Materials

Wide range of materials

Selecting the correct material combination for a shaft seal is decisive for its reliable functioning and durability. For this reason we have various standard materials and a great number of special materials for the elastomer part, the spring and the reinforcing ring to offer.

The standard materials are designed to cover a wide application range and for the large majority of applications, are available directly from stock.
For applications with special demands, we can offer you special materials which, due to their composition, are customised to fulfil your requirements.
Should there actually be an application for which no existing material composition is suitable, we will be happy to develop a suitable combination for you (minimum quantity given).

Production

The production of the materials is carried out according to predetermined, strictly monitored production processes and enables the complete traceability from the end product back to the first production step.

The decisive part of a shaft seal is the elastomer part. The term "elastomer" has its origin in the elasticity of the rubber material which can be deformed without much pressure but immediately reverts to its original shape when released. The basis of these elastomers is caoutchouc. Caoutchouc can be obtained as natural caoutchouc on plantations or as is customary for shaft seals today almost exclusively from synthetic rubber in the chemical industry.

To meet the different requirements on modern sealing materials, apart from various basic rubber materials, there are also many varying compounds. Each mixture follows a specific, defined and controlled recipe and consists, in addition of the basic caoutchouc, of fillers, softeners, vulcanizers, processing auxiliaries and other additives.

In a moulding process, the so-called vulcanisation, the finished shaft seal is produced from the rubber compound. The plastic rubber put into a mould tool on a press and subjected to pressure and heat is transformed into elastic rubber material and bonded with the reinforcing ring. The dynamic sealing edge is either ready moulded or is done afterwards in a trimming process. The last production step is the insertion of the spring in the spring groove

Overview of the materials nomenclature

Chemical designation of the basic polymer	Abbreviation acc. to	
	DIN ISO 1629	**ASTM D 1418**
Acrylonitrile-butadiene rubber	NBR	NBR
Fluoro rubber	FKM	FKM
Ethylene propylene diene rubber	EPDM	EPDM
Silicone rubber	VMQ	VMQ
Hydrogenated acrylonitrile-butadiene rubber	HNBR	HNBR
Polyacrylate rubber	ACM	ACM
	DIN EN ISO 11043-1	**ASTM D 1600**
Polytetrafluoroethylene	PTFE	PTFE

General descriptions of the materials

Acrylonitrile-butadiene rubber – NBR

Among standard seals such as O-rings and radial shaft seals, NBR is the most widely used material. The reasons for this are good mechanical properties, high abrasion resistance, low gas permeability and the high resistance to mineral oil based oils and greases.

NBR is a copolymer of butadiene and acrylonitrile. Depending on the application, the content of acrylonitrile can vary between 18% and 50%. Low ACN content improves cold flexibility at the expense of the resistance to oil and fuel. High ACN content improves the resistance to oil and fuel while reducing the cold flexibility and increasing compression set. To obtain balanced properties, our standard NBR materials have an average ACN content around 30%.

NBR has good resistance to:

- mineral oil-based oils and greases
- aliphatic hydrocarbons
- vegetable and animal oils and fats
- hydraulic oils H, H-L, H-LP
- hydraulic fluids HFA, HFB, HFC
- silicone oils and silicone greases
- water (max. 80°C)

NBR is not resistant to:

- fuels with high aromatic content
- aromatic hydrocarbons
- chlorinated hydrocarbons
- non-polar solvents
- hydraulic fluid HFD
- glycol-based brake fluids
- ozone, weathering, ageing

Application temperature range:

- Standard types -30°C to +100°C (short term 120°C)
- Special grades possible down to -50°C

Hydrogenated acrylonitrile-butadiene rubber – HNBR

HNBR is obtained by selective hydrogenation of the double bond of the butadiene molecules of the NBR rubber. With higher degrees of hydrogenation HNBR exhibits distinctly better resistance to high temperatures, ozone and ageing as well as improved mechanical properties.

The media resistance of HNBR is the same as that of NBR.

Application temperature range:

- -30°C to +150°C

Fluoro rubber – FKM

FKM materials have conquered many applications in which high thermal and / or chemical resistance is required. FKM also has excellent resistance to ozone, weathering and ageing. Very low gas permeability, FKM is recommended for vacuum applications.

FKM has good resistance to:

- mineral oil-based oils and greases
- aliphatic hydrocarbons
- aromatic hydrocarbons
- chlorinated hydrocarbons
- hydraulic fluids HFD
- vegetable and animal oils and fats
- silicone oils and silicone greases
- fuels
- non-polar solvents
- ozone, weathering, ageing

FKM is not resistant to:

- glycol-based brake fluids
- polar solvents (e.g., acetone)
- superheated steam
- hot water
- amines, alkalis
- low-molecular organic acids (e.g., acetic acid)

Application temperature range:

- -15 to +200°C short term +220°C
  down to -35°C is realistic with special grades

Ethylene propylene diene rubber – EPDM

EPDM can be used in a wide temperature range, has good resistance to ozone, weathering and ageing and is resistant to hot water and steam. Peroxide cured EPDM materials have better resistance to temperature and chemicals and obtain better compression set values than sulfur cured EPDM.

