MSHA Annual Refresher Training

Module 4

Safe Ground Control Practices

MSHA Training Requirement:

Instruction on the recognition and avoidance of equipment, roadway, and travel hazards. [Section 46.5(b)(2)].

Learning Objectives:

1. Identify and define key ground control concepts and terms commonly used in mining operations.
2. Implement ground control guidelines to maintain a safe worksite, including inspecting, scaling, rock fixturing, and managing loose material.
3. Understand how to reduce hazards from highwalls, pits, and rock formations.
4. Utilize appropriate safety measures and equipment when operating drilling machinery.
5. Evaluate drilling hazards and demonstrate an understanding of how drilling activities can impact ground stability.

Module Sections

- 4.1 Introduction to Safe Ground Control Practices
- 4.2 Ground Control Planning, Inspecting, and Scaling
- 4.3 Maintaining Ground Control Stability
- 4.4 Drilling Safety

4.1 INTRODUCTION TO SAFE GROUND CONTROL PRACTICES

Understanding safe equipment operations at a mine worksite is critical to ensure the safety of workers and protect equipment. The rules from 30 CFR 56 Subpart B (Ground Control) and 30 CFR 77 Subpart K (Ground Control) outline specific guidelines to prevent accidents and maintain an organized work environment in the following situations:

- In changing ground conditions
- Around highwalls, rock formations, and pits
- With drilling equipment

In this module, you will review the key regulations that focus on ground control at mine sites.

You will learn how to:

1. Identify and define key ground control concepts and terms commonly used in mining operations.
2. Implement ground control guidelines to maintain a safe worksite, including inspecting, scaling, rock fixturing, and managing loose material.
3. Understand how to reduce hazards from highwalls, pits, and rock formations.
4. Utilize appropriate safety measures and equipment when operating drilling machinery.
5. Evaluate drilling hazards and demonstrate an understanding of how drilling activities can impact ground stability.

Module Warmup

Why safe ground control practices matter?

Understanding ground control concepts and drilling safety is crucial for you to ensure your safety and the efficiency of your equipment. Ground control encompasses various practices and techniques aimed at stabilizing the rock and soil around a mine site to prevent hazards like collapses and rockfalls.

According to MSHA, falling rocks and materials from hazardous highwalls have resulted in ongoing fatalities and serious injuries to miners.

Preventing these kinds of accidents and injuries involves understanding ground inspection protocols as well as the importance of regular assessments to identify and address issues promptly. Similarly, drilling safety is paramount due to the inherent risks associated with operating drilling equipment, such as mechanical failures and ground instability.

The rest of this module will help you further understand key group control practices, why they are important, and how they will help you to be safe at a mine site.

4.2 GROUND CONTROL PLANNING, INSPECTING, AND SCALING

When working at your mine site it is important to understand the techniques and practices used to maintain ground control. Ground control is crucial in both underground and surface mining to prevent:

- Rock falls
- Collapses
- Other ground-related hazards that could endanger you, your fellow miners, and your equipment

In this section, we will look at some best safety practices for ensuring your ground is always safe.

Ground Control Planning

The first step in ensuring that your worksite's ground is safe is ensuring that you know the plan for ground control. Your mining operator must create a formal, organized control plan to manage highwalls, pits, and spoil banks.

The ground control plan needs to be based on good engineering to make sure that you and others are safe. Your work should always be done in a way that ensures the stability of highwalls and spoil banks.

This is important because unstable highwalls and spoil banks can collapse unexpectedly, causing serious injury or even death to you or others nearby. Ensuring their stability should be a top priority to keep everyone safe at the mine worksite.

Once your mine's Ground Control plan is made, your operator has to send a copy of it to the MSHA Coal Mine Safety and Health district office. They also need to tell them where the mine is, the name of the mine, and who operates it. This helps make sure you, and everyone else responsible for activities at a mine worksite follows the safety plan!

General Ground Control Guidelines for Maintaining a Safe Worksite

Inspecting

What should you know about inspecting the ground at your worksite?
Your mine operator will designate an experienced person to examine and test for loose ground. Your supervisor or other selected person will check the ground in areas where you are going to work before you start, after you blast, and during your shift if the ground changes. If necessary, your designated "inspector" will test ground conditions as well. You or a selected person will

also check highwalls and banks near where you or others walk or drive at least once a week, or more often if the ground keeps changing.

