MSHA Part 46 New Miner Online 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

Code of Federal Regulations Reference Material

This module covers important topics from 30 CFR 56 Subpart B (Ground Control) and 30 CFR 77 Subpart K (Ground Control).

CFR Subtopic Regulations: 30 CFR 56 Subpart B (Ground Control)

- 56.3000 Definitions.
- 56.3130 Wall, bank, and slope stability.
- 56.3131 Pit or quarry wall perimeter.
- 56.3200 Correction of hazardous conditions.
- 56.3201 Location for performing scaling.
- 56.3202 Scaling tools.
- 56.3203 Rock fixtures.
- 56.3400 Secondary breakage.
- 56.3401 Examination of ground conditions.
- 56.3430 Activity between machinery or equipment and the highwall or bank.

CFR Subtopic Regulations: 30 CFR 77 Subpart K (Ground Control)

- 77.1000 Highwalls, pits and spoil banks; plans.
- 77.1000-1 Filing of plan.
- 77.1001 Stripping; loose material.
- 77.1002 Box cuts; spoil material placement.
- 77.1003 Benches.
- 77.1004 Ground control; inspection and maintenance; general.
- 77.1005 Scaling highwalls; general.
- 77.1006 Highwalls; men working.
- 77.1007 Drilling; general.
- 77.1008 Relocation of drills; safeguards.
- 77.1009 Drill; operation.
- 77.1010 Collaring holes.
- 77.1011 Drill holes; guarding.
- 77.1012 Jackhammers; operation; safeguards.
- 77.1013 Air drills; safeguards.

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. Let's look at a few of these historical incidents and consider how you might protect yourself from similar hazards:

- A miner with 3+ years experience was struck by **a rock fall while walking between entries under an unsupported roof**. The rock, measuring approximately nine feet by four feet by fourteen inches, resulted in fatal injuries to the miner.
- A **pit wall collapsed engulfing an excavator operator** while he was outside of the excavator.
- When trying to secure material to be hoisted from a pit, a miner died and another miner was seriously injured when **a piece of granite fell and struck both miners**.
- A 22-year old rock drill operator with one year of experience was injured when **his shirt got caught in a rotating drill steel**.

- A 53-year old miner with thirty-two years of experience died in an underground metal mine when **his clothing became entangled in the drill steel while operating a jackleg drill.**

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.

Key Terms: Common Ground Control Concepts and Definitions

Let's review some common concepts and definitions.

- **Bank**: Sloped side of an excavation or natural formation.
- **Barriers:** Physical structures placed around a hazardous area to prevent loose material from falling into places where it could pose a danger to workers.
- **Control levers:** Mechanism or device used to operate and control the drilling equipment. These levers are typically used to start, stop, adjust, or control the drilling process.
- **Ground control:** Managing and stabilizing the rock and soil around your mine to ensure the safety and efficiency of your work.
- **Highwalls:** Vertical or steeply sloping walls that you create during mining operations.
- **Pits**: Pits refer to large, deep holes or excavations in the ground created during your mining work.
- **Rock fixtures**: Structural reinforcements installed in mines to stabilize the rock and prevent collapses.
- **Scaling**: The process of removing loose rock and debris from the walls, ceilings, and faces of underground mine tunnels and chambers.

Preparing for Learning Safe Ground Control Practices

Many of the federal regulations concerning how to ensure safe ground control may seem very technical in nature, especially if you are new to mining! While you may encounter challenges that require special expertise, there are simple precautions you can take to better recognize hazards and prevent accidents to you and your equipment.

When you visit a mine site for the first time, or begin your work for the day, it is smart to:

- Know the components of a ground control plan and how to assess changing conditions.
- Ensure you or a designated person completes regular inspections to identify and address hazards promptly.
- Look for signs of hazardous areas and do not access them until they are made safe.
- Handle, transport, and stack loose material carefully and securely.
- Follow safety protocols when using or moving drill equipment.

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.

