Sealing solutions for the oil and gas industry

Protecting productivity, profitability and sustainability worldwide

The Power of Knowledge Engineering

This is no place for ordinary seals.

SKF is no ordinary seals provider.

A unique blend of knowledge

Backed by more than 100 years of rotating machinery application experience, SKF is synonymous with high quality bearings. And strategic investments in lubrication technology have positioned us as the largest global supplier of lubrication systems as well.

This combination of knowledge areas gives SKF a deep understanding of the tribology of mechanical systems, a key capability that's allowed us to become a leading seals supplier for rotating and reciprocating machinery applications across the world's major industries.

SKF has also invested heavily in fundamental research, material science and fabrication technology, an effort that's allowed us to develop seal innovations for static applications that fulfill the most demanding oil and gas industry requirements.

With our broad manufacturing footprint we can offer seals in standard profiles or fully customized designs. And our moulded and machined seal production capabilities enable everything from rapid prototyping to serial production to replacement parts.

A proven oil and gas industry pedigree

For many decades, SKF has worked with OEMs, maintenance providers and end-users to solve some of the oil and gas industry's toughest application challenges. Today, we draw from knowledge areas across SKF to improve on these technologies and develop next-generation sealing solutions.

Customized sealing solutions

Oilfield media and environments can severely limit seal life and performance. When harsh operating conditions are more than standard catalogue seals can handle, SKF can help. Drawing on comprehensive SKF sealing materials and profiles, our seal specialists can rapidly develop customized sealing solutions to meet virtually any application demand.

Whether your application is upstream, midstream or downstream, whether you need to develop a new seal or upgrade an existing one, SKF solutions can help:

- **Increase productivity and reliability**
- **Improve safety and sustainability**
- **Reduce maintenance and downtime**
- **Extend equipment service life**
- **Reduce total operating costs**
- **Meet increasing regulatory demands**
- **Cut product development times**
- **Enable media and energy savings**




Supporting uptime from crown block to b

Drawing on decades of oilfield experience, SKF has developed a range of sealing solutions to make your exploration, drilling, stimulation and completions run more smoothly and reliably. At work in some of the industry's most challenging onshore applications, SKF seals are protecting productivity in fields and facilities worldwide.

Seals for hoisting and rotating equipment

To guard against costly downtime, key bearings in draw works, top drives and rotating control devices (RCDs) require robust protection from the elements and/or production fluids. SKF offers a proven range of heavy-duty seals that keep lubricants in and contaminants out of bearings in the toughest oilfield environments.

SKF heavy industry seals

Protecting uptime in some of the world's harshest industries and applications, SKF heavy industry seals can deliver robust performance for an array of rig applications. The extensive range includes heavy-duty metal-cased seals, rubber outside diameter seals with metal inserts or rubber-reinforcement, and polyurethane seals.

Seals for downhole tools

Downhole, seals must be able to withstand extreme pressures and temperatures, plus exposure to various drilling and formation fluids. Robust rotary and reciprocating seals from SKF are field and lab-tested to get the job done.

