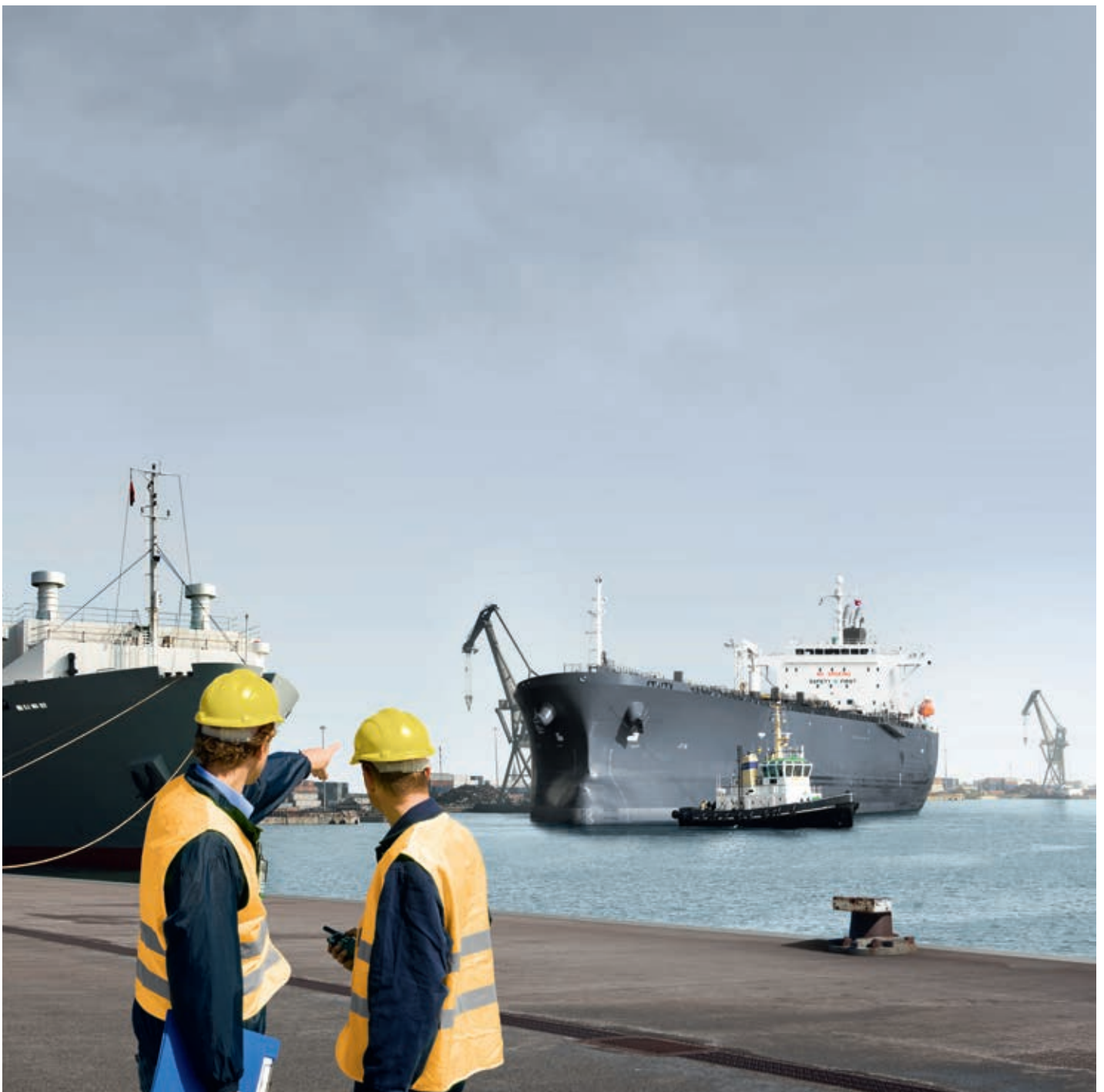


# Drive and control solutions for marine engineering: Reliable, efficient, durable





## At home in shipping – tailor-made solutions from Rexroth

Storm or rough swell, tropical or arctic oceans, on the surface or at a depth of 6,000 meters: The most important requirement for marine engineering is its reliability. For more than 50 years, Rexroth has been equipping ships of all kinds with drive and control solutions for numerous different tasks. We accompany OEMs, shipyards and ocean carriers from the design and commissioning through the entire life cycle of the ship and ensure that our technology works reliably and efficiently.

It is the task that decides which technology is needed. Robust hydraulics, IndraDrive ML electrical heavy-duty drives with an output of up to 4 MW or hybrid systems – we will put together the technologically and economically optimum solution for you. That reduces your engineering expense, for we perfectly match all components to each other and supply everything from a single source. At all times, our focus is on availability and reliability.

