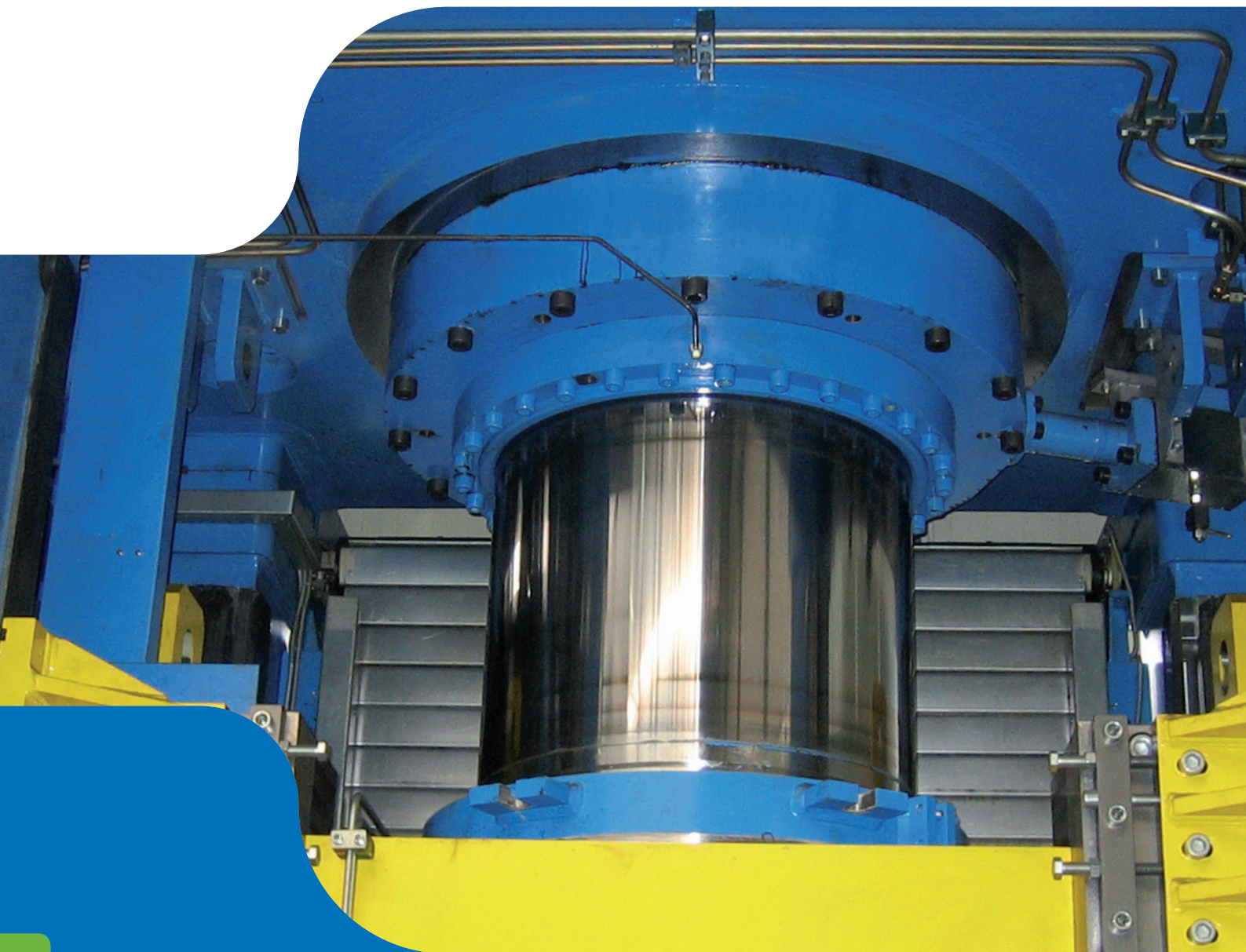


Sealing solutions for the machine tool industry

Customized machined seals and engineered plastic parts



Sealing solutions customized



for your system performance

SKF is a supplier of top quality, highly reliable products to the machine tool industry. Customers benefit from SKF's comprehensive field experience and extensive knowledge in the sealing technology for cutting and forming machine tools.

Optimized sealing solutions

SKF helps customers to achieve their strategic goals:

- Improved safety at work
- Increased productivity
- Reduced effects of contamination
- Increased service life
- Reduced Total Cost of Operation (TCO)
- Reduced operating media and energy consumption
- Increased Mean Time Between Failures (MTBF)

SKF provides the most flexible options for the machine tool industry: sealing solutions and Advanced Engineered Plastic Parts (AEPP) for wet, abrasive and contaminating environments in cutting and forming machines.

Competences

SKF is a leading supplier for standard and custom engineered sealing solutions. Based on many years of experience, especially in the area of cutting and forming machines, SKF is able to support the machine tool industry with

- on-site solution analysis,
- application engineering,
- material development for high speed solutions, increased wear resistance, reduced friction etc.



- integrated solutions consisting of seals and advanced engineered plastic parts,
- just-in-time availability of standard seals and customized sealing solutions,
- moulded seals for higher volume orders.
- Gaskets for flange connections
- Static seals and O-rings
- Advanced engineered plastic parts

Customers benefit from flexibility and short delivery times for customized seals. SKF machined seals are always made from high-performance materials and cover the following product groups:

- Hydraulic and pneumatic sealing systems
- Sealing solutions for rotary distributors and joints
- Radial shaft seals
- V-rings

Finding the most suitable sealing solution is a complex and rewarding task. SKF's experience shows that a sealing system can always be optimized.



The right sealing solution for extreme conditions

Whenever reduced maintenance costs, increased productivity or process reliability are important – SKF is there with improved machined sealing solutions for the machine tool industry.

The following points are essential when selecting the right seal for the harsh operating conditions of the machine tool industry.

Operating environment

The purpose of sealing is to keep operating fluids or lubricants in the system and/or contaminants out.

Aggressive contamination can be a concern. Abrasive particles like chips or material dust, cooling fluids or emulsions may affect the sealed machine part.

Fluids

Fluids affect the sealing system in many ways. The sealing material has to be compatible with internal or external fluids. Those could be lubricants, coolants, operating media in a hydraulic system, but also auxiliary cleaning or assembly media.

Operating parameters

Impact of type, speed and duration of the motion on the sealing lip is critical. Motion can be linear, rotating or pivoting, continuous or discontinuous. Operating pressures as well as possible system and application related pressure peaks are also to be considered.

Elevated temperatures may also affect the seal and its performance. In most cases, media temperature and motion speed determine the actual temperature at the sealing lip, but an elevated ambient temperature can also affect the performance of the seal.

Machine design

The operating fluid determines the seal selection in rotating as well as in reciprocating equipment.

In rotating equipment, the machine can be lubricated with grease, oil, or oil-air. In a reciprocating application, the operating fluid can be hydraulic oil, water-based fluid or compressed air.

Shaft misalignment must be considered when choosing the sealing lip design for rotating applications. Shaft-To-Bore Misalignment (STBM) and Dynamic Run-Out (DRO) are also relevant. For large sized reciprocating machines, the rod misalignment may also be of concern. The structural condition of the seal's counterface strongly affects the sealing performance.

Housing design and its structural condition determine the seal design. Open housings require a self-retaining sealing solution. Closed housings provide a perfect fit for elastomeric seals. SKF supplies customized seals for standard and non-standard housing dimensions.

Improvement potentials

Finally, the most important indicators for possible improvements are the existing seal performance and the reasons for seal failure and /or necessary seal replacement.

