Cutting and forming machine tools

Customised machined seals and engineered plastic parts

ECONOMOS

Contents

The SKF brand now stands for more than ever before, and means more to you as a valued customer.

While SKF maintains its leadership as the hallmark of quality bearings throughout the world, new dimensions in technical advances, product support and services have evolved SKF into a truly solutions-oriented supplier, creating greater value for customers.

These solutions encompass ways to bring greater productivity to customers, not only with breakthrough application-specific products, but also through leading-edge design simulation tools and consultancy services, plant asset efficiency maintenance programmes, and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but it now stands for much more.

SKF – the knowledge engineering company

Sealing solutions for the machine tools industry

As a supplier of top quality, highly reliable products to the machine tools industry, our customers benefit from our comprehensive field experience and extensive knowledge in the sealing technology for cutting and forming machine tools.

Our optimised sealing solutions enable our customers to achieve their strategic goals

- Improved safety at work
- Increased productivity
- Reduced effects of contamination
- Increased durability
- Reduced maintenance and downtime
- Media and energy savings

SKF Economos solutions provide the most flexible options for the machine tools industry: seals and advanced engineered plastic parts for wet, abrasive and conta-minating environments in cutting and forming machines.

SKF Economos competences

- Application engineering
- Extensive list of success stories
- Material technology
- Standard and custom engineered sealing solutions
- Advanced engineered plastic parts (AEPP)

SKF Economos is the leading supplier for standard and custom engineered sealing solutions. Our extensive knowledge in the machine tools industry is based on many years of experience in dealing with the requirements for cutting and forming machines.

SKF Economos performance

- On-site solution analysis
- Innovative custom engineered solutions
- Immediate availability of machined standard seals and customised sealing solutions
- Injection moulded seals for higher volume orders

Our customers benefit from our flexibility and our short delivery times for customised seals. SKF Economos products 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
- Oil shaft seals, V-rings
- Flat seals for flange connections
- Static seals and O-rings
- Advanced engineered plastic parts (AEPP)

Finding the most suitable sealing solution is a complex and rewarding task. Our experience shows, that there is always potential for optimisation.

The right seal for extreme conditions

Whenever reduced maintenance costs, increased productivity or process reliability matter – SKF Economos is there with improved sealing solutions for the machine tools industry.

The following points must be considered when selecting the right seal for the harsh operating conditions of the machine tools industry.

Sealing purpose

The purpose of sealing is to keep operating media or lubricants in and/or environmental contamination out of the sealed system.

Environment

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

Media

Media affect the sealing system in many ways. The sealing material has to be compatible with the sealed and environmental media. This could be a lubricant, coolant, the operating media in a hydraulic system, but also auxiliary cleaning, or assembly media.

Operating parameters

Type, speed and duration of the motion at the sealing lip are relevant. Motion can be linear, rotating or pivoting, continuous or discontinuous. Relevant are not only operating pressures, but also possible system and application related pressure peaks.

Elevated temperature 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 wiper seals, for example.

Machine design

The type of lubrication affects the seal selection for rotating equipment. The machine can be lubricated e.g. with grease, oil, or oil-air. In a reciprocating application, the operating fluid determines the seal selection. It can be hydraulic oil, water-based fluid or pneumatic.

Shaft misalignment must be considered when choosing the sealing lip design for rotation. Shaft-to-bore misalignment (STBM) and dynamic run-out (DRO) are both relevant. For large sized reciprocating machines the rod misalignment may also be of concern. The condition of the counter-surface at the point of sealing (at the sealing lip) also affects the sealing performance.

Housing design and its condition determine the seal design. Open housings require a selfretaining sealing solution.
Closed housings ensure a perfect fit for elastomeric seals. SKF Economos also supplies customised seals for non-standard housing dimensions.

Improvement potentials

Finally, the most important indicators for possible improvement potentials are the existing seal performance and the reasons for seal failure and /or necessary seal changes.

The seal's performance may affect productivity, process reliability, mean time between failure (MTBF) and maintenance schedules. Optimising a sealing solution can be a complex task. Our experience for sealing solutions and your experience in your special application, indicate the optimisation and cost saving potential (in terms of total cost of ownership – TCO) for optimised sealing solutions.

