

Understanding underground

Intelligent solutions for tunneling and underground civil engineering



Cleaner environment with safe tunneling

In the future, underground construction will be more and more essential for increasing the quality of life. As traffic and parking will go underground in the cities, tunnels will make our urban environment cleaner and safer.

Underground construction has its challenges: The costs and risks are always higher compared to above the ground construction. There's always some uncertainty when predicting how the ground will react to the effects of excavation. With proper equipment and with the project process in place, you will be able to excavate efficiently in a safe and environmentally friendly manner.

We at Sandvik focus on continuously developing novel tunneling methods, making equipment safer, more efficient and more productive, giving a result of the highest quality. Our engineers are committed to **decreasing unwanted discharges** – be it exhaust emissions, dust, oil, or something else. In addition, Sandvik equipment is made of almost **100% recyclable materials**, most of the machine types

using biodegradable oils.

SAFETY. OUR TOP PRIORITY.

Sandvik equipment is carefully designed with safety in mind. Our engineers constantly develop solutions to **serve the safety of your operations**, and equipment to offer a protective working environment, with the best of ergonomics. Even so, safety goes beyond machine features and design. It is a state of mind – and one of Sandvik core values. In addition to developing state-of-the-art equipment, we also focus on safety of our own processes: All Sandvik production operations are ISO14001 and ISO9001 certified.

A breath of fresh air



At your service

Understanding underground



Intelligence boosts productivity

Our high quality products, project expertise and comprehensive services are a result of close customer cooperation, open mind and hard work. Investing heavily on research and development (R&D) to maintain a fast pace of product development, Sandvik is always looking for new ways of thinking and more efficient ways to excavate rock.

As a result, we have learnt to understand underground and have thus developed a product portfolio to support the tunneling business on a completely new level, bringing forth the latest in information technology for the job sites to benefit from.

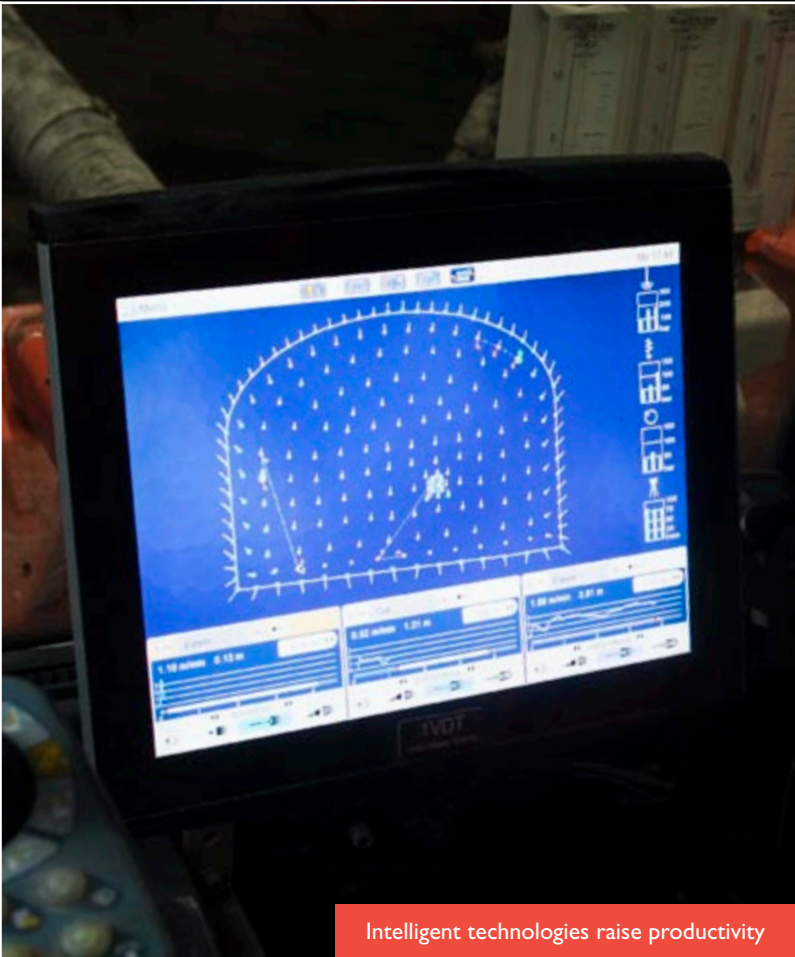
REVOLUTIONARY INNOVATIONS

Revolutionary innovations are born from disobeying conventionality. At Sandvik R&D, we focus on finding solutions that seem to fly in the face of excavation principles. To ensure the best solutions, we have specialized R&D centers for different fields of rock excavation. The Sandvik **Cutting Technology Center** runs its own in-house cutting test laboratory, letting us address particular customer requirements and offer the latest solutions in mechanical cutting for all kinds of soil and rock. In addition, we have specialized R&D centers for **Drilling Control, Rock Drill and Drilling Tools technologies**. As the only manufacturer in the industry, we have a **unique test mine** for practical testing in real life conditions.

