The Drive & Control Company

Rexroth
Bosch Group

Hydraulics for large 2-stroke engine systems: Precision components – low maintenance, economical

Reliable. Efficient. Safe. Proven. Hydraulic system quality is the metric by which all engines are judged

Transport volume increases, emission standards, operating cost reductions, no allowance for unscheduled downtimes – reasons enough to search out system components that are intelligent and preferably single sourced. Hydraulic components which complement each other by delivering precision and efficiency while setting the standard in the market. Extremely long service life with global service availability. Reduce your total cost of ownership (TCO) by leveraging our reliability. Welcome to Rexroth!

Longer life, lower TCO
Given the extremely long useful life of large 2-stroke engines, lifecycle costs are critical. Fuel consumption and maintenance costs are the key determining factors. High quality and reliability levels help keep maintenance costs low and minimize unscheduled downtimes. To address the increased burden of fuel costs and emission standards, the Rexroth hydraulic design engineers have developed specialized large engine components. These components provide environmentally compatible engine operation, and optimized fuel economy. They are also especially notable for one thing in particular: Significant reduction in the total cost of ownership (TCO)

Complete engine hydraulic systems from a single source
Rexroth offers all the hydraulic system components from a single source. Large engine applications benefit from a market leader with unmatched expertise and product breadth.

Field-proven axial piston pumps for fuel injection and variable exhaust valve activation, FIVA valves (designed for min. 250 million load cycles), start-up units, and reliable cartridge and directional valves are readily available at key maritime centers around the world. All components offer long service lives and complement one anothers specifications perfectly. In addition, a special REMAN program for axial piston pumps is available.

