

Drill and Blast Cycle

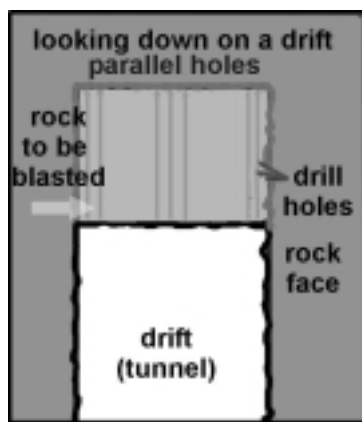
(Courtesy of Sandvik Tamrock Canada)

This animated video demonstrates the steps involved in making a tunnel. The example shown is a large tunnel, such as one made to be used by cars or trains, but the tunnelling process is the same for mining underground.

Step 1 Drilling and Surveying

A **jumbo** is used to drill holes in the rock face. This one has three **drilling arms** and an **operator tower**. It is run by electric cable; a hose brings water to the drills. The drills are **pneumatic** (new-mat-ic). That means that the drill bits both hammer and rotate. Broken bits of rock are flushed out by water. These drill holes are 2.4-3.6 metres long.

The diagram in the lower right of the screen shows the location of holes drilled on the rock face, and the order in which they are drilled. The first sets are straight holes (parallel cut) located around the edge of the face and in the middle. A second set (V-cut) is angled toward the center. These allow the rock to be blown away from the face into the **drift** (tunnel).



Step 2 Charging with Explosives

Holes drilled are next filled with explosives. This is done by miners standing on the ground and, if the rock face is high, by using another **jumbo** with booms to lift the miner. Charging may be done using **cartridge explosives**, also known as *stick powder* or *dynamite*. The cartridges are placed in the holes and pushed to the back using a wooden ramrod. A waterproof detonator cord, or fuse, hangs out of the end of each hole. The primer that starts the explosion is at the end of the fuse in the bottom of the hole.

Charging may also be done using **bulk explosives**. This granular material, commonly ammonium nitrate fuel oil, is blown by air into the holes. Again the fuse with a primer at the far end hangs from each hole.

Step 3 Blasting and Ventilation

The individual fuses are connected to subfuses (yellow box) then to a main fuse (red box) in a way that ensure the holes are blasted in a proper sequence, from the center outward, one after the other. Although more than 100 explosions may be set off, one after the other, the blast sequence is completed in several seconds.

After the blast rock dust and gases are sucked out via the main tunnel while fresh air is delivered via a **ventilation duct** on the tunnel ceiling.

Step 4 Loading and Hauling

In a mine the broken rock is called **muck** and the process of loading and hauling is called **mucking out**. Here an **electric shovel** loads the muck into a **hauler dump (HD)**. As it works away, the muck is squirted with water, which is delivered by hose to the shovel to keep the dust down. The HD is articulated in the middle, that is, it has a joint that allows the machine to bend around tight corners. The driver sits in an armour-protected cabin. Depending on the layout of the mine, the HD will haul the muck to an ore pass, another dump truck, a tram, or a stockpile, all eventually ending up at a primary crusher.

In some locations mucking is done using a **scoop tram**, or **LHD** - short for load-haul-dump. This machine, as the name implies, loads up with muck, hauls the muck and dumps the muck - so there is no need for a separate shovel.

Both the HD and scoop tram run on either solid rubber or foam-filled rubber tires. They are used because air-filled tires may explode under the extreme weight and heat of friction caused by the loads.

Step 5 Scaling and Cleaning

Scaling refers to removing all the *loose* (loose rock) from the roof and walls of the drift. There are three methods. 1. A **hydraulic breaker** mounted on a boom operates like a jackhammer, dislodging fractured material. 2. A rotating **cutting head** mounted on a boom revolves and so brushes or chews loose material from the roof and walls. 3. **Scaling** uses a wedge of steel mounted on the boom to drive into rock fractures and scrape off loosened material.

When the rock is highly fractured, miners refer to this as **bad ground**; it must be sprayed with concrete to prevent loose rock from continually sloughing off. The concrete is sprayed from a high-pressure air hose that must be mounted on a boom if the walls and roof are high.

Step 6 Rock Bolting

The final method for stabilizing rock faces is most commonly **rock bolting**. A jumbo is used here to first drill holes into the rock. The holes vary from 2.4-6 metres long. Next a steel rod with a wedge threaded on the end is inserted in the hole. When it is in place, the rod is turned so that it pulls out against the wedge, forcing it into the walls of the hole. The outside end of the rod is secured with a steel plate and large nut. Geologists and engineers at a mine determine the spacing and depth of rock bolts required for the conditions at their site.

Under the poorest ground conditions it may be necessary to put **steel arches** in place to hold up the walls and roof of a tunnel. In other situations a steel mesh may be secured to the walls and roof to prevent other loose materials from falling on workers below.