Drive & Control in the Steel Industry:

All-round Service for Sharp Edges
An exceptional bending press for use in the food industry was constructed by Darley in the Netherlands using Rexroth technology.

The German company Voith Paper is successfully using Rexroth roller rail systems in its latest slitter-winders.

Swedish company Texo AB’s new loom achieves a higher speed by using new light-alloy loom guards driven by electric servotechnology from Rexroth.

A hidden world, secret caves and bizarre discoveries. Potholers and cave explorers penetrate ever deeper into the underground systems of the Mexican peninsula of Yucatán, one of the largest cave exploration regions of the world.
Change in Top Management:

Manfred Grundke to Succeed Winfried Witte as of May

Winfried Witte (62), President of Bosch Rexroth AG, will be retiring on April 30, 2004.

He took over in 1996 as Chairman of the Board of Management of Mannesmann Rexroth GmbH, being appointed President of Mannesmann Rexroth AG in 1997. Since May 2001 he has been President of the newly-founded Bosch Rexroth AG.

His successor as of May 1, 2004 will be Manfred Grundke (48), Executive Vice President for Sales Automation as well as President of the Electric Drives and Controls Business Unit.

Czech Republic:

45th International Machine Construction Fair in Brno

The 45th International Machine Construction Fair took place from September 15 to 19, 2003 in Brno (Czech Republic). This fair is rich in tradition and is the largest of its kind in Central and Eastern Europe.

More than 600 customers visited the Rexroth Stand. Rexroth was represented in all technologies: Industrial hydraulics, Electric Drives and Controls, Linear and Assembly Technology, Pneumatics, Service Automation and Mobile Hydraulics.

Main theme of the fair was the imminent entry of the Czech Republic into the EU. The extensive program of conferences, seminars and discussions were particularly well received by visitors and exhibitors alike. The most important topic of these events was the general impact of EU membership on the machine construction industry: the changes, the opportunities and also the risks. The visit of the Commissioner of the European Commission for Economics and Development, Philippe Busquin, to the fair, underlined its significance with respect to the future eastward expansion of the EU.

A total of 2,300 exhibitors from 36 countries presented their products over a floor area of 69,500 sq. m. There were more than 100,000 visitors to the fair, 11,000 of which were prospective foreign customers from 60 different countries.

Netherlands:

Foundations Laid for Record-breaking Bridge in China

Rexroth in the Netherlands, responsible within Bosch Rexroth AG for turnkey projects and special hydraulic cylinders, was awarded the contract to build the largest hydraulic cylinder ever to be used in piling barge applications.

The order comprises four cylinders with stroke lengths of 11.5 and 13 meters, diameters of 900 and 1000 mm respectively, and each cylinder weighing approx. 60 tonnes.

A piling barge will be used to the pile the foundation for the Hangzhou Bay’s Cross-Sea Bridge near Shanghai, the longest bridge in the world. The purpose of the hydraulic cylinders is to position the pile platform vertically and stabilize it, while the steel piles with an exceptional length of 85 and 95 meters, are then driven into the seabed.

Rexroth’s know-how and experience in supplying a similar hydraulic system – if somewhat smaller – were decisive factors in awarding the contract. The universal alignment of the company, represented here by Rexroth China, who supplied the drive and control systems, was also considered an advantage.

The whole project is due for completion in 2010.
bauma 2004 will be opening its doors from March 29 to April 04, 2004. With around 500,000 sq. m of exhibition space it is the leading fair for the construction machinery branch and this year it is bigger than ever. Electronics is currently the topical subject in this branch. What is meant here is the integration of the latest electronic components into drive and control systems of the different types of construction machinery.

Rexroth, the drive technology specialist, will be exhibiting in Hall A4 on Stand 317, over a floor area of more than 500 sq. m, displaying a number of innovations such as the CAN-Bus control module for M4 High Pressure Load-Sensing Control Blocks. Furthermore new models of the RC control device family for harsh mobile applications will also be on show. These electronic control devices permit implementation of virtually every closed loop control task in mobile devices. Rexroth offers components optimally tuned to one another – from pumps, motors and transmissions, sensors, switching electronics and control electronics through to software for application-specific vehicle optimization.

You can experience the wide spectrum of mobile hydraulics at bauma 2004 in Hall A4, on Stand 317, as well as on the Internet under www.boschrexroth.com/brm.

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didacta 2004:
Sophisticated Training Systems

Rexroth exhibited a considerable number of new developments for basic and advanced vocational training at didacta in Cologne (Germany), which took place from February 09 to 13, 2004. Focus was on the idA “international didactic Alliance” founded last year, with career specialists Christiani and Leybold. Together they are developing innovative mechatronic training systems and marketing them via the well-established sales channels.

Amongst the exhibits on the 48 square metre stand was a high shelving system for sophisticated CIM development systems (Computer Integrated Manufacturing). The shelving is fitted with a PLC control with Profibus DP along with a screen panel from Rexroth as the operating console. Due to the flexible method of connection, it can be used in combined production cells or CIM systems.

A further highlight of the exhibition was the new development for the DS4 hardware trainer: the HNC 100 TSU (Training and Simulation Unit). The HNC 100 TSU combines the HNC 100 digital axis control from Rexroth with the possibility of simulating NC programs and control systems directly on the training unit, as well as training on how to use the HNC 100, i.e. the programs supplied can be given a dry run on the training unit. In the second step, the TSU is connected directly to the Rexroth “HyControl” hydraulic axis. The programs can then work under near-practical conditions.

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Jubilee:
40 Years Bosch Rexroth in Brazil

In 1964 Rexroth Hidráulica Ltda. (Brazil) opened up an office in the center of São Paulo with just two employees, importing products from Germany. In three years production of valves, cylinders and hydraulic power units started in Diadema. Today Rexroth Brazil has 470 employees, 223 of whom work at the Pomerode production site, with 247 in the nine countrywide sales offices and at the Head Office. In addition to this a network of 77 Rexroth distributors ensure a presence covering the whole of Brazil, the fifth largest country in the world.
Mental blocks at home:

No Company Can Afford to Ignore China

What would you consider to be the most remarkable thing about China?

Kirsten Lange: The dynamics, the pace of change, and the speed at which the people and companies in China are adjusting to these transformations. Five years ago we were still having to explain to Chinese companies what various figures for return on investment meant. Today even large state-run businesses are absolutely success orientated, driven by the marketplace, and very eager to learn. A kind of unprecedented momentum for innovation seems to be prevailing in China; the people and companies there are really very ambitious and hungry for success.

Which Western companies would you say should be thinking about becoming more active in China?

Kirsten Lange: Not every company needs to go to China, and yet no company can afford to ignore it! Every company needs to assess whether it can use China as a supplier source, as a sales market, or as a low-cost production site. Last year’s trade volume with China for the European Union and U.S. reached around US$125 billion—each—an increase of over 40 per cent compared to the previous year. For example, China is one of the largest sales markets for machine tools, and we are expecting a large increase in the export of Chinese capital goods. At present the market share of Chinese capital investment in Europe and the U.S. lies at around 2 to 3 percent but with massively increasing rates.

Would you say it is always worth setting up your own production site in China?

Kirsten Lange: As already mentioned, I believe each company should make this decision on an individual basis. We estimate, however, that in the next few years 15 to 20 percent of all production jobs in the Western world could well move to low-wage countries, especially to China. The labor costs of a Chinese worker are typically 4 percent of his or her German counterpart. Just to survive in the markets where it is currently established, every company has to define what absolutely has to stay here. Everything else could then be moved abroad.

Would you say this was also relevant to capital goods?

Kirsten Lange: Yes, of course: Critical for the production site location is less the technological complexity of a product than how important proximity to the customer is. Products which are more customer-specific and whose technology is driven by the customers should be produced in geographical proximity to the customer, no matter where the customer may be. But China should always be considered when making decisions regarding the choice of supplier.

Is that only relevant for straightforward, cheap products?

