MSHA Part 46 New Miner Online Training

Module 7

Fire Prevention and First Aid Procedures

MSHA Training Requirement:

An introduction to the rules and procedures for preventing fire hazards and providing basic first aid. [Section 46.5(b)(3), Section 46.5(c)(2)].

Learning Objectives:

1. Identify potential fire hazards and preventive safety measures associated with flammable materials found in mining operations, such as fuel, oils, solvents, and gases.
2. Learn the proper firefighting equipment maintenance and inspection schedules to ensure readiness in emergency situations.
3. Understand general firefighting procedures and protocols that you can build upon based on guidance from your mine operator and specific mine worksite.
4. Follow safety measures to mitigate fire hazards during hot work.
5. Define and differentiate between first aid and medical treatment in the context of mining-related injuries.
6. Implement required first aid procedures for possible mining injuries.

Module Sections

- 7.1 Introduction to Fire Prevention and First Aid Procedures
- 7.2 Fire Prevention
- 7.3 Firefighting Equipment and Procedures
- 7.4 Preventing Fires During Hot Work
- 7.5 First Aid Procedures

Code of Federal Regulations Reference Material

This module covers important topics from the 30 CFR Part 77 Subpart L (Fire Protection) and Part 56 Subparts C (Fire Prevention and Control) and Q (First Aid).

CFR Subtopic Regulations: 30 CFR 77 Subpart L (Fire Protection)

- 77.1100 Fire protection; training and organization
- 77.1101 Escape and evacuation; plan
- 77.1102 Warning signs; smoking and open flame
- 77.1103 Flammable liquids; storage
- 77.1104 Accumulations of combustible materials
- 77.1105 Internal combustion engines; fueling
- 77.1106 Battery-charging stations; ventilation
- 77.1107 Belt conveyors
- 77.1108 Firefighting equipment; requirements; general
- 77.1108-1 Type and capacity of firefighting equipment
- 77.1109 Quantity and location of firefighting equipment
- 77.1110 Examination and maintenance of firefighting equipment
- 77.1111 Welding, cutting, soldering; use of fire extinguisher
- 77.1112 Welding, cutting, or soldering with arc or flame; safeguards

CFR Subtopic Regulations: 30 CFR 56 Subpart C (Fire Prevention and Control)

- 56.4000 Definitions
- 56.4011 Abandoned electric circuits.
- 56.4100 Smoking and use of open flames
- 56.4101 Warning signs
- 56.4102 Spillage and leakage
- 56.4103 Fueling internal combustion engines
- 56.4104 Combustible waste
- 56.4130 Electric substations and liquid storage facilities
- 56.4200 General requirements
- 56.4201 Inspection
- 56.4202 Fire hydrants
- 56.4203 Extinguisher recharging or replacement
- 56.4230 Self-propelled equipment
- 56.4330 Firefighting, evacuation, and rescue procedures
- 56.4331 Firefighting drills

- 56.4400 Use restrictions
- 56.4401 Storage tank foundations
- 56.4402 Safety can use
- 56.4430 Storage facilities
- 56.4500 Heat sources
- 56.4501 Fuel lines
- 56.4502 Battery-charging stations
- 56.4503 Conveyor belt slippage
- 56.4530 Exits
- 56.4531 Flammable or combustible liquid storage buildings or rooms
- 56.4600 Extinguishing equipment
- 56.4601 Oxygen cylinder storage.
- 56.4602 Gauges and regulators
- 56.4603 Closure of valves
- 56.4604 Preparation of pipelines or containers

CFR Subtopic Regulations: 30 CFR 56 Subpart Q (First Aid)

- 56.18010 First aid

7.1 INTRODUCTION TO FIRE PREVENTION AND FIRST AID PROCEDURES

Understanding fire prevention and first aid procedures at a mine worksite is critical to ensure the safety of workers and protect equipment. The rules in 30 CFR Part 77 Subpart L (Fire Protection) and Part 56 Subparts C (Fire Prevention and Control) and Q (First Aid) outline specific guidelines that focus on fire prevention and first aid at mine sites.
This module will help you conduct work safely as you work:

- Around fire hazards, such as flammable material and electrical equipment
- With properly inspected and maintained firefighting equipment in case of emergency
- Alongside fellow miners who might experience injuries at the worksite

You will learn how to:

1. Identify potential fire hazards and preventive safety measures associated with flammable materials found in mining operations, such as fuel, oils, solvents, and gases.
2. Learn the proper firefighting equipment maintenance and inspection schedules to ensure readiness in emergency situations.
3. Understand general firefighting procedures and protocols that you can build upon based on guidance from your mine operator and specific mine worksite.
4. Follow safety measures to mitigate fire hazards during hot work.
5. Define and differentiate between first aid and medical treatment in the context of mining-related injuries.
6. Implement required first aid procedures for possible mining injuries.

Module Warmup

Why Fire and First Aid Practices Matter?

In any mining operation, ensuring safety involves being prepared for emergencies and fire hazards. In the event of a fire, prompt evacuation according to established protocols is crucial to safeguarding lives and minimizing damage.

Preventing fires requires several key practices:

- Having properly functioning and maintained firefighting equipment
- Maintaining awareness of your surrounding environment
- Being trained in basic first aid
- Responding swiftly and effectively to injuries
- Ensuring immediate medical attention can be provided to those in need

Integrating these safety practices ensures a comprehensive approach to protecting you and others, as well as maintaining a secure worksite at your mine.

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

- A 60-year-old contract employee died after complications from **a fire igniting on the Caterpillar haul truck** he was operating. It is likely that the fire could have been prevented if the contractor confirmed that the fire suppression system was properly installed and maintained.
- A 62 year-old contractor died when **multiple methane gas explosions occurred** while he was in the direct line of the explosion forces. The mine operator and contractor could have mitigated these risks by ensuring that the mine ventilation plan was followed and confirming that specific torches were not being used for this task.
- Nearly **300,000 total days of lost mining work** were reported in one year as a result of nonfatal injuries that could have been treated with basic first aid. The top reported injuries were sprains or strains, followed by fractures, cuts, and bruises. Understanding how to prevent and treat these kinds of injuries with basic first aid can reduce your risk of getting hurt or missing work.

To recap, preventing these kinds of accidents and injuries involves understanding:

- Fire prevention guidelines
- Equipment inspection protocols
- The importance of handling flammable material properly and safely

Similarly, knowing basic first aid is paramount in case an accident occurs. Immediate and appropriate first aid can significantly reduce the severity of injuries and can potentially save lives. This includes knowing how to treat burns, control bleeding, prevent shock, and administer CPR.

Key Terms: Common Fire Prevention and First Aid Concepts and Definitions

Let’s review some common concepts and definitions.

- **Cardiopulmonary Resuscitation (CPR**): A vital technique used in emergencies where someone's breathing or heartbeat has stopped.
- **First Aid:** First aid refers to the initial, immediate care that you give to a person who has sustained a minor injury or illness.
- **Flashpoint**: The lowest temperature at which a liquid gives off enough vapor to catch fire when near a flame or spark.
- **Hot Work:** Any work that produces sparks, flames, or enough heat to initiate a fire or flames during operation.
- **Reverse Current Protection:** A safety mechanism to stop electric current from going in the wrong direction.
- **Shock**: When the body does not get enough blood or oxygen to its vital organs and tissues.

- **Self-Propelled Mobile Equipment**: Vehicles or machinery that can move independently, often used in mining operations.

Preparing to Learn Fire Prevention and First Aid Procedures

Many of the federal regulations concerning fire prevention and first aid procedures 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 fire hazards and prevent injuries to you and others.

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

- Begin noticing potential fire hazards around you, such as charging stations, storage of flammable material, or people doing hot work.
- Take measures to always reduce the risk of fire by handling flammable materials carefully and following protocol when conducting work.
- Confirm that you know how to operate and where to find the firefighting equipment, evacuation, and rescue procedures for your specific mine worksite and all machinery you use.
- Be ready to administer basic first aid in the event of an emergency or injury.

The rest of this module will help you further understand key fire prevention and equipment concepts, why these procedures are important, and how they will help you to stay healthy and unharmed while at a mine site.

7.2 FIRE PREVENTION

As you begin your career in mining, understanding fire prevention and response practices is crucial for your safety and the well-being of everyone on site. At your mine worksite, flammable materials such as fuel, chemicals, and gases are often present, and fire hazards must be carefully managed to prevent accidents and protect lives.

