Fundamental guide to core bit configurations

Drillers' guide

Epiroc

Content

Introduction

Once you have determined the hardness and condition of the ground you will be drilling, as well as all the other factors that go into choosing the right matrix, the next step will be to choose the core bit configuration.

Once again, the drilling conditions are an integral part of the equation, and some types of ground require different configurations to ensure that the drilling fluids reach the bit effectively. This is necessary to:

- Clean the cuttings away from the face of the bit.
- Cool the bit to prevent burning.

This guide is intended to describe as many options as possible, with the goal of helping you select the right configuration and as a result, significantly improve core bit lifespan.

Configuration options

Shape of waterways

Pie-shaped waterways tend to flush rock cuttings away more easily in soft and broken rock, while Turbo waterways will typically offer a higher penetration rate. A detailed description of each configuration is included in the upcoming pages.

Discharge option

Typical competent ground will not require any additional discharge options as the ejection of cuttings will be sufficient with a basic configuration.

However, a discharge option can be useful in cuttings in block-like creating additional space for the ejection of cuttings from block-like formations.

A comparison chart is included in the next pages.

Width of the waterways

The width of the waterways on the configuration you choose should depend upon the type of ground in which you will be drilling.

For example, in ground with clay, shale or other materials that can swell, you should consider configurations with larger waterways that allow fluids to flush rock cuttings that can cling and clog the bit.

Number of waterways

To obtain more cutting ability from the bit with less weight on the bit (WOB), you should consider adding more waterways to your configuration.

Other options

There are other options that can significantly enhance a core bit lifespan, such as crown height, and additional outer diameter and inner diameter reinforcements. Custom designs are also available to adapt core bits to the most particular projects.

General rules of thumb

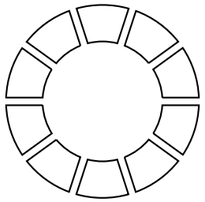
You want to make sure that the drilling fluid has enough velocity to clear the rock cuttings from the bottom of the hole and to carry them up to the top of the borehole.

No choice is made without considering other drilling parameters and rate of penetration.
The number, shape and width of waterways will impact the amount of diamonds in the matrix.

Fewer waterways and smaller widths allow for more space in the matrix for diamonds.
The opposite case would be a turbo option that would cut the rock faster, but would also have fewer diamonds.

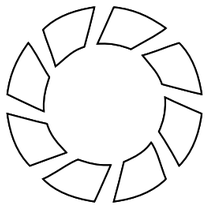
It is possible to do tests with one bit to find the perfect configuration for a job. If, for example, you have tried several matrices and find no great difference between our product and a competitor's bit, it could be just a matter of trying a few different configurations.

Shape of waterways overview



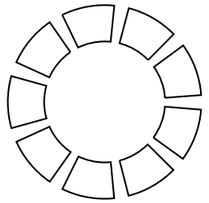
Standard

This configuration has been available for a long time. It has been popular since diamond impregnated core bits were introduced and can be used on most impregnated core bits.



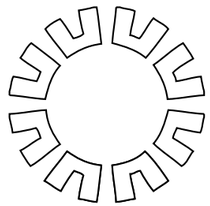
Cyclone

The cyclone can increase drilling fluid ejection and is a good choice of configuration for broken ground, clay and shale ground conditions.



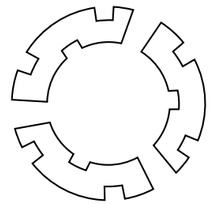
Pie-shaped

The Pie-Shaped configuration is the most popular option. Designed with wedged waterways, it is often the preferred choice when drilling in abrasive conditions.



