wassara

START-UP GUIDE

WATER-POWERED DTH DRILLING

EDITION 1, 2015.01

WELCOME

This guide will help you plan and start-up a successful drilling operation with the water-powered Down-the-Hole (DTH) equipment from Wassara.

A checklist is also available if you require more information. You can also talk to a competent member of the Wassara team, should you have any questions.

SAFETY

Safety is paramount when working with mechanical equipment. Always wear protective clothing and safety equipment, and observe all safety regulations. Do not wear loose clothing that may get caught in rotating parts.

Drilling with a percussive hammer can result in excessive loud noise; therefore you should use the proper ear protection to safeguard your hearing against damage.

Eye protection must be worn at all times.

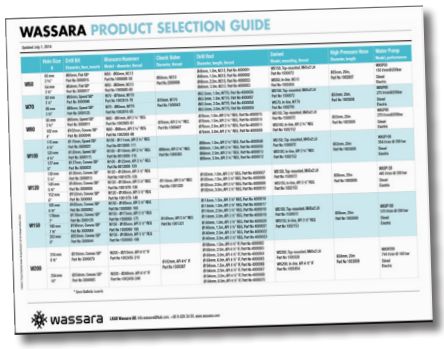
Hammers can be heavy – always use proper and approved lifting equipment and take every precaution to safeguard yourself against injury. Keep hands clear at all times – beware of getting fingers trapped between the chuck and the bit or between casing rods. Do not use hands or feet to clear the top of the borehole at any time.

PLANNING FOR DRILLING

DRILL STRING

Configuring the drill string correctly is a vital part of planning a successful drilling operation. Using an oversized bit or an undersized Wassara hammer will decrease drilling efficiency and may even damage the hammer. It can also lead to insufficient up-hole velocity of return water, whereby the cuttings and debris will not be transported to the surface.

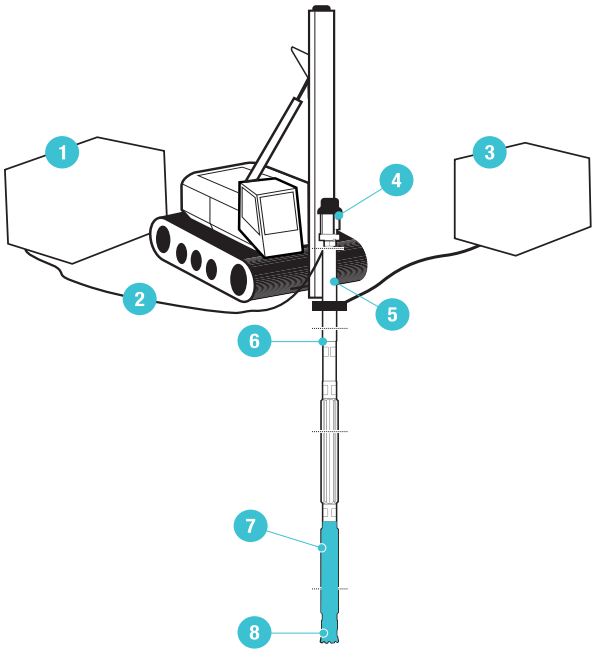
To optimise the drilling operation, follow the configuration guidelines in Wassaras Product Selection Guide, PSG. The latest PSG can be downloaded from: www.wassara.com/psg



COMPLETE DRILL STRING

A complete drill string for drilling with Wassara comprises:

1. High-pressure pump
2. High-pressure hose
3. Water handling system
4. Swivel
5. Drill rods
6. Check valve
7. Wassara Hammer
8. Drill bit



PLANNING FOR DRILLING (cont.)

1 HIGH PRESSURE PUMP

Always use a Wassara Pump System to ensure the Wassara hammer delivers maximum performance.

1. The operating water pressure ranges from **50 – 180 bar (725 – 2 610 psi)**, depending on the size of the hammer and formation.
2. Depending on the size of the hammer, degree of wear and the drilling conditions, the water supply needs to deliver between **150 l/min (50 USgpm)** (W50) and **740 l/min (195 USgpm)** (W200).
3. The product data sheet for a Wassara hammer comprises detailed information about what pressure and flow are required in formations like Collaring, Casing, Fractured rock and Competent rock.

Please refer to the product data sheet for the actual hammer size.

