NEW MINER & ANNUAL REFRESHER TRAINING STUDENT GUIDE

VERSION I

Author: Lowell Institute for Mineral Resources
University of Arizona
March 2016

ACKNOWLEDGEMENTS

ALPHA Foundation for the Improvement of Mine Safety and Health Grant AFC113-6

Parts of this study were sponsored by the ALPHA Foundation for the Improvement of Mine Safety and Health, Inc. (ALPHA FOUNDATION). The views, opinions and recommendations expressed herein are solely those of the authors and do not imply any endorsement by the ALPHA FOUNDATION, its Directors and Staff.

CONTENTS

Acknowledgements **2**
Pre Test **10**
Introduction to Miners' Rights **19**
Your Rights under the Act 19
Every Miner's Responsibilities under the Act 19
Discrimination 20
Inspections 20
Right to Pay 20
Contesting Enforcement Actions 20
Training 21
Health 21
Information 21
Legal Responsibilities 21
Supervisor Responsibilities 22
Rules to Live By 22
Miners' Rights Quiz **23**
Introduction to Communication **24**
Handheld Communication Devices 24
Signage 25
Non-verbal communication 25
Flagging and Tagging 26
Removing Flagging and Tagging 26
Incident Management 27
Emergency alarms 27
Communicating Emergencies 27
Determining Emergency Response 28
Other Non-Emergency Procedures 28
Coal Mine maps 28
Communication Quiz **30**
Introduction to Transportation **31**
Light Vehicle Inspections 31
Exterior Conditions 31

Safe Operating Speeds and Control of Equipment 34
Parking Procedures and Brake Performance 35
Parking Brake 35
Transportation Quiz 37
Introduction to Health and Hazard Communication 38
Hearing Protection 38
Health Effects 39
Monitoring Noise Exposure 40
Audiometric Testing 41
Hearing Conservation Program 42
Silicosis 42
Chemical Hazards 43
Forms of Chemicals 44
Routes of Exposure 44
Toxic Effects of Chemicals 46
Types of Health Effects from Exposures to Toxic Chemicals 46
Chronic Exposure 47
Chemical Labels 47
Material Safety Data Sheet or Safety Data Sheets 48
NFPA 704 Health Diamond 50
HMIS and HMIS III 51
Personal Hygiene 58
Health & Hazard Communication Quiz 59
Introduction to Hazard Recognition 60
Consequence Thinking 60
Identifying and Evaluating Hazards and Risks 60
Broad Categories of Hazards 60
Identifying Hazards 61
Area Inspections 61
Standard Operating Procedures (SOPs) 61
Job Safety Analysis 62
Hazard Identification, Risk Assessment and Determination of Controls (HIRADC) 62
Reducing Risk – Hierarchy of Controls 62
Hazard Control Strategies 63

Hazard Recognition Quiz **65**
Introduction to First Aid safety **66**
Scene Safety 66
Emergency Response 66
Triage 68
Personal Safety 68
Bleeding 68
Other Injuries 69
Shock 69
Burns 70
First Aid Safety Quiz **71**
Evacuation Plans & Fire Safety **72**
Mine Plans 72
Underground Emergency Evacuation 73
Barricading 73
Refuge Chambers 73
Underground Evacuation Drills 73
Fire Safety 74
Fuel Classifications 74
Fire Prevention 74
Fire Extinguishers 75
Fighting Fire 75
Emergency Action Plan 76
Evacuate a Burning Building 77
Stop, Drop, & Roll 77
Underground Fires 77
Evacuation Plans & Fire Safety Quiz **78**
Introduction to Personal Protective Equipment (PPE) **79**
Personal Protective Equipment (PPE) Basics 79
Selection and Fit 80
PPE Condition and Inspection 80
Donning and Removing PPE 81
Monitoring Harmful Airborne Contaminants 90
Before Wearing a Respirator 90

