Workshop on Technology Development & Mechanisations of Mines
20th Jan 2015
IHC, New Delhi
COMMITTED TO SUSTAINABLE PRODUCTIVITY

We stand by our responsibilities towards our customers, towards the environment and the people around us. We make performance stand a test of time. This is what we call – Sustainable Productivity.
**FACTS IN BRIEF**

<table>
<thead>
<tr>
<th>Established</th>
<th>1873 in Stockholm, Sweden</th>
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<tbody>
<tr>
<td>Four focused business areas</td>
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<tr>
<td>▪ Compressor Technique</td>
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<td>▪ Industrial Technique</td>
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<tr>
<td>▪ Mining and Rock Excavation Technique</td>
<td></td>
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<tr>
<td>▪ Construction Technique</td>
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<tr>
<td>Global presence</td>
<td>Customers in more than 180 countries</td>
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<tr>
<td>Employees</td>
<td>40 200 in 90 countries</td>
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<tr>
<td>Annual revenues 2013</td>
<td>BSEK 84 (BEUR 9.7)</td>
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</table>
LEADERSHIP IN SUSTAINABLE PRODUCTIVITY
A LEADING INDUSTRIAL PROVIDER

Sales per customer category

- Services: 7%
- Construction: 23%
- Mining: 26%
- Process industry: 28%
- Manufacturing: 11%
- Others: 5%
CUSTOMERS EVERYWHERE

North America 20%
South America 10%
Asia/Australia 27%
Europe 32%
Africa/Middle East 11%

February 24, 2014
Atlas Copco Group Presentation
SUPPORTING A WIDE VARIETY OF INDUSTRIES

Revenues per business area

- Construction Technique: 15%
- Compressor Technique: 40%
- Mining and Rock Excavation Technique: 34%
- Industrial Technique: 11%
A STRONG BRAND PORTFOLIO
CUSTOMER-FOCUSED STRUCTURE

- Board of Directors
- President and CEO
- Group Management and corporate functions

Compressor Technique Service
- Compressor Technique Service
- Industrial Air
- Oil-free Air
- Vacuum Solutions
- Gas and Process
- Quality Air
- Airtec

Industrial Technique Service
- Industrial Technique Service
- MVI Tools and Assembly Systems
- General Industry Tools and Assembly Systems
- Chicago Pneumatic Tools

Mining and Rock Excavation Technique
- Mining and Rock Excavation Service
- Underground Rock Excavation
- Surface and Exploration Drilling
  - Drilling Solutions
  - Rock Drilling Tools
  - Rocktec

Construction Technique Service
- Construction Technique Service
- Specialty Rental
- Portable Energy
- Road Construction Equipment
- Construction Tools

Common service providers
Drilling Solutions is one of six Atlas Copco companies in this business area – the only company in the business area with its headquarters located outside of Sweden.
ATLAS COPCO DRILLING SOLUTIONS
Product range and applications

Blasthole drilling
Water well drilling
Oil & Gas drilling
ROCK DRILLING METHODS

Hole diameters from 7/8” up tp 16”

The tophammer method
- Principle: In the simplest of terms, the tophammer drilling method goes back to manually hitting the end of a drill steel with aledge hammer. As recoil makes the rod jump back it is rotated to ensure that the hole is round. In a similar way the impact energy of the rock drill piston is transmitted to the drill bit in the form of shock waves. Drill cuttings are removed from the hole bottom by air or water flushing.
- Hole diameter: 5/8” - 5 1/8” (15.87 - 134 mm)

The COPROD® system
- Principle: The rock drill is situated on the feed beam on the rig and impact energy is imparted from above. Threadless impact rods are stacked inside the threaded drill pipes. The impact rods are used solely to transmit impact energy and feed force, while the drill pipes transmit rotation. COPROD combines the speed of tophammer drilling with the hole straightness of the down-the-hole method.
- Hole diameter: 3/4” - 6 1/8” (19.05 - 156 mm)

The down-the-hole method
- Principle: The hammer is situated down the hole in direct contact with the drill bit. The hammer is rotated by the drill bit similar to the down-the-hole method. The difference compared to DTH drilling is that the RC-hammer is designed for drilling long holes, not only for blasting, but also for water wells, shallow gas and oil wells, and for geothermal wells. In mining it is also developed for sampling using the reverse circulation technique (RC-drilling).
- Hole diameter: 4 1/4” - 6 1/8” (107 - 156 mm)

