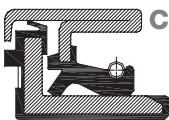
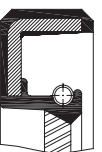
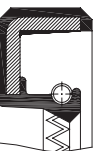
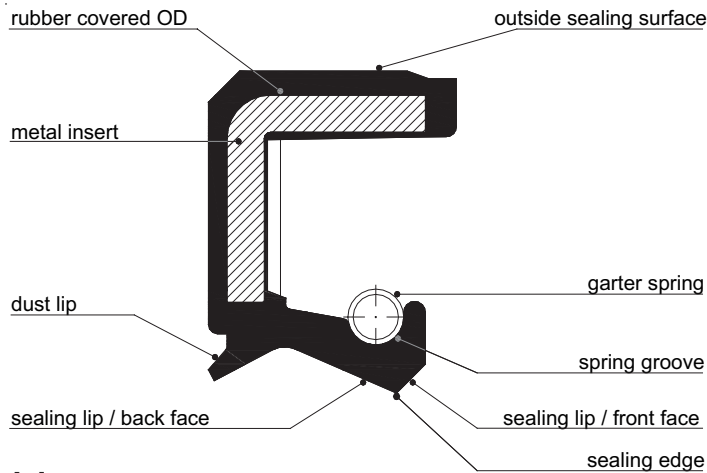


Additional types

	AS - P	Reinforced sealing lip for overpressure, with or without additional dust lip		B - O	Outer metal case, sealing lip without garter spring
	AS - PX	Reinforced sealing lip and special metal insert for overpressure, with additional dust lip		C - O	Outer metal case with reinforcing metal inner ring, without garter spring
	A - DUO	Twin sealing lips with two garter springs		C - TE	Inner metal case and sealing lip on O.D.; type B-TE available as well
	A - O	Sealing lip without garter spring		C - DUO	Outer metal case with reinforcing cap, twin sealing lips with two garter springs
	A - FL	Different spring groove for a better spring retention, waved O.D.		COMBI SEAL	Combination of a shaft seal and an additional lip in polyurethane against soiling, all in one housing
	A - LD	Sealing lip with hydrodynamic ribs, left rotation		CASSETTE SEAL	Integrated sealing system: oil seal, wear sleeve and dust protection in one unit
	A - RD	Sealing lip with hydrodynamic ribs, right rotation		RADIASEAL	Rotary shaft seal with fabric reinforced outer diameter
	A - WD	Sealing lip with bi-directional hydrodynamic ribs		SPLITRING	Rotary shaft seal only rubber, split
	ASX7	Waved rubber covered O.D., metal insert, sealing lip with garter spring, with or without dust lip		DINA Seal Metal OD	Rotary shaft seal for needle bearing applications, without spring
	A - EC	End covers		DINA Seal Waved OD	Rotary shaft seal for needle bearing applications, without spring
	A - TE	Rubber covered I.D. and sealing lip on O.D.		C64D	Rotary shaft seal for heavy industry

