

MSHA Part 46 New Miner Online Training

Module 1

Course Introduction and the Mining Work Environment

MSHA Training Requirement:

An introduction to the mining work environment, the methods of mining operations, and common equipment. [Section 46.5(b)(1), Section 46.5(b)(7)]

Learning Objectives:

1. Understand the MSHA requirements for Part 46 New Miner Training.
2. Review the structure and assessment methods for this Part 46 New Miner Training.
3. Recognize the role and responsibilities of key stakeholders involved in ensuring mine safety in the US.
4. Identify and describe various common mining techniques, equipment, and environments.

Module Sections

- 1.1 Course Structure and Assessment Methods
- 1.2 MSHA New Miner Training Requirements
- 1.3 Mine Safety in the United States
- 1.4 Mining Accidents, Hazards and Your Right and Responsibility to Report
- 1.5 Basic Mining Process
- Appendix: Contributions of the American Miner

Code of Federal Regulations Reference Material

This module covers important topics listed below from the Code of Federal Regulations Subtopic Regulations 30 CFR 46 Subchapter H (Education and Training):

- 46.1 Scope.
 - 46.2 Definitions.
 - 46.3 Training plans.
 - 46.4 Training plan implementation.
 - 46.5 New miner training.
 - 46.6 Newly hired experienced miner training.
 - 46.7 New task training.
 - 46.8 Annual refresher training.
 - 46.9 Records of training.
 - 46.10 Compensation for training.
 - 46.11 Site-specific hazard awareness training.
 - 46.12 Responsibility for independent contractor training.
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1.1 COURSE STRUCTURE & ASSESSMENT METHODS

This course covers important topics from the Code of Federal Regulations: Title 30 - Mineral Resources - Chapter 1 - Mine Safety and Health Administration, Department of Labor. It reviews essential concepts and regulations that are part of your MSHA Part 46 New Miner Training.

In this introductory module, you will learn how to:

1. Review the structure and assessment methods for this Part 46 New Miner Training course.
2. Understand the MSHA requirements for Part 46 New Miner Training.
3. Recognize the role and responsibilities of key stakeholders involved in ensuring mine safety in the US.
4. Examine contributions of the American Miner and key advancements in the U.S. mining industry.
5. Identify and describe various common mining techniques, equipment, and environments.

Key Terms

Let's review some common mining concepts and definitions. This will help you become familiar with terms you will likely hear on the job site.

You can refer back to this section at any time or review the full list of mining concepts and definitions in the Module Resource Materials area.

- **Miner:** Anyone working at a mine, including operators, supervisors, and contractors doing mining tasks. This also includes construction workers exposed to mining risks. It does not include scientists, delivery drivers, customers (like truck drivers), vendors, or visitors. Maintenance workers who do not regularly work in active mining areas are also not considered miners.
- **Mining operations:** Activities such as developing mines, drilling, blasting, extracting minerals, crushing rocks, and moving materials within the mine. It also includes maintaining mining equipment.
- **New miner:** A person starting work as a miner for a mining company or contractor and who hasn't done this job before.
- **Newly hired experienced miner:** An experienced miner starting a new job with a mining company or contractor. Experienced miners who switch mines but stay with the same employer, like drillers and blasters, are not considered newly hired experienced miners.
- **U.S. Mine Safety and Health Administration (MSHA):** A federal agency that sets standards, conducts inspections, and provides guidance, training, and technical assistance to ensure safe mining practices nationwide.

Great! Let's review the structure, objectives, and assessment methods for your Part 46 New Miner Training course.

Course Structure

Each module in this course includes background information on the U.S. Mine Health and Safety Administration (MSHA) training requirement you will learn about, the primary learning objectives that support the MSHA requirement, and relevant instructional and assessment methods.

The beginning of each module outlines the primary MSHA or other federal guidelines that will be presented in the module. It also includes a Warmup with Key Terms, and an overview of indecent reviews or useful statistics that will help you better understand and prepare for the larger module objectives.

Additionally, each module includes a comprehensive Module Resource Materials section, which contains a complete list of key definitions and terms and a simplified list of relevant CFR regulations.

You will also find other study materials and checklists that expand on and reinforce the learning objectives.

Assessment

You will complete a multiple-choice Quiz at the end of each module. This course includes a total of 8 Quizzes (one for each module).

What score do I need to pass the Quiz?

You must pass each Quiz with a score of 70% or greater.

How many times can I take each Quiz?

You can attempt each Quiz as many times as you would like until you earn a passing score.

How long do I have to complete each Quiz?

There is no time limit to each Quiz. However, ensuring a strong browser and internet connection will help you avoid potential lost work or inaccurate scoring; take each Quiz when you have dedicated time and connection.

Course Modules

- Module 1: Course Introduction and the Mining Work Environment **(You are here!)**
- Module 2: Electrical Hazards and Safety Protections
- Module 3: Traffic Control, Transportation, and Equipment Safety
- Module 4: Safe Ground Control Practices
- Module 5: Airborne Hazards and Respiratory Devices
- Module 6: Hazardous Chemicals and HazCom Programs
- Module 7: Fire Prevention and First Aid Procedures
- Module 8: Miner Rights and Responsibilities

1.2 MSHA NEW MINER TRAINING REQUIREMENTS

The MSHA governs training requirements for new and experienced miners. New miners must complete training that meets the standards in 30 CFR Part 46, which this course is part of!

