

USA **M**INING & **C**ONSTRUCTION

MECHANIZED ROCK EXCAVATION WITH ATLAS COPCO

NO 1 2010

INTRODUCING... THE NEW ROC T35M

**SEE NEW EXCORE
BIT AT PDAC!**
(Also on p. 24)

**POWERFUL BREAKER GETS THE JOB
DONE WHEN BLASTING COULDN'T**

**LEARNING FROM OUR NEIGHBORS:
THREE STORIES FROM MEXICAN MINES**





11



28



7

FEATURED

Vol. 1, 2010

PAGES 4-6 FOLSOM DAM Atlas Copco drill fleet works in tight area with challenging ground conditions for this project.

PAGES 7-9 FOLLOW THE GOLD Gold, silver, copper, lead mined with reverse circulation and the Atlas Copco ROC L8 and Secoroc RC 50 hammer.

PAGES 10-12 NUMERO UNO Atlas Copco Robbins 34 RH C QRS raise drill increases productivity for the whole mining fleet.

PAGES 13-15 HIGHER PRODUCTION New mine in Penasquito gets it right using all Atlas Copco equipment.

PAGES 16-17 KEEPING PEACE HB10000 is one of the world's heaviest, most forceful breakers, yet is precise enough to work in the heart of Harlem.

PAGES 18-19 BREAKER MAINTENANCE Routine breaker maintenance and correct operating lets you pick your downtime.

PAGES 20-22 TERRA FIRMA Find solid ground with Atlas Copco foundation and reinforcement products.

PAGES 22-23 BRIDGING THE GAP Symmetrix helps difficult bridge project when other methods couldn't.

**ON THE COVER
PAGES 4-6**



PAGES 24-27 EXCORE EXCELS
Tests of newest Atlas Copco bit show great success in varied ground conditions.

PAGE 28 DOWN THE HOLE
Center of Excellence sells, rents, supports everything for DTH projects.

USA MINING & CONSTRUCTION

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POSITIVE EXPERIENCES

Weathering the storm means working for the short and long term

The start of 2010 is well upon us, and we all anticipate an increase in activity in Atlas Copco specialty drilling segments. We are well prepared to quickly meet any level of business activity through our channels, our diverse product ranges, our package solutions and our unmatched support staff.

Although 2009 was a challenging year in the industry, we in the Geotechnical Drilling and Exploration Division were extremely busy, providing specialty drilling and stabilization solutions as reported in this issue of M&C USA, and in recent issues of our Deep Hole Driller Magazine. Our division provides many specialty products that complement all Atlas Copco business lines, and allow our channels to provide products and solutions to the drilling segments that did have active projects.

Despite the economy, we have invested in and launched new products this year, preparing us for the future.



EDITORIAL

By Gene Mattila
Business Line Manager
Atlas Copco Geotechnical
Drilling and Exploration

Among these are:

- Mustang – a geothermal drill rig package for urban areas
- Flex D Grout Plants – a unique plant that provides an unparalleled combination of flow and pressure
- Elemex – an improvement in our Symmetrix system that controls air flow and cuttings discharge
- Excore – a new generation core drilling bit that improves both life and productivity
- T111 – a large diameter self-drilling anchor for micropiles.

Along with the above new products, our increased training, improved inventory flow, enhanced sales and service support, and collaboration with all of our divisions allows us to be a market leader. We are prepared for the short- and long-term future.

To state a famous quote, “It is not how you weather the storm, but how you play in the rain.”

WHERE TO FIND ATLAS COPCO

Atlas Copco Construction Mining Technique USA LLC and Atlas Copco Construction Equipment LLC provide sales and support for Atlas Copco customers across the USA.

For CMT products call **800-732-6762**, or one of the stores below:

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NV	Elko	775-777-2204
MA	Ludlow	413-589-7439
MD	Baltimore	877-797-0987
TN	Knoxville	888-339-0344
WI	Milwaukee	866-254-8511
TN	Nashville	615-641-3000
PA	Clark's Summit	800-950-1049
CA	San Diego	866-374-5757
GA	Atlanta	888-762-3745
CA	Sacramento	916-655-3005
AZ	Tucson	520-834-0400



For compressors and tools, contact
Atlas Copco Construction Equipment
800-760-4049



Atlas Copco

FOLSOM DAM

Big Job for Drill Fleet



Production has ranged between 250 to as many as 800 holes drilled per day on this site, which has drills working in close proximity on very difficult ground conditions. Boulders make the topsoil uneven and the soft formation below causes blasts to lose energy.

Atlas Copco ECM 585, ECM 590, ROC D7 and the newest Atlas Copco crawler – the ROC T35M – drill and shoot an average of 11,000 cubic yards of material daily.

The Folsom Dam improvement project is a driller's dream job ... if that driller loves a challenge.

When completed the \$62-million project will include an additional spillway, a coffer dam and ancillary access road construction. The entire project requires extensive rock excavation using a fleet of drills in an ever-changing formation – a situation that presents some very difficult drilling.

The project has had as many as 16 drills on site at one time with an average

of 11 drilling most days. Those rigs include the Atlas Copco ECM 585, ECM 590, ROC D7 and the newest Atlas Copco crawler, the ROC T35M. In total an estimated one million yards of material will be drilled and shot when complete. After nearly five months into the year-long excavation phase, 321,000 yards of material have been removed. Long after excavation is complete, concrete and road work will put the overall project at a finish date of 2015.

Production has ranged between 150 to as many as 500 holes drilled per day. Because of the tight work area, many times multiple areas are prepared for blasting at one time. Site foreman Courtney "Stumpy" Andrus says, "It's not uncommon for us to have three or four shots in one day."

Andrus says of the number of drills and the tight working area, "We have as many working as we can to stay ahead. Sometimes it looks like [the drills] are working on top of each other." In the 3,800-foot-

long site, with a 300-foot drop, there are times the drill area is as small as 200 square yards.

The standard hole size is 3 inches in consolidated ground, but at times 4 1/2-inch holes are drilled so 4-inch PVC can be inserted at depths from 5 to 20 feet to collar the hole. Once the explosive cartridges are inserted, the PVC is removed prior to blasting.

“Honestly, I’m really surprised at the average 400 to 800 feet drilled per day – that’s what we wanted,” says Andrus. The drilling program equates to 25,000 to 30,000 feet per week. In addition to the drills making good time, the crew has had no major mechanical problems.

ORGANIZATION IS CRITICAL

A key aspect to this project’s success has been organization. Drill and blast contractor Foxfire Constructors, Inc. of San Clemente, California, a Native American/woman-owned business that specializes in tunnels, mines, and quarries, is

“We have as many working as we can to stay ahead. Sometimes it looks like [the drills] are working on top of each other.”

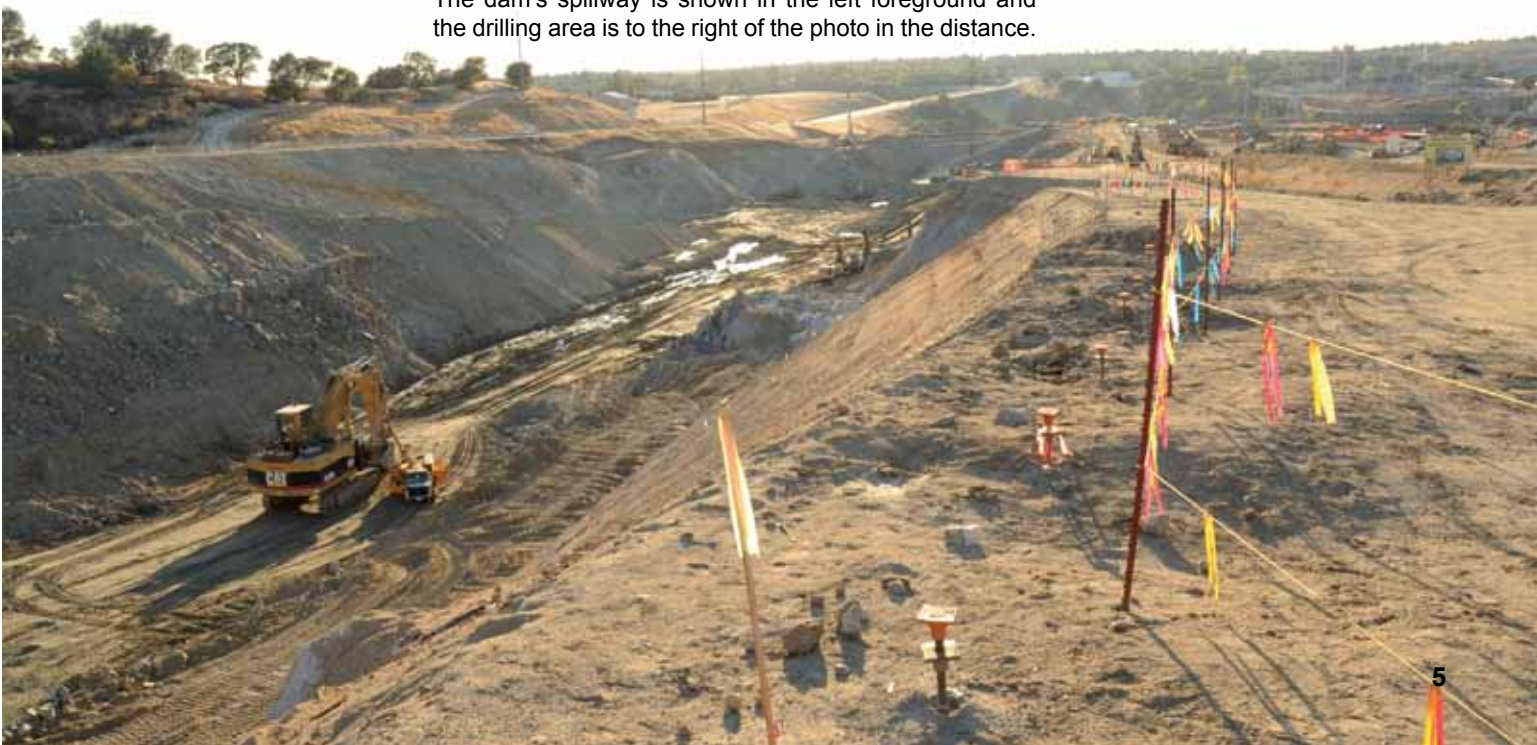
— Site foreman Courtney Andrus



“Basically all of our seasoned drillers have had the opportunity to share their experiences on this project. This has been a team effort. Everyone’s opinion counts.”

— Rich Strohm,
Foxfire’s project manager
on the Folsom site

The dam’s spillway is shown in the left foreground and the drilling area is to the right of the photo in the distance.





SMOOTH OPERATING

The ROC T35M is the newest surface crawler drill rig replacing the ECM 585 for hole diameters of 2.5 to 4.5 inches. Drill depths go to 82 feet with standard T45 steel or the optional T51 steel. The rig uses the COP 1840 hydraulic rock drill. Also new to this product for the U.S. market is the larger compressor, offering 270 cfm at 140 psi.