The below regulations outline essential rules to help you minimize fire risks by controlling how flammable materials are handled, stored, and used.

These regulations will also help you to stay alert to changing conditions at your mine worksite that can impact fire prevention and response.

General Fire Precautions

Before looking at specific guidelines for preventing fires at your mine worksite, let's first consider some general principles to keep in mind as you navigate your mine operation.

- Ensure that buildings or places where you are working have enough exits so everyone on site can get out quickly if there is a fire. Know exit locations before you begin work!
- Always be mindful of your physical and material surroundings when working. Heat sources that can start fires, such as equipment or machinery that can produce sparks or open flame, must be kept *away* from materials that can catch fire easily, such as paper products, plastics, flammable liquids, or chemicals.
- Be sure there are clearly visible signs that warn against smoking and using open flames if you are working in an area that has a risk of fire or explosion.

Preventing Fire Hazards from Fuel and Electrical Sources

Your mine worksite will likely have a variety of equipment that runs on **electricity** or **fuel**. For example, conveyor belts, pumps, lighting systems, battery charging stations, and electric drills all require electricity or rechargeable batteries to function. Additionally, excavators, bulldozers, trucks, and generators, for example, run on fuel.

Consider these precautions when working around electric or fuel power sources:

1. **Safe refueling:** Before refueling internal combustion engines where the fuel tank is part of the equipment itself, the engine must be turned off and completely stopped. However, this rule does not apply to diesel-powered equipment. This ensures safe refueling practices are followed to prevent fire hazards.
2. **Disconnecting electric circuits:** If you are no longer using an electric circuit, be sure you turn it off and fully disconnect it to ensure it cannot accidentally be turned on again.

3. **Conveyor belt slippage detection:** Conveyor belts run on electricity. If the belt slips, it can cause friction and generate heat; the heat can be enough to ignite the belt or other nearby materials, causing a fire. In areas where you would find it hard to escape during a fire caused by belt slippage, belt conveyors must have a system that can detect this and stop the main pulley automatically. Alternatively, they must have switches that can stop the main pulley if needed. When the conveyor needs to run but the automatic system is temporarily bypassed, someone must be there to watch the belt at the main pulley

7.1: Conveyor belt used in above-ground mining operations.

Battery-Charging Stations

Your mine worksite might use fuel or electricity to power battery-charging stations for electric vehicles, tools, and machines to be recharged. These stations can be a fire hazard for several reasons, such as:

- The release of hydrogen gas when charging a battery
- Electrical malfunctions
- Heat generation

To reduce the risk of fire, be sure to follow these guidelines when working around battery charging stations:

- **Adequate fresh air flow:** Always ensure that your battery-charging stations have enough fresh air flow, so hydrogen gas does not build up.
- **Distance from flammable material or gases:** Just like you should not smoke when fueling your car at a typical gas station, you should not smoke, have an open flame, or allow anything that could start a fire around the battery charging station while batteries are being charged.
- **Reverse current protection:** If these stations are connected directly to power systems with direct current, check that they have safety mechanisms to stop the electric current from going in the wrong direction. This is known as reverse current protection and is important to prevent battery damage, protect equipment, and reduce overheating, which can cause fires and explosions.
- **Proper warning signage:** You should easily see signs that indicate 'no smoking' or 'open flames' while batteries are being charged at all of your battery-charging stations at a mine worksite.

As your mining operation likely uses fuel and other flammable material on site, it is often **stored** in the work site. Let's look at how to properly store and handle flammable liquids next.

Handling and Storage of Flammable Liquids

A variety of flammable liquids are important to the mining process. For instance, you may use:

- Fuel for machinery
- Oils to maintain your equipment
- Blasting agents to break rocks
- Paint to mark safety zones
- Chemical solvents to extract or refine materials

When at your mine site, stay alert and aware of where and when flammable and combustible liquids (like greases) or gases are being *used, moved, stored*, or *handled* and keep these general safety rules in mind:

- Do not smoke or use open flames in areas where flammable or combustible liquids (like greases) or gases are present.
- Clean up flammable liquid spills or leaks quickly or control it so it does not cause a fire.
- Properly dispose of rags or similar cleaning materials that can absorb flammable substances by putting it in a metal can or similar container.

Handling Flammable Liquids Safely

Now that you understand the general precautions for working with flammable liquids, let's look at how you can safely handle them.

If you must handle flammable liquids, follow these guidelines to keep you and your mine worksite safe from potential fire hazards:

- Flammable liquids should **not** be used to clean.
- Solvents should **not** be used near open flames, heat sources, or in environments where the temperature could make the solvent catch fire easily**.**
- Combustible materials like grease, lubricants, paints, or flammable waste must **not** gather in places where they could start a fire.
- Until they are properly disposed of, waste or rags with flammable or combustible liquids that could start a fire should not be left out; they must be put in covered metal or similar containers that can handle flames.

Storing Flammable Liquids Safely

Mining operations require easy access to things like fuel, paint, oils, solvents, greases, and other compressed gases to perform mining activities efficiently and effectively. As a result, many of these materials will likely be stored at your mine worksite. Let's look at some ways you can store these properly in order to minimize fire hazards.

Flammable liquids must be stored following the guidelines set by the National Fire Protection Association. When small amounts of these liquids are taken out for use, they should be kept in **safety cans** that are properly labeled.

What are safety cans?
Safety cans are small containers (holding up to five gallons) designed to release pressure safely if it gets hot. It has a spring-closing lid and a cover on the spout to prevent spills and reduce the risk of fire. Using these cans minimizes the likelihood of accidental ignition from sparks, static electricity, or other heat sources, which improves the safety of storing these liquids.

Knowing the **flashpoint** of a liquid can help you to ensure the flammable material is being stored properly. The flashpoint refers to the lowest temperature at which a liquid gives off enough vapor to catch fire when near a flame or spark. Liquids with lower flashpoints may need to be stored in cooler environments or in specially designed containers to prevent accidental ignition.

When storing and working with fuel, be sure the fuel lines have valves that can shut off the fuel supply at its source. These valves must be maintained in a way that reduces the risk of fires.

Next, to avoid creating a danger for you and others, be sure that you do not store or gather flammable materials *within 25 feet of the following*:

- Electric substations
- Above-ground storage tanks containing flammable or combustible liquids

- Any collection of containers holding more than 60 gallons of flammable or combustible liquids
- Any dry grass, weeds, bushes, or other materials that can catch fire

Additionally, the area around electric substations and transformers should be kept clear of dry vegetation and other materials that could catch fire. This clearance must extend *at least 25 feet* in every direction.

7.2: Example of standard electrical substation.

Finally, when you are designating locations and containers for storing flammable materials, be sure that any above-ground tanks holding flammable liquids are securely placed on strong foundations. Confirm that the pipes used for draining these tanks have flexible connections or other special fittings to prevent damage caused by the tanks settling.

To summarize, always stay alert for flammable materials at your mine worksite. These materials should be kept away from open flames, heat sources, and dry vegetation in order to reduce the risk of a fire starting.

Nice work! You are now able to implement key principles for fire prevention, especially when handling flammable material. Next, we will look at proper equipment you should have available to you at the worksite, as well as fire prevention procedures you can expect to learn once you arrive at your assigned location.

7.3 FIREFIGHTING EQUIPMENT & PROCEDURES

To help reduce the risk of fire, your mine worksite will have various firefighting equipment. This can include items such as fire extinguishers that are suitable for various types of fires, fire hydrants to deliver water to a fire, fire suppression systems installed in certain areas to detect and automatically suppress fires, and more. This section will provide you with the general requirements for maintaining and using your equipment. Be sure to check with your mine operator for specific details on the firefighting equipment your mine worksite uses!

General Equipment Requirements

Every mine is required to maintain equipment and gear to handle fires that could endanger you and others at the worksite. Specifically, your mine operator must provide firefighting gear on site to stop fires early, and appropriate gear for bigger fires, or an agreement with the local fire team to handle such situations.

The firefighting gear should be the correct type, size, and quantity to put out any kind of fire that might start. Additionally, it must be placed in a strategic location that is easy to get to, clearly marked, and ready to use anytime.

Firefighting Equipment in Coal Mines

If you are working in a coal mine, the firefighting equipment that is available might look a little different. For coal mines, your mine operator is required to provide enough equipment to fit the mine's size and conditions on the ground. This equipment must meet the following requirements:

Waterlines

- Waterlines must be able to deliver 50 gallons of water per minute at a nozzle pressure of 50 pounds per square inch.
- If storage tanks supply the water, each tank must hold 1,000 gallons for every 1,000 tons of coal processed per shift on average.

