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BOSCH REXROTH AND BOSCH REXROTH JAPAN ACTIVITIES IN INDUSTRIAL HYDRAULIC SYSTEMS

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ABSTRACT

Bosch Rexroth (BR) is worldwide player in hydraulics. And we are approaching each country to meet with local requirements. Japan is one of our target markets. Bosch Rexroth Corporation (BR-Japan) is strong position in Japan for mobile applications. In parallel, industrial is also our important profitable market. This paper presents BR and BR-Japan activities in industrial application, especially steel, press, test machine, marine, power generation. Additionally new products and system are introduced.

KEY WORDS

Innovative products, Open interfaces, electrohydraulics, multi-technology,

COMPANY INTRODUCTION

Bosch Rexroth AG looks back across 200 years of tradition and has always successfully mastered its current challenges. Thus the company is among the oldest companies active worldwide. Bosch Rexroth sees in this the obligation to continue this history of success with innovations and customer orientation.

With approximately 33,000 employees, Bosch Rexroth AG earns approximately 5.5 billion Euros in revenue. For years, the company has been growing at above-market rates in Asia and Eastern Europe, and in the traditional industrial markets it has been gaining market share. For many years, the quotas for research & development and investments have been above the industry average and they have laid the foundation for further profitable growth.

As a global player, Bosch Rexroth is represented on location in more than 80 countries with production locations, sales and service offices, and dealers. In a worldwide manufacturing network, the control concept proved at Bosch guarantees reproducibly-high quality

with local content. From an organizational standpoint and in its business processes, Bosch Rexroth combines user experience with expertise on location. 67 production locations in 25 countries, own sales and service in 39 countries

Rexroth brand combines a broad product portfolio that includes all essential drive and control technologies, from individual components through to system solutions, and the ability on this basis to offer integrated automation solutions with superior functions. In both individual technologies and for multi-technology solutions, Bosch Rexroth combines best-in-class products with extensive consulting expertise. Here Bosch Rexroth combines technological and economic benefits for the customer: supply from one source reduces interface costs and simplifies the customer's processes from project planning to purchasing, logistics, and start-up through to service. This reduces costs across the entire lifecycle. Bosch Rexroth is the technology and market leader for Drive & Control.

Bosch Rexroth offers automation solutions for industrial and factory automation, mobile applications, and individual projects (platform technology, steel

construction for hydraulic engineering, entertainment, offshore, etc.). Thus Bosch Rexroth is active in worldwide growth markets with high innovation potential. For its approximately 500,000 customers, Rexroth develops and produces standard components with high configurability and variance as well as complete system solutions with extensive software expertise

COMPANY PRODUCTS

Bosch Rexroth's product range covers the entire spectrum of motion technology: hydraulics, electrics, pneumatics in conjunction with mechanics and the associated control technology. Only the specialist Rexroth offers all drive & control technologies and integrates them into complete automation solutions.

INNOVATIVE PRODUCTS

Technology

For Bosch Rexroth, technology leadership in automation means shifting the boundaries of the technically-possible so that the user can be more productive. Best-in-class components form the basis. But the full customer benefit lies only in the combination of application experience and the modular design of the Bosch Rexroth automation system. Electrohydraulics in new dimensions are field bus-capable, highly-dynamic, and positioned with μm precision. Electropneumatics combine digital regulation technology with robust mechanical technologies. Integrated measuring systems and the ready-to-connect, pre-configured Cartesian motion system show how

much progress mechatronics has made. The open controls combine an extremely high motion quality consistently with an open SPS for scalable motion-logic integrations.



Figure 2 Innovative products

- 1) Digital regulation electronics with NC functionality HNC 100 2X
- 2) Roll rail guide with integrated measuring system
- 3) Electropneumatic pressure regulation valves
- 4) Bosch Rexroth IndraMotion with integrated motion control and SPS

