

Sealing materials introduction

Due to increasing requirements within sealing technology, the importance of selecting the appropriate sealing material is emphasized. Sealing materials are facing higher temperatures and pressures, higher sliding speeds and poorer lubricating fluids. The new generation of fluids like HFA and HFB fluids and biologically degradable hydraulic fluids (vegetable oils and synthetic esters) present new challenges to develop new sealing materials.

SKF Economos acknowledged this with the transfer of R&D from a standard solution provider to a developer of special, tailor-made solution. It became obvious that projects in close client co-operation succeeded best in achieving the optimal sealing solution.

SKF Economos has recognised all the advantages of Polyurethane in sealing technology. From our point of view, the superior characteristics of these materials have not yet been fully explored and leave scope for many other applications. In the future we expect a much stronger trend in this direction.

SKF Economos offers 15 standard materials that are featured in this brochure. All these materials have been developed by SKF Economos to meet standard customer needs. In addition, we supply special materials like SKF ECOFLAS, engineering thermoplastics

like SKF ECOTAL and high-temperature plastics, e.g. PPS, etc.

Classification of sealing materials

In sealing technology, mainly two groups of macromolecular (polymer) substances are used: elastomers and thermoplastics.

Macromolecular substances are organic compounds, its molecules consist of several thousands, often even millions of atoms, known as macro, giant, string or chain molecules. They can be created either by modification of highly molecular natural materials (e.g. natural rubber) or by depositing low-molecular elements (so called monomers) through various chemical reactions (synthetic materials, plastics).

Elastomers

Elastomers are materials that can be highly expanded by exerting relatively little power. Because of their structure, elastomers have a high retractibility, which means the compression set is very limited. There are two

main groups of elastomers; rubber materials and thermoplastic elastomers.

The rubber materials are polymers, which are formed by chemically cross-linked macromolecules with various vulcanization additives. Due to their chemical bonds they do not melt but rather begin to decompose at high temperatures. The cross-links also results in that the rubber materials don't dissolve or, depending on the medium, swell or shrink.

Thermoplastics

The Thermoplastic Elastomers demonstrate the characteristic properties of elastomers over a wide temperature range, but with the processing behaviour of thermoplastics. They can be melted at high temperature and can be processed with traditional thermoplastic processing techniques. Thermoplastic elastomers are soluble and they generally swell less in comparison to their chemically cross-linked equivalents.

Engineering Thermoplastics are e.g. SKF ECOTAL, SKF ECOMID, SKF ECOFLON and SKF ECOPAEEK.

Thermoplastics can be melted. They are polymer materials, which are essentially harder and rigid at their application temperature compared to elastomers. Depending on the chemical structure, the properties vary from hard, to stiff, to ductile and flexible. Due to the morphological structure, extensive stretching is non-reversible and moulded parts remain in the deformed state. Thermoplastics are therefore called Plastomers.

Engineering Thermoplastics are applied in the sealing technology for back-up rings and guide rings, bearing bushes, etc.



SKF Economos standard sealing materials

Polyurethanes

ECOPUR (TPU) green

ECOPUR is a thermoplastic polyurethane elastomer, with an excellent abrasion resistance, low compression set, high physical properties and tear strength. ECOPUR is mostly used for U-cup seals, lip seals, wipers and chevron packings, but it may also be used for dampers and other machined parts. Products made from this material can be used in mineral oil, in water up to 40 °C and in bio-degradable hydraulic oils like vegetable oils and synthetic esters up to 60 °C (in these hydraulic fluids it is better to use H-ECOPUR instead of ECOPUR). Depending on the seal design and the installation housing seals made of ECOPUR can be used up to 400 bar (for higher pressure anti-extrusion-rings are required).

