Straight-hole
bench drilling

Sandvik full-scale approach to hole-precision in bench-drilling operations
Many factors influence the straightness of a drill hole in bench drilling operations; rock properties, drilling method, the condition, power and set up of the drill rig and, ultimately, the design of the drilling tools.

The proper use of sophisticated monitoring systems in the drill rig (e.g. a Sandvik Tamrock Rock Pilot System) will also have an influence. Not only on the quality and straightness of the drill holes, but also on the service life of the tools. With such a system in operation – and by carefully choosing the most appropriate drilling tools – hole deflection of less than 2% is within reach.

If the drill rig is correctly and stably positioned, the feed aligned properly and the drill parameter settings adjusted to match normal rock properties, it should be possible to reach an acceptable level of drill hole straightness with a standard tool solution. A Sandvik MF drill string with a normal skirt button bit (spherical or ballistic) is generally quite sufficient to achieve acceptable margins of hole deflection when drilling in competent rock.

Various rock types, however, require customized solutions to achieve straight holes. In these cases, several types of specially designed Sandvik drilling tools are available. Tools that offer solutions to minimize hole deviation and optimize drilling patterns.

Start off with Sandvik MF extension rods

A drill string with Sandvik MF-rods offers stiffer connections than a string with separate coupling sleeves due to the 50% reduction in thread play. Starting off with Sandvik MF extension rods and – as the conditions and situation demand – fitting the drill string with Sandvik Retrac bits, Drop-Center bits, Guide bits and Guide/Pilot tubes, bench drilling operations step by step can be improved.

If rock conditions involve soft and/or broken formations use a Sandvik CAPP bit with ballistic buttons instead of spherical buttons.
A drill string with Sandvik MF-rods offers stiffer connections than a string with separate coupling sleeves due to the 50% reduction in thread play. Drilling with a stiffer rod package results in improved hole straightness, as well as superior energy transmission and higher drilling efficiency.
A Sandvik T35 tool system enables 54 or 57 mm holes to be drilled using the same stiffer rod dimension as for T38. Thus it can produce straighter holes than the traditional R32 system.

Sandvik GT60 permits the drilling of holes down to 92 mm. By using a GT60 tool system when drilling the typical T51 hole size (102 mm), hole straightness can be greatly improved – thanks to the much stiffer and stable rod package.
Each drill string dimension in extension drilling has an ideal bit diameter with which optimum drilling results are obtained. The right balance between the bit and the rod (and the rock drill piston) not only gives the best energy transmission and drilling efficiency, but also a straighter hole.

Straighter holes mean easier and faster drilling and charging. Less bending and fatigue stresses on the drill string also result in longer tool service life. Add to this the advantages of better blasting results – controlled rock fragmentation, less risk of flyrock, back-break and ground vibrations as well as smoother benches – and you combine the numerous economic benefits with the potential to meet safety requirements.

**Straighter holes can cover total tool costs**
Whatever your current hole deviation – if you can improve hole straightness by just 3%, and use it to increase your burden and hole spacing, you can reduce drilling and blasting costs by at least 5%, thanks to lower specific drilling and charging.

In a normal bench drilling operation, drilling tool costs make up about 5-10% of total drilling and blasting costs. This means that you can save almost the total rock drilling tool costs by drilling straighter holes! And there is a lot more to be gained. Step by step.

**Just start counting**
Assuming a bench drilling operation with a bench height of 20 m, hole depth of 22 m, and a bit diameter of 76 mm, the following results can be achieved: Replacement of a normal Sandvik MF extension rod by a Sandvik Guide tube as the first rod and using a Sandvik Retrac, Drop-Center bit can offer an increase of 100 mm in burden and hole spacing. Consequently, a hole burden and spacing increase from 3.0 to 3.1 meters corresponds to savings in drilling and blasting equal to total rock drilling tool costs.

![Bench height: 20 m. Hole depth: 22 m.](image)

- 22 m (T38, 64 mm) holes drilled in competent granite without guiding equipment.
- Same holes drilled with a Guide tube and a Guide bit attached.
The next step in improving hole straightness is to use Sandvik CAPP Drop-Center bits. The design of the Drop-Center bit is similar to the Retrac bit but features a different bit face.

**Concave bit face**

The center of the bit face has a concave design to better withstand the gauge wear that can cause a flat face design to become dome-shaped, which in turn may cause hole deviation.

**SANDVIK RETRAC BITS**

If hole deflection cannot be kept within acceptable limits by using a normal skirt drill bit, the next step is to use the unique Sandvik CAPP Retrac bit with the MF-rod.

**Special skirt design**

This bit has a special skirt design, the diameter of which is only slightly smaller than that of the bit head. The design of the bit body gives the bit good guidance against the hole wall. The Sandvik Retrac bit features cutting edges at the rear to help the bit drill backwards in case the drill string gets stuck.

**Ballistic buttons**

By using Sandvik CAPP Retrac bits with ballistic buttons, hole deviation can be further reduced. Button shape provides better cut in the rock, helping to maintain hole direction.

Sandvik CAPP Retrac bits are available from 51 mm up to 140 mm (2 – 5 1/2”) to suit Sandvik extension rods T38, T45, T51 and GT60. The Retrac bits are available with either spherical buttons or ballistic buttons.

Sandvik CAPP Drop-Center bits are available from 64 mm up to 140 mm (2 1/2 – 5 1/2”) to suit Sandvik extension rods T38, T45, T51 and GT60. The Drop-Center bits are also available with either spherical or ballistic buttons.
To really optimize the entire drill string for precision drilling of long holes with very high demands for hole straightness, Sandvik MF extension rods should be integrated with a Sandvik Guide tube as the first rod and with a Sandvik Guide bit up front.

