Large hydraulic cylinders: Customized solutions
At Rexroth, your project is our challenge. We design and manufacture custom built cylinders, high pressure piston accumulators and pressure vessels for your individual applications. Our large hydraulic cylinders range from bore 200 mm up to 1.500 mm and strokes up to 24.000 mm. Our highly skilled specialists have a unique expertise for a large variety of industry sectors and know the special requirements of your application.
Rexroth has an outstanding track record of building large hydraulic cylinders for more than five decades. Our proven application-based engineering and production processes give you the assurance that every cylinder is perfectly crafted and suited to its task. Safe and reliable operations are important to all industries where these heavy cylinders are used. We work consistently to maintain industry-specific standards from classification societies such as LLOYD’s Register, DNV, the American Bureau of Shipping, Rexroth and customer standards.

One of the most essential parts of large hydraulic cylinders is the piston rod surface. Rexroth has been a pioneer and trend setter in developing new technologies that improve uptime and reduce Total Cost of Ownership. All in-house surface technologies are bundled under the brand name Rexroth Enduroq.

Rexroth offers more than unusual dimensions and dedicated surface technologies. We deliver extra functionalities like integrated measuring systems, as well as complete drive and control solutions with perfectly matched power units, hydraulic piping and control systems. And we supply additional services like project management, engineering, commissioning, supervising and training. One-stop-shopping at Rexroth reduces the complexity of your project by instating clearly structured responsibilities.

As a global player with an international network in production, sales and service, Rexroth is always as big as you need it: as a cylinder supplier; as a main contractor for drive and control projects; and/or as a partner for lifecycle management support. Large hydraulic cylinders from Rexroth give your machinery the perfect fit – every time!

Further information: www.boschrexroth.com/lhc
Engineering and production: Using the real performance potential

Large hydraulic cylinders are used to transmit heavy forces in often extreme environments. Additionally, they must operate reliably and safely over a long period of time. Only systemized engineering and production processes can make sure that the cylinder always meets the individual requirements. Rexroth has developed sophisticated design tools and unique inhouse research facilities for a reliable and cost-efficient cylinder design.

Avoiding deflection and buckling
Our experts calculate the deflection and buckling of hydraulic cylinders. All typical mounting styles, friction moments in spherical bearings, transverse loads, accelerations and eccentric loads are taken into account. The calculations also encompass typical phenomena as ballooning of the shell, fabrication clearances in the cylinder guiding and identification of the bearing material. The result is a precise prediction of the cylinder under pushing as well as pulling loads.

The eccentric position of the rod in the head, as well as the piston in the shell, is thoroughly analyzed. Local stresses in the rod, shell and bearings are precisely calculated. In several cases a force stroke diagram is required. These advanced and detailed calculations are the basis for a reliable and cost-efficient cylinder design.

Unique inhouse research facilities
> Calculating every detail to develop the perfect cylinder that stands any individual demand
> Integrated electronics for measuring systems
Preventing fatigue
Rexroth has developed several unique construction details, as well as a set of demands for the materials, in addition to the applicable standards. These details are calculated with FEM (Finite Element Method) and combined with calculation methods according to recognized standards in order to realise a reliable design without critical fatigue.

The calculations cover parameters such as material type and thickness, local stresses, amplitudes, stress gradients and the number of load cycles. A load spectrum is required for cylinders in dynamic applications.
The art of surface technologies: Improving uptime whilst reducing Total Cost of Ownership

The piston rod surface of large hydraulic cylinders is one of the most essential parts of the hydraulic installation. The right combination of surface technology, seal concept and hydraulic medium defines the eventual uptime and Total Cost of Ownership. Rexroth has been one of the pioneers and trend setters in developing various in-house technologies for every industry and application.

Best surface technology
Rexroth Enduroq uses an integrated concept for selecting, engineering and producing the best surface technology in any industry or application. It bundles all in-house surface technologies for piston rods. To develop this concept, Rexroth analyzed service data from its installed cylinder base, which is the largest one in the world.