H-ECOPUR (TPU) red

H-ECOPUR is a hydrolysis-resistant thermoplastic polyurethane elastomer. It combines the engineering properties of ECOPUR with a high resistance to hydrolysis (degradation in water) which is otherwise rare when it comes to polyurethane's. E.g. it is stable in water up to +90 °C and has an outstanding stability in mineral oil. Because of its resistance to hydrolysis H-ECOPUR can be used for water hydraulic and for applications in mining, tunnelling and manufacturing of presses. H-ECOPUR is particularly recommended for the use in pure and seawater, for HFA and HFB fluids and biologically degradable hydraulic fluids (vegetable oils and synthetic esters) and food articles. H-ECOPUR is in conformance with various food regulations and can be used for many food-, beverage- and healthcare applications.

G-ECOPUR (CPU) red

G-ECOPUR is a cast hydrolysis-resistant polyurethane elastomer with similar properties to H-ECOPUR especially regarding its chemical



stability. G-ECOPUR can be used in the same hydraulic fluids as H-ECOPUR. Generally, G-ECOPUR is used for seals with a diameter range from 600 mm up to 4 000 mm.

T-ECOPUR (TPU) blue

T-ECOPUR is a thermoplastic polyurethane elastomer, that has been developed for low temperature applications. The properties of T-ECOPUR are similar to those of ECOPUR, but the minimum service temperature is extended to -50 °C. For that reason T-ECOPUR should be used under severe climatic conditions and for applications in freezing plants.

S-ECOPUR (TPU) grey

The new polyurethane brand has been optimised in regard of the tribological characteristics (friction and wear), achieved by an addition of a synergetic combination of solid lubricants. This special material is therefore best suited for most severe applications in the water hydraulics as well as in the non-lubricated pneumatics.

Hard grade polyurethanes

X-ECOPUR (TPU) dark green

X-ECOPUR is a thermoplastic polyurethane elastomere developed by SKF Economos. The composition of the material provides outstanding friction and wear properties as well as high pressure resistance. Therefore the material is well suited for the use as a composite seal, for wipers working in heavy-duty applications as well as for engineered plastic parts that need high elasticity and superior resilience behaviour.

Due to the exceptional extrusion resistance seals made of this material are working at higher pressure levels and larger clearances than those made of standard polyurethanes and PTFE compounds.

XH-ECOPUR (TPU) dark red

Compared to the standard grade H-ECOPUR, XH-ECOPUR has a significantly higher hardness. The composition of the material based on special raw materials provides outstanding friction and wear characteristics as well as pressure resistance. This material exhibits an outstanding chemical and hydrolysis resistance for applications in mineral oil, biodegradable hydraulic fluids (HETG and HEES, etc.) and water based fluids (HFA and HFB).

XS-ECOPUR (TPU) dark grey

Compared to the S-ECOPUR standard material XS-ECOPUR has a higher hardness and therefore further improved sliding properties. XS-ECOPUR has a better extrusion resistance than the standard material and therefore sealing elements of this material can be used at higher pressures, assuming the same profiles are used. XS-ECOPUR should be used instead of X-ECOPUR and XH-ECOPUR under poor lubricated working conditions. The material can also withstand dry-running depending on the overall service conditions.

Elastomers

SKF ECORUBBER-1 (NBR) black

SKF ECORUBBER-1 is an elastomer based on acrylonitrile-butadiene rubber and is used for U-cup seals, chevron packings, special seals and various components. This material has good resistance to mineral oils and greases and HFA, HFB and HFC pressure fluids. However, the material is not resistant to glycol-based brake fluids, HFD fluids, aromatic fluids (such as benzene), esters, ketones and amines or concentrated acids and bases.

SKF ECORUBBER-H (HNBR) black

SKF ECORUBBER-H is a hydrogenated or saturated acrylonitrile-butadiene rubber, suitable for applications in aliphatic hydrocarbons like propane or butane and mineral oils and greases (for short times up to 170 °C) and for sulfonated crude oil. Furthermore, it can be used in many diluted acids and bases and salt solutions even at elevated temperatures and in glycol-water mixtures. SKF ECORUBBER-H is not compatible with fuels with high content of aromatic hydrocar-

bons (premium blend petrol), gasolines (petrol/alcohol blends) ketones, esters, ethers and chlorinated hydrocarbons like trichloroethylene and tetrachloroethylene.