Together with OEMs and shipyards, we develop tailor-made drive and control solutions for many different tasks. Components specially developed for applications on the high seas are the basis. These are resistant to salt water and arctic conditions, and if required they can also be made explosion-proof. The Marine sector management pools our worldwide application experience with technological expertise. The focus here is applications on deck and below deck:



#### **Winch drives**

Complete system solutions for winches of all kinds, including newly developed electric control technology.

#### **Cranes**

Complete drive systems for maritime and offshore cranes including newly developed electrical control technology.

#### **Rudder systems**

From rudder machines to swivel drives for azimuth thrusters or jet drives, Rexroth solutions reliably ensure that the ship remains maneuverable.

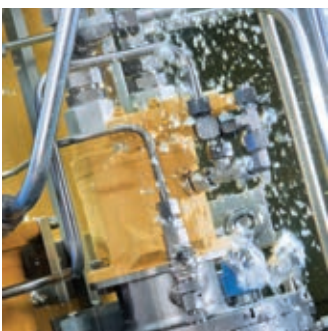


#### **Dredgers**

We offer complete systems solutions for working hydraulics in all kinds of dredging ships.

#### **Loading hatches and auxiliary drives**

Rexroth's broad product range holds the right solution for all automated motion tasks.



#### **Underwater applications**

Special hydraulic components for underwater applications can withstand the pressure encountered at a depth of 6,000 meters.

# Winch drives: Strong, reliable, versatile

Safely lifting heavy loads and lowering them again in a controlled manner, winches depend on power and reliability. They also have to be optimally configured for their task in terms of power and function. Rexroth offers an extensive spectrum of components and system solutions for winch drives. Compact winches in a closed circuit, in an open circuit or secondary-control drives with active heave compensation. Rexroth is the right partner for winch drives in all power classes.



- ▲ DSE control block
- ◀ Towing winches with direct hydraulic drive
- ▼ Winch gears





- ◀ **Offshore winches with active heave compensation**
- ▶ **Active heave compensation in Barge Master System**



Hydraulic winch drives combine the unrivaled power density of our hydraulics with extreme robustness and reliability. All necessary components from Rexroth – motors, control blocks, gears, brakes, controls and hydraulic power units – are designed for the special conditions encountered at sea. Corrosion-resistant materials and coatings, plus specially protected connections, are resistant to salt water and guarantee a long service life.

High torque at slow speeds, high dynamics or ATEX configuration: Rexroth hydraulic motors satisfy all requirements for different types of winches. We integrate saltwater-resistant brakes into the motors, on request with remote control. Compact GFT-W planetary gears efficiently transmit the forces, and a broad range of control valves fulfills exactly the range of functions that you require.

Control blocks specially configured for winch drives impress with their broad range of functions. The HICWB control block is designed for installation on deck, the DSE control block for installation directly on the motor. This reduces piping expense for you and saves in installation space.

### Active heave compensation

Your winch should position loads exactly on the sea bed. Rexroth's active heave compensation system registers the movements of the ship and integrates them into the internal control processes. The result: Compensation of more than 95 percent of wave movements. And more still: Secondary-control winch drives recuperate up to 70 percent of their energy every time the ship rises and falls. This reduces the installed power needed.

Besides this high-precision variant, Rexroth also offers simpler versions for primary-controlled and linear heave compensation. Furthermore: Rexroth has extended the product spectrum for winch drives to electric controls with preprogrammed basic functions. Read more about this on page 8.

# Maritime cranes: Complete solutions for all movements

Turning, lifting, lowering: Maritime cranes ensure that goods are delivered and handled smoothly regardless of the infrastructure at the harbor. With Rexroth as your system partner, you will simplify your engineering and reduce your complexity because all drive and control functions come from a single source. They are perfectly matched, with the right interfaces and functions.

Open or closed circuit, Rexroth's hydraulic solutions always offer the exact force and range of functions that your maritime crane requires. Furthermore, our Marine Engineering specialists will support you throughout the entire engineering process and compile tailor-made system solutions to meet your specifications. Depending on the specific requirements, we use both electric and hydraulic drives.

Our hydraulic power units are produced to tried and tested standards on the basis of large-series components. They are manufactured in accordance with strict quality methods, like those employed in the automotive industry. The modularity of high pressure control blocks in plate construction creates a high degree of freedom for individually compiled functions.



◀ **Offshore knuckle boom crane with active heave compensation**



Image source: ODIM/Rolls-Royce



- ▲ Maritime cranes with Rexroth drive technology
- ◀ ROV LARS with active heave compensation



**Load sensing boosts efficiency**

The 3M7 control block offers all the advantages of modern hydraulic solutions in an open circuit. Load sensing regulates the flow according to consumption. This boosts efficiency and reduces energy consumption when several consumers are working at the same time.