The seal's performance can affect productivity, process reliability, MTBF and maintenance schedules. Optimizing a sealing solution can be a complex task. SKF applies its experience to customers' specific operating environment to jointly identify system optimization and cost saving potentials (in terms of TCO) generated by an optimized sealing solution.





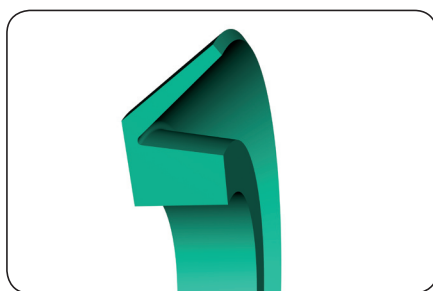
Machined seals – the flexible concept

SKF is a leading player in the global custom-made machined seals market, specializing in complete sealing services for cutting and forming machine tools. SKF serves many countries worldwide with its global sales network.



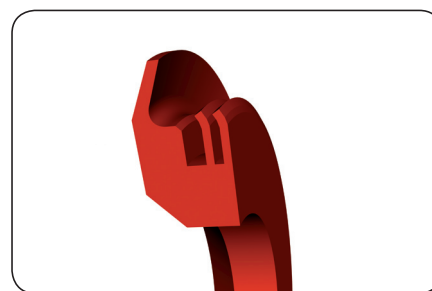
Standard seals

- Seals in standard dimensions
- Extensive range of materials
- On-time availability



Customized seals

- Standard seal profiles modified to specific requirements
- Virtually unlimited dimensions
- Extensive range of materials
- On-time availability (approx. 24 hours)



Custom engineered seals

- Application engineering service
- Customer related designed sealing solutions
- Virtually unlimited dimensions and profiles
- Extensive range of materials
- Short delivery time

Due to the flexible production process, SKF can supply standard and special seals in customized dimensions and high performance sealing materials up to 4 000 mm in diameter as one piece. Large seals with diameters up to 10 000 mm and above are assembled using a special welding technique. SKF's machined seals competence centers provide global availability with truly local service, being very close to the end customer. In some selected locations you can also find:

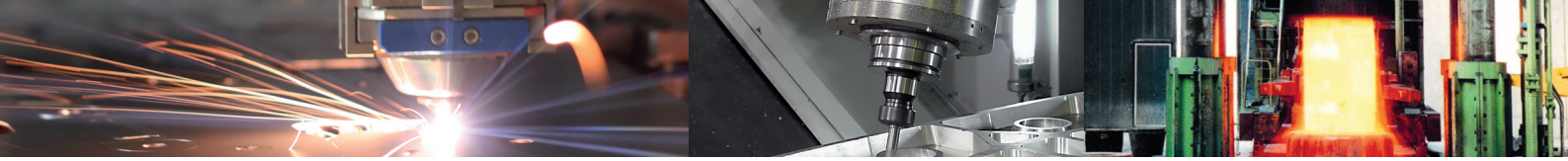
Advanced engineered plastic parts

Turned, milled and moulded parts, made of high performance plastic materials.

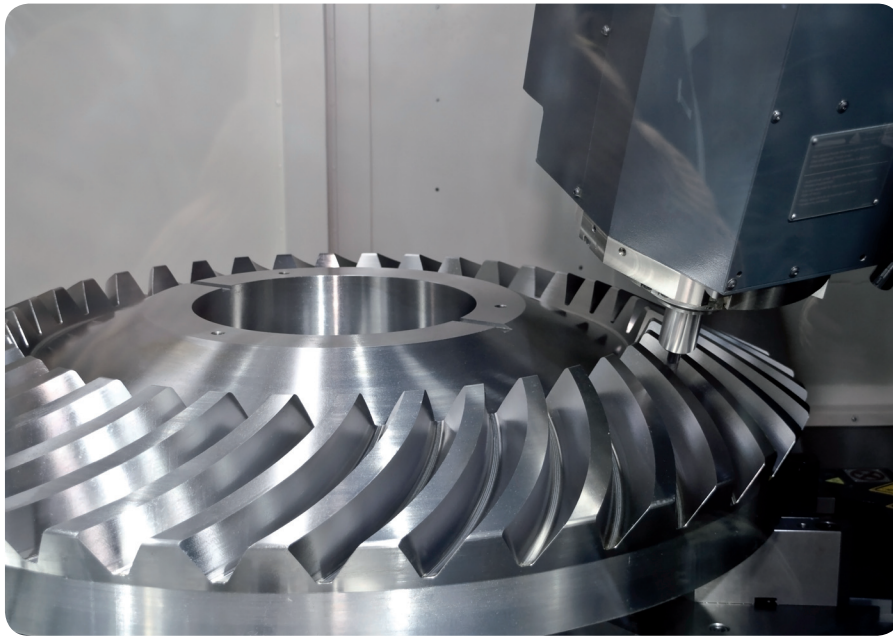
Other business and services

Maintenance and repair of hydraulic and pneumatic cylinders; gaskets and products manufactured using water-jet cutting technology.



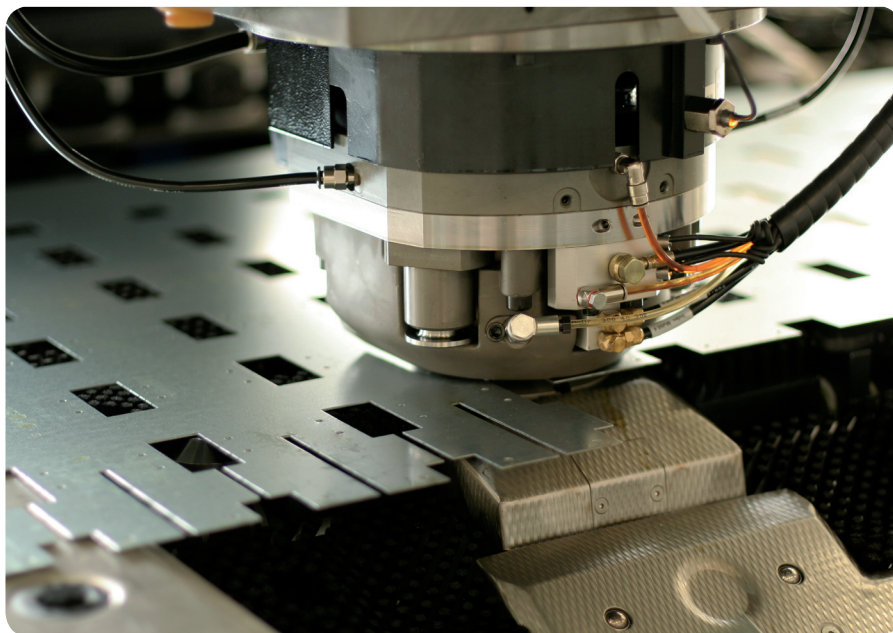


Machine tools



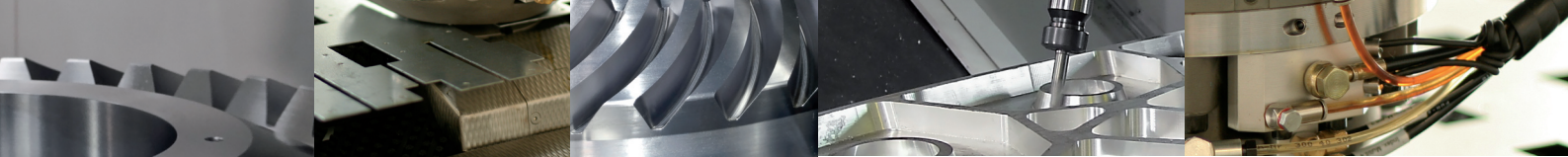
Cutting machines

- Machining centres
- Transfer
- Turning
- Drilling
- Boring
- Milling
- Grinding
- Honing
- Lapping
- Gear cutting
- Sawing



Forming machines

- Presses
- Hammers
- Bending
- Folding
- Shearing
- Punching
- Notching
- Forging
- Wire working



Cutting

Seals for rotary distributors

Rotary distributors or rotary joints regularly rotate at low speeds compared to spindles and have to operate at high pressures (up to 300 bar).

