MSHA Part 46 New Miner Online Training

Module 5

Airborne Hazards and Respiratory Devices

MSHA Training Requirement:

Instruction and demonstration on the use, care, and maintenance of self-rescue and respiratory devices. [Section 46.5(c)(1)]

Learning Objectives:

1. Understand the basic processes for monitoring respirable dust levels at mine worksites.
2. Identify and describe restricted chemical substances commonly encountered in mining operations.
3. Implement protective measures against airborne contaminants and physical agents to comply with exposure limits, including sampling, monitoring, record keeping, and conducting surveys.
4. Properly use, inspect, and maintain self-rescue and respiratory devices.
5. Follow recommended diesel fueling practices and maintenance standards for diesel engines.
6. Identify risks associated with exposure to diesel particulate matter (DPM) and employ effective control measures to mitigate this hazard.

Module Sections

- 5.1 Introduction to Airborne Hazards and Respiratory Devices
- 5.2 Respirable Dust
- 5.3 Chemicals and Physical Agents
- 5.4 Radiation Protection
- 5.5 Self-Rescue and Respiratory Devices
- 5.6 Diesel Contaminants and Protections

Code of Federal Regulations Reference Material

This module covers important topics from 30 CFR Parts 56/57 Subpart D (Air Quality, Radiation, and Physical Agents) and 30 CFR Part 70 Subpart A (General).

CFR Subtopic Regulations: 30 CFR 56 Subpart D (Air Quality, Radiation, and Physical Agents)

- 56.5001 Exposure limits for airborne contaminants.
- 56.5002 Exposure monitoring.
- 56.5005 Control of exposure to airborne contaminants.
- 56.5006 Restricted use of chemicals.

CFR Subtopic Regulations: 30 CFR Part 57 Subpart D (Air Quality, Radiation, Physical Agents, and Diesel Particulate Matter)

- 57.5001 Exposure limits for airborne contaminants.
- 57.5002 Exposure monitoring.
- 57.5005 Control of exposure to airborne contaminants.
- 57.5006 Restricted use of chemicals.
- 57.5015 Oxygen deficiency.
- 57.5037 Radon daughter exposure monitoring.
- 57.5038 Annual exposure limits.
- 57.5039 Maximum permissible concentration.
- 57.5040 Exposure records.
- 57.5041 Smoking prohibition.
- 57.5042 Revised exposure levels.
- 57.5044 Respirators.
- 57.5045 Posting of inactive workings.
- 57.5046 Protection against radon gas.
- 57.5047 Gamma radiation surveys.
- 57.5060 Limit on exposure to diesel particulate matter.
- 57.5061 Compliance determinations.
- 57.5065 Fueling practices.
- 57.5066 Maintenance standards.
- 57.5067 Engines.
- 57.5070 Miner training.
- 57.5071 Exposure monitoring.
- 57.5075 Diesel particulate records.

CFR Subtopic Regulations: 30 CFR 70 Subpart A (General)

- 70.1 Scope.
- 70.2 Definitions.

5.1 INTRODUCTION TO AIRBORNE HAZARDS AND RESPIRATORY DEVICES

This module will help you conduct work safely as you encounter airborne and chemical hazards at mine worksites. You will learn how to:

1. Understand the basic processes for monitoring respirable dust levels at mine worksites.
2. Identify and describe restricted chemical substances commonly encountered in mining operations.
3. Implement protective measures against airborne contaminants and physical agents to comply with exposure limits, including sampling, monitoring, record keeping, and conducting surveys.
4. Properly use, inspect, and maintain self-rescue and respiratory devices.
5. Follow recommended diesel fueling practices and maintenance standards for diesel engines.
6. Identify risks associated with exposure to diesel particulate matter (DPM) and employ effective control measures to mitigate this hazard.

Airborne Physical Agents and Chemical Hazards

You are likely to encounter airborne hazards at your mine worksite. Sometimes these hazards might be known, or other times, they may be unanticipated. Either way, these hazards pose a significant risk to your health.

The airborne hazards that you might encounter at a mine worksite can be categorized into two types:

- Physical agents
- Chemical agents

Airborne **physical agents** mainly include particulate matter such as dust and fibers. Dust, generated from drilling, blasting, and transporting ore, can contain harmful substances like silica and coal dust, leading to lung diseases such as silicosis and coal workers' pneumoconiosis or black lung disease. Another example of airborne physical agents includes asbestos fibers. If you inhale these tiny fibers, you can develop asbestosis and mesothelioma.

What are the control measures for physical agents at mine worksites?
Control measures for physical agents involve:

- Ventilation systems
- Using respirators correctly
- Regular air quality monitoring

On the other hand, you may face airborne **chemical agents**, which include harmful gases, vapors, and fumes. Methane, carbon monoxide, and hydrogen sulfide are common gases released in mining, posing the risk of you experiencing asphyxiation, toxicity, and poisoning. If you are around diesel exhaust and chemical vapors from solvents and adhesives, for example, you could experience respiratory problems and long-term cancer risks.

What are the control measures for chemical agents at mine worksites?
Control measures for chemical agents involve:

- Gas detection systems
- Effective ventilation
- Use of less harmful substances
- Respirator protection

In summary, both physical and chemical agents require *specific* control strategies to ensure your health and safety, with physical agents focusing on dust control, and chemical agents emphasizing sampling, detection, and the management of these hazards.

Module Warmup

Why Preventing Airborne Hazards Matter?

Understanding how to identify and prevent airborne hazards at mine worksites is not only a procedural requirement but an invitation to take personal responsibility to learn and confidently follow safety regulations and procedures.

Consider the following accidents reported by MSHA that resulted from devastating airborne hazard incidents at mine worksites. Notice the cause and consequence of each incident; think about what steps you might have personally taken to help prevent or respond to these incidents based on what you learn in this module.

Airborne Hazard Incident 1: On July 31, 2019, a 62-year-old contractor with 30 years of mining experience sustained fatal injuries when three methane ignitions occurred in an air shaft. The victim and three contractors were preparing to seal the intake air shaft of an underground mine. At the time of the ignitions, the victim was trimming metal so that it would fit inside wooden forms and was in direct line of the ignition forces.

MSHA issued the following reminders after the accident occurred:

- Do not use cutting torches near unventilated air shafts. Allow no sparking or hot metal from grinding or torching to drop into an air shaft opening. Install non-combustible barriers below welding, cutting, or soldering operations in or over a shaft.
- Conduct proper examinations for methane immediately before and during welding, cutting, soldering or using any spark causing tool (grinder, drills, etc.), especially in areas likely to contain methane. At an air shaft, monitor for methane continuously, at appropriate levels, including the bottom of the air shaft.
- Use properly calibrated methane detectors that can detect concentrations greater than 5%.
- Be aware of potential hazards when working around a shaft opening. Take additional safety precautions when the barometric pressure changes.

- Continuously ventilate an air shaft until the last moment before pouring concrete to seal the shaft.
- Make sure all employees are tied off while working around the shaft opening.
- Provide adequate training on the characteristics of mine gases and in the use of handheld gas detectors, including the use of extendable probes or pumps.

Airborne Hazard Incident 2: July 29, 2016, a 58-year-old miner with 40 years of mining experience sustained fatal injuries when an ignition occurred in the shaft he and another miner were working above. The two miners were welding threaded blocks to secure guarding around the drive-shaft between a motor and dewatering pump. Methane ignited within the shaft, and the victim was in the direct line of the ignition force. On August 4, 2016, the victim died from the injuries received during the accident.

MSHA issued the following reminders after the accident occurred:

- Do not weld, cut, or solder with an arc or flame where methane is detected in excess of 1% by volume. Provide supplemental ventilation in work areas where methane may be encountered.
- Conduct proper examinations for methane immediately before and periodically during welding, cutting, or soldering, especially in areas likely to contain methane. Perform examinations with properly calibrated methane detectors that are capable of detecting concentrations greater than 5%.
- Ensure smoldering metal or sparks from welding, cutting, or soldering do not result in the ignition of combustible materials or methane. Install non-combustible barriers below welding, cutting, or soldering operations in or over a shaft.
- Provide adequate training on the characteristics of mine gases and in the use of handheld gas detectors, including the use of extendable probes or pumps.
- Always use non-sparking tools when working where there is a potential for flammable or explosive methane concentrations and, when practicable, utilize options which do not involve welding or cutting when working near these areas.

These incidents reported by MSHA highlight the potential consequences of neglecting airborne physical and chemical agent safety protocols and regulations at mine worksites. By understanding key airborne hazards, you will be better able to avoid similar accidents and keep both yourself and your coworkers safe.

Key Terms: Common Airborne Hazards and Respiratory Device Concepts and Definitions

Let's review some common concepts and definitions.

- **Active workings**: Areas where miners are required to work or travel.
- **Concentration**: A measure of the amount of a substance contained per unit volume of air.
- **Diesel particulate matter (DPM)**: A component of diesel exhaust (DE) that includes soot microparticles made up primarily of carbon, ash, metallic abrasion particles, sulfates, and silicates.
- **Equivalent concentration**: Represents the amount of respirable dust (including quartz) breathed in while working in a coal mine, measured as the substance contained per unit volume of air.
- **Fit test:** A procedure to assess respirator fit on an individual, conducted either qualitatively or quantitatively.
- **Mining Research Establishment (MRE) instrument**: The first device used for dust sampling, and often considered the standard for determining equivalent sampling devices.
- **Radon daughters**: Particles formed when radon undergoes radioactive decay.
- **Representative dust sample**: A typical dust concentration level in a given area, expressed as an equivalent concentration.
- **Respirable dust**: Dust posing a health risk if inhaled into the lungs.
- **Working level months (WLM)**: A unit of measurement calculated based on exposure rounded to half-hours and the average concentration of radon daughters present.

Preparing for Airborne Hazards and Respiratory Devices

Many of the federal regulations concerning airborne hazards and respiratory devices may seem very technical in nature, especially if you are new to mining. While you may encounter chemicals or other agents or at your worksite that require special expertise or training, there are simple precautions you can take to better recognize and prevent airborne hazards.

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

- Make sure you have all required PPE and verify that the PPE is in good working condition.
- Confirm which, if any, chemicals and physical agents might be present in your immediate and surrounding work area.
- Ask about the most recent respirable dust and radon reports.
- Identify the location of areas marked "Respirator Required".

The rest of this module will prepare you for both physical and chemical agents, paying particular attention to dust, chemicals, radiation, and diesel. Additionally, you will learn about the effective use of self-contained self-rescuers (SCSR) and respiratory devices and how they will help you manage airborne hazards at a mine site.

5.2 RESPIRABLE DUST

A Brief Overview of Key Dust Sampling Concepts

Understanding dust in mining is crucial because of its significant impact on your short *and* long-term health. Inhalation of various types of dust can lead to severe respiratory diseases and aggravate asthma and allergies. Additionally, high dust levels can reduce visibility, leading to accidents, and in the case of coal dust, create explosive hazards. Effective dust management is essential to protect your health, ensure a safe working environment, and maintain operational efficiency. In this section, we will look at some key concepts for how dust is sampled and monitored at your mine worksite.

