Drilldown Challenges – Drives and Controls for Drilling Machines

The Drive & Control Company
Drilling machines are pioneers. In many cases they are the first machines to be used in the construction process. They are often operating on wild land, across rough terrain or underground. They are drilling blast holes in quarries and tunnels for traffic, laying under- ground lines and ensuring safe foundations, thus creating the basic requirements for great visions and plans. The more important is thus a continuous development of the drilling technology. Today’s drilling machines are the basis for tomorrow’s visions. The objective of Rexroth is to optimize lasting the technology of drilling systems together with our customers.
Drilldown Challenges –
The Everyday Life of a Drilling Machine

Each drilling is a trip to the unknown. All previous analyses and knowledge of the drilling area are only valid till the drilling is identifying the actual conditions. In this context it does not matter whether a relatively small blast hole has to be drilled or a foundation hole with a width of several meters has to be realized. The competence to cope with each and any technical probabilities is the great challenge for modern drilling machines. Rexroth is taking up this challenge!

Drilling machines are no ready-made equipment. After all, the point is to meet highly specialized challenges. The proverb “A chain is as strong as its weakest link” is particularly true when developing drilling machines. Lasting innovations are not only requested with view to hydraulics and gearbox technology. The electronics for control and data collection are playing an increasing important role – load limiting controls, mast positioning and auto-return functions are just some examples, always closely connected to the hydraulics and gears. We at Rexroth do know our subject perfectly and are thus in a position to develop together with our customers operationally safe and practice-relevant solutions.

Blast hole drilling machines
Speed, power and accuracy are indispensable basic requirements for a blast hole drilling machine to operate profitably – either for surface mining or for underground.

Construction drilling machines, reaming and milling
Depending on the required task, pile drilling machines, anchor and injection drilling machines may be agile little “weasels” or intelligent powerful hulks. Their range of application is enormous. Small machines are used in basements; high performance machines are paving the way for building entire airports.

Directional drilling machines
Drilling under roadways, rivers or buildings is requiring an extreme accuracy over long distances and thus an exceptional technical skill. In these applications controllability of the entire drilling process is the central challenge.

Universal drilling machines
A maximum flexibility is requested for different applications such as well drilling, soil or seismological analyses. No problem with universal drilling machines for important drilling length or depth.
Drilling with Our Units is the Tops

Which pressure is needed for which material? Which speed and feed force has to be applied? Which total hardness is required? Drilling applications have always had the highest expectations on material and technology. This is valid for the whole machine down to the smallest detail. Therefore, we established our application center for drilling equipment. No matter if blast hole construction, directional drill or universal drilling machines – together with you we are developing complete and operational system solutions for drilling machines.

Good ideas need to come into the right hands
A great project is starting with a spontaneous brainwave – you have an idea for a new drilling machine. In our application center for drilling equipment we are providing every opportunity to make your ideas come true. It is the ideal place to develop, test and implement innovative concepts. The experts at Rexroth will get to the bottom of your questions and will support you in looking for the optimal solution.

State-of-the-art technology needs confidence
Step by step, the idea is shaping up and we are making a common target of your ideas. Therefore, Rexroth experts are always focusing on your ideas during the cooperation, thus creating an atmosphere of confidence and assurance. Together, we will achieve our common purpose part by part.

Safety comes with the experience
Your ideas are resulting in concrete plans. During this process you may rely entirely on the experience of Rexroth. The knowledge of our unique product portfolio for hydraulic drives and control systems, along with the experience in vehicle electronics due to the connection with Bosch, is granting additional assurance in designing your drilling machines.

No reason to panic: our tests
Excitement is growing. Can this idea really be implemented? In our modern test rigs for system development we will find out together. There, under precisely defined ambient conditions, we are thoroughly examining all drilling machine functions. The extensive experience of our commissioning engineers – required at the world’s largest and most important construction sites – is a further guarantee for the success of your project.
The Heart of All Drilling Equipment –
Drive and Ventilation

Drilling machines are top athletes. Power, accuracy, persistence and technology are crucial to their success. The drilling system efficiency is defined by the interaction between the engine, the installed pumps, ventilation and connected power units for special functions. Requirements towards the drive configuration could hardly be more different. An optimal use of the engine power by space-saving integrated solutions, the optimum combination of hydraulics and electronics as well as a high practical suitability – these are the central requirements. The better the adaptation, the more efficient, flexible, intelligent and, at last, successful the drilling system can be presented.