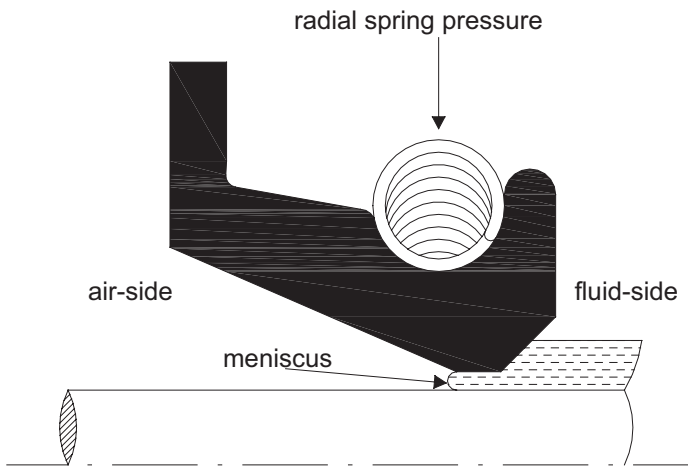
Technical data

Description of rotary shaft seal



Working principle

The area between the sealing edge and the shaft is the most important. The sealing effect is achieved by preloading the sealing lip, making its internal diameter slightly smaller than the shaft diameter. The garter spring ensures constant mechanical pressure and maintains the radial force to the shaft, flattening the sealing edge to a defined width. Sealing is provided by the surface tension of the hydrodynamic oil film between the seal flattened area and the shaft. Oil thickness must be between 1 and 3 μm to avoid leakage. The meniscus acts as an interface between the outside air and the fluid. Any break in the meniscus will result in leakage. This can occur if the shaft contains scratches along the seal path.



Metal case

The metal insert or case is used to give strength and rigidity to the seal. Normally it is made of cold rolled steel in accordance with DIN 1624.

To avoid rust or chemical attack, stainless steel can be used:

- Chrome Nickel AISI 304 (1.4301);
- Chrome Nickel Molybdenum AISI 316 (1.4401).

Garter spring

The garter spring maintains the radial force exerted by the sealing lip around the shaft surface. Normally produced in spring steel wire SAE 1074 (DIN 17223) or stainless steel wire Chrome Nickel AISI 302/304 (1.4300/1.4301).

For special applications also stainless steel springs in AISI 316 (1.4401) are available. All our standard shaft seals produced in FPM compound are fitted with stainless steel springs in AISI 302/304 (1.4300/1.4301).

Installation and operation

Shaft

The shaft surface finish is of primary importance for efficient sealing and for achieving a useful lifetime. Basically the hardness should increase with increasing peripheral speed. According to DIN 3760 minimum hardness required is 45 HRC. At a peripheral speed of 4 [m/s] the hardness should be 55 HRC and at 10 [m/s] 60 HRC. Recommended hardness depth: 0.3 [mm] if shafts are not fully hardened.

Lubrication is also very important.

Surface finish as specified by DIN 3760 must be Ra 0.2 to 0.8 [μm], Rz 1 to 5 [μm], with R_{MAX} 6.3 [μm]. Rougher surfaces generate higher friction, hence higher temperatures. Machining defects and scratches on the shaft must be avoided.

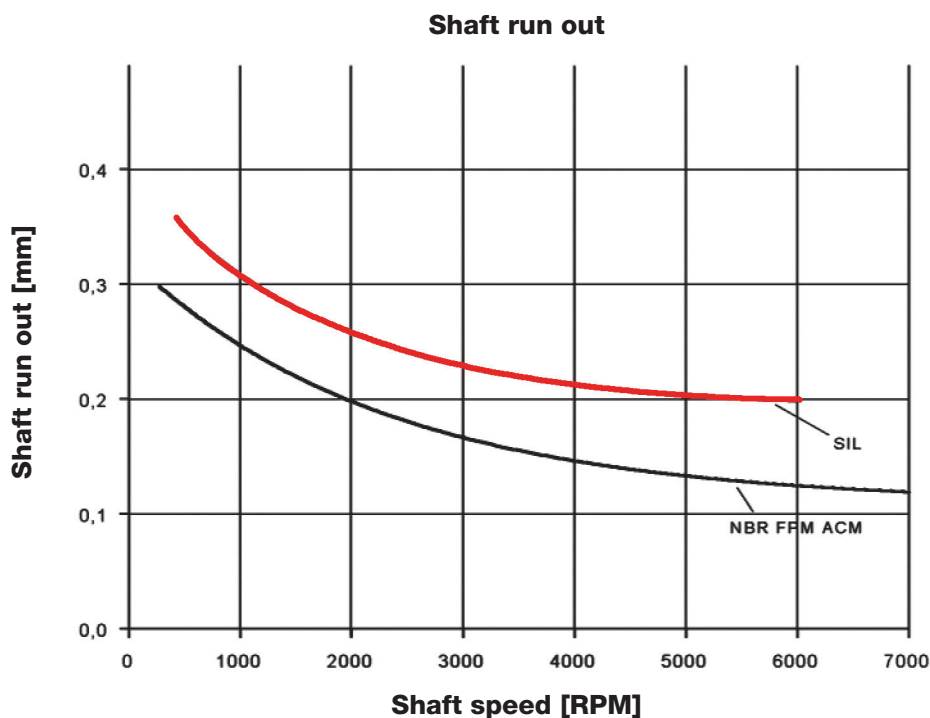
Even very small defects could be sufficient to increase the film thickness, eventually rupturing the meniscus and causing leakage. It is also important to avoid spiral grinding or marks, because they can cause a pumping effect and leakage.