One of the popular features that make this drill different than its predecessor is the updated automatic hydraulic sensing system, also called COP Logic. Boyd Pollard, a Foxfire Drilling Company driller with 33 years of experience says, "The auto-drilling, anti-jamming feature makes this drill better than any drill I've ever ran. There is no banging when you get to soft ground."

Atlas Copco's Product Support Manager Masanori Kogushi commented that COP Logic offers a more smooth and quick response for the operator.

Boyd Pollard



working for Martin Bros. Construction of Sacramento. Drills have been purchased or rented from Atlas Copco's customer center in Sacramento.

Due to the tight specifications of the Bureau of Reclamation, the Bureau has to quantify the rock before drilling can begin. Foxfire is in constant communication with the U.S. Bureau of Reclamation. Drill and blast foreman Tony Galvez says, "The area is then surveyed and the drilling operation can begin."

According to Rich Strohm, Foxfire's project manager on the Folsom site, the project has led to some complicated drilling. "California is famous for its difficult ground conditions, but I've never seen anything this unusual."

Nothing is consistent on the project, Strohm points out. The geology changes every 100 to 200 feet from the top all the way to the river. "Drilling is good; blasting is more difficult because of the soft areas in the formation that absorb the explosive energy."

EXPERIENCE COUNTS

Foxfire also had to use different drilling methods at various times on the project. "We had to do stab holes and temporary casings. Basically all of our seasoned drillers have had the opportunity to share their

experiences on this project. This has been a team effort; everyone's opinion counts," said Strohm.

Looking at a cross section of the spillway excavation, the formation consists of granite boulders that protrude where they are locked into less consolidated rock. Pre-splitting is done on the spillway slope to give it a clean edge and shotcrete is applied after excavation to support the wall.

"Protecting the wall has been big on the job," says Strohm. To do this, sometimes the line holes are not loaded, acting as a relief line to the ground that will remain. On the outside, a 5-foot stab hole is drilled then a 3-foot buffer hole is drilled on a 14-degree angle prior to the first vertical hole. Each cut is generally 17 to 20 feet with 30-foot depths being the most to date. The pattern is generally 5x5 and 8x8 feet.

The project has not been an easy one, but the drills are doing the job each driller is asking of them. For the last 50 years the Folsom Dam has been a critical flood safety and reservoir water source for the people of Sacramento and the surrounding area. With the completion of this backup system, it will continue to be an important part of the area's infrastructure long into the future. **M&C 110**



Follow the Gold



Reverse circulation drilling pays off at Palmarejo, where gold, silver, copper and lead are efficiently mined



“Why reinvent the wheel? Take the best mining methods and apply them. It’s great to bring in fresh ideas from other places.”

— Kerry Barker, mining manager

One doesn’t happen upon Palmarejo Mine by accident. Dense jungles cover the aggressive mountainous terrain. The passable roads that were built in the last few years to haul equipment were once only low maintenance paths. When Coeur d’Alene Mines Corporation began this project, it took six to eight hours to drive to the mine from the last community on the road, San Rafael. Today it takes three hours. Since the mine opened just 18 months ago, the property has gone from a steep mountainous ravine to two very productive open pits and a multi-level underground operation with three portals ... and looks to have a very promising future.

Mining operations at Palmarejo have developed around the quality of the ore body and multiple veins at varying elevations. Two separate excavation areas are opening up the mountain from above, while long-hole stope mining is in the mountain’s base.

Mining manager Kerry Barker says these mining methods are what best serve the geology and formations. Palmarejo was a “blank canvas” when work began. “Why reinvent the wheel?” Barker said. “Take

the best mining methods and apply them. It’s great to bring in fresh ideas from other places. We have great people who don’t kick and fuss with new ideas.” ▶

Palmarejo is located in the state of Chihuahua in northern Mexico and lies in Mexico’s premier silver region, the gold-silver belt of the Sierra Madre Occidental. Palmarejo mine was built on a rugged mountainside. To begin operations ground had to first be leveled. According to one manager, “Any flat piece of ground here was man-made.”



Above: Drilling a 56-degree angle with a 45-degree azimuth and 59-foot depths defines the type of rock, quality of ore body, weight of sample and voids. Samples of cuttings from the ROC L8 and its Secoroc RC50 reverse circulation hammer are collected for analysis. The results help the Palmarejo Mine to optimize its ore recovery.

Left: Examining the quality of the cuttings samples, taken every two meters. Atlas Copco's Melchor Ramirez (left) and Palmarejo geologist Arturo Soto.

MINING AND EXPLORATION WITH ATLAS COPCO

Atlas Copco equipment is involved in every aspect of mine development and exploration. Barker said, "We like Atlas Copco around here, and that includes the great service." The open-pit production drilling is done with DM 45 HP blast hole drill rigs that allow mobility on the benches. Boomers and Simbas are used for the long-hole stope mining with cement backfill. "The cement backfill method is very successful in the U.S. and is the best for [Palmarejo]," said Barker.

Palmarejo uses two Atlas Copco ROC L8 RC drill rigs to perform reverse circulation (RC) drilling ahead of the open pit operations.

There are two places for all mined rock to go – the mill or waste pile. General Manager Stuart Mathews said, "It only takes 20 trucks going to the wrong place to know it's worth it."

The ROC L8 RC works ahead of the pit operation by about three months, drilling on

REVERSE CIRCULATION

RC is a drilling method that uses a dual-wall pipe system. RC drilling can be done using both rotary drilling and percussive drilling methods. It is the formation that determines what method to use. Rotary drilling is mainly used for soft and unconsolidated formations, while hammer drilling is the preferred method in more compact rock because of its higher productivity. However, some soft formations cannot be drilled with percussive drilling.

High pressure air runs the hammer between the outer and the inner pipe. A shroud is used to seal off the hole wall above the bit. This allows cuttings to be instantly transported up through the center of the bit, through inner tubes of the hammer and further up through the inner tubes of the pipes. A discharge system on the rig reduces the speed of the material, which can be well over 100 meters per second. All material enters a cyclone, which collects the material and gets rid of the air within the sample. The cyclone is placed over a sample system, which allows a smaller, representative sample. A sample size of about 11 pounds is normally required for further testing.

Producing a good quality sample is the sole reason for RC grade control drilling. Productivity comes in as a close second. The ROC L8 RC, together with a Secoroc RC50 hammer, offers a very effective combination to meet these two goals.



**Secoroc
RC50**



pattern with the ore zone over-drilled by 30 percent. The holes are drilled at 56 degrees and a 45-degree azimuth. The veins run 10 degrees northwest on a 57-degree angle. "There are actually two veins we are drilling," said geologist Arturo Soto.

The separate veins, named La Blanca and La Prieta, are a short distance apart, joining towards the west then separating again. Soto said, "The hanging wall between the veins can present economic grade ore." Taking samples allows them to decide what is quality ore as they drill through it.

For the most part the RC drilling is easy, with the only problems being some shale above the ore body and occasional water. Shale creates some difficulty in drilling, but hitting water is more of a hassle for the drillers. When encountering water, the driller must clean the air holes in the bit and hammer between holes to ensure integrity in the samples.

"We have 3D modeling of the mine, but sometimes you're just not sure and RC drilling makes you sure," said Soto.

The RC drilling is obviously used to measure the ore body and test the gold, silver, lead and copper in the ore, but it also has another important use. "Just yesterday we ran into two voids when drilling," pointed out Soto. Locating voids, historic mine openings and soft and unconsolidated rock is an important use of the ROC drills. The voids are mapped to ensure safe drilling for the DM 45 HP rigs that will follow.

It takes drill operator Oswaldo Gaxiola and helper Victor Hernandez about 30

minutes to drill and bag each hole. "When I hit soft rock, I have to back off and clean the hole, then go back in slowly," said Gaxiola, who learned to drill just two months ago and finds the ROC L8 RC easy to operate. Gaxiola really likes the auto-drill functionality on the ROC L8 because it does most of the work and keeps him from hanging up in the hole.

An average shift includes drilling about 12, 59-foot holes per drill rig. Soto pointed out he cares more about quality samples than fast drilling.

PROMISING FUTURE

The local people have long been connected to this area by agriculture and mining. It's said by the locals their ancestors were mining here 500 years before the arrival of the Spanish Conquistadors in 1521. In total 720 people work at the mine and about 60 percent of the labor is made up of local people.

Palmarejo was targeted for a 10-year life with an annual production of 110,000 ounces of gold and 9 million ounces of silver.

Stuart Mathews is convinced RC drilling is the best solution for managing the mine development. "It ends all arguments about reconciliation. Quality samples are needed to make quality decisions; RC drilling for grade control is the only way to go."

average of 12, 59-foot holes per day, or 300 holes per bench. The RC holes are 4½ inches in diameter.

On a daily basis, the open-pit operation recovers an average of 3,000 tons of ore and, monthly, moves a total of 1.5 million tons of waste.

The underground mining includes 3½ miles of drift at a 16½ x 16½-foot heading, advancing 98 feet or 2,000 tons a day for a total of 100,000 tons per month.

"We use the ROC L8 for horizontal drain holes too, but the rig is made for RC drilling," said Mathews. "In-pit grade control is the way of the future. I can't understand why it isn't done everywhere. It's the only way to go."

Basically, in-pit RC drilling is like drilling a bench twice, once for grade control and once for blasting. At 59 feet the drill penetrates three benches at once. The holes are drilled on a 32 x 32-foot



NÚMERO

Number one. Ichibon. Numéro uno. Номер один. ... No matter how you say it, the silver in Fresnillo puts it in a class by itself.

Having the right machine can be the difference between doing a job right, or simply getting it done. The new Atlas Copco Robbins 34 RH C QRS raise drill rig has given the Fresnillo PLC Praono Mine at Zacatecas, Mexico, an opportunity to increase productivity while maximizing its entire fleet.

Fresnillo is special among mines. Its thick veins of high grade ore give the mine the distinction of being number one in the world. The mine produces an average of 500 grams per ton of ore, and one vein, San Alberto, averages 700 grams per ton. The San Carlos vein has been mined for years to a current total length of 5 kilometers with an average of 500 grams per ton.

Mine Superintendent Martin Robledo put the San Carlos vein in perspective. "When the 500-gram, 4-mile-long vein appeared at the 656-foot level, it was 16 feet wide and continues that way to the 2,000

foot level."

Of its many veins, the lowest grade ore the mine realizes is 200 grams per ton. As a comparison, the *world* average is 200 grams per ton.

In total, the mine produces 3 million ounces of silver per month from 8,000 tons of ore produced each day. Two thousand tons are trucked from the San Alberto ramp and 2,000 tons and 4,000 tons are hoisted from two separate shafts. For future growth the mine is currently in the process of developing a new shaft, boring two parallel 12-foot-diameter raises with a Robbins 73RH C commissioned in early 2009.