In addition to winch drives, our product range also includes complete slew drives, including controls. These are based on the MOBILFLEX-GFB slew drive, which is in use in tens of thousands of applications. This combination of hydraulic motor with multiple-stage planetary gear is especially compact and simple to install as a complete assembly group.

Axial piston pumps, load lowering valves and joysticks round off the system solutions. Furthermore: Rexroth has developed modular electric control systems with preprogrammed functions especially for maritime cranes and winches. Read more about this on the next page.

- ▶ Hägglunds heavy-duty drives
- ▶ Control blocks
- ▶ Slew drives
- ▼ Pumps and motors



# Electric controls: Just configure and start

You are looking for a preprogrammed control for winches and cranes that you only have to configure? Rexroth now offers two control systems controlling scalable single and multiple-axis systems. The functions needed for winches and maritime cranes are pre-programmed and satisfy the necessary maximum safety requirements up to level e.







- ◀ Control units
- ◀ IndraMotion MLC
- ▼ Control panels



Rexroth has developed a modular control system with standard hardware and predefined software just for winches and cranes – ready to install in a compact control cabinet.

The variant based on the RC28-14/30 control unit is ideal for simple tasks. This has been tried and tested on mobile working machines in all climatic zones. IndraMotion MLC – a control system that is widely employed in machine and systems construction – performs more complex tasks. Both control systems regulate electric and hydraulic drives and communicate with higher-order control systems through open interfaces.

The control systems decentrally analyze analog and digital signals and regulate both the drives and the hydraulic power unit. All functions needed for the safe operation of winches and cranes are preprogrammed.

The following additional functions can be realized as options:

- ▶ Mooring, constant tractive force
- ▶ Active heave compensation
- ▶ Active tension control when lifting loads
- ▶ Anti-slack cable when setting a load down
- ▶ Automatic overload protection, AOPS
- ▶ Manual overload protection, MOPS

The individual functions are programmed using international standardized SPS languages according to IEC 61131-3. Control devices can be connected directly to the controls. From drive to control: Everything from a single source, perfectly matched and demonstrably reliable. Rexroth tests its control systems extensively on a winch test bed before they are commissioned, substantially reducing the commissioning time. The test bed is also available for customers.

# Electric drives of up to 4 MW

For all the advantages of hydraulics, electric drive technology is gaining importance in marine engineering. Rexroth was the pioneer that developed the world's first maintenance free servo motor in 1979. Today, the product spectrum includes electric drives in the power range of 100 watts to 4 MW.

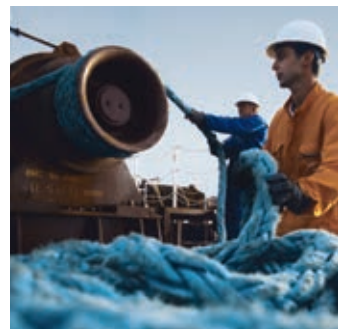
With its line of large electric drives, Rexroth offers a finely scaled range of very powerful drive solutions from 110 kW to 4 MW. The new drive systems give users numerous options for boosting energy efficiency. They recover braking energy, making the power available to other drives or feeding it back into the electrical system. Users can exploit other potentials with concepts for static and rotating energy storage systems.

The 'Safety on Board' safety functions integrated into the drives guarantee standard-compliant machine safety without a detour to a higher-order control system. This makes engineering simpler and allows a consistent modularization. Large electric drives feature the two certified safety functions 'Safe Torque Off' and 'Safe Motion'.

The drives use open interfaces for all standard protocols to exchange information with the higher-order control system. This enables them to fit into a wide range of different control architecture.



◀ **IndraDrive ML:**  
Large electric drives  
from Rexroth for power  
up to 4 MW



# Working at 6,000 meters under the sea

Remotely operated vehicles (ROVs) employed many thousands of meters under the sea present especially high demands. Only hydraulics have the power density needed for such demanding tasks. Therefore, Rexroth has developed complete drive solutions for working at depths of up to 6,000 meters.

Looking for new extraction sites for raw materials, exploration vehicles can increasingly often be found at extreme depths. The extraction of these raw materials, along with various other operations, requires technology that is capable of operating at great depths and reliably generating high forces.

Rexroth has picked up this challenge and developed complete drive systems for deep-sea working machines and remotely operated vehicles (ROVs) capable of withstanding the high water pressure. The decisive factor is that there must be absolutely no air intrusion in the system. To this end, our engineers have modified standard valves such that they reliably eliminate air intrusions and expel existing air bubbles. These deep-sea valves have already proven their worth in a wide range of applications, e.g. in offshore wind energy generation and in oil and gas extraction. Rexroth deep-sea components also provide the right drive for the first few steps in underwater mining.