Recommended machining tolerance is ISO h11 according to DIN 3760 (see table below).

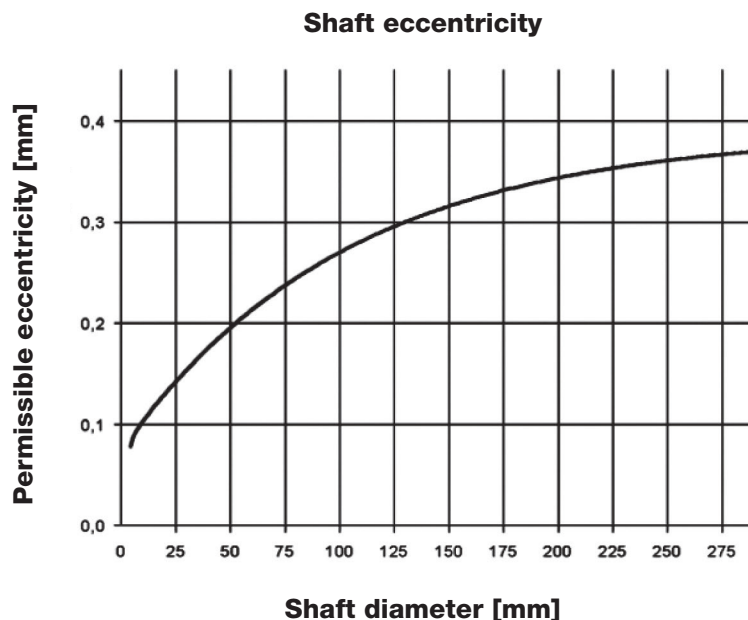
Shaft diameter [mm]		Tolerance [mm]
from	to	h11
6	10	0 -0,090
10	18	0 -0,110
18	30	0 -0,130
30	50	0 -0,160
50	80	0 -0,190
80	120	0 -0,220
120	180	0 -0,250
180	250	0 -0,290
250	315	0 -0,320
315	400	0 -0,360

Installation and operation

The best working condition is achieved when the shaft is perfectly rotating centered and concentric to the axis of the rotary shaft seal. Obviously this is not possible and inevitably some shaft run-out is always present. Therefore the sealing lip must compensate for it. The higher the rotation speed is, the smaller the permissible shaft run-out can be. This can be compensated by the sealing lip, because the inertia of the sealing lip prevents it from following the shaft movements. It is therefore advisable to install the seal immediately adjacent to the bearing where the shaft's oscillation is at its minimum.



Eccentricity between shaft and housing bore centers must be avoided as much as possible so as to reduce unilateral load (wear) of the sealing lip.



Housing bore

A good press fit of the shaft seal into the housing bore is vital.
The result is a stable installation.

Recommended machining tolerances of the housing bore diameter for rotary shaft seals are ISO H8 according to DIN 3760 (see table below).

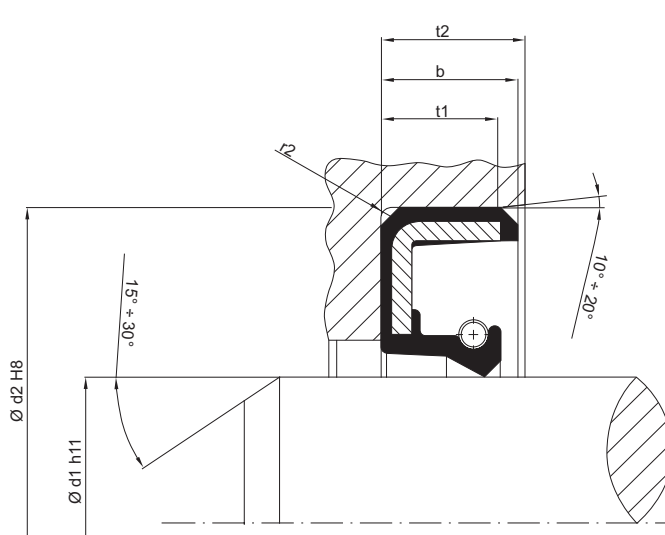
Housing bore [mm]		Tolerance
from	to	H8
10	18	+0,027 0
18	30	+0,033 0
30	50	+0,039 0
50	80	+0,046 0
80	120	+0,054 0