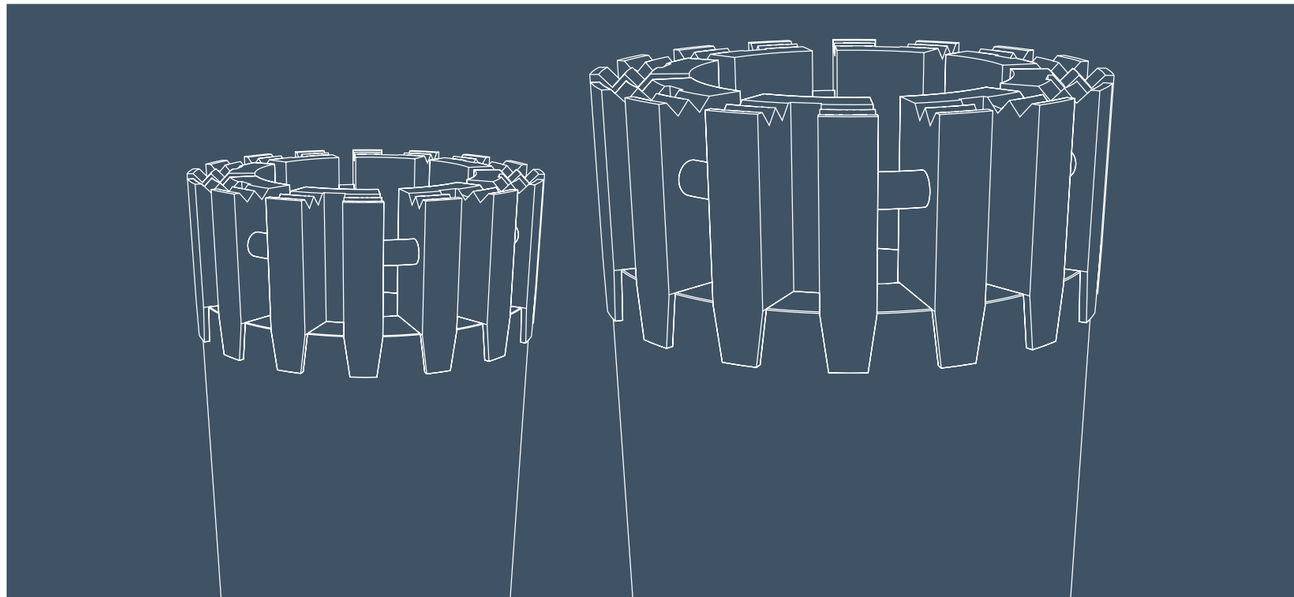
Turbo pie-shaped

The turbo pie-shaped configuration, provides good ejection of fluids and rock cuttings.



Jet

The Jet configuration is similar to the Turbo pie-shaped configuration. It is an excellent choice for competent and non-abrasive rock formations.



Standard

This option is known as a Standard configuration. Well-known and available for a long time, it's been popular since diamond impregnated core bits were first introduced and can be used on most impregnated core bits.

- Provides great fluid circulation from the inside to the outside diameters.
- Is available with wider and/or larger waterways.

The Standard configuration provides good results in fractured ground. In abrasive ground where the outside diameter is wearing out too quickly, it offers just a little more "meat" at the outside diameter to help prevent this wear. This configuration's outside diameter is more resistant to wear when compared with some other configurations.

This configuration has shown to provide good results in highly fractured ground as it withstands pressure well.

The use of this configuration makes the bit tougher when used on a gear driven machine, as the segments are thicker and stronger.

Cyclone

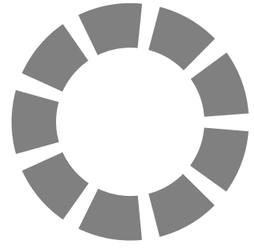
The cyclone can increase drilling fluid ejection and is a good choice of configuration for broken ground, clay and shale ground conditions.

The cyclone configuration:

- Is designed with specifically angled waterways.
- Provides excellent ejection of drilling fluids.
- Works best in broken ground and clay.

The cyclone configuration is a great choice when drilling in the mountainous conditions where clay seams are very common. In these conditions, waterway blockages can occur if you are using a configuration with smaller waterways. The cyclone's larger and angled waterways reduce this type of blockage.

Pie-shaped



The Pie-Shaped is the most popular option designed with wedged waterways and is often the preferred choice when drilling in abrasive conditions.

- Has pie-shaped openings to ensure greater ejection of rock cuttings that may block waterways.
- Is recommended for higher rotation speeds.

This configuration provides good results in fractured ground as its design allows it to cut well in these conditions.

Many drillers will try both the Pie-Shaped along with the Turbo Pie-Shaped configurations in order to get better bit life results.

Turbo pie-shaped

The turbo version of the pie-shaped provides good ejection of fluids and rock cuttings.

- High performance "free cutting" bit.
- In some cases, can reach higher penetration rates when compared with the non-turbo.
- Is available with wider and/or larger waterway configurations.

This is an excellent choice of configuration for normal to fractured ground and has been known to increase the rate of penetration. The design of the crown face means there is less contact area which can provide easier sharpening.