Furthermore, the Rexroth range includes corrosion-protected hydraulic cylinders with numerous detail solutions that are suitable for deep-sea operations. These are coated with the Enduroq 3200 coating system to protect the components against corrosion by salt water, other chemical compounds and mechanical stress. Enduroq 3200 is also the only coating to satisfy the strict DNV specifications. The sealing concept has also been modified for the extreme pressure situation.

Rexroth drive systems feature numerous sensors and actuators such as the CIMS MK 4 path measurement systems integrated in the cylinders. The hydraulic motors and pumps are also continuously monitored. This means the operator always has an overview of the current operating conditions and can recognize impending wear or other problem. This increases reliability and maximizes availability – even at 6,000 meters under the sea.



# Rudder systems: Always on course

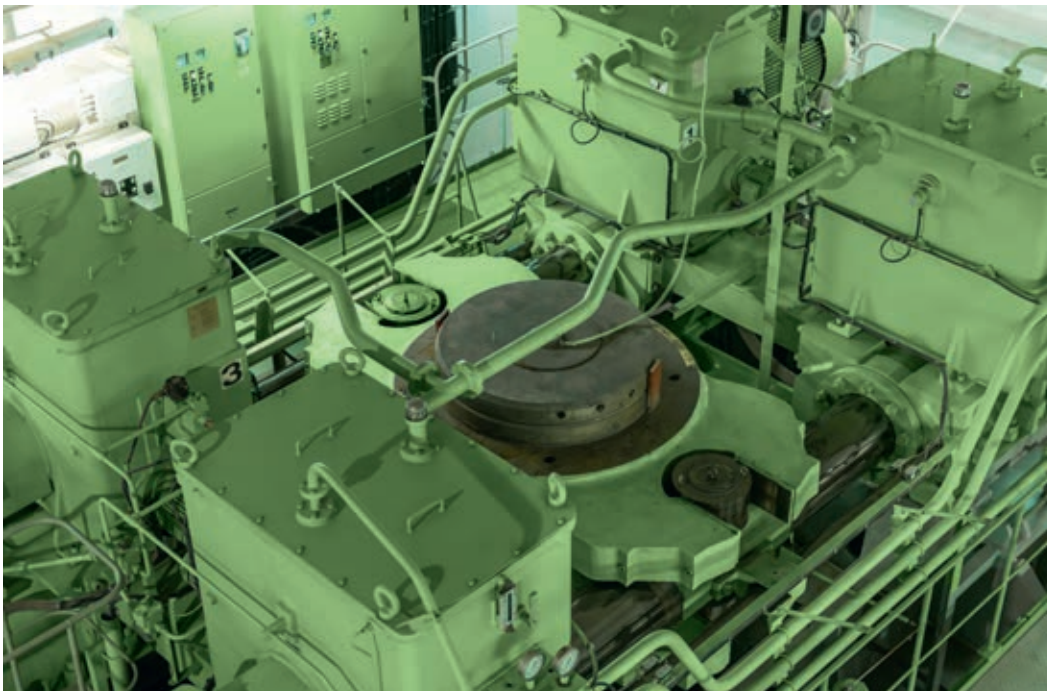
The maneuverability of ships has to be guaranteed under all circumstances. Rexroth system solutions reliably fulfill this requirement. But our new, variable drive concepts offer even more – maneuverability through GPS-monitored maintenance of a position on high seas.

## **Rudder systems**

Positioning the ship's rudder precisely and powerfully for decades: This is exactly what Rexroth components and systems have been doing for more than 50 years in international shipbuilding. The hydraulic actuators sensitively convert the control commands from the bridge into movements of the rudder. We support all concepts with different cylinder configurations. Rexroth hydraulic systems are wear-free, energy-efficient and robust.

## **Azimuth drives**

Azimuth drives for active steering substantially increase maneuverability, even on large ships. Rexroth has already realized numerous solutions, including some with Hägglunds hydraulic motors, for extending and retracting the azimuth thrusters and for rotating the nacelle. Because it is designed as individual units, the hydraulic system fits into tight installation spaces yet provides the needed power.



◀ **Hydraulic rudder system on a container ship**



(Source: wikimedia.org – licensed under CC0)

- ◀ Azimuth thruster with Hägglunds motors for adjusting the nacelles
- ▼ Maximum maneuverability in tight spaces made possible by the cycloidal drive – equipped with Rexroth drive technology



Axial piston pumps from the A4 series provide the necessary flow according to requirements. They regulate speed, direction and torque needed to adjust the nacelles using type A2 axial piston motors together with a MOBILEX-GFB gearbox, or directly using a Hägglunds motor.

#### **Pitch adjustment and jet drives**

Other drive concepts make use of variable pitch propeller blades. The hydraulic actuators are positioned here in the propeller housing and adjust the blades purely by hydraulic means, without any electrical power input. Rexroth also supplies variable jet drives for thrust and direction control with all the necessary components. As a system partner for hydraulic adjustment, Rexroth was involved in the development of the Cycloidal Drive. This system makes it possible, for example, to maintain an exact position at high sea.