Intelligence characterizes Sandvik equipment. For example, with their advanced features, our data jumbos of today represent the 5th generation of their kind.

To ensure your access to the best solutions in the field of rock excavation, we work in close cooperation with universities, research institutes and specialist associations everywhere in the world. As an example, one of the research and development projects produced a more effective, energy-saving cutting system for tunneling roadheaders, while another resulted in a new roadheader type, equipped with state-of-the-art profile control and automatic sequence control systems. The DTi jumbos with iSURE® process optimization tool in drill and blast are yet another outcome of our R&D cooperation, delivering uncompromisingly accurate drilling results to minimize blasting vibrations and taking safety in tunneling – and in tunnels – into new heights.

Own test mine guarantees quality



Intelligent technologies raise productivity

Different methods for different needs

When a project starts, you have to choose between different excavation and working methods. Whether drill and blast, mechanical excavation or hammer tunneling is the best choice depends on various aspects related with the project at hand, such as geology and rock conditions. Sandvik's expertise covers all these methods, helping you to get the most out of your investment. Drilling rigs, roadheaders, hammers and tools as well as maintenance, training, service and support packages for tunneling are all available.

ROCK SCIENCE SUPPORTS PROJECT SUPERIORITY

Sandvik's in-house engineering capacity offers you assistance in project studies and simulations. You can utilize our **project studies** to optimize your excavation process and get recommendations for a balanced fleet.

Project simulations help in analyzing the complete process, working procedures and the resources needed. Among other things, the new iSURE® **tunneling project management and information analysis tool** helps in optimizing the drilling and blasting patterns. It gives

specific guidance for different stages of drilling and blasting, keeping project costs low while guaranteeing smooth proceeding of tunneling work.

Our geotechnical department helps you in geology related issues, assessing the drillability and cuttability of the rock found in your project. With a collection of several thousands of rock sets, our geotechnical department also has excellent tools for rock data comparisons.

Optimizing the excavation process



Optimized fleet makes life easy

Accuracy is the key in tunneling projects, meaning a low level of under- and overbreak, resulting in lower costs and improved safety. No matter which method you choose, the tunnel should be exactly where it was planned to be – on time and on budget. For this, you need equipment and tools to deliver superior quality and are the best match to your tunneling project. Our goal is to meet that need.



TUNNELING JUMBOS

Robust, stable, extremely powerful Sandvik drill rigs come in several models with strong, high precision universal booms and advanced hydraulic rock drills for great tunneling performance. They come with a wide range of options and various levels of automation, including total computer control.

ROADHEADERS AND CUTTING UNITS

Sandvik roadheaders are extremely powerful rock-cutting machines designed to excavate roadways, tunnels and chambers continuously without using explosives. Their ability to excavate the desired profile without causing harmful vibrations is highly valued for both environmental and safety reasons. The roadheader family also includes multi-purpose hydraulic-driven cutting heads for mounting on excavators.

LOADING AND HAULING

Combining smart geometry with powerful thrust, high breakout forces and responsive controls, the Sandvik LHDs fill the bucket quickly and optimally while ensuring operator safety and comfort and low cost per ton. The powerful, ergonomic, highly maneuverable and cost-effective Sandvik haul trucks cover payloads from 15 to 60 tonnes and are built for tough working conditions.

BOLTERS AND BOLTS

The Sandvik bolters supply premium safety in operations through their consistent, mechanized rock bolts installation, comfortable, sound- and dust-proof cabins, and easily accessible maintenance points. With over 30 years of field experience the Sandvik bolters offer maximized productivity in rock support. The Sandvik rock bolt system – RX300 – is suitable for any ground conditions. The system offers a comprehensive, solution for fast and easy rock support, substantially reducing downtime in any tunneling application.