Training 91
Selecting the Type of Respirator 91
Inspecting, Cleaning and Storing Respirators 98
Personal Protective Equipment (PPE) Quiz 100
Self-Rescue & Respiratory Devices 101
Respirators 101
Air Purifying Respirators 101
Atmosphere-Supplying Respirators 102
Physical Requirements 104
Fit Test 104
Cartridge Respirators 105
Maintenance 105
Self-Rescuer (Underground) 106
Regulatory Requirements 106
Discard Conditions 106
Operation of the Self-Rescuer 108
Self-Rescue & Respiratory Devices Quiz 109
Introduction of Dust Control 110
Black Lung (COAL) 111
Surface Risks 111
Silicosis 111
Mine Operators' Responsibilities 111
Dust Controls 112
Dust Control Safety Quiz 115
Ground Control 116
Surface 116
Spoil Embankments 116
Highwall Hazards 116
Signs of Potential Slope Failure 117
Approaching Highwalls 117
Water Hazards 118
Seepage 118
Berms, Guardrails, and Travelways 118
Illumination and Night Work 119

Housekeeping 119
Underground 119
Scaling 119
Underground coal 120
Underground metal 121
Ground Control Quiz 122
Introduction to Mine Gases 123
Gas Concentration 123
Gas Properties 123
Gas Types 124
Effects of Noxious Gases 124
Carbon Dioxide (CO_2) 124
Toxic Gases 124
Explosive Gases 126
Controls 126
Mine Gases Quiz 127
Introduction to Mine Ventilation 128
Principles of Airflow 128
Friction Pressure 128
Shock Loss 128
Blowing Fan 128
Mine Ventilation Plan 130
Mine Ventilation Quiz 131
Introduction to General Electrical Safety 132
General Electrical Safety 132
Conductor 132
Insulator 132
Current 132
Voltage 133
Dangers of Electrical Shock 133
Electrical Burns 134
Electrical Fires/Explosions 134
Arc Flash 135
Electrical Fires 135

Recognizing Electrical Hazards 135
Overhead Power Line Hazards 135
Electrical Wiring, Component Hazards and Inspections 136
Ground-Fault Circuit Interrupter (GFCI) 136
Annual Cord Inspections 137
Fuses and Breakers 137
Hand Tools 138
Electrical Cords 138
Shovel Cables 139
General Electrical Safety Quiz 140
Introduction to Explosives & Blasting 141
Explosives and Blasting 141
Drill Holes 141
Blasting Equipment 141
Blasting Perimeter 142
Blast Warning 142
Explosive Hazards 143
Blasting Operations General Code of Safe Practices 143
Explosives & Blasting Quiz 145
Introduction to Working at Heights (General Hazard Awareness) 146
Working at Heights 146
Falls from the Same Level 146
Falls from Heights 147
Working from Ladders 148
Open-Holes in Walkways 148
Open-Hole Permit 150
Barricading/Guarding 150
Handrail Specifications 151
Working at Heights (General Hazard Awareness) Quiz 152
Introduction to Confined Space (General Hazard Awareness) 153
Confined Spaces 153
The Three Criteria 154
Warning Signs 155
Confined Space (General Hazard Awareness) Quiz 156

Post Test **157**
Glossary of Common Mining Terms **166**

PRE TEST

Miners' Rights

1. Name two of your rights under the Federal Mine Safety and Health Act of 1977 on the lines below.

2. Which section of the 30 CFR can you find training requirements?

3. What are your responsibilities under the Federal Mine Safety and Health Act of 1977 Act? Select all that apply.

    a. Provide truthful statements and representations during inspections or investigations.
    b. Protect others against discrimination
    c. Comply with all Federal and State laws and regulations.
    d. Notify the operator, supervisor or other responsible person when refusing to work in unsafe or unhealthy conditions.

Communication

1. Name two forms of communication used at a mine site.

2. Mark is a mechanic at an underground coal mine. His supervisor, Gerry, has asked him to take a look at a continuous miner that stopped running inside the mine at around 14:00 hours. To perform his work, he will likely enter and exit his work area multiple times to get tools and communicate with his supervisor via page phone. In order to properly alert other workers to this hazard and his work, he should:

    a. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair.
    b. Be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.
    c. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 14:00 hours.
    d. Flag the area, but does not need to tag it.
    e. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 200' level.
    f. Flag it, and be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.

3. As defined earlier, which of the following situations do NOT constitute a medical emergency (select all that apply):
    a. Chest pains (any)
    b. Broken bone
    c. Difficulty breathing
    d. Altered mental status/unconsciousness
    e. Seizures
    f. Neck/back pain
    g. Severe bleeding
    h. Major trauma

Transportation

1. Anytime vehicles rated at 1 ton or higher are left unattended, they (select all that apply):
    a. Must be set to 'Park'
    b. May need to have their headlights turned on for safety
    c. May need to be chocked, unless parked into a parking windrow or ditch.
    d. Must have the wheels turned into berm or bank when parked on a slope.

