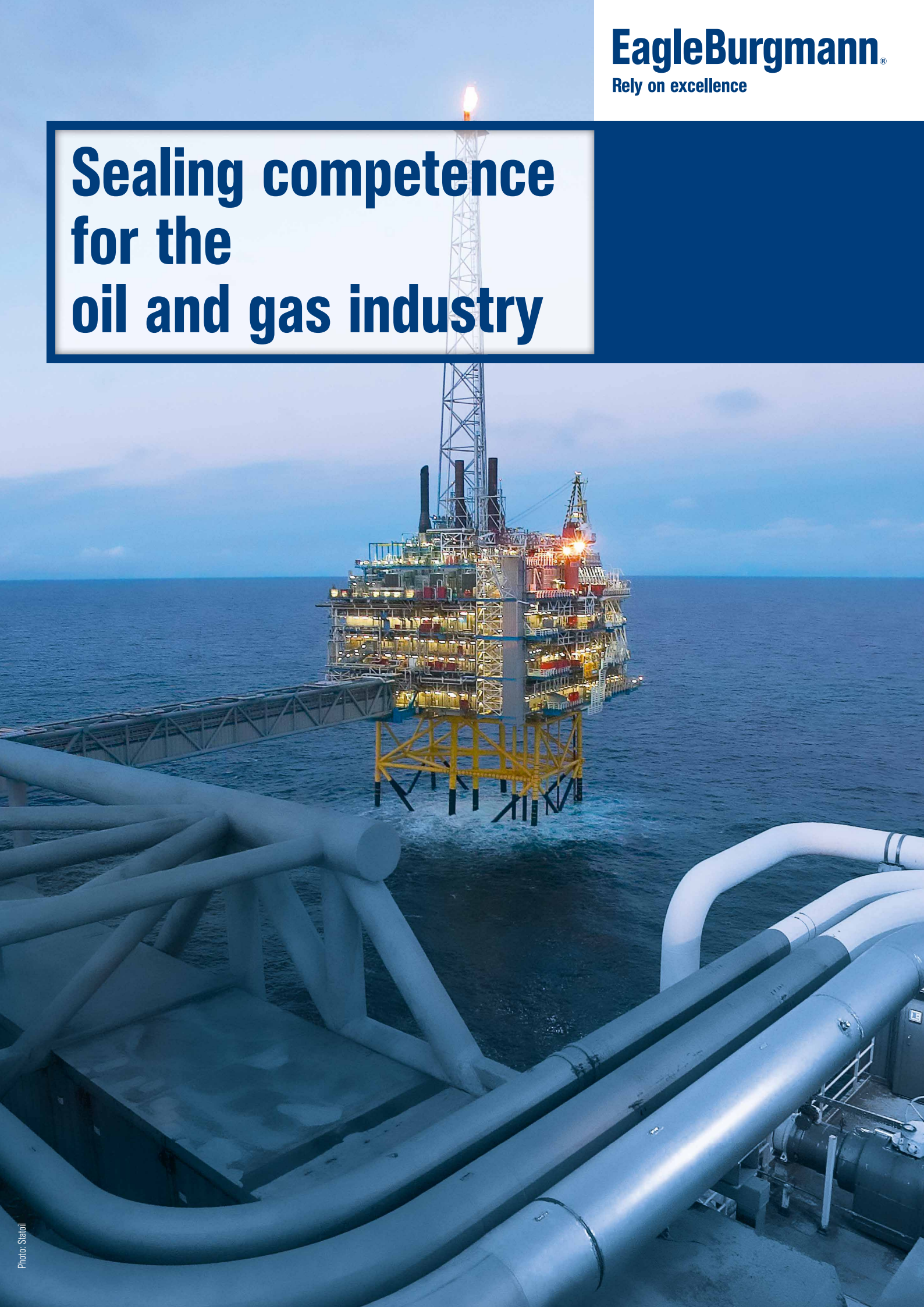


EagleBurgmann[®]
Rely on excellence

Sealing competence for the oil and gas industry



As versatile as the requirements of the oil and gas industry: So are sealing solutions from EagleBurgmann.

Norway

35 oil platforms offshore are equipped with seals from EagleBurgmann.

ESPO pipeline, Russia

60 dual seals and 64 single seals for high-pressure crude oil pipeline pumps in use.

CNRL, Canada

More than 100 multiphase pumps with EagleBurgmann mechanical seals in the heavy oil production using cyclic steam stimulation.

Middle East

Ring-type joints for wellheads and successful deployment in subsea environment.

A large offshore oil platform is shown at night, illuminated by its own lights. The platform is a complex of steel structures, including a tall derrick and various levels of decks. In the foreground, a series of large, parallel pipes run across the platform, leading towards the background. The sky is dark, and the ocean is visible in the distance. The overall scene is industrial and dramatic, with the warm glow of the platform's lights contrasting against the cool blue tones of the night sky and sea.

PDO, Oman

More than 50 water injection pumps are equipped with SHFV seals and corresponding supply systems.

Sulzer Pumps, United Kingdom

The world's largest water injection pump operates using EagleBurgmann high-pressure seals and an API Plan 53B supply system.

FPSO in Tupi oil field in Brazil

Newly developed triple high-pressure seal (type SHF-D11) for 600 bar and above CO₂ injection pumps.

EagleBurgmann expansion joints are used in gas turbine exhaust systems on oil platforms.

Sealing partner of the global oil and gas industry

EagleBurgmann is one of the world's leading system suppliers of sealing technology and has been a partner to the oil and gas industry for many years. From the beginning, we've brought our innovative approach to shaping the sealing technology in this demanding industry. Throughout the world, our products and solutions are successfully deployed from upstream, midstream and downstream to on- and offshore and subsea applications – including those involving the most extreme climatic and geological conditions.

Comprehensive industry-specific knowledge

We understand the needs of the oil and gas industry and have an in-depth insight into the various processes involved. Strict requirements are placed on sealing technology as increasingly demanding fields are tapped in order to ensure cost-effective, efficient and safe production. With our application expertise and technical consultancy skills we are able to provide reliable and cost-effective solutions for every need.

Full-service partner with a global presence

Research and development, consulting, engineering, design, production and a broad range of modular services are competences that our customers use to their benefit. Our comprehensive network of production sites and sales and service centers means that we are always close to you, wherever you are in the world.

Sealing technology: A key component in the operation of industrial plants.



Reliably safe and very economical

No industrial production plant can be operated without seals. The number of sealing locations and media to be controlled is correspondingly large. So there are quite a number of plant components that need to be sealed: rotating equipment, such as pumps, agitators and compressors; fittings and flanges, not to mention pipes and ducts carrying gases and liquids.

The reliability of the entire plant depends on many individual parts. The seals, as key components, play an important role. They protect systems and components from external influences and contamination as well as help prevent emissions. They thus increase process safety, availability and the economic viability of the plant.

Sealing technology also often offers considerable potential for reducing costs – through process-orientated design and standardization, for example. The right product portfolio and knowledge of the processes and standards used allows EagleBurgmann to implement solutions that are not only technically safe and reliable, but economically first-rate as well.

