Minova manufacture a range of compressed air operated, telescopic leg type drilling & bolting machines. My intention today is to give you an overview of the 5 main product variations and their applications. These are all lightweight, high performance machines, which were developed originally for the mining industry.

The design of the machines makes them readily adaptable to different types of drilling and bolting applications, and as such they can be used in the tunnelling and civil engineering industries. The machines offer flexibility, rapid set-up, ease of use, little maintenance requirements and low operational costs.

Minova are able to provide design proposals for the mount and operation of our machines to suit many different applications.

Slide 2

The Super Turbo Bolter is a compressed air operated, telescopic leg type drilling & bolting machine used for the installation of resin bonded rock bolts in underground roadways. The machine is lightweight, portable and offers a large degree of flexibility in terms of the bolting pattern and operating height.

The Super Turbo consists basically of an air motor and a drill unit mounted on a telescopic leg which usually has 2 or 3 extending sections. The operations of the machine, which include drill rotation, leg thrust and water feed, are all via a centralised rigid control handle, which is connected to the head unit by means of a distribution pin. The handle provides the operator with full control of the machine away from the immediate drilling area and under the protection of previously supported ground.

The telescopic leg provides the thrust to the 4 piston motor, which rotates the drill chuck through a crank shaft and gearbox. In this way the drill rod and drill bit can be rotated and thrust through the roof strata to drill the hole. Similarly, with the use of an adaptor, the roof bolt can be spun and thrust through resin capsules, mixing the resin and installing the bolt. Finally, the torque from the motor...
can be used to ‘break out’ the shear pin on the nut end of the bolt, allowing a washer plate to be tightened up to the strata.

**Super Turbo Bolter**

| Leg extension |
| Impact resistant and hard wearing leg material |
| High performance piston motor |
| Lightweight and strong |

**Slide 3**

Essential Health and Safety Requirements have been adopted in the design and use of our machines. Minova’s drilling & bolting equipment has been designed and manufactured so that it is fit for its function, and all measures have been taken to reduce or where possible, eliminate any risks that may occur either during normal or abnormal use.

The machines are supplied as stand alone units, but we recommend the use of special hose line fittings which are considered essential for safe operation of the machines and should be fitted on both the air and water supply lines.

All operators should be fully trained and be familiar with the safe operation of the machines. On site training can be provided by Minova if required.

Instructions for the safe use of our machines, including start up checks and the correct drilling & bolting procedures; along with troubleshooting and basic maintenance, are supplied with each machine.

All the materials used in the construction of the machines, including the non-metallic parts, have been examined and do not present a health and safety hazard to the operator. They are considered suitable for use in an underground mining environment.

The Super Turbo Bolter is designed to be moved and located in position by hand, and is fitted with a lifting handle attached to the base and carrying handles on either side of the head unit. By the use of these handles one man can easily lift and move the machine to the next bolting position. The handles on either side of the head unit are also used by the operator to support the machine during the setting up of operations.

The Super Turbo has also been designed and constructed with the aim of reducing vibration produced by the machine to the lowest possible level, as required by the UK’s ‘Supply of Machinery (Safety) Regulations’ 1992.

**Slide 4**

Compared with other similar machines Minova’s Super Turbo Bolter offers some significant benefits to the user.

Due to the reduced ‘fixed height’ achieved by side mounting the motor, rather than a top mounting, the design of the Super Turbo enables it to achieve greater leg extension on 2 leg stages than other machines achieve on 3 stages. This is very important since there is almost 50% more thrust
developed, due to the larger cross sectional area of the 1st stage, when drilling or installing a bolt with the Super Turbo as compared with other machine types which require a 3 stage leg for similar reach. This design has the further benefits of faster drilling rates and less drill rod changes. The Super Turbo leg assembly is made with fundamentally different construction techniques, giving it a much longer operational life and increased resistance to damage. This gives the user longer machine availability rates and reduces leg replacement costs.

Power comes from a 4 cylinder high performance and low maintenance motor. This motor design gives higher and more consistent power output with longer service intervals. The careful selection of materials and design has resulted in the Super Turbo being the lightest and strongest machine of its type, enabling it to be operated reliably and effectively in the toughest mining environments.