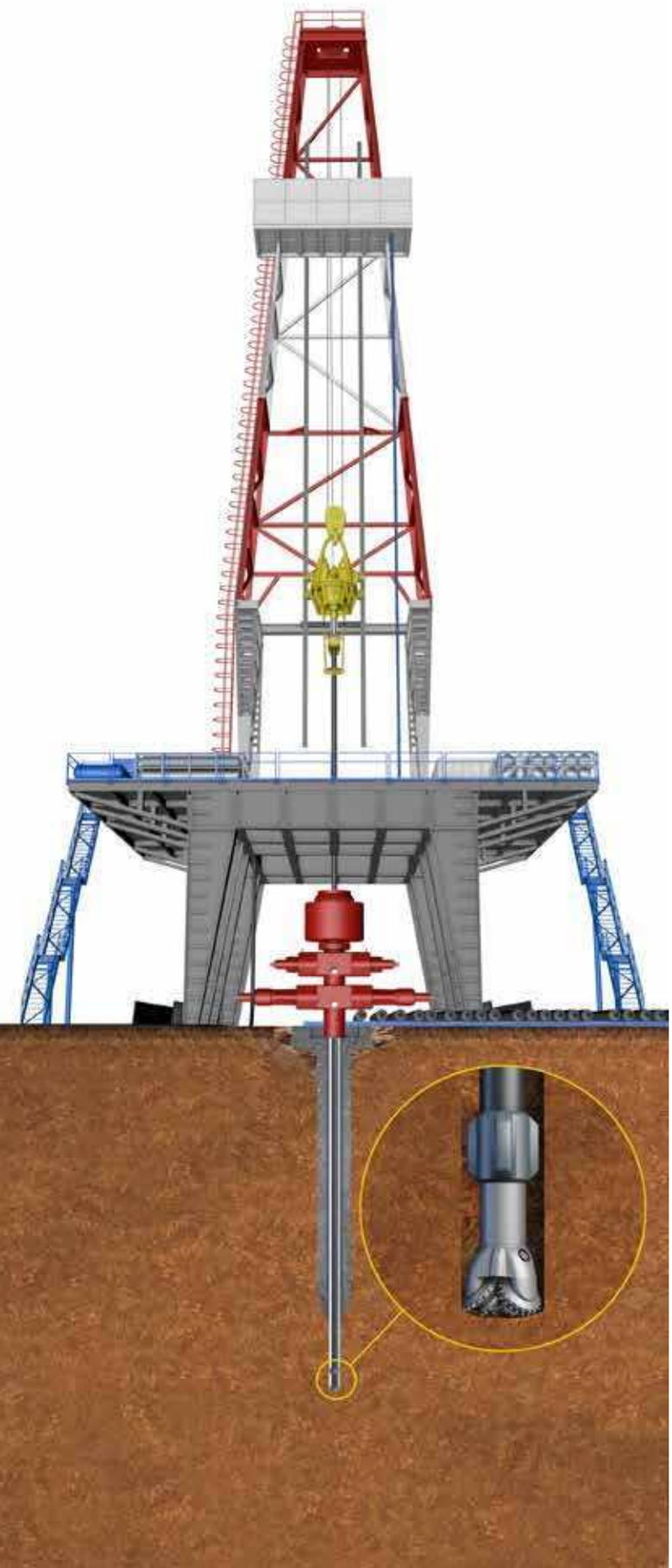
High pressure rotary seals

SKF has developed advanced rotary seal designs and materials to handle extreme downhole pressures. The SKF Teflathane seal incorporates a low-friction PTFE seal ring bonded to a rubber body. The all-rubber DM2 seal separates drilling mud from lubricants in oil-lubricated mud motor bearings.

Reciprocating seals

In many downhole tools, being able to open and close key doors and valves, or drive linear motion components in the drill string depends on reliable reciprocating equipment. Reciprocating seals from SKF protect system components and uptime. Poly-O seals are available in many special rubber compounds to withstand downhole conditions. The SKF Spectraseal Z combines a low-friction PTFE base with a robust rubber seal.

bottom-hole



Seals for wellhead

Today's wellhead equipment must endure higher pressures and temperatures, and meet tougher regulations and certification requirements than ever. Unique sealing solutions from SKF are helping manufacturers meet these requirements with wellhead seal solutions that perform reliably, from spud-in through production.

FS seals
Achieving effective high-pressure static sealing against casing and tubing surfaces is a considerable challenge. FS seals can help you meet it with a proprietary NORSOK M710-approved grade of HNBR. This SKF-developed material gives FS seals excellent resistance to explosive decompression and chemical attack.

Locking T-seals
Featuring a patented innovation on the popular T-seal design, locking T-seals mechanically lock backup rings in place to enable easier, damage-free installation. The seals provide a high performance replacement for S-seals, as they can handle higher pressures and temperatures while reducing damage to metal components.

Hydraulic seals for blow-out preventers
SKF offers an extensive range of hydraulic sealing solutions for blowout preventers (BOPs). For ram BOPs, SKF offers a wide variety of rod and piston seals and guide rings.

Gate valve stem and seat seals
SKF offers an array of choke and valve seals for pressure control applications during drilling or production on Christmas trees. SKF gate valve stem and seat seals have been used in customer valves to pass API 6A PR2 tests up to 20 kpsi (*1 378 bars*).