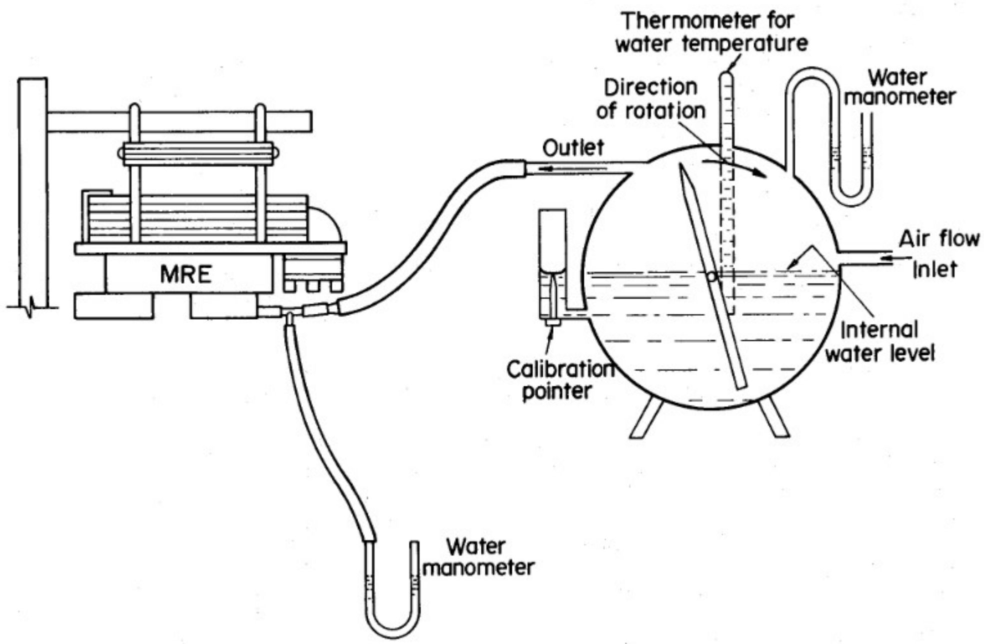
First, **respirable dust** is a dust that poses a risk to your health because it can be inhaled into the lungs, leading to respiratory issues and other health problems. **Quartz** is one problematic material that you may encounter in respirable dust in coal mines, as it is often associated with valuable resources like metals and ores.

Federal regulations refer to quartz as crystalline silicon dioxide (SiO_2) that is not chemically combined with other substances and has a distinctive physical structure. This is important for you to understand because it indicates the durability and resistance to breakdown of quartz. This means that if you inhale respirable dust that contains quartz, it is likely that tiny particles will remain in your lungs for a long time!

How do you monitor respirable dust levels?
To monitor respirable dust levels, a **certified person** must collect a **valid respirable dust sample** by using devices approved by regulatory agencies; these are also known as **approved sampling devices**. These devices measure the concentration of respirable dust in the air during your mining activities. A **certified person** is an individual authorized by regulatory authorities to conduct respirable dust sampling and maintain or calibrate sampling equipment. Their certification ensures accurate monitoring and equipment maintenance.

Devices to Monitor Respirable Dust Levels

The first device used for dust sampling was developed by the Mining Research Establishment and is aptly called a **MRE instrument**. It is specifically known as a gravimetric dust sampler that has four parts to help separate dust so that it can be measured properly. Though less common today, the MRE instrument is still the standard for determining equivalent sampling devices. The results obtained with an MRE instrument are often required for comparison to other sampling devices, so it is important for you to know about this instrument as part of the history of dust monitoring in mining.



5.1: Schematic of MRE instrument.

Another approved sampling device is the **Coal Mine Dust Personal Sampler Unit (CMDPSU)**. This specific device is used in coal mines to monitor dust levels during your work shifts. It collects samples of respirable dust for analysis, providing crucial data for assessing yours and others' exposure levels.

Another approved device, the **Continuous Personal Dust Monitor (CPDM),** continuously monitors dust exposure throughout your work shift. It provides real-time data on dust levels, allowing you to take immediate action if levels exceed safety thresholds.

What should I look for when testing airborne dust levels?

When using an approved device to test for dust levels in the air, your goal is to determine **equivalent concentration,** which represents the amount of respirable dust (including quartz) you are breathing in while working in a coal mine. **Concentration** just means a measure of the amount of a substance contained per unit volume of air. This will help you understand your exposure levels during your work activities, which will be important later.

Measuring Equivalent Concentration

Equivalent concentration is measured in **milligrams per cubic meter of air (mg/m^3)**. To identify equivalent concentration, you would first use your sampling device to collect dust from the air over a certain amount of time, with your unit of time being in minutes. To calculate the volume of air, you would multiply your time sampled (in minutes) by the sampling airflow rate (in cubic meters per minute). Next, you would divide the weight of the dust you collected on the filter (in milligrams) by the volume of air that passed through the device during that time (in cubic meters). This will give you the concentration in milligrams per cubic meter (mg/m^3).

To make it easier to understand and compare across devices, you would then convert this concentration to an equivalent value set by the Mining Research Establishment (MRE) instrument, depending upon the device you used.

1. If you used the CMDPSU, you would multiply the dust concentration by a set number given by the Secretary of Labor.
2. If you use the CPDM, you can program the device to automatically show the equivalent concentration at the end of the shift.

Sampling Locations for Respirable Dust Levels

Respirable dust level samples are taken in a variety of locations, with one primary area being known as a **designated area (DA)**, which the mine operator selects in the mine ventilation plan. (You can review the Module Resource Materials for developing a successful mine ventilation plan). The DA is where they take samples to check how much dust is being produced in the **active workings,** or any place in a coal mine where miners are normally required to work or travel. The District Manager has to agree that the DA is a good spot, and then MSHA gives it a four-digit number to document the sample location.

At times, you may work with a **mechanized mining unit (MMU)**, which is heavy machinery or mining equipment for material production. They may include excavators, bulldozers, haul trucks, drill rigs, loaders, and more. Because MMUs introduce additional equipment into an area, they can increase dust levels for you and others working in that location. To help track the machinery location, each mechanized mining unit in the mine gets a four-digit ID number from MSHA. This number stays with the unit, even if it moves to another part of the mine. However, there are two important guidelines:

1. If two sets of mining equipment work in one area, but only one crew works on them at a time, they are considered one MMU.
2. If two or more sets of equipment work at the same time in the same area, they each get their own MMU ID number.

Both DAs and MMUs have **production shifts,** or a shift in which material is produced; for DAs, it can also include routine or normal day-to-day activities that occur in that area.

If the MMU produces at least 80% of the average amount it usually produces based on the last 30 shifts (or all shifts if there are fewer than 30 recorded), then it is known as a **normal production shift.**

What does this have to do with dust samples? Great question!

When monitoring dust, you, your mine operator, or another authorized worker may have to get a **representative dust sample,** or typical dust concentration level in a given area. Remember that this has to be expressed as an equivalent concentration. To ensure these levels are representative of the work at your mine site, it is important to define what each of these areas mean for measurement:

1. When sampling around an MMU, this means a sample around normal mining activities.
2. When sampling at an active working, this means during which the amount of material produced is equivalent to a normal production shift.
3. When sampling at a DA, when material is produced and routine-day-to-day activities are occurring.

Once you know the results of respirable dust samples, you may find that some MMUs have a **designated occupation** (DO), which means that there is a specific job or task being performed on an MMU that has been identified as having the highest respirable dust concentration. This designation helps your operator and others to focus on areas where dust levels are highest, allowing for better control and monitoring of potential health risks for you and other miners.

Similarly, an **other designated occupation** (ODO) is when an additional task on an MMU besides the main one (DO) is designated for sampling per regulations. Each ODO gets its own unique four-digit number for identification by MSHA. This helps ensure that all areas with significant dust exposure are monitored properly to reduce your risk of exposure.

Phew! This was a lot. Let's recap with a summary.
Understanding and effectively monitoring respirable dust levels is crucial for ensuring your health and safety, as prolonged exposure to such dust, particularly quartz, can lead to severe respiratory conditions like pneumoconiosis and silicosis. Utilizing approved sampling devices that compare with the MRE in proper areas such as active workings cannot only protect your health but also help in maintaining operational efficiency by optimizing dust control measures and ensuring your worksite adheres to federal safety regulations. We will look at some of these concepts in further detail in the remainder of this module.

Nice work! You have some of the foundational pieces for understanding some of the regulations guiding the control of dust at your worksite. Let's continue to explore some of the things that can affect your air quality at your worksite.

5.3 CHEMICALS AND PHYSICAL AGENTS

When you are at a mine worksite, it is important to consider the various factors that can affect the quality of the air around you. Dust, gases, and chemicals can be present, or exacerbated by primary or secondary work processes. For example:

- Primary active mining processes such as drilling, blasting, cutting, and transporting materials can produce dust that can get into your lungs.
- Various toxic, flammable, or other harmful gases can also be present or generated in mines through secondary processes such as blasting, drilling, and the decomposition of organic matter that releases these gases.

Regardless of the mining work process, working directly with chemicals such as explosives, diesel fuel, or rock dust additives can often release harmful vapors if not handled properly.

In this section, we will look at safety procedures regarding the restricted use of chemicals and specific protective measures that you can take against chemicals and contaminants.

Restricted Use of Chemicals

You might use chemicals *for* your mining work or you might find that your work can *produce* chemicals and harmful gases. For instance, you might use chemicals to extract minerals from ores, separate metals from rocks, and process raw materials. In doing so, you may have chemical byproducts or other harmful substances left.

Whether you are working in a surface or underground mine, there is a list of chemical substances that are not allowed to be used or stored *unless* you are trained and skilled to do so. Even if you are trained and approved to work with these chemicals, you are required to work with them under specific laboratory conditions that have been approved by a nationally recognized agency acceptable to the Secretary of Labor.

Let’s review this list of chemicals, grouped by toxicity attributes, in the table below. It will help you become familiar with what these chemicals might look like, smell like, and some of their uses. You can also review a full description of these chemicals in the Module Resource Materials section.