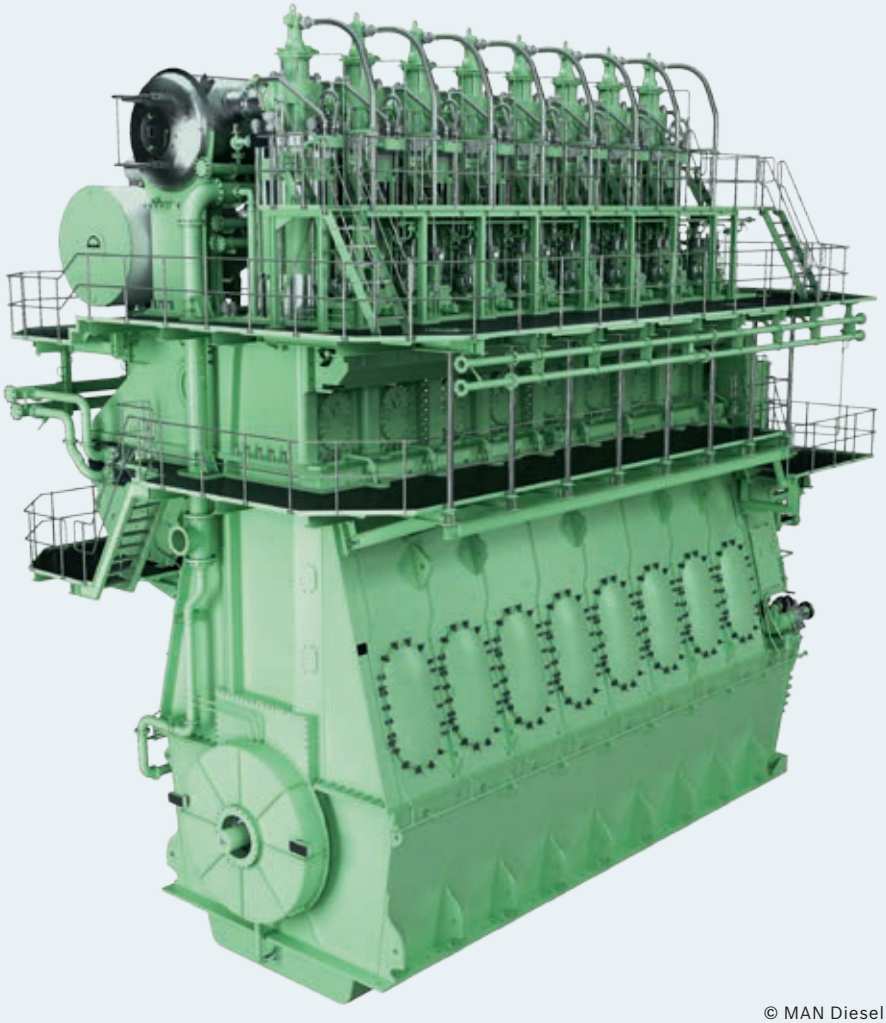
Partner for large engine OEMs

Leading engine manufacturers, shipyards, shipping companies and sub-assembly suppliers have relied on Rexroth for decades. Efficient system components and application-specific know-how set Rexroth apart from the competition. Solutions range from components specifically designed for maritime use, through to complete systems. Rexroth electro-hydraulic expertise has been called upon from the inception of the first electronic camshaft. Because even the best engine is only as good as the sum of its components.

Engines for marine propulsion systems, railway locomotive and stationary power stations

Rexroth system components: More power – less consumed where it counts

No compromises when it comes to reliability, ruggedness, readiness, economy, ease of maintenance and durability. That is what large engines need and epitomizes the challenge that all hydraulic drives and controls have to fulfill. In response, Rexroth developed a complete program of components that have the capability to not only meets statutory and regulatory requirements but also sets the standard in the large engine market. A standard that has created an industry-wide benchmark.



◀ **For every type of large 2-stroke engine, Rexroth has the right compo-nents**

You define the requirements for your engine, we deliver the right components. With Rexroth quality.

◀ **FIVA valve – fuel injection control and exhaust valve activation**

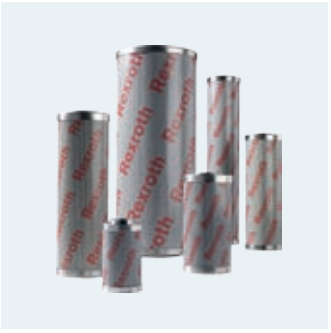
◀ **Cartridge (logic) valves for compact circuit design layout and for hydraulic system pressure limitation**

◀ **A4VSO axial piston pump – driven directly by the engine, it delivers the hydraulic energy supply in accordance with requirements for fuel injection and activation of the exhaust valves**

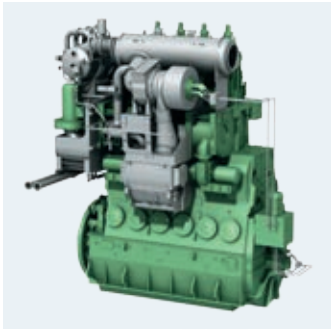
◀ **Proportional valves – pilot valves for axial piston pumps, certified with maritime societies type approvals**

◀ **Start-up units –pressure-controlled motor pump group(s) for supplying the hydraulic pressure and volume flow before and during engine start-up**

◀ **Directional poppet valves meter the proper amount of engine oil for the lubrication of the piston rings**