Multiple mining methods are used at Fresnillo. Currently, 30 cut-and-fill stopes and 20 long hole stopes are active. "It takes about a year from the time we begin developing a stope block before it's in production," said Robledo.

The process of developing a long hole block includes multiple stopes about 656 feet long, one above another, up to 100 feet. For long hole stopes, multiple levels are mined at one time. For example, the 330 level is being opened to the 350 level, which in turn is being opened to the 370 level. The mine will blast multiple levels at one time, removing the ore from the lowest



Mine Superintendent Martin Robledo (right) stands on a pile of cuttings from a raise drill.

◀ The 34RH C QRS raise drill braces itself against the roof to stabilize the drilling platform.

UNO



The four-cutter Secoroc reamer cuts a clean raise between levels.

A MEXICAN LEADER

Raiseboring, as a method of driving various types of shafts, is well established in Mexico and Atlas Copco is a market leader in the country's mines. These raiseborers, called Atlas Copco Robbins, incorporate the very latest technology for quick set up and push-button operation, as well as high performance reamers and cutters from Atlas Copco Secoroc.

Fresnillo PLC, which operates three mines, is a forerunner with six units of various types on site: a Robbins 73RAC and a 73RH C, two 73RDC and two 34RH C QRS (Quick Raisebore Set-up).

Since the mid-60s, Atlas Copco has produced raiseborers for driving shafts in a wide variety of mines around the world.

level. Each blast will consist of about five holes on each level.

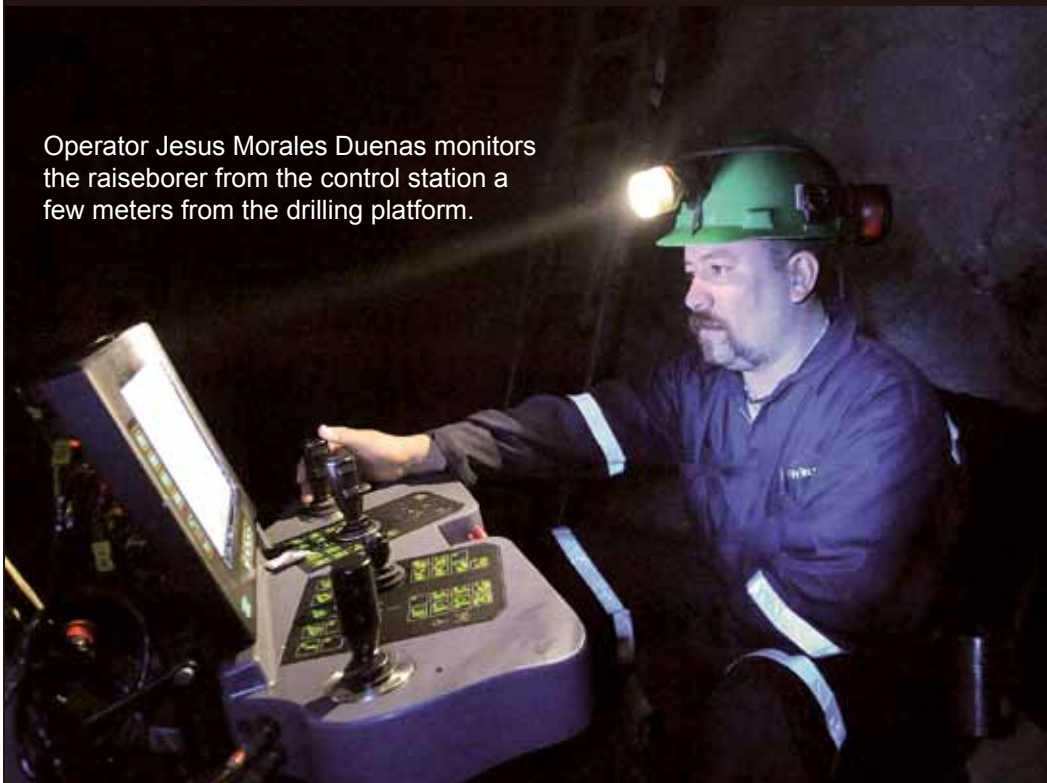
The 34 RH was purchased to make the entire process, including connecting the stopes, more efficient. In the past the Simba was used for this, but as Robledo said, "The idea is to use the Simba for Simba work."

THE RIGHT MACHINE

Six months ago the 34RH C QRS raise drill was put to work at Fresnillo, and as of August 2009 had completed 15 bored raises. Of those, ten were for slots for its long hole production operation and five for ventilation holes. It takes one to three weeks to bore each raise with the 34 RH, but Robledo would like to get to a one-week average.

The 34RH C QRS was specially designed to be able to rapidly drill small diameter raises in the mine. The machine drilling platform is transported with the raise drill on a diesel powered crawler transporter. When the machine arrives ►

Operator Jesus Morales Duenas monitors the raiseborer from the control station a few meters from the drilling platform.





◀ To develop twin 12¼-ft diameter shafts, Fresnillo is drilling down to its 600 level with a new Atlas Copco Robbins 73RH raise drill. The drilling has been extremely accurate. The first raise of 541 ft saw just 7.8 inches of deviation and only 1 inch on the second raise. To install the drill, a deep concrete foundation must first be poured at the drill site.

ing down the pilot hole. When the shaft is completed the pipe with the reamer is pulled back to the machine and removed at the upper level, eliminating the need for operators to remove or install the bits at the lower level.

When drilling a conventional bored raise, the 34RH raise drill drills an 11-inch pilot hole to a lower level where the pilot bit is removed. A Secoroc reamer with four cutters is installed and the raise is back reamed to the machine.

Once drilled, the 4-foot hole becomes the “slot” relief raise to blast to when production drilling begins. On average the slots are 78 feet long, but they have gone as deep as 98 feet at Fresnillo.

FOCUS ON PRODUCTIVITY

It’s all about controlling the dilution when choosing which drilling method to use – DTH or top hammer. “When the vein is below 10 feet, we use the 1254 top hammer and 2-inch bits,” Robledo said. When greater they will use the COP 44 down-the-hole hammer and a 4-inch bit.

The mine has Atlas Copco Diamec 252, 262 and U6 exploration drills in addition to all the other equipment in operation. “We are drilling 3¾ miles of “N” [core size] monthly,” said Robledo.

In the six months since the 34 RH C QRS rig has been drilling, it has made the overall mine plan more productive. “We have drilled 15 raises 1,500 feet so far and had no problems,” he added. It is estimated 1,000 feet are put on the Secoroc cutters before they need replacing.

Fresnillo is a monster in comparison to other mines, and it produces more silver at a higher grade than any other mine – and the end of its productive life is nowhere in sight. Fresnillo has more than a promising future and now it has the right equipment to get there.

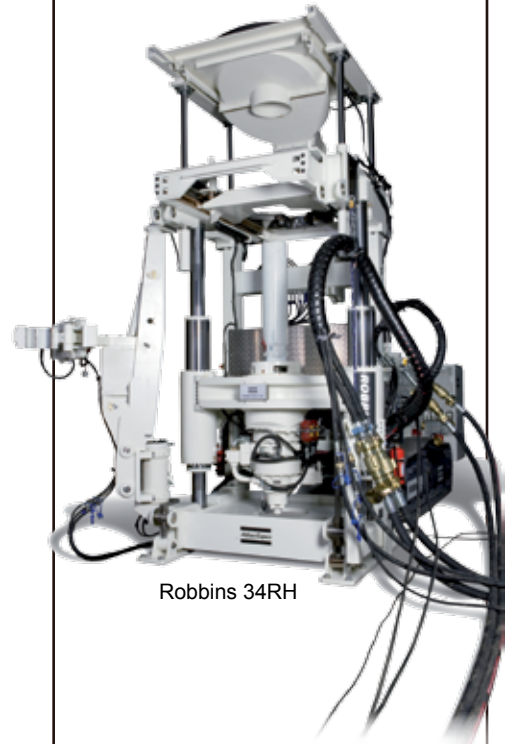


at the drill site it is erected with hydraulic cylinders on the transporter and quickly positioned with the diesel crawler. The drilling platform is then leveled with hydraulic cylinders in the platform. The machine is connected to its hydraulic power pack and hydraulic stinger cylinders are extended to the roof. The rig is now stable for drilling the pilot hole, down reaming and back reaming.

The QRS designation refers to “Quick Raisebore Set-up,” so named since no concrete pad is required to set up the raise drill. This is the first raise drill that can drill bored raises without having a concrete base to set up the machine.

The 34RH C QRS can drill 28-inch shafts down reaming a pilot hole, or back ream a conventional raise to 4 feet in diameter in most rock types. When down reaming, a pilot hole is drilled to a lower level, and then the drill pipe is removed and a **Secoroc 720 mm ▶ down reamer** with three cutters is installed in the 34RH raise drill. The pilot hole is down reamed with the cuttings go-

More about Atlas Copco Raise Drills



Robbins 34RH

The Robbins 34RH is a low profile and small diameter raise drill, ideal for slot raises, back filling and narrow vein mining applications.

PRODUCT HIGHLIGHTS

- The single power pack hydraulic drive features variable speed and good torque limiting control.
- Rigid columns provide efficient torque reaction, extending the service life of the thrust cylinders.
- Telescopic thrust cylinders provide high thrust in low profile.

THERE’S ALWAYS MORE... OTHER ATLAS COPCO ROBBINS RAISE DRILLS

- Medium diameter (4 to 8 ft)
 - Robbins 53RH and
 - Robbins 73RAC
- Large diameter (8 to 19.5 ft)
 - Robbins 83 RH
 - Robbins 91 RH
 - Robbins 97 RDC
 - Robbins 123 RH
 - Robbins 123 RVF
 - Robbins 191 RH

M&C 1 '10



HIGHER PRODUCTION



“As far as drilling goes, everything here comes from Atlas Copco. The Pit Viper 351 will drill 50 holes per 12-hour shift.”
—Tim Collins, Mine Manager

In just 14 months the Goldcorp Peñasquito Mine in the state of Zacatecas, Mexico, has gone from a flat and open valley to a high production mine with over 500,000 tons of rock mined daily. However, it was first necessary to find the right combination of equipment and support.

In a short period of time Peñasquito has become Mexico’s largest open-pit mine – comprised of the Peñasco and Chile Colorado/Azul deposits – containing gold, silver, lead and zinc.

WIDE OPEN SPACES

The deposits occur in a wide valley bordered to the north by the Sierra El Mascaron and to the south by the Sierra Las Bocas. The geology begins at the surface with approximately 98 feet of alluvium, and like the bottom of an ancient sea, the terrain is generally flat with rolling hills covered

with arid vegetation and sparse brush. The elevation of the property is approximately 1 mile above sea level.

Mine Manager Tim Collins said, “I’m used to mining in mountains; this is easy mining in comparison.” This virtually flat topography has also assisted in the mine plan that includes moving large amounts of rock. The mine’s crusher load is shared with two lines with a daily total production capacity of 130,000 tons of ore.