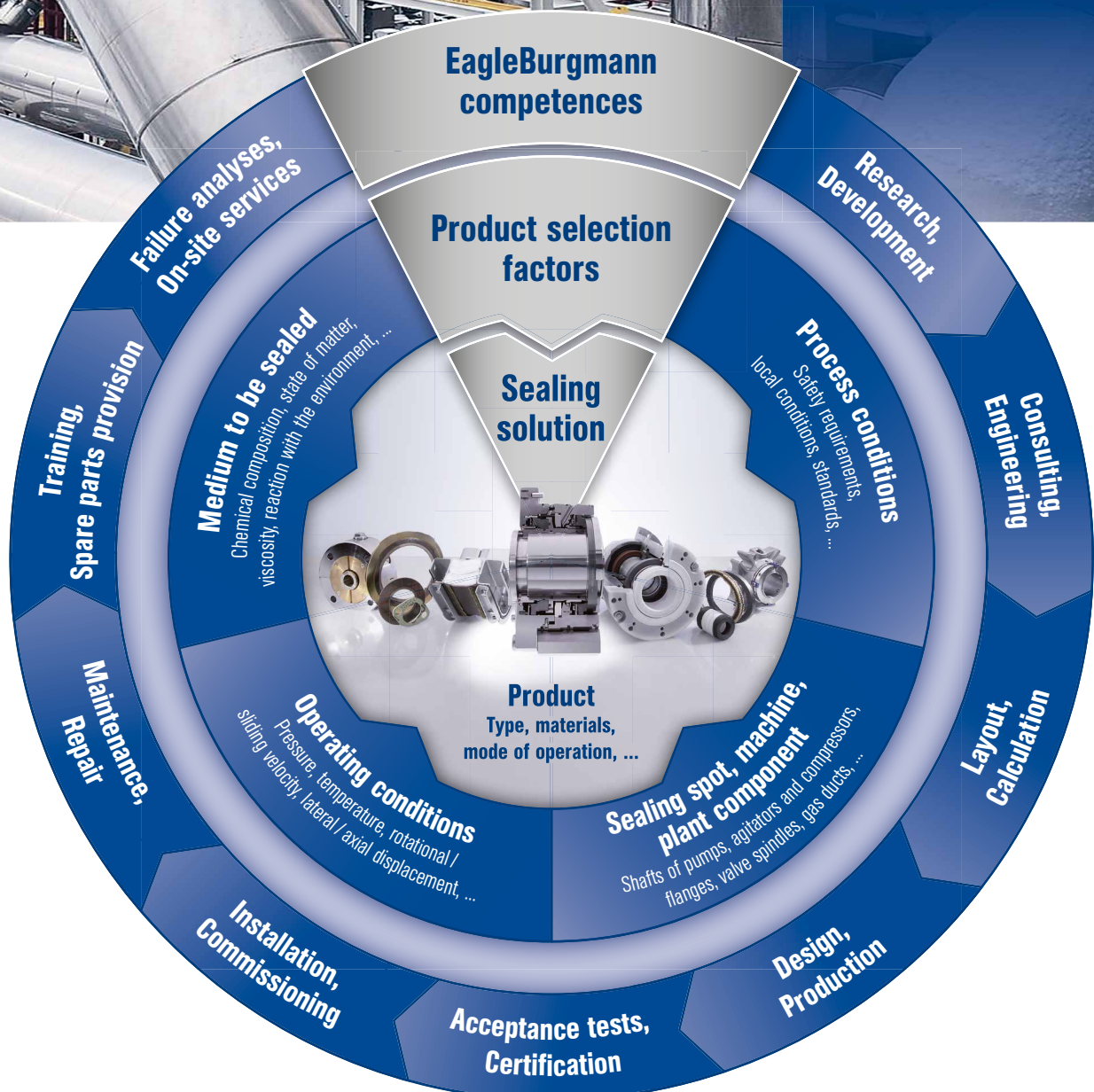




Sealing solutions to meet any requirement

Several factors play a major role when choosing the product, the product type, the materials used and how it is operated: process conditions at the sealing location, operating conditions and the medium to be sealed.

No matter what requirements our customers have, we know how these factors affect functionality and economic viability, and we translate this expertise into outstanding long-term, reliable sealing solutions. EagleBurgmann has all the expertise needed to manage and support the entire development, life and service cycle of its sealing solutions.



Experience, demand and commitment: The building blocks for optimized sealing solutions.

Reliable market partner with worldwide presence

With over 60 subsidiaries and 250 locations worldwide, we use our global focus to the benefit of our customers. Thus our production network, which has plants in Europe, Asia, North and South America, ensures that we are always in line with market requirements, produce on attractive terms and are able to supply regional markets.

We also have a comprehensive network of sales and service centers that covers every important economic region. Being close to our customers also means we are precisely acquainted with their processes and individual requirements.

EagleBurgmann is part of the German Freudenberg Group and the Japanese EKK Group. We have access to all the resources we need to offer optimum support to major customers at the international level and to become a long-term, reliable partner to them.

Consulting and engineering with substance

Technical expertise grows from knowledge. This does not only have to mean knowledge of sealing technology, it also takes into account the machines, components and media to be sealed, along with the manufactured products and industrial processes and process conditions.

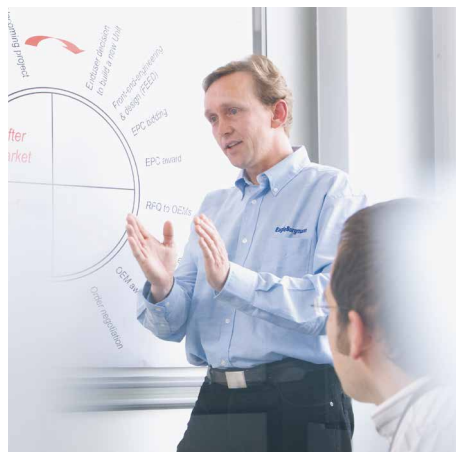
Knowledge management helps us keep our comprehensive knowledge up to date and make it available to the entire company. We use databases, courses and training to develop our employees and bring together our industry expertise from all around the world.

Our dedicated and committed employees use this wide and varied know-how to give our customers well-founded advice on how to choose the best product from the technical and economic viewpoints and how to calculate and design according to need.

High-level research and development

We invest a great deal in research and development in order to consistently improve the performance of our products. EagleBurgmann carries out publicly sponsored research projects and works together with institutes and universities. Joint projects with customers and suppliers are a regular source of new solutions.

Two large research and development centers in Germany and Japan, combined with a worldwide network of testing facilities, allow us to respond flexibly to the requirements of our customers. We run acceptance test rigs for pump, agitator and compressor seals, development and testing laboratories for expansion joints and special test benches for acceptance tests and certification of seals to API 682.



Wide-ranging standard portfolio and tailored solutions

Largely standardized and modular product series are an essential part of our portfolio. But we also offer individual solutions and provide the necessary development, engineering and production capacity for this purpose. Using the latest calculation and design methods, such as 3D-CAD, we adapt our products to customer-specific requirements or design new solutions. Worldwide design standards ensure that the most stringent technical requirements are met.

EagleBurgmann produces to the most demanding internal and external standards at various locations around the world. At all of these locations, we use ultra-modern equipment, optimized and standardized production processes and a great vertical production range – all building upon the reliable base of our excellent employees. Our quality management systems are certified to ISO 9001, for example.

Protection of humans, the environment and industrial plants

Safety is an elementary requirement for industrial sealing technology. It is ultimately all about protecting humans, the environment, products and resources. A lot of what EagleBurgmann does goes far beyond the legal requirements. This sense of responsibility is part of the company culture and is firmly anchored in the guiding principles of the group.