Maintenance-free operation on the rig, ship

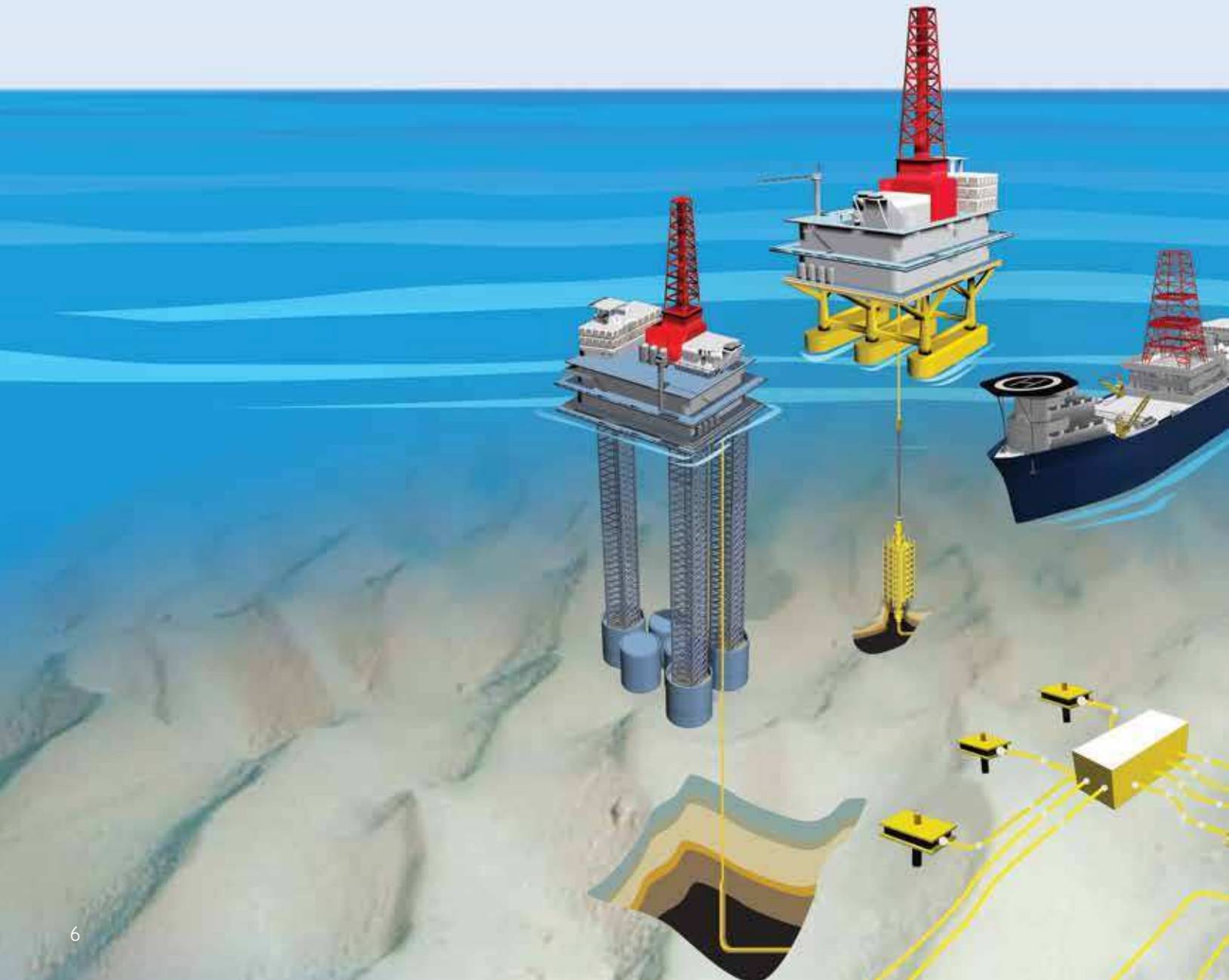
Deeper water, deeper wells and increasingly stringent regulations. It's a challenging mix of operating and market conditions – one that SKF is helping offshore and subsea equipment manufacturers meet with sealing solutions for long-term, virtually maintenance-free operation.

Subsea connectors, valves and swivels

Deepwater subsea field operations demand trouble-free deployment and long service life. Innovative subsea sealing solutions from SKF can deliver both in even the most extreme deepwater sites.

Crown seal

With a long history in multiple subsea applications, the crown seal features a high durometer thermoplastic elastomer cap loaded by a rubber o-ring energizer. The cap offers lower friction, better extrusion resistance and better rolling resistance than an o-ring. SKF crown seals can be used to retrofit standard o-rings for easy conversion.



and sea floor

SKF Spectraseal
Combining special compounds of inert PTFE material and corrosion-resistant metal springs, SKF Spectraseal provides virtually unchanged operation – for years longer than conventional rubber seals. Used in rotary, reciprocating and oscillating applications, SKF Spectraseal can be customized to meet specific application requirements.

Locking T-seal
Subsea connectors and tools often require engagement of sealing joints remotely. The patented locking T-seal is designed for ease of installation without damage. Retention features assure that the backup rings stay securely in place to avoid loose components pinching between assembly components and damaging the seals.

Swivel stacks and turrets for floating production and offloading

Floating production equipment and transport vessels must keep flowing channels connected, even as they move with shifting winds and currents. But the seals that support 360-degree rotation in swivel stacks, turrets and buoys are prone to damage during installation that can lead to problems later. SKF large diameter seals are easy to install and proven to keep production fluids in and seawater out.

Large diameter seals
SKF large diameter seals feature an SKF-developed G-ECOPUR polyurethane with enhanced chemical and hydrolysis resistance. SKF also applies a special welding technique to join split profile segments on-site, eliminating the need for costly, time-consuming equipment disassembly.