The company reports that annual production over the life of the mine (estimated 22 years) is expected to ramp up to ▶



even have a driver's license." Today, however, 70 percent of Peñasquito's truck drivers are women, many who had never driven before hiring on at the mine, as a result of Goldcorp's investment.

Operating millions of dollars in earth moving equipment required an intensive training program that put the workers in simulator and practical experiences before they entered daily production. To meet the daily production

needs at Peñasquito the mine is running some of the largest mining equipment available. In total the company operates four Bucyrus 495 shovels, three Komatsu WA1200 wheel loaders, 57 Komatsu haul trucks, eight dozers, four wheel loaders, three motor graders, five water trucks, and all the other equipment needed to move rock.

approximately 500,000 ounces of gold, 30 million ounces of silver and over 400 million pounds of zinc.

As of December 31, 2008, proven and probable gold reserves totaled 17.4 million ounces. Silver reserves totaled 1,045.7 million ounces, while lead and zinc rose to 7.07 million tons and 15.36 million tons respectively. Measured and indicated gold resources, inclusive of proven and probable reserves, increased 39 percent to 17.8 million ounces. Measured and indicated silver resources increased 55 percent to 1.3 billion ounces.

DEVELOPMENT PLAN

When developing the Peñasquito project, Goldcorp had the advantage of a clean, flat canvas. The community at large and its entire infrastructure – roads, electricity and clean water – were taken into consideration. The project is considered a total community improvement program that includes educating future generations by building schools.

When looking at potential employees for Peñasquito, the surrounding area had a healthy population base, but most had no mine experience. Collins said, "My labor pool was not just 'green,' but many didn't

ground, Peñasquito purchased rigs with Atlas Copco's Rig Control System (RCS), which simplifies the drilling functionality for the operator.

"These drills have it all," said Collins. "The operator only needs to move it and level it and the rig drills its own hole." Collins said he does have four experienced drillers who like to drill manually and they can match the autodrill computer skills. "There are times when the bit can take more down pressure and less rotation; a skilled operator can feel that," said Collins.

SMART MINING

With the Rig Control System (RCS), the mine integrates common drilling functions associated with operator control such as collaring a hole with low pressure air and down pressure, applying just the right amount of water when needed, and

To stay ahead of all that earth moving equipment, and to drill and blast a half-million tons of rock daily, the mine needed a special drill fleet and drill management program. The mine operates only Atlas Copco drills, including eight Pit Viper 351 blast hole drill rigs plus a DML drill and an ECM 590 drill for specialty work. Production hole size is 12 ¼ inches for the 45-foot (15-meter) bench height. Different types of Atlas Copco Secoroc epsilon tricone bits are used based on ground conditions, and all the drill pipe is Team Alloy Steel from Atlas Copco Thiessen.

Learning drill operation and functionality also required extensive training, but any seasoned driller will tell you it takes time to understand what is going on in the ground – the art of feeling the formation. To speed up this process, or eliminate the need entirely to learn how to "feel" the



anti-jamming in poor formations, with high-tech functions like GPS hole navigation, rig remote access and communication, wireless remote tramming and data hole logging.

RCS is for efficiency in drilling, but many features are also for the safety of the miners and equipment. Two of these many features include jack interlocks and tram interlocks to ensure the rig and tooling is secure before a rig can even move.

“It’s not all about footage,” said Collins. The mine has installed a complex dispatch system that integrates with the GPS on each haul truck, shovel, drill and every other piece of mining equipment. The entire operation is monitored from a control room where two dispatchers and a maintenance person watch and direct the activity in the mine.

All data is recorded and it is retrievable by those in the mine who need constant equipment information; however, it also can be monitored in real time through a web-browser interface anywhere in the world.

“Technology is the future of mining,” said Collins. Organization to this level also supports the mine’s safety efforts. “If you’re monitoring maintenance and operational data to this level, decisions are made when they need to be made. Mining is more efficient today than it once was – technology has a lot to do with that – and safety can only move forward at the same time.”

MATCHING TOOLING AND FORMATION

When searching for the right equipment Alan Hernandez, project engineer – Technical Services, and Tim Collins spent



Tim Collins points out the working areas of the Peñasquito mine

seven months traveling around the world trying to decide which products fit the program. “There were some hard decisions, but for drills it was always Atlas Copco,” said Hernandez. More time was spent debating *which* Atlas Copco drill models would fit best with the plan, according to Hernandez’s memory.

“We looked at feasibility studies, calculations, pit design, tonnage – every scenario that would determine what would work best. For most equipment it was a matter of elimination. The choice consistently came down to service and support, but with Atlas Copco there was no debate,” said Collins.

“As far as drilling goes, everything here comes from Atlas Copco,” said Collins. Collins compliments the speed and penetration rate of the Pit Viper 351. “The 351 will drill 50 holes per 12 hour shift, and that’s just flat punching holes in the ground,” said Collins. Overall the fleet average at Peñasquito is 2,300 to 2,500 holes drilled per week.

To keep ahead of the crushers, the

mine plan includes keeping about 15 million tons of blasted inventory in the pit. “I like to keep at least a month ahead,” said Collins.

This inventory allows time to support the drills. The maintenance plan includes having two or three rigs down per week for preventative maintenance. “That takes care of normal wear and tear. I can say the Cummins engines in all our drills are solid; they don’t even burn oil,” said Collins.

Just as the drill was sized to meet the production requirements of the mine, matching the bit to the formation is just as critical. To reach a daily production schedule of 500,000 tons in just 14 months, it can also be said that the people operating and servicing the equipment have been a match.

“The best day we’ve had was 790 holes,” commented Collins, recalling the day everything worked just right. “I’m surprised we are moving the tons we are, but I do have good people.”

M&C 1 '10

Atlas Copco Team Alloy Steel ‘LASTS’

Rig service and consumables at Peñasquito are supported by Atlas Copco Mexicana out of Mexico City. In addition to parts and training, Xavier Garcia, Key Account manager for Goldcorp, personally supports consumables. “Twice a month Xavier spends nearly a week here analyzing bits. Sometimes it feels like he practically lives here,” said Mine Manager Tim Collins. Garcia spends that time at the mine looking at bits, analyzing the wear and bit life.

To date the epsilon tricone bit line has changed from eH53CA to eH61CA, eH620A and eH640A to adjust to the formation. “We are constantly reviewing bit wear and performance. We’ll keep playing with bits until we settle on the one that works the best,” said Collins. “A great advantage has been the use of the Team Alloy Steel from Atlas Copco Thiessen with steel grade 4140, which seems to last forever.”



An Atlas Copco Secoroc bit with hole reamer prepares to drill.



KEEPING PEACE

with the neighbors

One of the world's most forceful breakers is precise enough to use in the heart of Harlem, and productive enough to put the crew ahead of schedule.

New York Concrete was hired by Skanska USA for 45,000 yards of bulk rock excavation on the future site of City University's Advanced Science Research Center. When complete, the center will occupy 400,000 sq ft between two buildings that share a common basement.

The complex is a \$550-million project with an additional \$50 million of infrastructure development in the area. The glass-curtained building will be a shining jewel in the heart of Harlem.

Frank Forte, Skanska's project superintendent, has been on the site from the beginning. Drilling and blasting was Forte's recommended method for excavation from the start of the project. He was on site when the first test hole was drilled. "Originally, every expert agreed blasting would be the only way to break through the rock. We tried a smaller hammer in the testing phase, and it barely rattled the Manhattan schist and granite," said Forte. "But then, fortunately, we found something extra-powerful to handle the project."

At the first meeting with potential bidders on this excavation project, Forte laid it out to everyone. John Russo, New York Concrete's head of operations, recalled Forte's advice to potential bidders, "From the beginning Frank wanted to make it very clear to everyone bidding on the job that excavation on this site would be challenging."

Bobby Keane, New York Concrete's site supervisor, said they covered their bases. To investigate the hammer option, operator John Triplett



"It hits like a freight train. It's borderline unbelievable what [the HB 10000] can do."

— Frank Forte,
project superintendent

and Russo traveled to Texas to observe a demonstration of the newly introduced HB 10000 model hammer from Atlas Copco. After Russo saw it in operation he knew it could be used for the Skanska job. He then worked with his local dealer, Hoffman Equipment Co.

NO ROOM FOR ERROR

After spending his career building high rises in New York, Frank Forte knows about working next to neighbors. “If you’re going to build in New York City it’s important to always be mindful of the fact that people may live very close to where you’re working,” said Forte.

Looking at this job, it first appeared perfect for blasting – an uncommon opportunity in the populated city of New York – with open space and a controlled area with no buildings within a hundred yards. But just on the edge of that perimeter is a neighboring science building with a nuclear imaging system doing electromagnetic testing with equipment that didn’t have specifications as to what vibration it could handle. So, the tolerance spec for New York Concrete was no vibration.

To accommodate its neighbor, the excavated area had a 300-ft vibration-free zone around it. Seismic equipment was set up to monitor the construction progress. “Skanska is working very closely with the local community and client to make sure that everyone is happy with the way the project has proceeded,” said Forte.

IMPACT ENERGY

The Atlas Copco HB 10000 hammer hits with 12,000 ft-pounds of energy per strike – 400 times a minute. Forte said, “It hits like a freight train. It’s borderline unbelievable what that hammer can do.”

Currently the crew is two months into the four-month excavation phase of the project. “We are right on schedule with the excavation,” said Keane. “The excavation is moving along smoothly.”

When John Russo estimated the job, he thought it might take three breakers to do it, but for much of the project two was all that was needed to keep up with the mucking excavator and articulated haul truck. “The bulk of the work is being done with the HB 10000 on a Komatsu PC800 excavator. We have one Komatsu PC600 excavator running a Rammer and a Tramac as backup,” said Russo.

The high productivity is a result of the

“I am impressed with the performance of the hammer and shocked over the bit life.”

— John Triplett,
excavator operator

HB 10000 and the skills of the operator. Excavator operator John Triplett has 26 years experience of operating equipment in New York City. He is also a certified crane operator. He testified that the HB 10000 is nothing less than amazing. “I have run every hammer there is, and this thing is really something – it’s amazing. Plus, it allows me to trim within an inch.”

Triplett said, “I am impressed with the performance of the hammer and shocked over the bit life.” New York Concrete is using the Silver Line bits provided by Atlas Copco. They have two bits; the second is on now, while the first was removed for sharpening.

Triplett said of the rock’s hardness, “The rock is 40 to 60 ton and up to 80 in some spots. I was in 80 all last week and that’s nasty stuff. I thought with a hammer that hits as hard as the HB 10000 we could go through one [bit] a day, but I got six weeks on the first point and at least 15,000 yards.”

When looking at production levels, Triplett said the HB 10000 will outperform the two other hammers on the job. “This hammer will do double what our biggest hammer will do,” said Triplett. On Triplett’s best days, he said he has hammered 1,500 and 2,000 yards.

Another challenge on a job like this, Russo said, is how to remove the rock. The area was core drilled to test the hardness, but that isn’t the critical factor in moving the rock.