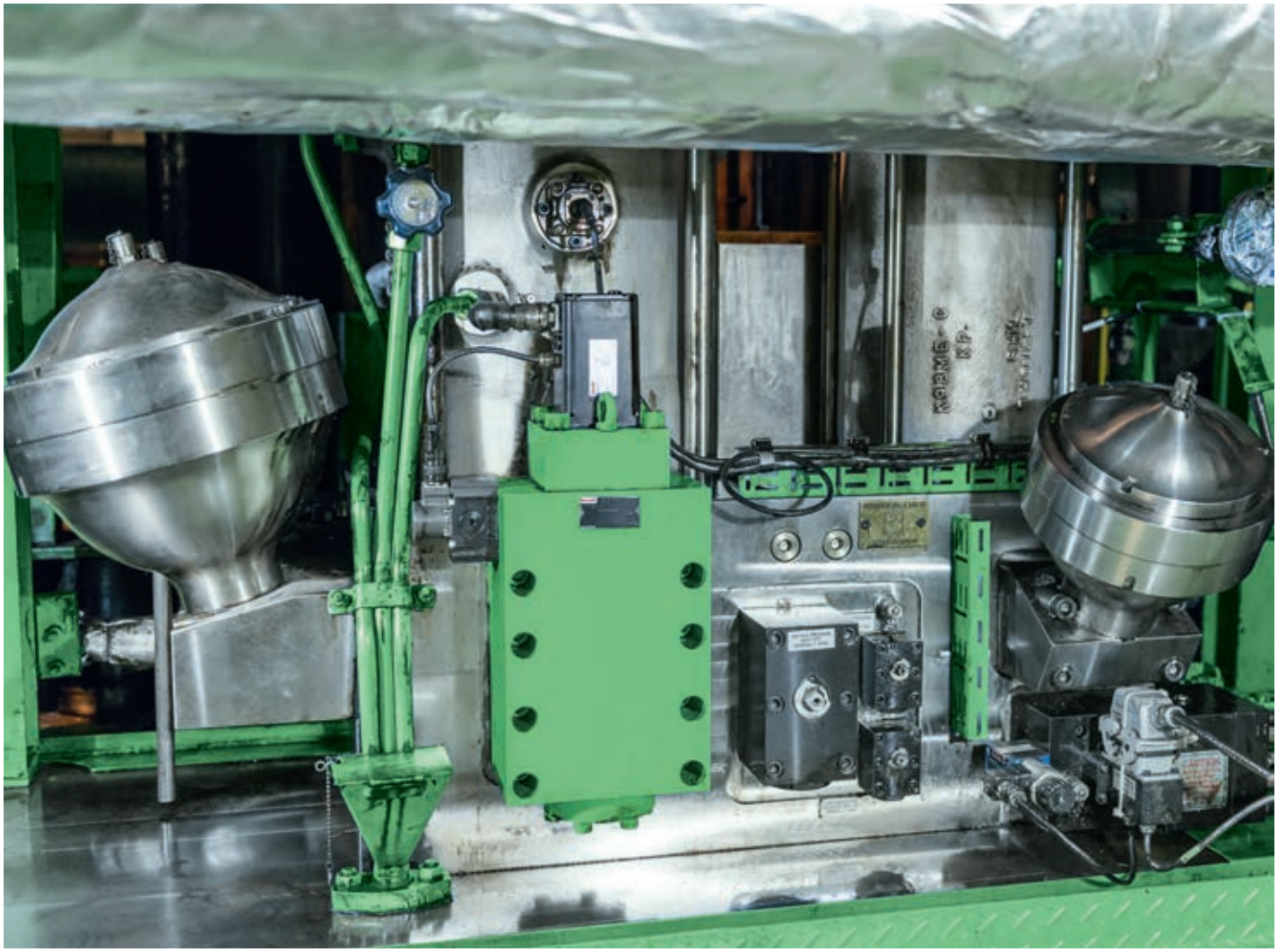
◀ **Filter systems – filter technology adapted to the requirements of the application ensures optimum operating conditions for the hydraulic components and reduces the total cost of ownership (TCO)**



◀ **Turbo hydraulic system-components for a system for reducing fuel usage. Energy is recovered from the turbocharger (exhaust gas volume flow) and is returned to the engine's crankshaft**

FIVA valve – the core component: Designed for over 250,000,000 load cycles

The new generation of the Rexroth FIVA valve carries out the injection profiles specified by the control system with absolute precision. This enables fuel consumption to be reduced and ultra-low emissions to be achieved – even in extreme conditions: These servo valves are designed for more than 250 million cyclical changes of load, which means a service life of at least five years. This results in significant reduction in maintenance intervals, downtime and unproductive idle times, and therefore containment of maintenance costs.