- **Highwalls:** These are the vertical or steeply sloping walls that you create during mining operations. They are often left behind after you excavate minerals or ores from the ground and can be dangerous to you if not properly stabilized.
- **Pits**: Pits refer to large, deep holes or excavations in the ground created during your mining work. You may dig these pits to access valuable minerals or ores beneath the surface.
- **Spoil Banks:** Spoil banks are mounds or piles of waste material (known as 'spoil') that accumulate during your mining operations. You would typically remove this material during the excavation process to access the desired minerals or ores.

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. Additionally, when walking around your worksite, be sure you do not work or walk between machinery and a highwall or steep bank if the machinery might block your escape in case of a rock fall or slide. However, it is okay to walk there if you need to get off the machinery.

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.

I think there was a freeze! Can that affect ground conditions?
Yes. After every rain, freeze, or thaw, highwalls, banks, benches, and sloped terrain must be checked before you or anyone else works in those areas. These checks must be recorded as required by MSHA regulations. MSHA rules governing these checks typically include:

- Notifying the operator
- Evacuating workers from the area
- Taking corrective action
- Reporting the conditions in a specific book approved by the Secretary of Labor

Additionally, at least one authorized person must sign the report each day that the area is examined and recorded.

During your inspection, if you find any highwalls or banks that hang over dangerously, be sure they are removed. If you also find any other unsafe conditions in the ground, then you must be sure they are fixed quickly. If these unsafe conditions cannot be immediately fixed, the area must be clearly marked with a warning to keep you and others safe.

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: The process of 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.

Incident - Slope Failure and Scaling: A front-end loader operator at a quarry observed a significant slope failure at the "dirt dump" or refuse pile located on the top rim. Approximately 10,000 to 15,000 tons of material slid down to multiple benches below. Fortunately, there were no injuries reported. The affected area was immediately barricaded and posted against entry to prevent further incidents.

4.1: To avoid dangerous mining landslides (as seen above), use proper tools and methods when scaling any area of a mining worksite.

What can you learn?

- Consistently monitor and examine slopes (for both high and low walls) for signs of instability.

- Properly grade surfaces of dump piles to ensure proper water drainage.
- Provide timely warnings of instability so that proactive measures can be taken to minimize the impact of slope displacement.
- Collect and analyze geotechnical information to design stable slopes. Once cracks or signs of instability are detected, the area should be evaluated by a qualified engineer, and equipment should *not* operate across these cracks until stability is confirmed.

Incident - Highwall Failure: An excavator operator was trapped in the cab of his excavator for several minutes when material from a highwall bank fell, engulfing the excavator. The operator sustained injuries to his arm before being rescued.

4.2: Failure to examine each angle of a highwall can lead to disaster; always take proper precautions

What can you learn?

- Examine highwall and material piles from multiple perspectives (bottom, sides, and top/crest); look for signs of cracking, displacement, or other indicators of distress.
- Maintain safe access to the top of highwalls.
- Conduct supplemental checks during and after inclement weather.
- Immediately remove personnel from hazardous conditions and utilize barricades and warning signs.
- Avoid undercutting or over-steeping slopes.

You will also 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.

In summary, be sure you:

- Follow your operator's ground control plan, which includes stabilizing highwalls, pits, and spoil banks to prevent collapses and other hazards.
- Check for loose ground regularly, especially after weather and mining events.
- Correct hazardous conditions promptly, clearly marking areas until they are fixed.
- Use safe and secure measures when scaling.

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.

4.3: 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. For instance, coal mines are typically underground and benefit from ground support to prevent roof falls. Open pit mines have highwalls where stability is needed to prevent rockfalls. Finally, road or rail tunnels often need structural support of the tunnel walls and ceilings. In short, rock fixtures are essential in mining because they maintain the integrity of the mine's structure, ensure a safe working environment for you, and allow for continuous, efficient mining operations.

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.

If using rock bolts and accessories specified in ASTM F432-95, mine operators must:

1. Get a certification from the manufacturer confirming the materials meet ASTM F432-95 standards, and
2. Make this certification available to inspectors and miners' representatives.