DRILLING AND CUTTING TOOLS

Transmitting intensive impact energy and rotational force into the rock with the least possible loss of energy, Sandvik rock tools deliver good rock breakage, high penetration rates and excellent productivity. Our cemented tungsten-carbide tipped cutting tools cut and remove material quickly and economically and provide high productivity with less strain on the machine and lower energy consumption.

HYDRAULIC BREAKERS

Reliable, low-maintenance, easy-to-fit and tough performance Sandvik hammers raise productivity and optimize results in any tunneling project where a boom-mounted percussive tool is needed.

MOBILE CRUSHERS AND CONVEYOR BELTS

A wide range of mobile crushing and screening solutions are available on crawlers or on wheels. Compact, very stable and of low weight, the Sandvik crushers meet high demands for mobility both on site and on the road. Sandvik belt conveyor, combination of lightweight construction and reliable components, makes muck removal fast and effective.

SUPPORT AND SERVICE

Sandvik offers worldwide parts and consumables support, technical support, training and education, repair and rebuild services as well as financing. Now also for BASF-Meyco machines



A revolution in accuracy

The iSURE® tunneling project management and information analysis tool is one of the cornerstones in intelligent tunneling. **It helps optimizing the drilling and blasting patterns.** The project costs will remain low and smooth proceeding of the tunneling work is guaranteed as the iSURE gives specific guidance for different stages of the process. With the DTi jumbos, they form an unbeatably accurate rock excavation system for tunneling and underground spaces.

STARTING FROM THE END

Only seamless interaction of drilled pattern, charged explosives and detonator delays can provide optimum excavation results in terms of round bottom and profile control, drilled meters, powder factor, pull-out rate, vibration control, tunnel advance and costs. Therefore, an overall approach for the tunneling project is an absolute necessity when excavation quality is on focus.

iSURE® is **an integrated solution that combines tunnel line, theoretical profile design, drill plan design, bolting**

plan and data collection analysis. The undeniable strength of the tool is the pattern designed – contrary to the traditional approach – at the end of the round where successful blasting is at its most critical stage. This provides hole burden calculus and optimization of hole location, ensuring optimized blasting and supplying better pull-out, decreased need for scaling, increased rock loadability and smoother collaring in the following round.

The tool consists of four separate modules: iSURE® Tunnel for drill and blast design, drilling pattern design, longhole pattern, tunnel line and project files; iSURE® Report for drilling management and process development; iSURE® Analysis with measuring-while-drilling data collection; and iSURE® Bolt with bolting pattern navigation, and reporting and analysis of bolting.

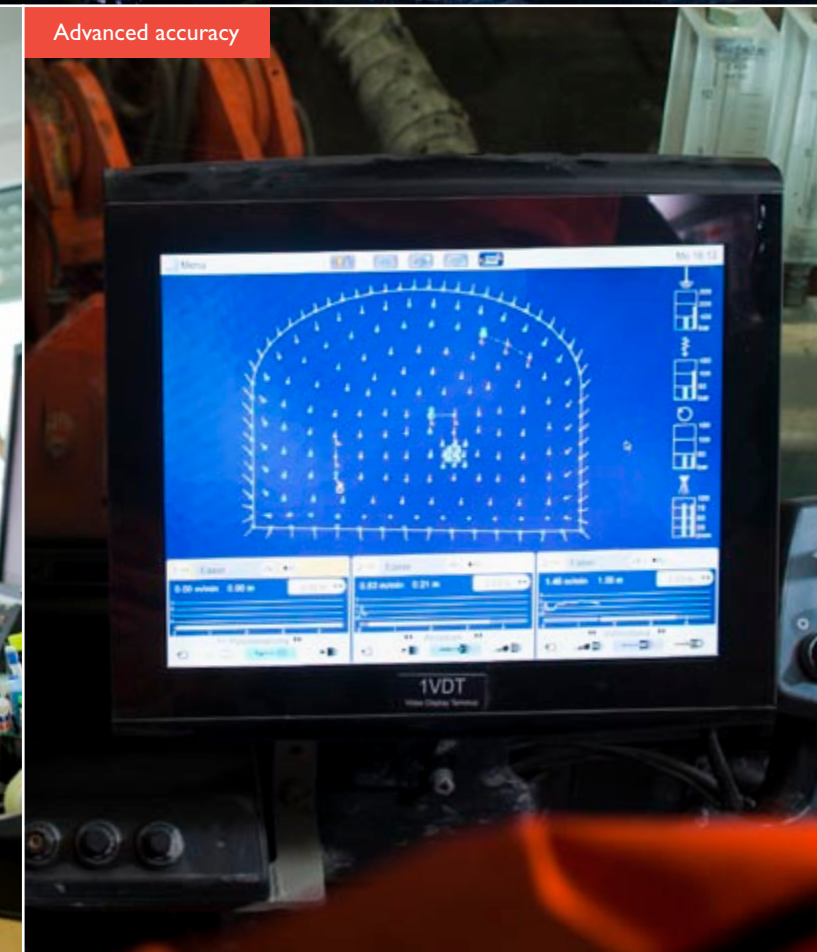
”Sandvik’s unrivaled intelligence in tunneling gives us a whole new perspective on how things can be done.”