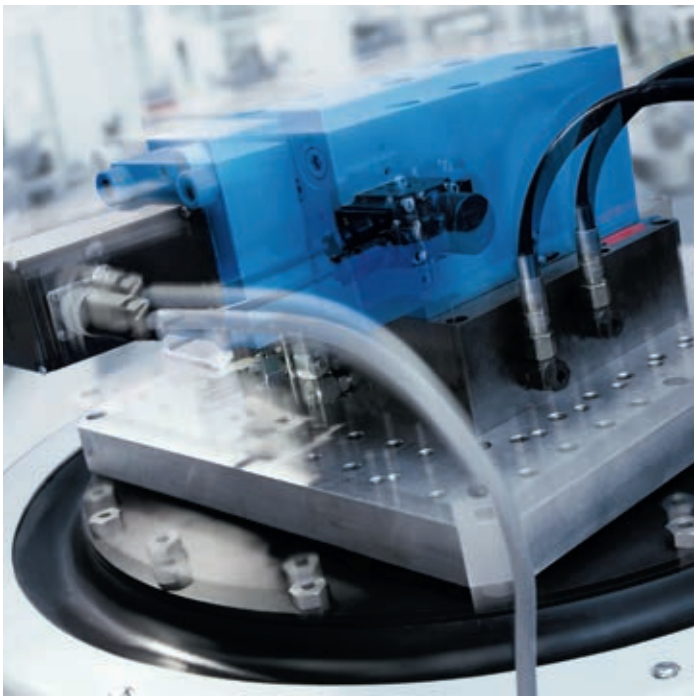


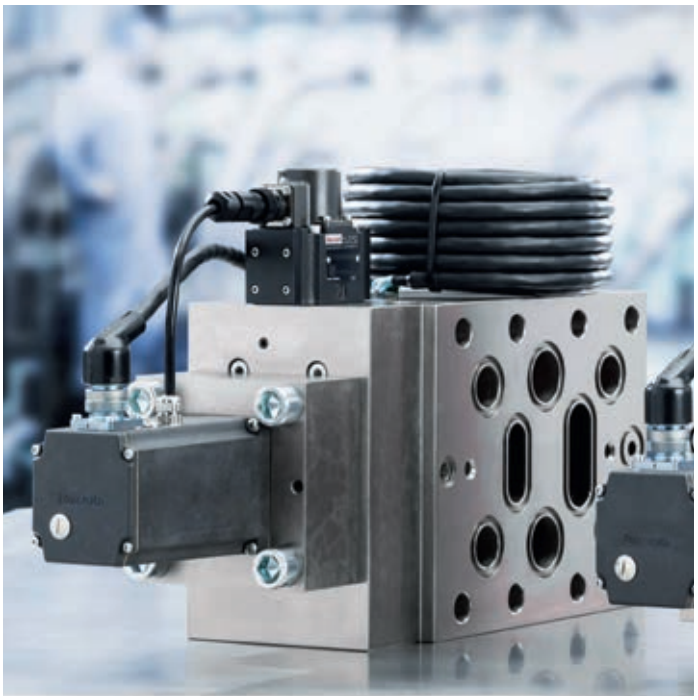
Less wear, greater efficiency
Rexroth has been on board from the very beginning of the first variable valve timing for large engines (electronic camshaft) utilizing FIVA valves. Subsequent designs benefited from this experience, yielding significant improvement in the engine's power curve.

Rexroth uses cutting-edge testing methods and the latest calculation and simulation technology for product development. This includes vibration and deformation analysis, prototype testing and optimization, all which guarantee product quality of the highest standard.

The critical factor for longer life is a significant reduction in internal friction of the main spool. For the Rexroth FIVA valve it is lower than usual – at it's peak by more than 95 percent! The reduction in wear creates the conditions for a significantly longer life cycle with minimal operating costs. During engine commissioning, the FIVA pilot valve is protected from contamination damage by a sandwich filter.

