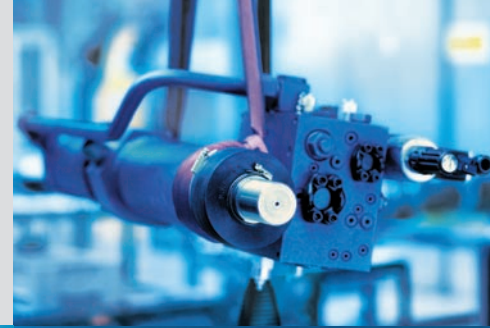


# Hydraulic Control Technology for Wind Turbine Generators



Extra efficiency in manufacture, operation and maintenance



# Environment-Friendly Power Generation with Hydraulic Control Technology from Rexroth

Pitch control

Drive train brake

Yaw system

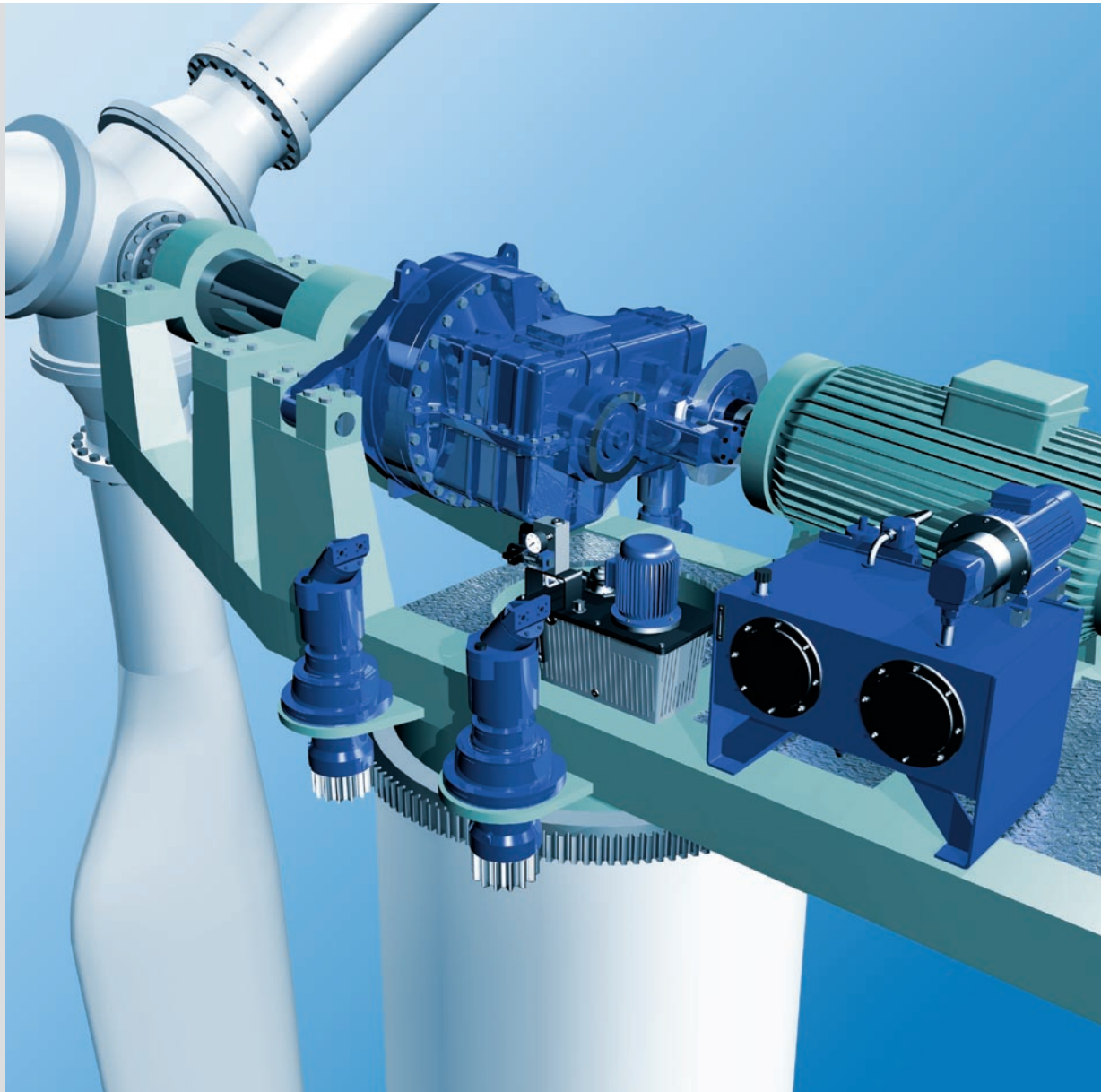
Subassemblies

Power units

Motor-pump groups

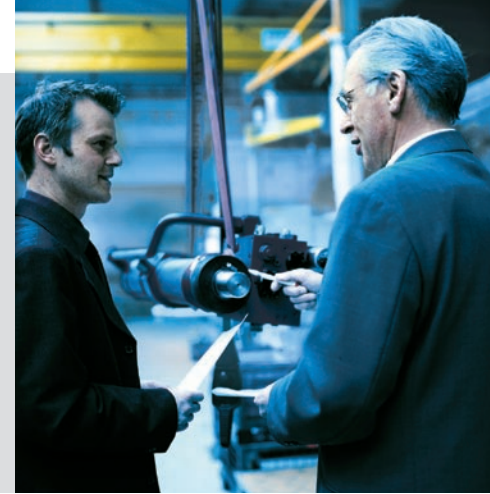
Accumulators

Filter and cooler subassemblies



The future belongs to energy generation from “renewable sources”. A fine example of this is the generation of electricity from wind power. The more efficiently the technological groundwork is accomplished – from development and operation

through to maintenance of the turbine – the faster sustainable energy generation methods will establish themselves in the marketplace.



The comprehensive drive & control expertise of Rexroth makes wind turbines more efficient – thanks particularly to the technological advantages of hydraulics in terms of high power density in limited space, low-maintenance and rugged design and, not least, outstanding controllability:

**Boosting efficiency:**

- More precise actuator drives
- Shorter control cycles