LINUS NYQVIST
Work Planner
Bilfinger Berger Civil Odenplan AB
Sweden

Managing the whole project



Advanced accuracy





No fuss Just drilling

DTi SERIES – ON THE FAST TRACK

Sandvik DTi series' intelligent tunneling jumbos are **fast, accurate** and **user-friendly**. The series is available in four models for excavation of 12–211 m³ cross sections, including face drilling, bolt hole drilling and mechanized long-hole drilling.

The DTi jumbos are designed with successful operations in mind. Together with the iSURE® tunnel management program, their **intelligent control system**, high frequency RD525 rock drills, robust booms and advanced drill string guides offer **excavation results of the highest quality, with the lowest costs**. Although meant for automatic use, their advanced features - **Lock-to-Target**, **QuickStep**, and **Dynamic Correct** - allow the operator to finetune the process if the rock conditions so require. The DTi cabin offers the operator a comfortable safety zone with excellent visibility and ergonomic work stations.

The DTi design focuses on **ease of service**. The components are damage-protected, and all daily service points are accessible from the ground level.

DT SERIES – ALL-AROUND PERFORMANCE

The DT series offers a full range of 1 to 3 boom machines for 9–203 m³ cross sections, equipped with a utility boom when needed for fluent work process. Modular design makes the jumbos flexible and versatile: They can be used for fast face drilling, mechanized long hole drilling and bolting tasks. The DT series includes models from hydraulic controlled drill rigs with safety canopy to computer controlled rigs with a cabin. Instrumentation is available for versions.

The Sandvik DT series guarantee cost efficiency via minimized over- and underbreak. Their excellent advance rates and optimized cycle times keep your tunneling project in time.

VISIONS MADE REAL

As all Sandvik equipment, the DTi and DT jumbos are engineered with safety and environment in mind. Big tires and safe brake systems offer excellent stability while advanced safety cabins offer the highest standard insulation of noise and vibration. The large window surface guarantees excellent visibility.



”We are really happy with the DTi and iSURE system. We can save time in preparation works as well as the site itself, and you can really see that the system is designed for the people on site.”

HARALD KOMPATSCHER
Production Manager
Consorzio Galleria Roveredo, Switzerland

Tough tools

Guaranteed productivity

Straight holes, high penetration rate and low costs per meter are the key factors in productive tunneling. Sandvik rock tools offer all this. As the only supplier with in-house resources for both cemented carbide production and R&D as well as drill steel production and R&D, Sandvik can control the **whole supply chain from raw material to finished products**. We constantly upgrade and develop our tool system components to provide new, profitable solutions of the highest quality for rock drilling professionals.

EXCELLENT ACCURACY. LOW COSTS

The Sandvik Alpha drill string rod/bit connection features advanced thread design. The short thread on the hexagonal rods in the tool system results in a rigid, integrated power pack drill string. This offers **superior resistance to bending stresses, improved bit guidance**