Power with brains – Bodas complete hardware and software solutions for intelligent power management

With the universal Bodas load limiting control LLC, Rexroth is offering a central electronic control element for optimizing machine effectiveness. It is granting the ability to continuously adapt the hydraulic power consumption of the various function groups to the currently available engine power. Furthermore, Rexroth is offering additional software and hardware packages enabling individual drilling system solutions. For more details, please refer to the chapter “Electronics”. Further info at www.boschrexroth.com/mobile-electronics

Fan systems – a new lease of life

Effectively cooling power units, even under the most extreme application conditions – whether in continuous operation, in the desert or underground – is only one of the requirements vis-à-vis today’s fan drives. All this has to be carried out with minimal energy consumption and is supposed to meet legal requirements with view to emission protection, waste gas and noise load. The more accurately the fan system can be integrated in the overall performance of the drilling system, the more effective the fan performance. Rexroth is granting the optimal solutions for every system size. Our spectrum is including fan drives with simple gear pumps till the high end version, the axial piston pumps A10VO, A10VN and A10VM with temperature sensor TS and hydraulic or electronic control technology. Further info at www.boschrexroth.com/fan-drives

Complete units

Easy installation and space-saving assembly without a power drive transmission – these are just two advantages of our compact units. The double pump ABVE for example is providing two separate high-pressure circuits, an integrated pilot oil supply, control valves and power take-off for additional units. The rotary groups in bent axis design are furthermore granting the highest rigidity – ideal for extremely rough application areas. Further info at www.boschrexroth.com/axial-piston-pumps

Variable pumps – individual solutions in kit systems

A large-scale variety of combinations

The exceptionally large scale of Rexroth products within the A4VG, A10VO, A11VO and A20VO series is facilitating the search for individual solutions importantly. Variable thru drive options for creating multiple pump units and controller variants for different control strategies in all sizes and power classes are leaving no wish open. Further info at www.boschrexroth.com/mobile-electronics
Drilling in the Right Direction – Control Systems

Making power available where it is needed – in a way that can precisely be metered and controlled – would be unthinkable without control systems. The controlled interaction of all a drilling system’s functions is the critical factor of its suitability. Rexroth is mastering all varieties of modern control technology. The ability to combine all Rexroth components is enabling us to design individual solutions, from open center control to the intelligent load sensing (LUDV) system. From mechanical controls to electronic onboard variants for automatic entire drilling processes. From internal summation for combining specific pump circuits to priority switching of individual functions or limiting the power of individual consumers. All of this is supplemented by individual piston designs for more efficiency, comfort and service life.

More details are available at www.boschrexroth.com/control-blocks and www.boschrexroth.com/joysticks

Simple solutions with development potential – open center and pump controls

Mono-block M8-22

Sandwich control block SM12

The M0, MB and SM series open center control blocks are granting a simple, robust and proven open center control technology based on our large-scale cost effective product range. Auxiliary functions can be integrated easily. The variety of components is also providing the basis for comfortable, energy-saving pump control technology.

Apply powerful yet sensitive pressure – load sensing systems

Load sensing control block M4-14

LUDV control block M7

A demand-oriented and energy-optimized supply for the consumer, a flow control independent of the load pressure and a sensitive actuation are the advantages of the load sensing systems for our control blocks M4, SP and SB, requiring little additional piping and providing the possibility of an easy completion of the system. Additional control functions can be integrated in the control blocks, regardless whether they are open or closed center systems. Furthermore, the LUDV systems EX, MB and M7 are offering load independent performance and the load line control, even with a saturation deficit.

Drilling with sensitivity – joysticks

Hydraulic and electronic pilot control devices are making everyday business easier and more efficient. The Rexroth TH5, 6 and 7 solutions are convincing with low actuation forces and a variety of integrated switch and slider solutions. Their ergonomic design is furthermore permitting an especially sensitive control.