Our environmental management system is certified to ISO 14001 and our work safety management system to OHSAS 18001. Regular audits and numerous training courses raise awareness in employees and management alike. This develops a culture in which everyone feels responsible for work safety, the environment and health protection within the company and on our customers' own premises.

Modular service concept ensures maximum flexibility

Products and services are both sides of the same coin. Professional installation and commissioning, practical knowledge transfer, intelligent inventory management and regular servicing and maintenance extend service life and protect investments.

The need for services varies according to the operator and the system and is as diverse as the industry itself. Failure mode analysis, tailored on-site services and engineering services related to sealing technology play an increasingly important role.

Be it for individual sealing systems, critical process elements, specific plant units, or a comprehensive service agreement for entire plants – our TotalSealCare modular service concept has the solution for every requirement. The individual service modules can be combined as needed to ensure maximum flexibility.



Comprehensive product portfolio: Sealing solutions to meet any requirement.

An overview of the EagleBurgmann product lines

Our comprehensive product portfolio covers all the needs of the oil and gas industry. From mechanical seals for pumps and compressors, magnetic couplings, carbon floating ring seals, seal supply systems, compression packings and gaskets through single and multiple layered fabric, steel or rubber expansion joints.

Over the course of our long partnership with the oil and gas industry, we have developed a range of standard, high-grade solutions which meet many of the industry's diverse needs. We also design and manufacture special and one-off customer-specific solutions to suit individual applications.

This may mean a volume-produced seal or an engineered one-off solution. EagleBurgmann products are rugged, reliable and easy to assemble, and they offer a very attractive cost-benefit ratio. On the following pages, we introduce our product portfolio. This is followed by a number of sample applications from real life, divided between the fields of water and gas injection, pipelines, multiphase, and other technologies in the industry.

Mechanical seals for pumps



The entire range of liquid or gas lubricated seals. Available as standard seals or special versions, as single or multiple seals and for all categories and arrangements in accordance with API 682.

Successfully utilized in the oil and gas industry:

- Mechanical seals: e.g. SH, SHI, HRS, HJ42, H75, MFL85, Cartex, LL9UC, LH3B, LLB500, LYTC

Mechanical seals for agitators



For sealing shafts in mixers, kneaders, reactors, filters, dryers and special machines in normal and sterile processes. Rugged, economical, designed for practical application. For steel and glass-lined tanks.

Successfully utilized in the oil and gas industry:

- Mechanical seals: e.g. SeccoMix

Mechanical seals for compressors



The entire range of seals for process gas compressors. Rugged, non-wearing, contact-free operation. Available as single and dual seals, tandem seals, and tandem seals with intermediate labyrinth.

Successfully utilized in the oil and gas industry:

- Compressor seals: e.g. DGS, PDGS, LB800/EKU750
- Oil barrier seals: e.g. CobraSeal, CSE, CSR

Magnetic couplings



For very demanding applications. Hermetically sealed, leak-free and maintenance-free pumping and mixing. Our magnetic couplings reliably contain media within closed-loop systems.

Successfully utilized in the oil and gas industry:

- Magnetic couplings: e.g. MAK66, MAK885, NMB High Efficiency

DiamondFace technology: a landmark in mechanical seal coating technology

EagleBurgmann made a quantum leap in mechanical seal technology when it introduced DiamondFaces in 2007.

Innovative technology

A microcrystalline layer with all the attributes of natural diamond is applied to the sliding faces by chemical vapor deposition (CVD) at 2,000 °C (3,632 °F) in a vacuum furnace. Thick layers coupled with extremely flat and uniform sealing surfaces characterize this procedure, which was developed together with the Fraunhofer Institute for Surface Engineering and Thin Films in Braunschweig, Germany.

Outstanding properties

Seal faces with DiamondFaces are extremely hard and resistant to wear, have excellent thermal conductivity and exhibit excellent chemical resistance. The layer adhesion exceeds all known practical requirements.

Convincing benefits

For mechanical seals this means a considerably longer service life, with maintenance intervals extended accordingly and greatly reduced life cycle costs.

Carbon floating ring seals



Long-life, maintenance-free compact labyrinth cartridge seals with low leakage.

Successfully utilized in the oil and gas industry:

- Carbon floating ring seals: e.g. WKA250HD, WKA400HD, WKA802HD, WKA1100HP

Seal supply systems



Depending on the design, application and mode of operation, mechanical seals and magnetic couplings need supply units for flushing, cooling, pressurization and leakage compensation. EagleBurgmann supplies the entire range from a single source.

Successfully utilized in the oil and gas industry:

- Quench systems: e.g. QFT1000 / 2000 / 3000
- Thermosiphon systems: e.g. TS1000 / 2000 / 3016
- Closed buffer fluid circuit systems: e.g. SPO
- Buffer pressure systems: e.g. SPA
- Gas supply systems: e.g. GSS, SMS, RoTechBooster

Compression packings



The economical and reliable method of sealing pump shafts and valve spindles. A broad product range, innovative materials and material combinations, and special impregnating agents and lubricants enable us to provide solutions for even the most demanding requirements.

Successfully utilized in the oil and gas industry:

- Compression packings: e.g. Isartherm-Flex, Thermoflon SL, Fire-safe Packing 9650/SF

Gaskets



Ready-to-install seals or sheet materials. State-of-the-art materials, material combinations and production methods allow us to supply a multitude of versions, variations and shapes.

Successfully utilized in the oil and gas industry:

- Graphite seals: e.g. Stathotherm, Rotatherm
- Metal gaskets: e.g. Buralloy, Spiraltherm (Several hundred thousand seals in accordance with ASME16.20 in use worldwide)

Expansion joints



For ducts and pipe systems carrying gas – to reliably compensate for pressure and temperature fluctuations, vibrations and misaligned joints.

Successfully utilized in the oil and gas industry:

- Fabric expansion joints: e.g. Fluachem, KE-Flex, Fluaflex
- Metal expansion joints: e.g. Bredan, EJS
- Rubber expansion joints: e.g. KE

Special products



Special applications require innovative and specific solutions. As well as special seals and sealing elements for marine technology and the aerospace industry, we also provide high-quality metal bellows and diaphragm couplings.

Successfully utilized in the oil and gas industry:

- Diaphragm couplings

Upstream, midstream, downstream: Sealing solutions for the entire process chain.

Pumping, transporting, processing: The value-added chain in the oil and gas industry breaks down into three main segments: upstream (exploration and production), midstream (transport and storage), and downstream (processing and refining). We have significant experience in all segments and can offer advanced sealing systems and services to meet all technical, environmental, and economical requirements.