Dynamic seals for applications with rotating or pivoting movements within a rotary distributor have to handle different fluid pressure levels. To ensure positioning accuracy, it is very important to have sealing solutions available with low friction and minimum stick-slip tendency. The seals have to cope with a wide range of media (hydraulic oil, water, air, coolants, lubricants, etc.) and have to provide high wear resistance in order to achieve a long service life.

In one particular case, a modified rotary seal made of hard grade XS-ECOPUR outperformed the previously used PTFE-solu-

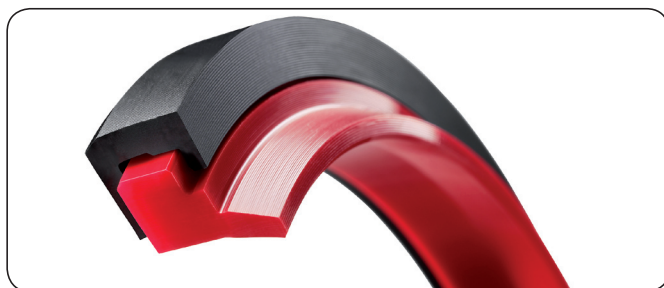
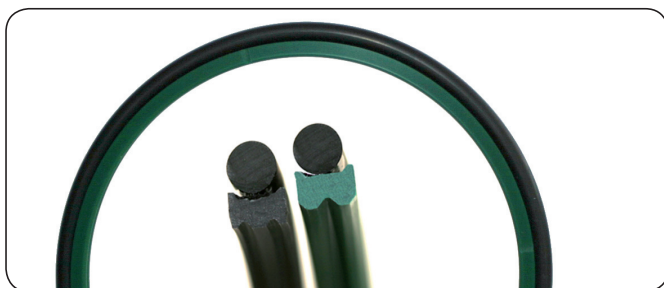
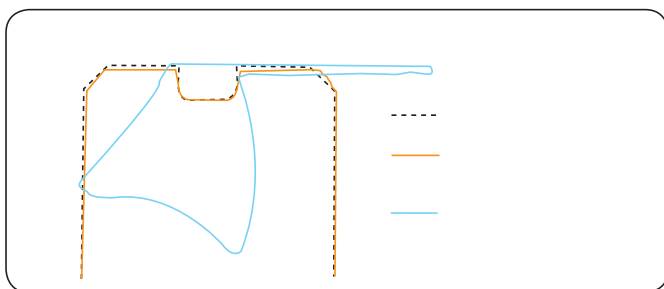
tion in wear resistance and sealing effectiveness. This resulted in a longer service life (more than 100 000 load cycles, compared to 60 000 previously experienced with a PTFE-solution). As shown below, only a very slight tendency to gap extrusion occurred. The achieved low friction at high pressure level resulted in a low temperature generation. In addition, the material is chemically resistant to all relevant fluids.

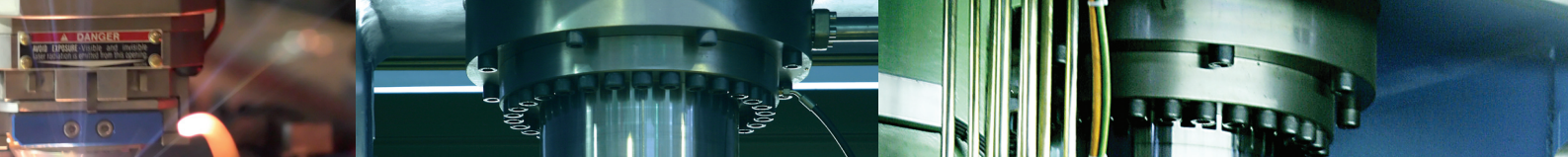
Seals for rotary tables

Rotary tables or indexing tables have to offer short cycle times and high precision indexing, even when transporting heavy loads. In that application, the seals have to provide low friction and low wear and have to be available in diameters exceeding 600 mm.

For this application, chemical resistance against coolants and lubricants is a must. SKF's special G-ECOPUR Polyurethane used as a base material for machined large diameter seals (up to 4 000 mm in one piece) provides excellent chemical and wear resistance as well as low friction.

SKF specially designed sealing solutions meet all the customer's requirements of reducing machine downtime and minimizing TCO.





Forming

Seal for forging presses

Dismantling large scale machinery for the replacement of seals is time consuming and related downtime costs are considerable.

In one case, a standard rubber fabric seal at the main cylinder had to be replaced. SKF has developed a procedure that allows the welding of large diameter polyurethane seals on site maintaining the full sealing capacity. For SKF, installing replacement seals is a common process that allows customers to keep production downtime to an absolute minimum.

Seals for ceramic powder presses

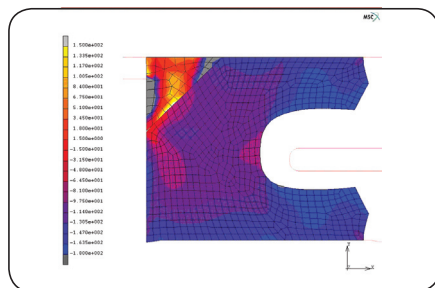
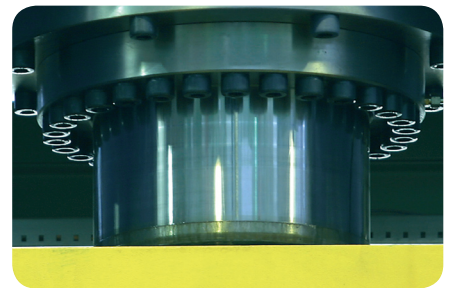
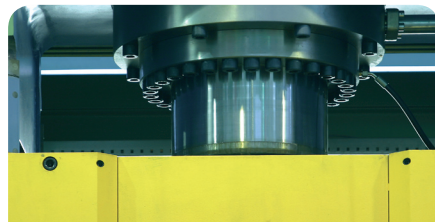
In the press technology sector, there are presses, which use pressures up to 3 000 bar and more in order to reach necessary forming forces with compact unit dimensions. Hot and cold iso-static presses and presses for sheet metal forming are just two common examples.

In one special case, SKF was challenged with the deflection of the cylinder, combined with the changing properties of the sealing material at ultra high pressure. Based on a Finite Element Analysis (FEA) for design and seal geometry optimisation, a sealing solution for these challenging conditions was introduced, which greatly increased the number of pressing cycles.

Seals for wood chipboard presses

To maintain a continuous operating process without unplanned downtimes, each machine component, even a simple seal, has to meet the highest performance expectations.

In this particular case, a customer required a sealing solution for a wood chipboard press. The hydraulic system of the press was operated with a water based fluid (HFA-E), which caused a lack of lubrication at the sealing surface. Combined with heavy loads at the sealing surface, these conditions may have led to extreme wear and reduced lifetime of the seals. By introducing the appropriate sealing profile, together with the high performance, wear resistant sealing material G-ECOPUR, SKF increased the lifespan of the seal from an average of 90 days to more than one year.