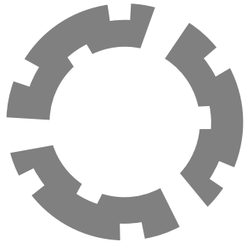
This configuration is recommended for higher rotation speeds making it an excellent choice when used with a hydraulic drill rig, but with the reduced contact area of the crown face, it is also suitable for lower-powered drill rigs.

If you are using the Turbo Pie Shaped configuration and find that it isn't cutting well, you should consider switching the matrix. More often than not, the choice of matrix is not suitable for the ground conditions and may be the cause of poor cutting ability.

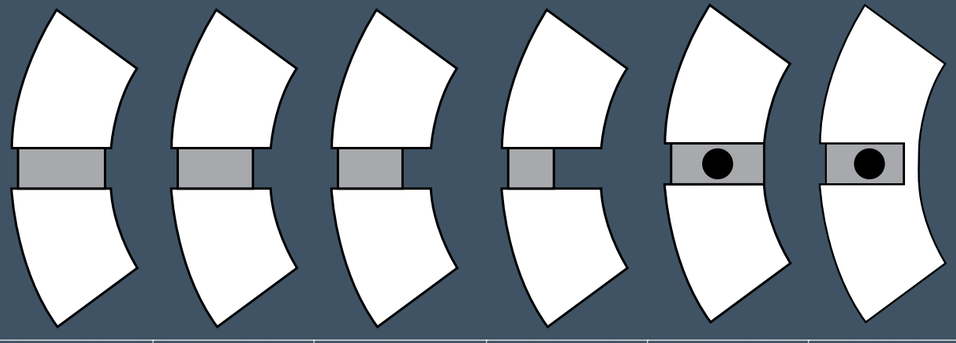
Jet

The JET configuration is very similar to the Turbo Pie-Shaped making it suitable for the same kind of applications.

- An excellent choice for competent and non-abrasive rock formations.
- Provides good ejection of fluids and rock cuttings.

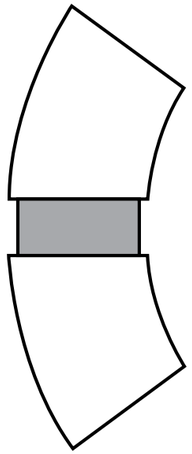


Discharge options chart



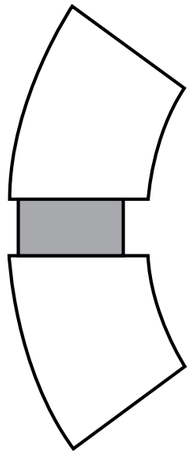
	STANDARD	DEEP WW	DOUBLE DEEP WW	TRIPLE DEEP WW AND SAND	FACE DISCHARGE	BLOCKED WW
Regular flushing	√					
Improved flushing		√	√			
Maximum flushing				√		
Flushing through the crown					√	√
Machined bevel for continuous water flow			√	√	√	√
Reduced core washing						√

The above chart refers to our most common discharge options for core bits. The discharge options are available in most of our core bit configurations. Waterways widths are available in standard sizes - your sales representative can help you select the best product for your needs.



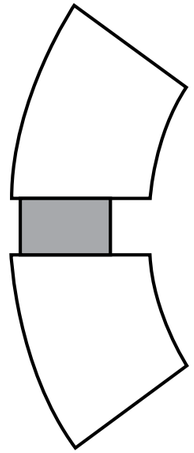
Standard

This is a tried and true option that has been used by drillers for many years. It provides good flushing of drill cuttings.



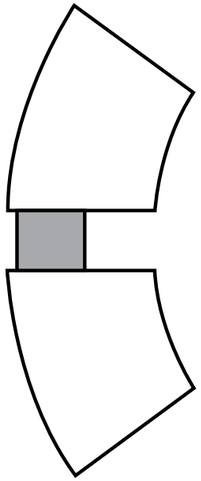
Deep ww

The deeper waterways of this design allow more water to pass, providing better flushing capability.



Double deep ww

The double deep ww design increases the space through which water can flow, resulting in more efficient and better flushing of drill cuttings.



Triple deep ww and sand

The lateral angle and the deeper waterways combine to provide the maximum flushing capability possible with this type of design.