What's the difference between a 'new' and 'experienced' miner?

'New miner'

You are a **new miner** if you fall into both of these categories:

- You are beginning employment as a miner with a production-operator or independent contractor.
- You are not an 'experienced miner'.

'Experienced miner'

You are an **experienced miner** if you fall into one of these categories:

- You were working as a miner on April 14, 1999.
- You have at least one year of total experience in surface mining or an equivalent field by October 2, 2000.
- You started as a miner after April 14, 1999, but before October 2, 2000, and have completed training for new miners as outlined in CFR 48.25 of the regulations published on April 14, 1999.
- You began working as a miner on or after October 2, 2000, completed 24 hours of new miner training under CFR 46.5 or CFR 48.25, and have accumulated at least one year of experience in surface mining or an equivalent field.

Note: If you are an **experienced miner**, you must follow the training and education guidelines under 30 CFR Part 48, and **this training is not for you!**

What if I have mining experience but am new to a mine, task, or operator?

If you are an experienced miner starting a new job with a mining company or contractor, you are not considered a 'new' miner. You are a **newly hired experienced miner**. [See 30 CFR 46.6]. Experienced miners who switch mines but stay with the same employer, like drillers and blasters, are not considered newly hired experienced miners. If you are a newly hired experienced miner, check with your MSHA Office or mine operator regarding your training options and requirements.

If you are a **newly hired experienced miner**, you likely need **alternative training** to fulfill your training requirements.

Now that we've established what a new miner is, let's discuss the training requirements. The MSHA sets the requirements for your new miner training. You must complete different training requirements at the following times:

- Before you begin work at a mine site
- No later than 60 calendar days after you begin work at a mine site
- No later than 90 calendar days after you begin work at a mine site

This course fulfills 24 hours of the Part 46 New Miner Training requirements. You must check with your local MSHA Office and your mine operator to verify that you have met all required training standards. Mine operators may have additional training requirements and safety protocols, and MSHA may revise training standards as needed. [See 30 CFR 46.5 for official MSHA training requirements].

Applicability of Part 46

Who is a miner?

A **miner** is anyone working at a mine, including operators, supervisors, and contractors doing mining tasks. This also includes construction workers exposed to mining risks.

Who is not a miner?

Many people may work near or around a mine worksite. Scientists, delivery drivers, customers (like truck drivers), vendors, or visitors, for example, may work at, near, or around a mine worksite, but they are **not** miners. Maintenance workers who do not regularly work in active mining areas are also not considered miners.

Even if you are not a ‘miner’, MSHA Part 46 regulations have applicability to everyone involved in the mining process.

Persons delivering goods, performing services, collecting material, or visiting and inspecting the property who are not regular employees, for example, may encounter health and safety hazards. Therefore, visitors to mine worksites can be subject to the Federal Mine Safety and Health Act of 1977, as well as any mine operator procedures or rules.

What about contractors or subcontractors?

All Contractors/Subcontractors performing services on mine properties are responsible for compliance with Part 46 of the Code of Federal Regulations (CFR 30) for Mineral Resources. Mine operators must also ensure that site-specific hazard awareness training is given to employees of independent contractors who are required to receive such training (CFR 46.11).

Additionally, your mine operator must provide site-specific hazard awareness training, as appropriate, to any person who is not a miner but is present at a mine site, including:

- Office or staff personnel
- Scientific workers
- Delivery workers
- Customers (including commercial over-the-road truck drivers)
- Construction workers or employees of independent contractors who are not miners under CFR 46.2

- Maintenance or service workers who do not work at the mine site for frequent or extended periods
- Vendors or visitors

Regardless of your status, if you are visiting or working at a mine worksite you should:

- Observe all posted rules and regulations, including speed limits, designated work areas, and safety procedures
- Carefully follow all verbal instructions given by worksite management or other authorized personnel
- Immediately report any hazards you may encounter to worksite supervisory personnel
- Only enter a worksite if you are cleared, trained, or authorized to

How to Complete Your Part 46 New Miner Training

New miner training can include a combination of learning methods. These might include:

- Classroom sessions
- On-site instruction at the mine
- Interactive computer-based training (like this course!)
- Other creative and modern training techniques

Check with your MSHA Office or Mine Operator to understand your full training requirements and how to document when you have successfully completed training.

Refresher Training and Documentation

After you complete your Part 46 New Miner Training, your mine operator must provide you with at least 8 hours of annual refresher training:

- Within 12 months of starting work at the mine
- Every 12 months after completing the previous refresher training

This refresher training will cover any changes at the mine that could affect your health or safety, and other topics relevant to operations at the mine. **Ask your mine operator about refresher training options.**

How is training documented?

It is your responsibility to keep records of your Part 46 New Miner Training. While mine operators have their own documentation and training record requirements, make sure to maintain your own training records for accuracy and safekeeping. **Ask for a copy of what your mine operator submits to MSHA regarding your personal training.**

1.3 MINE SAFETY IN THE UNITED STATES

All workplaces have mandatory requirements for ensuring safe and efficient worksites and processes. To help you understand the mine safety regulations that help keep you safe at your mine worksite, let's look at some key laws, stakeholders, and regulatory bodies who govern the health and safety of miners in the U.S.