**Low production costs:**

- Simulation techniques to speed up development
- Modular design through to the subsystem
- The entire technology from a single source
- Less assembly effort
- Simpler commissioning

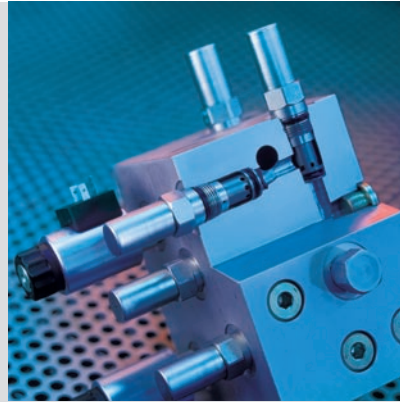
**Low operating costs:**

- Longer maintenance intervals
- Reducing loads
- Preventing overload
- Low wear

Manufacturers receive all the technology from a single source – standardized from a broad range of proven components or modified to customer specification. Owing to its outstanding knowledge of the industry, Rexroth, in its capacity as a component manufacturer and system supplier, can make any required modifications directly.

As a result of its worldwide presence, Rexroth contacts are always close to the customer.

## Ideally Positioned – Thanks to Precision Pitch Control



The availability of wind and grid capacity are the decisive factors for the wind turbine's operational state – with proportional valves for flexible adaptation. In normal operation the positioning motions can be executed sensitively and slowly to minimize stressing of the materials, while in extreme conditions they are performed suitably quickly to prevent damage to the turbine.

The ideal rotor blade pitch is accurately set by hydraulic cylinders.