Fire Extinguishers

- Different types of fires require different extinguishing agents. For instance, fires involving flammable liquids will require a **foam** extinguisher, whereas fires including ordinary materials such as wood require **water** extinguishers. As a result, fire extinguishers must be suitable for the specific fire risks present.

7.3: Sample fire extinguishers.

- There must be enough extinguishers of the right size for the fire risks. This will depend upon the size of the mine, the type of mining operations, and materials used at the mining worksite.
- After using an extinguisher, it must be replaced immediately with a fully charged one.
- Extinguishers must be approved by recognized testing agencies like Underwriter's Laboratories, Inc., Factory Mutual Research Corp., or others approved by the Mine Safety and Health Administration.

Fire Hoses

- Fire hoses and **couplings**, connectors used to attach hoses to other hoses, hydrants, and fire equipment, must meet specifications from Underwriter's Laboratories, Inc., or Factory Mutual Research Corp.
- Cotton or cotton-polyester jacketed hoses must meet U.S. Department of Agriculture Forest Service Specification 182 for mildew resistance.
- Water pressure at the nozzle should not be too high, to keep the nozzle operator safe.

Inspecting your Equipment

Your mine’s firefighting equipment needs to be checked on these schedules:

Type of Equipment	**Details of Inspection**	**Schedule**
Fire extinguishers - general	Visual inspection every month to make sure they are fully charged and ready to use. If used, they must be recharged or replaced right away with a fully charged one.	Monthly

Fire extinguishers - specific parts	A detailed check on mechanical parts, the amount of extinguishing material inside, and the condition of the hose, nozzle, and container to ensure the fire extinguisher will work well.	Yearly
Fire extinguishers - container	Test the extinguisher with water pressure or other methods to check that the condition and strength of the container are not damaged, corroded, or weakened and can safely hold and release the extinguishing agent.	According to 56.4201 Table C-1 or manufacturer's instructions
Firefighting system - inspection	Water pipes, valves, hydrants, and hoses in your mine's firefighting system should be visually inspected to see if they are damaged or getting worse.	Every three months
Firefighting system - test	Water pipes, valves, hydrants, and hoses in your mine's firefighting system should be tested to make sure they still work.	Annually
Fire suppression systems	Your or your mine operator should have a plan based on the manufacturer's specifications or the equivalent to inspect each part of the system to ensure it is functional. If a fire suppression system is only for protecting property and not people, surface systems do not need to be checked this often.	Annually
Fire hydrants	Your mine's fire hydrants must have: • Fittings that are the same or have adapters that can quickly be used with the mine's firefighting equipment. • Wrenches or keys nearby to open the valves. • Adapters available that can connect hydrant fittings to the hose equipment of any firefighting group the mine depends on.	Ongoing

After each check or test, the person performing the inspection must write down what was done and when. Records of pressure tests *(see fire extinguisher - container in table above)* should be kept until the fire extinguisher is checked again or not used anymore. Other records should be kept for one year.

Ensuring Proper Quantity and Location of Firefighting Equipment

In mining operations, particularly in coal mines, areas such as preparation plants, dryer plants, tipples, drawoff tunnels, shops, and other surface areas need to have firefighting equipment available to handle potential fires and ensure safety. Here's a brief explanation of these different facilities you may encounter at a coal mine:

1. **Preparation Plants**: These are facilities where raw coal is processed and cleaned to remove impurities, such as soil and rock. The coal is crushed, sized, and washed in preparation plants to produce a product that meets market specifications.
2. **Dryer Plants**: These are specialized facilities where coal or other materials are dried to reduce moisture content. Drying can improve the quality and efficiency of the material for further processing or transportation.
3. **Tipples**: These are structures used at mines to load coal into railroad cars or other transportation vehicles. Tipples typically include equipment for sorting and loading the coal.
4. **Drawoff Tunnels**: These are underground passages used to transport extracted materials from the mining site to the surface. They facilitate the movement of coal or other minerals out of the mine.
5. **Shops**: Maintenance facilities where equipment and machinery are serviced, repaired, and stored. These can include workshops for various trades like mechanics, electricians, and welders.
6. **Other Surface Areas**: This category encompasses any additional surface facilities or areas associated with your mine worksite. This might include offices, storage areas, parking lots, and other infrastructure necessary for the operation of the mine.

The firefighting equipment required in each of these worksite areas typically includes items such as:

- Fire extinguishers
- Fire hoses
- Water supplies
- Sprinklers
- Other fire suppression systems

The specific requirements can vary based on regulations and the potential hazards present in each area. The goal is to ensure that adequate measures are in place to quickly and effectively respond to any fire emergencies, minimizing risk to personnel and property.

Now that you understand the different facilities at your coal mine, let’s look at the firefighting equipment that is required at these areas:

- Structures that could catch fire must have fire extinguishers appropriate for the fire risk, following National Fire Protection Association guidelines.

- Preparation plants need waterlines with outlet valves on each floor and enough fire hose to spray water throughout. Alternatively, for areas prone to freezing or lacking water, you may use one 125-pound dry powder extinguisher per 2,500 square feet (wooden structures) or per 5,000 square feet (metal, concrete-block, or other non-flammable structures).

Requirements for Equipment

In addition to ensuring the areas such as preparation plants, dryer plants, tipples, drawoff tunnels, shops, and other surface areas have fire-fighting equipment, you will also need to ensure that you have proper fire extinguishers and protections *on* or *around* your tools and machinery.

Follow these guidelines:

- Mobile equipment like trucks, loaders, and bulldozers must have at least one portable fire extinguisher.
- Large equipment such as **power shovels and draglines,** which are both used to excavate and move material, must have at least one portable fire extinguisher; additional ones may be needed as per regulations.
- **Auxiliary equipment**, or tools, machines, and devices that support your main mining operations, like drills and sweepers, must have at least one fire extinguisher when more than 600 feet away from equipment with fire extinguishers.
- Permanent electrical installations must have fire extinguishers suitable for their fire risk, following National Fire Protection Association guidelines.
- Each of your above-ground or unburied combustible liquid storage stations and the transfer pump of each buried tank must have two portable fire extinguishers or equivalents.
- Vehicles transporting explosives and blasting agents must have fire protection as recommended in Code 495, Section 20 of the National Fire Protection Association Handbook, 12th Edition, 1962.

Special Fire Prevention Considerations for Self-Propelled Equipment

You will likely use a variety of **self-propelled equipment,** such as bulldozers, dump trucks, drill rigs, transport vehicles, or other specialized equipment. These have their own fire risks and hazards because they can generate heat, may have limited ventilation, and run on fuel or electricity, which can leak or become faulty.

There are a few key fire-preventive measures to consider when working with this type of machinery, so before operating self-propelled equipment, check for the following:

- If a fire or its effects could block your way out of self-propelled equipment, you must have a fire extinguisher on board.
- If a fire or its effects could affect others' escape but not yours, you must have a fire extinguisher on the equipment or within 100 feet.
- Instead of fire extinguishers, a fire suppression system can be used if you can activate it manually.
- Fire extinguishers or suppression systems must be able to put out any early-stage fire caused by the equipment's fire risks. They should be placed so you and anyone else trapped by fire can use them.

7.4: Active fire in self-propelled equipment.

Firefighting, Evacuation, and Rescue Procedures

So far, we have focused primarily on the equipment that you must have available and ready in case of a fire. However, additional aspects to firefighting that can help protect you against fire hazards include procedures for evacuation and rescue.

When beginning your work at the mine, here are some additional procedures you can expect to learn on site that will help prepare you for evacuation and rescue:

1. **Training**. As we have discussed before, firefighting gear and equipment must match the fire risks at each building, enclosure, and other areas (like custom coal preparation) in the mine. You and your fellow miners at the specific mine worksite must receive yearly training on how to use this firefighting gear and equipment.

2. **Fire plans**. Your mine operator must create plans for what to do in emergencies involving fires, including how to fight them, how to evacuate people safely, and how to rescue anyone who might be in danger. These plans should be worked out ahead of time with local firefighting groups.
3. **Fire alarms**. Your mine operator must have procedures or systems in place to sound the alarm quickly if there is a fire, so everyone who might be in danger can hear it right away.
4. **Fire alarm maintenance.** The systems that sound the fire alarm must be maintained so they will function properly in case there is a fire.
5. **Fire drills.** Your mine operator should assign firefighting responsibilities to specific individuals, and they must hold emergency drills for fighting fires at least twice a year.