Upstream

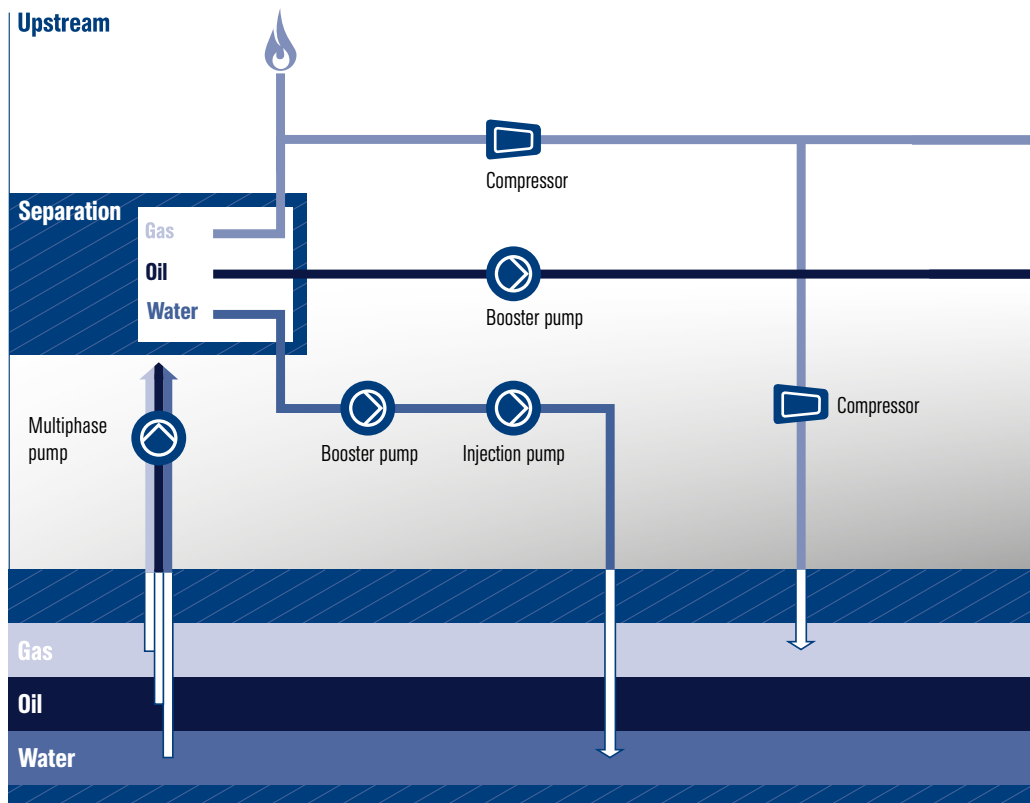
Depending on the method of production and product mixture to be pumped, oil and gas production at sea or on land requires special technologies and equipment. For drilling and floating production systems, FPSOs (Floating Production, Storage and Offloading Vessels), subsea conveyor equipment, as well as oil rigs and onshore surface mining equipment - reliable sealing technology provides the foundation for operational success and cost effectiveness under all conditions.

Whether onshore or offshore, sealing technology applied in oil and gas production must be robust to safeguard the service life of high-load pumps. As a result of their superior reliability, EagleBurgmann seals perform well in these extreme applications and are relied upon by operators around the world.

Midstream

Oil, natural gas, and their end products are transported in pipelines via pumps and compressors. Special pumps are used to move oil, gas, water, and sand mixtures through a pipeline to separation equipment located either on floating production platforms or in onshore facilities. The crude oil and gas are then conveyed to refineries for further processing.

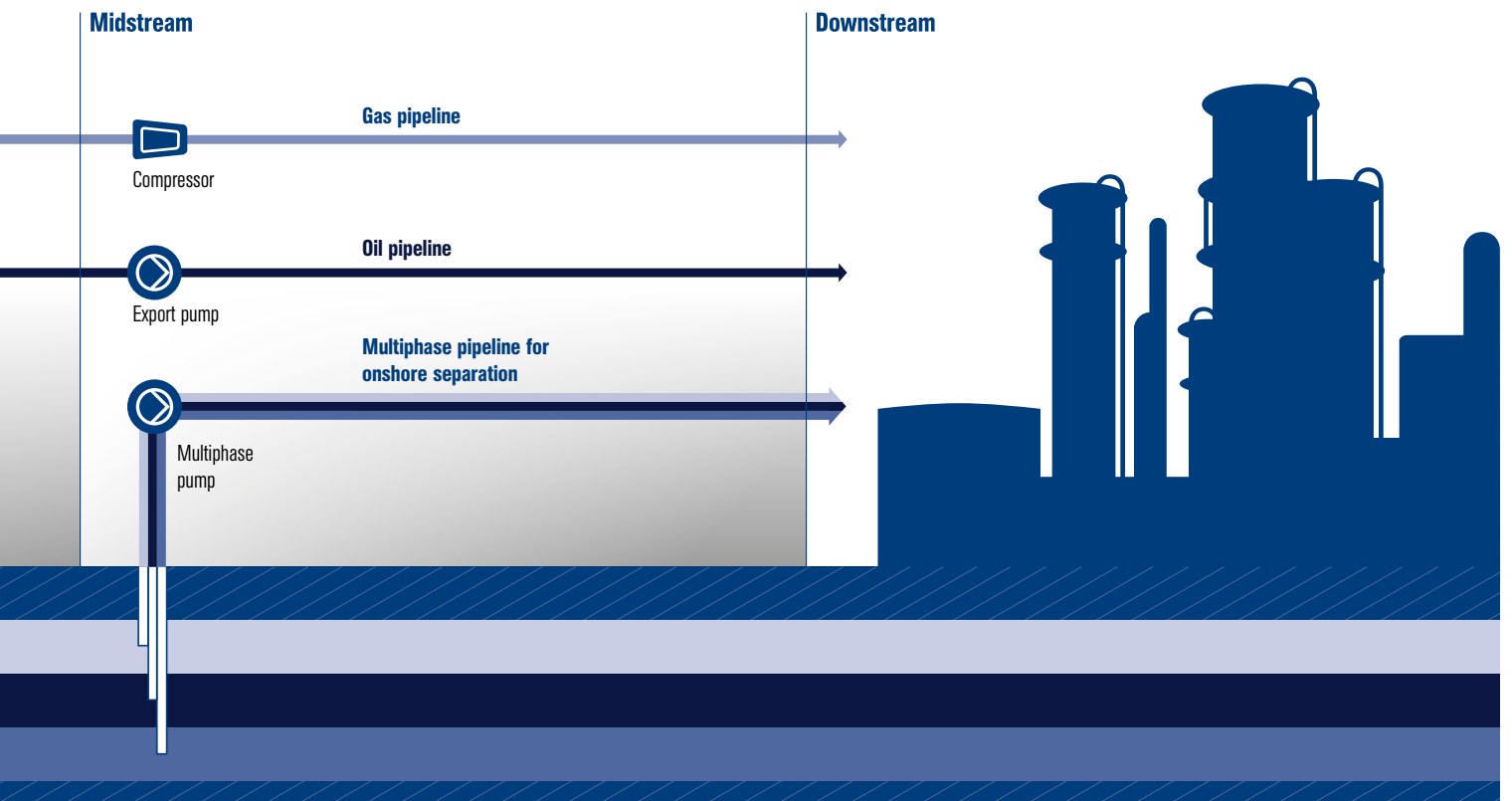
Maximum reliability and extended maintenance intervals are key requirements for sealing technology used in midstream applications. Standard seals typically do not offer the reliability required to meet the high operational demands in this area. Numerous operators therefore protect their pipelines by leveraging our expertise in providing custom tailored, optimized sealing solutions.