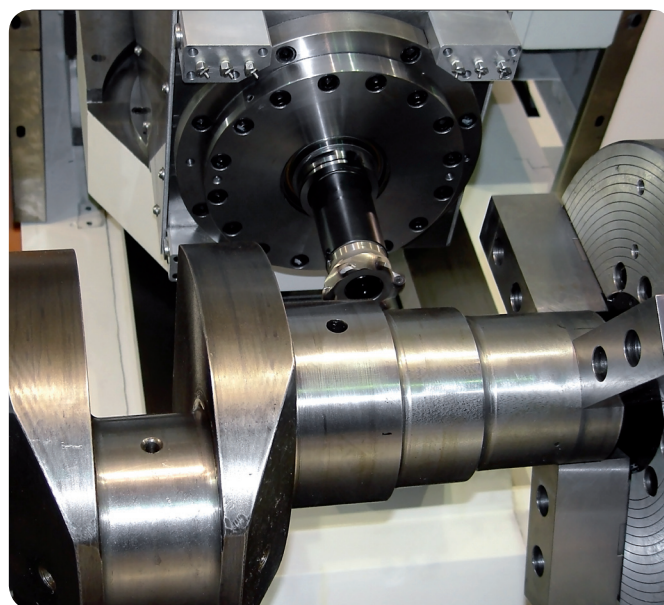


Optimized for your system performance

With more than 100 years of experience, SKF provides advanced sealing solutions and meets the requirements of applications and processes for the cutting and forming machine tool industry. This focus has led to the development of new, reliable products and materials specifically engineered, designed and optimized for your system performance.

After a detailed study of the customer's operation and needs, SKF will check its comprehensive list of standard products to find a suitable solution; alternatively, SKF can engineer customized solutions.

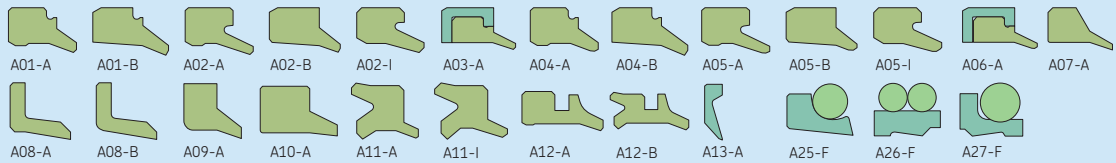
The unique SKF total service approach provides a solution with considerable advantages over conventional arrangements. With the SKF SEAL JET system, SKF supplies seals in a wide range of different sizes and offers cost-effective sealing solutions on demand – without any tooling costs or delays.



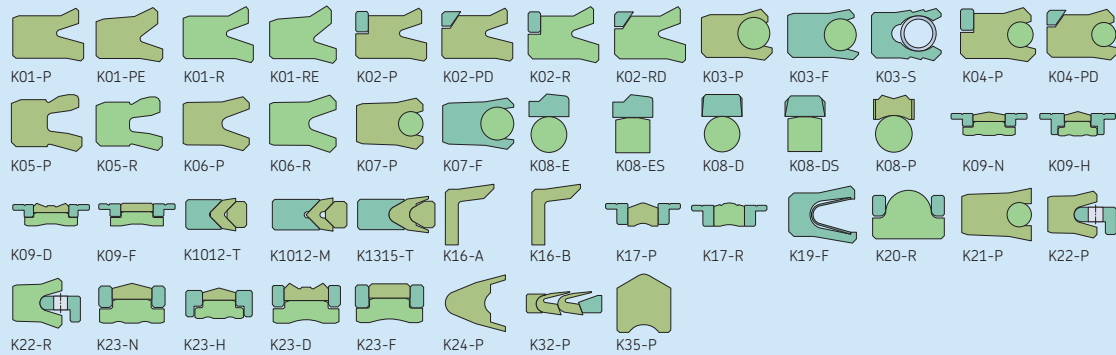


Standard machined seal profiles

Wipers



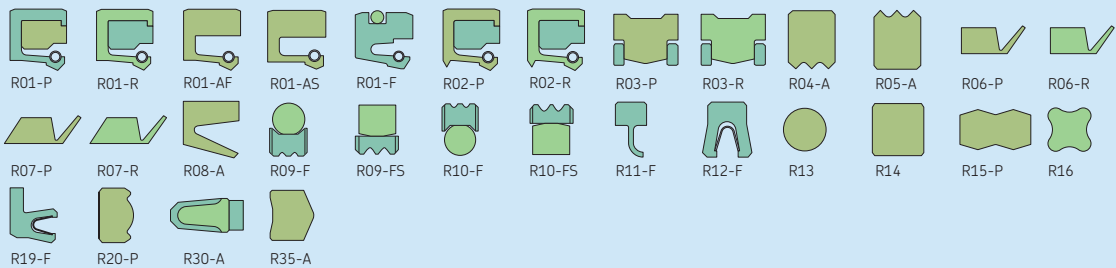
Piston seals



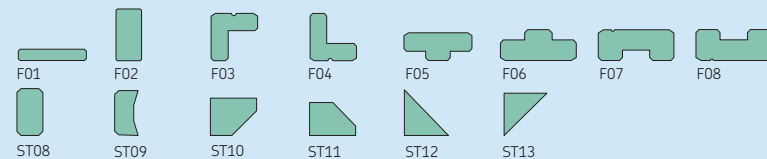
Rod seals



Rotary seals

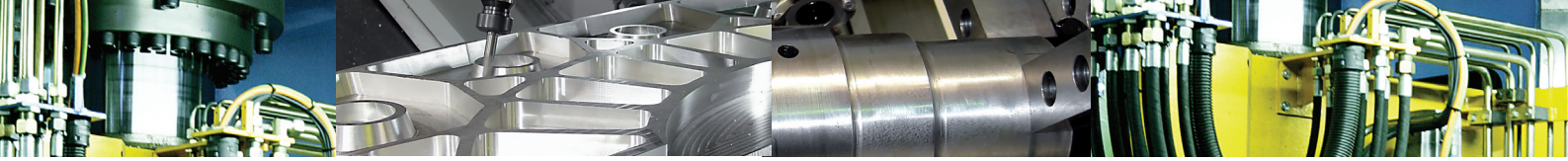


Guide and backup rings



O-rings and static seals





Advanced engineered plastic parts

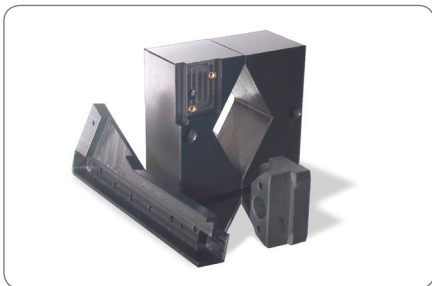
High performance plastic materials work at temperatures above +150 °C without any substantial change to their mechanical properties. For the machine tools industry, SKF offers machined plastic products made of these high performance polymers as well as standard thermoplastics.

SKF produces all seals and advanced engineered plastic parts as a single item, in small quantities, or larger quantities up to a couple of thousand, using machining or milling techniques.

So, whether prototypes or weight reduction or high performance products are needed, please contact our application engineers, who can advise you on the best possible solution for your application.