Now, you know a few basic guidelines for ensuring firefighting equipment is supplied and utilized correctly at your mine site. Let's now look at how to prevent fires during 'hot work' in mining.

7.4 PREVENTING FIRES DURING HOT WORK

Welding, soldering, cutting, grinding, and more are common processes in mining. This may also be known as **hot work**, or any work that produces sparks, flames, or enough heat to initiate a fire or flames during operation.

What's unique about 'hot work'?

Hot work is a *constant* fire hazard because the heat that comes from this work can ignite nearby flammable material immediately.

Take the following precautions to ensure safety during and around hot work.

Precaution 1: Confirm you have the Correct Fire Extinguisher

A fire extinguisher must be at every place where welding, cutting, or soldering with an arc or flame is done. However, you must also ensure that you have the correct one.

Before welding, cutting, soldering, thawing, or bending, first check for potential electrical hazards. If you are using an electric arc (meaning that you are using an electric current to generate heat) or open flame, then you will need to ensure that you have the correct fire extinguisher.

What would be the correct fire extinguisher in this case? Great question!

If your fire extinguisher uses water or foam, then this can create a risk of electric shock when used around electricity. So, where a conductive extinguishing agent–water or foam in this case-could cause an electrical problem, you need to make sure you have a **dry-chemical fire extinguisher** rated at least 2-A:10-B. This rating simply means that the extinguisher is effective on certain types of fires, specifically Class A (ordinary combustibles like wood, paper, and cloth) and Class B (flammable liquids and gases).

If you are using an open flame where there is no electrical risk, you will need a dry-chemical fire extinguisher or another type that matches the fire hazard there.

What about special fire extinguishers?
In some cases, you may be able to use **halogenated fire extinguishers**, which are known for their ability to protect sensitive equipment and environments without causing additional damage or requiring extensive cleanup. However, only Halon 1211 (CBrClF2) and Halon 1301 (CBrF3) can be used as halogenated fire extinguishing agents around hot work. If you use them in small or closed areas, follow the manufacturer's instructions so you do not breathe in the gases when they break down.

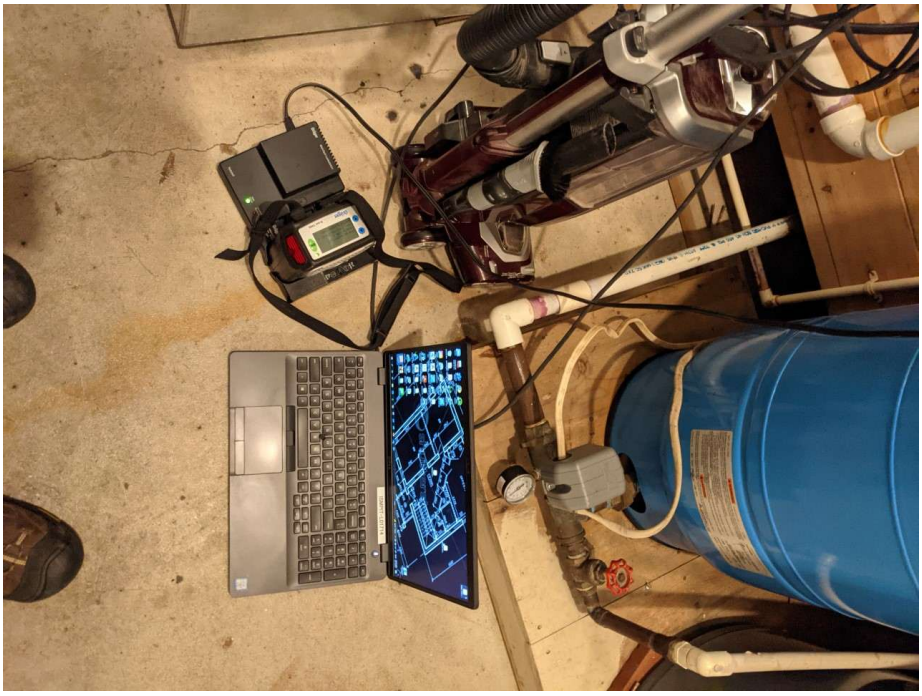
Precaution 2: Check and Monitor your Surroundings

Next, before you weld, cut, or use an open flame, check any nearby pipes or containers for liquids that can catch fire, gases that burn, or material that can explode. If you find flammable material nearby, be sure you:

- Drain, air out, and clean out all residue.
- Let out air from the pipeline or container so it does not build up during the heating.
- Fill the container or pipeline with safe air or water, if it is appropriate. Or use a gas detection device to ensure that it is free from flammable gas. Do this before and at frequent intervals while you perform your hot work.

Additionally, when you are welding, cutting, or soldering near material that can catch fire or burn, take steps to stop bits of hot metal or sparks from starting a fire.

Before you weld, cut, or solder where there might be methane gas, be sure you allow a qualified person to use a device approved by the Secretary of Labor to detect any methane. They must look immediately before and periodically during welding, cutting, and soldering. Be sure you do not begin or continue work where there's 1% or more methane in the air.



7.5: Sample gas detectors used inside of a potentially hazardous mine work site.

Precaution 3: Ensure Proper Storage and Cleaning

Oxygen and acetylene are highly flammable gases used to create the high temperatures needed for welding, soldering, and cutting. They are typically stored in **pressurized cylinders**. However, their flammability also makes them potential fire hazards if not handled correctly, so be sure to follow these safety precautions:

- **Storage**: Always store oxygen tanks separately from flammable liquids like grease and oil, as these can easily ignite and cause fires.
- **Cleaning**: Keep all meters, controls, and valves associated with these tanks clean and free of oil or grease. Meters and controls are the devices used to measure and regulate the flow of gases from the tanks, while valves are mechanisms that open or close to control the release of these gases.
- **Closure of Valves.** To stop gases from getting out by mistake from hoses or torches linked to oxygen and acetylene tanks or manifold systems, be sure to shut the tank or manifold system valves when you move the tanks, when the torch and hoses are alone, and the job or steps in the job are done.

Let's put this all together in a small scenario.

Imagine you have just finished using a cutting torch to slice through some metal in a mine. Before you move on to your next task, make sure you *turn off the torch, and close the valves* on both the oxygen and acetylene tanks. This action stops any remaining gas from escaping, which could mix and ignite, causing a fire or explosion. Additionally, *ensure that your tanks are still in a clean, dry area away from flammable substances*, and *check that the meters and controls are clean and free of any oil or grease* before you start your next job. By following these steps, you significantly reduce the risk of fire hazards in the mining environment for yourself and others who may work in this area after you.

Excellent work. Now, you are able to understand and implement important safety precautions to prevent fire hazards during hot work, such as welding, soldering, and cutting.

Let's now look at how to manage basic first aid procedures.

7.5 FIRST AID PROCEDURES

As you may have noted thus far, mining can be dangerous, with risks of cuts, falls, burns, and other injuries. While following safety procedures, such as the ones you are learning in this course, can help reduce your risk of injury, it is also important to be equipped with the knowledge to handle minor injuries and respond effectively in emergencies. This section will introduce you to essential first aid principles tailored specifically for the challenges you might face at a mining site.

First Aid Versus Medical Treatment

If you encounter a fellow miner having a medical issue at your worksite, they may need basic first aid or further medical treatment, depending upon the severity of the injury. Thus, it is important that you understand the difference between medical treatment and first aid, as you are only expected to know and provide first aid when necessary.

What is 'first aid'?

First aid refers to the initial, immediate care that you give to a person who has sustained a minor injury or illness. You typically perform this on-site and you are not required to have extensive medical expertise or specialized equipment. The primary goal of you providing first aid is to provide temporary relief and prevent the condition from worsening until professional medical treatment can be obtained if necessary.

What is 'medical treatment'?

In contrast to first aid, **medical treatment** involves more comprehensive care provided by healthcare professionals. It addresses more severe injuries or illnesses and often requires specialized skills, diagnostic procedures, and advanced medical equipment. Medical treatment aims to cure or significantly improve your condition and may involve ongoing care or multiple visits.

The key difference between first aid and medical treatment lies in the *severity of the condition* being treated and the *complexity of the care* provided. First aid is basic, immediate, usually temporary, and intended for minor injuries. In contrast, medical treatment is advanced, often ongoing, and intended for more serious injuries or illnesses requiring professional healthcare intervention.