If your mine operator chooses to use fixtures not covered by ASTM F432-95, then they must show:

1. How the alternative fixtures have successfully supported ground in similar conditions elsewhere, and
2. How they have been tested and proven effective in similar conditions in the affected mine. (Only necessary personnel can be present during these tests).

Installing Rock Bolts Safely

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

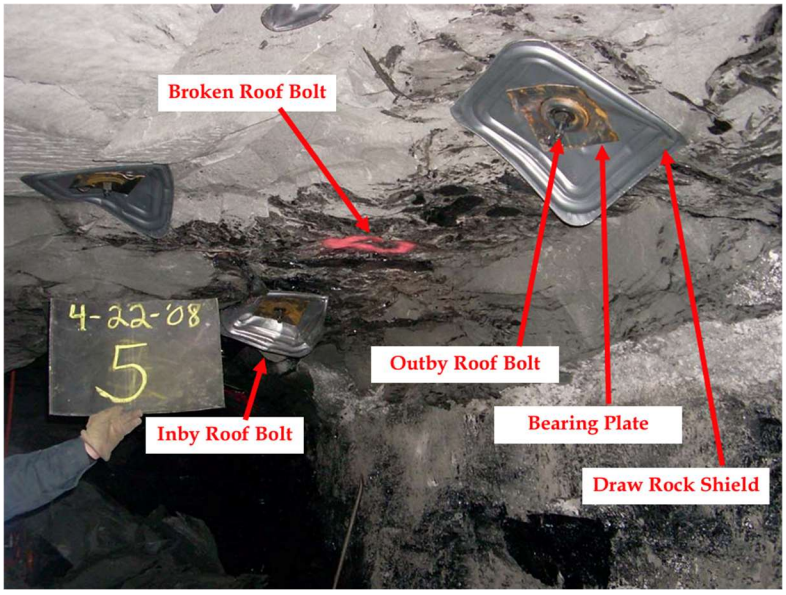
When installing rock bolts, your operator must ensure the following:

First, **bearing plates** must be used with fixtures if needed for effective support. *What are bearing plates?* They are large, flat plates typically made of steel or other durable materials that are used to distribute the load of a bolt or anchor over a larger area of the rock surface.

Next, you will likely use **finishing bits** to create precise and smooth holes in rock or concrete. These holes are essential for the installation of rock fixtures such as rock bolts and anchors, as well as for placing bearing plates. Finishing bits must match the manufacturer's recommended hole diameter within 0.030 inches. And, if using separate finishing bits, be sure they are distinguishable from other bits.

When installing these elements, you will often use **grouting cartridges** to enhance the stability and load-bearing capacity of your rock bolt. Grouting cartridges help secure elements in place and contribute to waterproofing and corrosion protection, extending the lifespan of the installed bolts and anchors. You must be sure your cartridges are not damaged or deteriorated.

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.



4.4: Roof and rib fall cavity with roof bolts

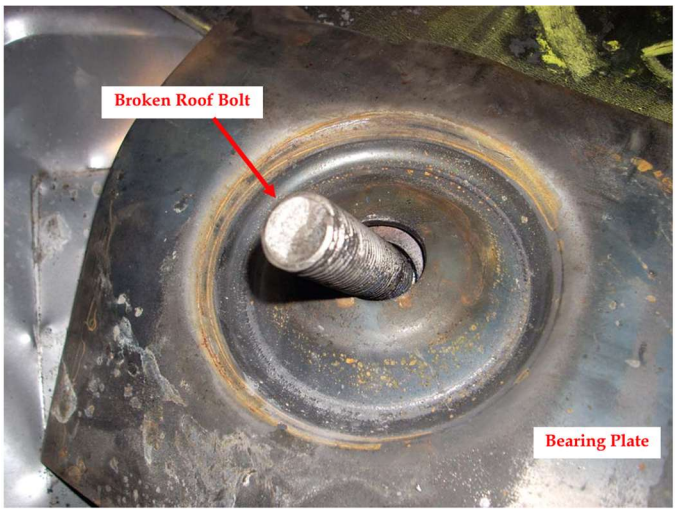
Testing Rock Bolts and Other Fixtures

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.