Chemical	**Appearance**	**Uses**	**Hazards**
Highly Toxic Chemicals			
Methyl-chloromethyl Ether	Clear, colorless liquid	Manufacturing processes	Highly toxic if inhaled, ingested, or absorbed through the skin; known human carcinogen

Bis(chloromethyl) Ether	Clear liquid with a very unpleasant smell	Previously used in plastics and textiles; now restricted	Highly toxic; carcinogenic
N-Nitrosodimethylamine	Yellow liquid with no apparent odor	Industrial or research purposes; previously in rocket fuel	Toxic and often fatal if ingested or inhaled; known carcinogen
Ethyleneimine	Colorless liquid with an ammonia-like odor	Polymerization products, adhesives, and binders	Very corrosive; can cause third-degree chemical burns
Chemical	**Appearance**	**Uses**	**Hazards**
Carcinogenic Chemicals			
4-Nitrobiphenyl	White to yellow needle-like crystalline solid with sweetish odor	No longer used in the U.S.; may be in international mining or hazardous waste	Potential carcinogen
Alpha-naphthylamine (1-Naphthylamine)	White or yellow crystalline material; turns purplish-red upon exposure to air	Dye and rubber manufacturing; weed control	Chronic health effects; carcinogenic
3,3-Dichlorobenzidine	Gray to purple, crystalline powder	Previously used in dyes and pigments; now restricted	Probable carcinogen
Beta-naphthylamine (2-Naphthylamine)	Flaky solid, white to reddish in color	Dye and agricultural chemical production	Hazardous if ingested, inhaled, or touched; carcinogenic
Benzidine	Odorless, white to slightly red crystalline powder	Previously used in dye production; now banned except for specialty uses	Carcinogenic; exposure through contaminated clothing or mining activities
4-Aminodiphenyl	Colorless to light brown sand-like powder; floral smell	Previously used in rubber and dye production; now used in cancer research	Carcinogenic; exposure through cigarette smoking
2-Acetylaminofluorene	White powder or tan solid	Previously used as a pesticide; now only in research	Known carcinogen

Chemical	Appearance	Uses	Hazards
Chemicals with Significant Health Risks			
Carbon Tetrachloride	Clear liquid with a sweet odor; odorless gas	Previously used in refrigerants, pesticides, and cleaning agents; now limited to industrial applications	Health risks leading to restricted use
Phenol (Carbolic Acid)	White crystals that can turn into a gas; aromatic	Used in plastics and related materials	Can cause burns on skin; somewhat acidic
4,4-Methylene Bis (2-chloroaniline) (MBOCA)	Yellow, tan, or brown pellets; odorless and tasteless	Used in polyurethane products, glues, plastics, and adhesives	Industrial health risks; controlled use
Beta-propiolactone	Colorless liquid with a slightly sweet, pungent odor	Disinfectant and sterilant for medical equipment	Can cause irritation, burns, and blistering if not handled properly
4-Dimethylaminobenzene	Yellow, leaf-shaped crystals	Dye for polishes, soap, and wax products	Affects skin, eyes, and lungs upon exposure

You might be wondering how you can remember all of these! The good news is that federal regulations require that you are trained in a dedicated lab with protective equipment before using these chemicals. You will not be permitted to use these chemicals without further guidance.

Protective Measures Against Chemicals and Physical Agents

Now that you are aware of some chemicals and contaminants that you will work with or be exposed to while mining, let’s look at the different protective measures you can take when working around chemicals and contaminants at your mine worksite.

To protect yourself and others from the negative effects of these chemicals and other contaminants, be sure you are aware of the following protective measures required by MSHA, *regardless* of whether you are working in above- or below-ground mines, and whether these mines are metal or nonmetal.

First, you or your mine operator may conduct surveys, or checks, for dust, gas, mist, fibers, and fumes. These must be done often enough to ensure that control measures are working effectively.

Second, you will need to be sure you are monitoring your oxygen levels when working underground. Your air in all active underground workings must contain at least 19.5% oxygen by volume. This is a safety threshold established to prevent you and others from experiencing hypoxia (a deficiency in the amount of oxygen reaching the tissues) or other health issues related to insufficient oxygen.

Finally, your and others' exposure to airborne contaminants should not exceed acceptable levels set by the American Conference of Governmental Industrial Hygienists (ACGIH). This document can be obtained from ACGIH or viewed at any Metal and Nonmetal Mine Safety and Health District Office. Short-term exposure above these limits should not exceed the permissible levels described by the ACGIH.

One exception to this is **asbestos** because of its known health risks – it can cause serious lung issues, even at low levels of exposure. We will discuss asbestos in the next section.

How do you prevent and control your exposure to airborne contaminants?
Great question! MSHA regulations advise that your exposure to harmful airborne contaminants should be controlled as much as possible by:

- Preventing them from getting into the air to begin with
- Removing them with special exhaust fans
- Diluting them with clean, uncontaminated air

However, where acceptable control measures have not been developed or if the work requires it–such as occasional entry into contaminated areas–you may work in higher levels of contaminants for a short time as long as you wear protective respiratory equipment. You will learn about protective respiratory equipment later in this module.

Asbestos

In addition to chemicals, there are other contaminants at the mine worksite that can affect your health and safety. One such airborne hazard that has been studied extensively is **asbestos**.

Asbestos is a type of mineral that breaks down into tiny, flexible fibers when it is crushed or worked with. It includes different types such as chrysotile, amosite, crocidolite, anthophylite, tremolite, and actinolite. An asbestos fiber is any of these tiny fibers that is longer than 5 micrometers (a tiny unit of measurement) and has a specific shape, which is that the length to diameter ratio is at least 3 to 1.


5.2: A close-up image of a chrysotile asbestos fiber.

You will find that asbestos has been commonly used in building materials such as:

- Insulation
- Roofing
- Flooring
- Automotive brake pads
- Automotive linings

Due to its harmful health effects, asbestos has been heavily regulated and phased out in many industries. However, you might be exposed to asbestos when you work around products that contain it, like certain types of insulation, pipes, or other construction materials. If these materials get processed or disturbed, tiny asbestos fibers can float in the air; you might breathe them in without even realizing it!

Checking for Asbestos

The first step to reducing your exposure and increasing your safety around harmful contaminants such as asbestos is to understand how to check for the presence of asbestos. To do this, you will use a technique called **phase contrast microscopy (PCM)** or equivalent that can accurately measure potential asbestos exposure exceeding the 0.1 f/cc full-shift limit or the 1 f/cc excursion limit (more on these limits in a moment). Then, using this technique, you will follow the OSHA Reference Method found in OSHA's 29 CFR 1910.001 Appendix A.

What is this method?

To summarize here, you would use special filters and containers designed for asbestos counting and sampling. You would aim to collect enough air to find a specific range, pack the fibers carefully, and calibrate your equipment before and after use. Then, you would take personal air samples in the breathing zone of employees, count the fibers following specific rules, and conduct quality control checks to ensure accuracy and reliability.

If PCM shows that asbestos levels might be too high, you should use a more detailed method called **transmission electron microscopy (TEM)** using the NIOSH Method 7402 and following similar steps summarized above. If the amount of asbestos in the air goes above safety limits described below, employees must leave that area.

Permissible Exposure Limits (PELs)

The second step to reducing your exposure to asbestos is understanding what limits are safe for you to work within. MSHA has already identified these limits for you.

During a full work shift, you should not breathe in more than 0.1 fiber of asbestos per cubic centimeter of air (f/cc). This keeps your average exposure low over a whole workday. Additionally, at any given time, you should not be around asbestos levels higher than 1 fiber per cubic centimeter of air, measured over a 30-minute period. This prevents any short periods of high exposure.

To summarize, you are likely to encounter a variety of airborne hazards when working at your mine worksite. These can include dust, chemicals, and asbestos. By understanding air sampling, monitoring, record keeping, and how to use personal protective equipment, you can reduce your risk of exposure and associated health effects of asbestos fibers. Understanding how to protect yourself and test for these hazards can help you to stay safe.

Great! Now, you understand important safety regulations for reducing your exposure to harmful chemicals, contaminants, and other airborne hazards at your mine worksite. Next, we will look at another possible hazard you can encounter: radiation.

5.4 RADIATION PROTECTION

You may work with products that contain or produce radioactive material at a mine worksite. For instance, uranium, certain kinds of coal, and phosphate can all contain levels of radioactive material or undergo radioactive decay. It is vital to protect yourself against exposure to radioactive material. In this section, we will review MSHA's regulations on monitoring, exposure, and protection against radon, radon daughters, and radiation.

Radon and Radon Daughters

Radon is an odorless, invisible radioactive gas that is found when uranium undergoes radioactive decay, which is an unpredictable process that begins with unstable particles within the material. When going into radioactive decay, radon becomes known as **radon daughters**, which can later emit radiation and lead to various health hazards, including cancer. You might be familiar with uranium and know it as a natural element found in all rocks in varying levels. But rocks with the highest percentage of uranium include volcanic rock, granite, dark shales, sedimentary, and metamorphic rock.

Radon Protections

There are six protections you can take to help mitigate harmful radon exposure at a mine worksite.

Protection One: Sampling

The first step to protecting yourself against radon is to regularly test the air in which you and others are working. You or someone else at your mine site must take at least one sample of exhaust mine air to check for radon daughter concentrations. The mine operator may request that the required exhaust mine air sampling be done by the Mine Safety and Health Administration. Sampling must be done using the procedures and equipment described in section 14.3 of the American National Standard Radiation Protection in Uranium Mines approved in 1973.

If the concentration exceeds 0.1 Working Level (WL), then further monitoring is needed. If you are working in uranium mines, then you will want to be sure that you or someone else is measuring radon daughter levels at least every two weeks in all active areas, or where workers are present (or will be present). If levels exceed 0.3 WL, then you will need to measure weekly until levels stay below 0.3 WL for five consecutive weeks.

If you are working in non-uranium mines, then you will need to measure radon daughter levels every three months if concentrations are between 0.1 and 0.3 WL, until levels are below 0.1 WL. Continue to measure annually thereafter. If levels exceed 0.3 WL, measure weekly until levels stay below 0.3 WL for five consecutive weeks.

If concentrations are less than 0.1 WL in the initial sample, then this means very low levels are found. You will then need to take at least one sample of exhaust mine air monthly for uranium mines, and you will not need to further sample exhaust air if it is for non-uranium mines.

Protection Two: Recording

Additionally, by recording radon sample information, you can help catch elevated radon concentrations earlier, allowing for quicker interventions before levels become hazardous. Any time you test a sample, be sure that you record the:

- Sampling date
- Sampling locations
- Results of all samples

Keep these records at the mine site or nearest mine office for at least two years. Be sure these records are available for inspection by the Secretary of Labor or their representative!

Protection Three: Monitoring Exposure Limits

By testing and recording radon samples, you can be sure that you and others are not exposed beyond safe limits. To do this, it is important to monitor your potential exposure when working at your mine worksite. This will help to protect your health and safety while working in a mine. Federal regulations stipulate that no one is allowed to be exposed to more than 4 Working Level Months (WLM) of radon daughters in a year. However, if the Environmental Protection Agency (EPA) recommends new exposure limits and the President approves them, these new limits will replace the old ones. Once the new limits take effect, no one can be exposed to radon daughters beyond these new limits.

Similarly, you should not be exposed to air containing concentrations of radon daughters exceeding 1.0 WL in active work areas, unless you are using appropriate respiratory protective equipment and there is a comprehensive program in place. This will be discussed in more detail in a later section.

You might be thinking, "*What does working level months (WLM) mean?"* Great question!

The short and simple answer is that **WLM** is a unit of measurement that is calculated based on your exposure and the average concentration of radon daughters present. To do this calculation, follow these few steps:

- **Step 1:** Figure out how many hours (rounded to the nearest half-hour) you spent in an active working area where radon daughters are present.
- **Step 2:** Determine the average level of radon daughters in the air for that area. This should be calculated to the nearest hundredth of a working level (WL). The average level of radon daughters in the air in a specific working area should be calculated by taking the average of all the samples taken in that area while workers are there. If a sample is taken by a federal or state mine inspector and shows the exposure level to miners, and

this result is reported to the mine operator within three days, it will be included in the average concentration. However, if the mine operator also takes samples at the same time as the inspector, they can use their own sample results instead.

- **Step 3:** Multiply the total exposure time by the average concentration of radon daughters. Then, divide this result by 173 hours (since there are 173 hours in a typical work month).

Protection Four: Exposure Record Keeping

Now that you know how to sample, test, record, and monitor your radon exposure, you should also know how these records are kept and tracked.

Your mine operator is required to keep track of how much exposure each worker gets to radon daughters in the air. While you may not be a mine operator when beginning your work in mining, learning about how exposure records are collected and maintained can help you understand your potential health risks and ensure that safety measures are in place to protect yourself and others.