SKF Economos – your flexible partner

SKF Economos is the leading player in the global custommade machined seals market. Specialising in complete sealing service for cutting and forming machine tools, we serve many countries worldwide using our global sales network.

Standard seals

- seals in standard dimensions
- machined or injection moulded seals
- immediate availability
- extensive range of materials

Customised seals

- standard seals modified to your specific requirements
- flexible material and dimensions
- machined seals
- shortest possible delivery time (availability permitting, from 24 hours)

Custom engineered sealing solutions

- application engineering service
- flexible machined sealing solutions
- shortest possible delivery time

Due to our flexible production process, we can supply standard and special seals in customised dimensions and heavy duty sealing materials up to 4 000 mm in diameter as one piece and larger using our welding technique. Our manufacturing concept provides a truly local service, being very close to the end customer. Our customer service encompasses:

Advanced engineered plastic parts

Turned, milled and moulded parts, made of in-house developed high performance plastic materials or materials from qualified suppliers.

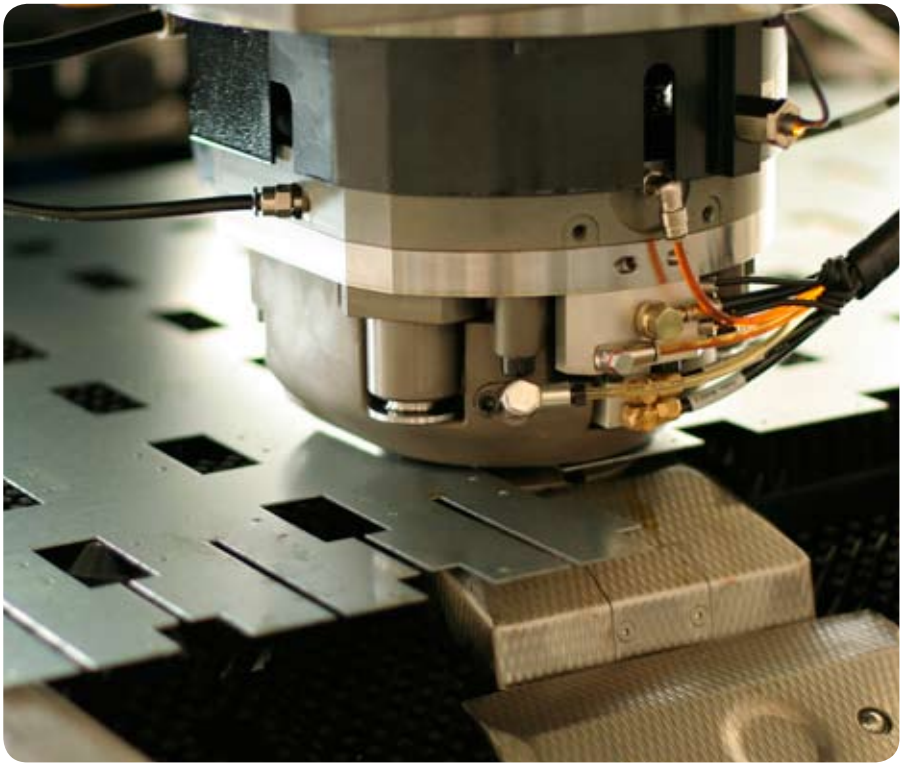
Other business and services

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

Machine tools

Cutting

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



Forming

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

Cutting applications

Rotary application under pressure

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

Seals for rotary distributors

Dynamic seals for applications with rotating or pivoting movements within a rotary distributor, have to handle different media 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, ...) 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-solution in wear resistance and sealing properties. This resulted in a longer service life (more than 100 000 load cycles, compared to previously 60 000 with a PTFE-solution). As you can see in the figure below, only a very slight tendency to gap extrusion occurred. The achieved low friction at high pressure level provided low temperature generation and had the added advantage, that the material was chemically resistant to all relevant media.

