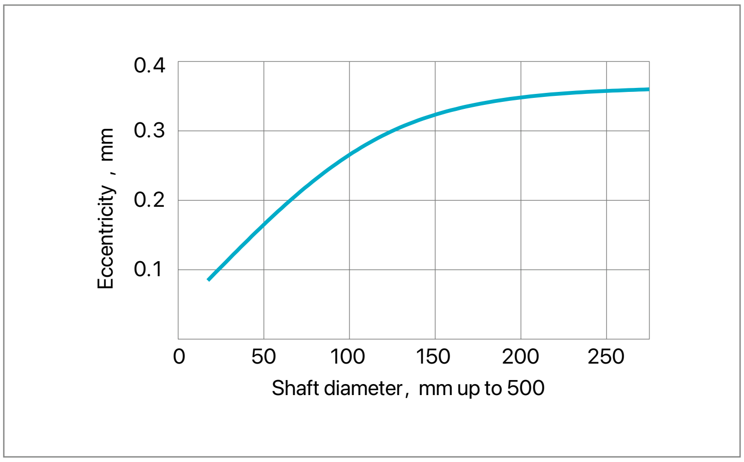
Shaft run out should as far as possible be avoided or kept to a minimum. At higher speeds, there is a risk that the inertia of the sealing lip prevents it from following the shaft movement. The seal must be located next to the bearing and the bearing play should be maintained at the minimum value possible.



Shaft run out

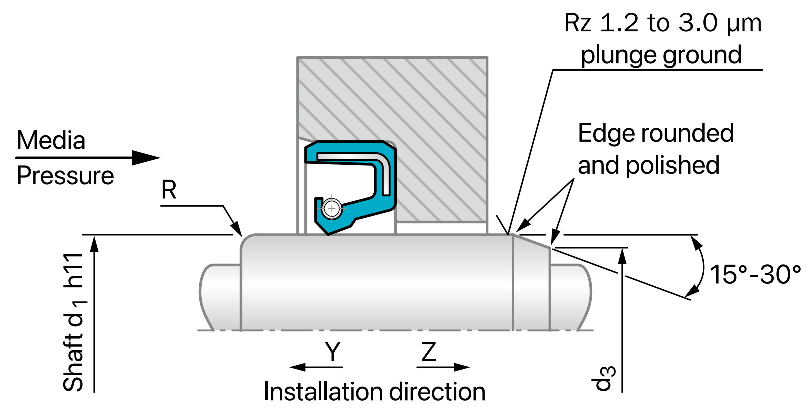
Eccentricity

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



Eccentricity

General Information



Installation of the Radial Oil Sealt

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 4 and Table 2.

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 480	d_1 - 11.0	12

Characteristics of the Shaft Surface

The running surface for Radial Oil Seals is specified in DIN 3760/61. The surface should meet the following

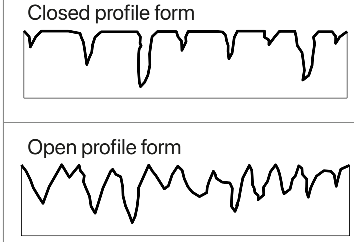
Hardness:	55 HRC or 600 HV, hardness depth min. 0.3 mm
Surface roughness:	Ra = 0.2 to 0.5 µm Rz = 1.2 to 3.0 µm Rmr = 50-70%, c = 0.25 x Rz

Surface Roughness

The functional reliability and service life of a seal depend to a great extent on the quality and surface finish of the mating surface to be sealed. Scores, scratches, pores, and concentric or spiral machining marks are not permitted. Higher demands must be made on the surface finish of dynamic mating surfaces than on static mating surfaces. Plunge grinding is recommended to eliminate the presence of helical "lead" on the shaft.

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

The material contact area, Rmr, is essential for assessing surfaces, as this parameter is determined by the specific profile form. This directly depends on the machining process employed.