The support and speed you need, worldwide

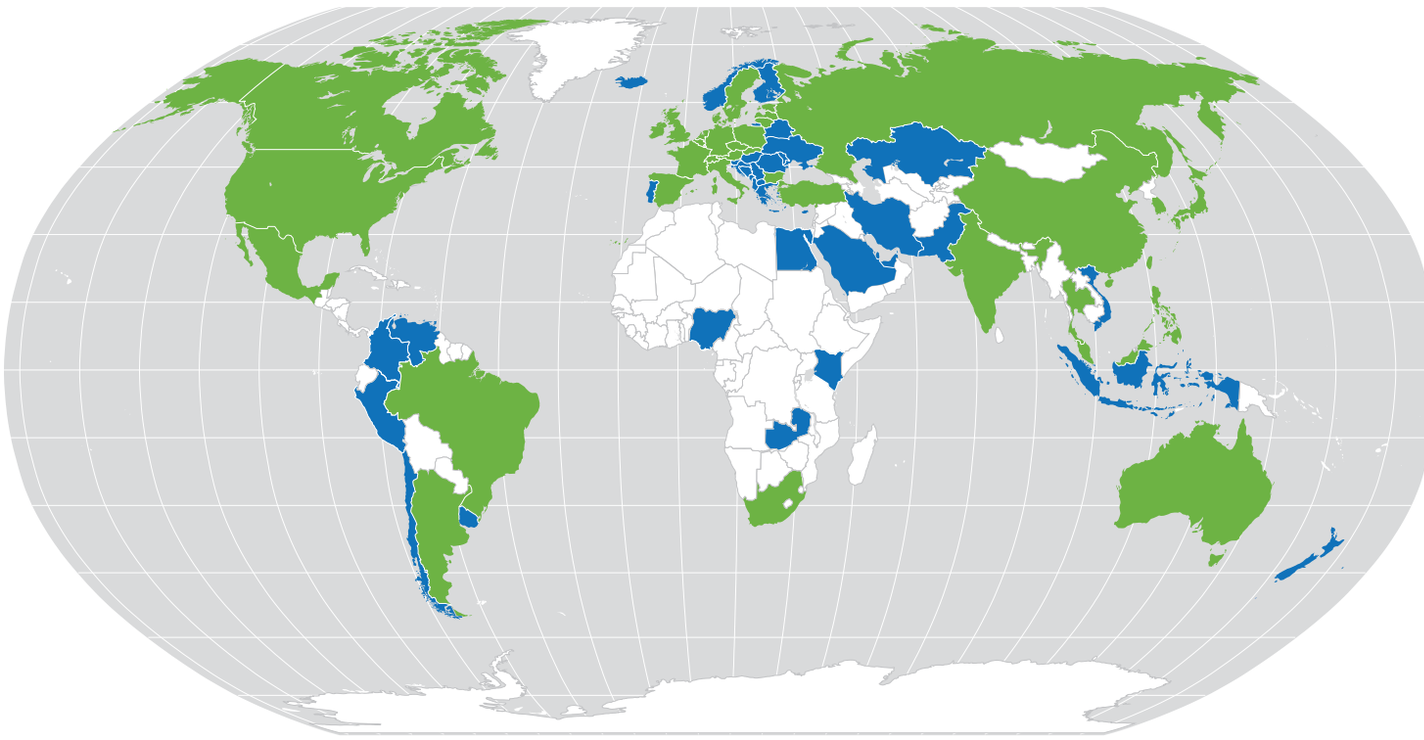
Combining capabilities in seal development, manufacturing and logistics, SKF's global sealing platform enables rapid development and delivery of optimized, certified solutions for the oil and gas industry. Wherever you need us, we can work with you closely throughout the seal lifecycle, from design and serial production to operations and maintenance.

Proximity and flexibility you can count on

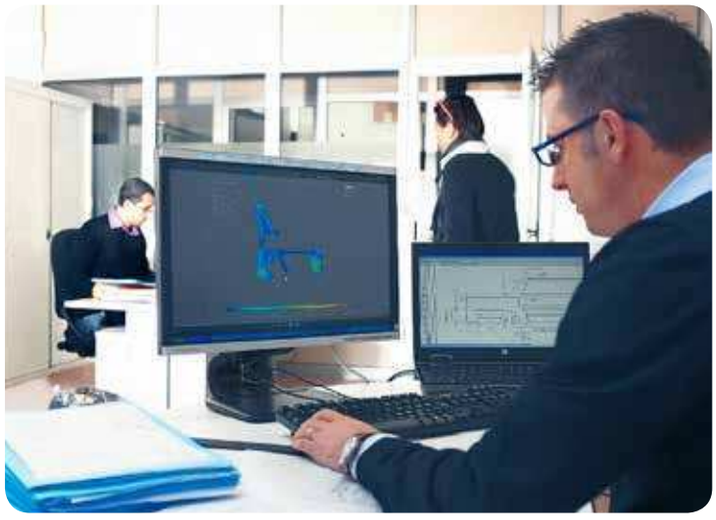
Dedicated SKF sales, engineering and customer service teams support oil and gas regions globally. Wherever you are, SKF sealing expertise and support is nearby, readily available through our efficient logistic services, distributors and dealers network and production sites worldwide.

SKF Solution Factory locations worldwide are also able to keep SKF close to our customers. Providing a gateway to SKF knowledge at each location, SKF Solution Factory can help you solve your toughest sealing challenges quickly.