The leg sections are manufactured on a filament winding machine, to form a tough, hardwearing, homogenous structure, using a carbon filled resin to provide the required conductivity. It would be cheaper and quicker to produce a laminate leg, as some manufacturers do, by first applying the resin to the mandrill and then winding on the dry filaments. A top coat of resin could then be applied. This design however produces a more brittle leg which is susceptible to surface damage and usually has a shorter working life.

The drive head comprising of the air motor and drill unit is a cast nylon component, which is subsequently machined and fitted with pistons, crankshaft, gears, bearings and seals. On retraction of the legs, an integral dump valve directs the used air not directly to atmosphere but through the transmission, which provides constant lubrication to the moving parts, thus reducing wear, whilst at the same time reducing the noise emission from the dump valve.
The machines work at their peak performance with 6 bar dynamic air pressure and 3.4m³/min air flow. Even at 4 bar however, the Super Turbo will drill and bolt satisfactorily and out perform its rivals due to the efficient 4 piston motor and the longer leg.

The water pressures and flows are only required if wet flushing is being employed. Air flushing or vacuum extraction systems are also available.

You can see how the thrust performance reduces with each additional leg stage used, due to there reducing cross sectional area. It's much better to be installing a bolt on the second stage of a Super Turbo than on the third stage of an equivalent ‘top mounted motor’ machine. This difference becomes even more pronounced if the air power is low.

Thanks to ingenious profiling of the teeth on the primary gear, Minova are able to offer a high torque option for cable bolting or when air power is low, or a high speed option for an improved drilling rate in soft ground.

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5 standard leg sizes cover every option from a closed height of 1m to an open height of 4.6m. This usually provides a machine for every occasion however if smaller or larger machines are required for specialist situations then Minova can design bespoke equipment to suit a customers needs.

At 45.5kg, even the largest standard machine can easily be handled by one operator.

The 19mm hexagonal chuck is the standard chuck option. It will accommodate either a 19mm hexagon drill rod or a 22mm hexagon with a 19mm drive end. This chuck allows rapid drill rod changes and provides good alignment. A high degree of sealing occurs between the drill rod and the base of the chuck whilst drilling. Rods with or without an o-ring water seal can be accommodated.

The chuck is also fitted with a long life, high pressure water seal which prevents the ingress of water into the gearbox.

We alternatively offer an externally threaded chuck. A drill rod captivation system can then be employed or, in conjunction with a threaded ‘E’ type adaptor we can fit various chuck extensions or use the ‘E’ type tubular male / female extension drill rods. This type of drill rod system is particularly suited to the higher thrusts associated with cable bolting.
I would now like to introduce the Stinger. The Minova Stinger is a lightweight aid to safe and efficient roof bolting. Versatile uses include locating and supporting ‘W’ straps and/or mesh during roof bolt installations. The provision of a control handle allows the operator to remain under supported ground giving added protection. The standard stinger can operate between 2.4 and 4.3m height, using the same air power as the Super Turbo. Again, shorter or longer Stinglers can be made to suit particular requirements.

Slide 10
Various top end fittings can be supplied to match the task in hand.
At just 30kg the Stinger only requires one operator and the power retract facility makes for easy handling.
The Stinger uses the same leg winding technology as the Super Turbo which results in low maintenance costs and the twin foot spike design gives good stability.
The built in dump valve prevents damage and over pressurising of the leg. A check valve is also fitted which maintains pressure to the leg in the event of a loss of air power.

Now we come onto Minova’s Rib Bolter.
The Remote Rib Bolter is a single stage compressed air drilling machine mounted on a light weight Stinger air leg. It is suitable for drilling and placing bolts at any angle through 360 degrees and in any direction. It is operated remotely through an umbilical hose. This allows the operator to use the
machine from a safe position and gives the added benefit of being classed as a ‘vibration free’ machine.
This versatile machine is suitable for a variety of strata reinforcement or exploration duties.

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Compared with hand held rib drills the Remote Rib Bolter has no hand arm vibration issues, is high speed particularly when long hole drilling, and offers easy and safe operation due to the power retract facility and the ability to work a safe distance away from unsupported ground.
For soft or broken ground situations the Remote Rib Bolter can be supplied with left hand rotation. This facilitates the installation of fibreglass self drilling bolts which can not be installed with a percussive drill. These bolts have a significant advantage over steel self drill bolts where either longevity or cut ability are desired.
The drilling unit is fitted to the Stinger leg with a quick release clamp which can be positioned to suit the bolting pattern. Alternatively different mounting options are available to suit other machinery such as road heading machines or face line equipment.