Let's look at some specific differences.

Medical treatment includes things like:

- Stitches for any wound
- Treating broken bones
- Putting on casts or other ways to immobilize an injured body part

- Treating infections from injuries
- Draining blood from bruises
- Surgically removing dead or damaged skin, such as from a burn
- Amputation or permanent loss of use of any body part
- Treating second and third-degree burns

First aid includes:

- Applying a one-time treatment for minor injuries like scratches, cuts, burns, and splinters
- Using ointments, salves, antiseptics, and dressings for minor injuries
- Ensuring safety of a burned or injured person until help arrives
- Watching for signs of shock and treating until the person reaches emergency personnel

Finally, let's look at the differences between first aid and medical treatment in regards to specific injuries that you might encounter at a mine worksite:

Injury	**First Aid**	**Medical Treatment**
Abrasions (Scrapes)	Cleaning, antiseptic application, non-prescription meds, bandaging, and observation.	Removing deeply embedded materials, multiple cleanings, treating infections, treating deep scrapes, and more extensive professional care.
Bruises	One-time soaking or cold compress.	Multiple soaks, draining blood, or other beyond-basic care.
Burns (Thermal and Chemical)	Cleaning or flushing the surface, soaking, cold compresses, antiseptics, non-prescription meds, and bandaging. First-degree burns are usually first aid.	Series of treatments, skin grafts, and surgical removal of dead skin. Most second and third-degree burns need medical treatment.
Cuts and Lacerations	Same as abrasions. Butterfly closures for cosmetic purposes only are first aid.	Non-cosmetic butterfly closures, stitches, surgical removal of dead skin, treating infections.
Eye Injuries	Irrigation, removing non-embedded foreign objects, nonprescription medicines such as over-the-counter eye drops, saline solution, or eye ointments.	Removing embedded objects, prescription medicines, or other professional care.
Inhalation of Toxic or Corrosive Gases	Moving to fresh air or giving oxygen once for a few minutes.	Any care beyond what is mentioned in first aid. If consciousness is lost, medical treatment is required.

Splinters and Puncture Wounds	Cleaning, removing objects with tweezers, using antiseptics, providing nonprescription medicines, bandaging.	Professional removal due to depth, size, shape, or location. Treating infections or reactions to required shots, such as tetanus.
Sprains and Strains	Soaking, using cold compresses, and applying elastic bandages.	Series of hot or cold soaks, whirlpool use, diathermy (treatment to generate heat in tissue to relieve pain and promote healing), or other professional care.

Steps to Provide First Aid at a Mine Worksite

Now that you understand what basic first aid is (and is not), let's look at the steps to providing first aid at a mine worksite.

Step One: Patient Assessment

When someone appears injured at your mine worksite, you should conduct a thorough assessment of both the scene and the individual *prior to* administering any first aid. This initial evaluation helps you to identify any life-threatening conditions and other medical issues quickly, ensuring the person gets the necessary medical care promptly. By understanding how to perform a proper patient assessment, you can make a significant difference in emergency situations and in the lives of your fellow miners! Here is how to conduct a basic assessment of someone who seems injured: (The order of these steps may vary based on the environment, hazard, injury, and condition of the injured person).

Are you and the injured person in a position to carry out the assessment?

- Ensure the safety of both yourself and the injured person by assessing the scene to identify potential hazards.
- Take measures to minimize infection risks by wearing gloves and other personal protective equipment.

Do you need help, and can you administer first aid?

- Call 911 or other emergency medical services immediately.
- Instruct someone else to retrieve the first aid kit and automated external defibrillator (AED), if available.

Is the person breathing?

- *Check the person's responsiveness and breathing.*
- If the person is conscious and breathing, obtain consent to provide assistance and quickly assess for any life-threatening conditions.
- If the person is not conscious or breathing, you may need to begin administering CPR, which will be explained in a later part of this section.

Are you ready to complete the assessment?

- Perform a visual assessment using the DOTS acronym (Deformities, Open injuries, Tenderness, Swelling) to identify any injuries and provide appropriate first aid. Later in this section we will explore how to administer basic first aid.
- Look for medical identification jewelry, which can provide critical information if the person becomes unresponsive.
- Try to determine the mechanism of injury (e.g., fall from a ladder, gas explosion, injury from a drill) to help anticipate potential injuries.

Is medical or emergency assistance on the way?

- While awaiting EMS arrival, if the person is conscious, ask them to explain their condition and symptoms to aid in assessment.
- Continuously reassess scene safety, the person's responsiveness and breathing, and the effectiveness of the first aid provided until advanced medical help arrives.
- Communicate all gathered information to ensure seamless transition of care to professional responders.

Often, your assessment will lead you to conclude that the person needs some basic first aid treatment until emergency medical services arrive. Let's look at how to provide treatment to cuts, burns, shocks, and other injuries, as well as how to administer CPR.

Step Two: First Aid Treatment

There are many types of injuries that can happen in the mining environment, such as burns, cuts, broken bones, sprains, heart problems, and shock. Remember that you are administering basic first aid in these situations, not medical treatment. After your initial assessment leads you to these injuries, follow the steps for providing care to the injured person.

Controlling Bleeding

You and other miners can sustain cuts from sharp tools, machinery, or even rocks. You could encounter an impalement injury if there is an accident with drills, picks, or other sharp tools. When working at your mine site, there is always the risk of injury from a fall, collision, explosion, or collapse. These accidents can result in severe bleeding from wounds, lacerations, and other physical trauma.

If you see that someone is injured and bleeding, be sure you prioritize controlling the bleeding. Blood loss can be serious, leading to your fellow miner suffering shock or even death if not managed properly.

To stop bleeding:

- Place a clean cloth on the wound and apply firm pressure with your hand or hold in place with something like a belt, bandage, or necktie until the bleeding stops.
- If possible, elevate the wound above the injured person's heart to help slow the bleeding.
- Once bleeding has stopped, do *not* remove the cloth over the wound; this can disrupt the clotting process and could make the injury begin to bleed again.

In cases of severe bleeding, you should apply pressure to the nearest major pressure point. These are typically found on the inside of the upper arm between the shoulder and the elbow or in the groin area where the leg meets the hip. However, direct pressure is generally more effective than pressure points or tourniquets, as it limits blood flow only at the wound site. Use pressure points only if elevation and direct pressure fail to control bleeding.

Avoid using a tourniquet except in extreme emergencies, such as a severed limb. Tourniquets can cause nerve and blood vessel damage and may result in permanent loss of the limb!

Treating Burns

Burns can happen in different ways: from heat, chemicals, electricity, or direct contact with hot objects. No matter the type, the first aid you provide is often the same.

For electrical burns, follow these steps first:

1. **Ensure Safety First**: Do not touch the victim if they are still in contact with the electrical source. Make sure the power is off, or the person is clear of the source before approaching.
2. **Check Vital Signs**: Once safe, check for breathing and circulation. Perform CPR if needed.
3. **Avoid Moving the Person.** Keep the affected person still, unless there is a hazard nearby that would put them in danger if they are not moved.
4. **Proceed with Steps 5-10 Below.**

For thermal, chemical, or contact burns:

5. **Cool the Burn**: Immediately run cool water over the burn for at least 30 minutes. If the burn is small, immerse it in water. Cooling the burn is more important than calling for help right away, so flush the burn first.
6. **Clothing**: If clothing is stuck to the burn, do not try to remove it. Cut or tear away any clothing that is not stuck.

7. **Cover the Burn**: Use a clean, moist cotton material to cover the burn. If you do not have clean cotton, do not cover it at all.
8. **Avoid Further Treatment**: Do not scrub the burn, apply soap, ointments, powders, apply ice, break any blisters, or use any home remedies.
9. **Provide Water.** If the burned person is awake, able to swallow, and does not have serious burns in their mouth, you can offer them water or other non-alcoholic drinks to keep them hydrated.
10. **Keep Warm**: Cover the injured with a blanket to maintain normal body temperature until your medical help arrives. Depending upon the severity of the injury, be on the lookout for shock.

Always prioritize cooling the burn and ensuring the person's safety and stability until professionals can provide further care.

Treating Shock

Shock can happen as a result of several injuries, such as the ones mentioned above. If you experience significant blood loss, physical or emotional trauma, or even dehydration, the body can go into shock and fail to get enough blood or oxygen to function properly.