WATER SUPPLY

Only non-abrasive fluids should be used to power the hammer. Particles bigger than **50 µm** can jam the mechanism and a high particle content will increase internal wear considerably. Do not exceed **150 mg** of solids per litre of water.

Sea water

The Wassara Hammer can be powered with salt water or other non-abrasive liquids. Make sure that the hammer is flushed clean with fresh water at the end of working day. This prevents excessive corrosion of the hammer.

2 HIGH PRESSURE HOSE

The hose must be able to handle up to **200 bar (2 900 psi)** of water pressure and the correct connection for the pump and swivel must be used. If the diameter is too small there will be insufficient water pressure to power the hammer.

See PSG

3 WATER DISCHARGE

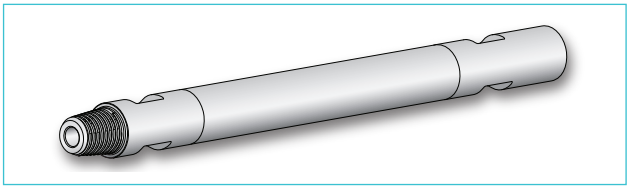
Always follow local rules and regulations for water disposal.

4 SWIVEL

The swivel must be designed to handle high pressure water.

See PSG

5 DRILL RODS



Wassara Drill rods have been specifically designed for drilling with high pressure water. Undersized drill rods can lead to insufficient up-hole velocity. The rod should be equipped with O-rings as leaking joints can result in pressure losses at each connection point. **Only Wassara Drill rods should be used.**

See PSG

6 CHECK VALVE

Always use a Wassara check valve between the hammer and the drill rods. This prevents cuttings and dirty water from entering the hammer when idle.

See PSG

7 HAMMER

Wassara water-powered DTH hammers are available for **Ø 60 – 254 mm (Ø 2 ⅜ – 10")** sized holes.

See PSG

8 DRILL BIT

Drilling with a non-Wassara bit can damage the piston. This can result in hammer failure and increased service costs.

Drilling with an oversized drill bit in hard rock formations can result in insufficient crushing of rock. The shock waves can then reflect back to the hammer and damage it.

See PSG

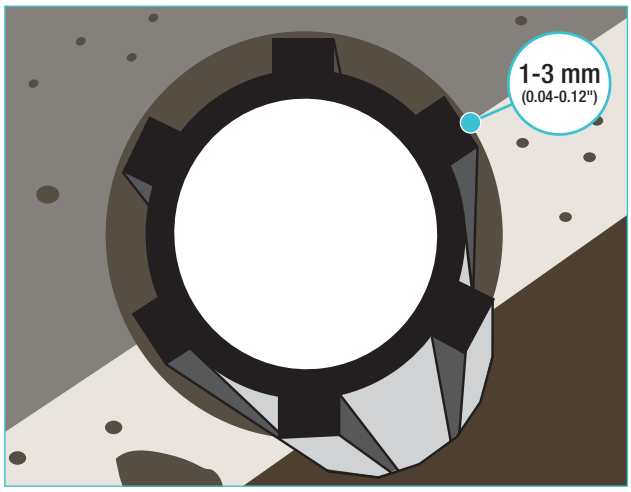
PLANNING FOR DRILLING (cont.)

DRILL RIG

The rig must be able to handle a water-powered DTH hammer.

1. The rotation speed varies from **25 to 250 rpm** and is dependent on hammer size and drilling conditions. *Please refer to the product data sheet for the actual hammer size*.
2. The feed force varies from **3 000 to 30 000 N** and is dependent on hammer size and drilling conditions. *Please refer to the product data sheet for the actual hammer size*.
3. The drill string rotates clockwise, like all DTH drilling systems.
4. The jaws must to be able to handle the actual size of the drill rods and hammer.