The Reverse circulation method
- Principle: The hammer is situated down the hole in direct contact with the drill bit. The hammer piston strikes the drill bit resulting in an efficient transmission of the impact energy and insignificant power losses with the hole depth. The method is widely used for drilling long holes, not only for blasting, but also for water wells, shallow gas and oil wells, and for geothermal wells. In mining it is also developed for sampling using the reverse circulation technique (RC-drilling).
- Hole diameter: 4 1/4” - 6 1/8” (107 - 156 mm)

Rotary drilling methods
- Principle: Rotation is provided by a hydraulic or electric motor driven gear-box, called a rotary head that moves up and down the tower via a fluid system, generating the pulldown required to give sufficient weight on the bit. flushing the drill cuttings between the wall of the hole and the drill rods is normally made with compressed air.
- Hole diameter: 4 1/4” - 6 1/8” (107 - 156 mm)

The PARD method
- Principle: By combining a low impact DTH hammer with the high feed pressure and torque of rotary tricone drilling, a higher level of energy can be provided for rock drilling, than what a DTH hammer or rotary drilling can create alone. The lightweight hammer piston strikes the tricone drill bit resulting in a transmission of the impact energy to the drill bit. The impact energy from the hammer is supporting the spitting and rock cutting process and is increasing the penetration rate.
- Hole diameter: 9 1/8” - 12 1/8” (231 - 311 mm)
BLASTHOLE DRILLING
in open pit mining

- **Drilling methods**
  - Rotary drilling
  - Down The Hole (DTH)
  - PARD method

- **Hole diameter range**
  4 – 16 inch

- **Weight on bit**
  25,000 – 125,000 lb

- **Rig size (weight)**
  60,000 – 415,000 lb

Aitik copper mine, Sweden
BLASTHOLE DRILLING

Applications

Rotary Drilling Products

- Pit Viper 311
- Pit Viper 275
- Pit Viper 231
- DML
- DML-SP
- DM45/50
- T48H
- DM30 II
- DM30
- DM25-SP

Atlas Copco Drilling Solutions division

Applications:
- Dimension stone industry
- Construction
- Aggregate (Cement and Limestone)
- Industrial minerals (Cement & Limestone)
- Coal
- Copper and base metals
- Iron and ferrous metals
RCS BASIC REPLACES ELECTRIC JOYSTICKS
RCS BASIC

- Hardware providing power to control system
- Input / Output hardware to connect sensors and actuators
- Sensors and actuators
- Display hardware to provide an up to date operator interface

- Software for realisation of the basic control functions
- Software providing optional functions
RCS KEY PROPERTIES

- PC-hardware based
- Distributed
- CAN-bus based
- Rugged
- Modular
  - Adaptable from 4 boom Boomers to “small” LHDs to large diameter surface drill
- Common Base software platform
- Distributed code loading
- Communication interfaces
- Interlocks for safety and equipment health

Customer Benefits
- One automation platform
- Flexible automation
- Improved control
ATLAS COPCO TECHNOLOGY
Rig Control System (RCS) Products
RCS COMPONENTS: CONFIDENCE + STANDARDIZATION

Sensors, Actuators, & Control Devices

- I/O Module
- CAN Cable
- Operators Station

- Standardized
- Strategically Placed
- Ruggedized
- Robust
- Troubleshooting
- Signals
- Familiarity
- Complete Control
- Full Awareness

- Simplicity: Cable Management
- Built for the Elements: IP 67 Rated
- "Eyes and Ears" Control, Sense, and Report

Inclinometer
Pressure & Temp Sensors
Proximity Sensors
Actuations

Video

Atlas Copco
RCS BASIC

- CAN Bus Infrastructure
  - Utilizes a Central Computer with a network of electronic modules
  - Hydraulic valves are electrically controlled, but the electrical signal comes from the PC’s input/output-modules via the software in the PC and not directly from the operator’s panel.

I/O Modules mounted to the valve stand on the PV-351
**RCS BASIC**

GRAPHICAL USER INTERFACE

- Multi Language Support
- Built in Diagnostic System
- Different Levels of Access
- Menu Based Settings
RCS BASIC

- Integrated touch screen computer into operator's pod with multi-function controllers, digital gauges that displays drill information.
**RCS BASIC**

- Digital View of
  - Head Position on Tower
  - Total Drilled Depth
  - Hole Depth Indicator
  - Target Depth with Alarm
  - Rod in Hole Lockout
  - Hole Number Counter
**RCS BASIC**