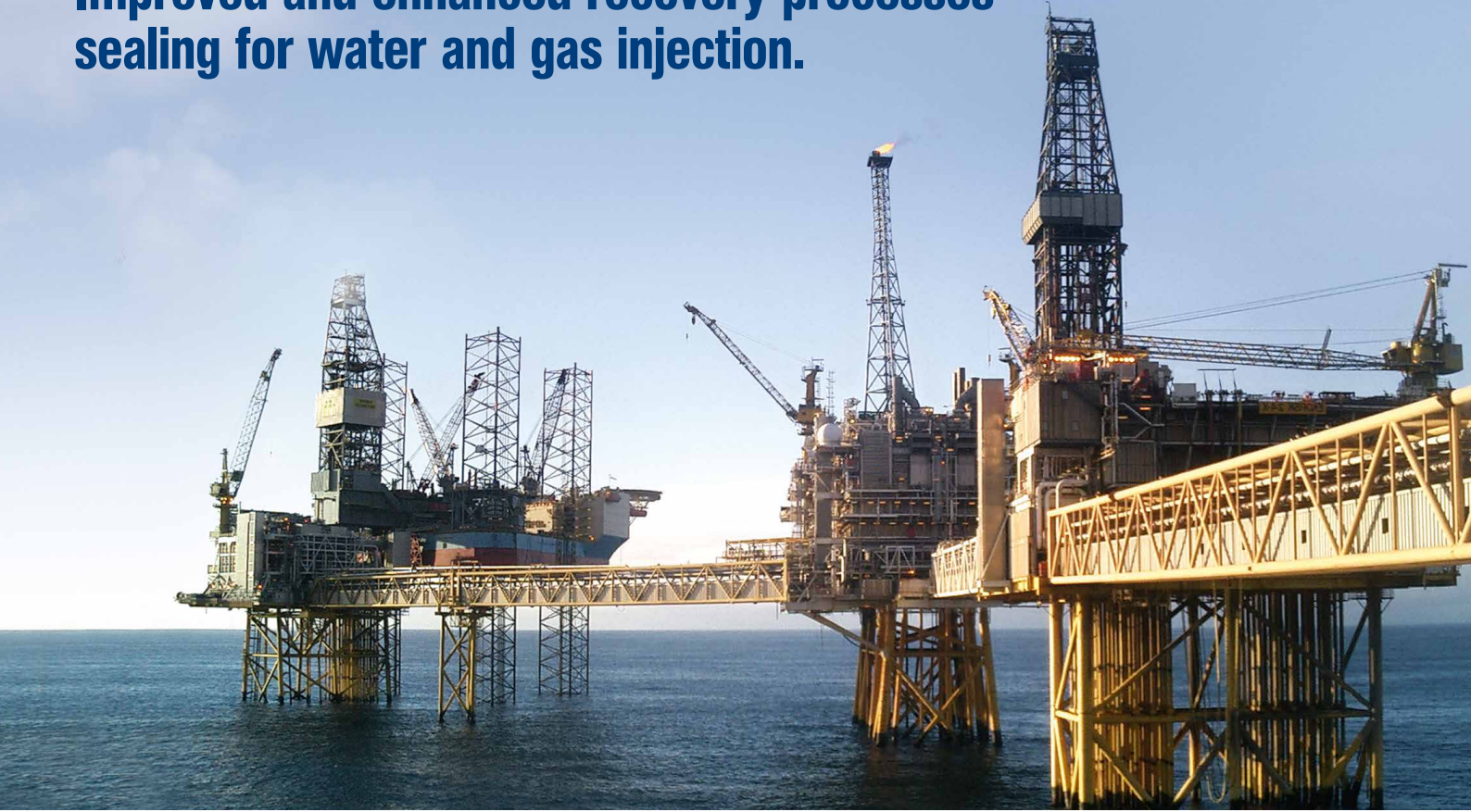
Downstream

Preliminary and intermediate products for the petrochemical industry, as well as multiple end products, are produced during the processing and refining of crude oil. These products include liquid gas (propane, butane), fuel (gasoline, diesel, heating oil, aviation fuel), wax, lubricants, bitumen, and sulfur.

With a comprehensive portfolio of seals and services, EagleBurgmann can meet all sealing requirements found in refineries. We offer mechanical seals and seal supply systems designed in accordance with API 682 - 3rd and 4th edition - for all categories, arrangements, and configurations. Due to their own unique complexity, details on our refinery sealing solutions can be found in their own separate brochure.



Improved and enhanced recovery processes – sealing for water and gas injection.

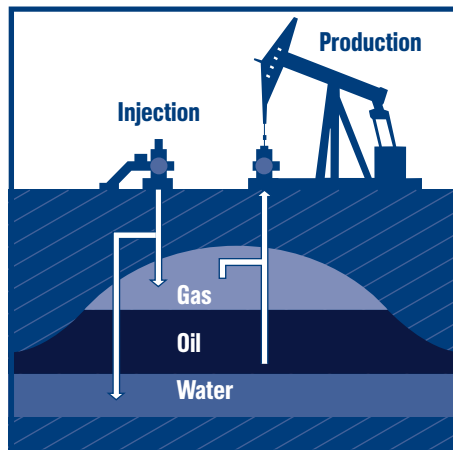


Sealing solutions for injection pumps and compressors

High pressures of up to 600 bar (8,700 PSI) and varying purity and solids concentration of the media, which can also be chemically aggressive and abrasive, are among the greatest challenges that sealing technology must overcome in water-injection applications.

For CO₂ gas injection, the gas-lubricated sealing systems of the compressors must withstand high pressure and be compatible with the purity of the gas in particular.

EagleBurgmann sealing systems have proven effective at sealing in the enhanced oil recovery process for many years. When it comes to water injection, our portfolio ranges from single mechanical seals to dual seals with barrier fluid systems. For both, special face materials, such as Buka 30 (a silicon carbide graphite composite material), and construction materials, such as super duplex, titanium or Inconel[®], represent state-of-the-art technology.



Numerous operators use our robust DGS seals in their gas injection compressors. We also supply perfectly configured seal management systems (SMSs) to safeguard optimal operation of the gas-lubricated sealing system.



A new developed pump seal from EagleBurgmann for dynamic pressures up to 600 bar, provided for a FPSO in the Tupi oil field off the Brazilian coast. The triple seal, type **SHVF-D11/100-KB1** is applied in a CO₂ injection pump. Medium: supercritical carbon dioxide; operating conditions: p = 481 bar (6,975 PSI); t = 40 °C ... 70 °C (104 °F ... 158 °F); n = 3,600 min⁻¹.



Statoil-Hydro's Brage platform in Norway uses an EagleBurgmann **SHFV-D4/160-E1-A3** as a dual seal in an Aker-Kvaerner water injection pump. Operating conditions: p = 44 bar (638 PSI); t = 7 °C ... 80 °C (45 °F ... 176 °F); n = 3,585 min⁻¹.



Saudi Aramco in Saudi Arabia uses a high-pressure compressor seal, type **PDGS/185-TA-U**. Operating conditions: p = 30 bar (435 PSI); t = -30 °C ... 130 °C (-22 °F ... 266 °F); n = 5,523 min⁻¹.



Since 2005, PEMEX (Petróleos Mexicanos) has been using the EagleBurgmann **DGS20/170-TA3-U** together with the **13-SMS-2-DGS20** supply system in a Dresser Rand suction gas compressor. Operating conditions: p ... 36 bar (522 PSI); t = 50 °C ... 130 °C (122 °F ... 266 °F); n = 8,295 min⁻¹.



Dual seal type **SHF-D2/202-E2**, installed in the **world's largest water injection pump** from Sulzer Pumps on a BP offshore platform in the Caspian Sea in Azerbaijan (AIOC project). Operating conditions: p = 9 ... 31 bar (131 ... 450 PSI); t = 18 °C ... 32 °C (64 °F ... 90 °F); n = 4,800 min⁻¹.



SHFV-D3/140-E3 dual seal with **SPN120** supply system, installed in a water injection pump from Sulzer Pumps at PDO (Petroleum Development Oman) in Oman. Operating conditions: p = 17 ... 22 bar (247 ... 319 PSI); t = 30 °C ... 80 °C (86 °F ... 176 °F); n = 4,700 min⁻¹.