Typical materials for AEPP

- Polyethylene with high or ultra high molecular weight (HMWPE, UHMWPE)
- Polyurethane (TPU, CPU)
- Polyoxymethylene (POM)
- Polyamide (PA)
- Polyethylene terephthalate (PETP)
- Polycarbonate (PC)
- Elastomers (NBR, H-NBR, FPM, FKM, EPDM, MVQ)
- Polyvinylidene fluoride (PVDF)
- Polyphenylenesulfide (PPS)
- Polytetrafluoroethylene (PTFE)
- Polyetheretherketone (PEEK)
- Polysulphone (PSU)
- Polyetherimide (PEI)
- Polyphenylsulphone (PPSU)
- Polyamide Imide (PAI)
- Polyimide (PI)
- Polybenzimidazole (PBI)



Clamping unit, SKF Ecomid

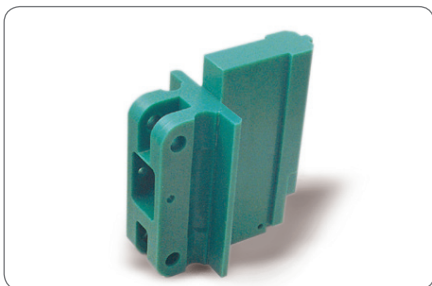


Gripper parts, XH-ECOPUR

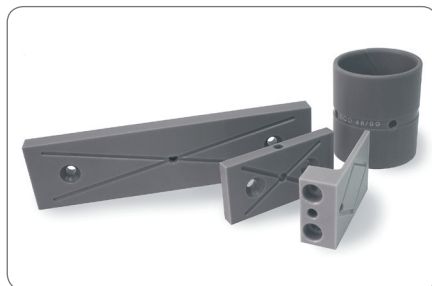


Special parts according to customer design specifications, SKF Ecopek

Sliding parts, SKF Ecowear



Sliding elements, SKF Ecomid



Lid module, SKF Ecorubber-3 + SKF Ecoflas



Sealing materials

Polyurethanes

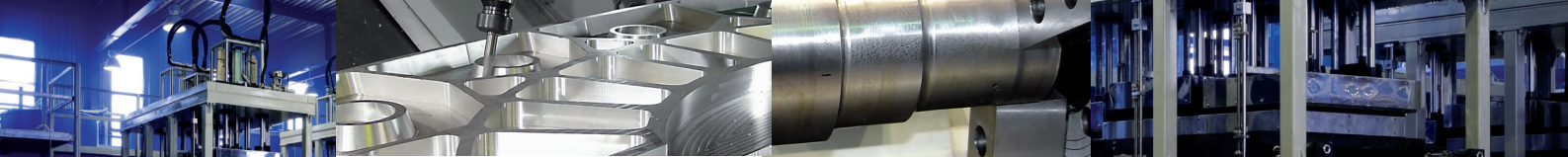
SKF has developed many high performance sealing materials. In particular, the polyurethanes have outstanding mechanical properties which outperform many other elastomeric sealing materials (like rubbers). Possible application limits are chemical resistance and in some cases, very high temperatures. For further information, please contact SKF competence centres for machined seals.

Material		Colour	Properties
ECOPUR	(TPU/TPE-U, 95 Shore A)	Green	Recommended for hydraulic applications, good chemical resistance
H-ECOPUR	(TPU/TPE-U, 95 Shore A)	Red	Outstanding chemical resistance against water-based fluids
S-ECOPUR	(TPU/TPE-U, 95 Shore A)	Grey/black	Outstanding sliding performance, similar mechanical and chemical properties to H-ECOPUR
T-ECOPUR	(TPU/TPE-U, 95 Shore A)	Blue	Low temperature grade, excellent cold flexibility, limited chemical resistance
G-ECOPUR	(CPU, 95 Shore A)	Red	Hydrolysis-resistant cast polyurethane elastomer (CPU) with similar properties to H-ECOPUR.
X-ECOPUR	(TPU, 57 Shore D)	Dark green	Increased pressure and extrusion resistance, recommended for composite seals, chemical resistance similar to ECOPUR
XH-ECOPUR	(TPU, 60 Shore D)	Dark red	Increased pressure and extrusion resistance, recommended for composite seals, chemical resistance similar to H-ECOPUR
XS-ECOPUR	(TPU, 57 Shore D)	Dark grey	Increased pressure and extrusion resistance, recommended for composite seals, chemical resistance similar to H-ECOPUR, outstanding sliding performance

Elastomers

High quality rubber standard grades with the commonly known features of elastomeric materials, good chemical resistance, but limitations in mechanical properties. For further information, please contact SKF competence centres for machined seals.

Material		Colour	Properties
SKF Ecorubber-1	(NBR, 85 Shore A)	Black	Standard grade, good chemical resistance
SKF Ecorubber-H	(HNBR, 85 Shore A)	Black	Standard grade with good mechanical and chemical properties
SKF Ecorubber-2	(FKM, FPM, 85 Shore A)	Brown	Standard grade with good chemical resistance
SKF Ecorubber-3	(EPDM, 85 Shore A)	Black	Standard grade with good mechanical properties, recommended for steam injection
SKF Ecosil	(MVQ, 85 Shore A)	Reddish brown	Silicone rubber with high resistance against weathering, ozone and ageing
SKF Ecoflas	(TFE/P, 83 Shore A)	Black	Fluoro-elastomer with outstanding resistance to hot water and steam



Thermoplastics and special materials ¹⁾

Thermoplastics and special glassfibre reinforced materials with outstanding mechanical properties. For further information, please contact SKF competence centres for machined seals.

Material		Colour	Properties
SKF Ecomid	(PA)	Black	Standard grade with good mechanical properties (glass filled grades for increased pressure resistance are also available) NOTE: Not to be used in water or moist environments.
SKF Ecotal	(POM)	Black	Standard grade with good mechanical properties (glass filled grades for increased pressure resistance are also available)
SKF Ecopaek	(PEEK)	Cream/black	Exceptional mechanical, chemical and thermal resistance
SKF Ecotex	(fabric reinforced material on polyester resin base)	Light orange	High wear and pressure resistance

PTFE and its compounds ²⁾

Top performance PTFE compound materials with highest chemical and temperature resistance, optimized for sealing applications. For further information, please contact SKF competence centres for machined seals.

Material		Colour	Properties
SKF Ecoflon 1	(PTFE, virgin)	White	High chemical resistance
SKF Ecoflon 2	(PTFE, 15% glass, 5% MOS2)	Grey	Good mechanical properties
SKF Ecoflon 3	(PTFE, 40% bronze)	Bronze	Good tribological properties, high pressure resistance
SKF Ecoflon 3F	(PTFE, 40% bronze)	Green	Outstanding extrusion resistance, other properties compatible with SKF Ecoflon 3
SKF Ecoflon 4	(PTFE, 25% carbon)	Black	High wear and pressure resistance
SKF Ecoflon 5	(PTFE, modified)	White	Unfilled modified grade to increased pressure and creep resistance

¹⁾ SKF also offers a wide range of individual thermoplastic materials specially designed for guide rings, backup rings, etc..

²⁾ SKF also offers a wide range of organic and inorganic compounds, such as PTFE + glass, PTFE + graphite (steam injection), PTFE + EKONOL, PTFE + PI, PTFE + PEEK, etc..