EPDM has good resistance to:

- hot water and hot steam
- many polar solvents (e.g., alcohols, ketones, esters)
- many organic and inorganic acids and bases
- washing brines
- silicone oils and silicone greases
- glycol-based brake fluids (special grades required)
  ozone, weathering, ageing

EPDM is not resistant to:

- all kinds of mineral oil products (oils, greases, fuels)

Application temperature range:

- -45°C to +130°C (sulfur cured)
- -55°C to +150°C (peroxide cured)

Silicone rubber – VMQ

Silicone materials have excellent aging resistance, oxygen, ozone, ultraviolet radiation and weathering and a very wide application temperature range with excellent cold flexibility. Silicone is physiologically harmless and therefore very good in food and medical product applications. Silicone has good electrical insulation properties and is highly permeable to gas. Due to the weak mechanical properties, silicone O-rings are preferably used in static.

Silicone has good resistance to:

- animal and vegetable oils and fats
- water (max.100°C)
- aliphatic engine and gear oils
- ozone, weathering, ageing

Silicone is not resistant to:

- silicone oils and greases
- aromatic mineral oils
- fuels
- steam over 120°C
- acids and alkalis

Application temperature range:

- -60°C to +200°C
- +230°C can be obtained by special grades

Acrylate rubber – ACM

ACM has good resistance to mineral oils with additives at higher temperatures. This makes ACM a preferred material in the automotive industry.

ACM has good resistance to:

- mineral oil-based engine, gear and ATF oils
- ozone, weathering, ageing

ACM is not resistant to:

- glycol-based brake fluids
- aromatic and chlorinated hydrocarbons
- hot water, steam
- acids and bases

Application temperature range:

- -20°C to +150°C

Polytetrafluoroethylene - PTFE

PTFE is a fluorinated thermoplastic material with many very positive characteristics for a sealing material. These include its very high thermal and almost unlimited chemical resistance. Of all the sealing materials described here, PTFE has the lowest friction coefficient, which commends the material for dynamic applications.

The pure PTFE material without fillers is physiologically safe and for this reason is also used in food-related applications and in medical technology.

PTFE with fillers is used for shaft seals.
Our type OS-W50 is produced as a complete turned piece made from PTFE carbon/graphite.
The OS-PA30. 31 and 32 types are provided with a clamped sealing lip made from PTFE glass fibre//MoS2.
Elastomer shaft seals can be provided with a thin PTFE film on the sealing lip to reduce friction (application e.g. car racing).

Application temperature range:

- -90°C to +250°C

Standard-materials for shaft seals

Material	Types	Hardness [Shore A]	Hardness [Shore D]	Colour	Application temperature range [°C]
NBR	Standard with elastomer sealing lip	70	-	black	-40 to +100
FKM	Standard with elastomer sealing lip	80	-	brown	-30 to +200
NBR	OS-N21	80	-	blue	-40 to +100
NBR	OS-G12	70	-	green	-40 to +100
PTFE carbon/graphite	OS-W50	-	62	black	-30 to +200 (limited by FKM O-ring in OS-W50)
PTFE glass fibre/ MoS2	OS-PA30 OS-PA31 OS-PA32	-	-	grey	-90 to +250

Special materials for shaft seals

Material	Types	Hardness Shore A]	Colour	Application temperature range [°C]
NBR anti-friction graphite	for all types with elastomer sealing lip, on request	70	black	-40 to +100
NBR anti-friction MoS2		70	black	-40 to +100
NBR food grade		70	black	-40 to +100
NBR high-temperature grade		70	black	-30 to +120
NBR high nitrile		70	black	-30 to +100
NBR low-temperature grade		70	black	-50 to +90
HNBR		70	black	-40 to +140
Silicon VMQ		70	red	-50 to +200
ACM		70	black	-20 to +150
EPDM		70	black	-40 to +140

We will be happy to offer you other material compounds in different hardnesses, colours and compositions, on request.

Spring materials

Type	Material Unalloyed spring steel wire according to DIN EN 10270-1	Stainless steel 1.4301 (SAE 30304)	Stainless steel 1.4571 (SAE 30316)
Standard	X	on request	on request
OS-F10 in FKM OS-F11 in FKM	–	X	on request
OS-W50 OS-W51	–	–	X

On request standard shaft seals can also be provided with stainless steel springs.

Application of spring materials

Medium	Material Unalloyed spring steel wire according to DIN EN 10270-1	Stainless steel 1.4301 (SAE 30304)	Stainless steel 1.4571 (SAE 30316)
Oils and greases	X	X	X
Water	–	X	X
Salt water	–	–	X

Case materials

Bauform	Werkstoff Unalloyed steel according to DIN EN 10139	Stainless steel 1.4301 (SAE 30304)	Stainless steel SAE 30316
Standard	X	on request	on request
OS-PA30 OS-PA31 OS-PA32	on request	–	X

On request standard types can also be provided with stainless steel cases.
Alternatively, the case can be fully covered with elastomer on one side or both sides.