# Dredgers: Heavy-duty work for a clear run

In shipbuilding, the trend for many years has been towards ever larger ships. These are more economical because they can load more freight. But for many harbors, that also means that the shipping channels and harbor basins have to be made even deeper, in addition to regular clearance work. This in turn means that dredger capacity will be fully utilized in the long term. For decades, Rexroth has specialized in equipping dredgers of all kinds with powerful and robust hydraulic system solutions.



In many different versions, dredgers take on the arduous task of clearing out riverbeds and ocean floors to keep shipping channels clear. On light grounds with loose sand and pebbles, pure suction dredgers are used. But as soon as the material becomes more solid, then the time comes to cutter dredgers. These have an additional cutting head with rotating chisels on the suction head.

Rexroth, as the system partner, configures the complete working hydraulics for such dredgers with numerous cylinders and rotary drives and the necessary hydraulic power units. Hydraulics specialists use simulation to compute the response in different load situations, ensuring that there is always enough power available.

### **Wider application window for hopper dredgers**

Hopper dredgers are seagoing suction dredgers with a movable drag head at the side. The loosened material is taken aboard the ship through the suction head and a pipe. Again, Rexroth realizes complete drive and control solutions for the entire working hydraulics and other hydraulic drives for the marine engineering sector.

The working results of a dredger depends decisively on how the suction head is positioned on the ocean floor. This is a major challenge, especially in rough seas. In addition to easy passive heave compensation systems, Rexroth also offers tailor-made active heave compensation systems. These improve the performance and widen the application window: Dredgers can then also be used in rough seas without precision being affected.

### **Controlled opening of the stern**

The material picked during dredging is often transferred from the dredger onto a split barge which dumps it at a specified spot. These vessels consist of two hull sections which can be folded apart to enable the hopper to be quickly emptied and then reloaded. This requires extremely reliable and powerful hydraulics.

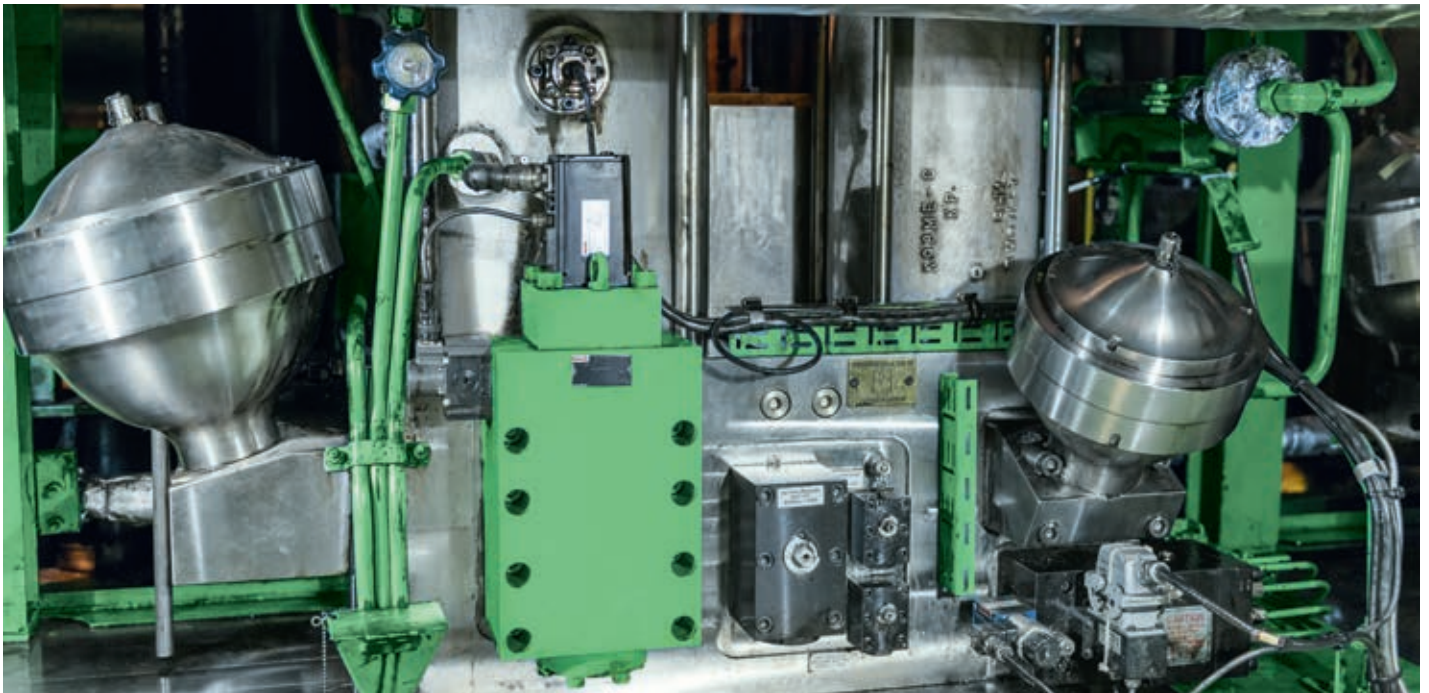
For many years, Rexroth has been equipping motor hoppers with the necessary drive and control systems for the folding mechanism. A central control panel controls the hydraulics. The double-action cylinders are protected against corrosion by an Enduroq coating system. The hydraulic control blocks ensure reliable function.

