RAISE BORING MACHINE

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RAISE BORING TECHNOLOGY

Raise boring, as a technique for system of driving raises (vertical or near vertical holes) continues to gain in popularity due to its many important advantages over conventional methods.

With its experienced team of engineers, TERRATEC has developed its own series of Raise Boring Machines, providing innovative solutions to the traditional Raise Boring Machine for the underground industry.

ADVANTAGES OF BORED RAISES

Raise boring offers several advantages over the conventional drill and blast method. The most important are safety, speed, physical characteristics of the completed hole, labor reduction and cost reduction.

The safety factor in raise drilling cannot be over emphasized. No men are exposed to the danger of rock fall from freshly blasted ground or to the continual use of explosives, with their fumes and inherent danger of misfires. Raises can be safely drilled in ground that would be extremely hazardous, if not impossible, to drive by conventional methods.

A hole drilled by Raise Boring Machine can generally be completed in a fraction of the time required for conventional methods.

TERRATEC’s RBM programme incorporates standard Raise-Boring Machines (TR Series), which are used in mining and civil construction to excavate large diameter single pass (1 to 6 meters) holes in hard rock. The Combination Down-Reaming/Rise-Boring (TDR Series) and Universal Borers (UB) Machines round off the product range required to drill a hole. The purpose of the hole can be for ventilation, ore passes, access ways, man movements or vertical conveyors.

RAISE BORING METHODS

Three basic systems of Raise boring

RAISE-BORING

In this system, the pilot hole is drilled down to a lower level in the mine or civil project. Once the pilot hole connects to the lower access level in the rock, the drill bit is removed and a reamer or raise head is attached and the reamer is rotated and pulled upwards. The broken rock falls to the lower level by gravity. This system operates with the drill string in tension and this provides the most stable platform.

DOWN-REAMING

In this system, the pilot hole is drilled downwards until it connects to a lower access level. The drill string (all drill rods, stabilizers and cutting bits) is retrieved and then a reamer is pushed downwards. The cuttings flow down the previously drilled pilot hole. This method uses drill string in compression and usually stabilizers must be installed to eliminate the potential of the drill string buckling.

BOX-HOLLING

The most difficult raise method, known as Box-Hole excavation, is to drill a pilot hole to any level up from the raise borer. Once the desired length is achieved the drill string is retrieved, and a reamer attached and pushed upwards. The broken rock falls down the enlarged hole onto a special collection chute attached to the top of the raise borer. This technique has been largely used to replace ladder rises, which completes the boxhole using conventional methods. Ladder rise excavation is very dangerous and is being legislated out of the industry in favour of mechanical means. TERRATEC’s engineers have designed the boxhole excavation system to be a safe and reliable process of drilling.
The original and most traditional series of Raise Boring Machines is the TR (Terratec Raise) series. These machines are designed to execute raises by Raise-Boring method only.

These drills can be manufactured for the excavation of up-reamed large shafts in diameter up to 6,000mm in a single pass.

1. HEIGHT
Terratec’s Raise Drills have the lowest standard profile in the industry.

2. HYDRAULIC DRIVE
Stepped hydraulic system for easy use and maintenance. Hydraulic control protects the Drilling Rods from Over-torque thus ensuring a longer life for them.

3. HOLLOW SHAFT
Hollow Shaft design on Gearbox and Drive Motor to allow flushing while boring the Pilot Hole.

4. FLOATING DRIVE
Manufacture is from forged steel for extra strength and with a unique sealing system which stops bailing water corroding the drive spline.

5. DIP ANGLE
Easy dip angle selection achievable with a single erection cylinder.

6. EASY TRANSPORT
Main sled structure manufactured from circular tube which assists with slew operations.

7. ROD HANDLER
It can lift all the Drill Strings, the Reamer and the Stabilizers enabling “One-Man” operation.

Power Unit
All Terratec Raise Borers install a unique Hydraulic Power Unit consists of a single sled containing all major hydraulic and electrical components including the motor pump assemblies, hydraulic reservoir, heat exchanger, filter, manifold block and stainless steel electrical cabinet. The Hydraulic System is fully controlled by a PLC, and the hydraulic components are universally available.

Reliability, low and ease of maintenance and operator acceptance (user friendly) are of paramount consideration in the design procedure.

**PROJECT REPORT: TR3000 FOR MEXICO**

- **RBM Type:** TR3000
- **Series Number:** R15
- **Location:** Mexico
- **Year:** 2012
- **Customer:** CAUSA
- **Nominal diameter:** 3,000 mm
- **Nominal Hole Depth:** 500 m
- **Installed Power:** 352 kW
- **Torque:**
  - Pilot Drilling: 78,000 Nm
  - Reaming Nominal: 237,000 Nm
  - Reaming Maximum: 266,000
- **R.P.M.:**
  - Pilot Drilling: 0 - 57
  - Reaming: 0 - 14
- **Thrust:**
  - Down: 1,600 kN
  - Up: 4,500 kN
- **Derrick Dip Angle:** 0° – 30°
- **Derrick Extended Height:** 4,490 mm
- **Drill String Length:** 2,300 mm

**TDR SERIES**

The dual purpose Raise/Down drilling machine is able to pass all drilling components through the worktable, including the Reamers. Consequently due to the machine being robustly designed for easy use and reliability, the system only requires one operator and it can be left unattended when required.