“Our operators are the best I know,”



said Keane. The skill comes with knowing how to find the natural flow in the rock to break it in the right place. It’s like cutting with the grain on a steak; you need to work with the rock, not against it.

Keane said, “The formation is layered in a north-south direction and breaking it requires using the natural seams found in the formation, chopping the next rock into the relief of the previous cut.”

“This remarkable hammer exceeded our expectations, and now the project is ahead of schedule,” said Forte. “Skanska, our client and its neighbors are happy that work is proceeding according to plans.”

Hydraulic Breaker Maintenance



Charlie O'Dell, a field service technician in Texas, prepares to recharge the nitrogen gas in the cylinder on an HB 7000.

When correct operating techniques and routine maintenance come together, you can “pick your downtime”

When it comes to hydraulic breaker maintenance, proper equipment operation is as important as routine preventative maintenance. These two factors work simultaneously to keep a breaker operating at peak efficiency with minimal downtime.

“When I conduct a seminar, I really stress operator training,” says Jeff Graham, Technical Support representative for Atlas Copco Construction Equipment. “Improper operation can really destroy a breaker just as much as a lack of maintenance.”

FROM THE OUTSIDE

Don't start breaking in the middle of the material. The breaker may not be able to break the rock very quickly. The working tool could get lodged in the material or overheat. It's like eating a sandwich. You don't start in the center; you start at the outside and work your way in, taking small bites to work your way into the material. Starting in

the middle will increase the likelihood of extended cycle times.

90 DEGREES, PLEASE

Always work 90 degrees to the work surface. (This is not the same as 90 degrees to the ground!) When an operator works at an angle, the tool is put under stress and can break.

“This is why we put breakers on excavators,” says Graham. “The excavator can angle the breaker in different directions so that you can obtain that 90 degrees to the work surface of the material you're working on.”

THEY'RE BREAKERS – NOT DRILLS

Never place the breaker straight down into the material like a drill, which can cause the tool to get wedged into the material. Instead, slightly rock the breaker 5 degrees in either direction. This allows the dust and debris to come out of the hole in order to easily remove the tool when you are ready

to move.

“You rock the breaker to find the sweet spot,” says Graham. “It's like playing golf. There's a certain spot on your golf club that you want to make sure you hit to get the most power and the farthest drive out of your hit. It's the same thing with a breaker. By finding the sweet spot, it reduces the amount of wear on the bushings and allows the breaker to work more efficiently.”

Also, never pry material apart with the breaker. It's not designed to break by prying, which can damage the tool. Instead, break larger material up into smaller pieces.

NO PROGRESS? MOVE ON

One of the most important things an operator can do is to avoid extended run time. “This is a common error,” says Matt Cadnum, vice president of Aftermarket for Atlas Copco Construction Equipment. “Our specs indicate a run time of no more than 30 seconds in any one place, but a good rule of



thumb is that if the material is not breaking in 10-15 seconds, then the operator should reposition the working tool.”

A lack of progress also indicates that the breaker may be improperly sized for the material. “When the debris and dust stop coming out of the hole and settle at the bottom, the tool is actually beating on the dust,” explains Graham. “The breaker is not transferring its energy from the tool to the material. Breaking power is decreased and you lose that energy. That lost energy is turned into heat from the friction. This heats up the end of the tool and starts to distort and destroy it.”

This excess heat can also damage the auxiliary hydraulics on the carrier because it’s working harder. “The carrier is only designed to handle a certain amount of generated heat from the attachment,” adds Graham. “If you run the breaker for long periods of time, you can overheat the carrier as well, and the cooling system for the carriers won’t be able to handle it.”

MAINTENANCE – ALL DAY, EVERYDAY

By putting some simple steps and procedures into practice throughout the day, an operator or technician can keep a hydraulic breaker operating at peak efficiency for longer periods of time.

Each morning, visually inspect the breaker and the carrier. Make sure nothing is cracked and that the hoses are intact and properly attached. The most important thing an operator can do, however, is to ensure that the breaker and the tool are greased properly.

“Several times a day the operator should draw the tool up near to him so he can see the tool and the bushing. He doesn’t even need to get out of the cab,” says Graham. “The operator should see wet black grease. If the tool looks grainy or powdery, then it’s very dry and not getting enough grease. If the tool is shiny, it’s not getting any grease at all.”

At this point, the equipment needs to be shut down to determine what is caus-

“The most important thing to do is to check the tool multiple times a day.”

— Jeff Graham
Technical Support, Atlas Copco



ing the lack of grease, whether it’s run out, a broken grease hose, or the central lube system is malfunctioning.

“Many customers in the field don’t realize how critical it is to lubricate the bushing and the tool, so their operators don’t do it,” says Cadnum. “That’s exactly why Atlas Copco incorporates automatic lubrication systems on all of its medium and large breakers. It’s so damaging to a hydraulic breaker not to be lubricated properly.”

A breaker should be lubricated every two hours at a minimum. A breaker cannot be over-greased unless it’s done improperly. Whenever a breaker is being greased, there needs to be down pressure on the tool so that the grease will not be forced up into the impact area of the tool and piston. The grease should travel down the tool to the area where the bushing is and exit the breaker.

Graham states that operators often ask how much grease should be used each day. “Different applications call for different amounts of grease. Longer cycle times mean more grease. If the material is light and it doesn’t take much to break through it, then less grease is needed. It all depends on the material. The most important thing to do is to check the tool multiple times a day.”

It’s not just the lubrication process itself that is important, however. It’s using the proper type of lubricant. “Using an off-the-shelf grease won’t work,” Cadnum points out. “You need something specifically made for hydraulic breakers. The stresses are such that the machine is very demanding and its needs very specific. The amount of friction, side loading and heat

on a breaker requires a tough lubricant with a high dropping point, and usually some solids added as well.”

Many manufacturers, including Atlas Copco, offer a type of grease with copper particles added to it. When all of the grease is pushed out of the breaker, the copper particles act like miniature ball bearings, providing some lubrication in a binding situation.

It is also important to regularly check that the breaker and the carrier are properly adjusted. “Most hydraulic excavators allow the operator to adjust the hydraulic input to the breaker right from the cab,” says Cadnum. “It’s extremely important that the operator understands what setting is appropriate for that hydraulic attachment. If the setting is incorrect, it could damage the breaker.”

Graham adds that when a breaker is moved to a different machine, the carrier needs to be flow tested and properly adjusted for that breaker. “Otherwise, it can really reduce the life of the hydraulic seals inside the breaker. Anytime the breaker has been rebuilt – and annually at a minimum – the carrier should also be flow tested and adjustments made as necessary.”

Finally, at the end of the day, the breaker should be stored standing upright. This takes the weight of the piston off the seals. Storing in this position also helps to keep rain from getting into the vital areas of the breaker. The shiny surface of the piston is exposed when the breaker is not running, and if the breaker is lying flat, water can sit on the piston and cause it to rust. If it’s not feasible to stand it upright, the best alternative is to elevate the bracket end of the breaker that attaches to the machine. Place a tarp over the tool end of the breaker to protect it against the rain.

Breakers can be very expensive to repair. However, “if you’re doing your routine maintenance and operating the equipment correctly, you should be able to schedule repairs when you are ready,” says Graham. “The whole idea is to ‘pick your downtime.’”

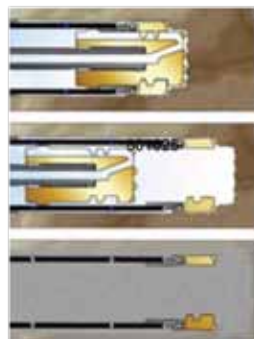
TERRA

If you're looking for solid ground

As existing structures are redesigned or new structures are built on an imperfect ground, the need arises for cost-efficient methods to stabilize soil. When an existing structure needs to have a foundation strengthened; when contractors have to reduce the risk of settlement between old and new construction; when a building has to sit on less-than-ideal ground – Atlas Copco's products are the answer.

ODEX AND SYMMETRIX

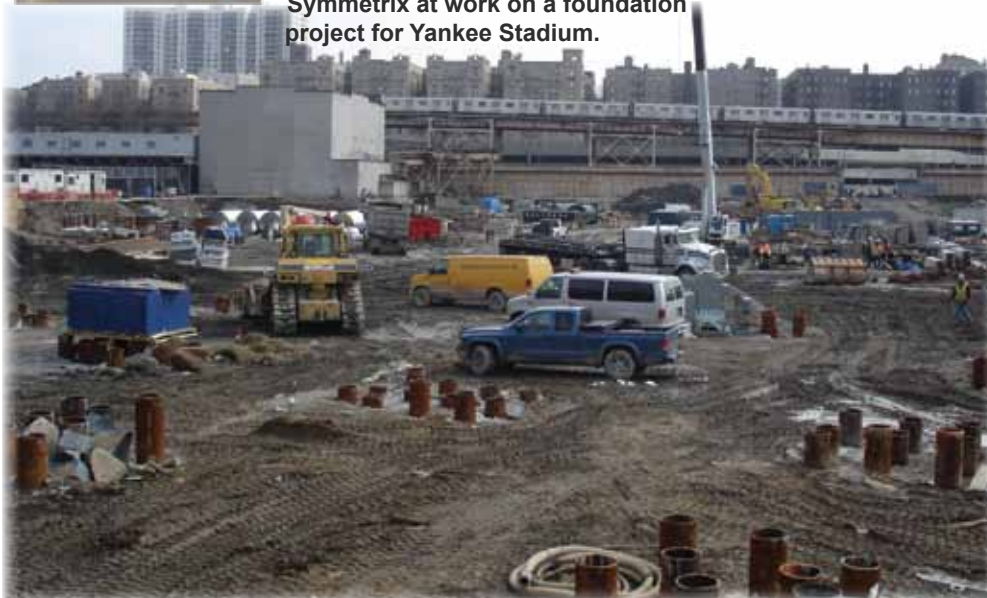
The drilling principle is based on a pilot bit and a reamer bit, which together drill a hole larger than the external diameter of steel pipe. This enables the pipe to follow the drill bits down the



◀Symmetrix:

- A pilot bit that drills away the center part of the hole and guides the drill string. The pilot bit is attached to any common DTH hammer shank or top hammer rod thread.
- A casing shoe welded to the casing pipe which is pulled down by the impact of the hammer and pilot bit.
- A symmetrical ring bit that is locked onto the pilot bit drills the void for the casing to advance down the hole.

Symmetrix at work on a foundation project for Yankee Stadium.



hole. Odex has an eccentric reamer bit while Symmetrix represents a concentric reamer called a ring bit.

Odex is applicable for micropiling in basic ground conditions – it works well with softer formations and to get around boulders. Casing diameters from 3½ inches to 10½ inches can be used to a maximum depth of 328 feet. The Odex system allows the complete drill bit to be retrieved – ready to drill the next pile. Odex also works in skin friction piles, when steel pipes are retrieved from the hole.