What if you find something concerning?
If you or others find any part of the ground to be dangerous, then it needs to be made safe before you and others can work in or access that area. While the corrective work is being done to make it safe, a sign should be put up to warn people from going in and getting hurt. When the area is left unattended, a barrier must be installed to prevent someone from going without authorization.

Everything looks great! Can I resume mining operations?
Remember that ground conditions change constantly. Once you begin scaling, installing rock fixtures, drill, or even experience changing weather conditions, you should always be looking and inspecting your worksite for unstable ground or loose material. This is an ongoing safety process!

Scaling

When you are working around highwalls, pits, mine tunnels, and in underground chambers, you must be sure you are scaling the location before you do any work in these or other hazardous areas. Scaling involves removing loose rock and debris from the walls, ceilings, and faces of underground mine tunnels and chambers. This is done to prevent rock falls and injury as a result of sliding debris.

When scaling, be sure you are using proper tools or methods to ensure that the work of making the highwalls safe is done securely and effectively.

You will need to ensure that you are scaling in a safe place where you and other miners are not at risk of being hit by falling rocks. If this is not possible, you must use other protections to keep you and others safe from falling materials.

If you find that it is necessary to manually remove dangerous materials from highwalls, be sure you approach the materials from a safe direction and remove the material from a secure location.

If you are scaling by hand, you must use a **scaling bar**. This bar should be long enough and designed in a way that allows you to safely remove loose rocks without putting yourself in danger.

Now, you know a few basic guidelines for ensuring ground control at your mine site. Let's now look at how to maintain ground stability.

4.3 MAINTAINING GROUND CONTROL STABILITY

In addition to inspecting and ensuring your ground is free from hazards, you must also work to stabilize rock formations and loose material to avoid accidents from falling or sliding material. Whether in coal mines with vulnerable roof structures, open pit mines with towering highwalls, or tunnels requiring reinforced walls and ceilings, you will need to maintain the *structural integrity* necessary for your mining work.

This section outlines the processes involved in:

- Preparing
- Installing
- Testing these support systems

to safeguard you and your equipment, as well as managing loose materials to reduce risks of accidents and injury.

4.1: Many mines contain miles of underground tunnel. Without proper lighting, people can easily become lost and disoriented while inside. Publicly available maps are oftentimes outdated!

Stabilizing Rock Formations

Mining operations can take place in a variety of terrains, climates, and environmental conditions. You could be working in deserts, mountains, urban, or rural areas.

If you are working in an area that has rock formations, your mine worksite will likely need additional ground support through a method known as rock fixtures. **Rock fixtures,** or ground

support systems, are structural reinforcements installed in mines to stabilize the rock and prevent collapses.

Rock fixtures can include methods such as **rock bolts**, which are long steel rods or bars inserted into holes drilled into rock formations. They are anchored into the rock to reinforce and support its structure.

Preparation for Rock Formation: Ensuring Rock Bolts Meet Standards

The first step in securing rock formations is ensuring that your materials and tools meet important safety standards. Your mine operator is required to follow a specific process for using rock bolts. Here is a summary of this process:

First, they must use ASTM F432-95 as a guide. This is a specific standard published by American Society for Testing and Materials (ASTM) International, which is a globally recognized organization that develops and publishes technical standards for a wide range of industries, such as mining.

The ASTM F432-95 is titled, *Standard Specification for Roof and Rock Bolts and Accessories* and covers the requirements for various types of roof and rock bolts used primarily in underground mining and tunneling applications.

Installing Rock Bolts Safely

Now that you have your equipment ready to go, what is next? Installation!

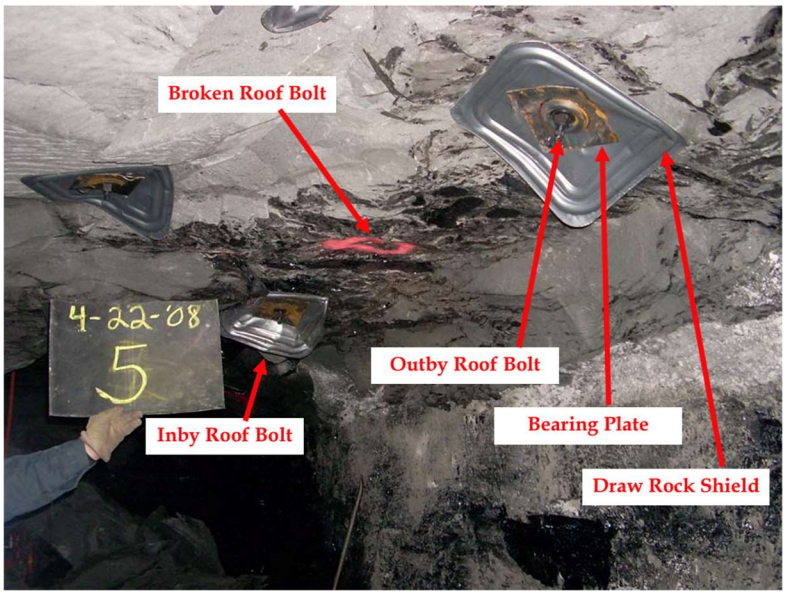
When installing rock bolts, your operator must ensure the following:

First, **bearing plates** must be used with fixtures if needed for effective support.

Next, you will likely use **finishing bits** to create precise and smooth holes in rock or concrete.

When installing these elements, you will often use **grouting cartridges** to enhance the stability and load-bearing capacity of your rock bolt.

If you are using rock bolts that rely on torque-tension for support, then you must follow torque requirements, which require that when you tighten (or **torque**) a rock bolt to secure the rock, you should apply a tension that is at least half as strong as either the bolt can handle (its yield point) or the rock can hold (its anchorage capacity). You choose the smaller value between these two to ensure safety. You should also be sure not to exceed the maximum force that the bolt or the rock can safely handle, as it could break or cause the rock to move unexpectedly, risking injury to you and others.

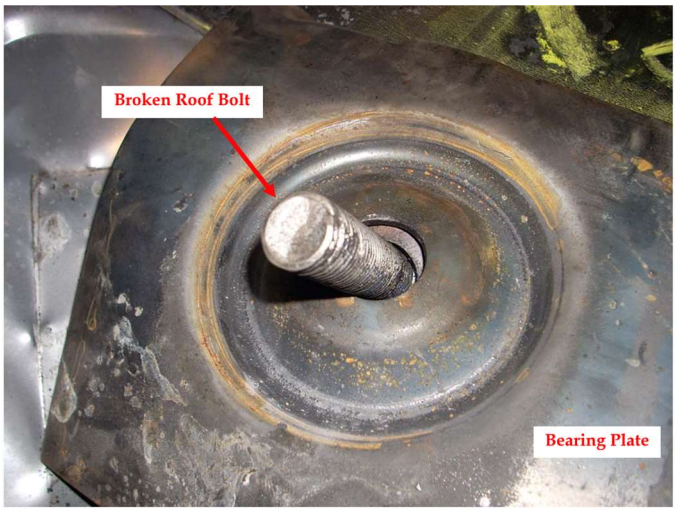


4.2: Roof and rib fall cavity with roof bolts

Testing Rock Bolts

After installing the first bolt, every tenth bolt, and the last bolt in each work area, you should check the torque (tightness) right away. If any bolt's torque does not match the required range, it needs to be fixed immediately to ensure safety and effectiveness.

If grouted fixtures can be tested by applying torque (twisting force), the first fixture installed in each area must withstand 150 foot-pounds of torque. If the fixture rotates in its hole (does not hold), a second one must be tested the same way. If the second one also rotates, it means corrective action is needed to ensure they hold securely.



4.3: Broken roof bolt

Managing Loose Material

Mining operations often result in loose material from several processes. These include:

- Blasting
- Drilling
- Excavating
- Extracting

At times, you may have to reduce the size of this material for easier handling, transport, or processing. This process of material size reduction is known as **secondary breakage**.

Additionally, when working, drilling, scaling, or completing other mining tasks, you may find that loose material can build up.

The buildup of loose material can come from natural instability of the area or your weather conditions, such as freezing, thawing, and rain, but it can also be caused by blasting operations or drilling-induced vibrations that destabilize the rock or soil. This loose hazardous material at the top of pits or highwalls can pose a danger to you and others below.

4.4: Loose mining material

To ensure your safety, be sure you move this material to a safe distance away. After finding an adequate location, you should then slope the material to its natural angle of stability to prevent it from falling.

You can also use protective measures such as barriers, baffle boards, or screens to provide equivalent protection.

If the loose material cannot be sloped to a stable angle or barriers are not sufficient, the material should be moved back at least 10 feet from the edge of the pit or quarry wall to prevent it from falling and creating a hazard.

Be sure that you address any other potential dangers near the edge that might cause material to fall and pose a risk to you and others.