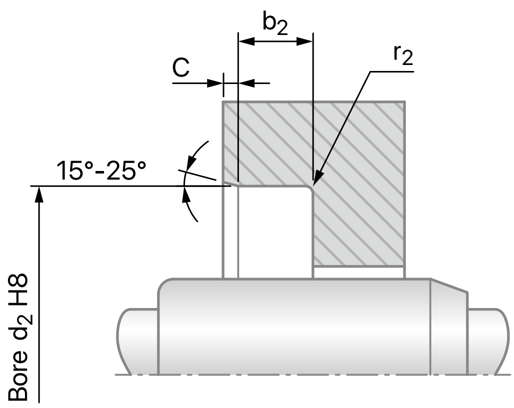


Surface Profile	Ra	Rz	Rmr
Closed profile form	0.1 µm	1.0 µm	70%
Open profile form	0.2 µm	1.0 µm	15%

Figure 5: Examples of various surface profile parameters

General Information

Design Instructions: Housing Bore



: Installation depth and lead-in chamfer

Housing Bore

For metric sizes, the tolerances are in accordance with ISO 6194-1, which provides a suitable press fit for the bore tolerance in ISO H8. The inch sizes are in accordance with ARPM OS-4. 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 damaging the bore, a seal with a larger outside diameter than that of the bearing should be selected.

Housing Dimensions

Ring Width b	C mm	b_2 (b +0.3) mm	r_2 max.
7	0.7 - 1.0	8.2	0.5
8	0.7 - 1.0	9.2	0.5
10	1.0 - 1.3	11.2	0.5
12	1.0 - 1.3	13.5	0.75
15	1.0 - 1.3	16.5	0.75
20	1.0 - 1.3	21.5	0.75

Surface Roughness of the Housing

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

General values: Ra = 1.6 - 3.2 µm
Rz = 6.3 - 12.5 µm

For metal-to-metal sealing or gas sealing, a good score-free and spiral-free surface finish are 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.

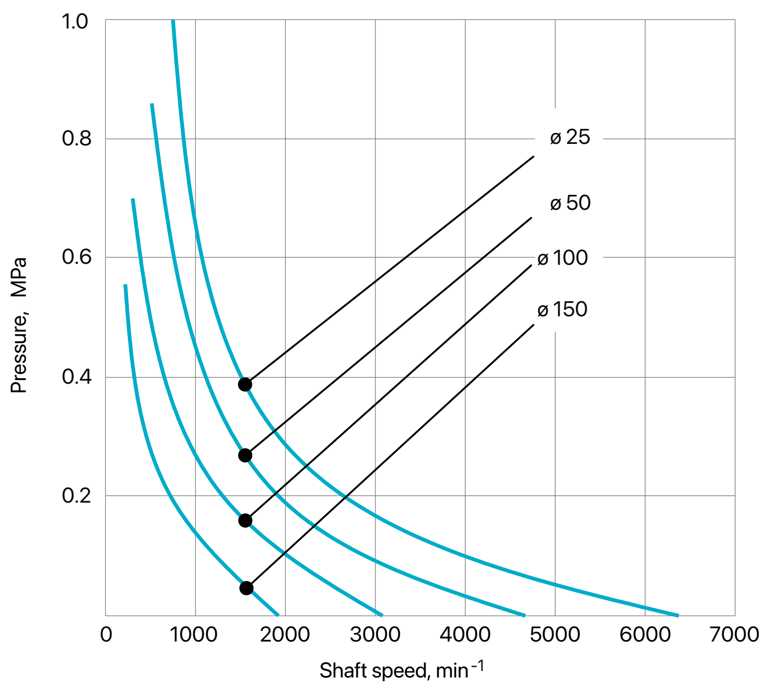
For detailed and current information about the materials, please scan the QR code.

General Information

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.

At very high pressures, seals with rubber-covered cases should be used 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.



Permissible overpressure for supported lip seals and for pressure seals

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