



Mining and minerals Processing industries

Customised machined seals



ECONOMOS



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

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Sealing technology in the fields of mining and minerals processing

SKF Economos is a global leader and is well known in the industry for providing standard and customised sealing solutions and engineered plastics components.

The nature of these industries challenges sealing technology, in that a broad range of aggressive requirements and conditions has to be met, in order to achieve successful outcomes.

It is usually a combination of aggressive requirements and conditions which demand specialized high quality products to achieve the most cost effective solutions. Sealing materials have to be compatible with a wide range of aggressive fluids and gasses and temperatures, whilst conforming to strict safety standards.

Sealing solutions are required to hold operating pressures and retain fluids from zero to 10 000 psi and beyond, preventing ingress of material and fluids from the external environment.

Sealing integrity is mandatory since equipment failures can result in serious harm to the economic viability of operations, the environment and human beings.

SKF Economos is an International supplier of high quality, highly reliable innovative sealing solutions and engineering plastics products to the global mining and minerals processing market.

As such we provide our fundamental knowledge in support of our customers operations to reduce "down-time" and extend equipment life.

SKF Economos has the capability to ship single pieces to 600 mm as required, same day if necessary, or up to 8 500 mm on an in-time basis.

Our engineering competence allows the creation of customised products, both in terms of materials and design that are compliant with our customers' requirements.



SKF Economos sealing solution involvements

SKF Economos is the leading player in the global custom-made machined seals market. Specialised in providing a complete sealing service to mining and minerals processing industries, its subsidiaries and partners serve many countries around the world.

Underground mining

- Miners and shearers
- Roof support systems
- Shuttle cars
- Specialised personnel and service vehicles
- Roof bolting systems
- Drilling units
- Conveyor systems

Opencast mining

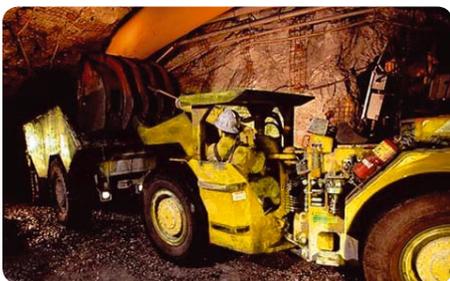
- Dragline hydraulic and mechanical systems
- Power shovel hydraulic and mechanical systems
- Loader hydraulic systems
- Haul vehicles
- Haul vehicles hydraulic systems
- Haul and mine roads maintenance units
- Bulldozers
- Bulldozers hydraulic systems and track pin sealing
- Conveyor systems
- Conveyor system drive and tail units
- Belt scraper systems
- Crushers
- Breaker and crushing units
- Workshop and maintenance equipment
- Drills

Processing

- Wash plant, pumps, gearboxes
- Ball and SAG mill Trunion and gearbox drive systems
- Bulk handling loading and unloading systems
- Bucket wheel hydraulic and drive systems

SKF Economos offers time saving retro-fit split element sealing solutions for:

- Gearboxes and drive units
- Pumps
- Difficult access sealing
- Worn shaft/rod sealing
- Ball and Sag Mill Trunion and gearbox drive systems (where lengthy strip down is a costly problem).



Processes in mining and minerals extraction

SKF Economos seals are present at all different stages of the mining and minerals processing.

Temperature

Transportation of molten slag using Pot Haulers (see page 8).

Installation

Downtime is the most costly expense on any mine site or mineral processing plant. Gear-box and other applications (see page 8).

Wear / reliability

Crushing or resizing of mineral ore prior to processing in a Ball- or Sag Mill (see page 8).

Sliding speed

Transporting ore from the mine site to the processing plant using Haul trucks (see page 10).

Functionality

Stock piling of coal using Stacker/Reclaimers (see page 10).

Pressure

Transporting ore from the mine site to the processing plant using Haul trucks (see page 10).





Special applications for mining and minerals processing industries

SKF Economos produces a large variety of seals and seal-kits for machines in the mining and minerals processing industries. The requirements are not only standardized but also for special applications and, of course, all produced in high performance materials.

Typical applications:

Roof support systems

Main cylinder seal kits, side shield seal kits.

Miners and shearers

Rotary seals, Multi lip seals, Piston seals, Wiper seals, O-rings.

Stacker / Reclaimers

V Lab face seals for guide wheels.