SKF ECORUBBER-2 (FPM, FKM) brown

SKF ECORUBBER-2 is an elastomer based on fluororubber (VITON®) that can be used for U-rings, lip seals, chevron packings, wipers and special seals. Its outstanding properties are high resistance to heat, weathering, ozone and many other chemicals. SKF ECORUBBER-2 is compatible with mineral oils and greases containing sulphur, HFD pressure fluids (nearly all phosphate esters and chlorinated hydrocarbons), crude oil and sour gas. SKF ECORUBBER-2 is not resistant to anhydrous ammonia, amines, ketones, esters, hot water and low molecular weight organic acids.

SKF ECORUBBER-3 (EPDM) black

SKF ECORUBBER-3 is an elastomer based on ethylene-propylene rubber and can be used for U-cup seals, lip seals and chevron packings. SKF ECORUBBER-3 has an outstanding resistance to hot water, steam, washing agents and polar organic solvents. SKF ECORUBBER-3 is not resistant to mineral oil and other unpolar media. Its resistance to weathering, ozone and ageing is good. When used in glycol-based brake fluids, national regulations have to be adhered to.

SKF ECOSIL (MVQ) reddish brown

SKF ECOSIL is a silicone rubber and can be used for O-rings, gaskets and special seals. Due to its poor mechanical properties compared to those of other rubber materials, SKF ECOSIL is mostly used for static applications. SKF ECOSIL is highly resistant to weathering, ozone and ageing. Thanks to the content of aromatic hydrocarbons the material is compatible with mineral oil.

SKF ECOFLAS (TFE/P) black

SKF ECOFLAS is a unique fluoroelastomer based upon an alternating copolymer of tetrafluoroethylene and propylene (TFE/P). This material is chemically related to fluoro-rubber. Compared to fluoro rubber materials SKF ECOFLAS shows slightly higher tensile strength and a quite similar heat resistance. The resistance of SKF ECOFLAS to mineral oils

is not as high as SKF ECORUBBER-2, but better than the mineral oil resistance of SKF ECORUBBER-1 and SKF ECORUBBER-H. SKF ECOFLAS exhibits outstanding resistance to hot water and hot steam up to 230 °C. The resistance to sourgas and amines, brake fluids (based on glycol, mineral oil or silicon oil) and fire-resistant hydraulic fluids is excellent. SKF ECOFLAS shows in contrast to SKF ECORUBBER-2 a good radiation resistance.



SKF ECOFLON 1 (PTFE-virgin) white

SKF ECOFLON 1 is a thermoplastic on the basis of polytetrafluoroethylene that is used for back-up rings, chevron packings, O-rings, rotary seals and gaskets. SKF ECOFLON 1 has the widest application range of all sealing materials. SKF ECOFLON 1 has an outstanding chemical resistance and will only be attacked by molten alkali metals and elementary Fluorine at high temperatures. Using PTFE seals, it should be noted that creeping occurs at relative low loads (pressures). SKF ECOFLON 1 is suitable for the food industry.

SKF ECOFLON 2 (PTFE +25% glass fibre + 5% MoS₂) grey

SKF ECOFLON 2 has improved compression strength as well as improved sliding properties in comparison to SKF ECOFLON 1. The chemical resistance is similar to SKF ECOFLON 1.

SKF ECOFLON 3 (PTFE +40% bronze) bronze

SKF ECOFLON 3 exhibits improved compression strength sliding properties as well as an

improved thermal conductivity in comparison to SKF ECOFLON 1.

SKF ECOFLON 4 (PTFE +25% carbon) black

SKF ECOFLON 4 shows improved mechanical strength, stiffness and hardness as well as improved sliding properties in comparison to SKF ECOFLON 1.