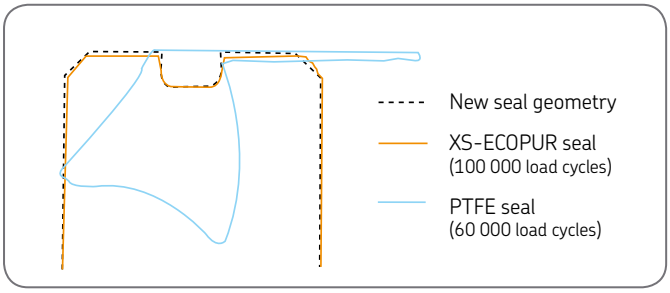
Large Diameter Seals made of G-ECOPUR

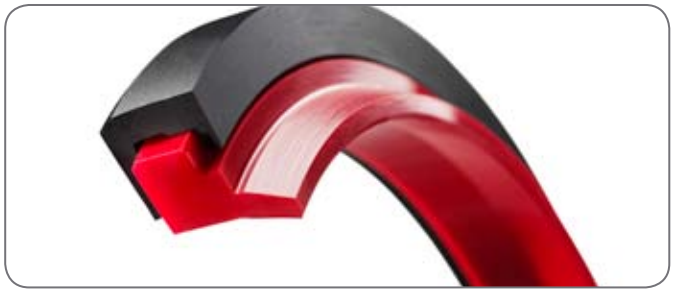
Rotary tables or indexing tables have to offer shortest cycle times, high precision indexing, even when transporting heavy loads. In that application the seals have to provide low friction, low wear and have to be available in diameters exceeding 600 mm.

Seals for rotary tables

For this application, chemical resistance against coolants and lubricants is a must. Specially designed sealing solutions meet all the customer's requirements in order to reduce machine downtime and to minimise the total cost of ownership (TCO).

Our 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.





Forming applications

Seal installation and welding – reducing downtime

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

Welding large diameter polyurethane seals

In another case, we had to replace a standard rubber fabric seal at the main cylinder of a forging press.

SKF Economos has developed a procedure, that allows welding of large diameter polyurethane seals on site maintaining sealing capacity. For us, installing replacement seals is a common process that allows customers to keep production downtime to an absolute minimum.

High pressure

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.

Seals for ceramic powder presses

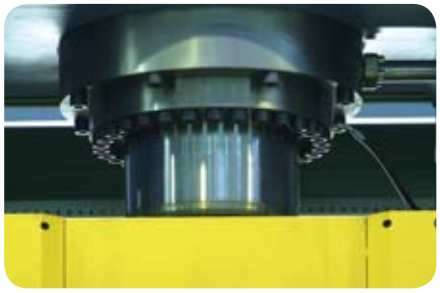
In one special case, we were challenged with the deflection of the cylinder, combined with the changing properties of the sealing material at ultra high pressure. Based on a Finite Element Analysis (FEA) for design and seal geometry optimisation, a sealing solution for these challenging conditions was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

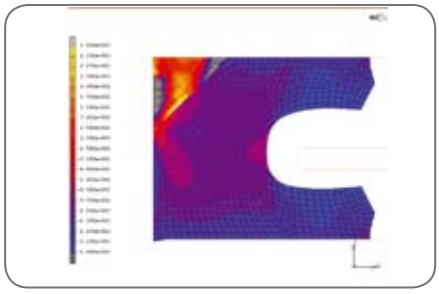
Wear resistance and reliability

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

Seals for wood chipboard presses

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 Economos increased the lifespan of the seal from an average 90 days to more than one year.





Optimised system performance

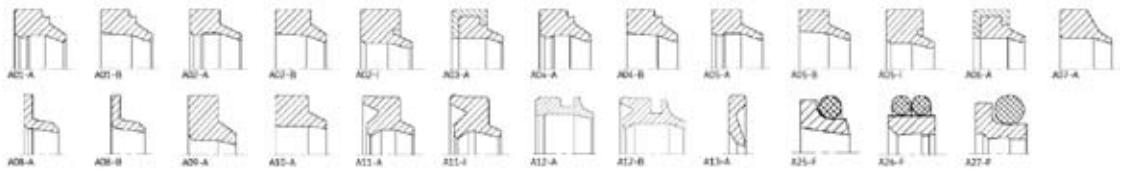
For more than 20 years SKF Economos has provided technically advanced solutions and met the requirements of applications and processes for the cutting and forming machine tools industry. This focus has led to the development of new, reliable products and materials specifically engineered and designed to meet the demands of your operation.

After a detailed study of your operation and your specifications, we select materials from our comprehensive range of standard products, or, if the application demands it, non-standard products; alternatively, we can engineer customised, tailormade solutions.