How radon exposure record keeping works:

In uranium mines, your mine operator must calculate and record the exposure of *everyone* who works underground. They need to record where each person spends their time underground, like in tunnels, work areas, lunchrooms, and other places, as well as note the level of radon daughters in those areas.

In non-uranium mines, if the mine has areas with high levels of radon daughters (more than 0.3 WL), your operator will also need to calculate and record each worker's exposure in those areas. They should keep track of where each person works and the levels of radon daughters there. If the radon levels in an area drop to 0.3 WL or less for 5 weeks in a row, they can stop tracking exposure for workers in that area. But if anyone has already been exposed to more than a certain amount (a fraction of a WLM) based on how many months they have worked that year, the tracking cannot be stopped for them.

Then, your mine operator should use a specific form called "Record of Individual Exposure to Radon Daughters" (Form 4000-9) to record this information for each person, including you. This form needs to include details about your current and total exposure to radon daughters. The operator must keep an original copy of this form for their own records, which can be checked by government safety inspectors.

Additionally, by February 15th of each year, or within 45 days after the mine shuts down for the year, the mine operator must send a copy of this form to MSHA. This copy needs to show the exposure data for you and all other workers who needed their exposure recorded during the previous year.

If the mine operator finds any mistakes on the forms they keep, they have to fix them! They also need to send corrected copies of any forms they have already sent to the Mine Safety and

Health Administration. This corrected copy should show what was wrong, when it was fixed, and it needs to be sent within 60 days of finding the error.

Your mine operator needs to keep records of everyone's exposure to radon daughters, either in the mine office or nearby, for a certain period as specified in the standards. These records, including copies of the "Record of Individual Exposure to Radon Daughters" form (Form 4000-9) or acceptable equivalent forms, should be available for inspection by State agencies, such as the Secretary of Labor.

If you or someone else asks for their exposure records, they should be provided upon written request. The blank form entitled "Record of Individual Exposure to Radon Daughters" (Form 4000-9) can be obtained on request from any MSHA Metal and Nonmetal Mine Safety and Health district office.

Finally, you should also know that smoking is prohibited in areas where exposure records are kept because smoking can introduce contaminants into the air, making it harder to accurately measure and manage the levels of harmful airborne substances like radon.

Protection Five: Respirators and Warnings

At times, working in a mine requires being in hazardous environments where levels exceed exposure guidelines, but the following measures can help ensure that your risk is reduced. In places where the concentration of radon daughters in the air is higher than 1.0 WL, you will need to wear special respiratory protective equipment that is approved by the National Institute for Occupational Safety and Health (NIOSH) or equivalent respirators under MSHA policy 42 CFR part 84. These respirators must be accompanied by a program that effectively selects, maintains, trains, fits, supervises, and cleans these devices. You can find more details on respirators by reading MSHA's Code of Federal Regulations Title 42 Chapter 1 Subchapter G Part 84, which discusses how respiratory protective devices are approved.

If you are using a respirator in a place where the air could be really dangerous, there needs to be at least one other person nearby who has extra equipment and knows how to rescue you if your mask stops working.

If there are parts of the mine where you or others are not currently working, but the radon levels are still high (more than 1.0 WL), those areas must be clearly marked with signs warning people not to go in without permission. The signs should also say that anyone who goes in there needs to wear respirators that are approved for safety.

If the radon levels are really high, like more than 10 WL, you will need extra protection. You should use air devices that either bring in fresh air from outside or a mask that can filter out both the radon gas and its daughters. This is to keep you safe from breathing in harmful levels of radon.

Protection Six: Annual Gamma Radiation Survey

Just like radon daughters are produced by the decay of radioactive material such as uranium, **gamma radiation** is produced through a similar process. Much like the electromagnetic radiation found in X-rays, gamma rays are invisible and can pass through most material, including human tissue, if their levels are too high.

Every year, underground mines that dig up radioactive ores need to do surveys to check for gamma radiation. These surveys follow a standard set by the American National Standards Institute. If the average gamma radiation levels are higher than 2.0 milliroentgens per hour in a work area, you must be given a special device called a **gamma radiation dosimeter** to measure your exposure. Records must also be kept of how much gamma radiation you and others have been exposed to – you should not be exposed to more than 5 rems of gamma radiation in a year.

To summarize, when working at your mine site, you or someone else at the operation must:

- Conduct sampling of exhaust mine air to check for radon daughter concentrations.
- Record radon sampling data and maintain records at the mine site.
- Monitor your exposure to radon daughters and comply with recommended limits.
- Understand exposure record-keeping requirements and how to request access to your exposure records.
- Use appropriate respiratory protective equipment in areas with high concentrations of radon daughters.
- Identify and comply with warning signs in areas with high radon levels.
- Conduct annual gamma radiation surveys in underground mines and monitor exposure levels.

Excellent! You now understand the importance of testing, monitoring, recording, and protecting against radiation. Next, we will look at how self-rescue and respiratory devices can protect you against airborne hazards.

5.5 SELF-RESCUE AND RESPIRATORY DEVICES

The use of respirators and self-rescue devices may be required, or necessary, due to the various hazardous conditions encountered in facilities, surface, or underground mines.

At facilities mines, such as processing plants or material handling areas, you may be exposed to airborne particles, gases, or chemicals released during the mining and processing of minerals. For example, dust generated from crushing, grinding, or handling of materials can pose respiratory hazards, leading to lung diseases if inhaled over time. Similarly, chemical agents used in processing operations can emit toxic fumes, necessitating the use of respirators to prevent inhalation-related illnesses.

Surface mining operations where activities like drilling, blasting, and earthmoving are often utilized, can release dust, silica, and other airborne contaminants into the atmosphere. If you are operating heavy machinery or performing tasks in close proximity to these activities you are at risk of inhaling harmful substances, making respirators vital for protecting your respiratory health.

In underground mines, where confined spaces and poor ventilation are common, the risk of exposure to hazardous gases like methane and carbon monoxide is heightened. Additionally, the potential for roof collapses or other emergencies necessitates the availability of self-rescue devices to help you escape safely in the event of an emergency.

Accordingly, you must know how to safely operate and maintain self-rescue and respiratory devices to mitigate risks from airborne hazards at mine worksites.

Use of a Self-Rescuer Device

As a miner, a Self-Contained Self-Rescuer device (SCSR) may be the difference between rescue, a proper recovery, or a fatality. While an SCSR can save your life, you must know how to inspect the unit correctly so that you can be sure that it will work properly when you need it.

What is a SCSR?
A SCSR is a portable tool that typically consists of a compact, lightweight canister containing a:

- Chemical oxygen generator
- Breathing bag
- Mouthpiece
- Nose clip

These components work in tandem to provide a temporary, but crucial, source of breathable air if you are in a compromised air environment.

How does a SCSR work?
The chemical oxygen generator within the SCSR undergoes a chemical reaction when activated, producing oxygen that is then delivered to the user through the breathing bag and mouthpiece. This self-contained system ensures that you have access to a clean air supply even in situations

where the surrounding atmosphere is contaminated with toxic gases such as methane, carbon monoxide, or hydrogen sulfide.

SCSRs are designed to be:

- Portable
- Easy to carry
- Either worn by the user while completing a work task or strategically stored in accessible locations throughout a worksite

The compact size of a SCSR allows for convenient deployment during emergencies without impeding your mobility or ability to perform safe emergency procedures until you are out of harm's way.

When might I need to use a SCSR?
A SCSR can provide respiratory protection during emergencies such as fires, gas outbursts, explosions, or escape and evacuation.

- **Gas Outbursts:** In mining operations, sudden releases of gases can occur unexpectedly. These gases, such as methane or carbon monoxide, can quickly render the air unbreathable. Self-rescuers become essential in these instances, offering a means of escape by providing a clean air supply.
- **Explosions:** Mine worksites are susceptible to explosions due to various factors such as volatile substances or equipment malfunctions. Following an explosion, the air may become contaminated with hazardous particles or depleted of oxygen.
- **Fire Incidents:** Fires are a risk at mine worksites where flammable materials may be present. In the event of a fire, the smoke produced can quickly fill the air with toxic fumes, making breathing difficult or impossible.
- **Escape and Evacuation:** In situations where evacuation routes may be compromised or inaccessible, these devices offer workers a means of self-rescue, enabling them to navigate through hazardous conditions and reach safety.

Proper SCSR Care and Maintenance

Federal law requires that mine operators follow a proper maintenance schedule to confirm the following SCSR maintenance tasks:

- Checking the reliability of self-rescuers
- Retiring older self-rescuers first
- Introducing new self-rescuer technology, as available and needed

Your mine management is required to inform you of the *type* and *location* of SCSRs at the worksite. You must also be given the opportunity to:

- Try on each type of SCSR at the worksite
- Practice switching from one SCSR type to another
- Receive direct training on the proper fit of each SCSR

In addition to SCSR guidance at an individual mine worksite, remember to always comply with the *manufacturer's recommendations* for inspection, storage, care, maintenance, and the proper way to put on your SCSR!

Follow these general SCSR maintenance guidelines to ensure your SCSR is in proper working condition:

- Factory service date label indicates that the unit is suitable to use.
- Seal is in place and undamaged (no cracks, chips, breaks).
- Case is not cracked, burned, or deformed.
- No parts are missing.
- Belt loops (if used) are intact.

Evacuating With a SCSR

If you must evacuate with a SCSR it is important to understand how the equipment may function and the personal experience that you might encounter.

A proper SCSR will isolate your lungs from toxic gases and provide breathable oxygen during evacuation. Once you have properly put on and properly secured your SCSR you should *never* remove the mouthpiece or nose clips, except if:

- You are transferring to a replacement SCSR
- You have reached a confirmed safe atmosphere

Removing the mouthpiece to talk or for any other reason may be fatal. *Keep your SCSR on!*

Does breathing with a SCSR feel the same as normal breathing?
Breathing with a SCSR differs from normal breathing; the temperature of the inhaled air will be slightly higher and there will be some breathing resistance. This is not harmful and does not warrant removal of the device. By proceeding as calmly as possible and controlling your physical activity level, such as walking pace, you will breathe more comfortably and maximize the duration of your SCSR.

What if I become scared or nervous while wearing my SCSR during an emergency?
It is normal to experience an emotional reaction during an emergency escape. You are experiencing stress and likely what is sometimes referred to as the fight or flight response. This is the survival instinct that we are all born with; it prepares us to fight or run. This response prepares the body to *help* you in your escape.

Psychologists call an incident like an emergency escape from a mine a "traumatic incident". Responses to a traumatic incident include physical, mental, emotional, and behavioral changes. Remember that strong reactions and emotions are normal. Individuals are different and may experience some or none of the following symptoms:

- Rapid heartbeat
- Dry mouth
- Sweaty palms

- Increased anxiety
- Fear
- Sweating profusely
- Feeling confused
- Feeling overwhelmed
- Shallow breathing
- Nausea
- Disorientation

These are *ordinary* human responses to an *extraordinary* situation.