A Brief Overview of Key Rules and Players

First, the **Federal Mine Safety and Health Act of 1977**, commonly known as the **Act**, serves as the foundational legislation, outlining safety standards and regulations for your mining work. It covers mandatory:

- Standards
- Inspections
- Enforcement
- Penalties

You will also find regulations concerning health standards such as dust control and respiratory equipment. If you are working in an underground coal mine, this Act provides safety standards on roof support and ventilation and compensation for miners with black lung disease. Together, these standards provide a comprehensive framework to improve your safety and health. This course covers key components of the Act in different modules.

Next, the **U.S. Secretary of Labor** (often known as the **Secretary**) is a member of the President's Cabinet and the head of the Department of Labor. The Secretary oversees the enforcement of labor regulations, sets the overall direction for labor-related issues, plays a role in policymaking related workplace safety issues, and delegates responsibilities as necessary.

The Secretary oversees two key agencies that directly impact your work as a miner:

- **National Institute for Occupational Safety and Health (NIOSH):** NIOSH conducts research, develops guidelines, and provides recommendations to improve occupational health and safety practices across various industries, including mining. They also oversee the approval process for things such as respirators.
- **Mine Safety and Health Administration (MSHA):** MSHA is a federal agency responsible for administering and enforcing the Act, sets standards, conducts inspections, and provides guidance to ensure safe mining practices nationwide. MSHA also provides training, technical assistance, investigations, and research to provide support to miners, increase awareness of hazards, and promote best practices for reducing injury and risk.

There are additional key agencies that provide input and support for your work as a miner. The **American National Standards Institute (ANSI)** is a non-profit organization overseeing the development of voluntary consensus standards in the U.S. In mining, ANSI's standards influence best practices for safety equipment, processes, training, and environmental guidelines.

Additionally, **District Managers** of MSHA work within specific geographical areas known as Coal Mine Safety and Health Districts. These districts are typically based in regions with a concentration of coal mines. District Managers oversee safety and health enforcement at the *local* level, conducting inspections and addressing concerns within their designated districts as well as engaging with mine operators, miners, and other stakeholders to promote safety and health. This course includes detailed information on MSHA and how to contact their offices.

Putting it All Together

Several key laws, stakeholders, and regulatory bodies directly impact your work as a miner. These entities work to educate, support, and train miners like you on how to stay safe at your worksite.

For example, the Federal Mine Safety and Health Act of 1977 establishes essential safety standards, including dust control measures and respiratory equipment guidelines, ensuring a safer working environment and addressing specific hazards like black lung disease. Agencies like MSHA enforce these regulations, conduct inspections, and provide training, while NIOSH develops guidelines and approves safety equipment. These combined efforts, overseen by the Secretary of Labor, ensure you are working in an environment where health risks are minimized, and safety practices are constantly being improved.

Having knowledge of the key players and regulations governing mine safety is vital for you as a miner because these frameworks directly protect your health and safety on the job.

1.4 MINING ACCIDENTS, HAZARDS, AND YOUR RIGHT AND RESPONSIBILITY TO REPORT

Mining is inherently hazardous due to the nature of the work and the environment in which it takes place. Training courses such as the one you are taking right now can help to prevent accidents, improve your awareness of such hazards, and equip you with the tools to report injuries in order to improve your safety.

Among the most common hazardous activities in mining are:

- Handling material
- Machine maintenance or repair
- Walking or running
- Operating equipment

These routine activities caused over half (61%) of total injuries in 2022. The most frequent injuries as a result of these activities include cuts, lacerations, punctures, or fractures of the hand or fingers, and back or leg sprains and strains.

Most accidents, hazards, and injuries like the ones noted above must be reported, typically by the mine operator. Understanding reporting procedures and paying close attention to the safety regulations in this course can help you to ensure your worksite is compliant with federal safety standards that help keep you and others safe.

- In 2023, there were a total of 94,195 reported standards violations across all types of mines.
- The most frequently cited standard violations came from underground mines where combustible materials are unsafely accumulating (3,236 violations), mine ventilation plans that are not approved (1,877 violations), and insufficient protection from falls of roof, rock faces, or sidewalls (1,399 violations).
- In surface mines, there were 1,311 violations of safety protocols for safely moving machine parts and 1,244 violations of the requirement for operators to submit a quarterly employment and coal production report.

Following accident reporting guidelines helps agencies identify trends, track workforce data, and improve emergency preparedness. In turn, these reports can improve your workplace safety and rights as a miner!

Your role in adhering to safety regulations and helping to enforce them is crucial in preventing accidents and ensuring a safe working environment for everyone. Remember, safety is a shared responsibility, and your actions and vigilance can make a difference in keeping yourself and others safe.

Rules and Procedures for Reporting Hazards

As a new miner, your understanding of the safety protocols and resources for reporting is critical for your safety and the safety of your coworkers. Reporting hazards and following proper procedures ensures that risks are identified and mitigated promptly, preventing accidents and saving lives. You are often the first line of defense in spotting potential dangers, making your vigilance and timely reporting essential.

How do I report concerns?

You can call MSHA's toll-free emergency line at 1-800-746-1553 or submit a Hazardous Condition Complaint online to report accidents, hazardous conditions, an impoundment, or an abandoned mine. You are allowed to do this anonymously and at any time, as the form is available anytime online and the emergency line is staffed 24 hours a day, 365 days per year.

Do I have to report these concerns?