"Plug&Play" simplifies integration and replacement
Rexroth also sets the standard for servicing: The integrated electronics allow the valve to be replaced easily during a service call, without any adjustment. Moreover, the "fail-safe philosophy" prevents damage to the engine – in the event of a supply voltage failure, the valve main spool moves to a predefined safe end position.

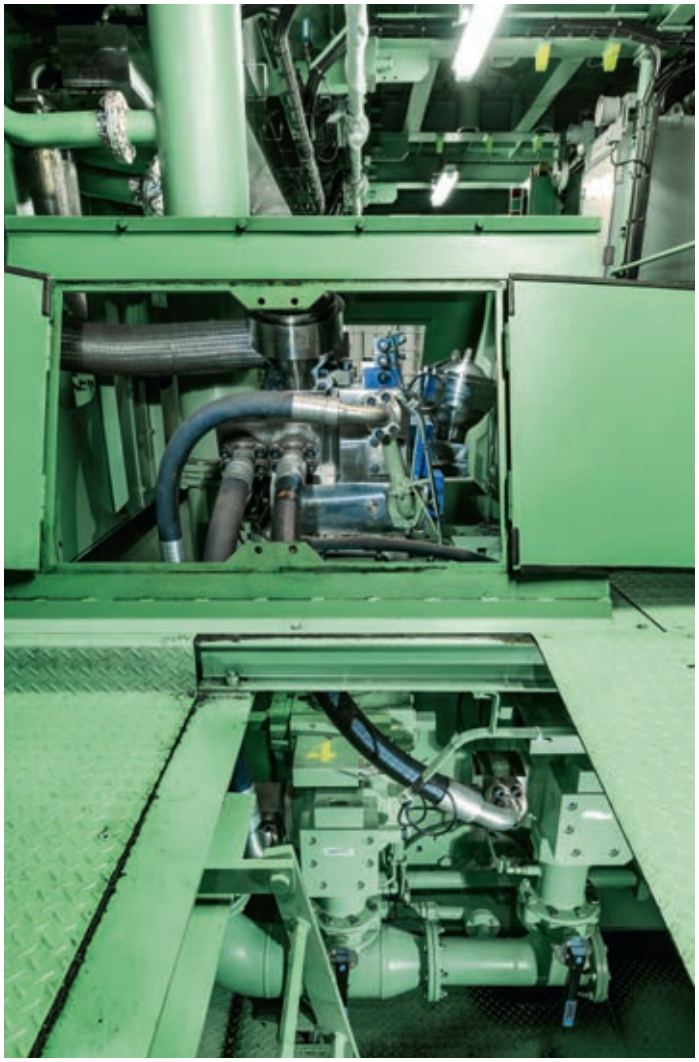




◄ **FIVA stands for "Fuel Injection & Valve Activation"**
▲ **Quality and reliability: FIVA valves pass the toughest load tests**
► **Precise, rugged and maintenance-free**

A4VSO – the continuous operator: Over 10,000 pumps in service worldwide

Regarding supply of pressurized oil for the electro-hydraulic control of the combustion process in a large engine, ruggedness and a high level of efficiency are the critical factors: With the proven swashplate design of the A4VSO axial piston pump, Rexroth has established itself as market leader for large 2-stroke engines. It provides variable volume flow adjustment and very good priming properties with low noise level and rapid control response. It is very reliable and minimizes unscheduled downtimes.



◄ **Main pumps for the oil supply on the engine**

► **Key data for the A4VSO:**
Nominal size: 40, 71, 125, 180, 250, 355, 500
Nom. pressure: 350 bar
Max. pressure: 400 bar