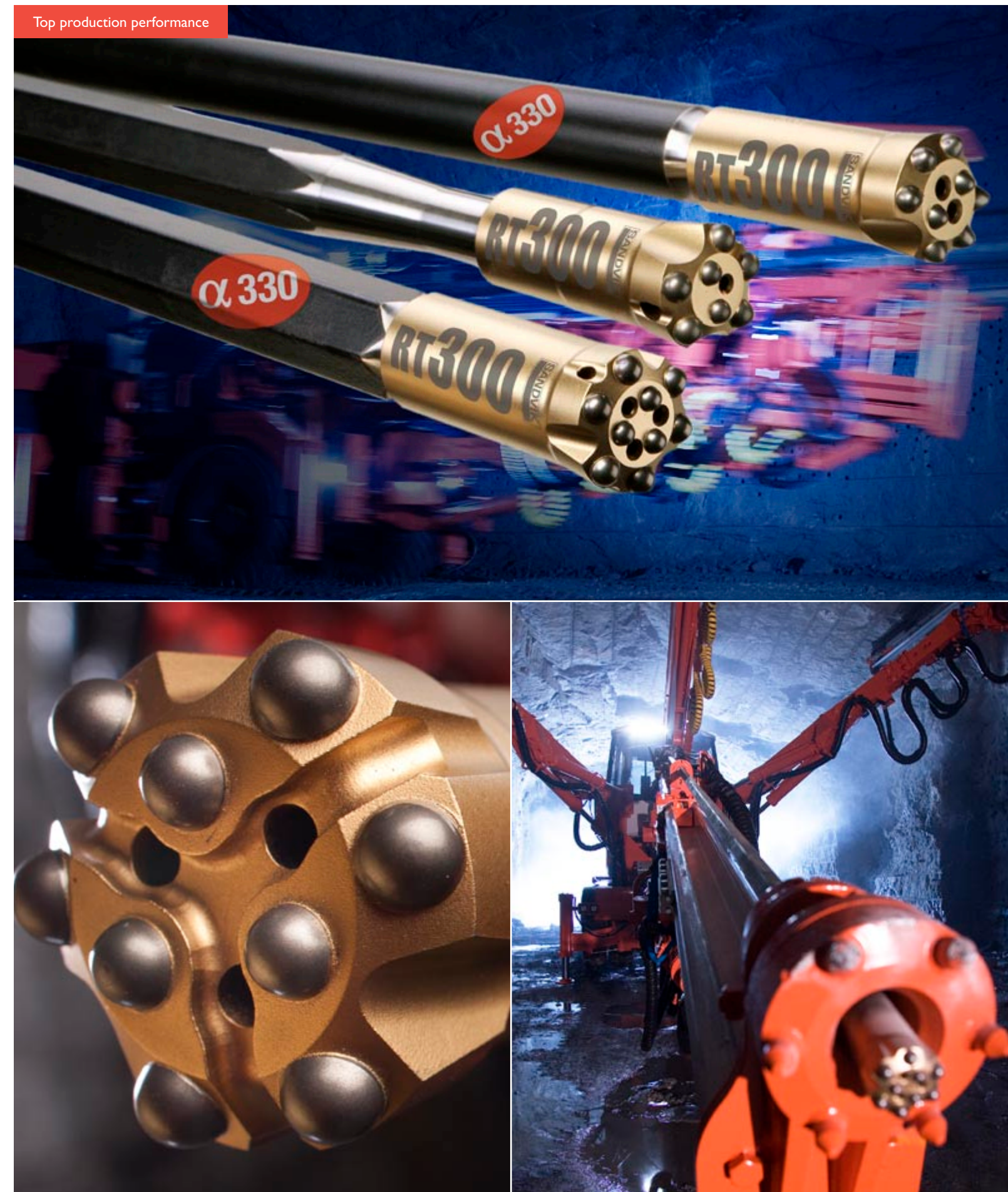
and **perfect energy transfer**. Providing longer life for the rod as well as the shank and the bit, Sandvik Alpha reduces total drilling costs by 20%.

NO MORE CARBIDE BREAKAGES

The RT300 series of button bits are made of optimum cemented carbide for drilling in an extensive range of rock types. The grade XT48 (XT for Extra Tough) carbide's higher density and more homogenous structure results in exceedingly **high wear resistance**. With Sandvik RT300s up front in your jumbo, you can maintain top production performance with extended bit life, reduced downtime, high productivity and minimized bit costs.

FAST GROUTING

Sandvik Extra is a unique system for grouting and exploration in tunnels. It offers fast transition from face drilling to long hole drilling, fast penetration and considerable savings in cement consumption. The system is particularly suitable for conditions with hard restrictions on inflow water.



Excellence in bolting



Rock solid hold

The ground conditions at the project site dictate the requirements of rock support. As safety requirements increase, so does the demand for fast, reliable and economic reinforcement methods. The Sandvik bolters supply **premium safety** in operations through their consistent, mechanized rock bolts installation and safe, comfortable, sound- and dust-proof cabins along with easily accessible maintenance points.