Enduroq 3200 is a dual layer, Ultimet-based, surface technology. It was specially developed for offshore splash zones (e.g. direct riser tensioners) and meets the highest qualification standard in the industry*. This standard has been developed by DNV in the Joint Industry Project, and Rexroth has played a prominent role in this development.
Other solutions

Other solutions for the cylinder rod surface include Enduroq 3000, a single layer Ultimet-based technology, as well as Enduroq 2000 and Enduroq 2200 which are both based on the proven HVOF technologies. Rexroth can also supply chromium-plated piston rods in applications where this has proven to offer the best combination of functionality, durability and Total Cost of Ownership.

Seal configuration

Rexroth has developed a Seal Matrix for all kind of applications and piston rod surfaces. This matrix is the result of an extensive ‘tribology’ development program in co-operation with world leading seal manufacturers. Tribology analyzes friction, lubrication and wear of interacting surfaces in motion.

Some seal configurations are able to withstand the complete extrusion gap, fit for speeds up to 15 m/s, useable for low-friction applications and have excellent wear properties. Other seal configurations are adjustable, maintenance friendly and non-sensitive to dirt.

*Guideline for qualification of wear and corrosion protection surface materials for piston rods (Report No. 2009-3295; revised 2010).
Life cycle management: Improving overall equipment effectiveness

More than 90% of the life cycle costs are determined during the design phase. As a partner already in the engineering phase of the installation, Rexroth can save you maintenance time and costs, not to mention improving availability over the complete life cycle.

Unique developments
Rexroth has developed unique construction details and piston rod technologies which offer a twofold advantage: in addition to a longer life span, Rexroth cylinders also save maintenance time and improve the uptime and profitability of installations.

Repair and maintenance
Rexroth offers a wide range of repair and maintenance services. Our maintenance concept is made up of spare part management and delivery, field service, regular health checks and inspections, repair and overhaul services and technology upgrades. With various specialised service centres around the globe to support your maintenance operations.
All manufacturing processes are organized according to BPS, the Bosch Production System, which is based on the principles of lean-manufacturing.

Rexroth lifecycle management comprises services for your application all over the world.
Marine: Ready for continuous challenges

<table>
<thead>
<tr>
<th>Dredging</th>
<th>Naval</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ trailing suction hopper dredger</td>
<td>▶ AOR replenishment</td>
</tr>
<tr>
<td>▶ cutter-suction dredger</td>
<td>▶ special equipment</td>
</tr>
<tr>
<td>▶ spud hoist dredger</td>
<td></td>
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<tr>
<td>▶ split hopper dredger</td>
<td></td>
</tr>
<tr>
<td>▶ split barge</td>
<td></td>
</tr>
<tr>
<td>▶ piling barge</td>
<td></td>
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<tr>
<td>▶ stone dump barge</td>
<td></td>
</tr>
<tr>
<td>▶ pipe laying vessels</td>
<td></td>
</tr>
</tbody>
</table>

Dredging, pipe laying or barges, in marine applications project cylinders have to perform under high forces and extreme environmental conditions. Rexroth offers customized, individual solutions perfectly matching to the requirements. Due to our extensive experience with classification bureaus, such as Bureau Veritas, DNV, ABS, LROS, Lloyds, GL, and others, Rexroth cylinders meet the specification right from the start.

**Special Features**
- optimum design because of application experience and highly specialized calculation and simulation tools
- piston rod coating with an extremely high wear and corrosion resistance
- first class seal and bearing configuration
- special shell mounted bearing against unpredictable axial forces
- cylinder integrated measuring system

**Bottom door cylinder**

to open the bottom doors of suction dredgers

<table>
<thead>
<tr>
<th>Piston diameter:</th>
<th>480 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston rod diameter:</td>
<td>200 mm</td>
</tr>
<tr>
<td>Stroke length:</td>
<td>3,350 mm</td>
</tr>
<tr>
<td>Application:</td>
<td>submerged in sea water</td>
</tr>
</tbody>
</table>
The deepening and maintaining of ports, rivers or canals is a continuous challenge. Dredging strongly depends on reliable, specialized large hydraulic cylinder technology.