Situated at a key hub of the North American oil and gas industry, the SKF Solution Factory in Houston, Texas delivers expert sealing engineering and fast, on-demand machined seal production.



- *Countries with SKF seals moulding and/or machining facilities, engineering, sales and customer service units*
- *Countries with SKF sales, engineering and customer services units*
- *In most countries in white, SKF is represented through authorized distributors/dealers*



Design and application engineering

Harsh new operating environments and regulations are making seal development for oil and gas applications even more challenging. Design and application engineering support from SKF can make it much easier.

As the world's only engineering company that develops both bearings and seals, SKF has a unique perspective on the interplay of elements in rotary sealing systems. And during our 100+ years of diverse industrial application experience, we've also developed a deep understanding of the conditions that affect reciprocating and static seals. Oil and gas sealing solutions from SKF benefit from years of research and development in sealing technology combining materials, design and tribology.

We can provide detailed on-site analysis of your operational requirements, and use SKF Simulator for seals software to help predict sealing performance under various conditions. SKF engineers also apply non-linear Finite Elements Analysis (FEA) to simulate almost any operating condition by using different seal geometries to identify the critical areas in the design.

Testing

Located throughout North America, Europe and Asia, SKF testing facilities can fully validate seal function and performance. These state-of-the-art laboratories conduct seal test trials that simulate harsh oil and gas industry operating conditions.

Advanced testing performed with 3-D modeling and simulation software is available, including key life testing that uses test profiles and operating conditions from real applications. SKF also conducts physical performance trials on our own sealing modules, as well as customer components and assemblies.

Machined seals: enabling solutions on dem

Proven sealing expertise

Building on our long leadership in the area of rotating seals, SKF has made strategic investments to expand our capabilities in static applications for oil and gas. Leveraging our experience in material development along with advanced modelling and testing, we have supported the industry with innovations for many years.

Many breakthroughs in valve development have three things in common:

- **Collaboration between valve OEM and seal development partner to meet a demanding new end user requirement**
- **A rapid prototyping phase to validate the initial concept**
- **Aggressive production ramp-up with expectations to control cost of series production**

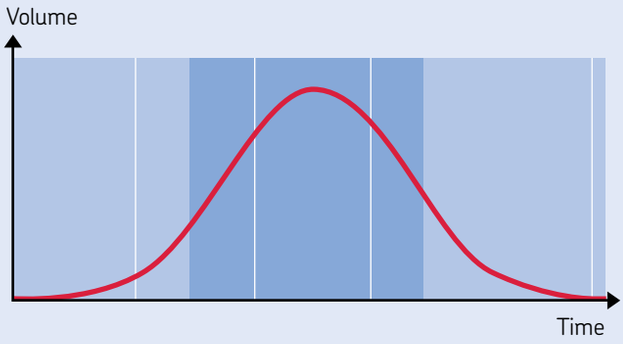
SKF has the proven experience to keep pace with your needs throughout the full cycle of innovation and volume production. One key aspect of this is our global fleet of strategically deployed CNC machining centers (over 100). And these are linked to our volume production plants for seamless transfer to a moulded seal design.

Machined seals for solutions on demand

SKF's machined seals concept provides a faster, more flexible alternative to moulded seal production. Combining a unique package of services, our machined seals concept gives SKF the ability to deliver polymer seals in a very short time, in virtually any dimension and design, for virtually any oil and gas application.

Services enabled by our machined seals concept combine several SKF strengths, including extensive application engineering support, a wide selection of seal profiles and materials, and worldwide availability. Together, these capabilities enable on-demand manufacturing for everything from a single seal to a low-volume series.

Life Cycle Supply Model



Machined seals
To cost effectively produce prototypes and seals in low volumes with short delivery time (in the introduction, initial growth, declining phase to meet replacement demand)

Moulded seals
To cost effectively produce seals in high volume (time in the growth and maturity phases)

hand

Application engineering support

We begin with a consultative process through which our engineers gain an understanding of your particular sealing application challenges. Once we determine your unique requirements, we can choose from the most appropriate seal profiles and materials to develop a solution.

Profile and materials selection

We select your seal profiles from an array of designs that are pre-programmed in our proprietary machining system, or we can work with you to design a fully customized profile. Our engineers will also determine the optimum sealing material.

Our world-class range of standard and special-grade machinable sealing materials comply with NORSOK, NACE, API and other key industry standards and regulations.