SKF ECOFLON 5 (PTFE modified) white

SKF ECOFLON 5 exhibits improved wear and abrasion resistance in comparison to

SKF ECOFLON 1. The material is suitable for food and beverage application.

SKF ECOTAL (POM) black

SKF ECOTAL is a semi-crystalline polyacetal-copolymer which is used for anti-extrusion rings, guide ring bushes, scrapers and for precision-machined parts with tight tolerances. SKF ECOTAL is one of the most important engineering thermoplastics with good physical properties, low water absorption and good chemical resistance. SKF ECOTAL can be used

in mineral oils, in water-based fire-resistant hydraulic fluids (HFA, HFB and HFC fluids). Concentrated acids and bases will attack and destroy it.

SKF ECOMID (PA) black

SKF ECOMID is a cast polyamide with good sliding properties and is used for back-up rings, guide rings and bearing components instead of SKF ECOTAL for a diameter above 260 mm. SKF ECOMID can be used in mineral oils and water-based fire-resistant hydraulic fluids. When designing parts out of SKF ECOMID for an application in water or water-based fluids, the swelling of the mate-

rial (SKF ECOMID absorbs water up to eight weight percent) must be taken into consideration.

SKF ECOPAEEK (PEEK) cream

SKF ECOPAEEK is a polymer with high tensile strength, stiffness, high heat distortion temperature and good sliding and friction behaviour. As far as strength and stiffness are concerned, SKF ECOPAEEK exceeds most technical plastics especially at high temperatures.

SKF ECOTEX (polyester resin + polyester fabric + graphite filler) light orange

SKF ECOTEX is a compound based on a thermosetting polyester resin and reinforced with fabric inlays. Due to the addition of graphite the material shows very good characteristics in respect to the tribological requirements of bearing materials in sliding systems. SKF ECOTEX shows high compressive strength and outstanding friction and wear properties. Therefore it is very well suited for guide rings and bearing bushes. Due to the very low absorption of moisture, SKF ECOTEX is particularly suitable for use in water and media containing water (swelling in water <0,1 %).

SKF ECOWEAR 1000 (UHMW-PE) white

SKF ECOWEAR 1000 is a semi crystalline thermoplastic material based on Polyethylene with a molecular weight of about 4 500 000 g/mol. SKF ECOWEAR 1000 has a very low coefficient of friction, an excellent wear resistance and impact strength (also at low temperature up to -200 °C), and in comparison to SKF ECOFLON a very high creep resistance and is almost water repellent and exhibits no swelling. The main applications for SKF ECOWEAR 1000 are in areas where the following properties are required:
- outstanding sliding properties
- wear- and dry running properties in case of bad lubricating and aqueous media

Special materials

Any thermoplastic with mineral-reinforced polyamides, high temperature plastics like Polyphenylsulfide, etc.. All standard materials can be modified by SKF Economos to achieve tailor-made and optimised sealing solutions.