Symmetrix is capable in all types of micropiling work whether there is end bearing or friction piles to be drilled. The concentric drill bit gives Symmetrix straight holes, deep pile drilling capability and quick pile setting. Symmetrix is an ideal tool for all kinds of ground conditions, even the hardest of rock, and is especially superior when there are big obstacles in the ground or sloping bedrock. Symmetrix can drill casings from 3 to 48 inches at any angle, even horizontal, to depths beyond 100 meters.

Micropiles installed with Odex and Symmetrix systems are particularly useful:

- When the ground contains boulders, concrete blocks, old foundations, which are very difficult or impossible to penetrate with other methods.
- When the foot of the end-bearing pile is drilled into hard rock.
- Where large load concentrations need to be accommodated.
- Where piles are exposed to lateral forces.

UNIGROUT IN MICROPILING

The Atlas Copco Unigrout™ grouting platforms offer a range of grout systems designed to prepare and inject silicate/cementitious based grouts into a rock formation, soil or manmade structure. The Unigrout grouting platforms are composed of one, or more, Cemix high-shear colloidal type mixer, a Cemag agitator and a Pumpac double acting single-piston pump, or a progressive cavity pump. The platforms are operated by fully hydraulic power units, with

Atlas Copco has the support you need

electric or diesel drive.

For micropiles, the Unigrout range provides a set of very compact, high performance, safe to operate, highly reliable and easy to clean and service grouting units. The Unigrout platforms can prepare a vast range of grouts (with very low water/cement ratios), and for higher productivity manually operated or fully automatic weight batching systems can be added in the design of the units.



Unigrout ▲

SELF DRILLING ANCHORING SYSTEM

The Atlas Copco MAI Self Drilling Anchoring System is a fully threaded hollow steel bar which can be drilled and grouted into loose or collapsing soils without the use of a casing.

MAI SDA™ micropiles can be installed successfully as a deep foundation solution into most unconsolidated ground conditions and are suitable for tension and compression loads. With the SDA micropiles the speed of installation is high and no primary drilling is required. Drilling, placing and grouting can be performed in one single operation, making high piling outputs possible.

The Atlas Copco MAI SDA micropiles offer self-drilling micropiling where the central hollow threaded reinforcement bar acts as both final reinforcement in the completed pile and as the drill rod during installation. The SDA system is installed with sacrificial drill bits under a grout flush. In granular deposits in particular the impregnation of grout into the surrounding ground significantly enhances the geotechnical capacity of the pile. Mass concrete and rock can also readily be drilled. These piles work well as both tension and compression piles and can be installed on a rake or inclined angle to provide reticulated pile solutions.

The larger diameters of SDA like R51 and T111 are used for micropiling. The T111, for large diameter micropiling, was recent-

ly introduced.

MAI SDA T111 consists of a 4.37-inch (111 mm) diameter hollow threaded rod with a sacrificial drill bit. Thanks to the full length rod thread and extension couplings, the system offers a flexibility to easily adjust the rod length to the site require-



T111 ▲

ments. This is especially useful if piling has to be performed in a confined workspace, for example with limited head room, which is often the case in underpinning. MAI T111 self-drilling micropiles can be installed with most topammer rigs, for example the Atlas Copco Mustang rigs. Because these compact rigs often work in cramped conditions, the short rod lengths leave room to add rods and install micropiles to the required length. With only light equipment needed for installation of the SDA micropiles and the elimination of large concrete mixing trucks, very little site preparation is required and there is less impact on the surrounding area in terms of exhaust fumes, noise and vibrations.

SWELLEX

The Swellex inflatable rock bolt system has gained worldwide recognition for its effective use on job sites. A Swellex bolt is made out of a welded tube folded on itself and sealed at one extremity. The operator simply drills a hole, inserts the bolt and then inflates it to a predetermined pressure using a dedicated inflation system. The Swellex pumps stop when reaching the recommended inflation pressure that guarantees the quality of the installation.

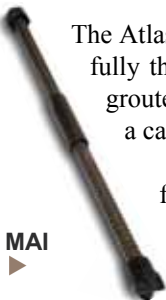
- Swellex Premium line is a relatively stiff rock bolt for work in moderate stress conditions.

- The Swellex Manganese line is a highly deformable rock bolt for large rock deformation. Due to its unique anchorage mechanism, Swellex bolts can adapt to a wide variety of ground conditions.



▲ Swellex

MAI



The latest in micropiling:

Elemex

Controls cutting removal

Drilled casings are one of most popular piling methods for foundations. DTH hammers are also increasingly used in foundation construction. At the same time, construction professionals are concerned about the use of compressed air, which might cause damage to surrounding structures due to air leakage or over-drilling. To meet this challenge, Atlas Copco has developed a new system and is now proud to present Elemex flushing control casing drilling system.

Use of DTH drilling systems in foundation construction gives plenty of benefits: high productivity, straight holes and deep hole drilling capacity, just to mention a few. However, when working close to existing foundations the method poses one great challenge – controlling the removal of cuttings from the hole with compressed air. The flow of compressed air needs to be strong enough to move the cuttings up to the surface but must not escape into the surrounding ground or remove excessive soil. This issue is most demanding in sensitive ground conditions. In clay, the compressed air can escape to surrounding working foundations and weaken the adhesion between soil and load-bearing elements. In sand, excessive flushing can unconsolidate ground, decreasing the capacity of existing friction piles, which in turn might cause pile buckling and settlements.

Conventional systems push air straight into the ground, which is a feature derived from rock drilling applications where the rock face needs as much air as possible to be cleaned efficiently. However, in overburden drilling conditions, flushing should be just powerful enough to get cuttings out from the hole, but not more.

The new and reliable Elemex system minimizes air escape to the surrounding ground since the high pressure air never faces the ground directly. The unique concept behind the Elemex design is built on redirection of the air flow. Once the air reaches the bit face, it is blown against the extended ring bit walls which redirects the flow across the face. This way, the air pressure is decreased just enough to allow an efficient flushing of the bit face without escaping to the surrounding ground.

By utilizing the Elemex system, not only do you get peace of mind from knowing that neighbouring structures are kept intact and people around the worksite are safe, you also get all the benefits from DTH drilling for maximized productivity.

With Elemex no special operator's training is needed to control the air flushing intensity; Elemex takes care of that for you. During Atlas Copco's extensive testing program, consultants in the field have measured the ground water level variation, and with Elemex there has been none. The tests also showed no settlement of the surrounding buildings.

M&C 1 10



New bridge spurs economic development by improving accessibility

When Birmingham Foundation Solutions was called upon to build the foundation for a bridge over Portage Lake Crossing in Noble, Ontario, the Atlas Copco Symmetrix system became a necessary part of the job. Symmetrix proved itself to be fast, reliable and accurate where conventional drilling equipment and methods couldn't be used effectively.

Birmingham Foundation Solutions in Hamilton, Ontario, has a sister company, Birmingham Construction. Todd Barlow, project manager, and Brian Davies, site superintendent, worked on this project, which



Thanks to the extended ring bit, the air flow is redirected across the bit face, resulting in an efficient flushing without air escaping to the surrounding ground.

Bridging a gap

Foundation project finds Symmetrix solution



was ordered by the Ministry of Transportation, Northern Infrastructure Development in order to promote business development in Northern Ontario by expanding Highway 69.

Birmingham was able to complete the bridge foundations in three months with both driven and drilled piles. The Atlas Copco Symmetrix system came into play when workers were challenged by sub-Artesian water pressure and a combination of fractured and sloping bedrock with loose overburden soils. This meant that seating and sealing a casing into the bedrock for the full face diameter of an 819 mm hole would have been unattainable with conventional drilling equipment and methods.

Barlow said, “We got significant penetration of hard and abrasive granite bedrock and with great environmental control

of the cuttings from the Bermingham reverse circulation system.”

Atlas Copco’s Symmetrix system is a patented method of drilling through overburden with casing. It can drill straight holes at any angle from vertical to horizontal equally effectively in the hole range of 90 to 1,200 mm, with a depth of more than 100 meters. It is a beneficial system when there is a risk of not connecting to the bedrock with a bored pile, or when settlement and movement of machining lines is a risk.

In this Northern Ontario project, Symmetrix R813/12.7-718/740-QL200S was used for two bridge abutments and two piers.

Birmingham Construction had to execute a bridge foundation design with drilled caissons tying into the sloping bedrock. The span between piers was 70 meters and

the bridge itself is about 200 meters long. Caissons were socketed up to 8 meters into solid granite bedrock. A conventional crane mounted vertical travel lead (VTL) system was used. The VTL method allows for fast and accurate positioning with the ability to adjust the height of the lead base up or down and skew or batter in any direction. Birmingham used a 70-ton crane with a 90-ft set of Bermingham C-18 vertical traveling leads.

The 819-mm casing was drilled through 3 to 11 meters of loose, saturated sands and silts and seated into the bedrock, which sloped from 20 to 80 degrees. Then a 718 mm rocket socket was drilled into the granite bedrock with the Symmetrix drill-through pilot bit. Some casings were incorporated into the permanent works because of the fractured and sloping bedrock ground conditions. Additional equipment used as a part of this job were a 16-ft hydraulic spotter, Bermingham BHD 30/30 hydraulic rotary head, Bermingham reverse circulation drill string, three Atlas Copco XRVS 476 high-pressure air compressors, and an Atlas Copco QL200S hammer.

Barlow said, “Symmetrix reduces our time on the job because it makes it possible to actually do the work that needs to be done. Conventional methods would take significantly longer to achieve with a significantly lower probability of success.”

Although Birmingham Construction has been using Symmetrix for more than a decade for challenging ground conditions, no special training is required. The people at Birmingham said they would recommend the Symmetrix system to other contractors. “It’s the only system capable of handling sloping and fractured bedrock effectively,” said Barlow. “We had a high quality of caisson construction as a result of the drilling system.”

Birmingham Foundation Solutions is Canada’s oldest foundation equipment company, founded in 1897. Birmingham Foundation Solutions also has another division that manufactures hammers under the name Bermingham. That division also manufactures diesel hammers, VTL leads, hydraulic drills, and STATNOMIC load testing equipment for the construction industry. Birmingham Construction is the arm of the company that’s made up of the personnel who work in the field.

EXCORE



EXCELS

Whether it was through the variable and unpredictable formations in a mine in Sweden or the extremely hard rock of South Africa – the new Excure bit definitely impressed its first users.

Excore is a new generation of diamond drill bits offering superior bit life and penetration rates. A global team engineered the Excure line by combining decades of practical experience with new technologies.

Atlas Copco's new Excure diamond bit line achieves greater penetration rates with an extended service life. As a result, contractors using Excure bits can drill both faster and deeper, but spend less time changing bits.

The metallurgy and design of the Excure bits allow their use in a wider range of applications than their predecessors. Drillers can reduce the types of diamond drill bits usually required to tackle different rock conditions on site. With simplified bit selection, productivity and cash flow are improved.