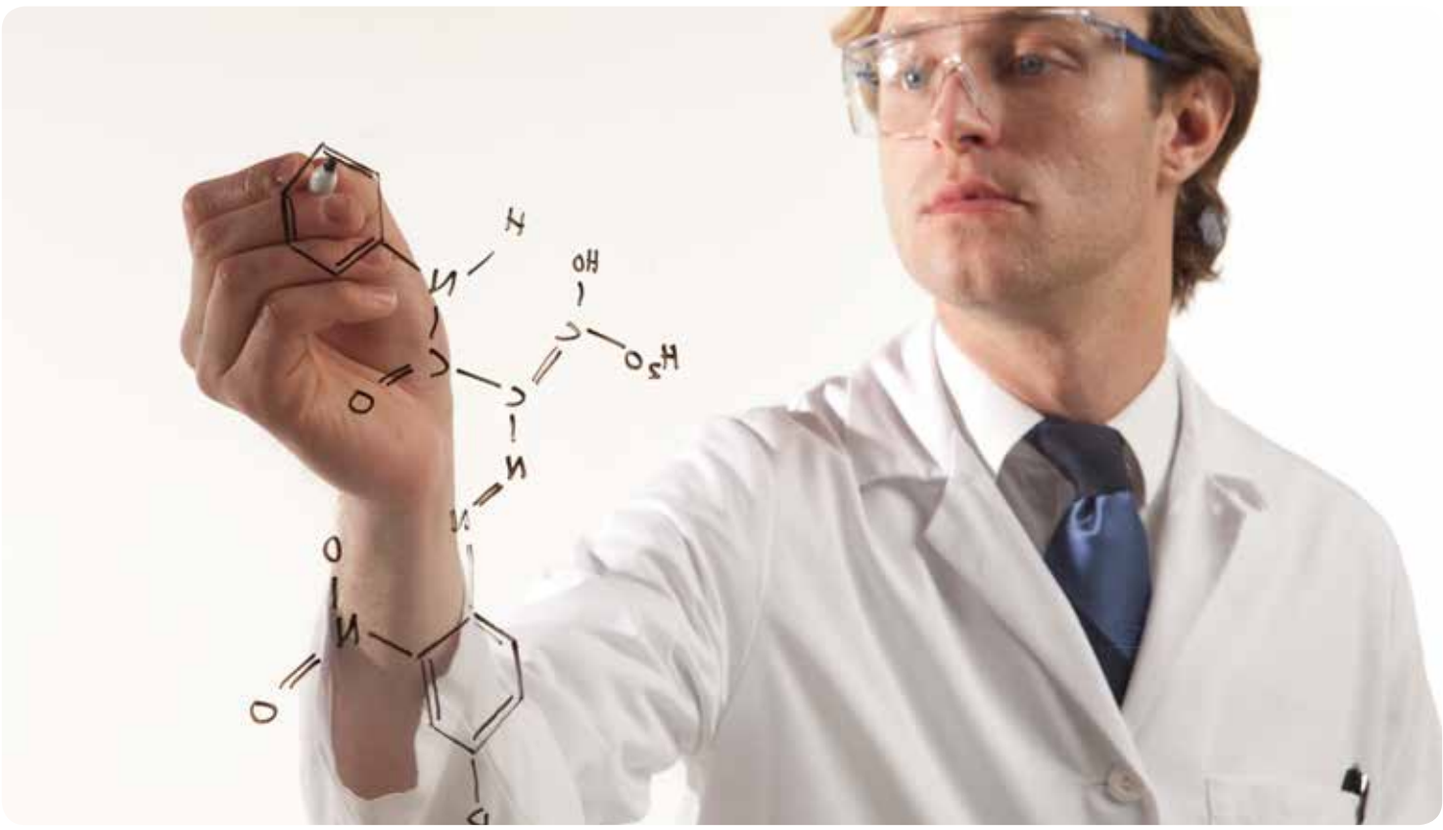
CNC manufacturing process

Featuring proprietary software and high-precision cutting tools, the SKF SEAL JET manufacturing system uses Computer Numerical Control (CNC) technology to machine polymer seals quickly. The system custom-machines a seal from a semi-finished tube of your specially selected materials.

Rapid delivery worldwide

The machined seals concept and related services are available globally at selected SKF Solution Factories and machined seals reference centres. Strategically positioned throughout the world's major industrial markets, these facilities support rapid manufacturing and delivery.

Optimized sealing materials for oil and gas



Seals for oil and gas applications can be exposed to everything from harsh drilling and completion fluids to high temperatures, pressures and contact forces. How well, and how long a seal performs in such conditions greatly depends on the choice of sealing material. SKF can help you select the optimum sealing material for your application by drawing from four major polymeric material groups:

- **Rubbers, such as nitrile (NBR) and hydrogenated nitrile (HNBR) and fluorocarbon rubbers (FKM, FPM, TFE/P, FFKM)**
- **Thermoplastic (TP) elastomers, such as polyurethane (TPU)**
- **Polytetrafluoroethylene (PTFE) and its compounds**
- **Plastics, such as polyetheretherketone (PEEK)**