Kirsten Lange: Just take a look at how quickly and successfully Chinese companies have moved into the telecommunications market and how they have proved to be especially competent in design and marketing. Research by BCG on production in China shows that it has often proved worthwhile to set up new, even technically demanding, product lines in China rather than trying to relocate old production sites suffering from price pressure.
Kirsten Lange, Managing Director of The Boston Consulting Group (BCG), Germany, has been professionally involved with China for over ten years. She lived in Shanghai where she helped set up the Shanghai BCG office.

**How come?**

*Kirsten Lange:* Because relocation costs can be relatively high. New product lines, on the other hand, can be planned in a completely different way. Furthermore, Chinese production sites are nowhere near as automated as those in the West. Added to the low labor costs are still considerably lower capital costs. This makes them often highly flexible and also able to adapt extremely quickly to new conditions. A factory in China is always built differently from one in the U.S. or Germany, yet it can produce technically high-quality products. A little anecdote on the topic of quality: A few years ago one of our customers relocated part of his production to China. When quality testing the first products, around 70 percent failed the test in the U.S. factory. But this didn’t stop the customer. When the reciprocal test was carried out several years later around 70 percent of parts produced in the U.S. failed the Chinese quality test. In short, the usually regional responsible production managers’ own interests also always plays a part.

**Where are the greatest difficulties?**

*Kirsten Lange:* In addition to the known problems, such as obtaining reliable market data, there is often a mental block, which makes it difficult to penetrate the Chinese market. This starts with target setting: Anyone who buys or produces in China in order to save 2 or 5 percent will seldom succeed. It only becomes interesting if a productivity increase of 15, 20, or more percent is the target and then new approaches can be pursued. Of the purely practical difficulties, distribution and logistics certainly rank first, especially if you take a look across the coastal region and beyond and consider the immense hinterland.
And product piracy?

Kirsten Lange: Of course every vendor part and every production site that comes to China will always bring know-how; unfortunately we can’t completely avoid that. Examples from the automotive industry demonstrate that very clearly. Illegal product piracy is a problem in China that can at least be kept in check by taking appropriate measures, but it can’t be completely prevented. Automotive companies were well aware that their Chinese partners were nabbing their technology, but they considered the market penetration more important. The significance of isolated knowledge as competitive advantage is sometimes, however, overestimated: In many areas it is more important to be quick, to bring innovations swiftly onto the market or even make a good copy. And this is more a question of internal processes than just technology.

What are the success factors for involvement in China?

Kirsten Lange: Speed, ambition, and patience; swift localization, working with the Chinese in China, and encourage personal contacts through changes in personnel. A Mr. Schmidt would find it difficult to call Zheng Xingchun in China if he didn’t even know which was his first name and which the surname. On the other hand, if they know each other, they become Peter and Xingchun who are solving a problem together. With one of our customers their involvement in China dwindled after ten years until a change in personnel increased the tempo. The new management set up a weekly telephone conference from 5:00 to 6:00 a.m. with all those involved in Europe, China, and the U.S. Simply through the fact that everyone was speaking to one another on a regular basis, more has happened in one year than in the ten previous ones.

Many thanks for talking with us.

A kind of unprecedented momentum seems to be prevailing in China; the people and companies there are really very ambitious and hungry for success.
For the machine manufacturer, steel processing constitutes an important key to the economic implementation of system concepts. An exceptional bending press for the food industry was constructed in the Netherlands using Bosch Rexroth technology.

Gleaming, polished stainless steel, transformed into enormous systems, towering up in the exhibition halls at the Nuremberg Exhibition Center. Here, at the Brau Beviale, one of the largest beverage industry fairs in the world, the importance of this raw material in the construction of plant and machinery for the food industry is particularly evident. Steel ensures neutrality of taste and purity of the end product during production. So no wonder that, alongside the automotive industry, the plant and machinery construction sector is one of the most important customers for and processors of the approximately 900 million tons of crude steel produced each year worldwide.

Economic viability: the large plant at the premises of the Dutch machine manufacturer Darley B.V. can be controlled by a single operator.
Heavy steel plates up to twelve square meters in size can be bent in a single operation on this machine.

Economically viable processing

In order to ensure a position of success in this enormous market, the machine builders are constantly searching for new ways of processing steel and steel plates more efficiently and economically for their own systems – for example in bending presses. These machines bend heavy steel plates and steel sheet billets on a straight edge. We differentiate between these machines depending on the nature of the bending aid; the sheet is either re-formed around a bending punch or swiveled around a fixed edge on a folding press. In order to shape a relatively large steel plate accurately, a number of bending aids need to work in absolute synchronization. Crucial factors are therefore precision and synchronism of the bending aids, as well as the shaping force applied, which is achieved in the majority of cases by hydraulic cylinders. One of the leading manufacturers of bending presses of this type is Darley B.V. of Eijsden in the Netherlands. This company has now produced an exceptional bending press for a leading machine manufacturer in the food and brewing industry. With technology from Rexroth.

“Our customer was looking for a system for the food industry to bend heavy, corrosion-resistant steel plates measuring 6x2 meters in a single operation with a pressure force of 800 tons”, says Robert Liet, Managing Director of Darley, explaining his customer’s requirement. This enormous pressure force, coupled with absolute precision and ultra-short reaction times, represents a real challenge for any systems manufacturer. In addition, the customer stipulated the condition that the machine should be capable of being operated by a single operator. But how can such a specialized and exceptional system be constructed so as to be economically viable? Robert Liet again: “We wanted to construct this system as far as possible using existing components and technologies with a view to the subsequent cost-effective supply of any spares that might be required. For this reason we were looking for a partner with the ability to supply as many components as possible from a single source.”

Around 900 million tons of crude steel are produced worldwide each year.
Extreme force deployment

In order to obtain the required force in relation to the bending aids, Rexroth supplied hydraulic cylinders with a bore diameter of 100 millimeters. By comparison, the norm on such systems is cylinders with a diameter of around 32 millimeters. "The three bending aids on the front of the machine and the two bending aids at the rear will now hold a heavy steel plate weighing 700 kilos in position during the bending operation", explains Bob Lamers, Sales Manager for the Netherlands at Rexroth and responsible for the project at Darley. When it came to the drive for the bending aids Darley also decided on a hydraulic solution from Rexroth. "The movement of the individual bending aids must correspond exactly to the movement of the steel plate in the forming operation", says Bob Lamers, "for this reason we went for a very fast and extremely accurate control valve from Rexroth for the control". A sensor measures the angle of the steel plate, transmits this angle to the control which performs a target/actual comparison with the speed of lightening and then activates the control valve. The speed of a process like this is almost impossible to imagine: from measurement of the angle up to 100% performance at the control valve takes just five milliseconds – "One of the fastest valves on the market" says Bob Lamers.

Vacuum grippers for perfect hold

Precisely locating the heavy steel plates which will later be used in the manufacture of large filling and packaging machines during the shaping process does not only call for the application of pure force. Vacuum-actuated grippers from Rexroth transfer this force from the hydraulic cylinders safely and surely to the workpiece. This process uses so-called vacuum ejectors with their own control electronics. These ejectors work on the Venturi principle, generating a vacuum by means of compressed air. The fact that this module has its own electronics ensures that the ejectors switch off automatically once 80% vacuum is reached and start automatically as soon as the
Bending presses are some of the most important machines in steel and sheet metal processing.

It is difficult to imagine an economy without the achievements of forming technology. Heavy plates are needed in the production of large ships, no high-speed train could reach speeds in excess of 300 km/hr without the use of profiles for the wagon support structure, wheel sets and special rails. Neither can automobiles, aircraft and spaceships get by without the appropriately formed steel sections. Washing machines or even dryers would be considerably more expensive and, in the beverage and food industry we would not be able to rely on absolute purity and authenticity of taste. Bending presses are machines that play a fundamental part in the production of these formed sections.

The vacuum ejectors with their own control electronics operate on the Venturi principle. The OBE control valve is characterized by its high response capability.