Properties

Polyurethanes

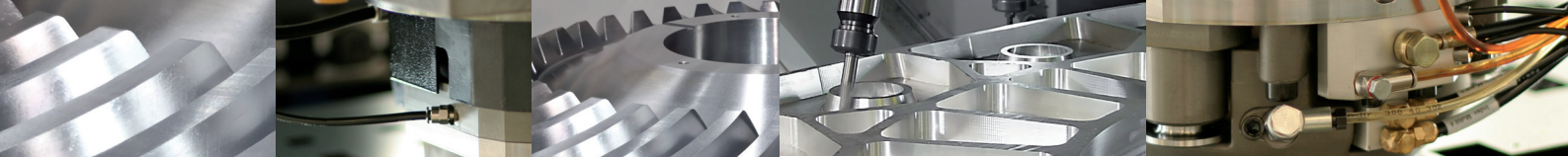
Properties	DIN	Unit	ECOPUR	H-ECOPUR hydrolysis resistant	S-ECOPUR solid lubricants	T-ECOPUR low temperature	G-ECOPUR hydrolysis resistant	X-ECOPUR hard grade	XH-ECOPUR hard grade hydrolysis resistant	XS-ECOPUR hard grade solid lubricants
			TPU	TPU	TPU	TPU	TPU	TPU	TPU	TPU
Standard colour	–	–	Green	Red	Grey/ black	Blue	Red	Dark green	Dark red	Dark grey
Durometer hardness ¹⁾	53505	Shore A	95 ±2	95 ±2	95 ±2	95 ±2	95 ±2	97 ±2	97 ±2	97 ±2
Durometer hardness ¹⁾	53505	Shore D	48 ±3	48 ±3	48 ±3	48 ±1	47 ±3	57 ±3	60 ±3	58 ±3
Density	EN ISO 1183-1	g/cm ³	1,2	1,2	1,23	1,17	1,17	1,21	1,22	1,25
Mechanical properties										
Tensile test ²⁾										
– Tensile strength ³⁾	53504	MPa	≥ 40	≥ 50	50	≥ 50	≥ 45	50	50	43
– elongation at break ³⁾	53504	%	≥ 430	≥ 330	400	≥ 450	≥ 280	400	350	350
– 100% modulus ³⁾	53504	MPa	12	≥ 13	17	≥ 12	≥ 11	21	25	25
Compression set ⁴⁾										
– after 22 h at 100 °C	ISO 815	%	–	–	–	–	–	–	–	–
– after 22 h at 175 °C	ISO 815	%	–	–	–	–	–	–	–	–
– after 24 h at 70 °C / 20% deformation	–	%	≤ 30	≤ 27	25	–	≤ 30	24	26	30
– after 24 h at 100 °C / 20% deformation	–	%	≤ 35	≤ 33	30	–	≤ 40	29	30	35
– after 70 h at 70 °C / 20% deformation	–	%	20	20	–	20	20	–	–	–
Tear strength	ISO 34-1	N/mm	≥ 100	≥ 100	120	80	≥ 40	140	170	180
Rebound resilience	53512	%	42	29	–	50	43	–	–	–
Abrasion	DIN ISO 4649	mm ³	18	17	21	15	25	18	20	29
Thermal properties										
Max. service temperature	–	°C	+110	+110	+110	+110	+110	+110	+110	+110
Min. service temperature	–	°C	–30	–20	–20	–50	–30	–30	–20	–20

¹⁾ 6,3 mm thick test specimens.

²⁾ Test specimens: Type S 2.

³⁾ Test speed: 200 mm/min.

⁴⁾ Tests were performed on discs Dia 13 × 6,3 mm. Compression rating 20% (TPUs) and 15% (elastomers). Test specimens are stored at elevated temperature in an air circulating oven for defined periods. Compression set represents the percentage of deflection, which did not return to its original shape.



Elastomers

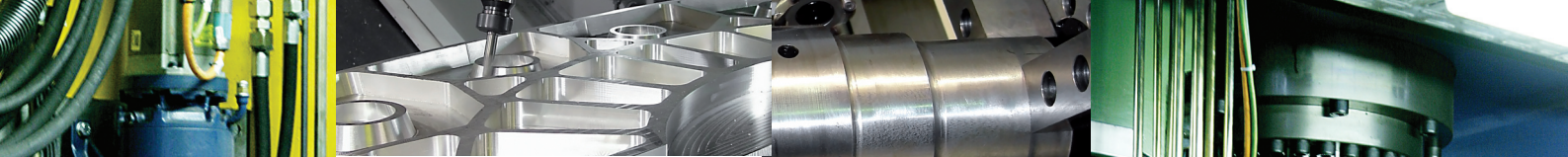
SKF Ecorubber-1	SKF Ecorubber-H	SKF Ecorubber-2	SKF Ecorubber-3	SKF Ecosil	SKF Ecoflas
NBR	HNBR	FKM, FPM	EPDM	MVQ	TFE/P
Black	Black	Brown	Black	Reddish brown	Black
85 ±5	85 ±5	85 ±5	85 ±5	85 ±5	83 ±5
36	34	34	34	34	31
1,31	1,22	2,3	1,22	1,52	1,60
≥ 16	≥ 18	≥ 8	≥ 12	≥ 7	13
≥ 130	≥ 180	≥ 200	≥ 110	≥ 130	220
≥ 11	≥ 10	≥ 5	≥ 9	≥ 5	8
≤ 15	≤ 22	–	≤ 15	–	–
–	–	≤ 20	–	≤ 15	29
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
20	30	21	15	44	–
28	29	7	38	8	19
90	90	150	120	–	110
+100	+150	+200	+150	+200	+200
–30	–25	–20	–50	–60	–10