Compressors of Saudi Aramco in Saudi Arabia are equipped with a **PDGS2/130-ZT3-U**. Operating conditions: p ... 50 bar (725 PSI); t = -20 °C ... 177 °C (-4 °F ... 351 °F); n = 15,800 min⁻¹.



Eighteen magnetic couplings type **MAKH66-110-3/43-00** are applied on the PRA-1 platform off the coast of Brazil to seal a centrifugal pump from Sulzer (ZF 25-200) in a buffer fluid system at 90 bar for supplying the mechanical seal of a crude oil pump. Since 2005, the couplings have lived up to their low-maintenance design in a location that is difficult to access. Medium: ISO VG 46 barrier fluid; operating conditions: p = 90 bar (1,305 PSI); t = 70 °C (158 °F); n = 3,500 min⁻¹.



An offshore plant in the North Sea has been fitted with an oversized **clamshell expansion joint** from Inconel® 625. The expansion joint encases and protects a damaged bellows (DN 2000) of a turbine. Operating conditions: p = 1 bar (14.5 PSI); t = 450 °C (842 °F).

Midstream process: Sealing high-wear media mixtures.



Sealing solutions for multiphase applications

Multiphase pumps can pump mixtures containing oil, water, and gas and transport them over long distances in a single pipeline to separation. Therefore, separation of the oil from the gas and associated flaring of the off-gas is not required near the well head. The pumps are used on- and offshore as well as subsea.

The pump types most frequently used are twin screw and helico-axial pumps, whose seals must simultaneously seal off liquid and gas. One of the challenges in this application is that the composition of the media fluctuates between 100 percent gas and 100 percent liquid. Transient operating conditions thus result for the pump and its mechanical seals, not to mention the fact that the media frequently contains waxes and sand, which may have considerable adhesive and abrasive properties.

EagleBurgmann particularly uses robust mechanical seals with extremely hard sliding materials, which have already become standard in many multiphase pumps offered by leading manufacturers. The range includes different types of single seals to buffered dual seals with pressurization via barrier fluid circulation systems.



In a pump station operated by Exxon Mobil in Africa, our **SHV-D4/170-E1** (API Plan 54) functions as a dual seal for a twin screw multiphase pump from Leistritz. Operating conditions: Gas content ... 99 %; p = 60 bar (870 PSI); t = 54 °C (129 °F); n = 1,200 min⁻¹.



At Saudi Aramco in Saudi Arabia, an **SHV-D2/145-E1** from EagleBurgmann is used as a dual seal in a helico-axial multiphase pump from Sulzer. Operating conditions: Gas content ... 99 %; p = 60 bar (870 PSI); t = 80 °C (176 °F); n = 4,000 min⁻¹.



CNRL in the Cold Lake region in Canada uses over 140 pumps with approximately 500 EagleBurgmann **HSHJ92S1/80-E3** seals. The seals are fitted in Bornemann twin screw multiphase pumps. Operating conditions: Gas content ... 95 %; p ... 6 bar (87 PSI); t = 150 °C (302 °F); n = 1,200 min⁻¹.



In Venezuela's Zuata field, a Bornemann twin screw multiphase pump has been operating with EagleBurgmann's **HSHJ97GS1/100-E1** (API Plan 32) single seal since 1998. Operating conditions: Gas content ... 98 %; p ... 25 bar (363 PSI); t = 93 °C (199 °F); n = 1,660 min⁻¹.



In Western Siberia, Rosneft relies on an EagleBurgmann cartridge **SH6/125-EF1** (API Plan 32) single seal to seal a Rosscor twin screw multiphase pump. Operating conditions: Gas content ... 97 %; p ... 40 bar (580 PSI); t ... 65 °C (149 °F); n = 2,200 min⁻¹.



A high-pressure multiphase test circuit from Statoil in Norway is equipped with a Bornemann MPC pump with an EagleBurgmann **SHFVI-D2/88-E1** dual seal and an API 53B supply system. Despite heavily fluctuating pressure conditions, the seal has never experienced any problems in active use. Operating conditions: p₁ = 10 ... 150 bar (145 ... 2,175 PSI); barrier fluid pressure: p₃ = 160 bar (2,320 PSI); t = 60 °C (140 °F); n = 1,800 min⁻¹.



A manufacturer of drilling equipment uses EagleBurgmann RX **ring type joints**, specially designed to withstand high pressures, in its wellheads. Media: drilling sludge, water/sand mixture, dihydrogen sulfide, natural gas, heavy hydrogen sulfide. The RTJ also provide reliable sealing in extreme conditions. Operating conditions: p ... 1,370 bar (19,870 PSI); t ... 60 °C (140 °F).

Pipelines: Sealing in the midstream process.



Sealing solutions for pipeline pumps

Extreme geological and climatic conditions characterize the global network of pipelines. Changes in altitude and long distances between pump stations, as well as limited access to the plants for servicing, maintenance and repair, place high demands on reliable technical equipment.

When it comes to sealing aggressive and abrasive crude oil, reliability and extended service intervals are required. Challenging conditions place high demands on the design limits of sealing and supply systems, which can handle frequent stop / starts and occasional pressure reversals or reverse pump rotation. Pressures up to 160 bar (2,320 PSI), ambient temperatures ranging from -55 °C ... $+60\text{ °C}$ (-67 °F ... 140 °F), sliding velocities up to 60 m/s (197 ft/s), and high oscillation loads that must be compensated. To meet this broad range of special demands,

EagleBurgmann leverages proven sealing concepts that are adapted to meet individual application requirements in close collaboration with plant engineers, pump manufacturers, and operators. The mechanical seals of our SH and HJ4 ranges, for example, have become the standard for crude oil pumps.



The ESPO (East Siberia – Pacific Ocean) pipeline operated by Transneft in Russia features EagleBurgmann **SHPV11-D** dual seals in Sulzer's pipeline pumps. The barrier fluid is not oil, but water. Sixty dual high-pressure seals for the main pipeline pumps and 24 API Plan 53B barrier systems with air-blast heat exchangers have been provided for the ESPO project. Operating conditions: $p = 10 \dots 78$ bar ($145 \dots 1,131$ PSI); $t \dots 50\text{ °C}$ (122 °F); $n = 1,540 \dots 2,845\text{ min}^{-1}$.

Another 64 single high-pressure seals of type **HRS8** with **ZY203** cyclone separator are installed in booster pumps. Operating conditions: $p = 5 \dots 62$ bar ($73 \dots 899$ PSI); $t = 15\text{ °C} \dots 60\text{ °C}$ ($59\text{ °F} \dots 140\text{ °F}$); $n = 3,000\text{ min}^{-1}$.



EagleBurgmann provided mechanical seals and a retrofitting concept for Petropiar/Ameriven (PDVSA Chevron Texaco) in Venezuela. The crude oil is now reliably sealed in a twin screw pump from Bornemann Pumps using an **HSJ47GS6/140-E1**, despite the high viscosity. Operating conditions: $p \dots 50 \text{ bar (725 PSI)}$; $t \dots 60 \text{ }^\circ\text{C (140 }^\circ\text{F)}$; $n = 1,185 \text{ min}^{-1}$.