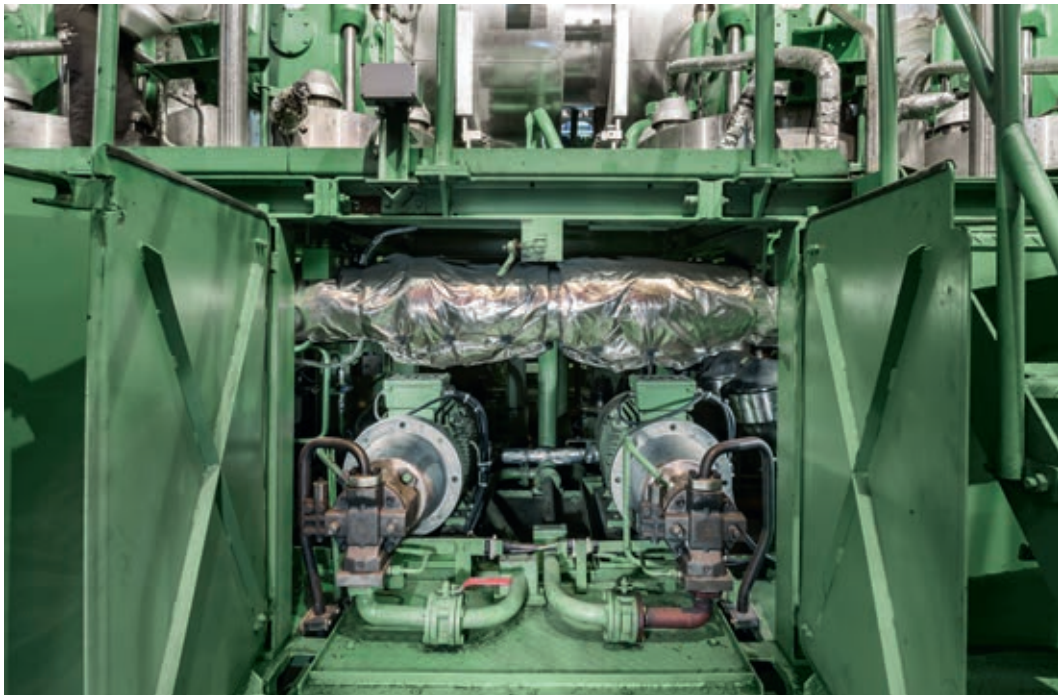
The core element of the hydraulics

More than 10,000 pumps have gone into service since 2002, ensuring uninterrupted reliable operation of large engines with electro-hydraulic control. It's modular design approach enables the A4VSO to be adapted very effectively to the specific conditions and requirements of each application.

For the ship to move in reverse, the large 2-stroke engine has to change the direction of rotation. The pump rotation reverse too, naturally. The A4VSO precisely provides the required volume flow precisely regardless. Durability, rapid control response times and good priming properties are just some of the features of the A4VSO pump.

Start-up units: Always ready to go, certified with marine type approvals

Redundantly configured start-up units complement other Rexroth components for engine hydraulic systems. Reliable and optimally matched to the other components, these units fill the accumulators and provide the volume flow required to start and operate the engine during engine start-up. As the main pumps only come online once the engine is up and running. The sizes of the A10 VSO axial piston pumps used here are not only efficient, but comply with all the regulations and certifications of maritime classification societies.



◄ **A10VSO axial piston pump**
► **Complete start-up unit assembly: motor-pump-group ABAPG assemblies for charging the accumulator**

Optimized technology with quality that's proven

The nominal pressure is 280 bar, with a maximum permissible pressure of 350 bar. Further improvements have also been made to the suction port of the A10VSO: It improves suction performance and reduces susceptibility to cavitation. The improvement has also reduced pressure pulsation, which extends the useful life of the high-pressure pipes.

In addition to serving as a start-up unit, these assemblies also ensure that the large engine is supplied with sufficient hydraulic energy when required. For example: if the ship has to be safely brought into port at reduced speed.

Cartridge and directional valves: Optimum protection and lubrication ensuring low consumption – always

Rexroth valves are used not just for fuel injection control and exhaust valve activation but for the precision metering of the lubricating oil as well. In injection systems the pressurized lubricating oil is metered with pinpoint accuracy by directional poppet valves, reducing oil consumption considerably. Operators of a ship in the 4,000 TEU class, for example, can count on a reduction of about 30 % in lubricating oil consumption, from 900 liters a day to less than 650 liters! Saving 250 liters of lubricating oil per day less also means lower emissions and a reduction in the TCO.