**Cylinder for piling barge**

- Piston diameter: 1,000 mm
- Piston rod diameter: 650 mm
- Stroke length: 12,870 mm
- Application: installation of piles in the sediment

**Cylinder for split barge**

- Piston diameter: 900 mm
- Piston rod diameter: 400 mm
- Stroke length: 3,500 mm
- Application: split barge, transportation of soil that hopper and cutter dredgers obtain during work
Offshore: Cylinders made for toughest demands

Designed for the aggressive offshore environment Rexroth cylinders meet the highest demands regarding safety, corrosion resistance and heavy duty operation. As the leading supplier Rexroth is continuously adopting new technologies. Intensive interaction with OEMs, end-users and consultants ensures that we understand market demands, whether it is deep-sea, arctic or any other demanding offshore application.

**Special features**
- cylinder designs based on decades of knowledge and field experience
- extremely high wear and corrosion resistance
- high quality seal and bearing configuration
- integrated high quality piping
- unique solution for Position Measuring system
- measuring systems for potentially explosive atmospheres
- welding for low temperature applications.

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**Heave compensation**
- wire line tensioning
- direct riser tensioning
- passive/active heave compensation
- linear concepts

**Skidding**
- rig skidding
- load out skidding

**Deck mating**
- deck mating systems
- fender systems
- integrated skidding systems
- decommissioning systems

**Jacking**
- positive engagement systems
- rack and pinion systems
- hydraulic concepts

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**Riser tensioner cylinder for oil-drilling vessels**

- **Piston diameter:** 560 mm
- **Piston rod diameter:** 230 mm
- **Stroke length:** 16,300 mm
- **Application:** dynamic application in aggressive environments
Whether high in the derrick, in the moon pool or deep down under water: Large hydraulic cylinders from Rexroth are accurate, reliable and cost effective.

**Cylinder for jack up system**

- Piston diameter: 600 mm
- Piston rod diameter: 280 mm
- Stroke length: 3,150 mm
- Application: transforming a ship into a platform

**Cylinder for heave compensation**

- Piston diameter: 300 mm
- Piston rod diameter: 220 mm
- Stroke length: 3,750 mm
- Application: compensating tidal influences on the system
Civil Engineering: Reliable solutions for highest uptime

Due to the critical functions, operation has to be secured under all circumstances. Rexroth is constantly in close contact with governments, consultants and contractors. All solutions are designed to specific standards and regulations like DIN, ASME, JADEE, NEN. Our experience with design standards and sector related requirements lead to lowest possible Total Cost of Ownership.

**Special features**
- extreme resistance against corrosion, scratch and wear
- first class seal and bearing configuration
- integr. measuring system, with or without redundancy
- submerged solutions possible
- mechanical locking system
- integrated oil reservoir possible
- special options for low temperature operations
- oil supply through piston rod possible

**Power generation**
- radial gates
- flap gates
- intake gates
- bottom outlet
- turbine regulation
- valves

**Ship locks**
- miter gates
- culvert gates
- double hook gates
- sector gates

**Moveable bridges**
- bascule bridges
- lifting bridges
- swing bridges
- roll-on/roll-off bridges

**Barriers**
- roller/sliding gates

**Bottom outlet cylinder for hydro power dam**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston diameter:</td>
<td>450 mm</td>
</tr>
<tr>
<td>Piston rod diameter:</td>
<td>150 mm</td>
</tr>
<tr>
<td>Stroke length:</td>
<td>15,415 mm</td>
</tr>
<tr>
<td>Application:</td>
<td>partly submerged and low dynamic</td>
</tr>
</tbody>
</table>
Whether you are constructing power generation plants, dams, ship locks, bridges or barriers, Rexroth is your worldwide partner for civil engineering.