Keep these practices in mind to stay calm during an escape:

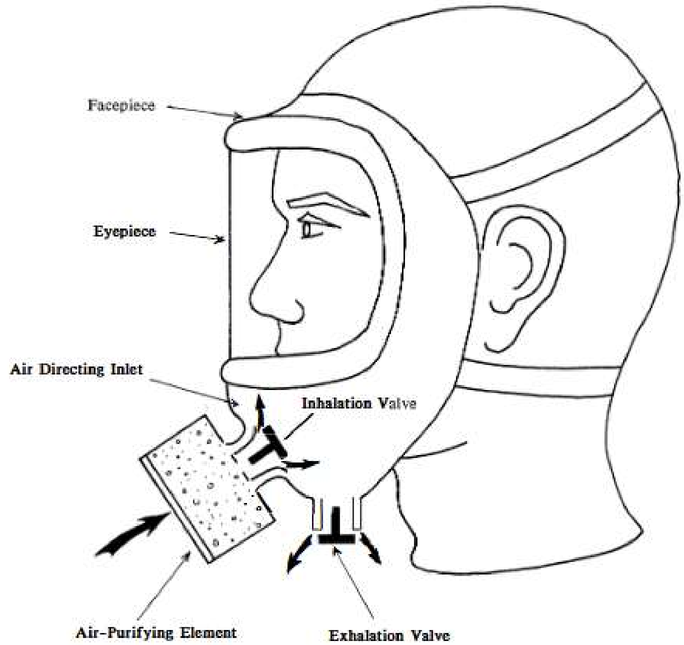
- Be conscious of slowing your breathing down.
- Walk at a steady pace.
- Stay with your "buddy" or crew.
- Watch out for each other.
- Think forward - think about getting out of the mine; focus on the escape.
- Do not remove the mouthpiece to talk.
- Do not remove your SCSR unit until you are in fresh air or ready to switch to a new unit.

Use of a Respirator

The airborne hazards that you might encounter at a mine worksite may also require the use of a respirator. Respirators are designed to purify the air that you breathe or protect you from breathing *specific* airborne contaminants. Therefore, when you begin work at a mine worksite, management should provide you with clear guidance on:

- Common hazards at the worksite that require a respirator
- The type, manufacturer, and model of respirators available at the worksite
- The limitations of these types of respirators
- The job duties and physical task areas where these respirators will be used

You must wear an assigned respirator whenever you are in designated work areas where there may be excessive exposure to dust or other hazards.



5.3: Typical Full-Facepiece respirator.

These areas must be clearly marked at a mine worksite as '**Respirator Required.**'

Additionally, supervisors will periodically inspect all 'Respirator Required' work areas to ensure that respirators are being used correctly. These checks will also include:

- Assessing the effectiveness of dust control measures
- Monitoring employee exposure levels
- Evaluating any discomfort or strain caused by wearing respirators due to breathing resistance or heat

This inspection should be part of management's daily walk-around routine!

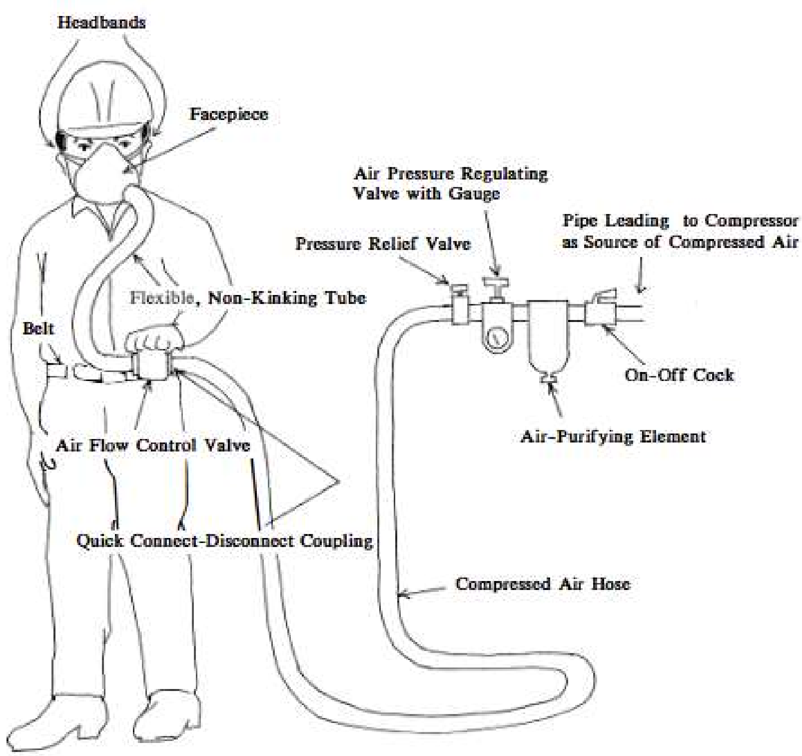
Types of Respirators

Each mine worksite may use different types of respirator devices for different mining tasks. Management must inform you of the specific types of respirators used on site. Below is a list of common respiratory equipment that you might use at a particular worksite.

- **Air-purifying respirator:** A respirator equipped with a filter, cartridge, or canister designed to remove specific air contaminants by filtering ambient air.
- **Atmosphere-supplying respirator:** A respirator that delivers breathing air from a source independent of the surrounding atmosphere, including, for example, supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
    - **Supplied-air respirator (SAR) or airline respirator:** An atmosphere-supplying respirator with a breathing air source not designed to be carried by the user.

- **Self-contained breathing apparatus (SCBA):** An atmosphere-supplying respirator with a breathing air source carried by the user.
- **Demand respirator:** An atmosphere-supplying respirator that supplies breathing air to the facepiece only when negative pressure is created inside the facepiece during inhalation.

- **Negative pressure respirator (tight fitting):** A respirator with negative pressure inside the facepiece during inhalation.
- **Positive pressure respirator:** A respirator with pressure inside the respiratory inlet covering exceeding ambient air pressure.
- **Powered air-purifying respirator (PAPR):** A respirator using a blower to force ambient air through air-purifying elements to the inlet covering.
- **Pressure demand respirator:** A positive pressure atmosphere-supplying respirator delivering breathing air to the facepiece when pressure inside is reduced during inhalation.



5.4: Continuous-flow respirator system.

Remember, management must inform you of the type, manufacturer model, and location of respirators used at a particular mine worksite!

Respirator Components and Functions

Different types of respirators may have different components and functions. Depending on which type of respirator you use at a mine worksite, you should check that its components are in proper working condition so it can effectively function.

Here are some common respirator components:

- **Canister or cartridge:** A container containing a filter, sorbent, catalyst, or a combination of these elements, used to remove specific contaminants from air passing through it.
- **Filter or air purifying element:** A component in respirators designed to remove solid or liquid aerosols from inhaled air.
- **Filtering facepiece (“Dust Mask”):** A particulate respirator with a filter integrated into the facepiece or composed entirely of the filtering medium.
- **Helmet:** A rigid respiratory inlet covering providing both respiratory and head protection against impact.
- **High efficiency particulate air (HEPA) filter:** A filter with at least 99.97% efficiency in removing 0.3 micrometer monodisperse particles.
- **Hood:** A respiratory inlet covering that covers the head, neck, and sometimes portions of your shoulders and torso.
- **Loose-fitting facepiece:** A respiratory inlet covering designed for a partial seal with the face.
- **Respiratory inlet covering:** Part of a respirator forming a barrier between your respiratory tract and air-purifying device or breathing air source, such as a facepiece, helmet, hood, suit, or mouthpiece with nose clamp.
- **Tight-fitting facepiece:** A respiratory inlet covering forming a complete seal with the face.

Additionally, there are specific processes to help ensure your respirator functions effectively.

Here are some different procedures and indicators that you might be asked to perform or evaluate before using a respirator:

- **Fit factor:** An estimate of how well a respirator fits a specific individual, typically indicating the ratio of ambient air concentration to concentration inside the respirator during use.
- **Fit test:** A procedure to assess respirator fit on an individual, conducted either qualitatively or quantitatively.
    - Qualitative fit test (QLFT): A pass/fail test assessing respirator fit based on the individual's response to a test agent.
    - Quantitative fit test (QNFT): An assessment of respirator fit measuring leakage into the respirator.
- **Maximum use concentration (MUC):** The highest atmospheric concentration of a hazardous substance providing protection to the wearer based on the respirator's assigned protection factor and exposure limit.
- **Assigned protection factor (APF):** The level of respiratory protection expected from a respirator or class of respirators in the workplace when a continuous and effective respiratory protection program is implemented by the employer.
- **End-of-service-life indicator (ESLI):** A system that alerts the respirator user when adequate respiratory protection is nearing its end, such as when the sorbent is approaching saturation.

Respirator Care and Maintenance

Just like any other equipment, respirators are only effective if they are in clean, good working condition. You should follow these steps to care for and maintain respiratory devices at a mine worksite:

- Inspect respirators prior to each use to determine that they are functioning properly.
- Clean and disinfect or replace the respirator on a regular basis according to manufacturer's recommendations, *or after each use*, if they are used by more than one person.

The table below details the specific steps you should take to properly clean and inspect your respirator.

Step	***Procedures***
Disassembly and Inspection	1. Remove filters, cartridges, or canisters from the respirator. 2. Disassemble facepieces as recommended by the manufacturer, including removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any specified components. 3. Dispose of or repair any defective parts.
Washing	1. Wash all components in warm water, not exceeding 43°C (110°F), using a mild detergent or a cleaner endorsed by the manufacturer. 2. Use a stiff bristle brush (non-wire) if needed to aid in dirt removal.
Rinsing	1. Thoroughly rinse all components in clean, warm water, not exceeding 43°C (110°F), preferably with a continuous flow of water. 2. Allow components to drain.
Disinfection	If the cleaner used lacks a disinfecting agent, immerse respirator components for *two minutes* in one of the following solutions: • Hypochlorite solution: 50 ppm of chlorine, achieved by adding approximately one milliliter of laundry bleach to one liter of water at 43°C (110°F). • Aqueous solution of iodine: 50 ppm iodine, made by adding about 0.8 milliliters of tincture of iodine to one liter of water at 43°C (110°F). • Other commercially available cleansers of equal disinfectant quality, *endorsed or approved* by the respirator manufacturer.
Final Rinsing	Thoroughly rinse all components in clean, warm water, not exceeding 43°C (110°F), preferably with a continuous flow of water.
Drying	Hand-dry components using a clean, lint-free cloth, or allow them to air-dry completely.
Reassembly	Reassemble the facepiece, ensuring filters, cartridges, and canisters are replaced as necessary.
Testing	Test the respirator to verify that all components function correctly and provide

	adequate protection.

Management must provide adequate cleaning and disinfecting facilities, as well as clean and sanitary storage locations, for respirator care and maintenance!

You must also follow the respirator manufacturer recommendations for the use, care and maintenance of each model of any reusable respirator provided by the company. Management must also provide you with instructions on where and how to obtain new disposable respirators or respirator cartridges if yours:

- Becomes unusable
- Is unsanitary
- Exhibits excessive breathing resistance or breakthrough

Proper Wear of a Respirator

To determine if you are wearing a respirator correctly your management team or worksite safety officer will certify that you have been trained and fitted in the use, limitations, and maintenance of respiratory devices available at the worksite.