What is shock?

Shock: When the body does not get enough blood or oxygen to its vital organs and tissues.

Even if the injury itself is not fatal, a person can go into shock and die if not treated correctly and quickly. Signs of shock include pale or bluish skin that feels cold or clammy, nausea, vomiting, dull and sunken eyes, shallow breathing, and unusual thirst.

Shock needs medical treatment, but you can help prevent it from getting worse. Here's what you can do if you notice a person in shock:

- Keep their airway open so they can breathe.
- Control any obvious bleeding.
- If possible, elevate their legs about 12 inches to improve blood flow.
- Keep them warm by covering them with blankets.

Do not give the person anything to eat or drink, as this can cause vomiting. Keep them lying flat on their back unless they are unconscious or bleeding from the mouth, in which case they should lie on one side to make breathing easier. Be sure you stay with the person until medical help arrives!

Managing Other Injuries

In addition to cuts, burns, and shock, you may encounter broken bones, sprains, strains, and dislocations of joints. Let's look at each of these and how to provide basic first aid to help ensure timely and effective healing for the injury.

Strain

A muscle **strain** refers to an injury affecting a muscle or tendon, the connective tissue linking muscles to bones. Minor strains may involve overstretching, while more severe cases can result in partial or complete tears of these tissues. Often referred to as pulled muscles, strains commonly occur in areas like the lower back and the hamstring muscles at the back of the thigh.

You will likely experience pain, tenderness, bruising, limited range of motion, muscle spasms, swelling, and muscle weakness depending upon the severity or the strain. Understanding these symptoms is crucial for proper diagnosis and timely treatment.

Initial first aid (and self-) treatment for strains typically includes the R.I.C.E. approach:

- Rest
- Ice
- Compression
- Elevation

These measures will help reduce swelling and promote healing. Mild strains can often be managed effectively at home, while severe cases may require surgical intervention for repair.

Sprain

In contrast, a **sprain** involves damage to the ligaments that connect bones together. It occurs when a ligament is stretched too far or torn, affecting its ability to hold joints in place. **Ligaments** are tough bands that connect bones to each other.

You should seek immediate medical attention if you experience:

- Inability to bear weight on the injured leg
- Joint instability
- Numbness
- Severe pain directly over the bones

These symptoms could indicate a severe tear or other complications.

Where might I experience a sprain?

Areas most prone to sprains include ankles, knees, and wrists, which may swell, bruise, and become painful after injury. Similar to strains, initial treatment often involves the R.I.C.E. approach: rest, ice, compression, and elevation to reduce swelling and promote healing. Healing times vary, and over-the-counter pain relievers like ibuprofen or acetaminophen can help manage pain during recovery.

Dislocation

A **dislocation** occurs when the bones in a joint are forced out of their normal position, often due to a fall, equipment accident, or injury involving contact. This injury typically affects larger joints such as the shoulder, but smaller joints like the thumbs and fingers can also be dislocated if subjected to forceful bending in the wrong direction.

If you think someone has dislocated a joint, you can first assess them by looking for:

- Deformities in the joint
- Difficulty in movement
- Sudden, severe pain and swelling

To administer first aid care for a joint dislocation, be sure to:

- Seek medical help promptly; delaying care can worsen the injury.
- Immobilize the joint with a splint to prevent movement until medical assistance is available.
- Avoid attempting to manipulate or force the joint back into place, as this can cause further damage to surrounding tissues such as muscles, ligaments, nerves, or blood vessels.
- Apply ice to the injured joint to reduce swelling and control any internal bleeding. Ice helps prevent fluid buildup in and around the injured area.

Fractures

Fractures, or broken bones, require immediate medical attention, especially if they result from significant trauma or injury. If you encounter someone who likely has a broken bone, be sure to follow these steps to prevent further complications.

- Call 911 if the broken bone is significant, or if the person is unresponsive, not breathing, or showing signs of heavy bleeding.
- Do not move or allow the person to move the injured area. This prevents further injury.
- While awaiting medical assistance, apply pressure to stop bleeding, immobilize the injured limb or joint to prevent movement, and consider splinting if trained to do so.
- Use ice packs wrapped in cloth to reduce swelling.
- Ensure the person is lying down with elevated legs to assist in managing shock symptoms like faintness or rapid breathing.

Administering CPR

Cardiopulmonary resuscitation (CPR) is a vital technique used in emergencies where someone's breathing or heartbeat has stopped, such as during a heart attack or near drowning incidents. It is important to take *immediate action* when performing CPR.

Before you Administer CPR: Assess the Person and Call 911

Imagine a fellow miner has fallen from a great distance and at first glance, they appear to not be moving. *What should you do first?*

Before initiating CPR, be sure you:

- Confirm that the environment is safe for the person needing assistance. In other words, be sure they (and you) are not in the way of falling material or other hazards.
- Assess whether the person is conscious or unconscious.
- If unconscious, gently tap or shake their shoulder and loudly ask, "Are you OK?"
- If there is no response, and you have someone nearby who can assist, instruct one person to call 911 or the local emergency number and retrieve the AED if available, while the other person begins CPR.
- If you are alone and have access to a phone, call 911 or your local emergency number immediately before starting CPR.

Overview of the Protocol

For those trained and confident in CPR, the protocol involves checking the person for a pulse and breathing, followed by chest compressions and rescue breaths, if necessary.

If unsure or rusty in CPR skills, focusing solely on *continuous chest compressions at a rate of 100 to 120 per minute* is recommended. We will look at these procedures in more detail below, but remember, to learn CPR effectively, you should take a certified or accredited first-aid training course that covers CPR techniques and the use of automated external defibrillators (AEDs).

If you feel hesitant or unsure about performing CPR correctly, remember that most 911 operators can walk you through the steps. If you are totally alone with no way to reach emergency personnel, know that taking action is always preferable to doing nothing at all. The decision to act could mean saving someone's life.

You can use the letters C-A-B to help you remember the sequence for performing CPR:

C: Compressions

A: Airway

B: Breathing

Let’s look at each of these step by step.

C: Compressions

Once you have confirmed that the person is unconscious, has no pulse and is not breathing, begin to administer compressions. If you can confirm that the person has a pulse, but is not breathing, you may skip this step and proceed to the next portion of CPR, airway.

If a person has a pulse but you cannot determine if they are breathing: Use both of your hands to push down forcefully on the center of the person's chest, aiming for a depth of at least 2 inches (5 centimeters) but no more than 2.4 inches (6 centimeters). This action should be performed at a rate of 100 to 120 compressions per minute. You can use the beat of the song "Stayin' Alive" for rhythm consistency. The focus on compressions is critical, as it helps restore blood flow to vital organs.

7.6: Every mine operator and miner must be prepared to know and carry out basic CPR protocol.

If you have not been trained in CPR or you are uncomfortable with your skills, you can stop here. Otherwise, proceed to the next step, opening the person's airway.

A: Airway

Once 30 compressions have been completed, open the person's airway using the head-tilt, chin-lift maneuver. This involves gently tilting the head back while lifting the chin forward to ensure an open airway. This will also ensure your rescue breaths are easier and more effective.

B: Breathing

If trained and confident, prepare to administer rescue breathing. This can involve mouth-to-mouth or mouth-to-nose techniques, depending on the circumstances and the condition of the person's airway. For instance, if the person's mouth is severely injured or cannot be opened, you can use mouth-to-nose. Additionally, if you have access to a bag-mask device with a HEPA filter at your mine worksite, it is recommended that you use this for rescue breathing.

Here's what to do to administer rescue breathing:

- After ensuring the airway is open with the head-tilt, chin-lift maneuver, proceed by pinching the nostrils shut for mouth-to-mouth breathing and creating a secure seal over the person's mouth with yours.
- Prepare to deliver two rescue breaths, each lasting about one second. Watch for the chest to rise after each breath.
- If the chest rises, give a second breath.
- If it does not, repeat the head-tilt, chin-lift maneuver and attempt another breath.
- Remember, each CPR cycle consists of thirty chest compressions followed by two rescue breaths. Be careful not to breathe too forcefully or too often.
- Maintain a steady rhythm of chest compressions to restore blood flow.

What if I detect a pulse?