The vacuum falls below 60%. Bob Lamers says: "A minimum 60% vacuum is required for locating the sheets in place. But to generate in excess of 80% vacuum permanently would be wasteful. The automatic switch-off function means that the user saves on expensive compressed air". It is possible to save 30% of the amount of compressed air in this way; however, depending on the plant’s cycle, the compressed air generated can be reduced by up to 80%. Gigantic potential for savings in a gigantic machine. But the vacuum ejectors also operate as an additional safety measure: probes are fitted in the individual grippers which also carry out a further check on the correct position of the steel plate. A powerful drive, together with a permanent monitoring facility, thus ensure a reliable and safe sequence of operation.

However, the sequence of operation is not only reliable and safe but also comfortable and convenient. Thanks to a special positioning system, a single operator is able to move the heavy steel plate to the correct position. For this plant Rexroth supplied ball rail guides as well as ball screw drives for the linear axes. Statistically, both linear technology components offer a high level of support as well as rigidities and also guarantee a high degree of positioning accuracy.

Keyword: Forming technology
Anything is possible!

The interaction of several business units created the synergies that make production of such an exceptional machine possible. Familiar components were used within a collaborative framework and combined in a new type of application. "Rexroth has bundled existing competence of a range of different disciplines", says Robert Liet. "This made it easier for us to work together and also made it possible to implement a project of this kind cost-efficiently".

So as to be able to offer his customers optimum service, Robert Liet would naturally like to retain competence in the hydraulics and pneumatics sectors within his own company. "But we can never keep pace with all the developments in these sectors and this is also not our core business activity. For this reason we are glad to have the flexible consultancy facilities and service offered by Rexroth". Thus Rexroth became involved in the project at a very early stage. As Robert Liet says, "because of this we were able to assess immediately what costs would be incurred and what was technically feasible". With the delivery of the new bending press to a leading German machine manufacturer in the beverage and food industry Darley and Rexroth have jointly proved that anything is possible!

Keyword: Bending presses

The term "bending press" may be applied to any machine used for bending steel sections or steel sheet billets on a straight edge. A variety of methods are used: either the metal is formed around a bending punch or bent over a straight bending edge using a press. The ram or swivel axis are crucial to the effectiveness and safety of the plant. It is here that, mostly moved by hydraulic cylinders, the shaping force is applied. In addition, the workpiece bending angle is constantly monitored by special measuring systems and adjusted as necessary.
"Our latest winders can move loads with a weight of up to 135 tons," explains Jürgen Hesse, engineering & development project leader for winding systems at Voith Paper GmbH, Krefeld, Germany. Winders mainly comprise an unwinder, a splicer, a slitter, and a rewinder. Their task is to slit Jumbo reels up to ten meters wide into narrower finished paper rolls. The paper rolls are shipped to printers, for example, who use them for rotary printing. "We make paper ready to use," says Jürgen Hesse, describing in a nutshell the activities of Voith Paper’s Finishing Team.

To keep up with the steadily increasing productivity of paper machines, the Voith Paper Finishing Team developed a new generation of unwinders for slitter-winders in 2000. The Jumbo reels – sometimes also called parent reels – are generally produced in calenders. Calenders are rolling machines that compress, flatten and smoothen the paper. The Jumbo reels are transported to the unwinder of the slitter-winder either in a magazine or by crane. The unwinder incorporates a 1000 kW brake generator. The first step is to connect the web of the new parent reel to the tail of the reel that is being emptied. This is done with the help of the splicer.

The rewinder rolls then draw the paper off the Jumbo reel. These rolls are either arranged alongside each other in a bed consisting of two carrier drums (two-drum winder) or are driven singly by a center drum (single-drum winder). Voith Paper offers both types of machines.

Roller Rail Systems cut costs by 30 percent

Voith winders achieve web speeds of up to 2800 m/min. During unwinding, the Jumbo reel is moved by guideways executing a periodic stroke of 20-30 mm perpendicular to the winding direction at a speed of up to 2.5 mm/sec. This oscillation equals any irregularities in the cross section profile of the paper web. The multi-ton Jumbo reel is moved by a Rexroth hydraulic cylinder.

In the past, the jumbo reel was set down on two flat bearings permanently installed in the floor. However, this solution was pushed beyond its limits as jumbo reels became increasingly heavy. Even though the majority of them were purpose-designed, flat or sliding bearings tended to stick-slip under more severe loading and wore out quickly.

"There is a marked trend in industrial applications for increasingly dynamic movement of increasingly heavy loads. One example of this is in papermaking, where Voith Paper is continuously pushing back the frontiers of technical feasibility through ever more effective machine and process technology. Whereas the working widths in the paper industry were limited to seven to eight meters only a few years ago, web widths of ten meters are now by no means uncommon. The weight that has to be moved has increased to well above 100 metric tons. In its latest generation of slitter-winders, Voith Paper uses Rexroth’s RSF 125 Roller Rail Systems, which have not only improved the design but also slashed the costs."
When Voith Paper began to redesign its machine, Rexroth had just announced the forthcoming launch of new, heavy duty roller rail systems. This was welcome news to Voith Paper. "For unwinding parent reels up to 75 tons, we calculated that the roller rail systems would yield cost advantages of about 30 percent while simultaneously improving the function," recalls Jürgen Hesse. Voith Paper lost no time in contacting Rexroth. While they were still negotiating with Rexroth – the roller rail systems had not yet been introduced to the market – Voith Paper received orders for slitter-winders with a winding width of 9.8 m, which raised the reel weight to well over 100 tons. "Rexroth had to develop matching roller rail systems in parallel to our machine design process," adds Hesse. "The result shows how successful our collaboration was."

The result was Rexroth’s size 125 roller rail system, which is setting the standard for heavy duty applications in linear motion technology. The jump in size from 65 to 125 offers the user quadruple the load capacity – up to 1000 kN in dynamic load capacity, while the static load capacity of the RSF 125 even reaches 2000 kN. With this achievement, Rexroth not only meets the current requirements of Voith Paper but also those of other customers like those in the steel industry. Tests have confirmed that the system has capacity reserves, too, and could move even heavier loads without straining. The field experience gained with the twelve RSF 125s that have since gone into operation in reel winders shows that the roller rail systems can easily cope with the enormous forces occurring when the jumbo reels are set down in the machine.

In line with its principle of interchangeability, Rexroth manufactures the guide rails and runner blocks of the new size with such high precision, especially in the roller track zone, that each individual component element can be replaced by another at any time. This makes infinite combinations possible.
The enormous capacity of RSF 125 Roller Rail Systems: Laden with a 53-ton weight an arrangement with four runner blocks can move 40 million meters – that’s once around the earth.

Each element can be individually ordered and separately stocked. Voith Paper’s winder uses four guideways with a length of 1316 mm and with two runner blocks each. Equipped with integrated full sealing and front lubrication units as standard, the runner blocks are insensitive to even the finest paper dust.

Friction reduced by over 90 percent

The new RSF 125s mean that the positive characteristics of rolling-element linear motion guideways can be utilized even for heavy loads. One major advantage they have over the commonly used sliding bearings is the very much lower power required to move the load resting on the guideways.

"With flat bearings, the friction coefficient was about 0.15. This has dropped to a mere 0.01 with the roller rail systems," says Jürgen Hesse. This more than 90 percent reduction in friction makes it possible to select a very much smaller hydraulic cylinder for the cross motion. It also simplifies the overall machine design, eliminating the need for crossbeams to transmit the shift forces. The pre-assembled guideways are mounted on pedestals and then aligned. This gain in height due to the guideways means that the new-generation unwinders can now stand on the shop floor, without having to be installed in a pit. The unwinder from Voigt is delivered to the customer in modules for mounting on pedestals, which greatly speeds up the installation and start-up procedure.

Heavy duty roller rail systems are now a standard feature at Voith Paper. The Krefeld team is of course pressing ahead with new development work. "We are already planning the next generation for paper reels weighing over 150 tons," announces Hesse. "Our design will include Rexroth roller rail systems as a matter of course."

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Photos and Graphics: Bosch Rexroth AG, Germany (7), Private (1)
Above the Clouds – An Aviation Milestone

The new A380 Airbus should manage to square the circle: Carrying more passengers over a greater distance yet quieter and more economical on fuel. An ambitious goal. Realized with the support of Rexroth technology.