2. When operating a piece of equipment, operators shall:
    a. Work as fast as their machine will go
    b. Maintain control of the equipment
    c. Utilize operating speeds that are consistent with travel way conditions and the type of equipment
    d. All of the above
    e. B&C

3. You do not need to wear a seat belt in a company vehicle when:
    a. You are operating a piece of equipment
    b. Are driving a haul truck
    c. Are a passenger in a haul truck
    d. None of the above

Health and Hazard Communication

1. How _____, how _____, and how _____ you are exposed typically influences the amount of a chemical or energy that enters the body, which is called the _____.

2. The four ways that chemicals can enter the body are:

3. Will is a mine contractor who has been tasked with applying an epoxy to a drop-chute at an iron mill. Before working with the chemical what should he do so that he understands the hazards? Select all that apply.
    a. Read the epoxy's Material/Safety Data Sheet.
    b. Read the health effects listed for it on Wikipedia.
    c. Read the hazard label on the epoxy container.
    d. Smell the epoxy.
    e. Read about others' experience with it on a discussion forum.

Hazard Recognition

1. What are the three steps in Consequence Thinking?
    a._____
    b._____
    c._____

2. What should you do if you are not familiar with the safety issues concerning your current task?
    a. Report to your supervisor and discuss ways to safely complete the work
    b. Continue working
    c. Leave the job unfinished
    d. Allow someone else to complete the job

3. Mike is an experienced continuous miner operator who is concerned he is beginning to experience hearing loss, and begins to think about ways to prevent himself from being exposed to noise. He is aware of the following potential controls: a) Enclosed cabins, b) Hearing protection, c) Remotely controlled equipment, d) Job task rotations, e) New equipment with bits that produce less noise. Match each control with its corresponding control category, and in order of effectiveness, by writing it on the lines below.

Most effective	_____	Elimination
More Effective	_____	Substitution
Somewhat Effective	_____	Engineering
Less Effective	_____	Administrative
Least Effective	_____	Personal

First Aid

1. First aid is the _____ and _____ care given to the sick and injured. The purpose of first aid is to provide _____ to injured individuals on mine property until _____ can be obtained.

2. Suzie works at a coal mine crushing facility as a shift supervisor. One of her crew members is seriously injured when a piece of equipment's hydraulic system fails, and his arm is crushed beneath it. When she responds to the scene she remembers the acronym SAMPLE, and that she needs to ask him about any (M) medications he may be taking. What other information should she gather while they wait for the emergency response team? Select all that apply.

   a. What his last meal was
   b. Any allergies he has
   c. How much pain he is experiencing
   d. His pre-existing medical history
   e. Any events that might be important for medical personnel to be aware of
   f. Any signs and symptoms he has or feels
   g. If he feels nauseous or in shock

3. The three steps that can control bleeding are:

Evacuation Plans and Fire Safety

1. What does P.A.S.S. stand for?
   P_____
   A_____
   S_____
   S_____

2. Carlos is an underground coal mine operator with ten years of experience. For the first time that he has been at the site, the emergency evacuation alarms begin blaring, and most of his crew members begin running towards their vehicles. He remembers that there are mine maps available at a nearby underground shop. What 1) should the map show that 2) could be helpful as his crew attempts to evacuate? Select all that apply.

   a. Fire doors
   b. Refuge chambers
   c. Locations of escape routes
   d. Principal air flow
   e. Ventilation doors
   f. Existing telephones

3. You come across a small electrical fire and it is blocking your means of escape. Prior to beginning work you performed a preshift and you know your fire extinguisher is capable of working to help you escape. So you reach for a _____ fire extinguisher to put the fire out.

Personal Protective Equipment (PPE)

1. Rob is a surface mine mill operator, and entrance to the mill requires the use of earplugs. Despite current noise controls, Rob has noticed that his hearing has been fading over time. What could be causing this? Select all that apply.
    a. Rob needs to learn how to better insert his earplugs.
    b. Rob has extra-ordinarily large ear canals and the standard earplugs just don't fit properly.
    c. Rob has extra-ordinarily small ear canals and wearing earplugs is uncomfortable, so he usually doesn't wear them.
    d. He doesn't usually wear his earplugs because they tend to get dirty and he gets concerned about hygiene.