- If you find that the person's pulse comes back during compressions, but they have not started breathing again, this means that they are likely in respiratory arrest. You can continue the rescue breaths, but continue to check for a pulse, because they can enter into cardiac arrest at any moment, and you will need to return to your C-A-B rhythm.
- *Should I use an automated external defibrillator (AED), or what if I don't have one?*
- If an automated external defibrillator (AED) becomes available, apply it as soon as possible, following its prompts. Administer one shock if advised, then resume chest compressions for two minutes before considering a second shock. If you are unfamiliar with using an AED, contact a 911 operator or another emergency medical provider for guidance.
- If an AED is not accessible, continue CPR until there are signs of movement or until professional medical assistance arrives.

In summary, when in an emergency, be sure to first ensure the safety of *both yourself and the injured person* by noting the scene around you. Try to call EMS, as well as others around you to help. Assess what is needed for the situation and act quickly, confidently, and according to the above protocol.

Excellent job. You are now equipped with critical concepts for administering basic first aid and CPR.

Fire Prevention and First Aid Procedures: 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:

- Implement safety measures to prevent fires.
- Understand the types and requirements of firefighting equipment and protocols necessary for different areas of a mining operation.
- Identify the specific fire risks associated with hot work activities.
- Describe procedures for safely operating and maintaining equipment used in hot work.
- Apply appropriate first aid techniques for controlling bleeding, treating burns, managing shock, and immobilizing fractures and dislocations.
- Demonstrate the correct sequence and technique for performing CPR.
- Explain the role and use of an automated external defibrillator (AED) in mining emergency response.

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 Fire Prevention and First Aid Concepts and Definitions

- **Auxiliary Equipment**: Tools, machines, and devices that support your main mining operations, like drills and sweepers.
- **Cardiopulmonary Resuscitation (CPR**): A vital technique used in emergencies where someone's breathing or heartbeat has stopped.
- **Dislocation:** When the bones in a joint are forced out of their normal position, often due to a fall, equipment accident, or injury involving contact.
- **Draglines:** Massive excavation machines, featuring a large bucket suspended from a boom and operated by cables.
- **First Aid:** The initial, immediate care that you give to a person who has sustained a minor injury or illness.
- **Flashpoint**: The lowest temperature at which a liquid gives off enough vapor to catch fire when near a flame or spark.
- **Hot Work:** Any work that produces sparks, flames, or enough heat to initiate a fire or flames during operation
- **Ligaments:** Tough bands that connect bones to each other.
- **Power Shovels:** Large excavating machines that can dig and lift material.
- **Reverse Current Protection:** A safety mechanism to stop electric current from going in the wrong direction.
- **Safety Cans:** Small containers (holding up to five gallons) designed to release pressure safely if it gets hot.
- **Shock**: When the body does not get enough blood or oxygen to its vital organs and tissues.
- **Self-Propelled Mobile Equipment**: Vehicles or machinery that can move independently, often used in mining operations.
- **Strain:** Injury affecting a muscle or tendon, the connective tissue linking muscles to bones.
- **Sprain:** Damage to the ligaments that connect bones together.

Hydrostatic Test Intervals for Fire Extinguishers

Table C-1 (CFR 56, Subpart C Fire Prevention and Control, 56.4201)

Extinguisher type	**Test interval (in years)**
Soda Acid	5
Cartridge-Operated Water and/or Antifreeze	5
Stored-Pressure Water and/or Antifreeze	5
Wetting Agent	5
Foam	5
AFFF (Aqueous Film Forming Foam)	5
Loaded Stream	5
Dry-Chemical with Stainless Steel Shells	5
Carbon Dioxide	5
Dry-Chemical, Stored Pressure, with Mild Steel Shells, Brazed Brass Shells, or Aluminum Shells	12
Dry-Chemical, Cartridge or Cylinder Operated, with Mild Steel Shells	12
Bromotrifluoromethane—Halon 1301	12
Bromochlorodifluoromethane—Halon 1211	12
Dry-Powder, Cartridge or Cylinder-Operated, with Mild Steel Shells[1]	12

[1] Except for stainless steel and steel used for compressed gas cylinders, all other steel shells are defined as “mild steel” shells.

National Consensus Standards on Fire Prevention and Control

(CFR Part 56, Subpart C, Appendix I)

Mine operators seeking further information in the area of fire prevention and control as aligned with MSHA standards may consult the following national consensus standards.

MSHA standard	National consensus standard
§§ 56.4200, 56.4201	NFPA No. 10—Portable Fire Extinguisher.
	NFPA No. 11—Low Expansion Foam and Combined Agent Systems.
	NFPA No. 11A—High Expansion Foam Systems.
	NFPA No. 12—Carbon Dioxide Extinguishing Systems.
	NFPA No. 12A—Halon 1301 Extinguishing Systems.
	NFPA No. 13—Water Sprinkler Systems.
	NFPA No. 14—Standpipe and Hose Systems.
	NFPA No. 15—Water Spray Fixed Systems.
	NFPA No. 16—Foam Water Spray Systems.
	NFPA No. 17—Dry-Chemical Extinguishing Systems.
	NFPA No. 121—Mobile Surface Mining Equipment.
	NFPA No. 291—Testing and Marketing Hydrants.
	NFPA No. 1962—Care, Use, and Maintenance of Fire Hose, Connections, and Nozzles.
§ 56.4202	NFPA No. 14—Standpipe and Hose Systems.
	NFPA No. 291—Testing and Marketing Hydrants.
§ 56.4203	NFPA No. 10—Portable Fire Extinguishers.
§ 56.4230	NFPA No. 10—Portable Fire Extinguishers.
	NFPA No. 121—Mobile Surface Mining Equipment.

Simplified Fire Prevention and First Aid Procedures Code of Federal Regulations Listing

- **Abandoned Electric Circuits:** Turn off and isolate abandoned electric circuits to prevent them from accidentally being turned on. [56.4011]
- **Smoking and Use of Open Flames:** No smoking or open flames where flammable or combustible liquids, greases, or gases are used or transported in a way that could cause a fire hazard. [56.4100(a)] No smoking or open flames where these materials are stored or handled. [56.4100(b)]
- **Warning Signs:** Post clear signs prohibiting smoking and open flames in areas where fire or explosion hazards exist. [56.4101]
- **Spills and Leaks**: If flammable or combustible liquids spill or leak, they must be cleaned up quickly or managed to prevent a fire hazard. [56.4102]
- **Fueling Internal Combustion Engines:** Turn off internal combustion engines before refueling if the fuel tank is part of the equipment, except for diesel engines. [56.4103]
- **Combustible Waste:** Do not let waste materials, including liquids, accumulate in quantities that could create a fire hazard. [56.4104(a)]
- **Flammable Waste:** Store flammable waste or rags in covered metal containers or equivalent containers with flame containment features until proper disposal. [56.4104(b)]
- **Electric Substations and Liquid Storage Facilities:** Do not store or allow combustible materials to accumulate within 25 feet of electric substations, unburied flammable liquid storage tanks, or any group of containers holding more than 60 gallons of flammable liquids. Keep the area within this perimeter free of dry vegetation. [56.4130(a)]
- **General Requirements:** Each mine must have onsite firefighting equipment for both early-stage fires and for fires beyond the early stages, or have prior arrangements with a local fire department. [56.4200(a)] This firefighting equipment must be capable of extinguishing any class of fire present and be strategically located, accessible, clearly marked, and maintained in a fire-ready condition. [56.4200(b)]
- **Inspection:** Inspect firefighting equipment regularly: Conduct monthly visual checks of fire extinguishers to ensure they are fully charged and operable. [56.4201(a)(1)] Conduct annual maintenance checks of fire extinguishers' mechanical parts, extinguishing agents, and other components. [56.4201(a)(2)] Conduct hydrostatic testing of fire extinguishers as per Table C-1 or manufacturer's schedule. [56.4201(a)(3)] Conduct quarterly visual inspections and annual functional tests of firefighting water systems. [56.4201(a)(4)] Conduct annual inspections of fire suppression systems as per manufacturer's specifications. [56.4201(a)(4)] Document and certify each inspection or test, retaining certification for hydrostatic testing until retesting or removal from service, and other certifications for one year. [56.4201(b)]
- **Fire Hydrants:** Provide fire hydrants with uniform fittings or readily available adapters for firefighting equipment, wrenches or keys to open valves, and adapters for connecting to external firefighting hoses. [56.4202]