Mobile Equipment (Haul trucks, shovels, drill etc)

Hydraulic seal kits for tilt and lift cylinders, track pin seals.

Conveyor systems

Rotary seals for head and tail pulley bearing housings.

Seal Kits

Various products.

Gear boxes

Split rotary seals, coupling seals, O-rings.

O-RINGS

EPDM, PTFE, Nitrile, Urethane.



① High temperature

When transporting molten slag temperatures outside the slag pot can be in excess of 120° Celcius

Solution for hauler strut cylinder

The strut cylinders are located very close to the slag pot and therefore the wiper is exposed to these high temperatures.

The replacement of the split brass wiper, retained with a wave spring, with a one piece PEEK wiper greatly increased the incidence of ingress as well as simplifying the installation. By introducing the appropriate sealing profile in combination with high performing materials (ECOPAЕК), SKF Economos achieved a much simpler installation process as well as improved wiping function further extending seal life.

② Installation

Seal installation and Split Seals (reduction of downtime)

Machinery for mining and mineral processing often is of very large scale or, in some instances, is difficult to access. Dismantling it in order to enable one to replace seals is time consuming and therefore expensive.

Split seal assemblies

Access to seals is often limited, specifically in gearboxes, as the drive unit and coupling must be removed to facilitate a seal change.

By retro-fitting the SKF Economos POSI Seal future seal replacements can be completed within an hour. Furthermore, the unique SKF Economos POSI Seal design features have extended seal life over standard moulded rotary seals.

③ Wear and reliability

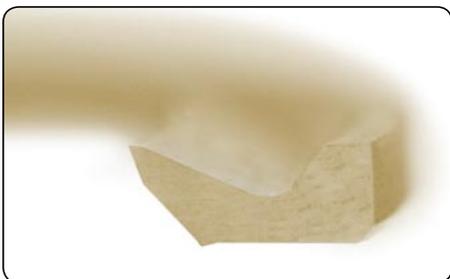
Trunnion seal upgrade

The harsh working environment, to which sag and ball mills are subjected, coupled with their physical magnitude, provide a challenging dilemma. The seal must provide superior oil inclusion functions as well as being able to exclude foreign materials from the bearing chamber, even during wash-down.

Trunnion seal upgrade

The SKF Economos DLP (Double Lip Purgeable) seal, also available in triple-lip-configuration for oil inclusion, is a split seal designed to minimise downtime. Our exclusive G ECOP-UR guarantees long seal life as well as reduced wear of the trunnion surface. The purging facility incorporated into the seal allows for purging the seal cavity of foreign materials further extending seal life.