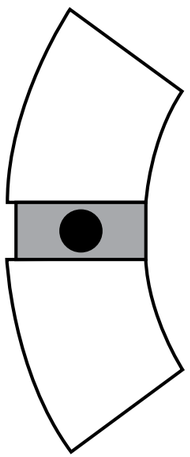
This configuration is a good choice for hard and abrasive ground conditions as well as soft, broken ground. It is a very popular choice for iron ore formations.

The triple deep ww configuration:

- Features a deeper waterway design to increase the space for water and mud to flow to the bit.
- Has waterways that limit water and pressure on the core sample.
- Ideal for soft broken ground.
- Is the preferred choice when sampling in overburden.

This configuration is the preferred choice when performing core sampling in overburden, as well as when using all triple-tube sizes (i.e. Q3). With its deep waterway design, it provides nearly twice the space for water and mud to flow to the core bit as compared to a face discharge design.

This means it can offer better and more direct cooling of the outside diameter of the matrix. This configuration can prevent the outside diameter from losing its gauge prematurely.

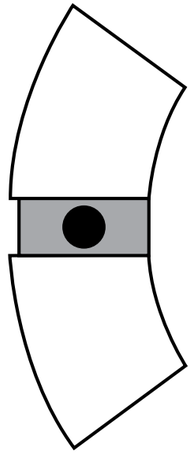


Face discharge

The face discharge design provides a round space in the wall for the water to pass through. This discharge option allows water to flush drill cuttings more effectively.

The face discharge configuration:

- Provides drilling fluid ejection though ports molded into the face of the bit.
- Provides low fluid pressure on the bit.
- Works well in relatively soft ground.



Blocked ww

This design includes blocked waterways to reduce erosion of the core sample. It has been proven to be very useful for core recovery in sandy conditions, making it a popular choice for geotechnical and environmental drilling.

Equally important is the fact that a minimum of water pressure and water is directed towards the core sample. This results in less erosion of the sample, thereby improving core recovery.

Width of waterways

The width of the waterways on the configuration you choose should depend upon the type of ground in which you will be drilling.

When drilling in **softer, unconsolidated ground** you should consider **wider waterways**.

When drilling in **harder, competent ground**, you should consider **narrower waterways**.

For example, in ground with clay, shale or other materials that can swell, you should consider a configuration with larger waterways that allow fluids to flush rock cuttings that can cling and clog the bit.

Number of waterways

To obtain more cutting ability from the bit with less weight on the bit (WOB), you should consider adding more waterways to your configuration.

Other options

Other options or add-ons are available that will tailor your core bit configuration to meet your drilling requirements.

Outer and inner diameter reinforcement:

In abrasive ground conditions, losing the inner or outer gauge of the core bit can become the main issue in ensuring optimal core bit lifespan. Additional outer and inner diameter reinforcements can be added to all matrices at a very low cost, helping to preserve the gauge until as much matrix as possible has been used.

Crown height

This configuration option can allow you to extend your core bit life. The height of the matrix crown should be considered when performing deep hole drilling. The higher the crown the more meters you can achieve before having to change a bit and this can increase your productivity. A matrix with a higher crown, such as the Vulcan or Jet series, currently comes in 16, 20 or 26 mm crown heights.

The Vulcan also provides other features such as a bridge technology that reinforces the diamond sections. The Vulcan 26 mm features a water management system that is constructed with destroyable pins under the bridge to ensure good fluid circulation all the way to the crown.

Jet features a robust and proven design that can withstand difficult drilling conditions. Both Jet and Vulcan can prevent the need for many rod pulls in deep hole drilling due to their longer bit life when compared to standard height crowns

Custom designs

In some cases, particular projects will require special adjustments to the core bit. In other instances, a whole new product has to be developed.

A good technical team and engineering department will be able to support the most unusual requests – don't be afraid to ask!

Conclusion

A wide range of configuration options from which to choose can help ensure that you achieve the best drilling performance, no matter what type of work needs to be done. However, the large number of choices can also be overwhelming, making it hard to know which one to pick.

As a result, many drillers stick to a few tried and true favourites. Unfortunately, while these choices can work for a period of time, drillers may find themselves in a particular formation where their favourite configuration no longer performs well. They are then faced with having to investigate and choose from other configurations that they are not familiar with.

All drillers should know that all Epiroc configurations are available with different waterway widths and come in most matrix heights.

For very challenging situations, we encourage you to contact our technical support team. They have wide and varied experience helping drillers navigate the many choices that are available.

Bear in mind that special configurations can also be customized for specific challenges arising from ground conditions.

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