Material data

Matrix 1

Properties	DIN	Unit	Polyurethanes								Elastomers				Thermoplastics										Thermoset					
			ECOPIUR	H-ECOPIUR	G-ECOPIUR	T-ECOPIUR	S-ECOPIUR	X-ECOPIUR	XH-ECOPIUR hydrolysis resistant	XS-ECOPIUR + solid lubricants	SKF ECORUBBER-1	SKF ECORUBBER-H	SKF ECORUBBER-2	SKF ECORUBBER-3	SKF ECOSIL	SKF ECOFILAS	SKF ECOFILON 1	SKF ECOFILON 2 +25% GF + 5% MoS2	SKF ECOFILON 3 +40% bronze	SKF ECOFILON 3F +40% bronze	SKF ECOFILON 4 +25% Carbon	SKF ECOFILON 5 modified	SKF ECOMID	SKF ECOTAL	SKF ECOWEAR 1000	SKF ECOPAEEK	SKF ECOTEX			
			TPU	TPU	CPU	TPU	TPU	TPU	TPU	TPU	NBR	HNBR			FPM, FKM	EPDM	MVQ	TFE/P	PTFE virgin	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PA	POM	UHMWPE	PEEK	-
Colour			Green	Red	Red	Blue	Grey/ black	Dark green	Dark red	Dark grey	Black	Black			Brown	Black	Reddish brown	Black	White	Grey	Bronze	Green	Black	White	Black	Black	Black	White	Cream	Light orange
Hardness	53505	Shore A	95 ± 2	95 ± 2	95 ± 2	95 ± 2	95 ± 2	97 ± 2	97 ± 2	97 ± 2	85 ± 5	85 ± 5			85 ± 5	85 ± 5	85 ± 5	83 ± 5	-	-	-	-	-	-	-	-	-	-	-	-
Hardness	53505	Shore D	48 ± 3	48 ± 3	47 ± 3	48 ± 3	48 ± 3	56 ± 3	59 ± 3	59 ± 3	34	34			34	34	34	31	57	60	64	64	65	59	77	82	61 ²⁾	86	M98 ¹⁾	
Density	EN ISO 1183	g/cm ³	1,2	1,2	1,2	1,17	1,23	1,21	1,22	1,25	1,31	1,22			2,3	1,22	1,52	1,6	2,17	2,25	3	3,13	2,1	2,16	1,15	1,41	0,93	1,32	1,21	
100% modulus	53504	N/mm ²	12	≥13	≥11	≥12	17	21	25	25	≥11	≥10			≥5	≥9	≥5	8	-	-	-	-	-	-	-	-	-	-	-	-
Tensile strength/yield stress	53504/53455	N/mm ²	≥50	≥50	≥45	≥50	48	50	50	43	≥16	≥18			≥8	≥12	≥7	13	27	18	22	22	15	30	65	62	20	97	-	
Elongation at break	53504/53455	%	≥450	≥330	≥280	≥450	400	400	350	350	≥130	≥180			≥200	≥110	≥130	220	300	200	280	300	150	360	120	40	-	≥50	-	
Modulus of elasticity – tensile test	53457	N/mm ²	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	1800	26 00	600	3 600	-	
Compression set																														
70 °C/24h 20% def.		%	≤27	≤27	≤30	20 ³⁾	25	24	26	30	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100 °C/24h 20% def.		%	≤33	≤33	≤40	45 ⁴⁾	30	29	30	35	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100 °C/22h	ISO 815	%	-	-	-	-	-	-	-	-	≤15	≥22			-	≤15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175 °C/22h	ISO 815	%	-	-	-	-	-	-	-	-	-	-			≤20	-	≤15	29	-	-	-	-	-	-	-	-	-	-	-	-
Rebound resilience	52512	%	42	29	43	50	-	-	-	-	28	29			7	38	44	-	-	-	-	-	-	-	-	-	-	-	-	-
Tear strength	ISO 34-1	N/mm	≥100	≥100	≥40	80	120	140	170	180	20	30			21	15	8	19	-	-	-	-	-	-	-	-	-	-	-	-
Abrasion	DIN ISO 4649	mm ³	18	17	25	15	21	18	20	29	90	90			150	120	-	110	-	-	-	-	-	-	-	-	-	-	-	-
Minimum service temperature		°C	-30	-20	-30	-50	-20	-30	-20	-20	-30	-25			-20	-50	-60	-10	-200	-200	-200	-200	-200	-200	-200	-40	-50	-200	-60	-40
Maximum service temperature		°C	+110	+110	+110	+110	+110	+110	+110	+110	+100	+150			+200	+150	+200	+200	+260	+260	+260	+260	+260	+260	+260	+100	+100	+90	+260	+120

¹⁾ Rockwell hardness
²⁾ DIN EN ISO 868

³⁾ DIN ISO 815: 70 °C/70h, 10% def.
⁴⁾ DIN ISO 815: at -40 °C

Data of other materials such as low temperature SKF ECORUBBER-H 85A-b-LT, special food grade materials etc. are available on request.