**Aggressive bit front design**

The Guide bit feature guiding ballistic gauge buttons which enable both very good penetration rate and at the same time maintain the ability to drill very straight holes. The bit front also incorporates excellent flushing characteristics. A unique body design with stepped retrac wings is designed to match the diameter wear of the front of the bit and make the bit perfectly lined up in the hole during its entire service life.

Sandvik Guide/Pilot tubes are available from 46 mm up to 87 mm (1 3/4 – 3 1/2”) to suit Sandvik extension rods R32, T38, T45, T51 and GT60. The Guide tube is recommended only as the first rod in a MF string.

Sandvik Guide bits are available from 51 mm up to 89 mm (2 – 4”) to suit Sandvik extension rods R32, T38 and T45.

**SANDVIK GUIDE TUBES**

Drilling precision can be further improved by using a Sandvik Guide tube or Pilot tube as the first rod in the drill string.

**Diameter close to bit size**

The diameter of the Guide/Pilot tube is as close as possible to that of the bit, resulting in a very stiff end of the drill string. Thanks to the guiding action of the tube, this tool combination offers the same straightness as DTH-drilling.

Sandvik Guide/Pilot tubes can be used with all types of Sandvik CAPP bits with matching diameters.

**SANDVIK GUIDE BITS**

Average hole deviation within 2-3%

Average hole deviation below 2%

Drilling precision can be further improved by using a Sandvik Guide tube or Pilot tube as the first rod in the drill string.

Diameter close to bit size

The diameter of the Guide/Pilot tube is as close as possible to that of the bit, resulting in a very stiff end of the drill string. Thanks to the guiding action of the tube, this tool combination offers the same straightness as DTH-drilling.

Sandvik Guide/Pilot tubes can be used with all types of Sandvik CAPP bits with matching diameters.

Using a Sandvik Guide tube or Pilot tube as the first rod in the drill string can further improve drilling precision. The Guide/Pilot tube is as close as possible to the bit, resulting in a stiff end of the drill string. Thanks to the guiding action of the tube, this tool combination offers the same straightness as DTH-drilling.

Sandvik Guide/Pilot tubes are available from 46 mm up to 87 mm (1 3/4 – 3 1/2”) to suit Sandvik extension rods R32, T38, T45, T51 and GT60. The Guide tube is recommended only as the first rod in a MF string.

Sandvik Guide bits are available from 51 mm up to 89 mm (2 – 4”) to suit Sandvik extension rods R32, T38 and T45.

**Precison drilling in special applications**
Proper bit grinding ensures maximum pay-off

With metallurgical properties and design matched perfectly to suit the drilling equipment, Sandvik rock drilling tools combine maximum service life with unrivalled performance – provided you take care of the bits up front with proper grinding equipment and routines.

Grinding too often pays more than too seldom

Any professional rock driller knows that a drill bit is not meant to be thrown away as soon as it becomes blunt. And a professional rock driller knows when a drill bit needs regrinding. To facilitate this task, we recommend the use of Sandvik grinding equipment. Our grinding units with accessories – including diamond grinding cups and bit holders – play a significant role in ensuring maximum pay-off from the drilling equipment.

Correct grinding adds considerably to drill bit service life. But equally important, it also enhances the performance of the entire drilling operation, especially hole straightness.

Benefits with straight hole drilling

- Fewer drilled holes – optimized drilling pattern with increased burden and spacing (less specific drilling)
- Reduced consumption of explosives (less specific charging), which accounts for 40-50% of the total drilling and blasting costs
- Longer service life of steel components (reduced drilling tool cost)
- Well-balanced fragmentation (higher productivity in crushers)
- Less secondary blasting
- Smoother and more even benches and less back-break
- Less risk of jammed drilling tools
- Improved safety – better blasting control
- Lower maintenance cost for rigs and rock drills
- Reduced fuel costs
- Less downtime – improved productivity
- Lower total operating cost
Controlled drilling and blasting have become increasingly important. Not only on economic grounds – reducing the cost of explosives, drilling and secondary mucking out operations – but also for security reasons, such as operator safety and controlling ground vibrations in urban areas.

By optimizing drilling patterns, fewer holes need to be drilled, fragmentation is tailored to your production and drilling equipment can be fully utilized to gain more meters at less cost.

**SimQuarry™ and Quarry Academy™**

Choosing the right equipment and tools is crucial for the overall results in the rock excavation process – from drilling through blasting, loading, hauling and crushing to the end product. By using the computer simulation program **SimQuarry™**, Sandvik Mining and Construction can offer valuable assistance in evaluating the entire quarrying process.

**Detailed system properties and 3D graphics**

**SimQuarry™** is an excavation process program which has revolutionized the modeling and analyzing of quarrying operations. Detailed system properties supported by 3D graphics deliver a new level of power and accuracy for quarrying process planning and analysis. The effects of any changes in the process can be seen instantly.

Sandvik Mining and Construction also offers a training program focusing on the quarrying process and the interdependence of its various sub-areas, called **Quarry Academy™**. The purpose of the training program is to highlight total optimization of the quarrying process. The crushing part of the studies is carried out in co-operation with Sandvik Rock Processing.

The **Quarry Academy™** can also be applied to various excavation operations like road and railway projects, hydroelectric power plants and other construction projects.

For more information, please contact your local Sandvik Mining and Construction office.