**Miter gate cylinder**
for ship locks

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<tbody>
<tr>
<td>Piston diameter:</td>
<td>300 mm</td>
</tr>
<tr>
<td>Piston rod diameter:</td>
<td>160 mm</td>
</tr>
<tr>
<td>Stroke length:</td>
<td>3,700 mm</td>
</tr>
<tr>
<td>Application:</td>
<td>medium dynamic, operating in splash zone</td>
</tr>
</tbody>
</table>

**Cylinder for bascule bridge**

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Piston diameter:</td>
<td>540 mm</td>
</tr>
<tr>
<td>Piston rod diameter:</td>
<td>280 mm</td>
</tr>
<tr>
<td>Stroke length:</td>
<td>5,500 mm</td>
</tr>
<tr>
<td>Application:</td>
<td>low friction, heavy mass movement</td>
</tr>
</tbody>
</table>
General industrial applications and presses: Life time and durability

The environment and working conditions are usually hard and intensive due to the frequency of movement and 24/7 operations. Life time and durability are key words to our engineers for custom tailored cylinders.

**Special features**
- optimal design because of application experience and highly specialized calculation and simulation tools
- piston rod surface technology, where required, with an extremely high wear and corrosion resistance
- first class seal and bearing configuration for demanding environments and long life time
- special rod sealing for submerged solutions
- manifold block, pre-fill valve or measuring system integrated in the cylinder design
- integrated high quality piping
- special design based on fatigue calculations

**General industry**
- pressure intensifiers
- cement rolling mills

**Presses**
- metal forming
- extrusion
- injection moulding
- compactors
- jack rams

**Main pressing cylinder for baling presses**

- Piston diameter: 720 mm
- Piston rod diameter: 700 mm
- Stroke length: 600 mm
- Application: multi shift high cycle movement under harsh conditions
Highly dynamic applications, such as presses for scrap, paper, baling, laundry and pipe bending require special features.

**Press cylinder with jack ram**  
for slab press

- Piston diameter: 480 mm  
- Piston rod diameter: 440 mm  
- Stroke length: 2,350 mm  
- Application: high efficiency with low force high speed, approach and pull back

**Double acting press cylinder**  
for forging press

- Piston diameter: 800 mm  
- Piston rod diameter: 750 mm  
- Stroke length: 1,950 mm  
- Application: high impact load case under severe working conditions
Steel mill and rolling mill applications: Cylinders that will stand the heat

The sheer force is impressive: In a plate mill a Rexroth custom built cylinder delivers a rolling force of 90,000 kN with a bore up to 1,500 mm. The environment in this industry is harsh and demanding with strong vibrations, high temperatures, dust and pollution. Most of the cylinders are expected to operate for several years in 24/7 operation.

**Special features**
- optimal design because of application experience and highly specialized calculation and simulation tools
- piston rod surface technology with an extremely high wear and corrosion resistance
- first class seal and bearing configuration for harsh and aggressive environment
- special rod sealing and coating for submerged solutions
- manifold block and measuring system integrated in the cylinder design
- integrated piping

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**Continuous casting machines**
- ladle turrets
- rotary joints
- segment

**Rolling mills**
- automatic gauge control
- roll change
- coiler

**Secondary metallurgy**
- ladle lift

**Furnaces**
- melting furnaces
- re-heat furnaces

**Non ferrous casters**
- vertical casting table control

**Automatic gauge cylinder for roll gap control**
- Piston diameter: 1,100 mm
- Piston rod diameter: 950 mm
- Stroke length: 40 mm
- Application: accurate, dynamic strip thickness control by high res. and integrated measurement- and servo-system
Strong vibrations, high temperatures, dust and pollution. The environment and working condition in heavy industry applications is harsh and demanding.

**Ladle turret cylinder for continuous casting**

- Piston diameter: 650 mm
- Piston rod diameter: 450 mm
- Stroke length: 645 mm
- Application: steel casting machinery continuously operating in high temperatures

**Non ferrous casting cylinder for billet or slab casting**

- Piston diameter: 380 mm
- Piston rod diameter: 320 mm
- Stroke length: 8,000 mm
- Application: underwater billet casting with a long stick-slip poor movement
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Bulk materials handling and mining: Right dimension for heavy work

In the mining industry large hydraulic cylinders operate non-stop with all kinds of materials under extreme conditions, whereas in bulk materials handling they have to withstand abrasive and seaport conditions or high vibration levels. Cylinders in tunnel boring machines are exposed to wear-intensive circumstances, whilst dealing with extreme side loads and torque acting on the cutting head.