Rexroth specialists are familiar with the special requirements of each type of ship and have the right solution. For example, the hydraulic power unit is tilted to 20 degrees when the two halves of the hull are folded open. Rexroth takes this into account with special modifications to guarantee flawless function under such conditions. Besides such standards, Rexroth also conducts project planning for tailor-made solutions for special ships such as back hoe dredgers.



# Green shipping: Reduced fuel consumption, reduced exhaust gas emissions

All around the world, awareness is growing of climate change and of the necessity to reduce exhaust gas emissions. At the same time, the economic pressure to substantially reduce fuel consumption is increasing. Rexroth is just the right partner for both challenges.



IMO Tier III and EPA Tier 4 set the pace: New exhaust emissions regulations are set to reduce the permissible level of exhaust emissions in the so-called Emission Controlled Areas (ECAs) by a further 80 percent compared to the regulations from the year 2000. Further ECAs are planned for the entire Mediterranean area and for Southern Japan. Large ships with slow-turning engines are only able to satisfy these specifications with a huge intervention in the engine technology.

▲ **FIVA valve – Controls the fuel injection and the actuation of the exhaust valves**





### 250 million load cycles

A decisive signal: Second generation FIVA valves from Rexroth. FIVA stands for "Fuel Injection & Valve Activation". This hydraulic actuator assumes the function of the camshaft and is thus responsible for controlling both the fuel injection and the exhaust valves of the latest generation of MAN ME engines. This technology ensures that the large engine always runs at its optimum operating point (depending on the engine load), reducing both fuel consumption and exhaust emissions.

Rexroth FIVA valves represent the state of the art when it comes to service life, for they are designed to withstand at least 250 million load cycles. That means they decisively extend the maintenance periods. At the same time, they substantially reduce fuel consumption, as demonstrated in practice operations.

### Turbo hydraulic system

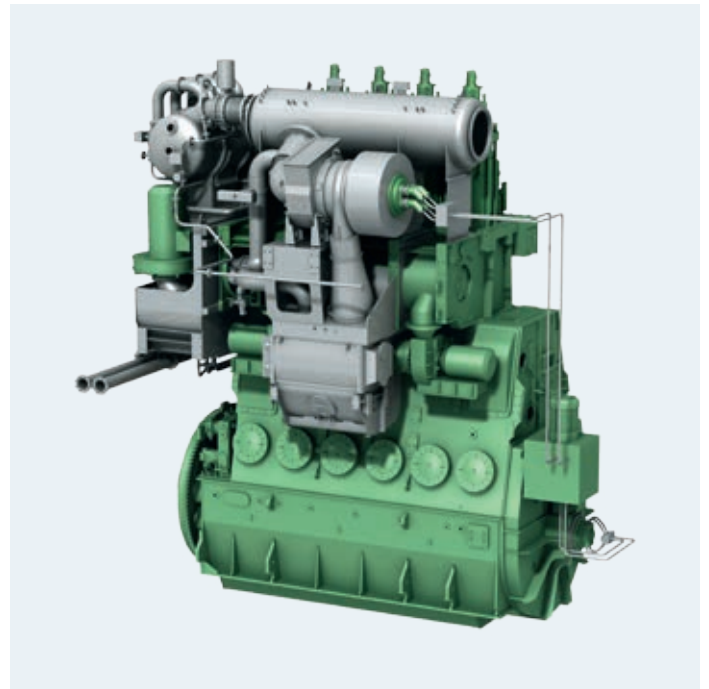
This compact complete system makes use of the energy in the exhaust gases of ship engines to reduce fuel consumption by up to four percent. It consists of standard components from the Rexroth hydraulics modular system: pumps, hydraulic motors and hydraulic power units with control block. This in turn means it has short payback periods.

### Energy efficient with every movement

Rexroth uses the universal Rexroth for Energy Efficiency system for all automation solutions. This combines four levers:

- ▶ an energy-efficient system configuration
- ▶ components with enhanced efficiency
- ▶ the requirement-based generation of power and
- ▶ energy recuperation with the turbo hydraulic system

We thus exploit all potentials for more energy-efficient solutions. This reduces fuel consumption and exhaust emissions even further.