▲ **Cartridge (logic) valves: In the event of an overload, the proven elements protect the system against pressure spikes**

▲ **Directional poppet valves: Used to inject lubricant into chambers with pinpoint accuracy. Lubricating oil saving up to 30 % per day!**

Large 2-stroke engines have engine oil (additive enriched) that is injected into special delivery chambers via the cylinder liner, at a rate dependent upon engine load. The piston rings ride on this film of lubricant. Manufacturers have developed a variety of similar lubrication systems. They all inject the oil under pressure and ensure that it is evenly distributed along the cylinder liner. The time window for the injection process is 4 to 20 msec.

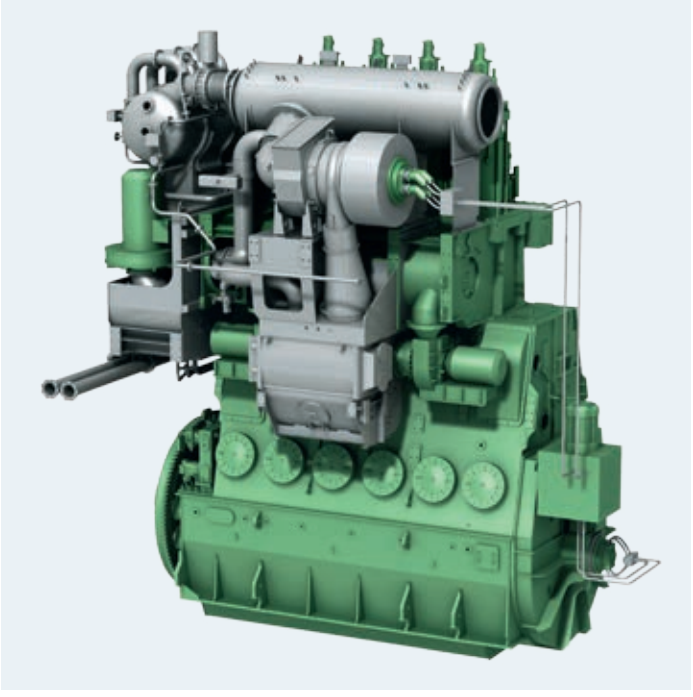
Cartridge (logic) valves are used for the interconnection of multiple pump circuits to form a common hydraulic circuit which includes pressure limitation for the entire system.

Turbo Hydraulic System: Simple to retrofit for fuel saving and increased total engine efficiency

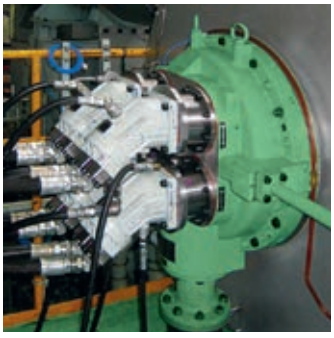
Rexroth is involved in the development of the revolutionary turbo hydraulic system for recovering energy from exhaust gas in large engines – with the complete hydraulic system comprised of pumps, hydraulic motor and a hydraulic unit with control manifold. This extremely compact and rugged system is designed for both original equipment implementation and retrofit for small and medium-sized large engines. It provides quick and easy fuel savings of up to 4 %, and emission reduction due to reduced consumption.

Rugged technology with very short payback period
Hydraulic axial piston pumps are driven by a turbocharger gearbox which enables kinetic energy to be harvested from the exhaust gas volume flow and converted into hydraulic energy. This energy is fed back into the large engine crankshaft via a hydraulic motor. This additional supply of energy results in a reduction in fuel consumption of up to four percent for the same power output. It also yields reduced emissions and an increase in the overall efficiency of the large 2-stroke engine. In addition, the recovered hydraulic energy can also be used for other engine functions too. The first turbo hydraulic system started its successful service on the world's oceans in 2012.