Housing bore [mm]		Tolerance
from	to	H8
120	180	+0,063 0
180	250	+0,072 0
250	315	+0,084 0
315	400	+0,089 0
400	500	+0,097 0

The maximum surface roughness of the housing according to DIN 3760 is Ra 1.6 to 6.3 [µm], Rz 10 to 20 [µm], with R_{MAX} 25 [µm].

We recommend the use of a shoulder or a spacer ring against which the seal can be installed. Should this not be possible the installer has to pay special attention that the seal is installed perpendicularly to the shaft axis.

To ease installation the entrance of the groove should have a chamfer inclined by 10° - 20° and a depth according to the ring thickness (see figure below). Also the mounting end of the shaft should have a chamfer inclined by 15° - 30°, with rounded and polished edge.



b [mm]	t1 [mm] (0.85*b)	t2 [mm] (b+0.3)	r2 [mm]
	min.	min.	max.
7	5,95	7,3	0,5
8	6,8	8,3	
10	8,5	10,3	
12	10,2	12,3	0,7
15	12,75	15,3	
20	17	20,3	

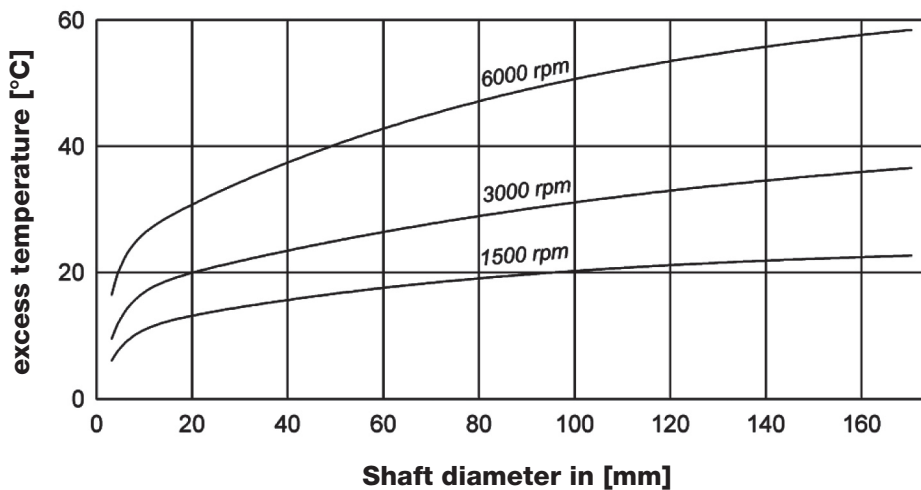
Lubrication

Lubrication is essential for good functioning and lifetime of the seal. The sealing lip does not actually run on the shaft directly, but on an oil film called meniscus. The thickness of the meniscus is usually between 1 - 3 μm , but is influenced by many factors such as oil viscosity, shaft surface finish, seal radial load and other mechanical parameters.

The first few hours of operation are called the «bedding-in» time. This is necessary not only for the meniscus to form, but also for the sealing edge to flatten. During this time limited leakage is possible.