For other kinds of tensioned and nontensioned fixtures, you or your mine operator must set up specific test methods to check that they work well. These tests help make sure they're strong enough to support the ground safely.

Finally, your mine operator must confirm that these tests were done and make this confirmation available to a government representative of the Secretary of Labor who checks safety.



4.5: 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**.

If you must perform secondary breakage, make sure the material (except hanging material) is secured or blocked off so it will not move and put you and others at risk. Be sure you break the material from a safe spot where other workers are not in danger.

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

- At the top of pits
- Along highwalls
- In other areas where people are working *or* traveling

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.

4.6: 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. Let's look at these in more detail below.

- **Barriers**: These are physical structures placed around a hazardous area to prevent loose material from falling into places where it could pose a danger to workers. Barriers can be made of various materials like wood, metal, or concrete and act as a protective wall.
- **Baffle Boards**: Baffle boards are panels used to deflect or slow down the movement of loose material. They are typically installed in a way that redirects falling debris away from work areas, reducing the risk of injury to workers below.
- **Screens**: Screens are mesh or grid-like structures that catch and hold back loose material. They allow smaller particles to pass through while containing larger, potentially hazardous debris. Screens can be made of metal or other strong materials and are used to prevent loose material from falling freely.

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.

Quarry: A specific kind of open pit or excavation site where stones, rocks, sand, gravel, and other materials are extracted from the ground. They are typically deeper than pits and focus on extraction, rather than any type of excavation.

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.

Incident - Loose Quarry Material: A 42 year-old ledgeman with over 16 years of mining experience, died after a granite block fell from a quarry wall and struck him. At the time of the accident, two miners were standing within four feet of a granite block that was left hanging on a quarry wall. Significant ground vibrations occurred as a crane lifted and broke loose an additional block, over 35 feet away. The vibration of lifting of the additional block caused the granite block, that the affected miner was standing by, to fall, striking him dead.

4.7: An accident from loose quarry material occurred because the mine operator did *not* correct hazardous ground conditions

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.

To ensure safe operation, MSHA requires that you determine the width and height of benches based on the type of equipment used and the specific operation being performed. By optimizing space for machinery and equipment, benches enhance productivity during mineral extraction or other mining tasks.

In summary, you must actively work to stabilize rock formations and loose material to avoid accidents from falling or sliding material. Be sure you:

- Follow procedures for installing and testing rock fixtures
- Manage loose material carefully
- Inspect your site for loose material again when making box cuts
- Create stable structures like benches to ensure safety

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. For instance, you may need to create blast holes for controlled explosives placement or install support systems like rock bolts or ground anchors to ensure the stability and safety of underground workings.

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 safely requires that you:

- Are highly aware of your surroundings
- Are thinking ahead about your strategy for drilling
- Have a plan in case things go wrong

Here are a few things to remember:

You must always ensure that someone is always watching the drills while they are being used. This helps to prevent accidents by allowing you to quickly respond if there is a problem, like equipment malfunction or unsafe conditions.

Additionally, you should not drill:

- From places where you cannot easily reach the control levers
- From unstable surfaces

- From equipment not meant for drilling

These measures reduce your risk of falling or losing control of the drill.

If you experience power failure while drilling, be sure to set the drill controls to neutral until you regain power. This helps prevent unexpected movement when power returns, which keeps you safe from sudden starts or equipment damage.

4.8: Using drills responsibly in both above-ground and underground mining is crucial for efficiency and production and essential for safety and hazard prevention

Drilling Processes and Equipment

Let's drill! When you first begin to drill at your mine worksite, 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.

How do you know that you are not touching the chuck or centralizer?
Here is what you can look for:

- **Chuck:** This is the mechanism that holds the drill bit securely in place *at the end of the drill*. It allows for the attachment and removal of drill bits as needed for different drilling tasks. The chuck's primary function is to grip the drill bit tightly and facilitate its rotation during drilling.
- **Centralizer**: The centralizer is a tool designed to keep the drill bit aligned and centered within the hole being drilled. It helps prevent the drill bit from deviating or veering off course, especially in situations where the hole may not be perfectly straight. *It is typically located just above or around the drill bit.* It often has fins or blades that extend outward.