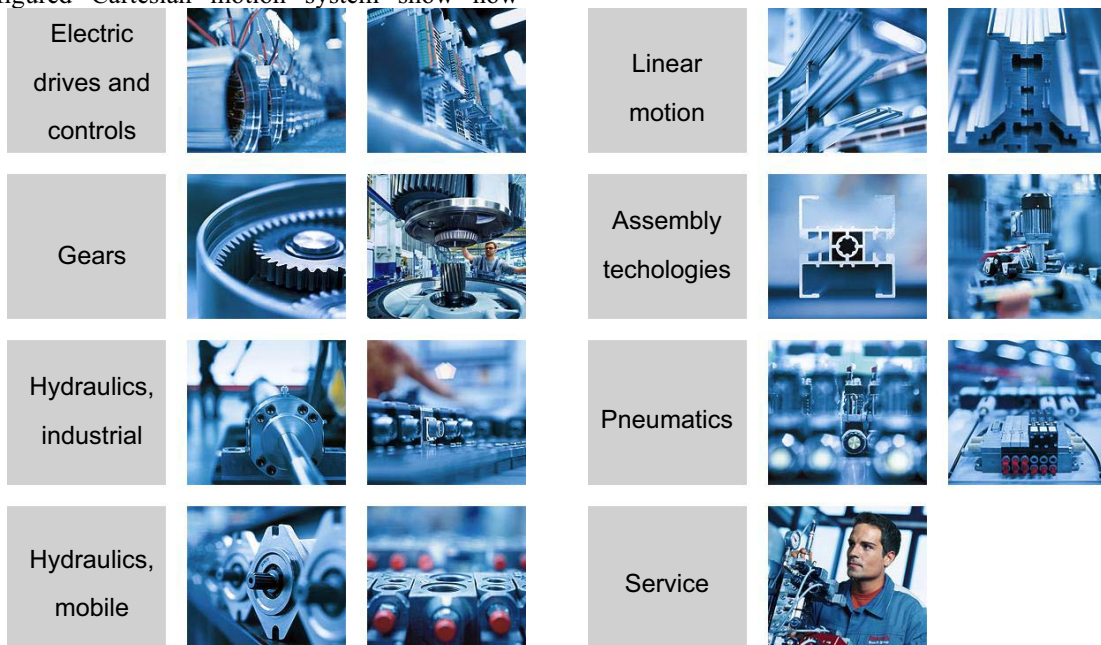


Figure 1 BR products

Openness

Bosch Rexroth drive and control technology consistently supports open interfaces that are defined in international standards.

Both for application programming according to IEC61131-3 and for communication between control and drives via SERCOS, international standards are used.

Bosch Rexroth also continues this openness during the introduction of Ethernet-based communication in industrial automation with SERCOSIII according to IEC62410.

This allows easy incorporation into the end customer's IT systems as well as the hard real-time communication between controls and drives.



Figure 3 Digital controller with open interface

Industrial hydraulics: the key products

1) Pumps and motors

Axial pistons, interior gears, exterior gears, radial pistons, tendon cells, etc. Pump combinations and compact units (finished components)

2) Cylinders

Tie-rod cylinders, round cylinders, servo cylinders with hydrostatic bearings and special cylinders. Up to 45 m in length user-related systems for many industries

3) Compact hydraulics

Magnetically-operated globe valve and slide damper, proportional valve with customized electronics, block models in aluminum or steel blocks

4) Industrial controls

Control valves, continuous valves, control electronics, control and regulation systems as well as valve plates Product and system technology. Solutions for every conceivable use case

5) Assemblies and accessories

Small assemblies, customer-specific assemblies, and large assemblies for nearly all applications

6) Gears, pitch and azimuth drives for wind energy installations

Generator gears for systems with output ratings from

660 to 5,000 kW, plus pitch and azimuth gears.



Figure 4 Hydraulics, Industrial application

SUCCESS PROJECT IN THE MARKET

Dubai Maritime City, Dubai

Bosch Rexroth gives a new meaning to the term "ships of the desert". Since April 2007, an automation project in Dubai, planned and supplied by Bosch Rexroth, has been hoisting oceangoing ships weighting up to 3,000 tons from the sea and transporting them overland to the maintenance and repair docks. Construction work has already begun on a second ship lift for even larger ships measuring up to 130 meters in length and weighing up to 6,000 tons.

Fourteen electric winches work in the first lift. Working in unison, they raise a platform under the ships at a rate of 30 cm/min. Within 40 minutes, the raising process is completed and a powerful wheel tractor with hydrostatic drive then pulls the ships over a rail transfer system to a dry dock.



Figure 5 Ship maintenance and repair docks

Bosch Rexroth won the contract for the two automation projects in a global bid for tenders with a tailor-made concept, and accepted responsibility as prime contractor for the complete process of project planning, supply and commissioning. The climatic conditions encountered in Dubai placed extreme demands on the technology. Burning sun and temperatures up to 50 degrees Celsius, sandstorms and very high humidity.

For the 14 winches in the first ship lift, Bosch Rexroth employed IndraDrive frequency converters with a maximum current draw of 210 amperes. In Dubai, they work with a torque of 150 Nm and still have power reserves. The maintenance-free asynchronous servomotors have a very high power density. Two redundant brakes, a holding brake integrated into the motor and a brake on the winch are each capable of securely holding the maximum weight, enhancing operating safety. The second ship lift will use a total of 28 winches to raise ships weighing up to 6,000 tons.