Properties

Thermoplastics

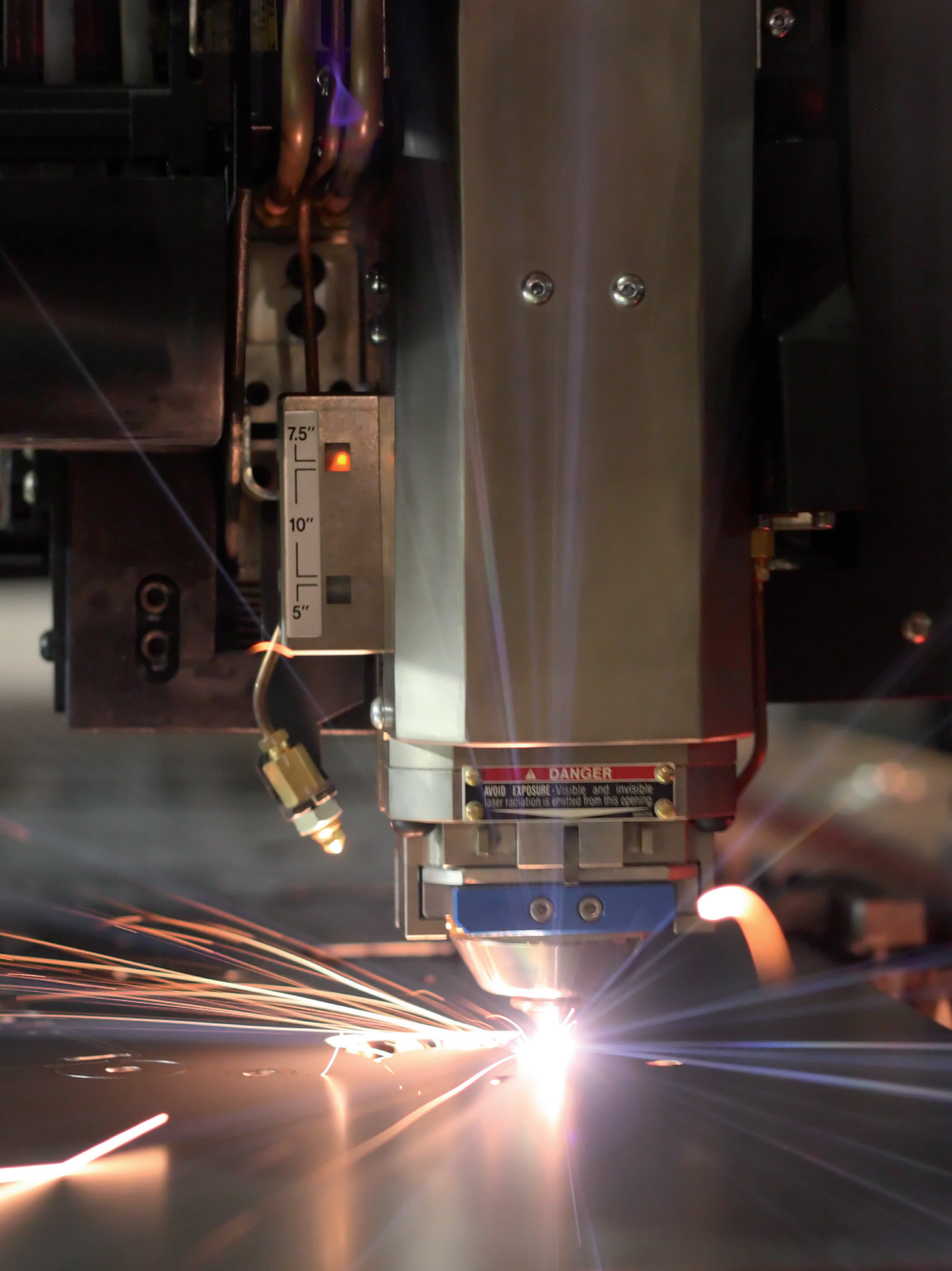
Properties	DIN	Unit	SKF Ecomid	SKF Ecotal	SKF Ecoppis	SKF Ecopaek
Standard colour	–	–	PA 6 G Black	POM-C Natural/black	PPS Beige	PEEK Cream
Density	EN ISO1183	g/cm ³	1,15	1,4	1,35	1,30
Hardness Shore D (3 s)	53505	Shore D	77	82	–	87
Ball indentation hardness ¹⁾	2039-1	N/mm ²	125	135	–	–
Water absorption						
– after 24 h immersion in water at 23 °C ²⁾	ISO 62	%	0,65	0,24	–	0,06
– at saturation in air at 23 °C / 50% RH	–	%	2,2	0,2	–	0,2
Thermal properties³⁾						
Coefficient of linear thermal expansion:						
– average value between 23 and 60 °C	–	m/m K	80 × 10 ⁻⁶	110 × 10 ⁻⁶	–	–
– average value between 23 and 100 °C	–	m/m K	90 × 10 ⁻⁶	60 × 10 ⁻⁶	126 × 10 ⁻⁶	–
– average value above 150 °C	–	m/m K	–	–	80 × 10 ⁻⁶	–
Max. allowable service temperature in air:						
– for short periods ⁴⁾	–	°C	170	140	260	310
– continuously: for 5 000/20 000 h ⁵⁾	–	°C	105/90	115/100	-/230	+260
Min. service temperature ⁶⁾	–	°C	-40	-50	-20	-100
Flammability ⁷⁾						
– oxygen index	4589	%	25	15	–	35
– according to UL 94 (thickness 1,5/3/6 mm)	–	–	-/HB/HB	-/HB/HB	V-0/-	V-0/V-0
Mechanical properties at 23 °C						
Tensile test ⁸⁾						
Tensile stress at yield / tensile stress at break ⁹⁾	527	MPa	65/-	62/-	95/-	100/-
Elongation at break ⁹⁾	527	%	120	40	15	46
Tensile modulus of elasticity ¹⁰⁾	527	MPa	1 800	2 600	3 450	3 700
Compression test						
– compressive stress a 1/2/5% nominal strain ¹¹⁾	604	MPa	26/51/92	–	–	–
Charpy impact strength – unnotched ¹²⁾	179/1eU	kJ/m ²	no break	–	–	no break
Charpy impact strength – notched ¹³⁾	179/1eA	kJ/m ²	3,5	7	–	7
Izod impact strength – notched	180/2A	kJ/m ²	3,5	7	–	6



PTFE and special materials

SKF Ecoflon 1	SKF Ecoflon 2	SKF Ecoflon 3F	SKF Ecoflon 4	SKF Ecoflon 5	SKF Ecotex fabric reinforced
PTFE White	PTFE Grey	PTFE Green	PTFE Black	PTFE White	Light orange
2,17 57	2,25 60	3,13 64	2,1 65	2,16 59	1,25
-	-	-	-	-	-
-	-	-	-	-	-
< 0,02	< 0,15	-	-	-	< 0,1
-	-	-	-	-	-
-	-	-	-	-	-
160 × 10 ⁻⁶	110 × 10 ⁻⁶	60 × 10 ⁻⁶	90 × 10 ⁻⁶	120 × 10 ⁻⁶	-
300 -260 -200	300 -260 -200	300 -260 -200	300 -260 -200	300 -260 -200	130 -120 -40
95 V-0/-	95 V-0/-	-	-	-	-
-	-	-	-	-	-
-27 300 400-700	-18 200	-22 300	-15 180	-30 360	55/- - 3 200
-8/- no break	-14/-	-	-	-	-
-	-	-	-	no break	-
16	12	-	-	-	-

- 1) 10 mm thick test specimens.
- 2) Tests were performed on discs Ø 50 × 3 mm.
- 3) The figures given for these properties are mostly derived from raw material supplier data.
- 4) Short exposure time (a few hours) in applications where no or only a very low load is applied to the material.
- 5) Temperature resistance over a period of minimum 20 000 hours. After this period of time, there is a decrease in tensile strength of about 50% compared to the original value. The temperature values given here are based on the thermal oxidative degradation, which causes a reduction in properties. NOTE: For all thermoplastics, the maximum allowable service temperature in many cases essentially depends on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- 6) Impact strength decreases with decreasing temperature; the minimum allowable service temperature is practically always determined by the extent to which the material is subjected to impact. The values given here are based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limits.
- 7) IMPORTANT: These estimated ratings derive from raw material supplier data and are not intended to reflect hazards presented by the materials under actual fire conditions. There are no UL-yellow cards available for these stock shapes.
- 8) Test specimens: Type 1 B.
- 9) Test speed: 5 mm/min.
- 10) Test speed: 1 mm/min.
- 11) Test specimens: cylinders with Ø 12 × 30 mm.
- 12) Pendulum used: 4 J.
- 13) Pendulum used: 5 J.



7.5"



10"

5"

▲ DANGER

AVOID EXPOSURE - Visible and invisible laser radiation is emitted from this opening.



Working fluids and sealing materials

Machine tools with a wide range of different working fluids may require chemical resistant sealing solutions. Due to increased safety and contamination regulations and standards, more and more combustible fluids, such as mineral oils, are replaced by fire-resistant fluids.

These fire-resistant fluids can be divided into two main groups:

- Water-based fluids and
- Synthetic fluids

The water-based fluids can be divided into fluids with high (HWB-fluids) and low (LWB-fluids) water content. The main chemical composition is summarised in **table 1**. Due to the water content of these fluids, the working temperature is limited to 60 °C to avoid equipment damage. For higher temperatures, fire-resistant fluids with a synthetic composition are available (HFD).

Generally, all fire-resistant working fluids strongly affect sealing materials and therefore the selection of the seal material must be more accurate compared to seals used in mineral oils.

SKF has many years of experience in sealing systems for these kinds of critical applications and has extensively investigated the compatibility of seals with these types of fluids. The results of these investigations and general recommendations for suitable sealing materials are summarized in **table 2**.