Cylinder performance depends on the seal system. The standard seal system is pressure-loaded with pressure-dependent friction; the high-performance seal system operates pressure-unloaded with pressure-independent friction. Rexroth cylinders are available with either system, depending on the customer's specific needs.

The cylinder is controlled by proportional valves in numerous possible variants:

### Valves with

- External electronics
- Integrated electronics
- Integrated electronics and position controller

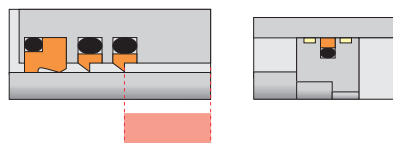
### Command value selection via a

- Current interface
- Voltage interface
- Field bus

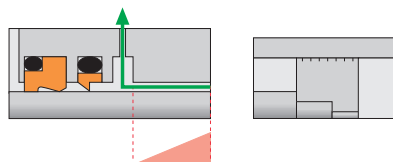
### Valve characteristic curves

- Linear
- Progressive
- Customized

**Standard seal system:**  
Pressure-loaded with pressure-dependent friction

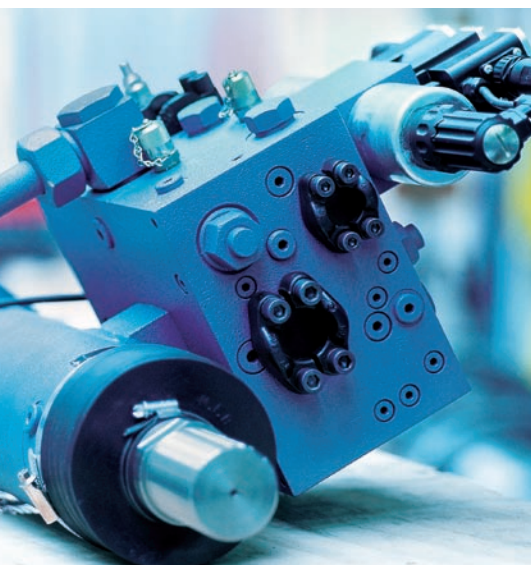


**High-performance seal system:** Pressure-unloaded with pressure-independent friction



Cylinders precisely controlled by proven, compact open and closed-loop control systems from Rexroth.

As the central drive element, the control block unites all the components in a single subassembly. As a result of its dual function as a component carrier and connecting element, the entire drive has been given an especially compact design. In addition to savings of space and materials, it also provides protection from environmental aggression and physical damage.