**4EE**  
ENERGY  
EFFICIENCY

**Turbo hydraulic system:**  
Complete compact system  
of pumps, hydraulic motor  
and hydraulic power unit  
with control block



# Saltwater-resistant and protected against explosion: The right components at the right place

Technical components on ships are exposed to extreme loading. Highly corrosive salt water, extreme temperature fluctuations and explosive environments demand solutions specially conceived for this application. Rexroth offers a broad spectrum of components which are resistant to salt water and arctic conditions as well as explosion-protected variants.

## **Protected against corrosion**

Preventing corrosion and upholding function for many years and decades: Rexroth employs corrosion-resistant materials and durable coatings for its saltwater-resistant component and assembly groups. Furthermore, clever details protect the functional capability, like specially designed electrical connections. Saltwater-resistant valves, control blocks and cylinders have been demonstrating their durability and reliability for decades.

## **Suitable for arctic conditions**

Temperatures down to minus 40 degrees Celsius demand special technical solutions. Rexroth offers a range of arctic-resistant hydraulic valves and actuators which reliably perform the functions even at such extreme temperatures.

## **ATEX-compliant explosion protection**

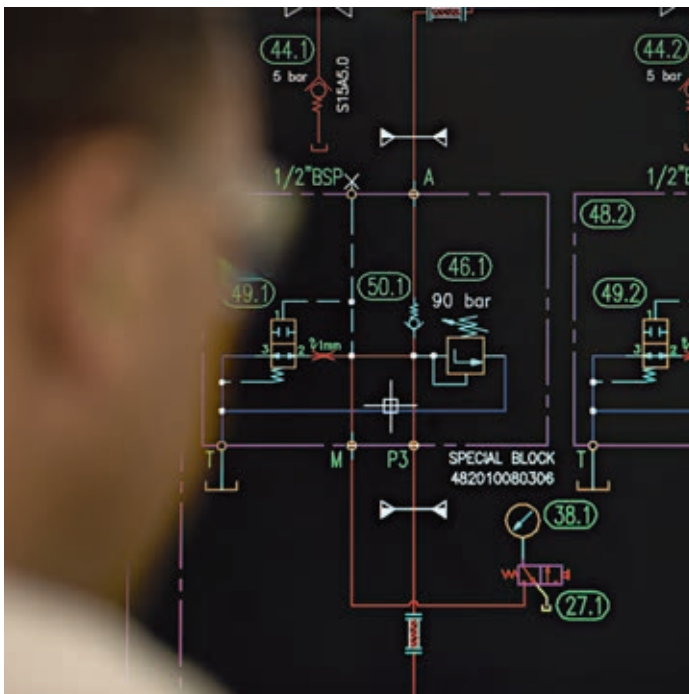
Gases, vapors, solvent fog and dust: Whenever technical operating materials are employed in explosive or potentially explosive conditions, lawmakers and certification agencies around the world stipulate special precautions such as ATEX in order to eliminate risks to people and to the environment.

Rexroth has a broad range of components and solutions that will help you fulfill explosion-protection regulations. All necessary components have successfully documented type examinations and are marked accordingly. Rexroth guarantees the quality assurance and traceability of its products. Supplies always include the complete documentation as specified in numerous different languages.



# Engineering partnership: Together from the idea to commissioning

Ever more capable and more complex technology is changing the entire engineering process. Rexroth can support you all around the world with the expertise and resources of a global partner. Rexroth specialists use specially developed simulation programs to make sure design is right for the concerned application and for the reliable function of the drive solutions.



It often starts with a simple question: Can't we use a new, more efficient and reliable solution? The Marine Engineering specialists at Rexroth love these challenges. They put all their know-how and application experience into developing exactly the right solution, together with you.

As a multi-technology specialist, we approach every task with an open mind. Electrical or hydraulic drive technology, controls and software: We examine every option until we have identified the most technologically and economically rational variant. We use simulation programs we have developed ourselves, which also take into account the special characteristics of fluid technology, to examine all options. Your benefits: Even before installation you have the security that the solution will satisfy your specifications.

Experienced engineers will support you through the installation and commissioning process. As your project partner, we will prepare the documentation and program the software. That leaves you to focus on your core competences and still reduce your time to market.



# Global service: Competence quickly available. REMAN concept included.

Rexroth Service is the competent partner for the entire life cycle of machines and systems – from planning to service life extensions. Rexroth offers a broad range of suitable service products to prevent or at least significantly reduce downtimes.



▲ **Close to the customer: maintenance, repairs, the global supply of spare parts, modernization or on-the-spot modifications – Rexroth is by your side in more than 80 countries worldwide!**

## **Spare parts service:**

### **The right parts at the right place**

If a component fails, it is important to get the right spare parts without delay. That is especially true for older machines and systems. Our experienced specialists will find the right solution in Rexroth's extensive product range – quickly and anywhere in the world.