The derrick of the machine is designed in modular units which makes disassembly of major components (for inspection, transport or repair) very easy to achieve. The prime feature of this machine is the hinged “horizontal double worktable doors” which swing up to allow a Reamer and Stabilizer to pass through the worktable doors. The swinging motion of the doors is controlled by the operator, via an electrical pushbutton on the control console.

These machines are designed to have sufficient torque and thrust capability to operate as a conventional Raise Boring Machine, but are sought after for their ability to down ream. This entails pilot drilling for guidance and spoil removal, then reaming downwards. The machines have sufficient equipment for rod handling capacity to lift the fully dressed reamer into the machine without any auxiliary external equipment; hence this machine can be controlled by one operator.

**Low Profile**

For those applications with very restricted space, Terratec implements the very Low Profile “L” Special Series. A sample of it is the TDRL-600 which can ream 720mm upwards and 1,500mm downwards using 48” Rods in only 3.5m overall extended derrick height.
TERRATEC's ultimate drill is its Universal Borer. With this one system, Raise-Boring, Down-Reaming and Box-Holing can be accomplished using the same derrick assembly. The design ensures maximum safety for the operating personnel on site giving a safe working environment.

Main Features of this System:
- Fast Interchangeability
- One-Man Operation
- Powered Pipe Handling & Muck Chute
- Diameter Range of 600mm to 1,500mm
- Integrated Thrust Torque Cylinders
- Modular Compact Design
- Cost Effective
- Exclusive Safety Features

By changing the floating drive box the machine can operate with 10 inch or 11¼ inch drill rods. However, TERRATEC machines are designed to fully utilize the capability of the various drill string.

TERRATEC’S STANDARD RAISE BORING MACHINES

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>UB SERIES</th>
<th>TDR SERIES</th>
<th>TR SERIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX. HOLE DIAMETER Raise-Boring</td>
<td>1,500</td>
<td>1,500</td>
<td>2,400</td>
</tr>
<tr>
<td>Down-Reaming</td>
<td>1,065</td>
<td>700</td>
<td>1,800</td>
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<tr>
<td>Box-Holing</td>
<td>1,065</td>
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<td>1,800</td>
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<tr>
<td>MAX. HOLE DEPTH (Max. Holes Diameter)</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>(m)</td>
<td>250</td>
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<tr>
<td>PILOT HOLE Bit Diameter</td>
<td>279</td>
<td>279</td>
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<tr>
<td>Rod Diameter</td>
<td>254</td>
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<td>Rod Length</td>
<td>1,066</td>
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<tr>
<td>INSTALLED POWER [kW]</td>
<td>121</td>
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<td>242</td>
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<tr>
<td>TORQUE Pilot Drilling [Nm]</td>
<td>11,700</td>
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<tr>
<td>Reaming Nominal</td>
<td>61,000</td>
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<td>Reaming Maximum</td>
<td>75,000</td>
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<td>ROTATION SPEED Pilot Drilling [rpm]</td>
<td>0 ~ 80</td>
<td>0 ~ 120</td>
<td>0 ~ 120</td>
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<tr>
<td>Reaming</td>
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<td>52,500</td>
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<tr>
<td>THRUST Down Ream [kN]</td>
<td>1,100</td>
<td>950</td>
<td>750</td>
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<td>Up Ream</td>
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<td>750</td>
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<tr>
<td>DERRICK DEP ANGLE From the Vertical [deg]</td>
<td>(30°)</td>
<td>(30°)</td>
<td>(30°)</td>
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<tr>
<td>MAX DIMENSIONS Height* [mm]</td>
<td>4,392</td>
<td>4,495</td>
<td>4,915</td>
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<tr>
<td>Derrick Operating</td>
<td>(3900)</td>
<td>(3900)</td>
<td>(3900)</td>
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<tr>
<td>Width</td>
<td>3,050</td>
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<tr>
<td>Length</td>
<td>2,450</td>
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<td>WEIGHT (Derrick only) [kg]</td>
<td>14,000</td>
<td>9,300</td>
<td>10,350</td>
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</table>

* The dimensions shown between brackets correspond to the ones of the Low Profile “L” Version

Apart from these standard models, TERRATEC can tailor make the Raise Boring Machine to meet any special requirements.

REMOTE DIAGNOSIS

Our optional Remote Diagnosis Program also allows to monitor the actual works of the Machine from TERRATEC’s Engineering Center and to detect any malfunction or abnormal symptom on the machine, preventing any damage and ensuring a long life for the RBM.