For example, they will conduct **respirator fit testing** in accordance with the respirator manufacturer and model number. During the respirator fit testing, you will be tested for adequate protection against:

- Bitrex solution aerosol
- Saccharin solution aerosol
- Stannic chloride smoke

During the test, you must perform the following exercises for at least 60 seconds each:

- Normal breathing
- Breathing deeply
- Turning your head from side to side (inhaling in each position)
- Nodding your head up and down (inhaling in the up position)
- Counting or reading the rainbow passage

After you complete these exercises, you will certify that you successfully completed the respirator fit testing by meeting the following conditions and self-certification statements:

- **Saccharin Protocol** – “I did not detect the test solution during any of the actions required in fit testing me with the respirator on which this test qualifies me for. I did, however, taste the test solution during the sensitivity test”.
- **Bitrex Protocol** – “I did not detect the test solution during any of the actions required in fit testing me with the respirator on which this test qualifies me for. I did, however, taste the test solution during the sensitivity test”.

- **Stannic Chloride Protocol** – "I did not smell the stannic chloride smoke with the respirator on and (or) did not need to cough because of it. I did smell the smoke when tested for sensitivity with the respirator off."

Do *not* attest to proper respirator fit testing if you cannot meet the conditions above!

When you begin work at a new mine worksite, you should ask the following questions before you proceed with any work tasks:

- What type of self-rescue devices are available on site, and where are they located?
- What types of respiratory devices are available on site, and where are they located?
- Where are the cleaning and storage supplies located?
- When can I complete any required respirator fit tests and inspections?

[Content on pp. 37-51 adapted from the Office of the Law Revision Counsel United States Code, "Public Law 109–236", MSHA, "Self-Contained Self-Rescuer Training Instructor's Guide" and OSHA, "Respiratory protection"]

5.6 DIESEL CONTAMINANTS AND PROTECTIONS

Diesel fuel is an important resource at your mine worksite. In addition to powering heavy machinery, such as loaders, haul trucks, excavators, and drills, diesel generators are used for lighting, electrical equipment, and as backup power sources in case of an emergency.

Recommended Diesel Fueling Practices

While useful, diesel fuel creates exhaust that contains harmful contaminants, including sulfur compounds, which can be dangerous to your health. Reducing sulfur content helps lower these risks, making your environment safer to breathe in. Additionally, low sulfur fuel and EPA-approved additives reduce harmful emissions, contributing to cleaner air and less environmental pollution. Finally, when you use low sulfur fuel and approved additives, you can help maintain the efficiency and longevity of your equipment, reducing breakdowns and maintenance costs.

To ensure you are reducing the risk of harmful contaminants, be to follow MSHA's two guidelines for safer fueling practices:

1. The diesel fuel used for your underground equipment must have very low sulfur content (no more than 0.05%). You or another operator must keep records proving they bought this low-sulfur fuel for at least one year.
2. You and any other operator may only use fuel additives that are approved by the U.S. Environmental Protection Agency in diesel equipment used underground.

Maintenance Standards for Diesel-Powered Equipment

You may have to bring equipment down into your underground mine to complete your work. If you use any diesel equipment underground, then you must be sure it is maintained properly by following these guidelines:

- If your engine is approved, then be sure it stays in approved condition.
- If your engine is not approved, then you must follow the manufacturer's maintenance guidelines for the engine's emission parts.
- Be sure your emission control devices on the equipment are working effectively.

Next, if you see that your equipment needs maintenance, then be sure to follow the **tagging and inspection requirements** below to ensure your equipment meets the maintenance standards outlined above.

- Your mine operator must allow you to put a visible, dated tag on the equipment if you see signs that it needs maintenance in order to follow the above standards. Signs include unusual smoke, odor, or other visible defects that affect emissions.
- Your tagged equipment must be checked by a *qualified* or *authorized* mechanic before the end of the next shift during which a qualified mechanic is scheduled to work. The tag must stay on until the check is complete.
- Your mine operator must keep a log of tagged equipment, including the date tagged,

date checked, mechanic's name, and actions taken. This log must be kept for one year after the check.

- Workers, mechanics, or others authorized to maintain diesel equipment must be qualified by training or experience. Your mine operator must maintain records proving this competence for one year after maintenance to be shown to authorities upon request.

Standards for Diesel Engines

If you bring any diesel engine into an underground mine, except for engines in ambulances or firefighting equipment used in mine emergency plans, you must ensure that it meets the following requirements.

The equipment must:

- Have a plate showing the engine is approved according to federal regulations (these include testing several technical aspects of the engine, exhaust, and emissions, among others).
- Ensure that the engine meets or exceeds the Environmental Protection Agency's standards for particulate matter emissions. You can access a listing of these standards in the Module Resource Materials section.

These requirements for diesel equipment apply to:

- Engines in newly bought equipment
- Engines in used equipment brought into your mine
- Replacement engines with a different serial number than the old one

They do *not* apply to engines that were already part of the mine's collection and rebuilt or engines and equipment that were transferred between mines operated by the same company.

Exposure to Diesel Particulate Matter

As we have mentioned, the exhaust from diesel engines contains a mixture of gases and very small particles that can create a health hazard when not properly controlled. In addition to sulfur, you could be exposed to **diesel particulate matter (DPM)** when working around diesel. DPM comes from diesel exhaust (DE) and includes carbon, ash, metallic abrasion particles, sulfates and silicates that can be harmful to your health. Even if you are exposed to high concentrations of DE/DPM for only a short while, you may experience headache, dizziness, and irritation of the eye, nose and throat. Your risk of cardiovascular, cardiopulmonary and respiratory disease and lung cancer may increase if your exposure to DE/DPM is longer.

Annual DPM Training

If you expect to come in contact with diesel emissions at your mine site, your mine operator is required to provide annual DPM training to you and all other miners. Your operator must also retain a record at the mine site of this training for one year after training completion. This training must cover the following topics:

1. The health risks associated with your exposure to DPM
2. The methods you can use to control DPM concentrations
3. Identification of the personnel responsible for maintaining those controls
4. Actions you must take to ensure the controls operate as intended

Federal Limits and DPM Compliance

There are regulations to help ensure that you are staying within acceptable, and under dangerous levels. These requirements are known as permissible exposure limits (PELs). MSHA has set, reviewed, and adjusted these limits for DPM several times since 2006. See the table below for a brief overview of these changes.

Historical Changes to DPM Exposure Limits

Limit	***Date***
308 micrograms of elemental carbon per cubic meter of air (308_{EC} µg/m^3)	May 20, 2006
350 micrograms of total carbon per cubic meter of air (350_{TC} µg/m^3).	January 20, 2007
160 micrograms of total carbon per cubic meter of air (160_{TC} µg/m^3).	May 20, 2008
*Limit = for an average 8-hour equivalent full shift airborne concentration	

Currently, as determined by MSHA in 2008, your exposure to DPM must not exceed 160 micrograms of total carbon per cubic meter of air (160 $_{TC}$ µg/m^3) over an eight-hour shift. This limit could change, and if it does, MSHA will announce it in the Federal Register, which is a daily publication of the U.S. federal government announcing new and proposed regulations, notice of hearings, and other documents.

DPM Exposure Monitoring

Your mine operator is responsible for checking the air regularly to make sure you are not breathing in too much DPM, as outlined in MSHA regulations above.

Additionally, you and your authorized mine representative are allowed to observe when air quality is checked. Your mine operator must let you know ahead of time when this will happen!

What happens if air quality checks indicate a problem?

If the air quality checks show that someone is breathing in too much DPM (as defined as exceeding 160 $_{TC}$ $\mu g/m^3$ over an eight-hour shift), your mine operator must quickly inform you about the problem by posting on the mine bulletin board, start taking action to fix it by the next work shift, and finish addressing the cause promptly.

The results of air quality checks for DPM, including any samples taken by the Secretary, must be posted on the mine bulletin board within 15 days of receiving them and stay there for 30 days. Your mine operator must also give a copy of the results to your authorized miner representative.

Your mine operator must keep records of air quality checks for five years from the date of sampling, including details of how they were done.

Diesel Particulate Records

The table below shows the records your mine operator must keep according to the regulations listed above, and how long they need to keep each record.

Diesel Particulate Recordkeeping Requirements

Record	***Retention time***	***Section Reference***
1. Approved application for extension of time to comply with exposure limits	Duration of extension.	57.5060(c)
2. Identity of PLHCP and most recent written determination of miner's ability to wear a respirator	Duration of miner's employment plus 6 months.	57.5060(d)
3. Purchase records noting sulfur content of diesel fuel	1 year beyond date of purchase.	57.5065(a)
4. Maintenance log	1 year after date any equipment is tagged.	57.5066(b)
5. Evidence of competence to perform maintenance	1 year after date maintenance was performed.	57.5066(c)
6. Annual training provided to potentially exposed miners	1 year beyond date training completed.	57.5070(b)
7. Record of corrective action	Until the corrective action is completed.	57.5071(c)
8. Sampling method used to effectively evaluate a miner's personal exposure, and sample results	5 years from the sample date.	57.5071(d)

If a record needs to be kept at your mine worksite, your mine operator can store it elsewhere, as long as they can quickly access it electronically from the mine site.

If the Secretary of Labor, the Secretary of Health and Human Services, or a representative of miners asks, your mine operator must promptly grant access to any record listed in the above table.

Your mine operator must allow you, as well as former miners or their representatives with written consent, to view any record required by 57.5071 or 57.5060(d) if it pertains to you. Remember that 57.5071 is about exposure monitoring, or your right to observe sampling, your right to be notified of exposure, and your right to see the results of monitoring, including corrective action. The second regulation, 57.5060(d), refers to the *mine operator's requirement* to take measures to reduce your exposure to DPM.

The first copy must be provided to you at no cost, with any additional copies available to you for a reasonable fee.

If your mine operator stops operating, they must transfer all required records to any successor operator, who must maintain them for the required period!

Accountability and Compliance to Meet DPM Levels

Let's imagine that you are working at a mine worksite, and your operation finds that your exposure is exceeding these levels. However, they are not able to address this just yet. *Then what?*

If your mine operator needs more time to meet the final DPM limit because of technical or financial issues, they can apply for a special extension from the District Manager.

Your mine operator must certify that they posted a copy of the application at the mine worksite for at least 30 days before applying and give a copy to your authorized miners representative.

If approved, the extension cannot last more than one year from the date of approval. Your operator can apply for more extensions, but each one cannot be longer than a year. The application must include:

- Proof that is not currently possible to meet the DPM limit due to technical or financial reasons.
- The latest DPM monitoring results.
- Steps your mine operator will take to reduce your and other miners' exposure to DPM during the extension.

Your mine operator must follow the terms of the approved extension, post the approved extension at the mine for the entire period, and give a copy to your authorized miner representative.

Compliance Determination Procedures

To ensure your mine worksite is staying compliant with DPM exposure limits, MSHA will determine if the DPM limit is not being met based on a single sample collected and analyzed by the Secretary according to the below requirements.

The Secretary of Labor will collect DPM samples using a special dust sampler and analyze them for elemental carbon using the NIOSH method 5040. The Secretary may also use other NIOSH-approved methods that provide equal or better accuracy and will use samples taken over a full work shift to check for compliance.

Controls that Your Mine Worksite Should Take

Additionally, your mine operator must use feasible methods to reduce your exposure to DPM to the safe limit. If these methods do not work well enough, are not possible, or do not lower DPM levels much, your operator must still try to reduce exposure as much as they can. Your mine cannot just rotate miners to meet the DPM standard—they need to find other ways to comply!