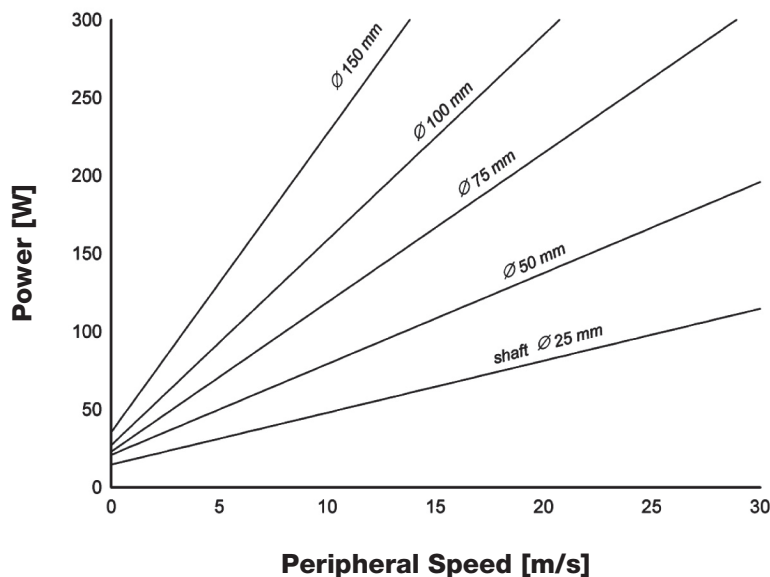
Adequate lubrication strongly reduces friction between sealing lip and shaft and also acts as a coolant to the generated heat. The lower the temperature can be kept, the longer the life expectancy of the seal will be. Should the fluid have poor lubricating capability (water and aqueous solutions), dust lip-type (AS, BS or CS) rotary lip seals must be used. In such a case make sure to fill the space between the two lips with grease. The friction heat also depends on the peripheral speed of the shaft.

Sealing lip frictional heat



Friction not only can be detrimental to the lip material, but also can cause a power loss which could be quite significant if low power is transmitted.