SKF Ecorubber-H: a rapid gas decompression-resistant HNBR

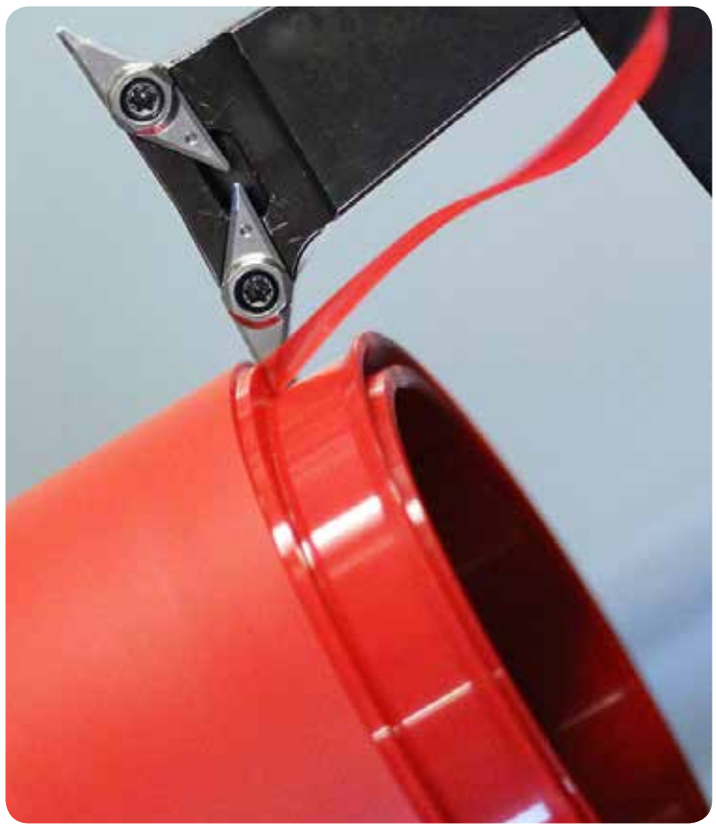
Sour gases under extreme pressures can penetrate seals and, following rapid decompression, explode to severely damage the seals. Seals under extreme pressures can also be chemically attacked by these supercritical gases.

To evaluate the ability of seal materials to resist this rapid gas decompression (RGD) and long-term aging, the industry has several test standards including NORSOK M710. SKF HNBR compound SKF Ecorubber-H-85A-b-ED has been certified to these demanding standards and has proven to be an excellent material for these severe environments.

H-ECOPUR: a chemical-resistant TPU

Highly suitable for downhole, subsea and hydraulic applications, SKF's proprietary H-ECOPUR material family combines robust physical properties with excellent resistance to hydrolysis. This thermoplastic polyurethane elastomer (TPU) offers excellent stability in saltwater, freshwater, HFA and HFB fluids, mineral oils and biologically degradable hydraulic fluids.

applications



Seal materials commonly used in oil and gas applications

	Temp. low	Temp. high	Grades certified per [2]	
	°C (°F)	°C (°F)	API 6A	NORSOK
Rubber				
NBR [1]	–30 (–22)	100 (212)		
XNBR	–20 (–4)	135 (275)		
HNBR [1]	–25 (–13)	150 (302)	X	X
EPDM	–50 (–58)	150 (302)		
FKM [1]	–20 (–4)	200 (392)	X	X
TFE/P	–10 (–14)	200 (392)		
FKM Extreme	–10 (–14)	200 (392)		
FFKM	–15 (–5)	290 (554)		
Thermoplastic elastomers				
Standard TPU	–30 (–22)	110 (230)		
Premium TPU	–20 (–4)	110 (230)		
PTFE				
PTFE	–200 (–328)	260 (500)	X	Pending
Filled PTFE	–200 (–328)	260 (500)	X	Pending
Plastics				
Acetal	–50 (–58)	100 (212)		
PPS	–250 (–418)	220 (428)		
PEEK	–60 (–76)	260 (500)	X	X
UHMWPE	–200 (–328)	90 (194)		

[1] Low temperature grades available
[2] Indicates SKF has grades available which have been externally tested and certified per NORSOK M710 and/or API 6A

SKF Ecoflon and 700 Series PTFEs for extreme applications

Engineered to handle extreme conditions, PTFE and its compounds can withstand aggressive chemicals plus high temperatures and pressures. SKF PTFEs use high quality fillers to offer best-in-class performance. Our family of carbon-filled PTFEs are proven to provide excellent surface finish and seal performance in demanding applications.

SKF Ecopaek (PEEK) for high temperatures and pressures

Seals operating under extreme pressures and loads are subject to extrusion and deformation. Seals exposed to high temperatures and chemicals can degrade rapidly. SKF Ecopaek (PEEK) provides a robust solution for these conditions and more.

Characterized by much higher hardness and stiffness than other thermoplastics, SKF Ecopaek is a sealing material staple in the oil and gas industry. It is produced with forming processes that help optimize the material's temperature and chemical resistance.

FFKM for high temperatures and harsh fluids

Featuring very broad chemical resistance and high temperature capabilities, perfluoroelastomer (FFKM) compounds from SKF perform where almost nothing else will.