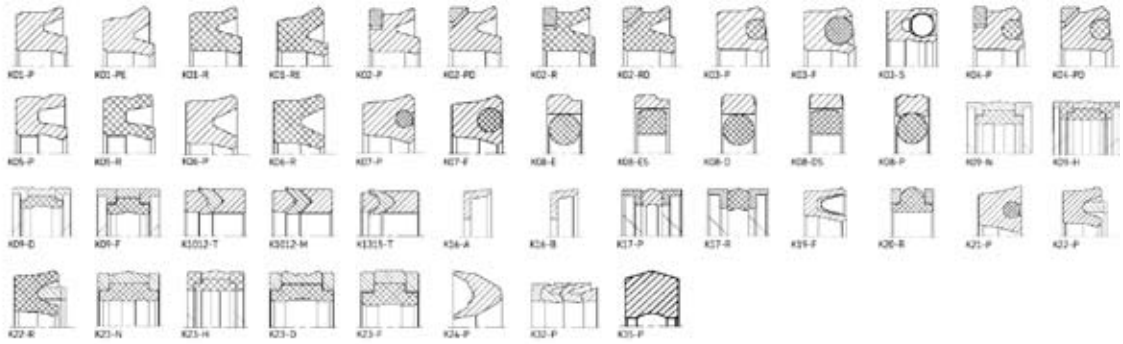
SKF Economos' unique service capability offers individual sealing solutions (on demand – without any additional tooling costs or delays), which give our customers considerable advantages.