With over 30 years of field experience, Sandvik is able to provide a **unique bolting concept** with maximized productivity in rock support. Our bolters are equipped with **the shortest bolting head on the market**, which can be adapted to **all types of rock bolts and lengths**.

The Sandvik bolters also feature an on-board cement mixing and grouting system, a fast rock drill and a utility boom. With separate feeds for each function, the robust square-shaped booms allow using adjustable wear parts.

Sandvik bolters and bolts offer premium safety in operations.

JUST ADD WATER

The Sandvik rock bolting system – RX300 – is suitable for virtually any ground conditions. Applications include road and railway tunnels, freshwater tunnels, hydropower plants and civil structures. The system offers **a comprehensive, packaged solution** for fast and easy rock support, substantially reducing downtime in any tunneling application.

The RX300 features a folded steel tube with a bushing at each end. When in the drilled hole, the tube expands radially to provide a flexible interlock with the rock. This gives immediate full bolt length support.

Involving no grouting or chemicals, the system is **clean and easy to install**. It adjusts to drill hole irregularities and diameter, and supplies reliable installation quality.

Fear no vibrations Just cut

Sandvik roadheaders are extremely powerful and robust rock cutting machines that let you focus on the essential: breaking on through to the other side. These roadheaders are designed to excavate roadways, tunnels and underground chambers without using explosives that cause harmful vibrations. This is highly valued for both environmental and safety reasons, making roadheaders extremely suitable for underground construction in urban areas. The Sandvik roadheaders are equipped with **state-of-the-art profile control**, **automatic sequence control system** and **on-line data processing possibilities**.

POWERFUL CUTTING.ADVANCED FEATURES.

Sandvik MT-series roadheaders for construction covers four models: MT720,MT620,MT520 and MT360. They feature powerful, **geometrically optimized, transverse cutter heads** – and MT520 also an interchangeable inline cutter head – proven to give the best cutting performance in a wide range of rock formations. Each of the machines has its specialty: The MT720 is a boom-type roadheader with modular design in the 100 tons class. Equipped with ICUTROC technology, it is at its best in hard and abrasive rock formations. The MT520 – also in 100 tons class - is designed with easily exchangeable modules and features an 8-meter cutting height module making the machine extremely suitable for large road tunnels. The MT300 is a robust and compact machine for water tunnel and road tunnel construction in the 50 tons class.

CUTTING HEAD.AN IDEAL COMPLEMENTARY TOOL.

Sandvik MA-series' hydraulic driven cutting heads are designed for **quick and easy mounting on suitable excavators**. With aggressive, geometrically optimized transverse cutting structures, tried and tested on some of the world's most rugged tunneling machines, they are efficient multi-purpose tools for various applications including scaling, tunnel rehabilitation, and roadway leveling. The Sandvik MA hydraulic cutting unit is an ideal complementary tool to close the gap between shovel and hammer/breaker or ripper. The MA units can be adjusted to fit different excavator units and they are available from 100 to 200 kW power range.