Table 1

Composition of water-based fluids

Category	Characterisation	Water content (%)	Non-water ingredients
HFA-E	Oil-in-water emulsion	90–98	Mineral oil, emulsifiers, stabilizers corrosion inhibitors, etc.
HFA-S	Synthetic solutions	90–98	Synthetic fluids, fluids in water antioxidants, corrosion inhibitors, detergents/dispergents
HFB	Water-in-oil emulsion	0–40	Mineral oil, emulsifiers, stabilizers corrosion inhibitors, etc.
HFC	Water-glycol solutions	35–50	Polyalkylene glycols, corrosion inhibitors, various additives

Table 2

Fluid compatibility of sealing materials

Category	Service temp. (°C)	Compatible sealing materials	
		Market standards	SKF recommendations
HFA-E	+5 to 60	NBR, HNBR and specially formulated FPM	Specially formulated polyurethanes (e.g. H-ECOPUR)
HFA-S	+5 to 60	Individual tests necessary	Specially formulated polyurethanes (e.g. H-ECOPUR), SKF Ecorubber-1/H/2/3
HFB	+5 to 60	NBR, HNBR and specially formulated FPM	Specially formulated polyurethanes (e.g. H-ECOPUR)
HFC	-20 to 60	NBR, HNBR, EPDM and MVQ	Depending on the temperature range, specially formulated polyurethanes (e.g. H-ECOPUR)

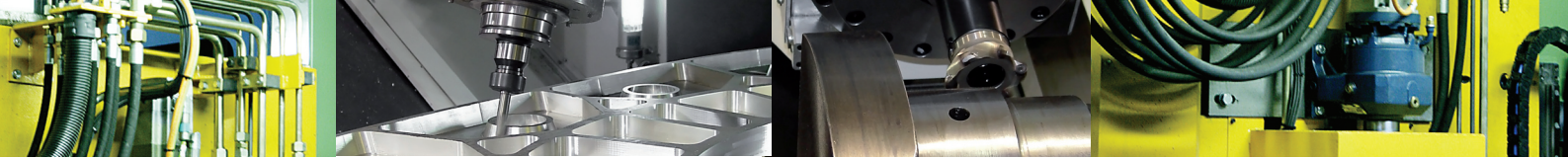


Chemical resistance

Chemical and environmental resistance ¹⁾	Temperature	Polyurethanes								Elastomers			
		ECOPUR	H-ECOPUR	S-ECOPUR	T-ECOPUR	G-ECOPUR	X-ECOPUR	XH-ECOPUR	XS-ECOPUR	SKF Ecorubber-H	SKF Ecorubber-1	SKF Ecorubber-2	SKF Ecorubber-3
Acids													
- inorganic, diluted	RT	-	+	+	-	0	-	+	+	0	0	+	+
- inorganic, concentrated	RT	-	-	-	-	-	-	-	-	-	-	+	+
- organic, diluted	RT	0	+	+	0	0	0	+	+	+	+	+	+
- organic, concentrated	RT	-	0	0	-	0	-	0	0	-	-	-	+
Alkalies													
- general	RT	-	0	0	-	0	-	0	0	0	0	0	+
Hydraulic fluids													
- mineral oil based	RT	+	+	+	+	+	+	+	+	+	+	+	-
60 °C		+	+	+	+	+	+	+	+	+	+	+	-
- synthetic oils													
HETG (triglyceride)	RT	+	+	+	+	+	+	+	+	0	0	+	-
60 °C		0	+	+	0	0	0	+	+	0	0	+	-
HEES (synthetic ester)	RT	+	+	+	+	+	+	+	+	0	0	+	-
60 °C		0	+	+	0	0	0	+	+	0	0	+	-
HEPG (polyglycols)	RT	0	+	+	0	+	0	+	+	+	+	+	+
60 °C		-	0	0	-	0	-	0	0	+	+	+	+
HEPR (polyalphaolefines)	RT	+	+	+	+	+	+	+	+	+	+	+	-
60 °C		0	+	+	0	+	0	+	+	0	0	+	-
Fire resistant fluids													
- HFA (water – oil emulsion)													
HFA-E	RT	0	+	+	0	0	0	+	+	+	+	+	-
60 °C		-	+	+	-	0	-	+	+	+	+	0	-
HFA-S	RT	0	+	+	0	0	0	+	+	+	+	+	0
60 °C		-	+	+	-	0	-	+	+	0	0	0	0
- HFB (oil – water emulsion)	RT	0	+	+	0	0	0	+	+	+	+	+	-
60 °C		-	+	+	-	0	-	+	+	+	+	+	-
- HFC (water – glycol)	RT	-	+	+	-	0	-	+	+	+	+	0	+
60 °C		-	0	0	-	0	-	0	0	+	+	-	+
Solvents													
- Toluene	RT	-	-	-	-	-	-	-	-	-	-	+	-
- Acetone	RT	-	-	-	-	-	-	-	-	-	-	-	+
- MEK	RT	-	-	-	-	-	-	-	-	-	-	-	+
Steam													
		-	-	-	-	-	-	-	-	-	-	-	+
Water													
	RT	+	+	+	+	+	+	+	+	+	+	+	+
	60 °C	-	+	+	-	0	-	+	+	+	+	+	+

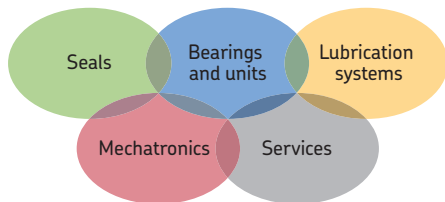
¹⁾ Rating legend:
 + Excellent
 0 Good / fair
 - Poor

IMPORTANT: The tables on this page and the next page provide valuable assistance in the choice of materials. The data listed here are within the normal range of product properties. However, they are not guaranteed, should not be used to establish material specification limits and should be used in combination with other design guidelines. Please contact SKF for additional information.



Thermoplastics

Chemical and environmental resistance	SKF Ecomid	SKF Ecotal	SKF Ecoppis	SKF Ecopaek	SKF Ecoflon 1	SKF Ecoflon 2	SKF Ecoflon 3	SKF Ecoflon 4	SKF Ecoflon 5	SKF Ecotex
Acids										
– inorganic, diluted	0	0	+	+	+	+	+	+	+	0
– inorganic, concentrated	–	–	0	–	+	0	0	0	+	–
– organic, diluted	0	0	+	+	+	+	+	+	+	0
– organic, concentrated	0	0	+	+	+	+	+	+	+	–
Alkalies										
– general	0	0	+	+	+	0	0	0	+	0
Hydraulic fluids										
– mineral oil based	+	+	+	+	+	+	+	+	+	+
– synthetic oils	+	+	+	+	+	+	+	+	+	+
HETG	+	+	+	+	+	+	+	+	+	+
HEES	+	+	+	+	+	+	+	+	+	+
HEPG	+	+	+	+	+	+	+	+	+	+
HEPR	+	+	+	+	+	+	+	+	+	+
Fire resistant fluids										
– HFA (water – oil emulsion)	+	+	+	+	+	+	+	+	+	+
HFA-E	+	+	+	+	+	+	+	+	+	+
HFA-S	+	+	+	+	+	+	+	+	+	+
– HFB (oil – water emulsion)	+	+	+	+	+	+	+	+	+	+
– HFC (water – glycol)	0	+	+	+	+	+	+	+	+	+
– HFD (water free)	+	+	+	+	+	+	+	+	+	+
Solvents										
– Toluene	+	+	0	+	+	0	+	+	+	+
– Acetone	+	+	+	+	+	+	+	+	+	–
– MEK	+	0	+	+	+	+	+	+	+	–
Steam	0	+	+	+	+	+	+	+	+	+
Water	0	+	+	+	+	+	+	+	+	+



The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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