Standard profiles for the machine tools industry

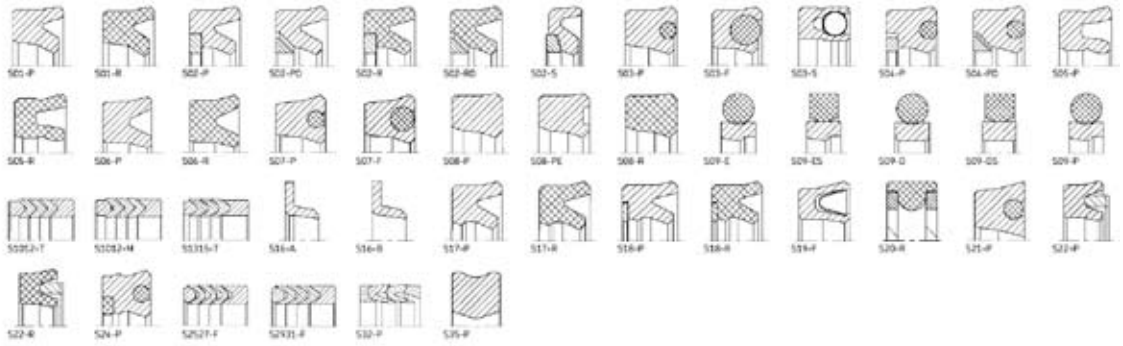
Wipers



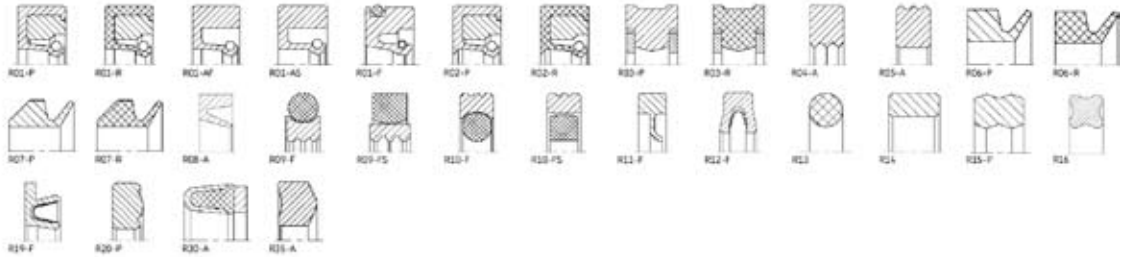
Piston seals



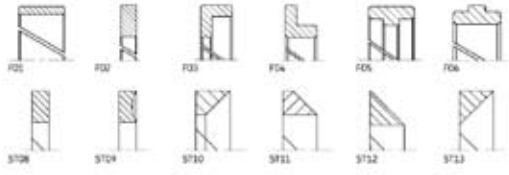
Rod seals



Rotary seals



Guide and backup rings



O-Rings and static seals

Advanced Engineered Plastic Parts

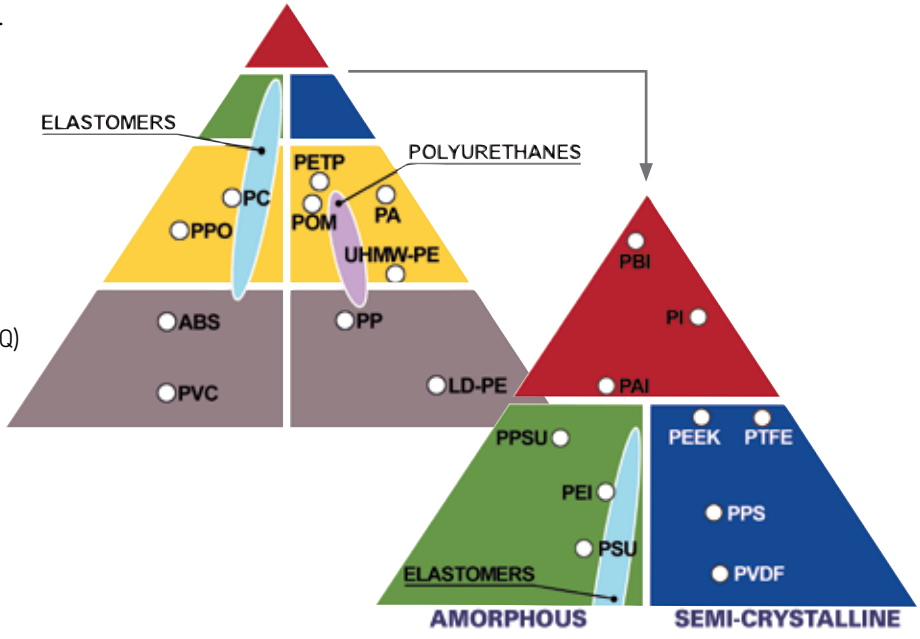
High performance plastic materials are also working at temperatures above +150 °C without any substantial change to their mechanical properties. For the machine tools industry SKF Economos offers machined plastic products made of these high performance polymers as well as standard thermoplastics.

As stated in our capability flyer, SKF Economos 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 you need prototypes, weight reduction or high performance products, please contact our application engineers, who can advise you on the best possible solution for your application.

Some typical engineered and advanced engineered plastic materials we process:

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)
Polyphenylensulphone (PPSU)
Polyamide Imide (PAI)
Polyimide (PI)
Polybenzimidazole (PBI)



Clamping unit, SKF Ecomid

Sliding parts, SKF Ecowear

Gripper parts, XH-ECOPUR

Special parts according to customer design specs, SKF Ecopaek

Slidaing elements, SKF Ecomid

Tube sealing element, SKF Ecorubber 3 + SKF Ecoflas

Sealing materials

Polyurethanes and elastomers

SKF Economos has developed many high performance sealing materials, in particular our polyurethane has outstanding mechanical properties which outperform all other elastomeric sealing materials (like rubbers). Possible application limits are chemical resistance and in some cases, very high temperatures. For further information, please contact your SKF Economos representative.

Polyurethanes

Material		Colour	Properties
ECOPUR	(TPU/TPE–U, 95 Shore A)	Green	Good chemical resistance, recommended for hydraulic applications
H-ECOPUR	(TPU/TPE–U, 95 Shore A)	Red	Outstanding chemical resistance against water based fluids
S-ECOPUR	(TPU/TPE–U, 95 Shore A)	Charcoal grey	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	Chemical resistance similar 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)	Charcoal-grey	Increased pressure and extrusion resistance, recommended for composite seals, chemical resistance similar to H-ECOPUR, outstanding sliding performance

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 your SKF Economos representative.

Elastomers

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

Thermoplastics, special materials and PTFE

Thermoplastics and special glassfibre reinforced materials with outstanding mechanical properties.
For further information, please contact your SKF Economos representative.