The huge sliding doors open. A large, white nose cautiously peeps out for the first time into the new, damp-cold world of Central Europe. The new machine is still being towed. She still needs the final coat of paint and some fine details of the luxury interior fittings still have to be completed. But soon she will be disappearing for the first test flight, saying farewell to the gray of the clouds. There is always a hint of wistfulness when a completely assembled aircraft leaves the huge hangar. Anyone who has had the chance of seeing an aircraft grow and take shape will not fail to be moved when the moment of departure comes. The aircraft hangar is simply a fascinating sight.

There is soon to be a special moment of departure in the Airbus hangar in Toulouse, France. The most modern passenger airliner in the world – the A380 Airbus – will be leaving the hangar. The A380 was designed by Airbus in collaboration with leading airlines, airports and aviation authorities and it should manage to square the circle: large, quiet, more favorably priced and ecologically friendly. This was made possible by new generation engineering, by savings on weight, by outstanding landing gear and state-of-the-art wing design.

Gigantic production plant

These wings will be produced at the Airbus manufacturing facility in Broughton in North Wales (GB) and then transported by ship to Toulouse. In the first phase large aluminum panels, over 35 meters long, are clamped into a huge processing station, fitted with spars and ribs, painted and equipped with electrohydraulic systems. These so-called wing assembly jigs, manufactured by US company Electroimpact, are over 60 meters long, 30 meters wide and twelve meters high, and have more than 170 electrohydraulically driven working platforms or flip floors. "Every flip floor is moved hydraulically in a horizontal direction along the wing area. The individual working platforms each have pivot points and can thus be controlled to the required angle along the wing. This way the fitters have easy access to the various parts of the wing," says Rexroth Project Manager Gary Livesey.

Technology from Rexroth is also used in the wing assembly panel. Here the aluminum panels are processed to form wings...
Technology

Rexroth technology is used at various stages of wing production for the A380.

Industrial hydraulics from Rexroth

Rexroth installed their own hydraulic cylinders, valve control packs and zinc-plated pipework mains, developed specifically for this application. The 170 flip floors on each jig are supplied via these pipes. The centralized hydraulic power unit is also supplied by Rexroth. 288 hydraulic cylinders, each with a valve assembly, are used to drive the flip floors. Each assembly consists of two Rexroth 4 WE6 control valves and special control modules, which control weight compensation and speed of the flip floors.

Four axial piston pumps and motors from Rexroth are used for the centralized hydraulic power supply, realizing a particularly large output volume. At a pressure of 210 bar the hydraulic pumps output 110 liters hydraulic fluid per minute towards the working platforms. The dimensions are huge: for the first fill alone more than 8,000 liters of fire-resistant oil is required. Even the so-called HAWDE lifts, used for transporting tools and operating materials, are supplied by Rexroth pumps of the Type A10VSO. These ensure an output of 290 liters per minute at 80 bar pressure and constant force, and guarantee safe operation. The pressure controllers on the pumps "recognize" a demand within the whole system: if the platforms are not required, the pump line will unload at no pressure into the reservoir. After a further 20 minutes the system will automatically revert to stand-by mode. Operational safety and economy – made by Rexroth.

Rexroth technology is used at various stages of wing production for the A380. Virtually branch-wide participation in this project, coupled with the remarkable response from the market, shows that Rexroth is on the right road: even at this early stage ten airlines have agreed to purchase more than one hundred machines. All those involved have a major goal in mind: the maiden flight in 2006, which will be a milestone in aviation history. Project Manager Livesey commented, "Every member of the team, whether design engineer, project manager or fitter, is looking forward to this moment." And this is understandable – even if it means that there first has to be another farewell.
Shipbuilding:

On Patrol in Rotterdam – Controlled by Rexroth

For many a ship’s captain an improvement: rotary speed and pitch of the positioning propeller can now be controlled with a single lever. Rexroth in Rotterdam (Netherlands) carried out the project design for the integrated control of the main motors as well as the positioning propellers supplied by the Danish company Mekanord. This remote control system is based on the Marex Open System with CAN-Bus developed by Rexroth.

The recently commissioned RPA2, Rotterdam Port Authority’s patrol ship, is fitted with an operating system which controls rotary speed and pitch of the positioning propeller with such precision, that the motors can be optimally loaded from creep to cruise speed. The propeller blades are adjusted with the aid of an electrohydraulic control, whereas the motors are controlled purely electronically. Both motor speed and propeller pitch can be changed with only one operating lever. The system developed by Rexroth is programmed so that by moving the operating lever not only is the speed increased, but in combination with this, the pitch of the propeller is also changed.

Apart from this, the three-wire CAN bus system from Rexroth can take over the operating functions, alarm systems and the monitoring functions of other equipment on board. It also ensures communication takes place between machine room and bridge. For this, the system uses digital codes, where each sensor and switch has its own identity or address. Data from external systems reach and leave the Marex OS System via an interface. The system is fitted with a backup system and a double power supply.

The Ship – The Facts

The patrol ship, over twenty meters long, is fitted with two 3412 Caterpillars, each with a power of 634 kW at 2100 rpm and reaches a speed of 19 knots. "Five knots more than planned," says Jaqueline Nelissen from the Engelaer Scheepbouw shipyard, Nijmegen (Netherlands). The RPA 2 can be used as an inspection ship, as a fireboat (but with limited fire-fighting power) and also in the fight against environmental pollution. It is equipped for a crew of nine.

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Automotive industry:
Lightning-fast Troubleshooting for Reliable Production Processes

Rexroth has launched a new electronic module, the DDL, for input and output diagnostics on fieldbus systems. If a fault exists, the system identifies exactly which component has failed and displays the information in text form, greatly reducing troubleshooting times. Machinery manufacturer MPE is the first firm in Sweden to use the technology.

MPE supplies mainly machinery for the automotive industry. They supplied the first machine with the Drive & Diagnostic Link (DDL) from Rexroth to Finnveden Powertrain AB. This machine assembles valve lifters for the fuel injection system of Scania's new truck. The machine is complex, with over 120 pneumatic cylinders and grippers. Efficient diagnostics were important in order to minimize troubleshooting times in the event of a breakdown. "With Profibus DP fieldbus and DDL technology the operator receives a fault message in text form and can quickly deal with any fault," says Joseph Makra, Sales Engineer at Rexroth in Sweden.

Fast fault diagnostics was one of the reasons why Finnveden chose Rexroth as the supplier for the pneumatics. Rexroth also supplied electrical servos, meters of guide rails, trolleys and a protective cage built of aluminum sections and Plexiglas. The machine assembles the components that make up the valve lifters in the fuel injection system. The valve lifter maintains contact with the camshaft, controlling the fuel injection into one of the engine cylinders. The precision required is very high.

"We left zero tolerance behind long ago," Bengt-Olof Nilsson remarks with a smile. He runs MPE together with his brother Lars-Erik.

Minus 194° Celsius and plus 182° Celsius

The shaft is bonded to the hub by shrink fitting, which means that the two components are at different temperatures when assembled. The shaft is cooled to −194°C with liquid nitrogen, while the hub is induction heated to +182°C. The temperature difference allows the shaft to be inserted without the risk of scratches. Once the temperatures have equalized the two parts grip each other as firmly as if they had been cast in one piece. Besides the shrink-fitting operation, the valve lifter passes through 14 other stations where everything from ball seats to rivets is mounted in place. At almost every station various lifter functions are tested.

"As well as being an assembly machine it carries out a final quality check," explains Nilsson. "If any of the lifter’s functions isn’t up to scratch it is rejected automatically."

Furthermore a detailed history of the assembly of each individual lifter can also be displayed – from the pressure used to press down a ball seat or rivet to whether or not the wheel rotates correctly on the shaft. This is important for quality assurance."

"To be able to guarantee deliveries we need a highly reliable manufacturing process," continues Nilsson. Any stoppages must be short ones. The ability to output fault messages as text obviously makes work easier for our machinery operators. If anything goes wrong we need be able to identify the problem right away.