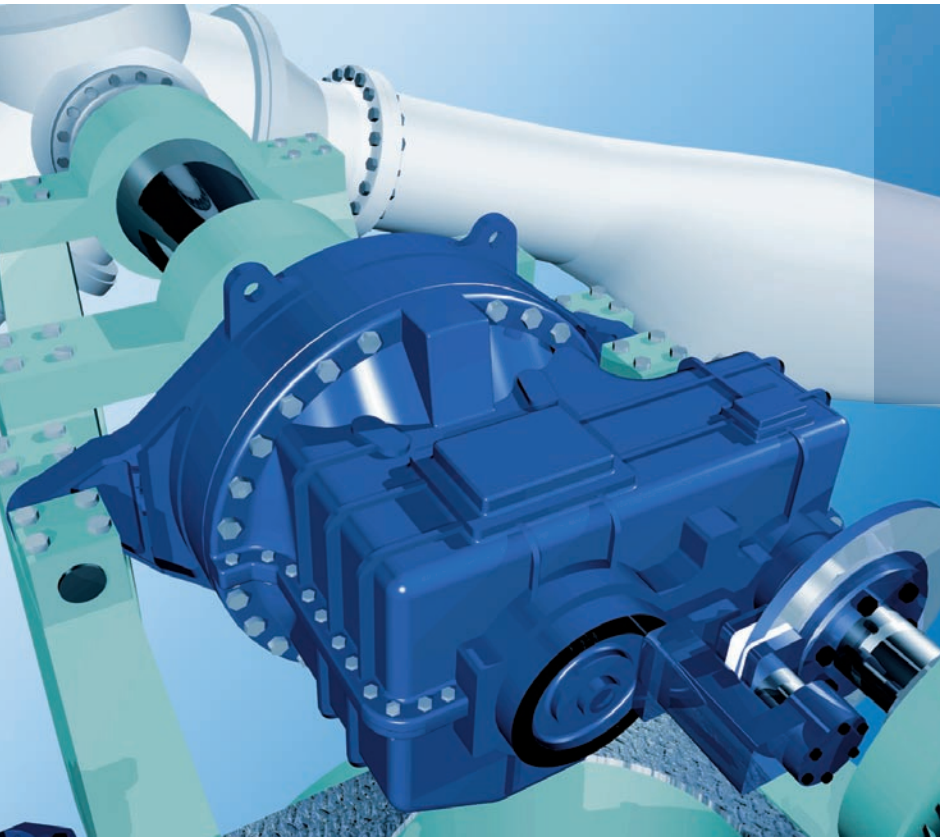


The compact cartridge valves employed in the central block control secondary functions:

- Passive position holding
- Counterbalancing
- Emergency stopping

The interaction of electrically and hydraulically operated seat valves significantly reduces the number of control signals and system-related internal leakage.

## Slowly but Surely – the Drive Train Brake



**Modulated pressure permits a wide variety of functions:**

- **Speed-controlled braking**
- **Torque-controlled braking**
- **Position-controlled braking**
- **Gentle braking**
- **Emergency braking**
- **Position holding**

In uncontrolled braking processes, the torque transmitted by the gearbox can easily exceed several times the rated torque and thus cause damage to the gearwheels and bearings. Time-consuming and hence costly failure, repair and replacement are the consequence.

Leading manufacturers of wind turbines therefore opt for the hydraulic modulation of braking pressure. To this end an independent hydraulic unit is employed to control all braking systems and circuits. With the aid of on/off valves, simple braking and holding functions are performed – servo, proportional and high-response valves give valuable plant components maximum protection from overload and damage.

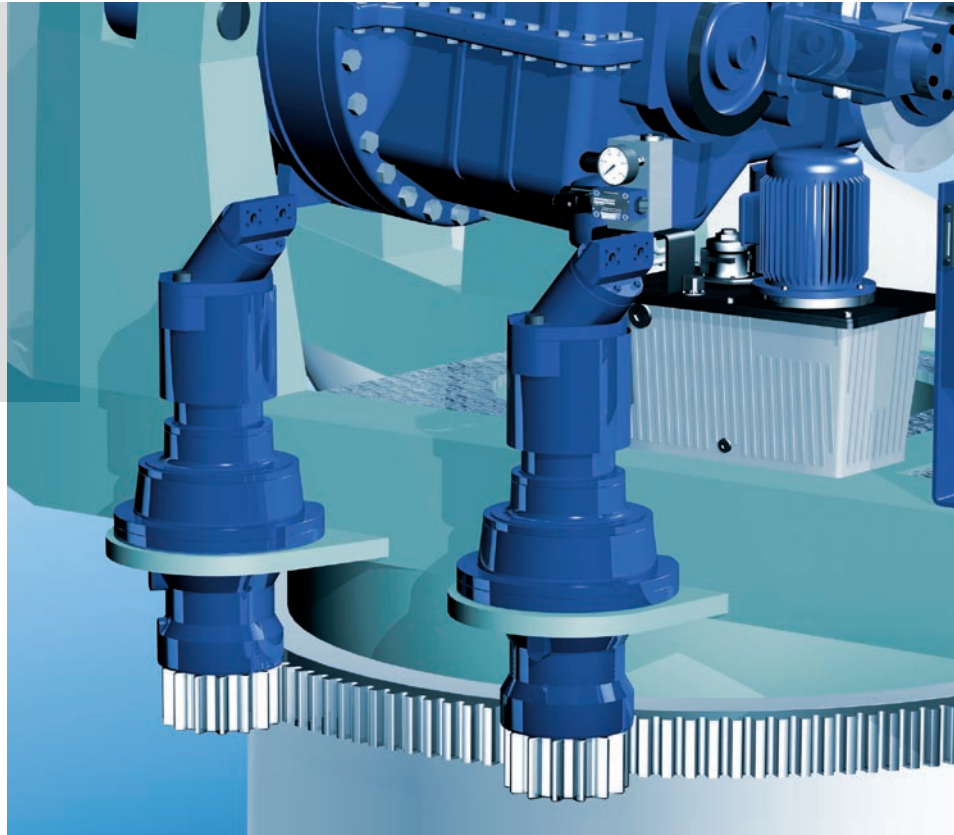
All the valves are seat valves and thus enable braking pressure to be maintained for extended periods, even during power failures.