2. Face shields must be used with _____ or _____.

3. This type of respirator uses a fan to blow air through the filter to the user.
    a. Full-face respirator
    b. Half-mask respirator
    c. Supplied air respirator
    d. Powered air-purifying respirator
    e. Self-contained breathing apparatus

Self-Rescue and Respiratory Devices

1. T/F I can wear a respirator that has just been handed to me, as long as it passes a positive and negative seal check.

2. Terry is an underground metal miner who needs to inspect his self-rescuer to be sure it is still in working condition. He checks the expiration date, and it has been 9 years since the date of manufacture, there is no in-service date listed. He cleans the device off and it weighs 843 grams – the manufacturer as-shipped weight reads 831 grams. The unit has is slightly dented, away from the seal. It does not appear to have caused a hole. Can Terry continue to use his SCSR?

3. It is important to have a functioning self-rescue device in an emergency. In order to maintain a functioning device follow proper _____ procedures.

Dust Control

1. Order these dust sizes from smallest to largest, and circle the most dangerous size: Inhalable, Total, and Respirable.

2. What is the MSHA exposure limit for respirable coal dust in surface and underground mines?
    a. 2.0 mg/m^3
    b. 1.5 mg/m^3
    c. 1.0 mg/m^3
    d. 0.5 mg/m^3

3. What are the three main types of dust controls?

Ground Control

1. Berms or guardrails must be (select all that apply):
    a. Made of a mixture of gravel and dirt
    b. Provided wherever a drop off could endanger individuals
    d. Effective in controlling fall/rollover hazards
    e. Mid-axle height of the largest vehicle traveling the road

2. Scaling involves the _____ of loose material from the roof, face and rib in hard rock mining.

3. Harry has been tasked with performing a visual inspection of the roof and ribs at the underground coal mine where he works. What should he look for? Select all that apply.
    a. Looking for bulges at the pillars' base
    b. Any stress cracks in the roof, floor or rib
    c. Abnormal rock formations such as kettlebottoms and clay veins
    d. A wet place that was formerly dry

Mine Gases

1. Match the occupational exposure limit with its definition:

a. Permissible exposure limit	1. Recommended exposure over 8-hr shift
b. Short-term exposure limit	2. Level that is 50% of PEL
c. Action limit	3. Allowable exposure over 15 minutes
d. Threshold Limit value	4. Point at which exposure can cause death
e. Recommended exposure limit	5. Allowable exposure over 8-hr shift
f. Immediately dangerous to life and health	6. Recommended exposure over 8-hr shift

2. Name 4 toxic gases that are encountered in mining:
    a. _____
    b. _____
    c. _____
    d. _____

3. What is the best engineering control for mine gases?

Mine Ventilation

1. What are the 2 main functions of mine ventilation?

2. What are 2 ways in which you can measure the airflow within the mine?

3. The pressure created by the fan and ventilation system must be great enough to overcome _____ and _____.
    a. positive; negative pressure
    b. frictional resistance; shock losses
    c. the outside wind; air generated by equipment
    d. shock losses; positive pressure

General Electrical Safety

1. Name 4 steps that should be taken if you discover an electrical hazard while working:
    a. _____
    b. _____
    c. _____
    d. _____

2. Hand-held tools can pose an electrical hazard. How can this hazard be minimized?
    a. properly maintain the piece of equipment
    b. always have 3 prongs
    c. wear gloves
    d. make sure the equipment is plugged into a grounded receptacle
    e. a, b, and c
    f. a, b, and d

3. What are the leading categories of on-the-job electrical death and injuries (circle all that apply)?
    a. contact with overhead power lines
    b. contact with electrical components
    c. contact with electric current of machine, tool or light fixture
    d. dropping tools in pools of water
    e. wiring and transformers

Explosives and Blasting

1. Unauthorized personnel/equipment should not be within ____ of blasting material or operation.
    a. 50 feet
    b. 100 feet
    c. 200 feet
    d. 250 feet

2. Vehicles carrying explosives must (choose all that apply):
    a. have signs
    b. be painted bright yellow
    c. have flags visible from all angles
    d. have fire extinguishers
    e. not be passed at any time