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Rexroth supplied products from three technologies as complete supplier.
Modern coastal protection:

Safe from the Storm Tide

Dark clouds move across the heavens, the meadows are deep green and muddy. It’s windy, damp and cold, and the rain is mercilessly beating down. Clothing is drenched. Typical spring weather in East Friesland, a stretch of land on the German North Sea coast. However, despite the inclement weather, tourists with an interest in technology are being drawn to the area. The reason: the Ems barrier. With a length of almost 500 meters, this is one of the largest and most modern river barriers in Europe – naturally with technology from Bosch Rexroth.

The Ems barrier is located around 60 kilometers from the mouth of the river, which flows into the North Sea, and it safeguards the hinterland against the impact of the heaviest storm tides. The average water level here during high tide is around 1.70 meters. After the flood in 1994 took river levels to an unprecedented high, the decision was made to build the barrier. With the barrier closed, storm tides of more than 3.70 meters above zero can now be stopped at the barrier and turned.

Tide dynamics unchanged

When building the barrier one important consideration was that, for environmental protection reasons, neither the breadth of the river nor the tide dynamics should be affected. But how could these requirements be met? After all, more than 12,000 cubic meters of underwater concrete had to be laid as a secure foundation for the structure on the sandy bed of the Ems. Moreover, several thousand tons of sheet piles had to be brought in and just short of 800, almost 40 meter long, steel piles were rammed into the river bed for the deep foundation.

The solution lay in the cross sectional size of the structure: the barrier has a total of seven openings. A main ship’s navigable channel with a clear width of 60 meters, an opening for river traffic 50 meters wide, as well as five other auxiliary openings. For an average tide, the barrier size chosen allows the tidal water to flow in and out without restriction. This means that even the frequent, ecologically important floods on the dyke foreshores of the Ems above the barrier are not affected. The size of the barrier has no impact on ship traffic, neither do the flow characteristics of the river during the year change.

If there is a storm tide, the gates of the auxiliary openings are closed. The main opening for large ships has a special segmented rotating gate and the one for inland traffic is also fitted with a segment. The rotating gate is composed of a gigantic barrier element that can be rotated against the river flow. In normal operation, when the barrier is open, this element lies in a hollow in the barrier foundation, the so-called sill. To dam the water by a storm tide, it is set against the incoming flow. Rexroth hydraulic cylinders on both piles rotate the gate and hold it in the different operating positions.

Lift gate (auxiliary opening), rotating segment gate (main shipping channel) and segment gate (opening for river vessels).
Complete hydraulic drive

Rexroth supplied not only the complete hydraulic drive system, but also the relevant engineering work. Every drive station is fitted with valves, pumps and large oil tanks. In addition, Rexroth supplied the hydraulic cylinders as well as their pipe connection to the drive station. A freely programmable PLC controller with PC console in the control station of the barrier operates the closing equipment.

The individual components for the hydraulic drives are gigantic: for example, the hydraulic cylinder on the rotating segment gate of the main navigation opening has the following measurements: piston diameter 870mm, rod diameter 450mm and a total stroke length of 12.8 meters. The pulling force on the cylinder is 9,500 kN, the pushing force 5,300kN. Also noteworthy is the synchronization of both hydraulic cylinders, based on identical forces, not identical strokes.

With a length of almost 500 meters, the Ems barrier is one of the largest river barriers in Europe.

The extensive involvement of Rexroth is naturally of great benefit to the operator: as system partner, Rexroth can cover the total requirements with respect to hydraulic drives for the project from its own production. The number of suppliers was thus considerably reduced.

The Ems barrier also offers benefits to the economic region of East Friesland. The Meyer shipyard in Papenburg, 32 kilometers upstream, is a major employer in the region. This shipyard builds cruise ships for shipping companies throughout the world. The ships are transported from the shipyard via the Ems into the open North Sea. Up to now, only ships with a draft of up to 7.30 meters could pass through. Thanks to the Ems barrier, the Ems can now be dammed to a considerably higher level. This requires gigantic water pumps, providing a continuous delivery of 100 cubic meters per second. Rexroth also supplied 24 intake gates for this. This damming causes the river to reach a level of 2.70 meters above normal zero, thus also making the Ems navigable for luxury liners with a draft of maximum 8.50 meters. Lower Saxony can therefore be sure that with the barrier, Papenburg Meyer can continue building ships in its state-of-the-art shipyard, thus retaining important jobs in the region.
Mining in Poland:

First Prize for 70-ton Mining Truck

In close co-operation with Rexroth, Polish company Legmet developed a new underground mining truck. Tests have already been successfully carried out by the Polish Mine and Copper Combine. The technical parameters of the mining truck, complete with hydrostatic drive from Rexroth, fulfil the requirements both of the customer and the design engineers. Mining inspectors also approved the new truck, which was likewise accepted by miners.

In order to output the copper and silver ore various high-tech mining, processing and transport machinery, such as drill rigs, bolters, loaders, dozers and mining trucks are used. Many of these robust underground machines are equipped with hydraulic systems from Rexroth.

One of the latest projects of Bosch Rexroth in Poland is the development of a hydraulic drive for an underground monster truck. The mining truck won first prize in the Mine and Copper Combine (KGHM) technical achievements competition.

KGHM Polska Miedz AG

The Polish Mine and Copper Combine, KGHM Polska Miedz, based in Lubin, is one of the largest producers of copper and silver in the world and has over 180,000 employees. In 2002 copper production amounted to more than 500,000 tons, which is 3.4 percent of total world production. This makes KGHM the seventh largest copper producer in the world. Due to its quality this predominantly electrolyte copper is known as "four nines" (99.99 percent) pure copper.

KGHM is also one of the world’s major silver producers (2nd) and extracted nearly 1,200 tons in 2002. The silver has been awarded the "Good Delivery Silver" certificate and is quoted both on the London Bullion Market and the London Metal Exchange.
Hydrostatic drive system

Bosch Rexroth Sp. z o.o recommended a hydrostatic drive system for the new heavy mining truck. Due to the overall weight of up to 70 tons each of the four wheels is fitted with one of the robust Rexroth planetary units Type GFT80. Each of the integrated planetary unit motors Type A6VM200 is fed from the DA control pump Type A4VG125. Separate supply of the individual wheels is necessary because, when the truck is turning, the wheels of one axle rotate at a different speed. This separate control offers a series of further benefits. For example, by using synchronization valves excessive slipping of the truck wheels can be prevented when on less firm ground.

Braking of the truck is carried out by inch valves integrated into the DA closed loop pump control. Operating the brake pedal causes these valves to decrease pump flow, thus ensuring wear-free motive braking.

Two cylinders carry out discharge of a dump box. The cylinders are controlled by M1-22 valve, fed by the pump Type PVQ122. This pump also feeds the steering system.

Technical data of Mining Truck

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<tr>
<th>Parameter</th>
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<td>Top speed</td>
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<tr>
<td>Braking system according to</td>
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</table>

Greater load capacity

Mining trucks are used to transport ore from the drift to the shaft hoist in ore mining. The more the deposit is exploited, the greater the transport track of the ore will be, from the working area to the main shaft. Up to now mining trucks used in Poland had a maximum capacity of 20 tons. A mining truck of higher capacity is necessary in order to transport the ore more efficiently, faster and more cheaply to the main shaft. Legmet Sp. z o.o. has developed a mining truck Type WKPL35/40 with a maximum load capacity of 45 tons, more than double that of previously used trucks.

Hydraulics of the mining truck.

High carrying force with extreme drilling power in a confined space are the particular features of the GFT transmission from Rexroth.

The Rexroth A6VM motors are integrated into the GFT transmission. This gives particularly compact wheel drives.

The Rexroth A4VG pump offers a particularly effective drive control with its integrated DA and inch function.

Many robust underground machines are equipped with hydraulic systems from Rexroth.

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Flexible Production Capacity in a Small Scale Enterprise

One decisive advantage of smaller companies is that they tend to be highly flexible. However, due to a lower number of workers, they have to consider automation if expensive production equipment has to run over several shifts or if a large contract must be filled. A new Rexroth articulated robot is now being used as an automation platform at Kissling Mechanik Laser in Switzerland. It takes over additional shifts on a laser engraving machine and provides the company with the production capacity necessary to accept larger orders.

