

# Drive & Control profile

## Mining A Miracle: Mobile drilling rig equipped with Rexroth hydraulics frees Chilean miners



Photo courtesy of Schramm, Inc.

When the Chilean government sent out the call for assistance, it was determined that the Schramm T130XD rig, equipped with Rexroth hydraulics, offered several potential advantages for the rescue.

The whole world watched as Schramm's T130XD mobile drilling rig, equipped with durable Rexroth AA11VLO130 variable displacement pumps, drilled deep into a Chilean gold mine and dramatically rescued 33 trapped miners in record time.

Gold mines are some of the deepest mines in the world. When disasters such as a mine collapse occur, the challenge of rescuing anyone trapped below can be monumental. On Aug. 5, 2010, a cave-in occurred at the San Jose gold and copper mine near the northern city of Copiapó, Chile,

trapping 33 miners about 2,300 feet below the surface.

They waited for 17 days until a small bore hole drilled from above reached their location, and the miners attached a message informing the world above that they were

### Challenge:

Rescue 33 miners trapped in a gold mine collapse, using Schramm Inc.'s advanced T130XD mobile deep drilling rig to drill a 28-inch wide hole through solid granite

### Rexroth Solution:

- Four Rexroth AA11VLO130 variable displacement axial piston hydraulic pumps
  - Open circuit pump with charge pump
  - Nominal pressure 5100 psi (350 bar)
  - Peak pressure 5800 psi (400 bar)
  - Displacement of 130 cc/rev. or 7.93 in<sup>3</sup>/rev.

### Results:

- High displacement capacity and proven reliability support the T130XD's performance
- Rexroth pumps power the top head and master cylinders of the drilling system—to manage thousands of feet of drill pipe
- Schramm rig originally designated as “Plan B” quickly turns into the primary rescue solution
- 80 to 90 day estimate of original drilling rescue timeframe was reduced to 33 days
- All 33 miners rescued safely

still alive. Thus began what would be one of the most thrilling and technologically innovative mine rescues in recent history. The star of the rescue was the T130XD mobile drilling rig from Schramm, Inc. (West Chester, PA [www.schramm.com](http://www.schramm.com)), equipped with hydraulics from Bosch Rexroth (Hoffman Estates, IL [www.boschrexroth-us.com](http://www.boschrexroth-us.com)).

### The search for survivors

Immediately following the collapse, Chile's government called in drilling professionals from across the country, and ultimately worldwide, to determine appropriate steps.

Examination of the mine's layout suggested one possible area where survivors (if any) might gather: a mechanics' room measuring approximately 538 square feet - the equivalent of a small apartment - situated 2,300 feet down. Drilling a bore hole that deep, with that level of accuracy for the endpoint, was compared to "hitting the head of a pin with a 20-foot pole."

The mining authorities were also concerned with the local geology: it was known that granite structures at the site were at least 20 percent harder than granite typically found in the U.S. Drilling consistency would be varied, with densities ranging from low to very high.

### Multiple rescue plans

The initial rescue plan, called "Plan A," developed by the Chilean authorities focused on using a complex drilling rig called a raise borer from another manufacturer, to drill a vertical rescue hole.

The raise borer vertical rig took time for arrival and set up, and required vertical placement precisely over the location of the miners. When the Plan A vertical hole was started on August 30, the miners had been underground for close to a month. It was estimated that drilling would progress at about 66 feet per day, and require 80 days to rescue them—if uninterrupted.

Although they were supplied with food capsules and other supplies through the initial pilot holes, estimates of their release ranging from "60 to 90 days" and "around Christmas" led to alternative plans for drilling rescue holes.

### Plan B: Bring in the Schramm T130XD

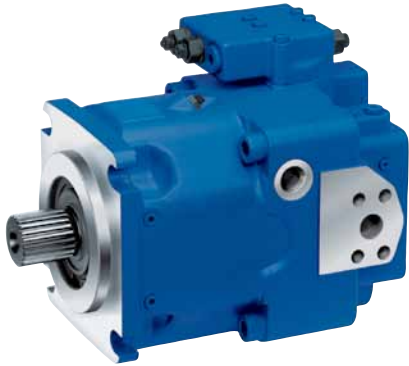
At the time of the San Jose collapse, a Schramm T130XD drilling rig was being operated about 1,000 km away, drilling large-diameter bore holes for water extraction at another deep Chilean mine site.

The T130XD is a heavy duty, heavy hoist carrier mounted drill rig designed to provide powerful drilling performance in a compact, all-in-one carrier mounted rig. It features a 760 hp deck engine, and was designed by Schramm for heavy-duty deep drilling applications with up to 130,000 pounds of pullback capacity. The



Photo courtesy of Schramm, Inc.