Thermoplastics and special materials [1)]

Material		Colour	Properties
SKF Ecomid	(PA)	Black	Good mechanical properties, glass filled grades for increased pressures are available. Not to be used in water or moist environments!
SKF Ecotal	(POM)	Black	Good mechanical characteristics; glass filled grades
SKF Ecopaek	(PEEK)	Cream/black	Exceptional mechanical, chemical and thermal resistance
SKF Ecotex	(fabric reinforced material on polyester resin base)	Orange	High wear and pressure resistance

Top performance PTFE compound materials with highest chemical and temperature resistance,
optimised for sealing applications. For further information, please contact your SKF Economos representative.

PTFE and its compounds [2)]

Material		Colour	Properties
SKF Ecoflon 1	(PTFE, virgin)	White	High chemical resistance
SKF Ecoflon 2	(PTFE, 15% glass, 5% MOS2)	Grey	Good mechanical characteristics
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, increased pressure and creep resistance

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

2) Additionally, SKF Economos 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** casted	**X-ECOPUR**	**XH-ECOPUR** hydrolysis resistant	**XS-ECOPUR** + solid lubricants
			TPU	TPU	TPU	TPU	TPU	TPU	TPU	TPU
Colour	–	–	green	red	charcoal grey	blue	red	dark green	dark red	charcoal grey
Density	53479	g/cm³	1,2	1,2	1,24	1,17	1,2	1,21	1,22	1,26
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
Mechanical properties										
Tensile test[1]										
– Tensile strength[2]	53504	MPa	40	50	50	50	45	50	53	45
– elongation at break[2]	53504	%	430	330	380	450	280	380	350	350
– 100% modulus[2]	53504	MPa	12	13	17	12	11	18	20	20
Compression set[3]										
– after 22 h at 100 °C	53517	%	–	–	–	–	–	–	–	–
– after 22 h at 175 °C	53517	%	–	–	–	–	–	–	–	–
– after 24 h at 70 °C/20% deformation	–	%	30	27	25	–	30	27	26	24
– after 24 h at 100 °C/20% deformation	–	%	35	33	30	–	40	33	30	30
– after 70 h at 70 °C/20% deformation	–	%	20	20	–	20	20	–	–	–
Tear strengh	53515	N/mm	100	100	120	80	40	140	140	160
Rebound resilience	53512	%	42	29	–	50	43	–	–	–
Abrasion	53516	mm³	18	17	17	15	25	20	20	20
Durometer hardness Shore A[4]	53505	–	95	95	95	95	95	97	97	96
Durometer hardness Shore D[4]	53505	–	48	48	48	48	47	57	60	57

Elastomers

SKF Ecorubber-1	SKF Ecorubber-H	SKF Ecorubber-2	SKF Ecorubber-3
NBR	H–NBR	FKM, FPM	EPDM
black	black	brown	black
1,31	1,22	2,3	1,22
100	150	200	150
–30	–25	–20	–50
16	18	8	12
130	180	200	110
11	10	5	9
15	22	–	15
–	–	20	–
–	–	–	–
–	–	–	–
–	–	–	–
20	30	21	15
28	29	7	38
90	90	150	120
85	85	83	85
36	33	36	34

[1] Test specimens: Type S 2.
[2] Test speed: 200 mm/min.
[3] Tests were performed on discs Dia 13 × 6,3 mm. Compression rating 20% (TPUs) as well as 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.
[4] 6,3 mm thick test specimens.