## Facing the Wind – the Yaw System

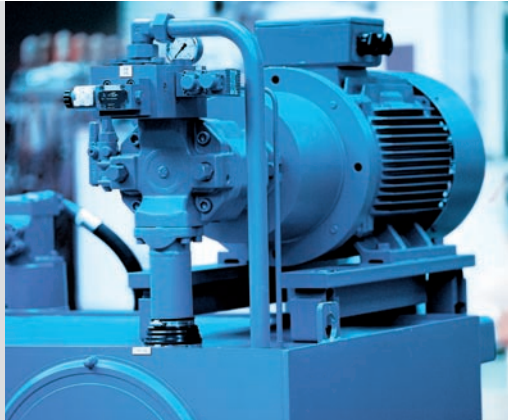
With the aid of an integrated motor-gearbox combination, the yaw system accurately points the entire “head” of the wind turbine into the wind.

Because of their high torque, a small number of drives are sufficient even for the biggest turbines.

If the yaw system drives are integrated in a hydraulic concept, they are powered by the central hydraulics system.



## Flexible Subassemblies



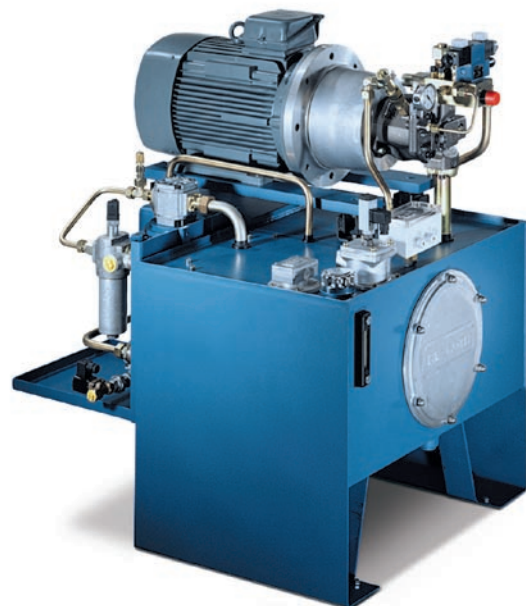
### **The power unit for power generation**

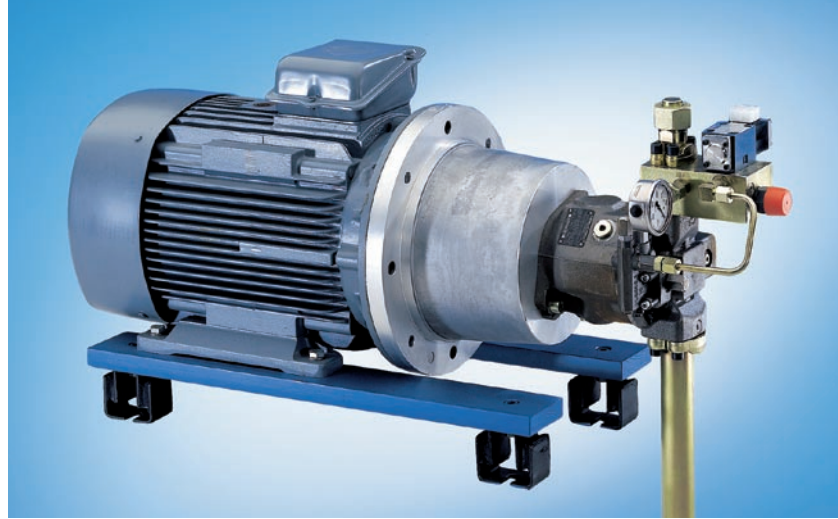
To move and control the components of a wind turbine, a standard power unit from Rexroth, consisting of standardized subassemblies, is almost always sufficient.