**Surface mining**
- stacker/reclaimers
- bucket wheel excavators
- belt wagons
- transport crawlers
- spreaders
- excavators

**Bulk materials handling**
- level luffing cranes
- ship loaders
- ship unloaders
- stack/reclaimers
- belt wagons
- spreaders

**Tunnel boring machines**
- hard rock tunneling
- shield tunneling

**Boom cylinder for track loader**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston diameter</td>
<td>320 mm</td>
</tr>
<tr>
<td>Piston rod diameter</td>
<td>180 mm</td>
</tr>
<tr>
<td>Stroke length</td>
<td>1,735 mm</td>
</tr>
<tr>
<td>Application</td>
<td>open-cast mining under abrasive and dirt conditions</td>
</tr>
</tbody>
</table>

**Special features**
- optimal design because of application experience and highly specialized calculation and simulation tools
- extremely high wear and corrosion resistance
- first class seal and bearing configuration
- unique pre-stressed piston/piston rod connection for dynamic operation
- spherical bearing protection system
- spare sealing flange premounted on the piston rod
- welding for low temperature applications
- integrated piping, manifold block and measuring system
Low weight and compact design, but at the same time a demand for high durability in extreme conditions: Rexroth cylinders perfectly meet the special demands and challenges, avoiding over dimensioning.

**Cylinder for hydraulic mining shovel**

- **Piston diameter:** 360 mm
- **Piston rod diameter:** 250 mm
- **Stroke length:** 6,198 mm
- **Application:** oil extraction from Canadian tar fields

**Thrust cylinder for shield tunneling**

- **Piston diameter:** 400 mm
- **Piston rod diameter:** 280 mm
- **Stroke length:** 1,700 mm
- **Application:** tunnel boring in wear-intensive circumstances
Special projects:
Unusual design for unusual demands

Our expertise in special projects supports you to realize the most challenging architectural designs. Movable roofs, for example in sport stadiums, typically are static large structures. Unstable movement should be avoided by all means because of high safety standards. For theatres and elevators, it is necessary to develop a compact design because of the limited built in space. Reducing stick-slip and noise levels are key in these applications.

**Special features**
- optimized tribology system in order to avoid stick-slip
- in-house simulation of dynamic system
- integrated measuring system to control movement
- optimal design to reduce built in dimensions
- high safety factors due to exceptional rules and regulations

### Special cylinders for movable roofs

<table>
<thead>
<tr>
<th>Piston diameter:</th>
<th>840 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston rod diameter:</td>
<td>400 mm</td>
</tr>
<tr>
<td>Stroke length:</td>
<td>15,213 mm</td>
</tr>
<tr>
<td>Application:</td>
<td>tennis arena with three movable roofs</td>
</tr>
</tbody>
</table>

**Stadiums**
- movable roofs
- movable floors
- platform supports

**Theatres**
- movable stages
- movable sceneries
- transport equipment

**Elevators**
- lifting equipment
- accumulator systems

**Geothermics**
- deep drilling
Large cylinders in special projects have to meet various requirements related to design standards, position measuring and mounting styles.

**Theatre cylinder**
for hydraulic movable floor

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Piston diameter</td>
<td>350 mm</td>
</tr>
<tr>
<td>Piston rod diameter</td>
<td>300 mm</td>
</tr>
<tr>
<td>Stroke length</td>
<td>13,778 mm</td>
</tr>
<tr>
<td>Application</td>
<td>national theatre with movable floors</td>
</tr>
</tbody>
</table>

**Special cylinders for deep drilling**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston diameter</td>
<td>280 mm</td>
</tr>
<tr>
<td>Piston rod diameter</td>
<td>250 mm</td>
</tr>
<tr>
<td>Stroke length</td>
<td>11,000 mm</td>
</tr>
<tr>
<td>Application</td>
<td>onshore and offshore oil and geothermic deep drilling</td>
</tr>
</tbody>
</table>