HOLE STRAIGHTNESS

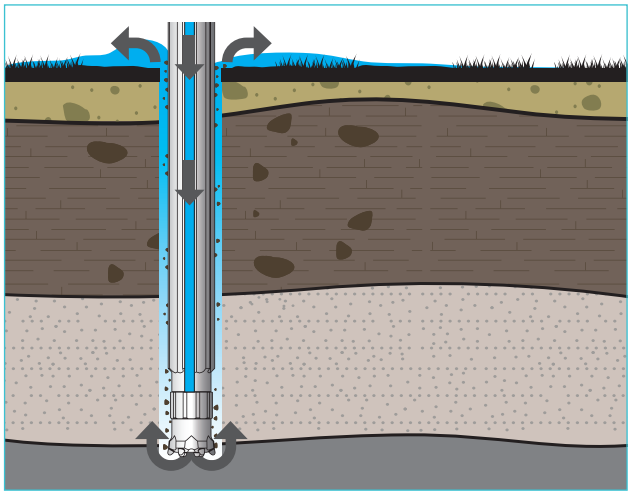


You can increase the straightness of a hole by reducing the difference in diameter size between the bit and the hammer.

Example: a W100 hammer with a **Ø 111 mm (Ø 4 ⅜")** is optimized for a **Ø 115 mm (Ø 4 ½")** drill bit. This creates a **2 mm (0.08")** gap between the hammer and the borehole.

Please note that reducing the operating pressure will not increase the straightness of the hole.

UP-HOLE VELOCITY



An up-hole velocity of **0.5 – 2.0 m/s** is sufficient to lift the cuttings out of the hole. The size of the drilled hole, the diameter of the drill rod and the water flow all have an effect on the water velocity. When calculating the up-hole velocity, the following equation can be used:

$$V \approx Q \frac{21.2}{D^2 - d^2}$$

V = Up-hole velocity in m/s

Q = Water flow in l/min

D = Diameter of drill bit in mm

d = Diameter of drill rod in mm

DRILLING

AT FIRST START

By following these instructions you will ensure all debris is removed. You will also be able to see if any water is leaking from the drilling system.

1. Run the pump for a few seconds before attaching the hose, to check the water supply.
2. Connect the hose and run the pump for a few seconds, to flush the hose.
3. Connect the hose to the swivel and run the pump for a few seconds, to flush the swivel.
4. Connect the hammer to the swivel/rotating unit and run the pump for a few seconds, to check the complete setup for any leaks.

OPERATING PRESSURE

Drilling in soft rock formations will speed up wear on the bit and chuck if pressure is too high.

Please refer to the product data sheet for information on the specific hammer size.

ROTATING SPEED

The Wassara hammer has a higher impact frequency (blows per minute) than air-powered hammers. This requires a higher rotation speed (rpm).

Please refer to the product data sheet for information on a specific hammer size.

WEIGHT ON BIT

One way to keep a sufficient weight on bit is to keep an eye on the water pressure to the hammer, while drilling on constant flow in a solid formation. If the water pressure is fluctuating when drilling, the weight on bit is insufficient. This is because the bit will enter the flush mode for a millisecond, causing the pressure meter to flicker. Increase the weight on bit until the water pressure is fixed and stable.

When drilling in soft formations, it might be tricky to find proper weight on bit. If the weight on bit is too high, the drill string can get stuck in the borehole. The solution could be to decrease the water pressure as this will require a lower weight on bit.

If the weight on bit is too low or the formation is too soft for the operating pressure, the drill bit will be moving excessively, activating the flushing mode which will cause the water pressure to flicker.

Please refer to the product data sheet for information on a specific hammer size.

AFTER DRILLING

STORING THE HAMMER AFTER OPERATION

Dry the hammer by running air through it for approximately one minute and then insert oil into the back of the head of the hammer. Run the hammer with compressed air for a few seconds so that the oil covers all the internal surfaces of the hammer. If it is going to be stored for a longer period (more than one week), we strongly recommend dismantling the hammer, drying the parts and applying some oil to them before assembling it again.

NOTES

NOTES

Wassara – cost-efficient and environmentally friendly drilling

LKAB Wassara is a Swedish company developing and manufacturing unique water-powered drilling systems for high performance in surface - as well as underground drilling operations. The heart of the Wassara drilling system is the world patented water-powered down-the-hole hammer.

The drilling systems have been used for more than 20 years in various applications within many industries; mining, exploration, ground engineering, dams, geothermal, marine, oil & gas storage. Our experience covers more than 25 million drilled metres working in different locations around the world. Reference studies can be found on our website.

LKAB Wassara was founded in 1988 and is owned by LKAB. LKAB is an international high-tech minerals group that produces iron ore products for the steel industry and other mineral products for many other industries and applications.

Explore more at www.wassara.com