Swift and accurate

The Swiss country unit from Bosch Rexroth AG worked with the company aXista robotik to set up a robot cell to mark the tubes linked to the existing laser engraving equipment. This cell is primarily made up of one turbo AR8 articulated robot with a double gripper, two places for pallets and a test station with a vision system—a picture recognition system for parts recognition. The tube racks are placed on one pallet section for the robot to pick up the tubes. The space for the new tubes can hold 35 racks in up to 16 levels. With an engraving cycle time of approximately 120 seconds per rack, there is enough material for over 18 hours of work. Since the racks are stacked, their position tolerance may change. The robot determines the exact rack position using laser sensors on the gripper to figure out where the corners are and the robot’s six different degrees of freedom help it to properly pick up racks that are in an incorrect position.

Kissling Mechanik Laser, located in Riehen near Basel, Switzerland, has been working with laser engraving since 1986. Its range of products is extremely varied. It spans from large company signs to M2 female threads, where 4 numbers are engraved 4 mm down in a drilled hole that is only 1.5 mm in diameter. One major challenge is using lasers to mark plastic tubes. These tubes are small containers with an 8 mm diameter and a height of 18 mm that are used to store substances for the chemical and pharmaceutical industries. Held in racks containing 96 tubes, each one is marked with a unique 2-D DataMatrix-EC200-code on the bottom.

Rexroth articulated robots allow an expensive laser engraving machine to be used in multi-shift operation.

Throughout the entire laser engraving process in the machine, the Rexroth articulated robot is on call to remove and feed in the parts.
The racks with tubes that have to be engraved are passed by the robot to a pneumatic feeding unit of the laser system. The robot’s double gripper shortens the time between removing engraved parts and feeding in the new parts. After engraving, the robot guides the racks to a test station with a vision system to check and document whether the matrix code is legible. The unit simultaneously assigns the identified tube to a position in the rack, which can be identified with a barcode. This data is then saved to a CD, which is sent to the customer with the corresponding shipment. The automated process rules out errors, such as switching numbers or assigning them twice. Additionally, it is possible to ensure that all the racks are completely stocked with flawlessly engraved tubes. Racks with flawed tubes are stored in a separate NOK section. Flawed tubes can also be identified onscreen and then manually exchanged.

Remote maintenance over the internet

aXista Robotik also decided to use the functions in the PC-based robot controller to quickly rectify disruptions to automated operation. The robot controller is linked to the Internet via an integrated Ethernet interface. If any disruptions occur, such as missing racks, repeated engraving errors, machine downtimes, or if a contract has been finished, then an SMS is sent to a cell phone via an Internet server. The system can thus call the system operator at any time and maintenance work can begin immediately, saving valuable production time.

A mobile connection to the laser engraving system is what makes this robot cell concept truly special, since the laser and robot can be easily connected or disconnected. This just takes a few minutes and requires a teach-in of 4 points. The company thus has the option of using the laser engraving system with feeding and handling units to work on orders with smaller lot sizes, and then connect the robot cell in the evening for serial production. The robots are usually connected on Thursdays so that the laser system runs around the clock on weekends.

Considerably more capacity

Rexroth articulated robots allow Kissling to use an expensive laser engraving machine in multi-shift operation without any extra personnel. This change brought about an increase in production capacity without sacrificing flexibility by using unadaptable production equipment. In addition, automation technology provides an extremely consistent level of quality, which is just what the chemical and pharmaceutical industries demand.

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Photos: Bosch Rexroth AG, Germany (6), Private (2)
Texo AB have developed a new loom that is about 30 percent faster than older models. This was made possible by replacing the traditional hydraulic shuttle with two light metal shuttles. Driven by electric servo technology from Rexroth the new shuttle accelerates from 0 to 125 mph in 50 milliseconds.

Texo make looms that weave cloths for the paper industry. The cloths are used in paper mills for pressing water out of the pulp. They are woven in different patterns depending on the process where they are used, and the patterns produce different surfaces on the finished paper. Texo is based in the Swedish town of Älmhult. "We supply over two thirds of all the looms on the world market. We only have two competitors, both of them in Germany," says Christian Carlsson, head of electrical design at Texo. In this highly specialized branch of weaving, the speed of operation of the loom is essential to success.

Facts

The ECODRIVE servo system is used in all the servo drives in the system.

The EcoX bus system allows a number of servo units to be coupled together for speed or angular synchronization without the need for any other components. At Texo torque synchronization between four shafts is used to control the two shuttles.

DriveTop is a software package specially developed for use in commissioning, parameterization and diagnostics of Rexroth drives. Parameterization of EcoX is possible with DriveTop.
Cycle now 30 percent faster

When a thread is to be carried through the warp, the two shuttles start at exactly the same moment from opposite sides, meet in the middle of the warp, and then instantaneously fly back again. At the moment they meet, the weft thread is passed from one shuttle to the other just before they part again. The entire operation takes just 350 milliseconds. This is made possible by the capability of the Rexroth ECODRIVE servo system to synchronize the shafts through its EcoX function.

Previous looms had a wooden shuttle that was thrown by means of a hydraulic system. The wooden shuttle weighed just under 9 lbs, its mass making accelerating and braking difficult. The new loom has a shuttle made of light alloy.

"With the old system our looms could only manage 60 picks per minute. A pick means that the shuttle carries a weft thread through the warp. The new technique gives us 83 picks per minute, that’s over 30 percent faster," says Stefan Svensson, Development Engineer at Texo.

Each shuttle is mounted on a carbon fiber belt. The belts each pass over a toothed wheel driven by two coupled, water-cooled, highly dynamic servo motors from Rexroth which are equipped with high-resolution sensors. The shuttles, weighing only 3 ounces each, accelerate from 0 to 125 mph in 50 milliseconds. In the acceleration phase they are subject to forces of 110 g.

Powerful motors for enormous speeds

To reach these enormous speeds the motors have to deliver their outmost in terms of torque and precision.

As well as the shuttle drives Rexroth supplied the motors which drive up to 32 shaft frames. These are the metal frames through which the 72,000 warp threads pass and which can be lifted to various heights relative to each other in order to obtain the desired pattern. The warp feed and tensioning are controlled by a PLC and driven by electric servo motors from Rexroth.

All of Texo’s looms are fully customized according to requirements. Texo has also developed its own operator software for the loom. Many orders are currently coming from China, which is expanding its paper industry. With world paper consumption on the rise, Texo is looking with great optimism to the future.
Tunnel construction:

Intrepid Tunneling through the Alps

The superlative always holds a very special charm. In particular tunnel driving machines always cause a sensation due to their remarkable efficiency and their immense size. We have just witnessed the beginning of a huge project in which these giants play the main part: the largest railway tunnel in the world is being built at St. Gotthard in Switzerland. It is estimated that the project will span ten years, most of this time being taken up drilling through the rock. Rexroth’s robust REDULUS planetary drives will ensure that the mole, nine-meter in diameter, can work its way through the rock powerfully and continuously.

With a total length of 410 meters, a total weight of 3,500 tons and a drive power of 3,500 kW, this gigantic drilling machine will bore through the first part of the new main Gotthard tunnel over a stretch of 30 km through gneiss, an extremely hard rock. After its completion – expected to be in the year 2013 – this railway tunnel will be the longest in the world with a length of 2 x 57 km.

This robust drive technology supplied by Rexroth contributed greatly to this success. Rexroth’s REDULUS planetary drives, which are also built into the Herrenknecht machines at St Gotthard, were developed specially for tunnel driving machines. Normally the gearing and bearings represent the Achilles heel of such powerful drives, but the know-how required here was provided by Rexroth specialists and is based on decades of experience in this field. The REDULUS series has been going since 1971, which means that considerable experience goes into every detail of Rexroth planetary drives.

As a rule the drives for tunnel driving machines are individually designed. Determination of transmission size and modification of the connecting dimensions in the housing are carried out individually. Drive technology itself has reached such a high level that no specific adjustments to the different machines are even necessary. For example, the sun and planet wheels are toughened and ground, whereas internal geared wheels are nitrated. All bearings and meshing are splash lubricated so that even with high transmission power no excessive wear occurs.