When you are collaring or creating holes in the ground, there are key hazards you should be aware of:

- When the drill bit is working, you must *not* be on the mast unless there is a safe platform and you are wearing safety belts. The **mast** is a tall, vertical structure that is designed to provide stability and support for the drilling operations, particularly for the hoisting and lowering of your drill pipes and other equipment.
- You and drill crews should stay away from moving augers or drill stems.
- You should never go under or step over a moving stem or auger.

What is a moving stem and auger?
In short, they are part of the drilling equipment that can move when it is in operation.

Auger: A spiral-shaped drilling tool that rotates to create holes in the ground or move materials like soil, gravel, or other loose substances. They are commonly attached to drilling equipment for you to bore holes for various purposes, such as exploration drilling, sampling materials, or assessing the stability of the ground.
Moving stems: Sections of pipes or rods used to extend the reach of a drilling tool or auger into deeper layers of soil or rock. They provide support and stability while allowing you to extract materials or install structural components.

You may also use churn drills or vertical rotary drills, which are special drills for attaining different depths. For instance, **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.

If you are using these drills, be sure you and others are *never* under tools that are suspended in the air. If you are starting holes, inspecting an area, or removing tools from a hole (such as changing drill bits or clearing obstructions), ensure that any suspended tools are securely lowered to the ground or platform. This precaution is essential to prevent accidental drops that could cause injury or damage to you and your equipment.

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.

- **Jackhammers:** Tools that use a chisel-like bit powered by compressed air or electricity to repeatedly strike and break apart hard materials like concrete, asphalt, or rock surfaces for repair or removal.
- **Jackleg Drills:** Handheld drilling machines that feature a pneumatic motor and a rotating drill bit to create holes in hard materials like rock or concrete.

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. Check the equipment or with your operator for how to ensure that the mast is in a safe position before moving, but this typically means lowering and properly securing it so that the mast does not move.

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, such as in underground mining operations. 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.

Safe Ground Control Practices: Let's Review What You've Learned!

You learned a lot of new information in this module. Some concepts might be completely new to you, or, you might have been familiar with some of the concepts or terms.

Either way, take a minute to review what you should now be able to do after completing this module.

You can now:

- Identify and define key ground control concepts and terms commonly used in mining operations.
- Inspect your worksite for ground control hazards
- Install rock bolts safely
- Use methods like scaling to manage loose material
- Utilize appropriate safety measures and equipment when operating drilling machinery.
- Move your drilling equipment safely and securely

If you are confident that you can accomplish these tasks above, proceed to the Quiz.

If you want more time to review and reflect on these tasks, return to the specific pages you want to review. You can also review additional expanded content in the Module Resource Materials.