In Korea, Latin America and Middle East, our dual seals of type **LB800/EKU750** are applied on screw compressors. Operating condition: $p = -0.01 \dots 5.7 \text{ bar (-0.2 \dots 82.6 PSI)}$; $t = 34.9 \text{ }^\circ\text{C} \dots 205 \text{ }^\circ\text{C (94.8 }^\circ\text{F} \dots 401 \text{ }^\circ\text{F)}$; $n = 1,859 \dots 11,281 \text{ min}^{-1}$. Medium: Gasified LNG with high percentage of methane.



In the Middle East, oil rigs and ships are equipped with safety hoods of type **MA-1** as fire-protection devices for rubber expansion joints used in the fire-extinguishing system and in pipelines to pump flammable liquids. The hoods have been certified for marine applications by Bureau Veritas.



The gas oil separation process (GOSP) at Saudi Aramco in Saudi Arabia has been optimized with a Sulzer pump with vertically arranged sealing system for pumping the crude oil. Dry running of the pump at start-up frequently led to failure of the competitor's seal. The operator then opted for EagleBurgmann single seal **DF-HJ4S4** with DiamondFace coating of the seal faces. Since its installation, the pump and seal have experienced no problems. Operating conditions: $p = 6 \text{ bar (87 PSI)}$; $t = 22 \text{ }^\circ\text{C} \dots 58 \text{ }^\circ\text{C (72 }^\circ\text{F} \dots 136 \text{ }^\circ\text{F)}$; $n = 1,760 \text{ min}^{-1}$.



The pump stations along the 700 km pipeline which extends from the Sudanese oil fields of Baleela to Karthoum have 300 EagleBurgmann seals of type **HJ4**, in different versions, installed in Bornemann screw pumps. Suction pressure $p = 4 \dots 50 \text{ bar (58 \dots 725 PSI)}$; $t = 29 \dots 70 \text{ }^\circ\text{C (84 }^\circ\text{F} \dots 158 \text{ }^\circ\text{F)}$; $n = 440 \dots 1,240 \text{ min}^{-1}$; viscosity of media: $990 \dots 1,700 \text{ mm}^2/\text{s}$.



BTC (Baku-Tbilissi-Ceyhan) in Turkey has applied EagleBurgmann **SHF3-D/135-E1** dual seals and the **SHV-D3/170-E1** in the crude oil pipeline pumps provided by Ruhrpumpen GmbH. Operating conditions: $p = 1 \text{ bar (15 PSI)}$; $t = 5 \text{ }^\circ\text{C} \dots 40 \text{ }^\circ\text{C (41 }^\circ\text{F} \dots 104 \text{ }^\circ\text{F)}$; $n = 1,490 \text{ min}^{-1}$; $p = 74 \text{ bar (1,073 PSI)}$; $t = 30 \text{ }^\circ\text{C (86 }^\circ\text{F)}$; $n = 1,800 \text{ min}^{-1}$.



EagleBurgmann Expansion Joints Solutions supplied several exhaust expansion joints with flanges for pipeline systems to a leading producer in Alaska, USA. The metal bellows joints are designed for temperatures up to $650 \text{ }^\circ\text{C (1,200 }^\circ\text{F)}$ and for pressures from vacuum to $1.03 \text{ bar (15 PSI)}$.



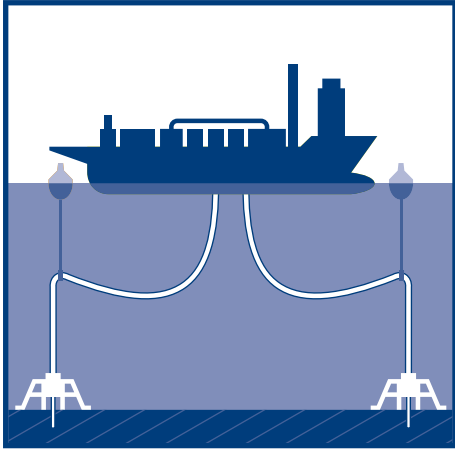
For the Greater Nile Petroleum Operating Company (GNPOC) in Sudan, a pipeline pump from Weir Pumps Ltd. is sealed using an EagleBurgmann **SHFV1-D/125-E1** dual seal in conjunction with a **SPN135/L003-D1** supply system. Operating conditions: $p = 46 \text{ bar (667 PSI)}$; $t = 75 \text{ }^\circ\text{C (167 }^\circ\text{F)}$; $n = 1,745 \dots 3,850 \text{ min}^{-1}$.



In Asia and the Middle East, EagleBurgmann numerous **diaphragm couplings** of type 74 are applied as joint between motor, gear box and compressor. Operating condition: power = $241 \dots 7,656 \text{ kW}$, $n = 2,950 \dots 11,281 \text{ min}^{-1}$.

Special applications: FPSO and Subsea.





FPSO – sealing solutions for mobile floating production systems

FPSOs (floating production storage and offloading vessels) are used to pump, store and load crude oil and natural gas. They take the oil from the pumping installations, process it, and pump it onto oil tankers for transport. The technical equipment largely corresponds to that of offshore drilling and production platforms.

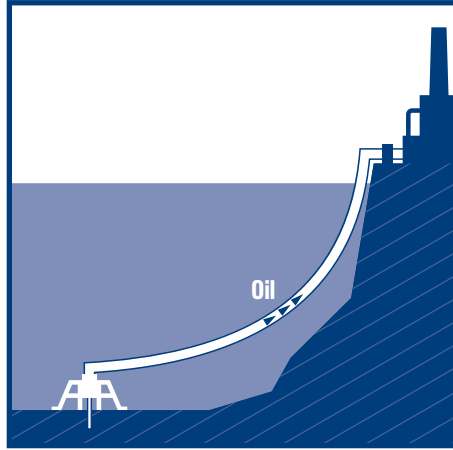
FPSO ships frequently represent a more flexible and cost-efficient alternative to conventional platform designs when it comes to offshore exploration and production, since a local pipeline infrastructure is not required.

EagleBurgmann offers, in particular, sealing systems that include the supply systems required for the numerous pumps installed, such as water injection pumps, oil supply pumps, cooling and heating pumps, and fire fighting pumps.

The FPSO Skarv tanker ship that BP Norge operates in the North Sea off the coast of Norway is one of the most state-of-the-art ships of its kind in this area. EagleBurgmann provided 12 single seals and 74 dual seals with 35 supply systems as well as 6 central refill units for pumps installed at this vessel.



EagleBurgmann mechanical seals type **H75VKF-D7/95-E1** are used in Bjorge AS centrifugal pumps on BP Norway's BP Skarv FPSO ship. Operating conditions: Medium = mixture of crude oil and formation water; $p \dots 15 \text{ bar (218 PSI)}$; $t = 29 \text{ }^\circ\text{C} \dots 130 \text{ }^\circ\text{C (84 }^\circ\text{F} \dots 266 \text{ }^\circ\text{F)}$; $n = 1,450 \text{ min}^{-1}$.



Subsea – sealing solutions for deep-sea extraction

Deep-sea conveying equipment on the sea floor currently extracts oil at depths down to 3,000 meters. This oil is then pumped directly onto ships or on land via underwater pipelines. This method also allows oil to be pumped in extremely deep areas that were previously unattainable.

High pressures, low temperatures and the fluctuating composition of the media pumped characterize the conditions for sealing systems in multiphase pumps. Since recovering and repairing lowered pump units is extremely expensive, the seals also have to ensure maximum fail-safe protection and extended maintenance intervals. Pressurized dual mechanical seals are typically used here.

EagleBurgmann SRX and SBS **ring type joints** were specially developed for subsea applications and meet API 17 D standards (specification for subsea wellhead and christmas tree equipment).