They should also provide you with respiratory protection if needed. Your respirators must have:

- Filters approved by NIOSH for being highly effective at trapping particles (HEPA filters).
- Filters approved by NIOSH as being 99.97% efficient.
- Filters approved by NIOSH specifically for DPM.

Respirators without power that use suction to filter air must use filters labeled R or P, or any filter approved by NIOSH for DPM. An R-series filter should only be used for one work shift.

If respirators become necessary for you to complete your work, your mine operator must arrange for a private medical check-up by a physician or licensed healthcare professional (PLHCP) at no cost to you, to see if you can use a respirator before you are required to wear one at your mine worksite. Here is how it works:

- If the doctor decides you cannot use a regular respirator, they will check if you can use a powered one.
- You will get a chance to talk with the doctor about your check-up results before they give them to the mine operator. If you do not agree with the PLHCP's decision, you can send additional evidence of your health or concerning medical conditions within 30 days.
- Your mine operator will get a written decision from the doctor about whether you can wear a respirator, and they must give you a copy.
- If conditions change at your mine that might affect your ability to wear a respirator, you will be reevaluated.
- If your PLHCP says you cannot wear a respirator, including a powered one, you will be moved to a different job in the mine where you do not need one. This should happen within 30 days, and you will still get paid the same. Any increased wages must be based on a new work classification.
- Your mine operator will keep a record of the doctor's name and their determination of your ability to wear a respirator for as long as you work there, plus six months.

Great! You now understand federal regulations on diesel fuel and engines, as well as the importance of testing, monitoring, recording, and protecting against DPM.

Airborne Hazards and Respiratory Devices Conclusion: 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:

- Demonstrate an understanding of the basic processes for monitoring respirable dust levels at mine worksites, including the selection and use of approved sampling devices, calculation of equivalent concentration of respirable dust, and recognition of designated areas and occupations for focused monitoring and control of dust exposure risks.
- Identify and describe restricted chemical substances commonly encountered in mining operations and implement protective measures against such hazards.
- Implement methods of protection against radiation and DPM, such as sampling, monitoring, record keeping, and using respirators.
- Apply recommended diesel fueling practices and maintenance standards for diesel engines to ensure safe and efficient operation of machinery at your mine worksite.
- Use and maintain personal protective equipment (PPE), such as SCSRs and respirators, to mitigate exposure to harmful chemicals and contaminants in mine worksites.

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 Airborne Hazards and Respiratory Device Concepts and Definitions

- **Active workings**: Areas where miners are required to work or travel.
- **American National Standards Institute (ANSI)**: Non-profit organization overseeing the development of voluntary consensus standards in the United States, influencing best practices for safety equipment, processes, and environmental guidelines.
- **Approved sampling devices**: Devices sanctioned by regulatory agencies to measure the concentration of respirable dust in the air during mining activities.
- **Asbestos**: An airborne hazard and type of mineral that breaks down into tiny, flexible fibers when crushed or worked with.
- **Assigned protection factor (APF):** The level of respiratory protection expected from a respirator or class of respirators in the workplace when a continuous and effective respiratory protection program is implemented by the employer.
- **Certified person**: Individual authorized by regulatory authorities to conduct respirable dust sampling.
- **Coal Mine Dust Personal Sampler Unit (CMDPSU)**: An approved sampling device used in coal mines to monitor dust levels during work shifts, collecting samples of respirable dust for analysis.
- **Concentration**: A measure of the amount of a substance contained per unit volume of air.
- **Continuous Personal Dust Monitor (CPDM)**: An approved device that continuously monitors dust exposure throughout a work shift, providing real-time data on dust levels.
- **Designated area (DA)**: A specific spot in the mine selected in the ventilation plan where samples are taken to check dust production in active workings or areas where miners are required to work or travel.
- **Designated occupation (DO)**: Indicates a specific job or task on an MMU identified as having the highest respirable dust concentration.
- **Diesel particulate matter (DPM)**: A component of diesel exhaust (DE) that includes soot microparticles made up primarily of carbon, ash, metallic abrasion particles, sulfates, and silicates.
- **End-of-service-life indicator (ESLI):** A system that alerts the respirator user when adequate respiratory protection is nearing its end, such as when the sorbent is approaching saturation.
- **Equivalent concentration**: Represents the amount of respirable dust (including quartz) breathed in while working in a coal mine, measured as the substance contained per unit volume of air.
- **Federal Mine Safety and Health Act of 1977**: Foundational legislation outlining safety standards and regulations for mining work.
- **Fit factor:** An estimate of how well a respirator fits a specific individual, typically indicating the ratio of ambient air concentration to concentration inside the respirator during use.

- **Fit test:** A procedure to assess respirator fit on an individual, conducted either qualitatively or quantitatively.
- **Gamma radiation**: Similar to the electromagnetic radiation found in X-rays, gamma rays are radioactive, invisible, and can pass through most material, including human tissue.
- **Gamma radiation dosimeter**: A special device used to measure your exposure to radiation if levels are higher than 2.0 milliroentgens per hour in a work area.
- **Maximum use concentration (MUC):** The highest atmospheric concentration of a hazardous substance providing protection to the wearer based on the respirator's assigned protection factor and exposure limit.
- **Mechanized mining unit (MMU)**: Heavy machinery or mining equipment for material production.
- **Mine Safety and Health Administration (MSHA)**: Federal agency responsible for administering and enforcing safety standards, conducting inspections, and providing guidance to ensure safe mining practices nationwide.
- **Mining Research Establishment (MRE) instrument**: The first device used for dust sampling, and often considered the standard for determining equivalent sampling devices.
- **National Institute for Occupational Safety and Health (NIOSH)**: Conducts research, develops guidelines, and provides recommendations to improve occupational health and safety practices.
- **Other designated occupation (ODO)**: Additional task on an MMU besides the main one designated for sampling.
- **Phase contrast microscopy (PCM)**: The first technique used when checking for the presence of asbestos.
- **Production shifts**: A shift in which material is produced.
- **Quartz**: Problematic material found in respirable dust in coal mines.
- **Radon**: An odorless, invisible radioactive gas found when uranium undergoes radioactive decay.
- **Radon daughters**: Particles formed when radon undergoes radioactive decay.
- **Representative dust sample**: A typical dust concentration level in a given area, expressed as an equivalent concentration.
- **Respirable dust**: Dust posing a health risk if inhaled into the lungs.
- **Secretary/Secretary of Labor**: Member of the President’s Cabinet and head of the Department of Labor.
- **Working level months (WLM)**: A unit of measurement calculated based on exposure rounded to half-hours and the average concentration of radon daughters present.

Particulate Matter Emission Requirements of the Environmental Protection Administration

EPA requirement	*EPA category*	*Particulate Matter Limit*
40 CFR 86.094-8	light duty vehicle	0.1 g/mile
40 CFR 86.094-9	light duty truck	0.1 g/mile
40 CFR 86.094-11	heavy duty highway engine	0.1 g/bhp-hr
40 CFR 89.112	nonroad (tier, power range)	varies by power range:
	tier 1 kW<8 (hp<11)	1.0 g/kW-hr (0.75 g/bhp-hr)
	tier 1 8≤kW<19 (11≤hp<25)	0.80 g/kW-hr (0.60 g/bhp-hr)
	tier 1 19≤kW<37 (25≤hp<50)	0.80 g/kW-hr (0.60 g/bhp-hr)
	tier 2 37≤kW<75 (50≤hp<100)	0.40 g/kW-hr (0.30 g/bhp-hr)
	tier 2 75≤kW<130 (100≤hp<175)	0.30 g/kW-hr (0.22 g/bhp-hr)
	tier 1 130≤kW<225 (175≤hp<300)	0.54 g/kW-hr (0.40 g/bhp-hr)
	tier 1 225≤kW<450 (300≤hp<600)	0.54 g/kW-hr (0.40 g/bhp-hr)
	tier 1 450≤kW<560 (600≤hp<750)	0.54 g/kW-hr (0.40 g/bhp-hr)
	tier 1 kW≥560 (hp≥750)	0.54 g/kW-hr (0.40 g/bhp-hr)
Key: "g" means grams, "hp" means horsepower, "g/bhp-hr" means grams/brake horsepower-hour, "kW" means kilowatt, "g/kW-hr" means grams/kilowatt-hour.		

Restricted Use of Chemicals Reference List

Carbon tetrachloride is a man-made chemical, found as a clear liquid with a sweet odor or in the air as an odorless gas. It was once used in various products like refrigerants, pesticides, and cleaning agents, but its harmful effects led to bans on many of its uses. Now, it's primarily limited to industrial applications due to its health risks.

Phenol, also known as carbolic acid, is a chemical that looks like white crystals and can easily turn into a gas. It is very aromatic, is somewhat acidic, and can be dangerous if not handled carefully because it can cause burns on your skin. Industrially, phenol is often converted into plastics or related materials.

4-Nitrobiphenyl looks like a white to yellow crystalline solid, shaped like needles, with a slightly sweet odor. It is no longer manufactured or used in the United States, but it could be present in international mining operations or hazardous waste.

Alpha-naphthylamine, also known as 1-Naphthylamine, is a sand-like substance, either white or yellow in color, that turns purplish-red when exposed to air. It is utilized in the production of dyes and rubber, as well as for weed control.

4,4-Methylene Bis (2-chloroaniline), also known as MBOCA, is a synthetic chemical mainly used in making polyurethane products. It typically appears as yellow, tan, or brown pellets and is odorless and tasteless. Products containing MBOCA include gears, gaskets, shoe soles, belt drives in electronics, wheels and pulleys for escalators and elevators, and various military applications. MBOCA is also used to set glues, plastics, and adhesives.

Methyl-chloromethyl ether is a clear, colorless liquid with vapor denser than air. It can irritate the eyes and lungs, and is highly toxic if inhaled, ingested, or absorbed through the skin. This chemical is used in some manufacturing processes and is known to cause severe short-term health effects. The EPA classifies it as a known human carcinogen.

3,3 Dichlorobenzidine is a gray to purple, sand-like powder that was once utilized in the production of dyes and pigments, as well as a curing agent for plastics. Due to its classification as a probable carcinogen, it is no longer used for dye manufacturing in the United States.

Bis(chloromethyl) ether is a clear, man-made liquid with a very unpleasant smell. It mixes easily with water but breaks down quickly and turns into gas in the air. It has been used to make plastics and textiles, but now it is rarely used because it is very restricted. Only small amounts are made in the U.S., and they are used in tightly controlled systems to make other chemicals. Sometimes, small amounts of this substance can also accidentally form when making another chemical called chloromethyl methyl ether.

Beta-naphthylamine, also known as 2-Naphthylamine, is a flaky solid, ranging from white to reddish in color. It will slightly dissolve in hot water and is denser than water itself. It is hazardous if you ingest, inhale, or touch it. You will find it in the production of dyes and agricultural chemicals.

Benzidine is an odorless, white to slightly red crystalline (sand-like) contaminant that is now banned in the US except for specialty uses. In the past, American industries used it to produce dyes for paper, clothes, and leather. You can be exposed by wearing benzidine-dyes clothing or if you inhale or touch contaminants during mining activities.

4-Aminodiphenyl is a colorless to light brown sand-like powder that has a floral smell. It can turn purple when exposed to air. It was used as an antioxidant for rubber and a dye intermediate but is now used for cancer research purposes as a model carcinogen. You can also be exposed to it through cigarette smoking or secondhand tobacco smoking.