Sensitive joysticks TH5

Ergonomic handles EC 2000+ and EC 4000

The hydraulic and electronic pilot control devices TH, THE and – new – ES with ergonomic handles are making the everyday business easier. Low operating forces and proportional regulating characteristics are permitting a sensitive control. Various curves are granting an optimal adaptation to the working hydraulics to be controlled. Different resting and reference positions are facilitating the work for the operator. In addition, a variety of switches, sliders and keys is available, of which type TH7 is particularly suitable for extreme outdoor conditions.

Pilot oil supply MHSTE

For control blocks without an integrated pilot oil supply, the compact unit MHSTE is available for supplying two to three independent control circuits. It is not only dispensing of integrated pressure relief and shuttle valves, but also of a variety of safety functions. Rexroth is also offering a whole range of valves of the MH2/3W series, allocating the control signals of the joystick to various control block axes in a cost-efficient manner.

More details are available at www.boschrexroth.com/control-blocks and www.boschrexroth.com/joysticks
Put the Right Pressure on Your Drilling Task –
Drill Drives

Rotary drive and feed motions, and sometimes hammering as well: everything has to match. Only in this way an impeccable drilling progress and a long service life of the boring tools can be realized. The drill drive has to take a lot: vibration, shocks, high pressure peaks in the hydraulics, lots of dirt and, in some cases, highly aggressive fluids. Of course, we are taking all of these requirements into consideration when developing our systems and special individual solutions.

The interaction of forces – power generation, power ratio and power control of a drilling system

We have the gears
Our compact planetary gears are made of high-alloyed forged steel using state of the art technology. The drives have proven successful for many years under difficult application conditions of drilling machines. The great number of available gear ratios combined with different motor sizes is covering all power categories.

We have the motors
Our robust motors for rough application conditions are disposing of small size increments for both fixed and variable motors. Different motor controllers, high power ratio and a wide speed range are providing an optimal adjustment to different drilling conditions such as rock, flushing and bore hole quality.

We Have the Controls
Rexroth is offering hydraulic as well as electronic control systems for drilling machines. The contact pressure control, for example, is adapting feed forces to the drilling torque, thus increasing the drilling progress and the service life of the drilling tool. The hammer pressure control is adjusting the impact force depending on the feed force. Finally, the drilling head control is ensuring a constant drilling power and a continuous drilling process. Along with the corresponding sensors, they are already integrated in the respective control blocks, motors and cylinders.
Ups and Downs of a Drilling System – Winch Drives

Lifting and lowering, powerful acceleration and accurate positioning – all this with a maximum safety for your staff. Winch drives are all-rounders for the different functions within the drilling machines. They are lifting the drill rod, bringing it into position and are moving the motor head. This versatility is also requiring a maximum flexibility in design. Here too Rexroth is showing its strength, providing all conceivable variants of individual components and complete factory-assembled units consisting of gearbox, hydraulic motor, winch brake valves and integrated speed sensor.

Winch gear GFT-W
The winch gears GFT-W are available as complete units with backup bearing, motor, valves and sensors. Their design is facilitating extremely compact winches with particularly small drum diameters. The integrated multi-disk brake is ensuring a firm grip on the loads. Ground gear teeth are ensuring low-noise operation and high efficiency.

Fixed and variable motors A2FM, A2FE, A6VM and A6VE
These fixed and variable motors are reliable, powerful drives for winch gears. Special rotary group designs are ensuring a quiet running at slow speed with accurate positioning of the loads and thus with a wide speed range for fast winch driving. The robust bent axis design is granting a maximum operational safety. The plug-in motor A6VE is disappearing almost completely in the gearbox and the overall width of the winch is minimized. The speed sensors are integrated in the motors in a space-saving fashion.

Winch brake valves
Fixed and variable motors are prepared for factory mounting of winch brake drives BVO and PD – including secondary pressure relief valves. The sensitive control characteristics of the brake pistons is permitting jerk-free startup and braking of the hoisting loads. Integrated in the brake valves is the control of the disc brakes in the gearbox and an anti-cavitation function for cavitation-free operation.

For an Even Better Start – Swing Gear Drives

Bringing the drill carriage quickly and accurately in position is resulting in a reduction of ineffective setup times and significant cost advantages in drilling operations. To succeed, the drive, gearbox and power distribution have to interact with precision. Therefore, Rexroth is offering gearboxes, swivel motors and valve solutions especially adapted to the respective function.