A total of 75 km has to be drilled through the mountain for the Gotthard tunnel project.
More than three decades of drive experience go into every detail of Rexroth planetary drives.

Extreme conditions

The TBM tunnel driving machines, which are being used for the main Gotthard tunnel, will become a part of tunnel construction history. With overlying rock of up to 2,300 meters the rock has to be drilled with a high level of stability and made safe. The four Herrenknecht TBM Grippers are each fitted with ten REDULUS GME series drives around the external diameter of the drilling head, and these transmit the power of 3,500 kW required. Such planetary drives, partly with thrust bearing, recommend themselves because their coaxial shape makes the necessary compact arrangement possible. The drive power can be distributed evenly over the diameter. There is still plenty of room for the drilling head bearing as well as for the removal of the waste.

In the next three years the TBM S-210 will break through and secure the around 14 km long East tunnel from Bodio to Faido. In parallel and since the spring of 2003 a TBM S-211 has been drilling the West tunnel with a drill diameter of 8.83 m. Rexroth also supplied the planetary drives here, ensuring the necessary torque for the duration of the drilling operation.

St. Gotthard Tunnel Data

- The St Gotthard tunnel is Europe’s largest and most expensive building site.
- With its 57 kilometers this is the world’s longest railway tunnel and Europe’s deepest route through the Alps.
- With virtually no incline the lowest point lies 2000 meters below the snowline.
- The 410 meter-long tunnel driving machine incorporates the following stages; drilling, securing, cementing, forming and removal of rock waste.
- The machine also eats its way through the rock at a rate of 10 centimeters per minute, and up to around 43 meters a day.
- The tunnel passes through harsh geological conditions, for example rock temperatures of up to 45° C, tectonically insecure zones and zones under considerable stress.
In order to guarantee the TBM units a long service life with their special load collectives a number of parameters had to be taken into account. Accordingly the planetary drives will run for up to 15,000 operating hours, even under the known harsh environmental conditions. They are driven either electrically or with hydraulic motors, according to the wishes of the machine manufacturer. With the hydraulic variant Rexroth variable displacement units of the A4VE series are generally used in conjunction with the relevant control system from the same manufacturer. Along with the S-210 and S0211 tunnel driving machines two other easily restraining hard rock Gripper TBMs are reducing the total drilling time of the Gotthard railway tunnel between Bodio and Faido. These will be drilling through the rock between Amsteg and Sedrun. The drive technology behind both the S-229 and S0239 machines, with a diameter of 9.58m and weighing 1,300 tons without trailing part is also made with Rexroth technology. There are also replacement drives on site for immediate fitting should they be required. The four GME planetary drives being used in the Gotthard TBMs are compact transmissions for control by electric motor. The required transmission ratios for these are between 30 : 1 and 160 : 1. The drive torques attained range from 2.4 to 2,000 kNm.

Under such extreme operational conditions heat is generated, but this problem is solved with a simple and effective solution: Rexroth REDULUS drives contain an additional water cooling system which ensures the correct operational temperature on the drive side of the machine which runs fast and therefore warmer.

A total of 75 km of tunnel has to be drilled through the mountain for the Gotthard project. In around ten years’ time Switzerland will then be able to offer another attractive route through the Alps; the project was decided upon by Swiss citizens in a referendum. Along with the Lötschberg main tunnel, which has a provisional completion date of 2007 and will take some of the strain off existing routes, there is urgent need for another North-South route. As with a perfectly functioning drive, all the gear wheel parts will have to knit smoothly together.
Supply Chain Management (SCM):

Faster, Better and More Convenient to the Customer

The supply chain is a network of businesses working together to manufacture, ship and store a product and to bring it to the end user. The electronic completion of business processes and re-organization in the sense of Supply Chain Management (SCM) are two of the main challenges facing companies today. Realizing the savings potential within this supply chain, an intensive information exchange between the manufacturer, suppliers, service suppliers and customer is necessary. The aims are: cost reduction, shorter delivery times and quality improvement.

To agree on material and information flow ranging beyond the company, various SCM concepts have been established to realize cost- and time-optimized organization of the logistics chain. By means of differentiated branch focus, SCM processes can have completely different concepts. "Just in Time" and "Quick Response" are two such examples.

In the last few years, many new SCM concepts have been developed, aimed mainly at the mutual win-win orientated optimization of the supply chain. "Collaborative Supply Chain Management" (CSCM) is the optimization of the total supply chain through extensive data exchange and joint decision-making processes between the business partners. This means, for example, two or more partners working together in co-ordination. They pursue the aim of building an information platform and of developing plans agreed and arising from this, to fully exploit optimization potential. CSCM is focussed on the interfaces between the supply chain partners. With the help of electronic data transfers they endeavor to synchronize previously lacking transparency and insufficient co-ordination in planning and control. Further aims of the SCM are: the phasing out of existing systems within the supply chain, improving the visibility of systems, offers and capacity, as well as the timely realization of bottlenecks.

SCM concepts have already established themselves in many branches of industry, such as the automotive industry and consumer goods. These concepts are also being increasingly applied in machine construction.

Bosch Rexroth AG’s Service Automation business unit uses SCM to define the management of the material, information and finance flow in the supply chain. SCM covers the processing of spare parts and repair items from internal and external suppliers via internal suppliers – the Competence and Service Centers in Germany for example – to customers worldwide.
With the A10VO...ED/5x, Rexroth offers a variable displacement pump for open circuit operation, which completely meets the economic requirements of the market. The A10 pump has proved itself over many years as a modern drive solution in the open circuit of tractors, combine harvesters, forestry machines, backhoe loaders and in many other applications.

The integrated failsafe behaviour by means of the ED function (electrohydraulic pressure control) makes the Rexroth pump an optimal drive for closed loop-controlled ventilator systems. With a power failure, the A10VO...ED/5x switches automatically to the maximum displacement volume. This means that the driven fans do not stop moving, but continue to cool the diesel motor. The Rexroth pump is characterized by its compact design, fast start-up and minimal hysteresis. In addition, it demonstrates excellent suction performance, which is of special importance in automotive technology.

The A10VO...ED/5x variable displacement pump is available in the nominal sizes 28, 45, 63 and 85 cm³ capacity. It is designed for the medium pressure range and can be operated up to a continuous pressure of 250 bar. The maximum permissible hydraulic pressure is set at 315 bar. The electrical connection is 12 V (1.2 A) and 24 V (0.6 A).

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Rexroth acquired the chain conveyors iX-Line from Flexindustries. Effective immediately, Flexindustries will become a sales partner in the Netherlands, responsible for the entire assembly technology product program at Rexroth.

The acquisition of the chain conveyor systems iX-Line from Flexindustries completes Rexroth’s VarioFlow product family, making it the most attractive program currently on the market. A whole new world has been opened, particularly to the food and packaging industries, since Rexroth now offers a complete program of stainless steel products with chain widths of 80, 100, 160, 240 and 320 millimeters.

Rexroth has also enhanced their chain offering with the new types universal, accumulation roller and roller cleated chains. Users can easily equip the universal chain with their own cleats or fixtures. The accumulating roller chain for example ensures not only a lower impact pressure, but also prevents slip marks on the printed surfaces of the packaging. The static friction chains and roller cleated chains are ideal for more complex conveying tasks involving different levels, with the products being transported on both inclines and descents without complex synchronization tasks. For vertical transportation the new wedge conveyor is also an option.

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Universal, open, scalable:
The new Rexroth IndraLogic PLC system

IndraLogic is the new generation PLC-based solution from Rexroth, which combines scalability and universality with standardized, open interfaces. Programming and running time are based on the proven PLC software from the company Smart Software Solutions (3S). Along with the complete speech range of the IIEC61131-3, offline simulation and extensive online functions such as monitoring, debugging and forcing are available.

For uniform engineering with extended motion logic solutions, IndraLogic is integrated as universal PLC components in all motion control systems from Rexroth. For ease of use of drive functions inside the PLC programs, there is a uniform building-block library to PLCopen.