MODULE RESOURCE MATERIALS

List of Safe Ground Control Practices Concepts and Definitions

- **Air drill:** A handheld drilling tool that utilizes compressed air as its power source.
- **Auger:** A spiral-shaped drilling tool that rotates to create holes in the ground or move materials.
- **Baffle boards**: Panels used to deflect or slow down the movement of loose material.
- **Bank**: Sloped side of an excavation or natural formation.
- **Barriers:** Physical structures placed around a hazardous area to prevent loose material from falling into places where it could pose a danger to workers.
- **Bearing plates:** Large, flat plates typically made of steel or other durable materials that are used to distribute the load of a bolt or anchor over a larger area of the rock surface.
- **Benches**: Flat, horizontal platforms created within excavation walls. They provide stable surfaces for you and your equipment
- **Box cut:** Provides a starting point for subsequent excavation and an access point into a new work area.
- **Centralizer**: A tool designed to keep the drill bit aligned and centered within the hole being drilled.
- **Chuck**: This is the mechanism that holds the drill bit securely in place.
- **Churn drills:** Manual or mechanized drilling tools used primarily for shallow drilling operations.
- **Collaring**: The initial step in the drilling process where the drill bit starts to penetrate the ground.
- **Control levers:** Mechanism or device used to operate and control the drilling equipment. These levers are typically used to start, stop, adjust, or control the drilling process.
- **Finishing bits**: Holes that are essential for the installation of rock fixtures such as rock bolts and anchors, as well as for placing bearing plates.
- **Ground control:** Managing and stabilizing the rock and soil around your mine to ensure the safety and efficiency of your work.
- **Highwalls:** Vertical or steeply sloping walls that you create during mining operations.
- **Jackhammers**: Tools that use a chisel-like bit powered by compressed air or electricity to repeatedly strike and break apart hard materials.
- **Jackleg drills:** Handheld drilling machines that feature a pneumatic motor and a rotating drill bit to create holes in hard materials.
- **Mast**: A tall, vertical structure that supports your drilling apparatus.
- **Moving stems**: Sections of pipes or rods used to extend the reach of a drilling tools or auger into deeper layers of soil or rock.
- **Pits**: Pits refer to large, deep holes or excavations in the ground created during your mining work.

- **Rock bolts**: A rock fixture method, which includes long steel rods or bars inserted into holes drilled into rock formations.
- **Rock fixtures**: Structural reinforcements installed in mines to stabilize the rock and prevent collapses.
- **Scaling**: The process of removing loose rock and debris from the walls, ceilings, and faces of underground mine tunnels and chambers.
- **Scaling bar:** A bar long enough and designed in a way that allows you to safely remove loose rocks without putting yourself in danger.
- **Screens**: Screens are mesh or grid-like structures that catch and hold back loose material.
- **Secondary breakage:** Reducing the size of the material for easier handling, transport, or processing.
- **Spoil banks**: Spoil banks are mounds or piles of waste material or spoil that accumulate during your mining operations.
- **Starter steels**: Specialized, short drill steel attachments used to start the drilling process.
- **Torque:** The twisting force applied to an object, often a bolt or a similar fastener, to secure it tightly in place.
- **Travelway:** A passage, walk, or way regularly used or designated for persons to go from one place to another.
- **Vertical rotary drills:** Heavy-duty drilling machines used for deeper and more challenging drilling operations.

Checklist to Prevent Back Roof and Rock Fall Hazards

Falling rock or other loose material created during mining operations can fall in locations that may block access to tunnels, entryways, or exits. This can create urgent safety hazards as miners can become trapped with little or no oxygen, or not be able to safely exit the work area to access supplies or medical care.

Consider the following best practices to help prevent serious injuries or fatalities from back roof and rock fall hazards:

- Train all miners and supervisors to conduct thorough examinations of the back/roof where persons will be working and traveling.
- Correct all hazardous conditions before allowing persons to work or travel in such areas.
- Provide additional support when back/roof fractures, or other abnormalities are detected.
- Be alert for changing conditions, especially after activities that could cause back/roof disturbance.
- Report abnormal back/roof conditions to mine management.
- Adequately support or scale any loose back/roof material from a safe location.
- Use a bar of suitable length and design when scaling.
- Danger off hazardous areas until appropriate corrective measures can be taken.

Drill Entanglement Safety

Drillers at mine worksites are exposed to rotating machinery that can entangle clothing and body parts and result in fatal or seriously disabling injuries. Additionally, drillers working alone or in remote areas must be able to communicate with others and be heard or seen.

Consider these fatal injuries from drilling complications at mine worksites:

- A 22-year old rock drill operator with one year of experience was fatally injured when **his clothing became entangled in a rotating drill steel** while spot drilling at a dimension stone quarry.
- A 30-year old contract driller with six years of experience died at a shale quarry **trying to manually thread a new drill steel while the drill head rotated**.
- A 53-year old miner with thirty-two years of experience died in an underground metal mine when **his clothing became entangled in the drill steel** while operating a jackleg drill.