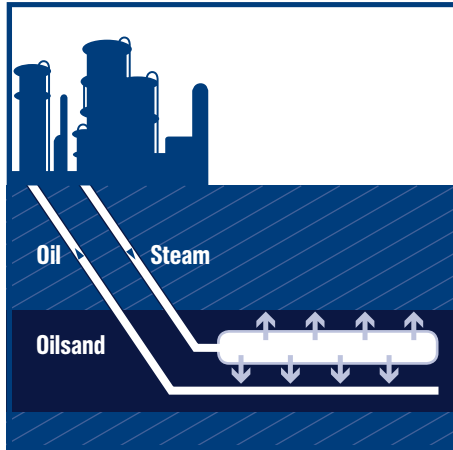
Subsea multiphase pumps sealed with EagleBurgmann **SH18/115** mechanical seals. Operating conditions: Media: oil-water-gas mixture; gas content: 25 ... 70 %; suction pressure: $p = 5 \dots 70 \text{ bar (73} \dots 1,015 \text{ PSI)}$; rotational speed: $n = 4,200 \text{ min}^{-1}$.



Mechanical seals type **LL9UC** are installed to seal shafts of sea water injection pumps installed at various FPSOs. $p = 35 \text{ bar}$; $t = +20 \text{ }^\circ\text{C} \dots +60 \text{ }^\circ\text{C (+68 }^\circ\text{F} \dots 140 \text{ }^\circ\text{F)}$; $n = 5,500 \dots 6,000 \text{ min}^{-1}$.

Special applications: Oil sands mining and liquefied natural gas (LNG).





Oil sand – sealing solutions for CSS and SAGD processes

Extraction of deep oil sand deposits via in-situ mining is growing in importance. Established processes to accomplish this are CSS (Cyclic Steam Stimulation) and SAGD (Steam-Assisted Gravity Drainage), which involve liquefying the bituminous oil mass by injecting hot steam so that it can be pumped with multiphase pumps.

The eccentric screw and twin screw pumps primarily used for this task are placed under enormous loads as are their seals. High pressures, high temperatures, the extremely abrasive media, and temporary dry-running of the pumps lead to heavy clogging of the mechanical seals. In extreme scenarios, the service life of conventional seals is just two weeks. Our innovative DiamondFace coating of the seal faces allows us to achieve much longer operation times.

An **HJ4S1** mechanical seal was applied in a pump from Bornemann Pumps as part of the “Deer Creek” project in Canada. The extremely hard diamond coating of the seal faces (DiamondFaces) extended the service life of the seal thirty times beyond that which would have otherwise been possible. Operating conditions: Media = condensate, bitumen, oil, gas, sand; $p = 1 \text{ bar (15 PSI)}$; $t = 100 \text{ °C (212 °F)}$; $n = 1,200 \text{ min}^{-1}$; $d = 80 \text{ mm (3.15")}$.



LNG – sealing solutions for the liquefaction of natural gas

Natural gas is liquefied with compressors by cooling the gas to $-163 \text{ °C (-261 °F)}$ in applications in which pipelines are not economically or technically viable. Volume is reduced by 600 percent. The liquefied gas is then no longer restricted to lines and can be stored in containers and transported by ship or LNG tankers.

The special demands placed on the sealing systems for gas liquefaction include large shaft diameters up to 350 mm (13.78") in the compressors and enormous temperature differences up to 250 Kelvin ($-110 \text{ °C ... +150 °C (-166 °F ... +302 °F)}$). Gas-lubricated mechanical seals from EagleBurgmann have proved reliable under these conditions for over 10 years.

EagleBurgmann DGS and PDGS for LNG compressors

Since 2001, a Qatar Gas LNG carrier has been equipped with compressors of different manufacturers, sealed with EagleBurgmann compressor seals types DGS and PDGS. The PDGS is specially qualified for LNG processes at leading manufacturers and operators of compressors. Operating conditions: Medium, product side = gas; $p = 31.5 \text{ bar (457 PSI)}$; $t = -170 \text{ °C ... +150 °C (-274 °F ... +302 °F)}$; $n = 25,555 \text{ min}^{-1}$; $d = 68 \text{ mm (2.68")}$.

Service made to measure: TotalSealCare.



Our seven service modules

Optimized services are major contributors to making sure that plants function smoothly – and that doesn't just begin with maintenance. With TotalSealCare, our modular service concept, we are able to cover all individual service requirements very flexibly. The individual modules can be combined as required.

1 Consulting & Engineering

After establishing and analyzing all of the installed seals in a system, we develop standardization concepts based on the "as-is" status. The results we strive for are to reduce the number of seal types, sizes and materials used and to improve the plant performance of the system. We advise you on codes of practice and statutory regulations and indicate what actions need to be taken.

2 Maintenance

In the plant or in the service center, qualified fitters and technicians look after all the aspects of seal maintenance – installation, start-up, servicing, conversion, overhaul and repair. We record and document functionally relevant data (failure reasons and related costs). This means it is possible to evaluate seal operating times and maintenance costs on a continuous basis, thereby defining measures for extending service intervals.

3 On-site Service

Our on-site service includes the components of an overhaul service, conversions and service container. We deploy a service unit directly to your premises: equipped with the basic range of seals or a stock of seals discussed with you in advance and staffed by qualified personnel. On-site, we assure production of the necessary gaskets, ensure that the documentation is complete and advise our customers on the selection and installation of seals. Our range of services also includes complete conversions (e.g. acc. to TA-Luft).

4 Inventory Management

Based on your individual requirements and the applicable quality regulations, we develop a concept for inventory management of complete seals and spare parts. Furthermore, we optimize stocking on-site or in the EagleBurgmann service center. In this way, you reduce your administration overhead and concentrate on your key operations.

5 Seminars & Training

We offer an extensive range of continuing education programs in sealing technology, developed for service and maintenance personnel, and skilled staff and engineers from various branches of industry including refining, chemical, power generation, foodstuffs, paper and pharmaceutical. Our program includes group seminars, individual training and seminars specifically tailored to your requirements held at our premises or at a location of your choice.

6 Technical Analysis & Support

A team of seal specialists is responsible for rectifying process malfunctions or "bad actors". The latest methods, such as thermography or data logging, are used for diagnosing critical items for the operation of the plant and for defining measures to resolve them. In our research and development centers, we perform realistic tests on test rigs or in original pumps. The objective is to extend the MTBF and to increase system reliability by individual and constructive solutions.

7 Service Agreements

We offer our customers specific agreements that are combined from the six service modules. Whether for individual seal systems, critical process elements, specific plant units or an extensive seal service for complete plants, the modular structure of our service makes it possible to satisfy individual requirements. With our well established monitoring instrument, SEPRO, we can also record all seal-related data for documentation and evaluation purposes.

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EagleBurgmann, a joint venture of the German Freudenberg Group and the Japanese Eagle Industry Group, is one of the internationally leading companies for industrial sealing technology. Our products are used everywhere where safety and reliability are important: in the oil and gas industry, refining technology, the petrochemical, chemical and pharmaceutical industries, food processing, power, water, mining, pulp & paper, aerospace and many other spheres. Every day, more than 6,000 employees in more than 60 subsidiaries contribute their ideas, solutions and commitment towards ensuring that customers all over the world can rely on our seals. Our modular TotalSealCare service underlines our strong customer orientation and offers tailor-made services for every application.

eagleburgmann.com

info@eagleburgmann.com