Rexroth's Linux-based control system with its tailor-made user interface synchronizes the drives with extreme precision. The maximum deviation between any two winches is less than 0.1 mm, an important condition for preventing the ships from slipping. Before the start of operations, the automation solution technically approved by a Lloyd's certification in accordance with the internationally accepted rules and regulations of Lloyd's Register, EMEA.

The Three Gorges Dam, China

Behind these lock gates there is a man-made reservoir, 663 kilometers in length. The Three Gorges Dam in China, in the central section of the Yangtze River, exceeds all normal dimensions. As the world's largest water engineering project, it generates 88,700 gigawatts of current, effectively reducing CO2 emissions by 100 million tons per year. The surface of the reservoir is twice as large as that of Lake Constance.

On the left flank of the 2,310 meter long dam, two separate waterways bridge the height difference of up to 101 meters in a series of five locks. The lock chambers, 208 meters long and 34 meters wide, are capable of taking ships weighing up to 10,000 tons.

Rexroth planned the drive and control technology for the lock gates at the top of the locks on the reservoir



Figure 6 Dam gate

side. These are especially critical when it comes to safety. While the bottom gates only ever have to hold back the water in the chamber, the top gates have to reliably hold back the whole reservoir. Rexroth designed the drive cylinders for the gates with a corrosion-resistant steel structure. The CERAMAX coating reliably protects the piston rods against wear and corrosion for their entire service life.

All around the world, Bosch Rexroth has supplied automation for more than 200 locks and is unrivaled in its expertise in this field. This was impressively demonstrated by the commissioning of the Three Gorges Dam. The Drive and Control solution immediately worked with a maximum of reliability.

Airbus A380, France, Spain, UK, Germany

Size does matter! The Airbus A380, capable of carrying 555 passengers, is the world's largest passenger plane, and even on the ground it challenges for new records. France's TLD developed the TPX 500 S aircraft tractor with a Rexroth hydraulic power unit specifically for the flying giant.

The tractor has no towbar, which makes the job of coupling the aircraft to the tractor vastly easier. The vehicle has a U-shaped tail end. It reverses up to the nose landing gear of the A380 and encloses the front wheel. Hatches then lock into the framework of the front landing gear. The push blade then moves forward and fixes the wheels to the hatches. The towing tractor then lifts the nose landing gear - and as such the aircraft itself - to transport it. Even though Airbus engineers limited the weight of the new giant aircraft to a fully laden 600 tons, that is still some 50 percent more than today's long-haul aircraft.

In contrast to working with a towbar, the TPX 500 S can be operated by just a single person. The driver has a direct view of the aircraft's landing gear. Complex maneuvering with heavy towbars and couplings, always prone to accidents, is now completely redundant. With this "piggyback" technique, TLD has simplified and accelerated the whole process considerably. Moreover, the locking mechanism on the TPX 500 S has absolutely no play, protecting the nose landing gear and allowing it to assume all transport tasks. This innovative solution guarantees considerably smoother acceleration and



Figure 7 Airbus A380

braking maneuvers. This is appreciated by both the landing gear and the passengers.

In order to make the towbar-less aircraft tractor powerful enough for the A 380, TLD worked in close cooperation with Rexroth on the development and design of the hydraulic power unit. The hydraulic power unit reliably supplies the required power for the 600-ton giant by means of two axial piston double pumps and two axial piston variable displacement motors with a power rating of 583 kW. In addition, Rexroth also reduced the number of lifting cylinders. This allows the TPX 500 S to fulfill the constantly increasing demands of end users with regard to improved reliability and longer service life. Together with Rexroth specialists from France, TLD completed the development in less than 12 months from the start of the project to the first delivery.

Great Beijing Wheel, China

In China's capital city, a new ferris wheel will break all world records in 2008/2009. Up to 5,760 passengers per hour will be able to enjoy the view across Beijing from the 200 meter high glass cabins. The control and drive solutions were planned and supplied by Rexroth. As the exclusive partner for the operator, the Great Wheel Corporation, Rexroth has thus developed the blueprint for many more ferris wheels.