While you are not required by law to report accidents, you should still report them, as it is the best way to ensure protocols are followed and your worksite remains safe. However, all mine operators are *required by law* to report accidents and injuries by calling the MSHA's emergency line no later than 15 minutes after becoming aware of an accident.

What kinds of accidents or hazards need to be reported?

If you are unsure if the incident is serious or not, you should still report it. However, MSHA guidelines state that reportable accidents and injuries include, but are not limited to:

1. Death of an individual at a mine.
2. Serious injuries that could potentially cause death.
3. Entrapment of an individual lasting more than thirty minutes, or that could potentially cause death.
4. Unplanned inundation (flooding or filling) of a mine by liquid or gas.
5. Unplanned ignition or explosion of gas or dust.
6. Unplanned fires in underground mines not extinguished within 10 minutes of discovery, or within 30 minutes in surface mines or surface areas of underground mines.
7. Unplanned ignition or explosion of blasting agents or explosives.
8. Unplanned roof falls in active mine workings that affect safety or operations.
9. Coal or rock outbursts causing evacuation or disrupting mining for more than one hour.
10. Unstable conditions at structures used to store mining waste and material (also known as impoundments, refuse piles, or culm banks) requiring emergency action or causing evacuations, including failures.
11. Damage to hoisting equipment endangering individuals or disrupting operations for more than thirty minutes.
12. Events at a mine causing death or injury to individuals not present at the mine at the time of the event. For instance, if toxic gases escape from the mine, they could drift into nearby areas, causing respiratory issues or poisoning.

Additionally, mine operators have requirements to report accidents, injuries, illness, and any damage done to the mining operation using the MSHA Form 7000-1 within 10 working days of the incident. Here is a brief overview of what operators must include on this form:

- The location and mining method

- Date of the injury or illness
- The conditions contributing to the accident (such as the reasons or factors contributing)
- Whether and what equipment was involved
- Names of any witnesses
- Information about the injured or ill miner
- Whether the injury or illness resulted in permanent total or partial disability
- What directly inflicted the injury or illness, such as the object or substance which directly affected the miner (e.g., machine struck the miner, vapor inhaled).
- Nature of the injury or illness using common medical terms (e.g., puncture wound, third-degree burn, fracture, pneumoconiosis). For multiple injuries, they must enter the most serious one.
- Part of the body injured or affected. Name the part of the body with the most serious injury (e.g., "ankle" if a miner has a bruised finger and a broken ankle). If amputation, enter the part of the body lost.
- Occupational Illness, such as occupational skin diseases or disorders (e.g., dermatitis, eczema, oil acne), dust diseases of the lungs (e.g., black lung), respiratory conditions due to toxic agents (e.g., pneumonitis, rhinitis), poisoning (e.g., poisoning by carbon monoxide), disorders due to physical agents (e.g., heatstroke, frostbite), disorders associated with repeated trauma (e.g., noise-induced hearing loss, bursitis), or all other occupational illnesses (e.g., infectious hepatitis, cancer)
- A description of the miner's work activity when the injury or illness occurred (e.g., setting temporary support prior to drilling holes for roof bolts)
- Information on the miner's return to duty

Consider how you might help your mine operator best document this required information. Remember, it is the responsibility of your mine operator to complete this form, but knowing this procedure can help you understand the role they play in maintaining safety standards and encourage you to assist them in gathering information to make the report promptly.

What happens when an accident or incident is reported?

Great question. After your operator makes a report, the MSHA District Manager will quickly decide if an investigation is needed and will inform your operator of the decision. If MSHA decides to investigate, they will start the investigation within 24 hours of being notified.

How can I remember all of this?

To simplify, try to remember this rule: **one call does it all!** Knowing that one call can cover most incidents at your mine site can help you to remember to report hazards to help keep you and others safe.



1.1: Always be prepared to know when and how to report hazards

Having knowledge of the key players and regulations governing mine safety is vital for you as a miner because these frameworks directly protect your health and safety on the job!

1.5 BASIC MINING PROCESS

As a new miner it is valuable to understand key contributions of the American Miner and advancements in the U.S. mining industry. These contributions and advancements set the stage for how, where, and why you might conduct tasks at a mine worksite.

Your role as a miner may change during your career. Therefore, it is helpful that you have a general background of various common mining techniques, equipment, and environments. Knowing these things is important because:

- You can grow in your mining tasks and skills
- You may be asked to work at a different mining site
- You may want to work for a different mine operator, or
- You may take on additional management responsibilities where awareness of broader mining considerations will be useful



1.2: A gold mine on federal land in Nevada; example of commonly dug and facilitated mining worksites

Primary Mining Industries and Advancements

There are five primary mining industries across the U.S. You may find yourself on a worksite at a coal, metal, non-metal, sand and gravel, or stone mine. In 2022 alone, there were over 12,000 active working mines. The table below indicates the makeup of mine types, 12,563 to be exact, in 2022.

Mine Type	Number of Active Mines
Coal	991
Metal	280
Non-metal	859
Sand and Gravel	6,162
Stone	4,271

[NIOSH Mine and Mine Worker Charts]

As you can see, the mining industry is a robust sector of the U.S. Let's learn more about different mine types and their associated basic mining processes.

Mine Types and Basic Mining Processes

As you begin work in the mining profession you will work with, or come across, various mining techniques, equipment, and environments.