Follow drilling safety standards and these best practices to reduce the risk of death or injury.

- Examine the drill and the surrounding work area before beginning drill operations. Assure that the area is free from tripping hazards and that drilling materials are safely arranged and well-organized to prevent accidents.
- Establish written policies for the type of clothing and methods to secure clothing when working around drills and assure the policies are followed. *Do not wear loose-fitting or bulky clothing when working around drilling machinery!*
- Avoid using objects that could become entangled with or thrown from moving or rotating parts.
- Stay clear of augers and drill stems that are in motion. Stop the drill rotation when performing tasks near the rotating steel. *Never pass under or step over a moving drill stem or auger!*
- Drill from a position with good footing and access to the controls.
- Never manually thread the drill steel while the drill head is rotating.
- Do not hold the drill steel when collaring holes or rest your hands on the chuck or centralizer.
- Assure that machine controls and safety devices such as emergency shutdowns operate effectively. *Never nullify or bypass machine control safety equipment!*
- Place emergency shut-down devices, such as panic bars, slap bars, rope switches, or two-handed controls in easily accessible locations.
- Safely position hoses and cables on and around drilling equipment. Design proper hangers, guides, standoffs and entrances to eliminate the necessity of handling hoses or cables in close proximity to rotating or moving equipment.
- Communicate regularly and frequently with drillers to assure they are safe and well.

Simplified Safe Ground Control Practices and Corresponding Code of Federal Regulations Listing

- **Highwalls, pits, and spoil bank plans.** Every mine operator must create and follow a solid ground control plan to safely manage all highwalls, pits, and spoil banks. The mining methods used should keep the highwalls and spoil banks stable. [77.1000]
- **Filing of plan.** The mine operator must submit a copy of this ground control plan, and any updates, to the MSHA Coal Mine Safety and Health district office. [77.1000-1]
- **Stripping.** Loose hazardous material must be removed from a safe distance from the top of pits or highwalls. The remaining loose material should be sloped at a stable angle, or barriers must be used to provide protection. [77.1001]
- **Box cuts and spoil material placement.** When making box cuts, necessary precautions must be taken to reduce the risk of spoil material rolling into the pit. [77.1002]
- **Benches.** To ensure safe operation, the width and height of benches must match the type of equipment used and the work being done. [77.1003]
- **Ground control.** Highwalls, banks, benches, and slopes leading into work areas must be checked after every rain, freeze, or thaw before workers enter these areas. This inspection must be recorded as per 77.1713. [77.1004a]
- **Overhanging.** Overhanging highwalls and banks must be removed, and other unsafe ground conditions must be fixed immediately, or the area must be marked as dangerous. [77.1004b]
- **Scaling highwalls**. Hazardous areas must be cleared of loose material before any other work is done. If scaling highwalls is needed to fix dangerous conditions, a safe way to do the work must be provided. If hazardous material on highwalls needs to be removed by hand, it must be approached safely and removed from a safe location. [77.1005)
- **Working around highwalls.** Workers should avoid dangerous highwalls or banks unless they are fixing unsafe conditions, and they must not be positioned where equipment could block their escape from falls or slides; special safety measures are required if repairs are needed between immobilized equipment and the highwall or spoil bank. [77.1006]
- **Drilling.** A qualified person must check all equipment at the beginning of each shift. Any safety problems found must be reported and fixed before using the equipment. [77.1007]
- **Relocation of drills.** When moving a drill from one area to another, secure the drill steel, tools, and other equipment, and place the mast in a safe position. [77.1008a]
- **Drill helper. I**f a drill helper is used, the operator must know where the helper is at all times while moving the drill. [77.1008b]
- **Operating drills.** Drills must always be attended to while in use. [77.1009a]
- **Operating position.** Do not drill from positions where you cannot easily reach the controls, where footing is unstable, or from the top of equipment not designed for drilling. [77.1009b]
- **Masts.** Avoid being on the mast while the drill bit is operating unless there is a safe platform and safety belts are used. [77.1009c]