The advantages:

- Low engineering effort
- Rapid delivery
- Standardized subassemblies
- Perfectly adapted components
- Mature technology with a proven track record
- Low maintenance, long service life

Rexroth is also capable of realizing customized solutions quickly and inexpensively.





### Rexroth motor-pump subassemblies

If manufacturers of wind turbines want a decentralized design, they can choose from a broad spectrum of electric motors and hydraulic pumps, all of which can be freely combined.

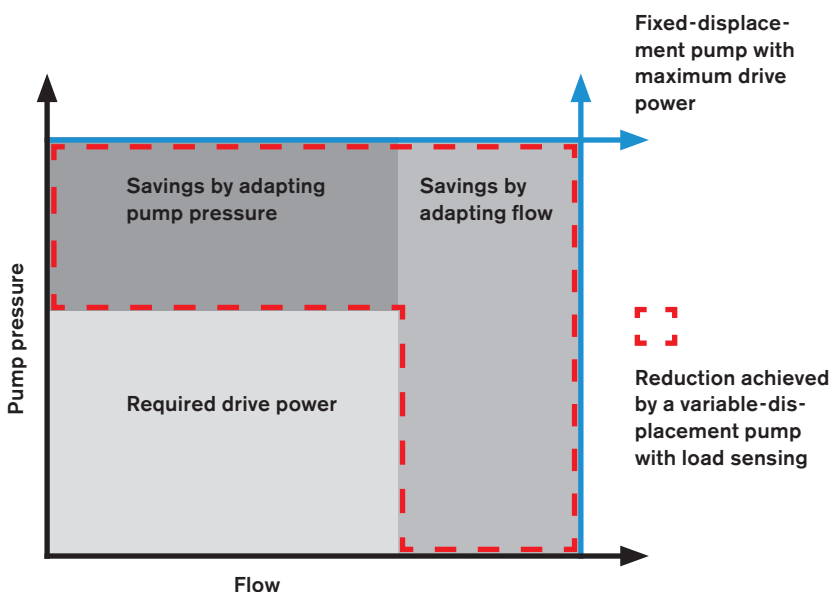
Rexroth supplies gear, vane and piston pumps with fixed or variable displacement and with mechanical or electrical pump controllers.

The “expensive” option: If a fixed-displacement pump is used with a fixed-setting pressure relief valve, the maximum drive power always has to be applied. If, however, less power is required from the drive, the excess power is lost unused via a pressure relief valve. During operation at reduced load, the excess pressure is released via a throttle – further loss of power. All loss is converted into heat in the valves, which have to be cooled, thus generating unnecessary expense as well.

By contrast, the “economical” option: Control pumps from Rexroth are renowned for their high, energy-conserving adaptability, material saving, longer service life and longer maintenance intervals.

In wind turbines, Rexroth axial piston pumps efficiently regulate pressure and flow. Via the mechanical pressure controller, the system pressure is permanently set at the pump – the pump only displaces as much oil as required. On the load-sensing solution, system pressure is additionally adapted to load pressure.

For electrical control, the system control refers to current operating conditions in calculating command values and adapts pump pressure and flow to the situation.





#### **Rexroth accumulator subassemblies**

Hydraulic accumulators not only serve as an energy reserve in emergencies, but also cover peak demand.