Managing Loose Material During Excavation Tasks

Another instance where you should also be aware of loose material is when you are creating a **box cut** at your mine worksite. Box cuts are often the first step in establishing a mining operation, as it provides a starting point for subsequent excavation and an access point into a new work area. It involves removing earth and rock to create a flat, open space, usually rectangular in shape and at ground level, where further work can be carried out.

What should I pay attention to when making a box cut?
When you make a box cut a significant amount of spoil material, or waste material, is often produced. It is important that you manage this spoil material carefully to prevent it from rolling into the center of the cut, or the pit, which could pose a danger to you and your equipment. By properly placing and stabilizing the spoil material, you can prevent accidents and protect your safety.

Finally, when you are making your box cut and resulting pit, you may also have to create **benches**. Benches are flat, horizontal platforms created within excavation walls. They provide stable surfaces for you and your equipment. Additionally, these platforms allow easy access to different levels within the pit or excavation and contribute to stability by supporting surrounding rock or soil.

You are well equipped for ensuring additional ground control stability at your mine worksite. Next, we will look at drilling safety, and how this can change your ground's conditions.

4.4: DRILLING SAFETY

Drilling plays a fundamental role in your mining work, as it is used extensively for tasks ranging from exploration to mineral extraction and ground support.

However, drilling in mining operations also presents significant hazards to you and others. The operation of drilling equipment involves powerful machinery and high-pressure fluids or gases, which can increase your risk of experiencing mechanical failures and your exposure to hazardous substances.

Also, if you are creating drill holes, this can introduce instability in the surrounding rock formations, potentially leading to ground collapses or rockfalls that endanger you and your fellow miners working nearby. So, while drilling is essential to your mining work, it is crucial that you follow strict safety rules and always be careful to prevent accidents.

Equipment Operation

As you have learned in previous units, you should expect a qualified person to check all equipment at the start of each shift. Any safety problems with the equipment must be reported, and equipment must be fixed *before* it is used. This applies to drilling equipment, too.

Once your equipment has been inspected thoroughly and deemed safe to use, you are ready to begin operating your drill equipment. Let's start by looking at some general safety practices that are important to remember before you start operating your equipment.

Before You Start to Drill

Operating drilling equipment requires situational awareness of your surroundings, equipment, and fellow mining workers.

Drilling Processes and Equipment

The initial step in the drilling process where the drill bit starts to penetrate the ground is known as **collaring**. When you are collaring, your goal is to create a stable entry point for the drill bit, which helps to guide your drill straight and prevent it from going off course.

Collaring requires the use of hand-held drills paired with starter **steels**, which are specialized, short drill steel attachments used to start the drilling process. They will help you create that straight and stable initial hole.

When you are collaring, be sure you do not hold the drill steel or rest your hands on the chuck or centralizer while starting holes.

You may also use churn drills or vertical rotary drills, which are special drills for attaining different depths. **Churn drills** are manual or mechanized drilling tools used primarily for shallow

drilling operations. They typically use a simple reciprocating motion to break up and remove material from the hole being drilled. This motion resembles churning, hence the name.

In contrast, **vertical rotary drills** are more heavy-duty drilling machines used for deeper and more challenging drilling operations. They employ a rotary motion to turn a drill bit, which cuts into the ground or rock.

There are a few more pieces of equipment you should be familiar with before you begin working around drilling equipment at your mine worksite. If you are using or working near **jackhammers**, **jackleg drills**, or similar drilling machines, be sure you are standing in an area where you will not get hit or fall if the drill breaks or gets stuck.

Remember, when collaring or drilling, your goal is typically to create a hole. If you drill a hole that is big enough to be dangerous to you or your equipment, be sure you cover or guard these holes.

Also, do you remember what you learned about being aware of loose material? If not, this is a great time to review this information, as drilling can change your ground conditions, and you may need to relocate, scale, or correct any hazardous loose material or ground that your drilling created.

Transporting the Drill Equipment

Your mine worksite may have multiple areas where your drilling equipment is needed. If you have to move a drill to a new area, how should you do this safely?

First, make sure that you secure drill steel, tools, and other equipment, and that you safely position the mast. Remember, the **mast** is a tall, vertical structure that supports your drilling apparatus.

Sometimes you may need to use an **air drill**, which is a handheld drilling tool that utilizes compressed air as its power source. They are often more portable, reliable and suitable for confined spaces. Before moving hand-held air drills to a different area, be sure you turn *off* the air and let it out of the hoses.

Finally, if you have or are acting as a drill helper, be sure the operator knows your location at all times while the drill is being moved!

Now, you understand how to inspect, operate, and move your drill equipment safely.