Schramm's T130XD mobile drilling rig, equipped with Rexroth AA11VLO pumps.



The reliability of the Rexroth AA11VLO pumps is especially critical in deep drilling applications requiring high pressure capacity and pullback force delivered by the drill rig.

T130XD was designed for drilling applications such as shallow oil and gas, deep water wells, geothermal exploration and...deep mine rescue.

A key component of the hydraulic system that powers the Schramm drill are the Rexroth [AA11VLO variable displacement axial piston pumps](#), supplied by local Rexroth distributor [Airline Hydraulics, Inc.](#) (Bensalem, PA [www.airlinehyd.com](http://www.airlinehyd.com)).

Schramm selected the Rexroth AA11VLO130 pumps when designing the T130XD because of their proven performance, particularly in deep drilling applications requiring the high pressure capacity and pullback force delivered by the rig.

Schramm's drill uses four Rexroth AA11VLO130 pumps, which supply hydraulic pressure to the top mast head and mast cylinders. The top mast head is the mechanism at the top of the drill mast that provides the pullback force to manipulate thousands of feet of pipe down the hole; the mast cylinders support this function.

Rexroth's AA11VLO series of axial piston variable displacements pumps are designed for hydrostatic drives in open circuits. They offer high power capacity and displacement in a compact design, with nominal pressure of 5100 psi (350 bar) and maximum pressure of 5800 psi (400 bar.) The AA11VLO130 is equipped with a charge pump enabling high input speeds, which is especially important at high-altitude operation, like Chile. Its 130 cc/rev (7.93 in<sup>3</sup>/rev) can operate at engine speeds up to 2,500 rpm.

When the Chilean government sent out the call across the country for assistance, it was determined that the T130XD rig offered several potential advantages for the rescue:

- The T130XD is well-suited for drilling with reverse-circulation down-the-hole hammers, making it especially ideal for drilling through the Chilean granite.
- Schramm's rig was designed to drill off a vertical axis, enabling it to

utilize one of the existing pilot holes to drill a rescue portal, and would not have to be emplaced directly above the miners.

- The T130XD in Chile was equipped with Schramm's highest capacity top head, capable of drilling holes up to 28 inches in diameter.
- The T130XD is designed for fast teardowns and relocations, enabling it to make the 1,000 km trip in relatively short time.

Given the advantages offered by the T130XD, the Chilean mining authorities developed a "Plan B" rescue plan: the T130XD would enlarge one of the 5.5-inch diameter initial probe holes, drilled with two passes. The first pass would increase its diameter to 12 inches and the second pass to 28 inches diameter, to allow a rescue rig to be lowered.

#### Putting Plan B into action

Arriving at the San Jose mine on September 30, the T130XD was quickly set up and drilling on the



Photo courtesy of Schramm, Inc.

The variable displacement pumps on the T130XD supply hydraulic pressure to the top mast head for manipulating thousands of feet of pipe.

first pass hole proceeded 24/7. The Schramm rig quickly outpaced the Plan A vertical bore hole rig, and had widened the pilot hole from 5.5 inches to 12 inches along the entire 2,260-foot length in a little over two weeks.

According to Schramm officials, the reliable performance of the Rexroth AA11VLO130 pumps was crucial to the speed of the drilling.

“The pumps are mission critical to the T130XD – if the pumps are out of commission, there is no hoist or rotation,” said Brian Brookover, Schramm control systems team leader. “It’s important to note that the Schramm T130XD used for the rescue had zero down time directly attributable to the rig throughout the rescue process. The Rexroth pumps did their part,” he said.

### **The entire world watches the final rescue**

Because the Plan B hole being drilled by the Schramm rig was going so much faster than the Plan A hole (which still had not completed its first pass), it appeared increasingly likely that the T130XD hole would be the rescue hole – and that instead of taking until “around Christmas,” the process could be completed by mid-October.

In preparation for its second pass, the T130XD was outfitted with a 12- to 28-inch expansion boring tool.



Photo courtesy of Schramm, Inc.

The AA11VLO130 pumps on the T130XD enable high input speeds, which is especially important for high-altitude operation.

The drilling would continue just as quickly with this larger down-the-hole hammer, which took full advantage of the rig’s high-capacity top head.

Most of the hole drilled by the T130XD was through solid rock; however, the top 300 feet was looser material. It was decided that this would be lined with 24-inch steel casing, to prevent loose rock from falling down the hole and jamming the rescue capsule. The T130XD’s flexible tilt-out head easily

handled both the drill pipe and the casing for this safety step.

On October 9, just 33 days after the T130XD began its drilling, the second pass was completed; four days later, as a worldwide audience estimated in the hundreds of millions watched, all 33 miners were safely re-united with their families and communities, and Chile celebrated a miracle under and above the earth.

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