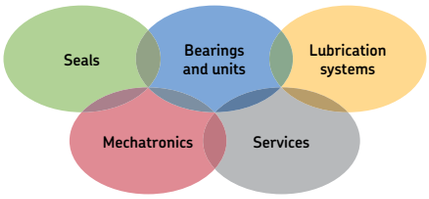
Chemical compatibility of SKF sealing materials

	Rubbers										Thermoplastic elastomers		PTFE			Plastics			
	NBR	Low temp NBR	XNBR	HNBR	EPDM	Fluoro-silicone	FKM	TFE/P	FKM Extreme	FFKM	Standard TPU	Premium TPU	PTFE	PTFE w/ C	PTFE w/ Glass moly	Acetal	PPS	PEEK	UHMWPE
Acids																			
Inorganic diluted	o	o	o	o	+	+	+	+	+	+	-	+	+	+	+	o	+	+	+
Inorganic concentrated	-	-	-	-	+	+	+	+	+	+	-	-	+	-	o	-	-	-	-
Organic diluted	+	+	+	+	+	+	+	+	+	+	o	+	+	+	+	o	+	+	+
Organic concentrated	-	-	-	-	+	o	-	o	o	+	-	o	+	+	+	o	+	+	+
Alkalis General	o	o	o	o	+	+	o	+	+	+	-	o	+	o	o	o	+	+	+
Alcohols General	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	o	o	+
Biocides																			
Diluted	+	o	+	+	+	+	+	+	+	+	o	+	+	+	+	+	+	+	+
Concentrated	-	-	-	-	+	-	-	o	-	+	-	-	+	+	+	o	+	+	+
Brines General	o	o	o	o	+	+	+	+	+	+	o	+	+	+	+	+	+	+	+
Carbon dioxide	+	+	+	+	+	+	+	o	+	+	o	+	+	+	+	+	+	+	+
Corrosion inhibitors																			
Amine based	-	-	-	o	+	o	-	+	+	+	o	o	+	+	+	+	+	+	+
Potassium based	-	-	-	o	+	o	-	+	o	+	+	+	+	+	+	+	+	+	+
Crude oil																			
Sweet	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sour – up to 5% H2S	-	-	o	+	-	o	+	+	+	+	+	+	+	+	+	+	+	+	+
Sour – above 5% H2S	-	-	-	-	-	-	-	o	o	+	+	o	+	o	o	+	+	+	+
Drilling mud																			
Diesel based	o	o	+	+	-	+	o	o	+	+	+	+	+	+	+	+	+	+	+
Ester based	-	-	-	-	-	o	o	o	+	+	o	o	+	+	+	+	+	+	+
Mineral oil based	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Silicate based	o	o	o	+	o	+	+	+	o	+	+	+	+	+	+	+	+	+	+
Glycols General	+	+	+	+	+	+	+	+	+	+	o	o	+	+	+	+	+	+	+
Hydraulic fluids																			
Mineral oil based	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
HFA (water-oil emulsion)	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
HFB (oil-water emulsion)	o	o	o	+	-	o	+	+	+	+	+	+	+	+	+	+	+	+	+
HFC (water-glycol)	+	+	+	+	+	o	-	+	+	+	o	o	+	+	+	+	+	+	+
HFD-R	-	-	-	-	+	+	o	+	+	+	-	-	+	+	+	+	+	+	+
HFD-S	-	-	-	-	-	+	+	o	+	+	-	-	+	+	+	+	+	+	+
HFD-U	o	o	o	o	-	-	+	o	+	+	+	+	+	+	+	+	+	+	+
Hydrocarbons																			
Aliphatic	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Aromatic	o	o	o	o	-	+	+	o	+	+	o	o	+	+	+	+	+	+	+
Hydrogen sulfide	-	-	o	+	+	-	o	+	+	+	+	+	+	+	o	+	+	+	+
Methanol																			
Diluted	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Concentrated	o	o	o	+	o	+	-	+	+	+	-	-	+	+	+	+	o	+	o
Natural gas	+	+	+	+	-	o	+	+	+	+	+	+	+	+	+	+	+	+	-
Sea water	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Solvents																			
Toluene	-	-	-	-	-	o	+	o	+	+	-	-	+	+	o	+	-	+	o
Acetone	-	-	-	-	+	-	-	-	-	+	-	-	+	+	+	+	+	+	o
MEK	-	-	-	-	+	-	-	-	-	+	-	-	+	+	+	o	o	+	+
Steam	-	-	-	-	+	-	-	+	o	+	-	-	+	+	+	-	+	+	o
Water																			
General	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Produced	o	o	+	+	o	o	o	+	o	+	+	+	+	+	+	+	+	+	+
Treated	o	o	+	+	+	o	-	+	o	+	o	o	+	+	+	o	+	+	+

+ = recommended
o = moderate attack or temperature dependent
- = not recommended

See inserts for more details about SKF solutions for the oil and gas industry.

The Power of Knowledge Engineering



The Power of Knowledge Engineering
Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF's global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.

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