- **Staying clear.** Stay clear of moving augers or drill stems. Do not pass under or step over a moving stem or auger. [77.1009d]
- **Safeguards.** If the power fails, place drill controls in the neutral position until power returns. [77.1009e]
- **Specific drill procedures.** For churn or vertical rotary drills, do not work under suspended tools. Lower all tools to the ground or platform when collaring holes, inspecting, or during any operation involving tool removal. [77.1009f]
- **Collaring holes operation.** Use starter steels when beginning to drill holes with hand-held drills. [77.1010a]
- **Collaring holes safeguards.** Do not hold the drill steel or rest your hands on the chuck or centralizer while drilling. [77.1010b]
- **Drill hole guards.** Cover or guard drill holes that are large enough to be a hazard. [77.1011]
- **Operating jackhammers.** Position yourself and others safely when operating or near jackhammers or jackleg drills, to avoid being struck or losing balance if the drill steel breaks or sticks. [77.1012]
- **Air drills safeguards.** Turn off the air and bleed the air hoses before moving hand-held air drills to another working area. [77.1013]
- **Wall, bank, and slope stability.** Use mining methods that keep walls, banks, and slopes stable. If benching is needed, the width and height should match the type of equipment used for cleaning benches or scaling walls, banks, and slopes. [56.3130]
- **Pit or quarry wall perimeter.** Where people work or travel, loose or unconsolidated material should be sloped to a safe angle or cleared back at least 10 feet from the top of the pit or quarry wall. Fix any other conditions near the perimeter that could cause a hazard. [56.3131]
- **Correction of hazardous conditions.** Fix ground conditions that are hazardous to people before allowing anyone in the area. Until fixed, post a warning and, if left unattended, put up a barrier to prevent unauthorized entry. [56.3200]
- **Location for performing scaling.** Perform scaling from a safe location that protects people from falling material or provide other protection from falling material. [56.3201]
- **Scaling tools.** When doing manual scaling, use a scaling bar. The bar should be long and designed to remove loose material without putting the person at risk of injury. [56.3202]
- **Secondary breakage.** Before starting secondary breakage operations, all material except hanging material must be secured to prevent any movement that could endanger workers in the area. Secondary breakage must be carried out from a safe location that does not expose personnel to danger. [56.3400]
- **Rock fixtures.** Rock bolts and accessories must comply with ASTM F432-95 or must be tested and proved effective in conditions similar to another mining area or similar to where they will be used with limited access. [56.3203a-b]
- **Rock fixture bearing plates.** Use bearing plates with fixtures when necessary for effective ground support. [56.3203c]

- **Rock fixture finishing bits.** Ensure finishing bits' diameter is within 0.030 inches of the manufacturer's recommended hole size. Use distinguishable finishing bits. [56.3203d]
- **Rock fixture grouting cartridges**. Do not use damaged or deteriorated grouting material cartridges. [56.3203e]
- **Tensioned rock bolts.** When using tensioned rock bolts, tension levels should be at least 50% of the bolt's yield point or the rock's anchorage capacity, whichever is less. Ensure the torque of specific bolts is accurately measured after installation. Correct any bolts falling outside the specified torque range. [56.3203f]
- **Test grouted fixtures with torque.** The first fixture in each area must withstand 150 foot-pounds of torque. If it rotates, test a second fixture similarly. Take corrective action if both rotate. [56.3203g]
- **Test rock fixtures.** Establish test methods to verify the effectiveness of other tensioned and nontensioned fixtures. Certify that tests were conducted and make this certification available to the Secretary's authorized representative. [56.3203h-i]
- **Examination of ground conditions.** Before starting work, after blasting, and as needed during shifts, supervisors or designated individuals must inspect and, if necessary, test ground conditions where work will occur. Highwalls and banks near travel paths must be inspected weekly, or more frequently if changing conditions require. [56.3401]
- **Activity near highwalls or banks.** Do not work or pass between machinery or equipment and highwalls or banks where escape might be hindered by potential falls or slides. Travel through these areas is allowed only when necessary for individuals to dismount safely. [56.3430]