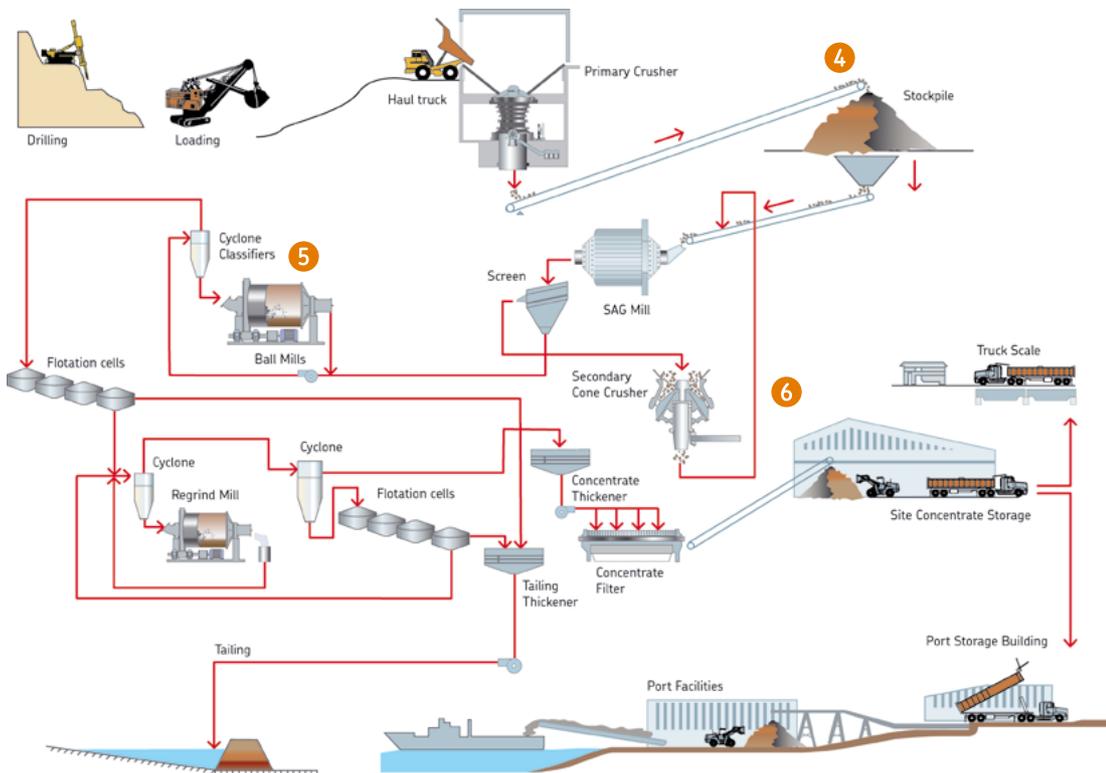
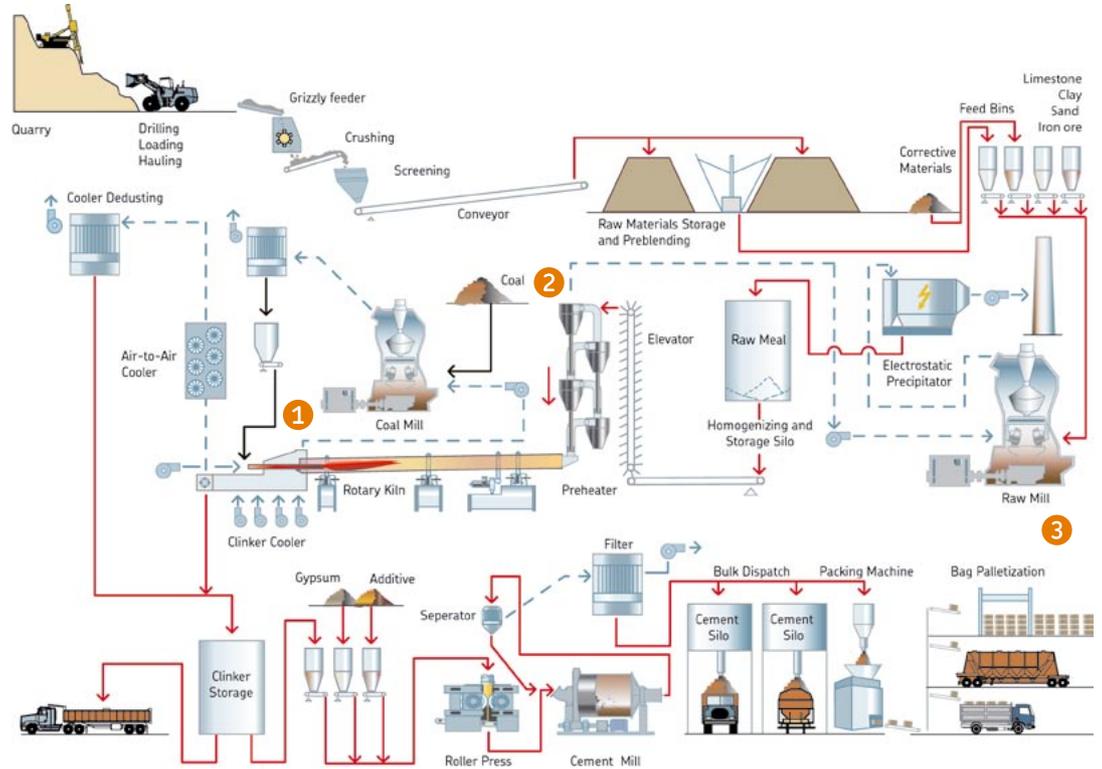
The SKF Economos DLP Seal has a proven track record in remote mine sites in some of the harshest conditions in the world.



Cement and mining process

Cement

- 1 High temperature
- 2 Installation
- 3 Wear and reliability



Mining

- 4 Sliding speed
- 5 Functionality
- 6 Pressure

4 Sliding speed

Cylinder seals

The mining industry can provide a wide range of adverse and varied conditions, sometimes unexpected and unforeseen.