Properties

			Thermoplastics			
Properties	**DIN**	**Unit**	**SKF Ecomid**	**SKF Ecotal**	**SKF Ecopps**	**SKF Ecopaek**
			PA 6 G	POM–C	PPS	PEEK
Colour	–	–	black	natural/black	beige	cream
Density	1183	g/cm^3	1,15	1,4	1,35	1,32
Water absorption						
– after 24/96 h immersion in water at 23 °C[1)]	62	mg	44/83	20/37	–	5/10
	62	%	0,65/1,22	0,24/0,45	–	0,06/0,12
– at saturation in air at 23°C/50% RH	–	%	2,2	0,2	–	0,2
Thermal properties[2)]						
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}	65×10^{-6}
Max. allowable service temperature in air:						
– for short periods[3)]	–	°C	170	140	260	310
– continuously: for 5 000/20 000 h[4)]	–	°C	105/90	115/100	–/230	–/250
Min. service temperature[5)]	–	°C	–40	–50	–20	–60
Flammabilty[6)]						
– oxygen indes	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[7)]						
– tensile stress at yield / tensile stress at break[8)]	527	MPa	85/–	68/–	95/–	110/–
	527	MPa	65/–	68/–	95/–	110/–
– tensile strain at break[8)]	527	%	25	35	15	20
	527	%	>50	35	15	20
– tensile modulus of elasticity[9)]	527	MPa	3 500	3 100	3 450	4 400
	527	MPa	1 800	3 100	3 450	4 400
Compression test						
– compressive stress a 1/2/5% nominal strain[10)]	604	MPa	26/51/92	19/35/67	–	29/57/–
Charpy impact strength – unnotched[11)]	179/1eU	kJ/m^2	no break	≥ 150	–	no break
Charpy impact strength – notched[12)]	179/1eU	kJ/m^2	3,5	7	–	3,5
Izod impact strength – notched	180/2A	kJ/m^2	3,5	7	–	6
Ball indentation hardness[13)]	2039-1	N/mm^2	165	140	–	230
Rockwell hardness[13)]	2039-2	–	M 88	M 84	M 95	M 105
Hardness shore D (3 s)	868	–	77	82	–	86

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 2,17	PTFE grey 2,25	PTFE green 3,13	PTFE black 2,1	PTFE white 2,16	orange 1,25
– – <0,01 <0,02	– – 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 –/27 300 300 400–700 400–700	–/18 –/18 200 200 – –	–/22 –/22 300 300 – –	–/15 –/15 180 180 – –	–/30 –/30 360 360 – –	55/– 55/– – – 3 200 3 200
–/8/– no break – 16 – – 57	–/14/– – – 12 – – 60	– – – – – – 64	– – – – – – 65	– no break – – – – 59	– – – – – M100 –

1) Tests were performed on discs ∅ 50 × 3 mm.
2) The figures given for these properties are for the most part derived from raw material supplier data and other publications.
3) Short exposure time (a few hours) in applications where no or only a very low load is applied to the material.
4) Temperature resistance over a period of min. 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. Please note however, that, as far as all thermoplastics are concerned, the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
5) 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.
6) These estimated ratings, derived from raw material supplier data, 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.
7) Test specimens: Type 1 B.
8) Test speed: 5 mm/min
9) Test speed: 1 mm/min.
10) Test specimens: cylinders with Ø 12 × 30 mm.
11) Pendulum used: 4 J.
12) Pendulum used: 5 J.
13) 10 mm thick test specimens.

Working fluids and sealing materials

Most machine tools contain many different working fluids, which may require chemical resistant sealing solutions. Due to improved safety- and contamination regulation standards, more and more combustible fluids, such as mineral oils, are being substituted with 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 up to 60 °C max. 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 Economos has many years of experience in sealing 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 summarised in **table 2.**

Table 1

Composition of water-based fluids

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

Table 2

Fluid compatibility of sealing materials

Fluid-category	**Service temp. (°C)**	**Compatible sealing materials** Common opinion	SKF Economos results
HFA–E	+5 to 55 (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, SKF Ecorubber-H, SKF Ecorubber-2 and SKF Ecorubber-3
HFB	+5 to 60	NBR, HNBR and specially formulated FPM	Specially formulated polyurethanes
HFC	–20 to 60	NBR, HNBR, EPDM and MVQ	Specially formulated polyurethanes and FPM have limited stability

Chemical resistance

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

[1] Rating legend:
+ Excellent
o Good / fair
– Poor

This table is a valuable help in the choice of materials. The data listed here falls within the normal range of product properties. However, they are not guaranteed, they should not be used to establish material specification limits and should be used in combination with other design basis information.