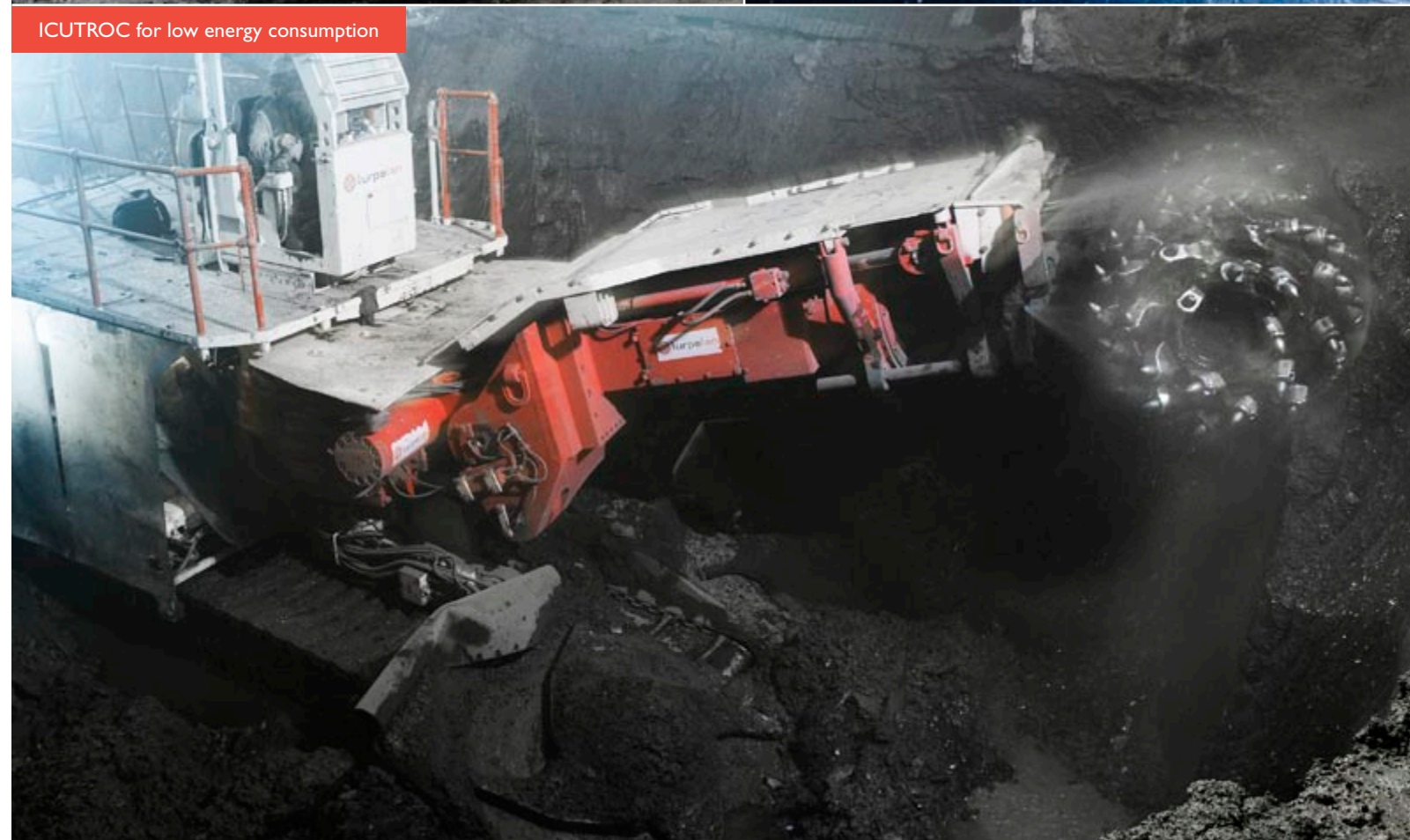
”I don't think one can find a better solution in mechanical cutting.”

SILVESTRE VILLA
Operations Manager
Lurpeko Lan Bereziak
Spain

Versatility with exchangeable modules



ICUTROC for low energy consumption



Reliable performance



Breaking the way through

Sandvik hydraulic hammers are reliable, low maintenance and easy-to-fit. Giving the highest performance, they raise productivity, optimize results and give a low cost per ton for the material broken. Our offering includes a wide variety, from small range to heavy-duty large series, of hammers for tunneling applications.

The small range hammers are available in a variety of housing and mounting configurations. They incorporate a **proven Sandvik Constant Blow Energy (CBE) system** that ensures maximum impact energy with every blow, giving optimum productivity and profitability.

The mid-range hammers represent the latest technology in breaker design. They are equipped with **SandvikVIDAT system** and a sound-suppressed housing for operator comfort.

The large models offer a powerful, durable and reliable breaker package for professionals worldwide. A pressure control valve ensures that every blow is delivered with maximum power while an optimised piston design transfers blow energy efficiently for the best breaking performance.

Manufactured with heavy duty housing and a **HARDOX lower boot for optimum wear resistance**, all models are designed to be easily maintained and reliable. **A built-in air port and channel** enable use of compressed air, which prevents dust entering the breaker power cell. In addition, **Ramair cools down the breaker mechanism** and improves lubrication when working on horizontal position.

Integrated into Sandvik breaker housing, **Water Jet** option is designed to **suppress air borne materials or dust** during hammer tunneling operation.

Sandvik hydraulic hammer offering includes a wide variety of hammers for tunneling applications

Comfortable operation

True productivity

Sandvik LHD loaders are developed for the toughest of underground applications, with overall production economy, safety and reliability in mind. Combining smart geometry with powerful thrust, high breakout force and responsive controls, they fill the bucket quickly and optimally. The LHD's low center of gravity ensures excellent machine balance. Together with high tramming speeds, this gives you very fast cycle times, resulting in extremely high productivity and low cost per ton shifted. All important auxiliary functions and safety features come as standard.