Seals for rear suspension cylinders

Haul truck suspension cylinders are designed to operate at relatively slow speeds and full strokes when carrying a full payload. But when empty the length of the stroke is greatly reduced and the speed greatly increased depending on road surface conditions.

SKF Economos was asked to investigate this sealing problem to ascertain the cause and develop a solution.

The shorter stroke, combined with faster speed resulted in less lubrications, higher friction and ultimate failure. By modifying the standard S03-P profile and introducing our S-ECOPUR friction modified polyurethane we were able to extend seal life well beyond cylinder warranty periods.



5 Functionality

Retro-fit design seal

Stock piling and retrieving coal is a necessary function carried out using a stacker / reclaimer.

V-Lab seal for belt scraper guide wheels

The coal is loaded onto a conveyor belt which requires a scraper to remove the wet coal dust from the belt. The belt scraper is guided by wheels, which are subjected to very aggressive conditions.

SKF Economos was approached to provide a sealing solution to replace the standard taconite arrangement. This was achieved with minimal modification to the existing wheel assembly by providing a specifically designed V-Lab seal and wear strip. Bearing life was extended from 6 weeks (worst case) to up to 2 years with minimal maintenance required.

Stacker / reclaimer located at a coal facility belt scraper guide wheels.



6 Pressure

Seals for cylinders

Superior SKF Economos materials and profiles extend warranty repair period for lift and hoist cylinders.

Seals for lift and tilt cylinders

The extremely adverse and varied conditions experienced by haul trucks on mine sites all over the world can put standard seals and sealing materials to the test. SKF Economos prides itself with being able to offer its customers a range of sealing materials and profiles that are suitable for the coldest European winters to the steamy conditions experienced in South East Asia.

SKF Economos has a proven track record in being able to evaluate the cause of premature seal failure and design and manufacture a solution with minimal downtime and maximum performance.



Proven to optimise system performance

For many years SKF Economos has been providing technically advanced solutions to meet the needs of applications and processes in the mining and minerals processing industries. This focus has led to the development of products and materials specifically engineered, designed, and proven to meet the demands of your operation.

After a detailed study of your operation and your needs, we will check our comprehensive list of standard products to find a suitable solution. Should the application demand a non-standard product, we can provide a customised solution.

The unique SKF Economos “total service” capability can manufacture (on demand – without tooling costs or delays) a solution which will provide considerable advantages over conventional arrangements.

The presented case studies exemplify our ability to provide customised, application specific sealing solutions.

Temperature, Installation, Wear, Sliding speed, Functionality, Pressure.





Mining compliant materials

The proper selection of sealing materials for a specific application is one of the key factors with regards to safety compliance and therefore safe operation.

Fire retardant fluids and 'FRAS' (fire resistant anti-static certificate of Mining Australian Body) requirement dictate that only special compliant high quality sealing materials be used.

A variety of materials are used in the mining and minerals industries.

These are categorized as follows.

- 1 Elastomers – rubber compounds
- 2 Thermoplastics
elastomers – polyurethanes
- 3 PTFE and a variety of its conditioning compounds
- 4 Thermoplastics – high performance plastic formulations

Elastomers are most frequently used materials for seals and gaskets in low to medium pressure applications.

- **SKF Ecorubber 1** (NBR) is most common for general applications.
- **SKF Ecorubber H** (HNBR) offers higher temperature and abrasion resistance than NBR.
- **SKF Ecorubber 2** (FKM / FPM) offer higher temperature, chemical and abrasion resistance and is usually formulated to meet FRAS requirements.
- **SKF Ecosil** (MVQ) offer excellent chemical resistance.

Thermoplastics elastomers (TPU/Polyurethanes) are the high performance solution with best mechanical properties, low compression set, best abrasion resistance and highest strength of the elastomer sealing materials.

- **ECOPUR** (TPU) offers high compatibility with mineral / synthetic oils and greases.
- **H-ECOPUR** (TPU) is a hydrolysis resistant material. Specially used with water-based hydraulic fluids.
- **S-ECOPUR** (TPU) is a self-lubricating sealing material specially optimised for water hydraulic or other low-lub-applications.
- **X-ECOPUR** (TPU) 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.

Where elastomers do not provide sufficient chemical or temperature resistance, **SKF Ecoflon (PTFE)** is the high performance solution. For anti-extrusion components **SKF Ecopaek (PEEK)** is selected to control extreme pressures.