## **Product overhaul:**

### **Fast, economical and as new**

Why wait till a component fails? It is often rational to preventatively replace worn or defective components during an already planned maintenance period. That will increase the level of availability of the motor with minimal expense.

## **Repair service:**

### **Industrially reproducible services**

It doesn't always have to be a replacement. An economical repair is often possible – especially with expensive components and modules – if you choose Rexroth as your partner. Our service workshops will quickly get your components back into working order.

## **Warranty:**

### **More security for your investment**

After repair work has been performed, you will enjoy a new parts warranty on all components for a period of twelve months.



**New, economical and environmentally acceptable:  
Rexroth REMANufacturing**

The REMANufacturing program for pumps and motors gives shipyards and ship operators a fast and economical solution for overhauling used units. These should be replaced in 5-yearly intervals or after about 32,000 operating hours.

The units are completely overhauled at our plant at Horb, Germany: All worn parts and valves are replaced by new components.

The service life of REMAN units is the same as that of new units. And they have a complete new parts guarantee! What's more, the Rexroth REMAN program is characterized above all by high reliability on account of the 100% testing on ultra-modern test beds, high levels of availability from our stocks, low standstill periods and straightforward handling for the shipping company.

Used units can be sent back to Rexroth. Rexroth will then grant a credit for these.

For detailed information, please visit  
[www.boschrexroth.com/service](http://www.boschrexroth.com/service)

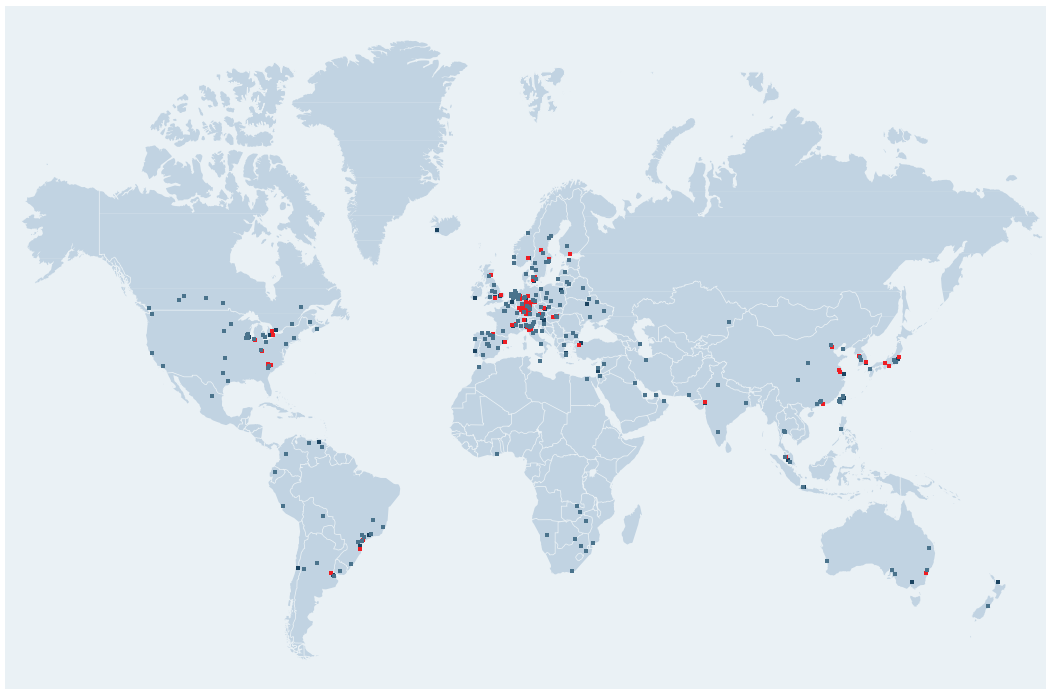


# We are close by wherever you need us

Rexroth is as global as commercial shipping. We are present on every continent, in more than 80 countries. This ensures short distances and fast solutions.

Rexroth links concentrated application experience in marine engineering with a global organization. Europe, Asia, North and South America, Africa, Australia. Our global production and service network covers all important shipping hubs. Regional logistics centers shorten the lead times for spare parts and service technicians from Rexroth are always close at hand.

As your project partner, we always speak your language. Regional marine engineering specialists coordinate our resources for your success. This means you have unlimited access to our expertise, for reliable, efficient and durable solutions in all areas of marine engineering.



◀ **Rexroth Service is by your side in more than 80 countries – from support on the spot to qualified testing services to repairs.**

- **Headquarters**
- **Production**
- **Sales**

Tough application,  
ingenious solution } Exactly



## Your benefits

- ✓ Increased reliability
- ✓ Enhanced durability
- ✓ Modular setup
- ✓ Improved efficiency
- ✓ Guaranteed service

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