"After two years of development and rigorous laboratory and field testing on numerous continents, in a variety of challenging drilling conditions, I can say with confidence that Excure is the best series of diamond drill bits we have ever developed," said Gerry Black, P. Eng., Product Manager, Premium Diamond Tools. "The new Excure line is a combination of decades of experience coupled with the latest in manufacturing and metallurgical techniques. Atlas Copco brought together an international team of engineers and metallurgists to develop a high performance line of diamond bits, and the result is the Excure."

Normally, a variety of bits are kept on hand for all possible ground conditions on the drill site. Because Excure can perform in various formations, fewer types of bits are needed in inventory. Excure's longer bit life means less frequent bit changes and, consequently, less trips pulling rods. This factor alone saves a lot of time for the driller.

Excure bit range has three application segments:

- Excure for soft to medium-hard rock with abrasive and fractured to competent formations (Matrix 1-4)
- Excure for medium-hard to hard rock with slightly abrasive and slightly broken to competent formations (Matrix series 5-8)
- Excure for hard to very hard rock with competent formations (Matrix series 9-10)

Each Excure type is also available with various crown designs: the Extended Channel Flush (ECF) for broken to competent formations; the patented JET profile for fast cutting in competent formations; and a face discharge design for extremely broken and triple tube applications. Combining these crown profiles with various crown heights ranging from 10-16 mm means each Excure bit type will cover a wider range of rock conditions.

TEST IN RENSTRÖMSGRUVAN MINE, SWEDEN

One of the deepest mines in Sweden (at 4,232 feet) is near the small community of Malå, 75 miles northwest of Skellefteå. Renströmsgruvan is one of the Boliden mines and has been in operation since 1952 and is still mined for its zinc, copper, lead, gold and silver. The mining method used there is cut-and-fill stoping, which involves backfilling with waste rock. In 2008 the mine produced 260,000 tons of ore and has found good results from exploration at 5,600 feet, as well as between the 2,000- and 2,600-foot levels.

Protek Norr AB, which specializes in surface and underground diamond core drilling, is drilling at the 2,800-foot level. The company employs about 50 drillers and helpers who operate 15 core drills across Scandinavia.

One of those drillers is Jerry Hedman, with 25 years experience as a diamond core driller. He has worked in underground core drilling at Renströmsgruvan since 1995 and said, "When working such a

long time in the same mine, you get very familiar with the geological formation in the mine and you know what to expect from your drilling tools."

Hedman has been drilling for about a year in an area of the mine with varied geological formations. The diamond drill bits have had a life of 330 feet. When drilling to 3,000 feet, he has to pull the rod eight times in order to change the drill bits. This rod handling consumes time and energy ►



Ingemar Larsson, Atlas Copco's sales engineer and (right) Jerry Hedman, core driller at Protek Norr AB

A FAIR COMPARISON

	Previous Bits	ExcORE
SOUTH AFRICA		
Bit life	200 ft	950 ft
No. of bits needed	8 bits	2 bits
No. of pulls to replace bit	7 pulls	1 pull
Time to pull rods	14 hours	2 hours
Capacity	98 ft/shift	177 ft/shift
Total time to drill	118 hours	74 hours
Total time per hole	132 hours	76 hours

SWEDEN		
Bit life	328 ft	1,063 ft
No. of bits needed	9	3
No. of bit changes	8	2
Hours between bits	16	4

that he would rather avoid. “It is the meters of core in the core box that matters to us,” Hedman said. “Rod running is just a waste of time and it leads to a lot of unnecessary heavy work.”

In order to increase the productive drilling time and to decrease the unproductive rod running time, it was clear that a new drill bit was needed. Ingemar Larsson, Atlas Copco’s sales engineer in the mine, suggested that Protek test Atlas Copco’s new diamond drill bit – ExcORE 7-9 JET ECF.

Hedman said, “When Ingemar suggested this new drill bit I hoped that it would perhaps last 500 to 650 feet.” Instead, he was impressed that the ExcORE had a length life of 1,100 feet. The best ExcORE bit during the test lasted 1,150 feet. And, he was able to cut rod running to two times rather than eight.

“The ExcORE drill bits work very well,” Hedman said. “They are easy to work with and they cut the rock very smoothly when the rock gets harder. It is just a question

of a slight increase of the feed force. They are free cutting and very well balanced. I did not have to sharpen the bits manually in the drill hole [by temporarily decreasing the amount of flushing water], which is good since manually sharpening of the drill bit considerably decreases the life length of the drill bit.”

Overall, the test showed an average length life of the ExcORE to be 1,070 feet – more than three times that of the drill bits that Protek used earlier in the same formations, using the same drill rig and other equipment. The same driller and helper did all the drilling.

Hedman needed a fourth of the time to change drill bits during the test, which he said enabled him to drill more, get more core in the box and save wear on the equipment. “I definitely recommend other drillers to try the ExcORE drill bit,” Hedman said.

“The new bit replaces six other bits needed in stock. This makes our operation much more efficient.”

— Charl Sommers,
store supervisor and buyer
for Drillcorp

TEST IN SOUTH AFRICA

Drillcorp is a South Africa-based drilling contractor with operations in several countries in southern Africa and Brazil. Drillcorp’s fleet includes more than 40 drill rigs, which are moved between sites once a contract is completed. As a result, operators and supervisors must ensure that contracts are finalized in time so drills can continue to the next site.

Sitting 155 miles west of Johannesburg, Orkney is a small town close to several gold mines. Recently, Drillcorp held a five-month contract for 65,600 feet of core drilling to define the values of a gold mine in the region. The mine had been operating since 1991, but due to a change in ownership it had been closed so it could be evaluated for further development.

To meet the timeline of the contract, Drillcorp had been running two drill rigs at separate locations to define the values of the ore 1,300 to 1,600 feet below the surface. With a total of 46 holes to be drilled, each rig first drilled a 1,600-foot pilot hole and then employed the wedge technique. (The wedge technique allows a much wider zone to be explored without additional drilling from the surface, saving time and money.) At depths ranging from 1,140-1,300 feet, Drillcorp placed a wedge to deflect the bit in a different direction. In this case the deviated holes were drilled out in steps of approximately 4 inches from the pilot hole.

As the project started, Drillcorp used the same types of drill bits that had been used previously at other sites, but they soon discovered the ground at the mine posed some challenges.

The bits did not cut the hard rock as expected. When more pressure was applied, it lifted the drill rig instead of cutting harder. In the toughest spots, the drill bits did not cut at all, but merely polished the rock. In addition the ground was frac-



**SEE EXCORE
AT PDAC SHOW!
(Booth # 723)**

tured and difficult to drill in without getting stuck.

Operators managed to drill about 100 feet per shift with a bit life of 200-230 feet, but only 32,800 feet had been drilled in three months. Unless more drill rigs were brought on site, the current production rate would not allow Drillcorp to complete the contract on time. For Willie Smit, a Drillcorp site manager with 17 years of experience with core drilling, it was clear a new solution was needed.

Jimmy Erasmus, sales engineer with Atlas Copco Exploration Products – Africa, suggested that Drillcorp test the Excore, Atlas Copco’s newly developed bit that had yet to be released to the market. Drillcorp agreed.

PUTTING IT TO THE TEST

When Drillcorp put the first Excore bit into action, there were 820 feet left of the current hole. Typically, Drillcorp would expect to change the bit at least three more times, spending at least six hours pulling rods on the remaining part of the hole.

However, one new Excore bit finished the hole; no replacement bits were needed. Furthermore, the bit still had some productive life left and drilled another 170 feet in the next hole. In total, the life of the Excore bit on the first test was 990 feet compared to a drill bit life of 200 to 230 feet that Drillcorp realized before.

The first 32,800 feet of the contract had been drilled using bits with an average bit life of 60-70 meters and a penetration rate of 98 feet per shift. The last 32,800 feet, drilled with Excore, saw an average bit life of 920 to 985 feet at a penetration rate of 177 feet per shift. Excore achieved an 80 percent higher penetration rate and more than four times longer bit life.

A couple of types of Excore bits with different designs were also tested. Some had a similar bit life, while others had a normal bit life of 230 to 262 feet given the conditions at the site.

Calculations also reveal a 40 percent savings in the amount of time needed to drill a 1,640-foot pilot hole.

During drilling operations with the Excore bit, Drillcorp did not change any settings on the drill rigs and used both the most and least experienced operators to get a fair result.

The fact that one Excore bit type could handle all the challenges Drillcorp faced also made a big difference. “The new bit replaces six other bits needed in stock,”



Bertie Zaaiman, sales manager Atlas Copco Exploration Products Africa, and the drill operator show some of the high quality core sample retrieved from 984 feet.

said Charl Sommers, store supervisor and buyer for Drillcorp. “This makes our operation much more efficient.”

This is not only important from an inventory perspective, but also for the operation. As rock conditions change, there may be a need to pull the rods to change bit type – even if it is only for a few decimeters. With Excore the same bit type could be used throughout the operation as the bit cuts through any of the formations encountered.

“We need bits for hard and soft rock, but we don’t know which until we are in the formation,” Smit explained. “If we need to pull rods to change a bit, it may be for only a few decimeters. It saves us a lot if we don’t need to do this.”

EXCORE FINISHES THE JOB

Because of the successful test results, Drillcorp immediately ordered 20 new Excore bits to complete the contract on schedule.

After finishing the contract, Drillcorp moved onto the next drill site in the region. Although the rock conditions were easier and would not have been a challenge for the previously used bits, Smit was anxious to test the Excore bits again.

“Even if we only gain small advantages in bit life and penetration rate, we will always gain with the flexibility and simplicity with Excore. This is an excellent bit; I would recommend it to anyone,” said Smit, “especially for the ground conditions we have experienced.”

Down the Hole Center of Excellence

In addition to being home to the Water Well Center of Excellence, Atlas Copco's Milwaukee branch is also a rental hub for DTH hammers and cluster drills and a center of expertise for their maintenance and repair for customers around the country.

The Atlas Copco store network carries various sizes of DTH hammers and cluster drills for rental customers. "We carry anywhere from our 4-inch class all the way up to our 20-inch class of hammers," says Sturge Taggart, Regional Branch manager in Milwaukee. "This allows you to drill a range from 4.5-inch to 36-inch diameter holes with a single-bit DTH hammer."

Several cluster drills are also in the rental system. Ranging in size from 30 inches to 92.5 inches, Taggart points out that Atlas Copco can work with a customer to manufacture specific diameters based on job requirements. "We work with our product company to fabricate these cluster drills since we are a center for their distribution and maintenance." This can apply to rental drills depending on the length of the project.

Trained technicians are also available to assist with startup operations and to provide any maintenance training if the customer is unfamiliar with the application of the product. On longer jobs, they will also rent a support container that houses a work bench and all associated tools needed to maintain the cluster drills or DTH hammers.



DTH Center Phone: 414-760-1193

Cluster drills and DTH hammers are often sent to the Milwaukee store for repair or refurbishing. If a customer requires a quick turnaround, highly trained technicians will go to any Atlas Copco branch to repair equipment. Drill bits can also be repaired. "The large diameter bits are very expensive, so it's worth refurbishing them to be used again. We have the equipment here to do it," says Taggart.