Many of the SKF Economos materials became standards in the Oil & Gas and Mining Industries as they offer cost effective quality sealing solutions. This has mainly been due to economics and the need for maintaining and increasing equipment availability and safety issues.

Pressure fluids – general classification

Seals in the mining and mineral processing industries face a wide range of more or less aggressive working fluids, that may severely attack the sealing materials and ultimately cause seal failure. Generally more and more combustible fluids like mineral oils are substituted by fire-resistant fluids to effectively reduce the incidence of fire related accidents.

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 summarized in table 1.

Due to the water content of these fluids the working temperature is limited up to 60 °C max. to avoid damaging of the equipment.

For higher temperatures fire-resistant fluids of synthetic composition are used (see table 2).

As these fluids are toxic major health and safety issues may arise.

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

Table 1. Composition of water-based fluids

Fluid-category	Characterization	Toxicity	Notes
HFD-R	Various grades of phosphate esters	medium/high	hazardous
HFD-S	Chlorinated hydrocarbons (mostly PCB)	high	hazardous
HFD-T	Mixtures of phosphate esters and chlorinated hydrocarbons	high	hazardous
HFD-U	Synthetic esters Silicone oils	no/low	biologically degradable

Table 2. Fire-resistant fluids of synthetic composition (HFD)

Pressure fluids and sealing materials

Generally fire-resistant working fluids can greatly affect the integrity of sealing materials, and therefore, careful selection of compatible sealing materials is required, when compared to mineral oils.

SKF Economos has extensive experience in sealing these kind of critical applications as well as having carried out extensive investigations of the compatibility of seals with these types of fluids.

The results of these investigations and general recommendations for adequate sealing materials are summarized in table 3.

Fluid-category	Service temperature (°C)	Resistant elastomers SKF Economos recommendations	Notes
HFA-E	+5 to 55 (60)	H-ECOPUR* (specially formulated polyurethane), NBR, HNBR, specially formulated FPM	–
HFA-S	+5 to 60	H-ECOPUR* (specially formulated polyurethane), NBR, HNBR, properly formulated FPM and EPDM	Individual tests necessary
HFB	+5 to 60	Specially formulated polyurethanes, NBR, HNBR, specially formulated FPM	–
HFC	–20 to 60	NBR, HNBR, EPDM and MVQ	Specially formulated polyurethanes and FPM have limited stability
HFD-R	>100	FPM (depending on fluid type), EPDM, MVQ (depending on fluid type)	–
HFD-S	>100	FPM, MVQ	–
HFD-T	>100	FPM, MVQ	–
HFD-U	Silicone oils >100	H-ECOPUR* (specially formulated polyurethane) up to 100 °C max. FPM (plastizer-free)	–
	Synthetic esters +80	H-ECOPUR* (specially formulated polyurethane) , FPM	–

Table 3. Fluid compatibility of sealing materials

The knowledge engineering company

The SKF brand now means more than ever to the customer. While maintaining its position as world leader in quality bearings, greater customer value has been created through new advances in technology, product support and services, making SKF a truly solutions-oriented supplier. Customer productivity has increased through leading edge application-specific products, design simulation tools, consultancy services, plant asset efficiency maintenance programs 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 customer 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 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 of up to 600 mm and some selected grades can be supplied in diameters of up to 1 600 mm for rubber materials and more than 8 500 mm in polyurethane materials. Milled parts, plates and sheets are available in a wide range of dimensions.

The SKF Economos production philosophy allows us to produce all seals and plastics parts as single item, in small quantities, or

larger quantities up to a couple of thousand, using machining or milling techniques.

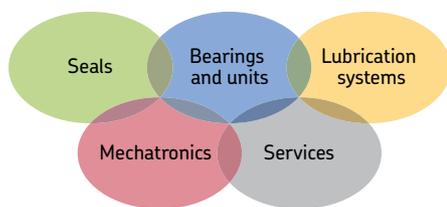
Larger quantities and high volume business will be produced using an injection moulding process, as used in the manufacture of “difficult” materials like polyurethanes and high performance thermoplastics such as polyetheretherketone (PEEK).

Occupational health, safety and environment

We are committed to providing a safe and healthy workplace, being the steward of the environment and natural resources within our scope of responsibility and to being a respected member of the community.



Our sealing experts are joining your team to develop unique solutions to your unique sealing needs.



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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