Swing drive GFB
Our robust and compact swing drives GFB for accurate positioning are variable in a wide range, covering all sizes and are especially optimized for the requirements of the rotary drives. Small increments for the transmission ratio are granting an optimal selection to match the specific requirements. The precise and with little clearance manufactured gearing is allowing an accurate positioning. Generously sized disc park brakes are ensuring that the position is maintained securely. Of course, our gearboxes are also available in form of compact units with hydraulic motors.

Swing drive motors A2FM and A2FE
These two swing drive motors have a specially calibrated group for particularly smooth startup and braking. Speed sensors are providing clean output signals to the electronic control units even at low speeds. Integrated secondary pressure relief valves are preventing jerks and abrupt load changes.

Control blocks
With our control blocks we are offering a variety of solutions for sensitive slew drive actuation. Open center controls or LC control blocks with integrated hydraulic, electric or electronic torque control – we have the right concept for any requirement.
Wheels or tracks? Closed or open circuit? The answer is primarily depending on the application field and the application mode. The most important consideration is always practicality when moving, braking and steering. All propulsion and drive concepts have to provide precise control and ease of use as well as economy and compact data. Rexroth has the perfect answer for all requirements.

Full Freedom of Mobility for Drilling Systems – Moving, Braking, Steering

Sprocket drives, wheel drives
Powerful driving performance, even in rough terrain – sprocket drives have proven successful for many years under the most difficult application conditions. The planetary gears of the GFT series are offering beneath heavy-duty gearing also a robust bearing with an optional mechanical shutdown for towing the vehicle. Rexroth is offering complete sprocket drives consisting of the planetary gearbox GFT with park brake, plug-in hydraulic motors A6VE (or A2FE including secondary valves) as well as the engine-mounted counter balance valves BDV – also available with an optional speed sensor. As drive gear series with fully integrated variable hydraulic motors A10VT in swashplate design, they are disposing of a valve system integrated in the port plate for maximum power density with a significantly reduced overall length.

Both drive units – with a plug-in or integrated motor – are used analogous in wheel driven vehicles.

Further info at www.boschrexroth.com/gears

Wheel drives
The advantages of hydrostatic drives are not only including a low number of gear stages and a high power at low engine speeds, but also a flexible drive arrangement. The engine can be positioned anywhere; optimal solutions are taking full advantage of the available engine power. One option is the reversible variable pump A4VG combined with the DA control system and variable motors A6VM. Together they are realizing high torque, appropriate travel speeds and a wide control range. Our planetary gearboxes GFT are also used here in combination with bent axis (or swashplate motors). The boost pump and the necessary valves for closed loop are already integrated.

Further info at www.boschrexroth.com/power-brakes and www.boschrexroth.com/power-steerings

Steering and braking
The Rexroth steering units LAG are quite possibly the most varied steering systems on the market. The large-scale variety of available variants is facilitating an optimal adaptation to the vehicle. Open or closed center, standard or special emergency steering functions – Rexroth is offering the right module for any application.

The hydraulic remotely powered brake system LT 07 is not only providing significant higher comfort, but also a number of other advantages. For example, the pressure is supplied by the already existing hydraulic system, the modular design is requiring little casing. Once the engine is started, the sensitive brake system is immediately in standby, offering precisely metered braking control even for heavy machines.

Further info at www.boschrexroth.com/power-brakes and www.boschrexroth.com/power-steerings
Good Drilling Requires Good Alignment

Accurate alignment of the mast or the carriage is the basic condition for an accurately drilled hole. Automation of the drill rod magazine handling the rods is saving labor and costs. Cylinder functions are requiring safety valves. A drilling machine has also to be equipped with a dust collector and a water pump drive. All of this is requiring an interaction of a large scale variety of components and a cost-effective system integration is mandatory. For this purpose, Rexroth is offering various modules including special control block disks, pumps and valves.

A network of intelligent control blocks

The Rexroth control blocks M4 with onboard electronics can easily and inexpensively be integrated in the overall control system via CAN-Bus. Thus entire function sequences can be automated, providing lasting relief to the operator. The configuration is carried out ex works.