Taggart describes a typical rental cus-

tomers as a building contractor putting in large diameter footings for buildings, high tension power lines, or a bridge contractor drilling for piles for bridge piers. "The capital investment on this equipment, which may only be used once or for a limited time, would be too high for a contractor to bid competitively," Taggart points out. "So, instead of purchasing a very expensive piece of equipment, it's much more economical to rent it."

THE DTH CENTER:

- **Rents** DTH hammers by the foot, day, week, month or job.

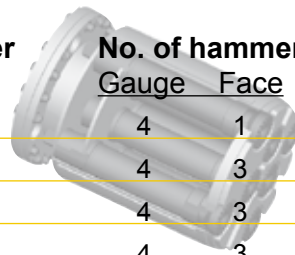
- **Supplies** drill string components: over-hammer shrouds, drill pipe, can rods, shock subs, blow out subs, swivels, oilers, water injection systems, hydraulic make-up, breakout tongs, air compressors, air hose, manifolds, and more.

- **Provides** consulting prior to bidding and on-site operation and maintenance supervisors.

- **Can** dress worn hammer bits, replace broken carbides, tear down, clean, inspect and rebuild hammers.

Atlas Copco cluster drills combine multiple DTH hammers into a single canister. The custom-engineered drills are manufactured to meet each customer's needs and feature exclusive, patented technology for self-indexing and quick-release bits.

The Range	Diameter	No. of hammers		Length	Weight
		Gauge	Face		
CDS 36 5/4	36"	4	1	63"	6,300 lbs
CDS 42 7/4	42"	4	3	63"	8,800 lbs
CDS 46 7/4	46"	4	3	63"	9,500 lbs
CDS 48 7/4	48"	4	3	63"	10,000 lbs
CDS 54 9/5	54"	5	4	63"	12,700 lbs
CDS 60 11/5	60"	5	4	63"	15,700 lbs
CDS 70 13/5	70"	5	8	63"	20,000 lbs



Atlas Copco also carries: compressors and generators, lubricants, flushing heads, subs, drag bits, casing bits, duplex adapters, inner drill steel and outer casing. Complemented by technical advice, Atlas Copco can provide everything to complete a project.

New Cobra™ gas drills and breakers now have cleaner emissions

Atlas Copco's new generation of Cobra™ gas drills and breakers have been designed for stricter exhaust emission standards. Featuring improved carburetor and filter systems and a redesigned noise reduction system that includes a catalytic element, the Cobra Combi, Cobra Pro and Cobra TT gas drills and breakers offer a 50-percent reduction in the emission of hydrocarbons compared to their predecessors.

Cobra Combi is a multi-purpose machine featuring a high impact mechanism with rotation option and a built in compressor for flushing. It is ideal for onsite jobs such as breaking, drilling, cutting, driving and compacting.

Cobra Pro is the combination of high percussive energy and high blow frequency. It delivers almost twice the impact energy



of other gas-driven breakers on the market and offers the same power-to-weight ratio as many pneumatic or hydraulic breakers. Cobra Pro is used for breaking concrete and asphalt, tamping, compacting, digging, driving posts, fences, rods, tent stakes and spikes.

Cobra TT has been specially designed for tie tamping. It works at the relatively high frequency of 1,620 blows/min. and the im-

act energy has been optimized to prevent pulverization of ballast.

All models feature an electronic ignition, choke and a redesigned fuel cap for better regulation of tank pressure. An optional guide roller is available for the Cobra Combi to make it easy to pull downwards to start the machine when it is positioned high in relation to the operator.

The high-capacity air filter can handle large quantities of dust, and it is easy to access for servicing. The new front cover features an integrated heat shield.

All Cobra machines work independently from external power sources. They feature a 90 cc, two-stroke motor with a fuel capacity of 1 liter. All three models feature the highest impact energy and lowest vibration levels of any other gas breaker

Atlas Copco introduces new hydraulic surface drill – the ROC T15

The ROC T15 is the smallest hydraulic rig in Atlas Copco's surface drill product line. The ROC T15 is a compact rig weighing 6,172 pounds. Completely operated by radio remote control for tramming, boom functions and drilling, the ROC T15 can drill holes between 7/8 inch and 1 3/4 inches in diameter to a maximum depth of 30 feet. Small in size but not small in power, it is easily transported to the job site and is ideal for a number of construction and small blasting applications.

The ROC T15 features the same type of stiff folding boom and durable aluminum feed as the larger models in the ROC line. Unique for a rig this size, the ROC T15 provides more than 60 square feet of horizontal coverage area.

Designed for stability, the ROC T15 can move quickly and safely over rough terrain. It can also be equipped with a hydraulic winch that has a variable line pull for working in extreme conditions. Specially designed front support legs help tramming in rough terrain.

Three different rock drills are available on the ROC T15. The Atlas Copco COP 1019HF rock drill uses 3/4-inch integral rods. The COP 1022HF uses 7/8-inch integral rods and tapered equipment; extension drilling is also possible with a 22 mm hex R25 shank

end rod. The COP 1028 uses a 1 1/8-inch SR28 shank end, speedrod combination. The ROC T15 is ideal for construction jobs such as excavating building foundations, trench blasting, and installing self-drilling anchors. The ROC T15 can replace breakers in small aggregate quarries, drill for rock bolts and be used for boulder blasting in both surface and underground environments.

"We are really excited about the introduction of the T15, as it takes us into a new market segment," said Maurice Hunter, Business Line manager, Surface Drilling Equipment.



MARKET PLACE



New QAS 600 generating set

Atlas Copco's new QAS 600 generator is the largest model in the QAS range. Rated at 575 kVA at 60 Hz, the QAS 600 is powered by a Volvo TAD 1641 GE diesel engine that drives a Leroy Somer alternator with PMG-Technology, and a 239-gallon standard fuel tank that ensures continuous operation at full load for a complete shift.

With standard features that maximize safety and minimize environmental impact, the QAS 600 is designed for easy transportation and onsite handling, making it ideal for rental, industrial, public utility and construction applications.

The QAS 600 is housed in zinc plated steel with a powder coat finish. The housing has also been designed to reduce noise. The QAS 600 operates at 77 dB(A) at 60 Hz, making it ideal in noise sensitive areas.

The enclosure features an integrated lifting structure that includes forklift slots, which facilitate safe and efficient handling, and an integrated bumper to protect against impact. The lifting structure is positioned at the center point of gravity, and is designed to support at least four times the maximum weight. The sturdy spillage-free frame is a 110-percent containment base for all the necessary liquids such as oil, coolant and fuel.

The new QAS 600 features a dedicated compartment for the electrical system, making it safe to access when operating. Isolating the electrical system from the engine compartment reduces vibration and temperature impact. Furthermore, the compartment door is sealed to help prevent water and dust infiltration.

Atlas Copco launches DrillAir™ Open Unit

Atlas Copco's Portable Air division completes its DrillAir range with the new Open Unit compressor, available in two models. The XRVO 1550 delivers 1550 cfm at 365 psi, and the XR XO 1400 delivers 1400 cfm at 435 psi.

The new dedicated open unit design delivers higher capacity and higher pressure effectively and efficiently. The higher pressure allows for faster drilling, while the higher flow removes cuttings more efficiently. Increased productivity is then gained by increasing speed.

Fuel consumption is optimized with the exclusive FuelXpert™ system. Conventional systems are based on pneumatically controlled engine speed and air inlet without accounting for fuel economy. These systems have focused on the stabilization of the regulating system, but have not looked at the optimal fuel consumption at each load. FuelXpert, via the engine electronic control module, regulates speed and air inlet with a view to optimizing fuel consumption for each working condition. Important when the air demand is lower than the capacity required, the system ensures the right capacity for the application.

The DrillAir Open Unit also offers longer component life due to Oiltronix™ technology. This electronic controlled oil temperature system extends the lifetime of air-ends, compressor components, oil and the oil separator. It also reduces or eliminates condensate (water) in the oil system. Oiltronix technology reduces the average oil temperature, prevents overheating and increases safety. The DrillAir Open Unit is available with a choice of a push fan or a pull fan. This option, along with the unit's ease of transport and installation, makes these units ideal for specialist applications and allows for greater flexibility in the integration with OEM configurations.



Atlas Copco introduces advanced formula synthetic compressor oils

PAROIL S and PAROIL S Xtreme from Atlas Copco help ensure that air compressors maintain optimum levels of performance while reducing operating costs.

These new and improved formulas not only offer the most advanced protection to the critical components of a compressor, but also provide durability in even the most severe conditions, including very high pressure and pipeline applications.

PAROIL S and PAROIL S Xtreme are fully synthetic premium quality oils that offer a high viscosity index. They allow for oil change intervals of 1,000 hours without any loss in performance or compressor longevity.

PAROIL S has been formulated to meet the demands of air compressors



working in severe conditions. Although primarily designed for high-pressure applications, PAROIL S can be used in all Atlas Copco portable air compressors operating in ambient temperatures between -13° F and 122° F.

Atlas Copco's PAROIL S Xtreme is designed to provide optimum levels of performance and protection for all compressors, including two-stage, in applications up to 507-psi operating continuously in ambient temperatures above 86° F. Both oils facilitate separation and drainage of condensation in the compressor. Balanced composition of the anti-foam and air release keeps the oil clean and prevents blocking of the oil separator, guaranteeing a low oil carryover.

**Featured
Rig**



Atlas Copco DMM2 Rotary Blasthole Drill/1992 EXCELLENT CONDITION

Location: Salt Lake City
75,000 pound bit load capable.
Complete certified rebuild by
Cate Equipment Drilling Solutions
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- Rebuilt rotary head and rotation motors
- New rod changer
- Rebuilt pull down and tower raise cylinders
- New axle
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- New A/C unit
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- Rebuilt undercarriage (including final drives and tram motors)
- Rebuilt main and double pumps and gear box
- All new hydraulic, air, and water hoses
- New wiring
- CAB refit
- Set up for 7⁵/₈" steel

Atlas Copco ROC F7-11/ 1998
Serial Number: AVO098A577
Location: Ludlow, Massachusetts
Engine Hours - 14,251 Impact Hours - 5,644

Atlas Copco ECM 590 Rod Rack/ 2007
Serial Number: 11536
Location: Nashville, Tennessee
Engine Hours - 1,652 Impact Hours - 775

Atlas Copco ECM 720/ 2003
Serial Number: 72358
Location: Charlotte, North Carolina
Engine Hours - 7,565 Impact Hours - 2,446



Atlas Copco ROC F9CR/ 2005
Serial Number: AVO05A513T Engine Hours - 3,893
Ludlow, Massachusetts Impact Hours - 1,196
Cop Rod system. Rack comes full with drill steel.

Additional details on these and MORE rigs online. www.atlascopcomarketplace.com

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- **Rock reinforcement products** keep faces stable and adapt to mass movements.

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