- **Extinguisher Recharging or Replacement:** Recharge or replace fire extinguishers promptly after use. [56.4203]
- **Self-Propelled Equipment:** Equip self-propelled equipment with a fire extinguisher if a fire could impede escape. If not, keep an extinguisher within 100 feet or use a manually activated fire suppression system. [56.4230] Fire extinguishers and suppression systems must be appropriate for the fire hazards of the equipment. [56.4230]
- **Firefighting, Evacuation, and Rescue Procedures:** Mine operators must establish and coordinate emergency firefighting, evacuation, and rescue procedures with local firefighting organizations. [56.4330(a)] Set up fire alarm procedures to promptly warn anyone in danger and maintain fire alarm systems in working order. [56.4330(b)]
- **Firefighting Drills:** Hold emergency firefighting drills every six months for designated firefighting personnel. [56.4331]
- **Use Restrictions:** Do not use flammable liquids for cleaning. [56.4400(a)] Do not use solvents near open flames, heat sources, or where they could be heated above their flashpoint. [56.4400(b)]
- **Storage Tank Foundations:** Mount fixed, unburied flammable or combustible liquid storage tanks on firm foundations, using flexible connections or special fittings to prevent leaks from settling. [56.4401]
- **Safety Can Use:** Store small quantities of flammable liquids in labeled safety cans. [56.4402]
- **Storage Facilities:** Flammable liquid storage tanks must: Withstand working pressures and be compatible with the stored liquid. [56.4430(a)] Be maintained to prevent leaks. [56.4430(a)] Be isolated from ignition sources. [56.4430(a)] Have vents to prevent pressure build-up and be isolated from ignition sources for Class I, II, or IIIA liquids. [56.4430(a)] Piping, valves, and fittings must also withstand working pressures and be leak-proof. [56.4430(b)] Provide containment or remote impoundment for tanks where escaping liquid could present a hazard. [56.4430(c)]
- **Heat Sources:** Separate heat sources capable of causing combustion from combustible materials. [56.4500]
- **Fuel Lines:** Equip fuel lines with valves to stop fuel flow at the source and maintain them to minimize fire hazards, except on self-propelled equipment. [56.4501]
- **Battery-Charging Stations:** Ensure battery-charging stations have enough ventilation to prevent hydrogen gas buildup. [56.4502(a)] Prohibit smoking and open flames at charging stations during battery charging. [56.4502(b)] Post visible signs prohibiting smoking or open flames at battery-charging stations during battery charging. [56.4502(c)]
- **Conveyor Belt Slippage:** Equip belt conveyors in confined areas with detection systems that automatically stop the drive pulley in case of belt slippage. [56.4503]
- **Exits:** Buildings or structures where people work must have enough exits for prompt escape in case of fire. [56.4530]
- **Flammable or Combustible Liquid Storage Buildings or Rooms:** Storage buildings or rooms for flammable liquids within 100 feet of workstations must have enough ventilation to prevent vapor buildup. [56.4531(a)] They must also: Have a fire resistance

rating of at least one hour, or [56.4531(b)] Be equipped with an automatic fire suppression system, or [56.4531(b)] Have an early warning fire detection device, provided no one's workstation is inside the building. [56.4531(b)] Flammable liquids used daily are not considered in storage. [56.4531(c)]

- **Extinguishing Equipment:** When welding, cutting, soldering, thawing, or bending: Use a multipurpose dry-chemical fire extinguisher or equivalent for the specific fire hazard. [56.4600(a)] Halon 1211 and Halon 1301 can be used in confined areas with precautions to avoid inhaling gases from thermal decomposition. [56.4600(b)]
- **Oxygen Cylinder Storage:** Do not store oxygen cylinders with flammable or combustible liquids, including grease. [56.4601]
- **Gauges and Regulators:** Keep gauges and regulators for oxygen or acetylene cylinders clean and free of oil and grease. [56.4602]
- **Closure of Valves:** Close valves to prevent accidental gas release when moving cylinders, leaving torches and hoses unattended, or after completing tasks. [56.4603]
- **Preparation of Pipelines or Containers:** Before working with pipelines or containers that held flammable materials, they must be drained, ventilated, and cleaned, vented to prevent pressure build-up, filled with inert gas or water, or checked for flammable gases with a detection device. [56.4604]
- **National Consensus Standards:** Mine operators can consult national standards for further information on fire prevention and control. [Appendix I to 56]
- **Fire Protection; Training and Organization** Firefighting equipment and facilities must match the fire risks at each mine structure, including custom coal preparation facilities. Employees must be trained yearly in using firefighting equipment. [77.1100]
- **Escape and Evacuation; Plan:** By September 30, 1971, every mine operator must have a specific escape and evacuation plan ready and updated for fire emergencies. [77.1101(a)] All employees must know the current escape plans, fire alarm signals, and procedures to follow in case of fire. [77.1101(b)] Escape plans must include well-maintained exits from all work areas, buildings, and equipment, and places where workers gather. [77.1101(c)]
- **Warning Signs; Smoking and Open Flame:** Signs warning against smoking and open flames must be clearly visible in areas with fire or explosion hazards. [77.1102]
- **Flammable Liquids; Storage:** Flammable liquids must be stored according to the National Fire Protection Association standards. Small amounts should be kept in labeled safety cans. [77.1103(a)] Unburied flammable liquid tanks should be securely mounted on firm foundations, with outlet piping that can handle tank settling. [77.1103(b)] Fuel lines need valves to shut off fuel at the source and must be placed to minimize fire risks. [77.1103(c)] Areas around flammable liquid storage tanks and electrical substations must be kept free of dry grass, weeds, underbrush, and other flammable materials within 25 feet. [77.1103(d)]
- **Accumulations of Combustible Materials:** Combustible materials like grease, lubricants, paints, or flammable liquids should not accumulate in places where they can cause a fire hazard. [77.1104]

- **Internal Combustion Engines; Fueling:** Internal combustion engines, except diesels, must be turned off before refueling. [77.1105]
- **Battery-Charging Stations; Ventilation:** Battery-charging stations must be in well-ventilated areas and have reverse current protection if connected directly to DC power systems. [77.1106]
- **Belt Conveyors:** Belt conveyors in fire-hazard areas must have switches to automatically stop the drive pulley in case of excessive slippage. [77.1107]
- **Firefighting Equipment; Requirements; General:** By September 30, 1971, every coal mine operator must provide enough firefighting equipment suitable for the mine's surface conditions. [77.1108]
- **Type and Capacity of Firefighting Equipment:** Waterlines: Must deliver 50 gallons per minute at 50 psi. Storage tanks should hold 1,000 gallons for each 1,000 tons of coal processed per shift. [77.1108-1(a)] Fire Extinguishers: Should be the right type and size for the fire hazard, replaced immediately after use, and approved by a recognized testing agency. [77.1108-1(b)] Fire Hose: Must meet Underwriter's Laboratories or Factory Mutual Research Corp. specifications, with water pressure safe for the operator. [77.1108-1(c)]
- **Quantity and Location of Firefighting Equipment:** Buildings: Must have portable fire extinguishers suitable for the fire risk, as recommended by the National Fire Protection Association. [77.1109(a)] Preparation Plants: Must have waterlines and enough hose to reach any point, or alternative extinguishers if water isn't available. [77.1109(b)] Equipment: Mobile equipment and large machinery must have portable fire extinguishers. Auxiliary equipment far from these must also have extinguishers. [77.1109(c)] Electrical Installations: Must have fire extinguishers suitable for the fire risk. [77.1109(d)] Combustible Liquid Storage: Two portable fire extinguishers must be near each above-ground storage station and transfer pump of buried tanks. [77.1109(e)] Explosives Transport: Vehicles must have fire protection as recommended by the National Fire Protection Association Handbook. [77.1109(f)]
- **Examination and Maintenance of Firefighting Equipment:** Firefighting equipment must always be in good working order. Fire extinguishers must be checked every six months, and the check date recorded on a tag. [77.1110]
- **Welding, Cutting, Soldering; Use of Fire Extinguisher:** A portable fire extinguisher must be available at each welding, cutting, or soldering location. [77.1111]
- **Welding, Cutting, or Soldering with Arc or Flame; Safeguards:** Precautions must be taken to prevent fires when working near combustible materials. [77.1112(a)] Before and during welding, cutting, or soldering in areas likely to contain methane, a qualified person must check for methane. Work cannot start or continue if air contains 1% or more methane. [77.1112(b)]
- **First Aid:** A trained first aid person should be present on every shift. This person must be able to assess patients, give artificial respiration, control bleeding, and treat shock, wounds, burns, and bone or muscle injuries. First aid training should be offered to all miners who are interested. [56.18010]