The advantage of this is that the installed power can be much lower, thus yielding savings in component sizes and energy consumption.

Wind turbines need special bladder-type accumulators that reduce the frictional wear occurring in rotary systems and withstand extremely low temperatures. Rexroth accumulators fill the bill perfectly.

#### **Rexroth filter-cooler modules**

Clean and cool oil is essential if the hydraulics system is to enjoy a long service life. For use in wind turbines, Rexroth supplies modules in different power categories.

With long supply lines, this subassembly can be used as a feed pump in order to prevent cavitation damage to the main pump. The system oil can be changed here. The subassembly can be integrated with ease into existing systems.



#### **Mechanical drive technology for wind turbine generators:**

- **Generator gear units**
- **Pitch gear units**
- **Azimuth gear units**

Brochure No.: RE 76110



# Intelligent hydraulics in new dimensions

Wherever forces need to be utilized economically, the advantages of industrial hydraulics are obvious – whether it is required to lift and lower loads smoothly, perform linear or rotary movements, achieve constant acceleration, maintain given speeds, approach positions exactly, transmit powers or interlink sequences.

Rexroth is the technology and market leader in industrial hydraulics with a comprehensive product range and distinct application expertise.

At Rexroth you can select from the worlds' largest standard product range in the field of hydraulics, application and customer-specific

system solutions of high quality. With advanced micro-electronics Rexroth has made hydraulics even more powerful.

For you, Rexroth is the ideal partner for developing highly efficient machines and production facilities – from the first point of contact to commissioning and throughout the entire life cycle. Teams that operate worldwide carry out the complete engineering of your systems and, if requested, up to the hand-over of turnkey systems and beyond – service included.

Thanks to the use of hydraulic drive and control technology from Rexroth you will be more competitive than ever.

**The Drive & Control Company**  
Bosch Rexroth offers an unique and comprehensive range of products and services across technologies from a single source in its six fields of technology and service areas – strong in high-quality individual technologies, combined with highest application-specific competence in system packages with integrated complete solutions.

Industrial  
Hydraulics

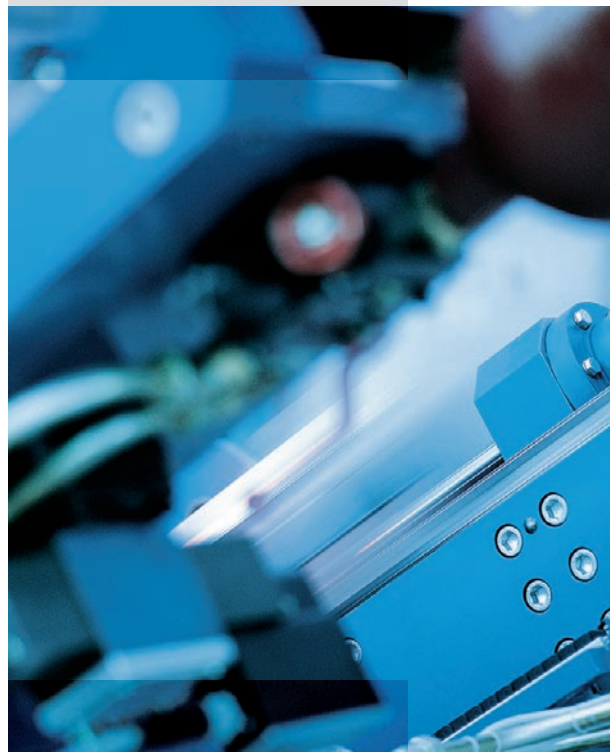
Electric  
Drives and  
Controls

Linear  
Motion and  
Assembly  
Technologies

Pneumatics

Service  
Automation

Mobile  
Hydraulics



## **Rely on service across technologies**

Rexroth integrates all services for the entire product spectrum in the field of factory and industrial automation into a single organization: from immediate support, spare parts service, field and repair service, retrofit/modernization through to training.

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