THE EASIER THE WORK, THE BETTER THE PRODUCTIVITY

One of the key areas in the design of Sandvik loaders is the operator ergonomics. Long shifts in a highly demanding environment emphasize the need for combining comfort with efficiency: The easier the work, the better the productivity. Our strong safety cabins offer adjustability of the user environment. High priority is also placed on ground level daily service. Therefore the machines are equipped with Vehicle Control and Management System, giving guidance in maintenance actions.

Sandvik diesel-powered LHD loaders are all equipped with efficient, low-emission diesel engines. They also come in electric versions, emitting no exhaust fumes, thereby offering an improved working environment and less ventilation costs for the tunnelers. The LHDs are especially suitable for small tunnels or projects with long tramming distances or steep inclines, but a wide range of choices with side-tipping bucket option are available for tunneling applications.

LOADED WITH AGILITY

Sandvik underground haul trucks are powerful, safe, extremely reliable, cost-effective and highly productive solutions for rock haulage. With FEA-optimized frames and dump boxes, powerful diesel engines, advanced power train technology, four-wheel drive and ergonomic controls, they are highly maneuverable and very fast. The Sandvik haul trucks have a compact design in relation to high capacity and short turning radius: all models are designed to operate fully loaded on long spiral gradients of up to 20 % at high speeds.



High speed. Fast cycles.



Sandvik LHD's are highly maneuverable and very fast.



Experience in conveying



Cost-efficiency in muck removal



Unique insights in conveying

Sandvik has a highly skilled projects division specializing in the design, manufacture, installation and commissioning of complete conveyor systems for use in a full range of conveyor applications. In addition to designing new systems from scratch, we undertake upgrading projects to expand or optimize and modernize existing conveyor systems.

Sandvik has developed numerous solutions for the special demands and extreme operating conditions of any conveyor applications. Our expertise extends to conveyor systems for all kinds of civil engineering application. The long-distance systems provide cost-effective and more eco-friendly alternatives to muck removal. Together with our innovative solutions for reducing noise and dust emissions, they point toward a cleaner, brighter future.

Thanks to our close involvement in all operational sequences in tunneling cycle, we have unique insight into the demands placed on handling cut rock at every stage of tunneling process.

Sandvik has developed numerous cost-effective solutions for tunneling operations.



Standing by you

Service is – of course – a matter of being available when problems occur. However, we at Sandvik prefer seeing it more as an investment; effective service is the key to profitable tunneling. No matter how good a machine is, at some point it will need service. Avoiding lengthy and costly downtime is a prerequisite for a smoothly running operation.

The trick really is to be proactive. This is where excellent machine serviceability and advanced features such as self-diagnostics and USB updating systems come in handy – they help you make well-grounded and preventive maintenance plans.

SERVICE THROUGHOUT THE TUNNELING WORLD

Investing in preplanned service will help you protect your business from unexpected risks and lets you concentrate on your main processes. Our service network covers every corner of the world. The service personnel has gathered experience from more than 30 000 mobile hydraulic machines and they can draw on each others expertise, anywhere, any time. Sandvik global logistics system ensures fast deliveries of consumables, ready-made maintenance kits and genuine spare parts for trouble-free operations. You can be sure that your machines are in the best hands.

We also focus on delivering the best support for a smooth start-up of your machine. Training programs customized for your needs are also available – with our professional, highly experienced product masters as trainers.

NOT ONLY SANDVIK BUT ALSO BASF-MEYCO

According to Sandvik and BASF-Meyco a global agreement, Sandvik offers maintenance and parts support also for Meyco machines. This offers simplicity for the customers - whenever there is a need for maintenance or parts, you will have one single point of contact.

Global service



Genuine spares for top performance



Support you can count on

Productivity in Action

Sandvik is a high-technology engineering group with world-leading positions in selected areas – tools for metal working, advanced materials technology, and mining and construction. We are represented in 130 countries.

Sandvik Mining and Construction represents one third of the overall Sandvik Group and serves a broad range of customers in construction, mineral exploration, mining and bulk materials handling. Our construction expertise covers quarrying, tunneling, demolition and recycling, and other civil engineering applications. Our mining products and services support customers on the surface and under ground, in all mineral, coal and metal mining applications from exploration to ore transportation.