Frictional power loss



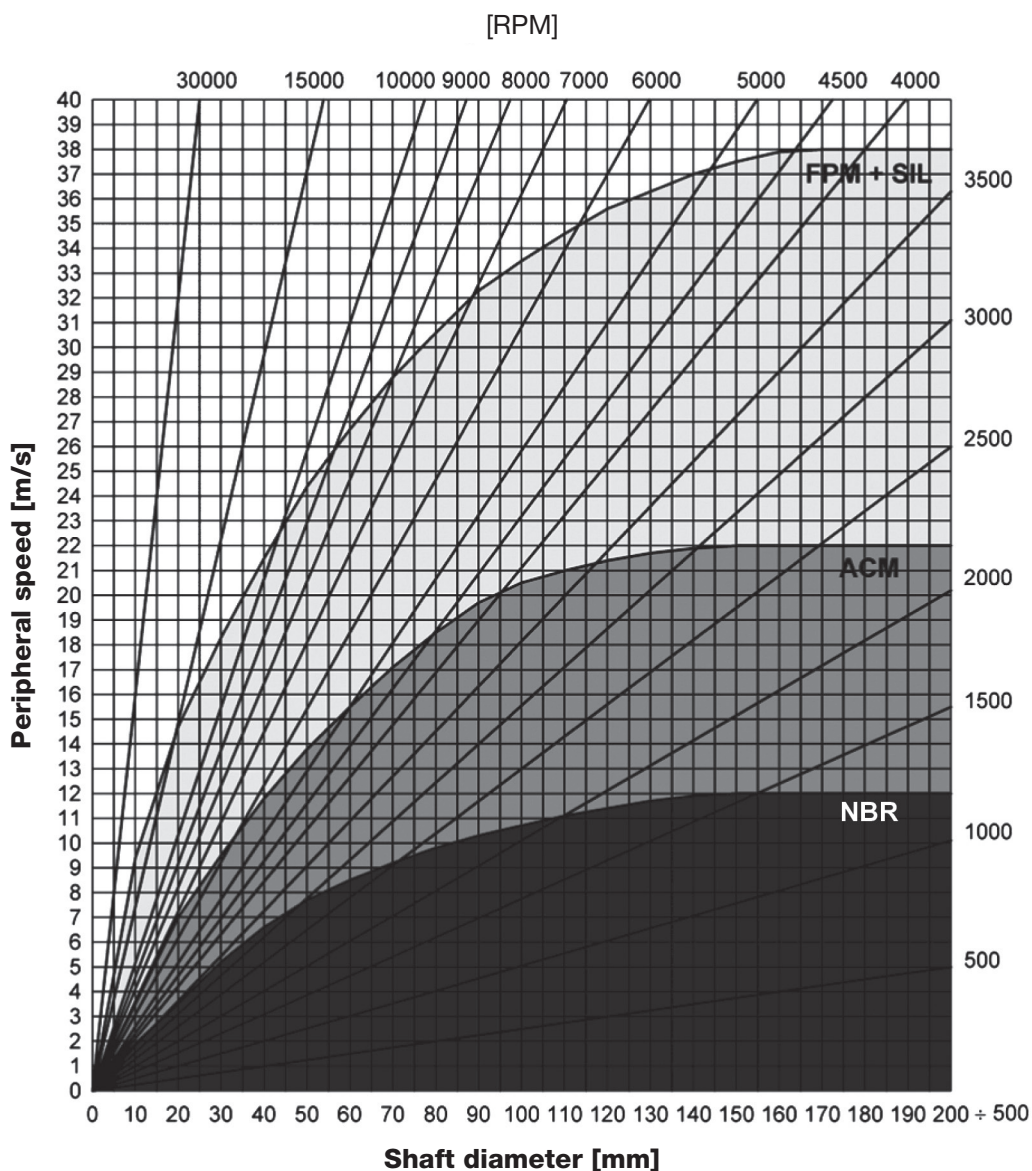
Temperature

The temperature measured on the sealing lip is the medium temperature increased by the temperature caused by frictional heat.

The higher the effective operating temperature is, the faster the ageing of the elastomer will be, thus affecting the performance of the sealing lip and the shaft.

Frictional heat depends on seal design and material, peripheral speed, sealing lip preloading, spring force, shaft design and surface finish, lubrication, medium, etc.