Ethyleneimine is a colorless liquid that has an ammonia-like odor. It has been used in polymerization products, such as plastics, rubbers, and resins, and in adhesives and binders. It is very corrosive and can cause third degree chemical burns.

Beta-propiolactone is a colorless liquid with a slightly sweet, pungent odor. It acts as a great disinfectant and sterilant for blood plasma, tissue grafts, vaccines, enzymes and surgical instruments. However, if you do not handle it properly, it can cause irritation, burns, and blistering.

2-Acetylaminofluorene looks like a white powder or a tan solid. It was produced as a pesticide, but now it is only used in laboratory research. It is a known carcinogen.

4-Dimethylaminobenzene has yellow, leaf-shaped crystals. You will find it as a dye for polishes, soap, and wax products. Little is known about its long-term effects on health, but it has been known to affect your skin, eyes, and lungs when you are exposed.

N-Nitrosodimethylamine is a yellow liquid with no apparent odor. It is only used for industrial or research purposes after it was used to make rocket fuel with harmful levels found in nearby air, water, and soil. This chemical can also be used in some cosmetic, toiletry, and cleansing products. It is often unintentionally produced in manufacturing processes. Be sure you do not swallow or inhale this chemical, as it is toxic and often fatal.

Developing a Mine Ventilation Plan

A mine ventilation plan helps ensure the safety and productivity of underground mining operations. The tips and best practices below outline the essential components to consider for a comprehensive ventilation plan. For a detailed list of mine ventilation plan regulations, see 30 CFR 75.371.

Mine Identification and Submitting Party

- Include the mine name, company name, mine identification number.
- List the name of the person submitting the plan.

Main Mine Fan Stoppages

- Outline planned and scheduled stoppages of main mine fans, excluding those for testing, maintenance, or adjustment.
- Include procedures for stoppage and restart.

Protection from Underground Explosions

- Detail methods to protect main mine fans and associated components if a 15-foot offset from the mine opening cannot be maintained.
- Specify precautions for main mine fans and intake air openings if combustible materials are within 100 feet.

Authorized Personnel, Access Control, and Electric Power Circuits

- List individuals allowed to enter the mine and describe their assigned tasks.
- Provide details if backup fan systems differ from the main fan system in ventilating capacity. Specify who will access these systems.

Ventilation Systems, Devices, and Booster Fans

- Specify section and face ventilation methods and minimum air delivery for each mechanized mining unit.
- Detail dust suppression systems on equipment, including types, locations, and operational details.
- Describe locations and operational conditions of booster fans installed in anthracite mines.
- Identify locations of ventilation devices and construction sequence for seals in worked-out areas.

Air Quantity Requirements

- Identify locations requiring air quantities exceeding specified thresholds (e.g., 3,000 cubic feet per minute).
- Specify minimum air quantity at working places not actively involved in coal cutting, drilling, or loading.

- Outline air quantity needs and ventilation specifics unique to anthracite mines, if applicable.
- Detail required air velocities on longwall or shortwall faces and locations for measuring velocities.

Air Quality Control Measures

- Describe machine-mounted dust collectors and maintenance procedures.
- Recommend operator practices to minimize dust exposure.
- Specify locations and frequencies for methane and dust tests. Describe control systems at underground dumps, crushers, and haulageways.
- Specify locations for methane and oxygen concentration measurements and airflow direction tests.
- Detail locations of carbon monoxide sensors and methods for maintaining ambient levels.
- Provide details of bleeder system design, effectiveness evaluation methods, and maintenance procedures, if used.

Spontaneous Combustion Measures

- Describe methane, carbon monoxide, and oxygen monitoring during and after pillar recovery to mitigate spontaneous combustion.
- Outline hazard control methods if bleeder systems are not used.

Escapeway Protections

- Specify dimensions and maintenance locations for escapeways.
- Outline air velocity requirements in trolley haulage entries.

By implementing these guidelines, mine operators can effectively manage ventilation systems to create a safe working environment underground. Remember, regular updates and reviews of the ventilation plan are essential to adapt to changing mine conditions and maintain compliance with safety regulations!

Simplified Airborne Hazards and Respiratory Rules and Corresponding Code of Federal Regulations Listing

- **Airborne contaminant levels.** These should not exceed the threshold limit values set by the American Conference of Governmental Industrial Hygienists (ACGIH) based on a time-weighted average. [56.5001a and 57.5001a]
- **Full-shift limit.** A miner's exposure to asbestos should not exceed an average of 0.1 fiber per cubic centimeter of air over an 8-hour shift. [56.5001b and 57.5001b]
- **Excursion limit.** At no time should a miner be exposed to more than 1 fiber per cubic centimeter of air, averaged over 30 minutes. [56.5001b and 57.5001b]
- **Measurement of airborne asbestos fiber concentration.** Use phase contrast microscopy (PCM) based on OSHA's asbestos standard or an equivalent method. If PCM results indicate potential exposure above limits, further analysis with transmission electron microscopy or an equivalent method is required. [56.5001b and 57.5001b]
- **"C" designation.** Employees must leave areas where the concentration of an airborne contaminant with a "C" designation exceeds its threshold limit. [56.5001c and 57.5001c]
- **Exposure monitoring.** Surveys for dust, gas, mist, and fumes must be done regularly to ensure control measures are working. [56.5002 and 57.5002]
- **Control methods.** Control employee exposure to harmful airborne contaminants by preventing contamination, using exhaust ventilation, or diluting with clean air. If these methods are not practical, employees may work in higher concentrations if they use proper respiratory protective equipment. [56.5005 and 57.5005]
- **Respirator use.** Respirators must be approved and suitable for their intended use. Employees must use these respirators following their training and instructions. [56.5005a and 57.5005a]
- **Respirator program.** Follow a respirator program based on ANSI standards. This includes selection, maintenance, training, fitting, supervision, and cleaning. [56.5005b and 57.5005b]
- **Emergency situations.** In atmospheres immediately harmful to life, at least one other person with backup equipment must be present to assist in case of respiratory equipment failure. [56.5005c and 57.5005c]
- **Restricted use of chemicals**. These chemicals can only be used or stored by skilled people in approved laboratory conditions set by a nationally recognized agency acceptable to the Secretary. [56.5006 and 57.5006]
- **Oxygen deficiency.** The air in all active work areas must have at least 19.5% oxygen. [57.5015]
- **Radon daughter exposure monitoring.** In all mines, a qualified person must take at least one air sample from the mine's exhaust to check for radon daughters using proper equipment and procedures. There are specific procedures for uranium and non-uranium mines, as well as steps to take when radon daughters exceed set thresholds. [57.5037a and 57.5037b]
- **Radon daughter recording.** Record the date, location, and results of all samples. Keep these records at the mine site or nearest mine office for at least two years. They must be available for inspection by the Secretary or their representative. [57.5037c]

- **Annual exposure limits.** No one is allowed to be exposed to more than 4 Working Level Months (WLM) of radon daughters in any calendar year. [57.5038]
- **Maximum permissible concentration.** Except as allowed by 57.5005, no one should be exposed to radon daughter concentrations over 1.0 Working Level (WL) in active work areas. [57.5039]
- **Exposure records.** Procedures for calculating and recording exposure in uranium and non-uranium mines. [57.5040a]
- **Maintaining Exposure Records.** Use "Record of Individual Exposure to Radon Daughters" (Form 4000-9) or an equivalent form. Update, maintain, keep records available for inspection as specified, and submit a copy to the Mine Safety and Health Administration (MSHA). [57.5040b]
- **Smoking prohibition.** Smoking is not allowed in any area of the mine where exposure records are required. [57.5041]
- **Revised exposure levels.** If the Environmental Protection Agency (EPA) recommends and the President approves new permissible exposure levels for radon daughters, employees must not be exposed to levels above these new limits after the effective dates set by the EPA. [57.5042]
- **Respirators.** In areas with radon daughter concentrations exceeding 1.0 Working Level (WL), miners must wear NIOSH-approved respirators for radon daughters. These respirators must also comply with federal regulations. [57.5044]
- **Posting of inactive workings.** Inactive areas with radon daughter concentrations above threshold limits must have signs warning against unauthorized entry and indications that approved respirators must be worn. [57.5045]
- **Protection against radon gas.** In areas where radon daughter concentrations exceed threshold limits, additional protection against radon gas is required. This can be provided by supplied air devices or face masks with absorbent material to remove both radon and its daughters. [57.5046]
- **Gamma radiation surveys.** Annual gamma radiation surveys are required in all underground mines where radioactive ores are mined. Surveys must follow standard procedure. If average gamma radiation levels exceed thresholds, gamma radiation dosimeters must be provided to all affected individuals, and records of cumulative individual gamma radiation exposure must be kept. Annual individual gamma radiation exposure must not exceed 5 rems. [57.5047]
- **Limit on exposure to diesel particulate matter.** A miner's exposure to diesel particulate matter (DPM) in an underground mine must not exceed federal limits. If a mine needs more time to meet the final DPM limit due to technical or economic issues, the operator can follow the procedures in this regulation to apply for a special extension. The mine operator must use engineering and administrative controls to reduce DPM exposure to or below the limits. If these controls are not enough, the operator must follow the procedures to ensure respiratory protection. Rotating miners to different jobs to reduce DPM exposure is not an acceptable control method. [57.5060]
- **Compliance determinations.** MSHA will use one sample collected and analyzed according to this rule as enough evidence to decide if there's a breach of the DPM limit. [57.5061]

- **Fueling practices**. Diesel fuel used to power equipment underground must have sulfur content no higher than 0.05 percent. Operators must keep purchase records for at least one year. Only fuel additives registered by the U.S. Environmental Protection Agency can be used in diesel-powered equipment underground. [57.5065]
- **Maintenance standards.** Diesel-powered equipment used underground must adhere to maintenance standards to ensure good condition and emissions protections. [57.5066]
- **Authorized people.** People authorized to maintain diesel equipment must be qualified through training or experience to meet these maintenance standards. Operators must keep evidence of their competence for one year after maintenance and provide it upon request to MSHA.
- **Engines**. Diesel engines brought into an underground mine area after July 5, 2001, except for those in ambulances or firefighting equipment used as per fire safety plans, must display a plate showing it is approved and meet or exceed the Environmental Protection Administration's particulate matter emission standards. [57.5067]
- **Miner training.** Mine operators must provide yearly training to all miners at a covered mine who could reasonably come into contact with diesel emissions on site. This training must cover specific topics to reduce health risks to miners. [57.5070]
- **Exposure monitoring**. Mine operators must monitor DPM exposure as often as necessary to determine if miners' average full-shift exposure exceeds the limit set in the regulations, considering typical mine conditions. Miners and their representatives must be given the opportunity to observe this monitoring. If monitoring shows a miner's DPM exposure exceeds the limit, the operator must follow procedures to notify and correct the problem promptly. [57.5071a-c]
- **Results of DPM monitoring.** Results must be posted on the mine bulletin board within 15 days of receipt and kept there for 30 days. The operator must provide a copy to the miners' authorized representative. The operator must retain DPM sampling results and sampling method details for five years from the sampling date. [57.5071d]
- **Diesel particulate records.** The "Diesel Particulate Matter Recordkeeping Requirements" table outlines records operators must maintain with specified retention durations. [57.5075]