Chemical resistance

	Thermoplastics									
Chemical and environmental resistance	**SKF Ecomid**	**SKF Ecotal**	**SKF Ecopps**	**SKF Ecopaek**	**SKF Ecoflon 1**	**SKF Ecoflon 2**	**SKF Ecoflon 3**	**SKF Ecoflon 4**	**SKF Ecoflon 5**	**SKF Ecotex**
Acids										
– inorganic, diluted	o	o	+	+	+	+	+	+	+	o
– inorganic, concentrated	–	–	o	–	+	o	o	o	+	–
– organic, diluted	o	o	+	+	+	+	+	+	+	o
– organic, concentrated	o	o	+	+	+	+	+	+	+	–
Alkalies										
– general	o	o	+	+	+	o	o	o	+	o
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)	o	+	+	+	+	+	+	+	+	+
– HFD (water free)	+	+	+	+	+	+	+	+	+	+
Solvents										
– Toluene	+	+	o	+	+	o	+	+	+	+
– Acetone	+	+	+	+	+	+	+	+	+	–
– MEK	+	o	+	+	+	+	+	+	+	–
Steam	o	+	+	+	+	+	+	+	+	+
Water	o	+	+	+	+	+	+	+	+	+

This table is a valuable help in the choice of materials. The data listed here falls within the normal range of product properties for dry materials. However, they are not guaranteed, they should not be used to establish material specification limits and should be used in combination with other design basis information.

The knowledge engineering company

The SKF brand now stands for more than ever before and offers customers a greater choice than ever.

While SKF maintains its leadership in the productions of quality bearings throughout the world, greater customer value has been created through new advances in technology, product support and services, making SKF a truly solutions orientated supplier. Customer productivity has increased through cutting-edge application specific products, design simulation tools, consultancy services, plant asset efficiency maintenance programmes and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but now offers even more.

SKF – the knowledge engineering company. Seals and sealing technology are part of SKF's essential skills and signify excellence and leadership. SKF Sealing Solutions supplies best in class standard seals, customised standards and custom engineered solutions.

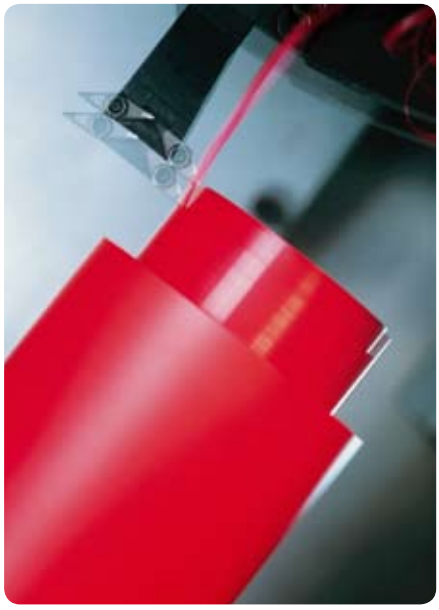
SKF Economos offers a unique and comprehensive seal consultancy service, providing customers with the latest advances in sealing technology. In cooperation with our customers we analyse operational requirements and applications. All our machined seals, whether standard or customised, are manufactured on demand without tooling costs or delays.

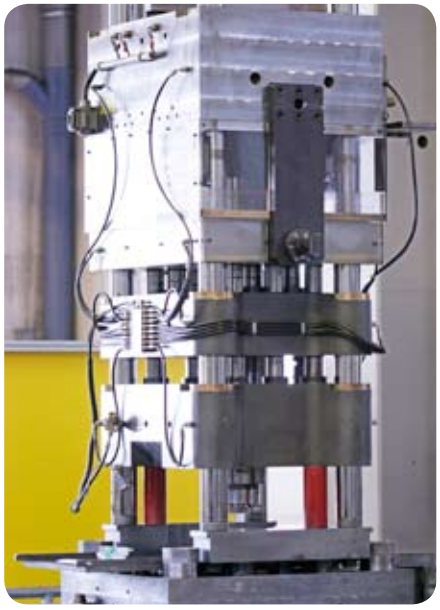
Material availability

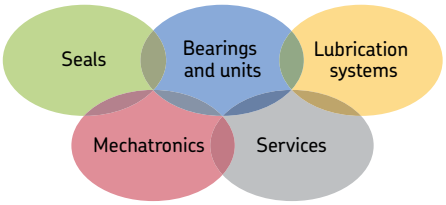
All the materials listed in this brochure are available in diameters up to 600 mm and some selected grades can be supplied in diameters up to 1 600 mm (rubber materials) and up to 4 000 mm – one seal, or larger dimensions using our specially developed welding technique (polyurethane materials). Milled parts, plates and sheets are available in a wide range of dimensions.

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

Larger quantities and high volume business are produced using an injection moulding process, as used in the manufacture of polyurethanes and high performance thermoplastics such as polyetheretherketone (PEEK).







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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