Rexroth IndraLogic is available as controller and PC-based software variant. The innovative clamping control IndraControl L combines the advantages of embedded PC architecture with the finely scalable I/O terminal system Rexroth-Inline.

IndraControl V is the new, universal HMI application portfolio from Rexroth. From small, controller-based operating devices and CE solutions through to industrial PCs, visual solutions for a wide range of requirements are available with IndraControl V.
Modern training tool for mechatronic engineers: mMS – modular mechatronic system from Rexroth

Together with new co-operation partner Christiani, Rexroth has developed the mMS module kit. mMS stands for "modular mechatronic system". Every module is supplied with extensive documentation. It guides the students in steps from the single function to the mastering of total functionality. There will be a new, useful production process depending on the combination and the extension stage. From single module to complete system, it can be extended step by step. The robust subassembly is built from tried-and-tested industrial components from Rexroth. Virtually all skills and knowledge of mechatronics can be acquired from this training system. It imparts knowledge of control technology, drive technology, bus technology, assembly technology, pneumatics, hydraulics and sensor technology. Problem-setting includes assembly and adjustment, troubleshooting, PLC programming, commissioning and project design.

The modules are designed as "Plug & Play" components. They can be set up as individual modules or in complex production systems for basic and advanced vocational training. Special training documentation for both students and teachers offers a guide to practical projects.

Built-in stroke adjustment:
Pneumatic cylinder for material handling

Many movements in material handling require end-position adjustment for picking a workpiece. To meet this need, Rexroth has developed a new version of the Guide Precision Cylinder with built-in stroke adjustment.

The basic GPC pneumatic cylinder has multiple advantages in the areas of movement, force, non-rotation, side-loading capacity and precision. GPC-E, the new version, is equipped with longer guide rods which are connected to a rear plate with a shock absorber, providing the ability to fine-adjust the stroke length. This function is most useful when the cylinder is used as a carrier for a gripper or suction cup.

In the standard version the outstroke is adjusted with a shock absorber. The home position can also be adjusted by means of an accessory. The GPC cylinder offers sufficient precision for a variety of applications. Particularly with applications that make moderate demands on load capacity and precision, the GPC-E is the cost-efficient alternative to expensive pneumatic slides.

The GPC-E is available in bore 12, 16 and 20 mm and standard stroke lengths up to 150 mm, in plain or ball bearing versions.

Pipework and cost reduction:
Rexroth IH20 Simplifies Hydraulic System Design

The new Rexroth IH20 hydraulic control of segment design offers individual modular solutions with control plates instead of complicated and expensive custom-made units. The segments, which are manufactured in large-scale production and can be combined to suit the individual application at hand, considerably cut costs of hydraulic drive technology when compared with previously common tailored solutions.

Through consequent segmentation, the modular plate system offers a high degree of variability and integrates different valve sizes. These range from size 6 to size 25. The modular design allows the free combination of different circuits and can also be used to realize complex sequences. An optional number of segments can be combined in the control block, and customer- or industry-specific circuits can be inserted at any place.

The control plates are offered in three sizes and allow maximum flow rates of 40 l/min to 500 l/min in the pressure channel. The control handles nominal pressures up to 320 bar. The use of the IH20 significantly reduces the pipework and thus the number of sealing points. The high availability resulting from large-scale production remarkably reduces the time to market for new designs.

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Cathedral of chalk bar the way. The rainwater seeped through the porous chalk stratum and over thousands of years forms these fascinating stalactites and stalagmites.

Hidden worlds, secret caverns and bizarre treasures – for potholers, grotto and cave explorers, the Mexican peninsula of Yucatán is paradise. In the interaction between man and technology, they penetrate ever deeper into the subterranean systems and branches of the world’s biggest cave exploration region.

Secret worlds, fascinating treasures. It is not uncommon for divers in the caves to find remains from the original inhabitants, who inadvertently lost their way in the tunnels of the cave system.

Still – absolutely still. Even the regular bubbling of the expired air does not break the stillness. Cathedrals of chalk bar the way, and with soft flipper strokes the diver floats past. You can see 200 meters through the clear water, but you can never see enough. The diver is drawn down even further to a small yellow sign almost 30 meters down. Here’s the Reaper. Robert Schmittner, leader of the four-man diving group, signals with his outstretched thumb that it’s time to surface. One a fixed line they rise slowly to the surface. For tourists, the adventure of grotto diving is over. For Robert Schmittner, the fascination of the underwater world begins after the yellow sign.

The 28-year-old German runs the Cenote Dive Center in Tulum, around 120 km from Cancun. He introduces tourists to grotto diving. His passion, however, is cave diving, penetrating into the deep, narrow and totally black branches of the underwater caves. The kick is in the exploring – the discovery of as yet unknown ways. Schmittner is a cave explorer, Yucatán his paradise. “Yucatán is the biggest cave diving area in the world,” he says. “There’s a total of over 460 kilometers of cave passages, with 96 different systems and more than 1500 cenotes.” Cenotes are the frequently occurring very small entry holes into the cave system. These occur as the underground currents wash away the porous chalk over time and the earth above them collapses. For the Mayas, the cenotes were like small wounds in the skin of Mother Earth. The subterranean currents their lifeline. For Schmittner they are the elixir of life.

Wide-ranging equipment

The aim of all cave explorers is to discover as accurately as possible the location, size and course of a system. Every expedition begins with the check of the equipment: a double bottle with compressed and purified air counts as one of the most important utensils. Inside, however, we find not pure oxygen, but a nitrox mix, where the oxygen content has been increased to over 30 percent. “Pure oxygen is toxic from six meters down”, explains Schmittner. A two-meter long so-called octopus pipe is also part of the equipment. Here the partner can be supplied with air in an emergency – no-one dives alone here. Using an underwater scooter with a small propeller drive, long distances can be covered quickly and with low power. Quite a few lines, a knife, a compass, various maps and waterproof writing equipment, along with a diving computer, complete the equipment. This computer, not much bigger than a large wristwatch, is a kind of life insurance: “The computer not only gives me information about the time spent underwater and the depth,” says Schmittner, “it also helps when surfacing, for adhering to the decompression phases.” Due to the different pressure loads nitrogen enriches in the blood, according to the water depth. Surfacing too fast would produce bubbles in the tissues, which can cause severe internal damage.

Location and course of the cave systems is determined by the compass direction. A line is laid and fixed to stalagmites, with a knot put in every ten feet. This enables the length of the system to be determined, at the same time helping with orientation in newly explored caves.
The fascination of cave diving – where it is wide enough a type of underwater scooter ensures swifter progress.

The location of the cave systems is determined by the compass direction. The cave tunnels, absolute forbidden territory to the tourist potholers, are pitch black inside. Guidelines are laid here and fixed to stalagmites. This is firstly for orientation purposes to enable the explorers to find their way out of newly discovered caves. Secondly, it is a way of determining the length of the system: “Every ten feet a knot is put into the line, so the length of the line can easily be calculated on the way back,” explains Schmittner. The details are noted with a pencil on a waterproof board and once on the surface again sketched to form a rough map, the so-called “stick map”. It requires a good 400 to 500 dives until a system such as “Dos Ojos” has been sufficiently researched, so that an accurate chart can be produced from the big map. With a length of 56 kilometers, Dos Ojos is the third largest connected system in the world.

However, it is not only the measurement that is important, but also the geological and cultural discoveries – how the caves were formed for one: more than 65 million years ago a meteorite hammered into the Earth’s surface and tore a crater of more than 180 km diameter into the Earth. In the ensuing period chalk sediment deposited itself in the crater. Rainwater seeped through the calcareous sandstone, these cavities forming bizarre rock formations. Towards the end of the Ice Age the sea level rose and flooded this subterranean world. The caves also continually divulge information on civilizations and cultures. Bone finds are common: As the cenotes were holy passages into the Underworld, they would throw in offerings such as earthenware vessels or food. Human remains and million-year-old animal bones have also been found. Being a cave diver in Yucatán – a fascinating career – but a quiet one.