In this section you will become familiar with common equipment and key steps in the mining process for each of the three mine types active in the United States and its territories:

- Facility
- Surface
- Underground

Facility Mines

Facility mines, also commonly referred to as "processing plants", transform raw materials extracted from mines into refined products. The key steps in the mining process at facility mines include:

- Material handling
- Crushing
- Grinding
- Beneficiation
- Refining

Let's explore each step in detail along with the common equipment used in the mining process at facility mines. The table below shows you different mining steps, equipment, and the overall process for facilities mining.

Facility Mining Step	Key Equipment	General Process
Material handling	Conveyors, bucket elevators, feeders	Raw materials extracted from mines are transported to the facility mine via trucks, railcars, or conveyor belts. Material handling equipment is also used to transfer raw materials within the facility.
Crushing	Jaw crushers, cone crushers, impact crushers	Raw materials such as ores, minerals, and aggregates are crushed into smaller particles to facilitate subsequent processing stages. Crushers reduce the size of raw materials by applying compressive forces, enabling easier handling and improved extraction efficiency.
Grinding	Ball mills, rod mills, SAG mills	Crushed materials are further pulverized into fine particles through grinding operations. Grinding mills rotate cylinders or drums containing grinding media, such as steel balls or rods, which impact and grind the feed material, increasing surface area for chemical reactions and separation processes.
Beneficiation	Flotation cells, magnetic separators, gravity separators	Beneficiation involves separating valuable minerals from gangue (unwanted materials) through physical and chemical methods. Equipment such as flotation cells, magnetic separators, and gravity separators are used to concentrate valuable minerals from the crushed ore based on differences in their physical and chemical properties.
Refining	Smelters, furnaces, electrolytic cells	Refined products are produced through smelting, refining, or chemical processing techniques.

		Smelters and furnaces melt concentrated ores to extract metals, while electrolytic cells use electricity to refine metals to high purity levels. Chemical processes may also be employed to produce purified compounds or products.
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Surface Mines

Surface mines, also commonly referred to as “open-pit mines” or “quarries”, involve the extraction of mineral deposits from the earth's surface using heavy equipment and machinery. The key steps in the mining process at surface mines include:

- Exploration
- Planning
- Stripping
- Drilling and blasting
- Loading and hauling
- Reclamation

Let's explore each step in detail along with the common equipment used in the mining process at surface mines. The table below shows you different mining steps, equipment, and the overall process for surface mining.

Facility Mining Step	Key Equipment	General Process
Exploration	Geophysical survey equipment, drilling rigs	Geological surveys and exploratory drilling are conducted to identify potential mineral deposits beneath the earth's surface. Geophysical methods such as seismic surveys and magnetic surveys help to map subsurface geological structures and anomalies indicative of mineralization.
Planning	Surveying instruments, mine planning software	Mine planners use survey data and geological information to design the layout of the mine, including pit dimensions, access roads, and infrastructure. Mine planning software is used to optimize pit designs, minimize environmental impacts, and maximize

		resource recovery.
Stripping	Bulldozers, scrapers, draglines	“Overburden”, such as topsoil, rock, and vegetation, is removed to expose the mineral deposits beneath the surface. Heavy equipment such as bulldozers, scrapers, and draglines are used to strip and remove overburden, creating access to the ore body for subsequent extraction.
Drilling and blasting	Drill rigs, explosives	Holes are drilled into the ore body using drill rigs equipped with rotary or percussion drilling methods. Explosives are then inserted into the drill holes and detonated to fragment the rock mass, facilitating excavation and extraction. Proper drilling and blasting practices are essential to ensure safety and minimize environmental impacts.
Loading and hauling	Excavators, haul trucks, loaders	Excavators load blasted ore and waste materials into haul trucks or loaders for transport to the processing plant or waste disposal area. Haul trucks transport materials from the pit to the designated destination, while loaders handle stockpiling and material handling within the mine site.
Reclamation	Soil compactors, seeders, revegetation equipment	Upon completion of mining operations, reclamation activities restore disturbed land to its pre-mining condition or suitable land use. Soil compactors are used to reshape the land contours, while revegetation equipment facilitates the planting of native vegetation to stabilize slopes and promote ecosystem recovery.



1.3: Aerial view of a surface mine in an Appalachian coal field

Underground Mines

Underground mines involve the extraction of mineral deposits from beneath the earth's surface through tunnels, shafts, and drifts. The key steps in the mining process at underground mines include:

- Development
- Drilling and blasting
- Loading and hauling
- Support

Let's explore each step in detail along with the common equipment used in the mining process at underground mines. The table below shows you different mining steps, equipment, and the overall process for underground mining.

Facility Mining Step	Key Equipment	General Process
Development	Tunneling equipment, drilling jumbos, roof bolters	Access tunnels, shafts, and drifts are excavated to reach the ore body (rock mass) underground. Tunneling equipment such as drill jumbos and tunnel boring machines create openings for further exploration and development. Roof bolters install support systems to reinforce the mine workings and prevent roof collapses.
Drilling and blasting	Drill rigs, explosives	Holes are drilled into the ore body (rock mass) using drill rigs equipped with