- Digital View of Electronic Gauges
  - Rotation Speed
  - Pulldown Force & Pressure
  - Rotation Torque & Pressure
  - Bit Air and Tank Pressure
  - Penetration Rate
  - Water Pump Output (%) & Flow
  - Air Flow Output (%)
  - Bubble level
RCS BASIC

- Digital View with interlocks
  - Carousel Position (Stowed)
  - Breakout Wrench Position
  - Rod Support Position
  - Angle Pins Status (Locked or Unlocked)
  - Vertical Pins Status (Locked or Unlocked)
  - Struts Status (Locked or Unlocked)
  - Jack Status (Retracted, On Ground, and Unknown)
RCS BASIC

- Built-in support system for diagnostics and troubleshooting.
  - Different Levels of Access
  - Actuator Calibration
  - Fault/Event Logging
  - Digital / Analog Signal Status
The RCS technology platform

- Safety interlocks
- Autolevel/Autodelevel
- Autodrilling
- GPS hole navigation
- Rig remote access & communications
- Measure while drilling
- Teleremote operations
- Autotramming
- **Autonomous Pit Viper operations**

— Our technology and automation program made big leaps this year with one Pit Viper running fully autonomous since March in iron ore with 90% availability, 10% improved productivity, and 20% improved bit life when compared to units operating with people on board.
“To be successful, automated equipment cannot be considered special or unique within the mine operation”
REMOTE OPERATIONS: CONTINUAL IMPROVEMENT
3 DATA AREAS

Pit Viper Reporting
(Surface Manager)

3rd Party Standardized
Communication

Real Time Viewing
(Desktop Viewer)
DATA MODEL

Common Communications Interface

Mine (W)LAN Integration

Centralized Data Collection

PV Reporting

Real Time Viewing

Third Party Interface
FUTURE

Near Future

What if…
SINGLE-PASS DRILLING

Advantages

- No carousel to maintain
- Less maintenance on primary and auxiliary breakout wrenches
- Eliminate adding and racking rods
- Saves up to 3 minutes per connection
- Much more productive in soft material
WHY ROTARY?  LONGER TOWERS

- Large platforms can support 30m length, 40 ton towers
- Enables drilling of truck/shovel benches in one pass
## SINGLE-PASS DEPTH

<table>
<thead>
<tr>
<th>Hole Depth</th>
<th>0'</th>
<th>10'</th>
<th>20'</th>
<th>30'</th>
<th>40'</th>
<th>50'</th>
<th>60'</th>
<th>70'</th>
<th>80'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 m</td>
<td>3 m</td>
<td>6 m</td>
<td>9 m</td>
<td>12 m</td>
<td>15 m</td>
<td>18 m</td>
<td>21 m</td>
<td>24 m</td>
<td></td>
</tr>
</tbody>
</table>

### Single-Pass Depths

- **PV-351**: 37' 55'
- **DM-H2**: 37' 55'
- **PV-311**: 37' 55'
- **DM-M3**: 37' 55'
- **PV-271**: 37' 55'
- **PV-275**: 37' 55'
- **DM75**: 37' 55'
- **PV-235**: 37' 55'
- **DML 35’**: 37' 55'
- **DML 30’**: 27' 40'
- **T4BH**: 27' 40'
- **DM45**: 27' 40'
- **DM30**: 27' 40'
- **DM25 SP**: 40' 50'

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**Tophead** | **Rotary Table**
CLUTCH

- Patent Pending Hydraulically Operated Automatic Wet Clutch
- Automatically Disengages the Air Compressor from the Engine when the Air is shut off.
- The Compressor typically consumes 30% of its rated power at Standby
- Clutch removes parasitic Engine loads at Start-Up since the Compressor is not engaged, therefore it decreases Engine Load and increases Engine Life
- The Compressor Hour Meter only runs when the clutch is engaged – this allows for the service to be based on actual Compressor Hours used and not Engine Hours
EARS (ELECTRONIC AIR REGULATION SYSTEM)

Simple volume and pressure control
- Air volume control delivers required air volume until the pressure limit setting is reached.
- Air pressure control allows the pressure limit to be reduced by the driller.
- System is monitored by a flow sensor in compressor inlet and a pressure sensor in receiver tank.

