How to drill deep holes

Diamond drillers' guide

Epiroc



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Introduction

As the world's easy-to-find ore bodies have already been mined, the need to drill deeper is always increasing. In diamond drilling, you could spend a lot of time drilling average depth holes but eventually you will be called upon to drill really deep holes. Deep hole drilling is a chance for drillers to show their knowledge and experience.

Most drillers consider a hole deep if it is deeper than 1,500 meters. At that depth, drilling is a little more complicated and extra care is required. It's the time to show your supervisor you can deal with increased load responsibilities.

In deep-hole drilling, you want to avoid any mistakes because the deeper the hole, the more money that has been invested in it and the more important it becomes to reach the target.

For example, if the average cost to drill a meter is $130, a 2,000 meter hole costs the mining company $260,000. A mistake in a deep hole takes a lot more time and money to correct.
A deep hole needs to be profitable for the mining company and for you as well.

This guide will provide suggestions and tips for avoiding mistakes, implementing best practices, and choosing equipment.



Take the time to think things through

Don't rush

If there is one piece of advice that is worth remembering, it would be: avoid rushing. You are wiser to go slow and steady when drilling deep holes. This will reduce the stress on your equipment and reduce the number of pullouts that will be required. Keep in mind that the goal is to continue drilling because that is when you are profitable and making money. No one is making any money during the time that you are pulling rods out of a 1,500 meter hole.

Be patient

When drilling deep holes, you need to take the time to think things through and be 200% sure of what you are doing. Making a mistake that causes you to burn a bit at 100 meters is an annoyance. However, burning a bit when you are 1,500 meters into a hole becomes a much bigger problem. Mistakes compound themselves when your hole is deep. The time it takes to change equipment is multiplied.

Ask

If for some reason you have doubts of what to do or how to do it, don't be afraid to ask your supervisor to confirm your decision and agree with what you will be doing. If you aren't sure about some function of the equipment or rig, err on the side of caution. You are better to ask questions, or ask for advice and help than to make a mistake in a deep hole. The result can be costly.

Be efficient but careful

While point number 1 above advises you to take your time, this does not mean waste time. You should try to do everything possible to avoid down time so you can spend more time drilling, but you should also investigate ways to be more efficient.

Increase the travel speed of the wireline equipment

- Always perform preventive maintenance that includes keeping the inside diameter of your drill rods clean, and washing your inner tubes, wireline and overshot. Equipment that is clean will travel faster down a deep hole. Use a product that degreases drilling equipment.
- Check to make sure you have the optimal hydraulic pressure setting on the wireline hoist so it will be able to pull the inner tube more quickly. However, pay attention and make sure you do not reach maximum tensile strength of the wireline cable - keep within a safety zone.
- Verify that your drill rods, inner tubes and the spindle shaft of your head assembly are all straight. If one of these components is not straight, it can affect the speed of descent. One way to better ensure straightness is to choose good quality drill rods. For example, Epiroc drill rods are manufactured under strict quality control guidelines to ensure they are free of curves, bends or other irregularities. Examine the latches on the head assembly to make sure they are not slowing down the descent down the bore hole. You should choose a durable latch, that will last long and continue to descend without additional drag on the inner diameter of the rods.
- Be aware that surrounding ground formations and your rod string can become magnetized. Consider using a brass extension on your overshot. Brass will not become magnetized and is heavier so your overshot can descend faster.
- Make sure every part is working as it should, and that all parts are clean and lubricated. If necessary, use a degreaser.

Reduce risk of equipment failure

- Always try to take measures to reduce the risk of equipment failure that will require you to pull out rods or go fishing for a rod.
- Choose the highest quality rods that are available in your market. For example, Epiroc drill rods are manufactured under strict quality control guidelines. Make sure to use proper care and handling procedures to keep the rods in optimal condition. Learn about the proper handling and maintenance of drill rods here.
- Inspect rod threads on every rod trip. While you may think that a periodic inspection is enough, when you are drilling deep holes, you should inspect your rods every time.
- Take the time to develop and implement a recurring maintenance program for your wireline equipment, including the head assembly, overshot, inner tube and core lifter. A good program should include setting a life expectancy for every part, recording all the dates when parts were changed and changing parts before they fail. These parts can then be re-used when you drill shallower holes, or where there will be less impact should these parts fail.