		<p>diamond drills or rotary drilling methods. Explosives are inserted into the drill holes and detonated to fragment the rock mass, allowing for easier excavation and extraction. Proper drilling and blasting practices are crucial to ensure safety and minimize ground vibrations.</p>
<p>Loading and hauling</p>	<p>Load-haul-dump (LHD) machines, underground trucks</p>	<p>Load-haul-dump machines or scoop trams load blasted ore and waste materials into underground trucks for transport to the surface or a processing plant. Underground trucks navigate through narrow tunnels and ramps to transport materials safely and efficiently within the mine.</p>
<p>Support</p>	<p>Roof bolters, rock reinforcement systems</p>	<p>Underground mines require extensive support systems to ensure stability and safety within the mine. Roof bolters install roof bolts or rock reinforcement systems to secure the roof and walls of the mine tunnels, preventing collapses and rockfalls. Ground support materials such as mesh, shotcrete, and rock bolts are used to reinforce weak rock formations and control ground conditions.</p>



1.4: Internal view of an underground mine

In summary, each type of mine—facility, surface, or underground—involves distinct processes and equipment tailored to the mine's specific characteristics and operational requirements. Understanding these differences is essential as you enter the mining industry, as it helps you be mindful of specific process and safety protocols and your responsibilities at a mine worksite. You can also review the Module Resource Materials for more information about the different products mined at each mine type.

The Mining Work Environment: 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:

- Understand how the Part 46 New Miner Training program requirements apply to you and how this course supports your training
- Identify various stakeholders involved in promoting and maintaining mine safety in the U.S.
- Generally describe common mining industries, types, techniques, environments, and equipment

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.

Appendix: Contributions of The American Miner

As a miner, you will join a workforce with a rich history marked by significant milestones and advancements that continue to support the foundations of modern infrastructure, materials sourcing, development, and trade.

Let's review some historical contributions and key milestones in different mining industries.

Coal Mining

Coal mining has played a vital role in the industrialization and development of the United States. It began in the early 18th century, primarily for household and industrial heating purposes. However, the real boom in coal mining occurred during the 19th and early 20th centuries with the rise of steam engines and the industrial revolution. The invention of the steam engine by James Watt in 1769 significantly increased the demand for coal, leading to the expansion of mining operations across the country.

Key Milestones in U.S. Coal Mining:

- **The Industrial Revolution (Late 18th to early 19th centuries):** Coal became a primary source of energy for steam engines, powering factories, locomotives, and ships, driving economic growth and urbanization.
- **The Rise of Coal Companies (Late 19th century):** Large coal companies emerged, dominating the industry and influencing government policies and labor practices.
- **The Appalachian Coal Fields (Late 19th to early 20th centuries):** The discovery of vast coal reserves in the Appalachian region fueled the expansion of coal mining, making the United States a major coal producer.
- **The Coal Act of 1938:** This legislation established the Bituminous Coal Commission to regulate labor relations and set minimum wage standards, improving working conditions for coal miners.

Coal mining in the United States not only fuels domestic energy production but also contributes to the global market. The country exports coal to various nations, including China, India, and European countries, supporting their energy needs and economic development.

Metal Mining

Metal mining encompasses the extraction of valuable metals such as gold, silver, copper, iron, and aluminum from ore deposits. U.S. metal mining dates back to colonial times when settlers first discovered gold in Virginia and North Carolina. Since then, metal mining has evolved into a sophisticated industry, driving technological innovation and economic growth.

Key Milestones in U.S. Metal Mining:

- **The California Gold Rush (1848-1855):** The discovery of gold in California sparked one of the largest migrations in American history, leading to the rapid development of mining towns and the expansion of metal mining operations.
- **The Comstock Lode (1859):** This massive silver deposit in Nevada attracted thousands of

miners and investors, significantly boosting the economy and infrastructure development in the region.

- **The Iron and Steel Industry (Late 19th to early 20th centuries):** The abundance of iron ore deposits in states like Minnesota and Michigan fueled the growth of the iron and steel industry, supplying materials for construction, transportation, and manufacturing.
- **World War II (1939-1945):** The demand for metals during wartime stimulated production, leading to increased mining activity and technological advancements in extraction and processing.

Metal mining in the United States not only supports domestic industries but also contributes to global supply chains, providing essential materials for manufacturing, infrastructure development, and technology production worldwide.

Non-metal Mining

Non-metal mining encompasses the extraction of minerals and resources other than metals, such as salt, gypsum, phosphate, and limestone. These minerals play critical roles in various industries, including agriculture, construction, and manufacturing. The United States has abundant non-metal mineral deposits, which have been exploited for centuries to meet the growing demand for raw materials.

Key Milestones in U.S. Non-metal Mining:

- **The Salt Industry (Colonial era to present):** Salt mining has been a vital economic activity since colonial times, with the U.S. becoming one of the world's leading salt producers.
- **The Phosphate Boom (Late 19th to early 20th centuries):** The discovery of phosphate deposits in Florida and South Carolina led to a boom in phosphate mining, supporting agricultural fertilizers and food production.
- **The Rise of Industrial Minerals (20th century):** The demand for industrial minerals such as limestone, gypsum, and silica sand grew significantly with the expansion of construction, manufacturing, and infrastructure projects across the country.

Non-metal mining in the U.S. serves diverse industries and markets, providing essential raw materials for agriculture, construction, manufacturing, and infrastructure development both domestically and internationally.

Sand and Gravel Mining

Sand and gravel mining involves the extraction of sand, gravel, and other aggregates from rivers, lakes, and quarries for use in construction, infrastructure development, and landscaping. The U.S. is one of the largest consumers of sand and gravel, with demand driven by the construction industry and infrastructure projects.