The compact and rugged design is also ideal for retrofits as well, and cost amortization takes less than three years, depending on the engine size. Where else can ecology and economy be combined so easily?



▶ **Compact complete system: Pumps, hydraulic motor and hydraulic power unit with control manifold**



Optimum fluid management: Reliable filter technology for reducing costs

Excellent service fluids at all times are an important condition for ensuring that large engines operate at full performance. This helps avoid expensive damage and machine downtime. Rexroth's wide range of filters and purification systems for hydraulic oil applications ensure optimal operating conditions across the entire lifecycle.

▲ **Rexroth range of filters**
◀ **320 PZR block assembly filter. Sandwich filters protect proportional and servo valves during engine commissioning**

From filter elements and complete filters to bypass filtration and drainage systems for fluids, the range of products contains precisely the right solution for just about every application. Innovative sensors and remote diagnostics provide the user with the means of monitoring quality, especially fluid purity, at any time. Condition monitoring systems signal when critical conditions are reached, enabling preventive service measures to be taken without having to schedule additional downtimes. Reliability is increased and costs reduced as a result.

The filter and purification systems can only do their job to optimum effect if they are precisely tailored to the specific medium and application. Trying to save costs can easily result in considerable potential for damage. Contaminated fluid reduces the performance and precision of the hydraulic system. In many cases it leads to early wear of system components and to unscheduled downtime.

For the initial commissioning of large engines in particular, Rexroth recommends that hydraulic fluid be supplied to the engine through a suitable filter system and that the purity of the oil be checked at regular service intervals. Even minor investments in Rexroth filter technology will significantly reduce overall operating costs for the operator.

Global service: Expertise available quickly. Including REMAN program.

Rexroth Service is your expert partner for whole lifecycle care of machines and plants – from planning right through to extended service life. For the components installed on large engines, Rexroth offers the service products to match, to prevent or significantly reduce downtime.

▲ **Close customer contact: Whether maintenance, repair, supply of spare parts world-wide, modernization or adjustments on site – Rexroth is always there to help you in over 80 different countries!**

Spare parts service:
The right parts in the right place
When a machine fails, it is vital to receive the right spare parts without delay. This especially applies in to older machinery. Our experienced specialists are sure to deliver the solution from the diverse Rexroth product portfolio – quickly and world-wide.

Remanufacturing:
Fast, efficient, as good as new
Why wait until a large engine breaks down? It often makes sense to replace wearing parts or defective components as a preventative measure during maintenance intervals or port of calls. This way you maintain the effectiveness of your engine with minimum outlay.

Repair service:
An industrial grade dependable service
Replacement is not always the only option. Particularly where expensive components and modules are concerned, a cost-effective repair is often possible – when you select Rexroth as your partner. Our service workshops soon get your components back in good shape.

Warranty:
Greater peace of mind for your investment
On completion of the repair and reconditioning work, you get a 12-month new parts warranty for all components.

New, economical and environmentally friendly: Rexroth REMANufacturing for A4 pumps

A REMANufacturing program for A4VSO pumps offers shipping companies and ship operators a quick and economical solution for the remanufacturing of used units. They should be replaced every five years or after approx. 32,000 hours in operation.

The units are given a complete overhaul at the plant in Horb (Germany): All wear parts and valves are replaced with new components.

The useful life of REMAN units is equivalent to that of new units. And you also get a complete new parts warranty for them! In addition, the Rexroth REMAN program can be counted on for high reliability because of the 100 % tests carried out on state-of-the-art test beds, high availability from our warehouse, low downtimes and easy handling for the shipping company.

Used units can be sent back to Rexroth. In this case you will get a credit note for them from Rexroth.

Detailed information is available online at
www.boschrexroth.com/service

Your advantages:

- ☑ Increased reliability
- ☑ Prevented downtimes
- ☑ Lowered emissions
- ☑ Reduced maintenance effort
- ☑ Extended useful life
- ☑ Significantly reduced TCO

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