Safety as a standard

The hose burst safety valve MHRB and the cylinder check G-meter PD are protecting the cylinder functions, permitting sensitive and constant lowering movements.

Versatile and adjustable

The variable pump A10VO is offering a large-scale variety of controls for an optimal energy consumption, such as pressure and flow control with superimposed or electro-proportional control.

Approved and cost-effective

The so-called open center working hydraulics are an approved technology for cost-effective and robust solutions. The centerpiece of these systems are the gear pumps AZP in combination with the control block SM12.
Going Underground with Brains –
The Modern Electronic Management BODAS

Mast positioning, auto-return, load limiting control – electronics are making their appearance also in drilling systems. With the mobile electronics system BODAS, Rexroth is offering the full range of electronic hardware and software, specifically developed and matched to the hydraulics and the rough requirements of the construction sites. All of this has been realized in close cooperation with Bosch. Drilling data records, remote diagnostics or electronic drill controls make sure that you may rely on the worldwide market leader for vehicle electronics also in the future.

The BODAS hardware kit
Electronics hardware in drilling systems has to take a lot: vibration, shocks up to 25g, temperature from -40°C up to +80°C, dust, road salt, mud or electromagnetic emissions from the transformer station next door. To cope with these challenges, our electronics are undergoing comprehensive tests in the Bosch laboratories. Also in their production we are leaving nothing to chance. Our controllers and sensors are manufactured on the highly automated assembly lines of the Bosch plants and are granting a maximum flexibility in use. Our versatile hardware kit is including all components for electronic control of the drilling machine. Here are a few examples:

- BODAS controller RC with protection class IP65 for 2 to 36 proportional solenoids and 2 to 20 switching functions can be expanded with virtually any number of Rexroth BODAS CAN I/O modules.
- Differently robust BODAS sensors for recording speed, sense of rotation, rotation angle, pressure, temperature and contamination are ensuring perfect input signals for the electronics.
- Rexroth is producing one of the few displays for rough outdoor use with the IP65 type of protection – the D13. Of course, it is CAN Bus compatible and can be operated reliably even when wearing gloves.

The BODAS software kit
Rexroth is offering exactly the software you are needing – cost-effective turnkey solutions adapted especially to your drilling application and not requiring any special programming skills. If you prefer, you may decide on your individual software – tried, tested and including detailed operating instructions. Thus, a quick and easy system integration can be realized. Of course, our product range is also including convenient service software. All most important basic and additional modules are available from Rexroth as ready-to-use BODAS software packages:

- Mast positioning MSP with integrated auto-return control ARR
- Load limiting control LLC
- Automatic fan control AFC
- Drive control DRC – extensible with ECO-drive
- You may also use our state-of-the-art BODAS design programming tool to program your individual software based on finished, tried and tested modules from the program library.

Further information at www.boschrexroth.com/mobile-electronics
Drilling systems have a long service life – as long as they can profit from the right service and support. Our service is available at more than 80 business sites as a competent partner for all drive, control and working hydraulics solutions related to drilling machines. Thus, you may not only rely on a product portfolio unique on the market, but also extensive support and service.

Service support during commissioning
To make critical moments successful ones, we are offering a large-scale range of comprehensive services:
- Support by our specially trained field service technicians
- Homologation of new projects
- Commissioning of systems and machines
- Measurements and trouble-shooting as service support
- On-site repairs by our technicians

Repair
A good system developer is also offering excellent after-sales service:
- Fast and reliable repair, using original parts, and conversions to the state-of-the-art technology
- Worldwide network of state-of-the-art repair workshops with a qualified staff and online access to the current design data
- Warranty volume similar to new parts
- Certified as to DIN ISO 9001
- Reman and replacement systems

Spare parts
The Rexroth service is characterized by speed and competence. We are granting:
- Original spare parts with manufacturer’s quality
- Pre-assembled modules and kits
- Sophisticated worldwide logistics
- Day-in/day-out shipment
- Service parts available even after discontinuation of series

Documentation and training
Knowledge is power! This is the motivation behind the education and training that we are offering in mobile hydraulics. At www.boschrexroth.com/mobile-training you will find our currently offered courses.