Key Milestones in U.S. Sand and Gravel Mining:

- **The Post-World War II Construction Boom (1940s-1950s):** The rapid urbanization and infrastructure development following World War II fueled demand for sand and gravel,

driving expansion in mining operations.

- **The Interstate Highway System (1956):** The construction of the interstate highway system in the United States required vast quantities of aggregates, leading to increased sand and gravel mining activity across the country.
- **Infrastructure Development (21st century):** Continued investment in infrastructure projects, such as road construction, bridge repairs, and coastal protection drives sand and gravel operations.



1.5: Ground level view of gravel mine

Stone Mining

Stone mining involves the extraction of various types of rock and minerals used for construction, industrial processes, and artistic applications. This sector includes the mining of materials like limestone, granite, sandstone, marble, and slate. U.S. stone mining has a long history, with its roots stretching back to early colonization and expanding significantly with industrialization.

Key Milestones in U.S. Stone Mining:

- **Early Quarrying (1600s-1700s):** The first significant stone quarries in the U.S. were established in the 17th century. Early settlers quarried local stone for building foundations, roads, and monuments, laying the groundwork for the U.S. stone mining industry.
- **The Building Boom (19th Century):** The 19th century saw a surge in demand for stone due to rapid urbanization and infrastructure development for the construction of bridges, railways, and public buildings spurred the growth of large-scale quarries and stone processing facilities.
- **The Granite Revolution (Late 1800s-1900s):** The discovery and commercial use of granite from quarries in New England, particularly in Massachusetts and Vermont, revolutionized construction. Granite became a preferred material for monuments,

buildings, and public structures due to its durability and aesthetic appeal.

- **Efficiency and Environmental Appreciation (Mid-20th Century-Present):** Advances in mining technology, including the use of diamond wire saws and automated machinery, have helped stone mining become more efficient and environmentally conscious, with improved methods for reducing waste and environmental damage.

Stone mining in the United States provides essential materials for a wide range of applications, from road construction and building foundations to decorative stone and sculptural art. It supports both local economies and national infrastructure projects, playing a crucial role in shaping the built environment.

Modern Trends in the U.S. Mining Industry

Technology and environment considerations have dominated modern trends in the U.S. mining industry. There is an ongoing effort to minimize the overall environmental footprint of mining operations, while capitalizing on enhancements in mining technology.

Key Technological Advancements (20th century to present): Mechanized mining equipment, conveyor belts, and advances in extraction techniques, such as hydraulic fracturing (fracking) for oil and gas production, have expanded the scope of mining activities across various mine types. Advanced mining techniques, such as remote sensing, automated drilling, and predictive analytics, have also improved efficiency, safety, and environmental performance in metal mining operations. Similarly, innovations in dredging equipment, screening technologies, and sustainable mining practices have improved efficiency and environmental performance in mining operations.

Key Environmental Regulations (20th century to present): Concerns over air and water pollution in the late 20th century led to the implementation of greater environmental regulations, shaping, for example, modern coal mining practices towards sustainability and cleaner technologies. Metal and non-metal mining operations have faced increasing scrutiny over their environmental impact, leading to stricter regulations and environmental mitigation measures. Additionally, concerns over habitat destruction, water pollution, and land reclamation have prompted the implementation of environmental regulations to mitigate the impacts of sand and gravel mining on ecosystems and communities.

MODULE RESOURCE MATERIALS

List of Common Mining Concepts and Definitions

- **Federal Mine Safety and Health Act of 1977:** Serves as the foundational legislation, outlining safety standards and regulations for mining work in the U.S.
- **Miner:** Anyone working at a mine, including operators, supervisors, and contractors doing mining tasks. This also includes construction workers exposed to mining risks. It does not include scientists, delivery drivers, customers (like truck drivers), vendors, or visitors. Maintenance workers who do not regularly work in active mining areas are also not considered miners.
- **Mining operations:** Activities such as developing mines, drilling, blasting, extracting minerals, crushing rocks, and moving materials within the mine. It also includes maintaining mining equipment.
- **New miner:** A person starting work as a miner for a mining company or contractor and who has not done the job before, and is not an experienced miner.
- **Newly hired experienced miner:** An experienced miner starting a new job with a mining company or contractor. Experienced miners who switch mines but stay with the same employer, like drillers and blasters, are not considered newly hired experienced miners.
- **National Institute for Occupational Safety and Health (NIOSH):** NIOSH conducts research, develops guidelines, and provides recommendations to improve occupational health and safety practices across various industries, including mining. They also oversee the approval process for things such as respirators.
- **U.S. Code of Federal Regulations:** Specific regulatory requirements and standards that miners must adhere to.
- **U.S. Mine Safety and Health Administration (MSHA):** A federal agency that sets standards, conducts inspections, and provides guidance, training, and technical assistance to ensure safe mining practices nationwide.

Common Facility, Surface, and Underground Mine Products

Examples of Facility Mine Products:

- **Refined Metals:** Facility mines process raw ores containing metals such as copper, gold, and nickel into refined metal products suitable for manufacturing industries. For example, a copper smelter receives copper concentrate from surface or underground mines and produces refined copper cathodes or copper ingots for use in electrical wiring, plumbing, and electronics.
- **Chemical Compounds:** Some facility mines specialize in processing raw materials into chemical compounds used in various industries. For instance, a phosphate beneficiation plant receives phosphate rock from surface mines and produces phosphoric acid or phosphate fertilizers for agricultural applications.
- **Construction Materials:** Facility mines may also process raw materials into construction materials such as cement, concrete, and asphalt. For example, a cement plant receives limestone and clay from nearby quarries and kilns them to produce cement clinker, which is then ground into cement powder for use in construction projects.