Perform detailed equipment inspection and maintenance

- A close inspection of all the parts of the inner tube, including the core spring, core case, joints, bearings, latch, rubbers, landing shoulder, spear head, sure lock and ball and pins will help reduce the risk of having to pull rods.
- Inspect the condition of your wireline and the splices periodically.
- Inspect the jaws on the rod holder and drill chuck before the start of a rod trip to reduce the risk of dropping rods. Most of the wear will occur on both the rod holder jaws and the drill chuck jaws.

Prevent deviation

Reaching the target is the goal when drilling deep holes, There are many factors that can influence the direction of a drill hole but as a rule, the deeper the hole, the greater the chance of deviation. Do everything you can to try and prevent or minimize bore hole deviation by using proper drilling tools, making sure they are in good condition and by applying the proper drilling parameters.

Learn more about preventing bore hole deviation here. Prevention is easier, cheaper and quicker than dealing with a hole that has deviated from your chosen trajectory.



Choose equipment carefully

While point number 1 above advises you to take your time, this does not mean waste time. You should try to do everything possible to avoid down time so you can spend more time drilling, but you should also investigate ways to be more efficient.

Choose the right core bit

- You should always choose a bit that is suitable for the hardness of the ground in which you will be drilling, but beyond that you should consider using full-face crowns which may help improve bit life in deep holes. Learn more about how to choose the right core bit here.

- When choosing core bits for deeper holes, you should be focused on bit life rather than penetration rate. There are so many limitations when drilling in these kinds of depths that hitting production records is unlikely.
- Always try to use the best quality bits available. Make sure the bits are manufactured under strict quality control guidelines, such as the ones used by Epiroc. This will help ensure superior quality and enhanced bit life.





Consider higher crowns

- Once you have a solid understanding of the type of ground conditions in which you are drilling, you can opt for 20-mm or 26-mm crowns, such as Vulcans. This can improve bit life and reduce the number of pullouts required. It has been shown that you can reduce more than 50% of pullouts by using a 26-mm crown instead of a 13-mm crown. Even with knowledge of the type of ground, you should keep in mind that drill holes can have different conditions even when they are in close proximity.

Pick the right rods

- Make sure your drill rods are straight before you start. Choose your rod threads carefully and make sure you use a good quality thread compound with at least 50% zinc, like Pipe Dope.

Use drilling fluid additives

Mud programs are a must

In deep hole drilling, you should be running a mud program even when things are going well. They will help keep your bore hole clean and stable. Use additives that are suitable for the type of ground formation you have, such as Sand Drill for sandy ground, or DD-955 for clay or shale.

Reduce vibration

Using a product such as DD-2000 to maintain viscosity. Torqueless is a good choice for keeping your equipment lubricated and helping to reduce vibration in the hole.



Implement new procedures

Deep hole drilling is an excellent time to implement new procedures that can prevent common problems. Some of the following are simple yet effective tips that you should consider.

- Consider pressure-testing your rod string every time you latch the inner tube. When the water blocks off as the inner tube lands at the bottom of the hole, you simply turn the pump off and wait before opening the release valve. You want to see if the rod string is holding pressure. If the rod string is not holding pressure properly, it may be a sign of excessive rod leakage that can lead to equipment failure and poor bit performance.
- Use a timer and get into the habit of timing how quickly your inner tube descends. You can use a simple kitchen timer. If you notice a drastic increase in the time it takes for your rods to descend, it can warn you that something is wrong. Use the timer to time your drilling runs as well, as this can be useful data.
- Always keep a log book and record what is in your hole and all other pertinent information, including details on new and changing ground conditions, such as fractures, voids, aquafers and changes in geology. You should also track all the equipment that was used – what kind of drilling mud products, bit consumption, all consumables, fuel, core lifters, etc.
- Try to avoid leaving the weight on the rods as much as you can. There could be a piece of core at the bottom of the bore hole that may damage the crown.
- When you are drilling and you reach the bottom of the hole with the bit, proceed very gently, as if you are landing a plane. Avoid dropping the bit to abruptly.
- Always pay close attention to your drilling parameters and try to anticipate what is going on in the hole before it happens.

Conclusion

Whether it be mastering deep hole drilling, improving penetration rates or learning how to mix drilling fluid additives, Epiroc's goal is to make drillers' lives easier and improve drilling performance.

We have a selection of useful how-to guides that are available here.

Should you ever need more precise technical assistance, you can always contact our knowledgeable technical team.



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