Assured compressor protection
- When switch is off, EARS will flow enough air through the compressor to maintain lubrication.
- EARS maintains minimum air pressure in the receiver tank.
- Excess pressure is vented to atmosphere.
- EARS automatically maintains both flow rate and minimum pressure in the receiver tank.
PV-270 SERIES BLASTHOLE DRILL

PV-271 Tower Options
- PV-271 - 55' (16.7 m) Single-Pass Depth
  plus 2 - Rod Changer for 25' rods yielding a total depth of 105'

PV-275 Tower Options
- PV-275 - 195' Multi-Pass with 4-Rod Carousel for 40' Rods
PV-270 SERIES

- **Tower Options**
  - 55' (16.7 m) Single-Pass Depth plus 2-Rod Changer for 25' Rods [PV-271]
  - 195’ Multi-Pass with 4-Rod Carousel for 40’ Rods [PV-275]

- **Engine Options**
  - Caterpillar C27 (Tier II) - 800 HP (597 kw)
  - Cummins QSK19 (Tier II) - 760 HP (567 kw)
  - Caterpillar C32 (Tier II) - 950 HP (709 kw)
  - WEG 6808 Electric motor – 700 HP (522 kw)
  - WEG 6811 Electric motor – 900 HP (671 kw)

- **Compressor Options**
  - 1900 CFM (53.8 m3/min) @ 110 PSI (758 KPa) Air Compressor
  - 1450 CFM (41.0 m3/min) @ 350 PSI (2413 KPa) Air Compressor
  - 2600 CFM (73.6 m3/min) @ 110 PSI (758 KPa) Air Compressor

8 X PV 271 are working in India at Reliance, Sasan
PV 351

- 10-5/8” to 16” (270 to 406 mm) Hole Diameter
- 65’ (19.8 m) Single-Pass Depth
- 135’ (41.1 m) Maximum Depth
- 125,000 LB (56,700 kg) Weight on Bit
- Up to 3800 CFM (107.6 m³/min) Air Compressor
- Up to 1650 HP (1,119 kW) Diesel Engine or 1400 HP (1,044 kW) Electric Motor
- Operating Weight
  – 385,000 lb (175,000 kg) Diesel
  – 415,000 lb (188,240 kg) Electric

5 X PV 351 are working India with South Eastern Coalfields
APPLICATIONS DEEP HOLE

- Water well
- Geothermal
- Shallow oil and Gas
- Mine dewatering
- Exploration
**Atlas Copco’s Deep Hole Product Line**

<table>
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<tr>
<th>Pullback in tlf</th>
<th>5000</th>
<th>15,000</th>
<th>28,450</th>
<th>30,000</th>
<th>40,000</th>
<th>70,000</th>
<th>50,000</th>
<th>70,000</th>
<th>100,000</th>
<th>120,000</th>
<th>200,000</th>
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<tr>
<td>Pullback in HL</td>
<td>22.2</td>
<td>66.7</td>
<td>117.7</td>
<td>133.5</td>
<td>177.9</td>
<td>311.4</td>
<td>222.4</td>
<td>311.4</td>
<td>444.8</td>
<td>533.8</td>
<td>880.6</td>
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<table>
<thead>
<tr>
<th>HOLE DEPTH (Depending on drill diameter)</th>
<th>150</th>
<th>300</th>
<th>450</th>
<th>600</th>
<th>750</th>
<th>1000</th>
<th>1170</th>
<th>1220</th>
<th>1350</th>
<th>1450</th>
<th>1550</th>
<th>1650</th>
<th>1800</th>
<th>2000</th>
<th>2100</th>
<th>2300</th>
<th>2450</th>
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<td>WaterWells</td>
<td>A</td>
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<td>Oil &amp; Gas</td>
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*The depths shown are for indication only and may vary depending on geological formations.*
Atlas Copco provides a number of service agreements, and can also conduct rig audits in the field.

**Service products**

Sustainable remanufactured components that ensure optimum, safe and reliable performance and minimal downtime. Atlas Copco Reman solutions are covered by a competitive warranty policy.

**Replacement parts and kits**

Kits and genuine replacement components which are developed and designed to ensure proper, safe and easy maintenance of your equipment in compliance with the Atlas Copco quality standards.

**Service tools**

Tools and support systems designed to provide enhanced and safe service of our mining and rock excavation equipment. Service tools are built with durability in mind, and many will last as long as our equipment.

**Reman solutions**

Atlas Copco’s training products provides training programs for both operators and technicians. We offer a wide range of training products for Atlas Copco mining and construction equipment.

**Training products**

Fluid management solutions

Enables optimal equipment operation. It ensures that all fluids are maintained in the most efficient, environmentally friendly and safest way possible. Atlas Copco offers superior fluids delivered and stored in a complete fluid solution package.
COMMITTED TO SUSTAINABLE PRODUCTIVITY.