Examples of Surface Mine Products:

- **Coal:** Surface mines extract coal deposits found near the earth's surface, typically in coal seams or coal beds. Coal extracted from surface mines is used as a primary fuel source for electricity generation, heating, and industrial processes.
- **Aggregates:** Surface mines produce aggregates such as sand, gravel, and crushed stone used in construction projects. Sand and gravel pits supply materials for road construction, concrete production, and landscaping, while crushed stone quarries provide base materials for roads and building foundations.
- **Precious Metals:** Some surface mines extract precious metals such as gold, silver, and platinum from shallow deposits. These metals are used in jewelry, electronics, and investment products. For example, a gold mine may use open-pit mining methods to extract gold ore from surface deposits.

Examples of Underground Mine Products:

- **Metal Ores:** Underground mines extract metal ores such as copper, zinc, and lead from deep-seated deposits. These ores are processed into metals through smelting and refining processes. For example, an underground copper mine may use sublevel caving or block caving methods to extract copper ore from a deep ore body.
- **Gemstones:** Some underground mines produce gemstones such as diamonds, rubies, and sapphires from geological formations deep below the earth's surface. These gemstones are used in jewelry, decorative objects, and industrial applications.
- **Salt and Potash:** Underground mines extract salt and potash deposits found in sedimentary formations beneath the earth's surface. These minerals are essential for food processing, water softening, and fertilizer production. For instance, an

underground salt mine may use solution mining techniques to dissolve salt deposits and pump brine to the surface for processing.

Recall that facility mines process raw materials into refined products, surface mines extract mineral deposits from the earth's surface, and underground mines access deeper ore bodies beneath the surface. Each type of mine presents unique work practices and processes for miners!

Simplified Part 46 and Mining Corresponding Code of Federal Regulations Listing

- **Scope:** Part 46 establishes the required training for miners and others working at surface mines, including those extracting materials like sand, gravel, and stone. [46.1]
- **Act:** The Federal Mine Safety and Health Act of 1977. [46.2]
- **Competent person:** Someone chosen by the mine operator who has the right skills and knowledge to train miners. [46.2]
- **Equivalent experience:** Similar work experience to mining, such as operating heavy equipment. [46.2]
- **Experienced miner:** A person who has worked as a miner for a certain amount of time or has completed specific training. [46.2]
- **Independent contractor:** A person or organization hired to perform work at a mine. [46.2]
- **Mine site:** The area where mining operations happen. [46.2]
- **Miner:** Anyone who works at a mine, including operators, supervisors, and certain contractors. [46.2]
- **Mining operations:** Activities like drilling, blasting, and extracting minerals. [46.2]
- **New miner:** Someone new to mining and not yet experienced. [46.2]
- **Newly hired experienced miner:** An experienced miner starting at a new mine. [46.2]
- **Normal working hours:** The regular work schedule for a miner. [46.2]
- **Operator:** The person or company running the mine. [46.2]
- **Production-operator:** The owner or person in charge of the mine. [46.2]
- **Task:** A specific job or part of a job that requires particular skills. [46.2]
- **Training Plans:** Mine operators need a written plan for training miners. This plan must include the name of the mine operator's company and mine, the designated individual or group in charge of training, a description of training methods and materials, a list of trainers and their qualifications, and evaluation procedures to check the effectiveness of the training. If a mine operator's plan doesn't meet these requirements, it must be approved by the Regional Manager. Miners must be informed about the plan and can request changes if needed. [46.3]
- **Training Plan Implementation:** Mining operators and miners must ensure that training follows the written plan, a competent person conducts the training, and the training is in a language understood by the miners. Mine operators can conduct training in various ways, including classroom instruction, on-the-job training, or online courses. [46.4]
- **New Miner Training:** Experienced miners starting at a new mine must receive training on the work environment and hazards, emergency procedures, and specific tasks and safety standards. This training must be completed within 60 days of starting work. [46.6]
- **New Task Training:** Miners assigned to a new task must be trained on the health and safety aspects of the new task and how to perform the task safely. This training must be provided before they start the new task. [46.7]

- **Annual Refresher Training:** Each miner must receive at least 8 hours of refresher training every year, covering changes in the mine that affect health and safety and Important safety topics relevant to the mine. [46.8]
- **Records of Training:** Mine operators must keep records of all training provided to miners, including the name of the person trained, the type of training and its duration, the date of the training, and the name of the trainer. These records must be available for inspection and provided to the miner upon request. [46.9]
- **Compensation for Training:** Training must be conducted during regular working hours, and miners must be paid as if they were working. If training is off-site, additional costs like travel and meals must be covered. [46.10]
- **Site-Specific Hazard Awareness Training:** Before anyone is exposed to mine hazards, they must receive training on site-specific risks and emergency procedures. This includes office staff, delivery workers, visitors, contractors, and miners moving to a new site within the same company. [46.11]
- **Responsibility for Independent Contractor Training:** The main mine operator must ensure that contractors receive site-specific hazard training. Contractors must also provide their employees with the necessary safety training and inform the mine operator of any hazards related to their work. [46.12]