Remote Rib Bolter

Most of the technical parameters are the same as for the Super Turbo however you will notice that the standard drill/feed unit has a stroke of 1.2m. This has been designed primarily to facilitate 1m extension drill rods for long hole drilling however with the use of a chuck extension the Remote Rib Bolter is an ideal tool for rock bolting in an arched profile roadway or circular tunnel.

Remote Cable Bolter

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(Slide 14)

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The 4th machine I would like to show you today is Minova’s Remote Cable Bolter.
This machine is designed for rapid, larger diameter and longer hole drilling with all the benefits of remote operation.
It comprises a 2 stage Super Turbo attached to a Stinger leg by a nylon guide bracket. As with the Rib Bolter, this arrangement is also ideal for 1m extension drill rods with the high thrust 1st stage of the telescopic leg being utilised for the majority of the drilling. The guide bracket has the useful facility of allowing the drill unit to be swung out of the way after the hole has been drilled. In low height roadways this significantly eases the installation of the flexible tendon. Once the tendon has been inserted into the hole the drill unit is swung back into place and located once more into the guide bracket. This guarantees correct alignment and ensures that the tendon can be safely spun through the resin capsule and installed to the strata.
Remote Cable Bolter

- Eliminates vibration problems
- Remote controls on umbilical
- Effective high performance thrust
- High torque motor
- Optional chuck speed
- Lightweight
- Reduced noise
- Low maintenance cost

Having the controls remotely on the umbilical hose once again eliminates any vibration from the machine. The operator can also stand away from the borehole in a safe position and away from the flushing water. Also he does not have to resist the torque action of a free standing Super Turbo and for operators who are drilling for most of the working shift this significantly reduces their work load. The combination of the high torque gear and drilling mostly with maximum thrust offers the fastest drilling rates for the given air power. A consequence of this is reduced maintenance costs per unit length of drilled hole.

The drill unit and Stinger sizes can be adjusted to suit specific job sites but you can see from the figures that the standard machine’s heaviest part is only 35kg and can therefore be easily handled by a single operator.

The other parameters are as you have seen before because the Remote Cable Bolter utilises standard components from the Super Turbo Bolter and the Remote Rib Bolter. These are mostly interchangeable, allowing for reduced spares stock holding.

Twin Leg Super Turbo Bolter

- Ultra high performance thrust even at low air pressures
- Twin leg stability
- High speed drilling and cable insertion
- Balanced for ease of handling
- 2/3/4 stage machines available
- Suitable for installation of solid anchors and flexible tendons

The Twin Leg Super Turbo is the latest development from Minova UK and is the final machine I would like to show you today.
Designed primarily for cable bolting in mines with reduced air power, the twin leg design develops double the thrust of the standard machine, offering maximum drilling rates and easier operator control.

It is also suitable for the installation of solid anchors and, because of the extra thrust capability, can be supplied with 4 stages. This caters for bolting in very low height situations with effective thrust even in low air power situations.

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Obviously the twin leg machine is going to be heavier than the standard Super Turbo, but at 55kg it is still very manoeuvrable.

You can see that at only 4 bar dynamic air pressure the Twin Leg machine delivers 1.3 tonnes of thrust from stage 1. That is a 30% improvement over the standard machine at 6 bar.

As with the other machines in the Minova range the ‘Twin Leg’ can be fitted with a captivated chuck option as shown in this photograph.

Even at reduced air power the drive unit produces sufficient rotational speed to correctly mix the resin and sufficient torque to both ‘break out’ a shear pin torque nut and then pre-tension a solid rock bolt.

Of course with higher air power all aspects of the performance are significantly increased and in experienced hands the drilling rates can be almost doubled.

The bolting machines I have outlined today are of course only one part of the geotechnical package. When used in conjunction with the best consumable materials and strata monitoring equipment, excellent results can be achieved.

I’d like to thank the conference organizers for inviting me to talk to you today. Also my Director, Peter Bell for permission to present this paper; and to several of my colleagues for help in it’s preparation, particularly Jim Scott & Nick Smith.

And finally, if you have any questions or would like more detailed technical information, please feel free to ask.

Thank you for your attention.