The Great Beijing Wheel has a total height of 208 meters. The diameter of the wheel is 198 meters. The drive hydraulics comprise four drive units, each with two double redundant motor/pump combinations. Each drive unit supplies a drive module, each with 8 hydraulic motors. A total of 32 special wheels press against the running surface on the ferris wheel. In addition, the hydraulics regulate the pressure of the wheels via variable cylinders. In rain and humid conditions, the cylinders increase the pressure to compensate for any slip of the wheels against the running wheel. Here, the force regulation system and the absolute measuring system integrated in the cylinders (CIMS) work together.

Besides the primary drive system, Rexroth also planned the fully automated boarding system that enables the passengers to board and disembark without the ferris wheel having to stop moving. Driverless electric feeder vehicles at the ground station move alongside the cabins. At the starting point, the doors open and within the space of 40 seconds, the passengers get out on the one side and after a short delay the new passengers get in on the other side. The higher-order control system synchronizes the feeder vehicles (which are driven by Rexroth's IndraDrive frequency converters) with the cabins.

In addition to the project planning, delivery and commissioning of the control and drive technology, Rexroth is also responsible for the entire maintenance of the ferris wheel. Here, Bosch Rexroth is basing its work

on the processes employed in the aerospace industry. After 16 hours of operation, the maintenance staff have 8 hours to perform all maintenance operations. Here, the visual inspection of the construction elements of the ferris wheel is a major operation.



Figure 8 Great Wheel in Beijing

Bolshoi Theater, Moscow

The largest single contract in the history of Bosch Rexroth is associated with one of the most famous stages in the world. Rexroth is the general contractor modernizing the complete stage technology, including the steel structures, of the Bolshoi Theater in Moscow, a UNESCO-listed site.

Only the very latest in stage technology will be used. The hydraulic pressure station, with a capacity of 50,000 liters and an output rating of 700 kW for the understage machinery, is able to move 7 giant stage podiums at once – a solution found nowhere else on Earth. For the overstage machinery that moves the complete set, Bosch Rexroth is installing 72 electromechanical winches as stage suspension barrels and 81 electromechanical winches as point hoists. Each winch has a capacity of 1,000 kg. Numerous other drives move the curtain, the lighting bridges, microphones and take on the many minor tasks that are necessary for the perfect performance. All drives and motors work extremely quietly so as not to disturb the artistic enjoyment.

Safe operation of all the technical equipment on the stage is provided by the Rexroth SYB 2000 stage control system, which has proven itself to be extremely reliable and easy to operate in many of the world's opera houses. In addition, Rexroth supplies all the audio and video equipment - from the microphones to the

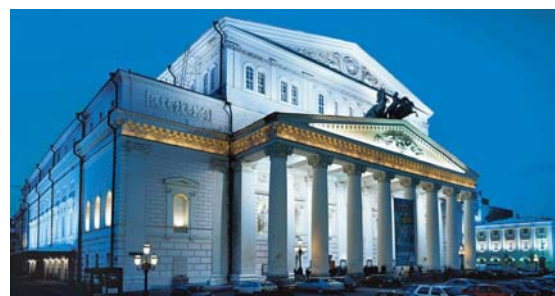


Figure 9 Bolshoi

complete television studio, and is responsible for the renovation work is scheduled to be completed in 2008. entire steel construction needed for the equipment. And then the Bolshoi will unite tradition with the latest technology.

Environmental friendly application

For worldwide environmental friendly technologies, Bosch Rexroth also support for these application.

One of typical application is Wind energy. Bosch Rexroth makes wind turbines more efficient – thanks particularly to the technological advantages on hydraulics in terms of high power density in limited space, low-maintenance and rugged design and, not least, outstanding controllability. Bosch Rexroth offers Pitch control, drive train brake, yaw system and subassemblies of power units, motor-pump group, accumulators and filter and cooler.

Another technology is marine two cycle diesel engine control system. Marine application also should consider exhaust emission control and low consumption. One of the solution is electro-controlled engine by controlling of the fuel injection profile and exhaust valve lift. Bosch Rexroth can offer the electro-hydraulic control system for this kind of technology.

CONCLUSION

The Rexroth Automation System integrates hydraulic, electric, and pneumatic drive technology, scalable control technology, and high-performance engineering tools by Bosch Rexroth into an automation system. This reduces significantly the integration effort in our customers' systems and enables our customers to use the optimal drive and control technology for the process.

In addition, Bosch Rexroth products support all relevant communication systems for industrial automation worldwide, which enables the easy integration of Bosch Rexroth products into the systems of machine manufacturers in the triad.

We believe with best-in-class components and their easy but high-performance integration into our customers' machines and systems, Bosch Rexroth can offers the best solution in terms of both function and economy.



Figure 10 Wind power



Figure 11 Marine engine