Permissible speeds in pressure-free state according to DIN 3760

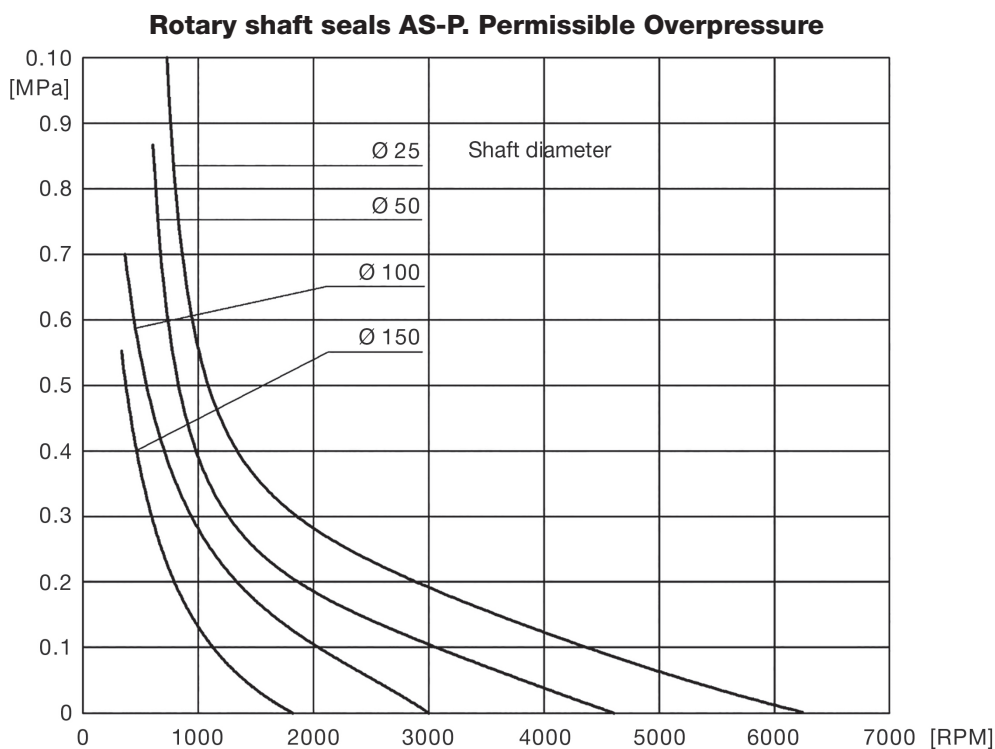


Rotary shaft seals

Pressure

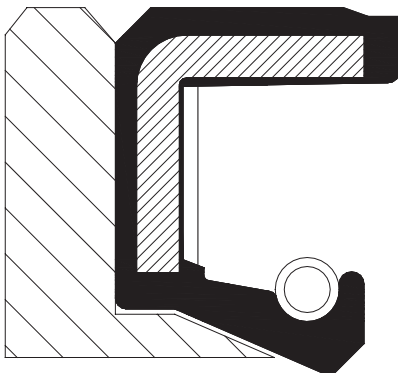
In applications where the rotary shaft seal is exposed to pressure the sealing lip is pressed against the shaft, thus increasing temperature. In some cases the pressure can even cause overturning of the sealing lip.

Over 0.02 [MPa] at higher peripheral speeds or over 0.05 [MPa] at low peripheral speeds back-up rings or special designed rotary shaft seals with stronger sealing lip and supporting metal insert must be used. For the latter we refer to our P-types (e.g. AS-P). Nevertheless permissible overpressures with P-type shaft seals are limited (see diagram below).



On request we can supply shaft seals with special reinforced lip to withstand pressure over the indicated value.

If back-up rings are installed standard rotary shaft seals can be used. However, back up rings increase costs and the necessary space for installation is often not available. Sometimes the use of back-up rings is not even possible, since it requires a very accurate housing as well as very low eccentricity of the shaft.



Specially designed rotary shaft seals (AS-P types) are therefore preferred, even if more accurate fitting and lower shaft's eccentricity than in normal cases are required.



Electromeric Sealing Materials

NITRILE RUBBER (NBR)

This elastomer is a copolymer of butadiene and acrylonitrile and is used for the majority of conventional fluid sealing applications.

- Working temperature range: about -30 [°C] to +100 [°C] (+120 [°C] maximum)
- Standard colour: black

Advantages:

- Good swelling resistance in mineral oils and greases
- Good swelling resistance in water and radiator fluid

Limitations:

- Poor resistance to high-alloyed hypoid oil
- Poor resistance to ozone, weathering and sunlight
- Not resistant to automotive brake fluid (glycol ether based)
- Poor resistance to polar fluids (ketones, ethers, esters)
- Poor resistance to chlorinated hydrocarbons (carbon tetrachloride, trichlorethylene)
- Poor resistance to aromatic hydro-carbons

FLUORO ELASTOMER (FPM)

Mostly known under the trade names VITON® from Du Pont, TECNOFLON® from Solvay and FLUOREL® from 3M. It has good chemical resistance and is recommended for high temperature applications.

- Working temperature range: -20 [°C] to + 200 [°C]
- Standard colour: brown

Advantages:

- Excellent resistance to mineral oils, greases (also with the majority of additives) and above all high-alloyed hypoid oils
- Excellent acid resistance
- Good resistance to aromatic and chlorinated hydrocarbons
- Excellent resistance to ageing, ozone and weathering

Limitations:

- Limited cold flexibility
- Poor resistance to polar fluids (ketones, ethers, esters)

SILICONE RUBBER (SIL)

Also referred to as MVQ or VMQ

- Working temperature range: -50 [°C] to + 200 [°C]
- Standard colour: red / orange

Advantages:

- Retains flexibility down to very low temperatures
- Withstands continuous heating at high temperatures without hardening
- Resistant to mineral oils and greases
- Excellent resistance to ageing, weathering and ozone

Limitations:

- Not recommended for use with aliphatic as well as aromatic hydrocarbons such as petrols and paraffin, and lighter mineral oils or steam over 0.35 [MPa]
- Not resistant to hot water (100 [°C]), acids and non-mineral automotive brake fluids
- Poor tensile and tear strength
- Poor wear resistance