3. _____ will be given prior to a blast commencement. The minimal warnings begin _____ minutes and then a one minute follow-up warning. After the one minute warning, _____ and _____ are required to ensure there is clear uninterrupted communication.
    a. Radio and/or alarm warnings; five; radio silence; work stoppage
    b. Sirens; five; radio silence; loud music
    c. Radio and/or alarm warnings; ten; radio silence; work stoppage
    d. Sirens; ten; turning off your radio; work continuance

Working at Heights

1. Name 4 ways in which slips and trips can be prevented:
    a. _____
    b. _____
    c. _____
    d. _____

2. Under certain circumstances, employees working on ladders may work without fall protection when:
    a. Their feet are not more than six feet from the ground
    b. The ladder is placed on a level surface
    c. They feel confident and comfortable with the task that they are working on
    d. a & c
    e. a & b

3. How many pounds of force must barricading for fall prevention be capable of withstanding?
    a. 100 pounds
    b. 200 pounds
    c. 250 pounds
    d. 400 pounds

Confined Spaces

1. A confined space (select all that must apply):
    a. Is large enough, and so configured that, an employee can enter bodily and perform work.
    b. Has only one entrance/exit.
    c. Has limited or restricted means of entry or exit.
    d. Is not designed for continuous human occupancy.

2. T/F One enters a confined space when any part of their body has broken the space's plane.

3. A Non-Permit Required Confined Space is a confined space that does not contain or have the potential to contain any _____ capable of causing _____ or serious _____.

INTRODUCTION TO MINERS' RIGHTS

See 30 CFR 46.5(b)(5); 48.5(b)(1); and 48.25(b)(1).
Applicable to: Sand and Gravel, Underground, and Surface mining.

The Federal Mine Safety and Health Act of 1977 gives miners many rights, because Congress wanted them to take an active, responsible role in matters of safety and health. You are encouraged to take advantage of your rights as well as know them (MSHA 2015).

YOUR RIGHTS UNDER THE ACT

If you are a miner, representative of miners, or applicant for employment:

- You have the right to be protected against discrimination when you exercise your rights under the Act, including reporting violations and unsafe conditions at any time

If you are a miner or representative of miners:

- You have the right to request that MSHA inspect your mine when you believe that an mminent danger, a violation of the Act, or a violation of a safety or health standard exists. You also have the right to be informed of, and participate in, enforcement proceedings under the act

If you are a miner:

- You have the right to be paid for certain periods of time when a mine, or part of a mine, has been closed because of a withdrawl order
- You have the the right to receive health and safety training during your normal working hours and to be paid for that time at your regular rate of pay
- You, and a fellow miner, have the right to have a representative accompany an MSHA inspector during inspections at your mine

If you are a representative who is also a miner:

- You have the right to be paid for time spent participating in health and safety inspections at your mine under certain circumstances

EVERY MINER'S RESPONSIBILITIES UNDER THE ACT

You have the responsibility to comply with all Federal and State laws and regultions, and company safety and health policies.

When refusing to work in unsafe or unhealthy conditions, you have the responsibility to notify the operator, supervisor, or other responsible person. This gives the operator an opportunity to address the situation.

You have the responsibility to provide truthful statements and representations (orally or in writing) during any inspection or investigation, or on any applications, records, reports, training certificates, or other documents requires to be kept or filed with MSHA.

DISCRIMINATION

Your Miner's Rights provides you protection against discrimination.

- You can't be fired, transferred to a lower paying job, not hired, harassed, or otherwise lose job benefits for exercising your rights under the Mine Act.
- You have the right to file or make a complaint under the Act of an alleged danger or safety or health violation.
- You may institute, testify, or assist in any proceeding conducted under the Act.
- You can get a medical evaluation leading to a possible transfer to another job location.
- You can be withdrawn from the mine for not having required safety and health training.

INSPECTIONS

Section 103(f) of the Act allows miners' representatives to participate in inspections. You or your representative have the right to accompany the inspector during enforcement activities without loss of pay. If you don't select a representative or one's not available, the inspector will consult with a reasonable number of miners about safety and health matters at your mine.
You are encouraged, at any time (even when you're not at your mine site) to let MSHA know when you:

- See a violation of the Act,
- Observe a violation of the regulations, or
- See an imminent danger.

You can do this by word of mouth or by calling or writing to any MSHA inspector or MSHA office. If circumstances warrant inspection, MSHA will inspect the mine to see if the violation or danger actually exists.

RIGHT TO PAY

If a withdrawal order is issued that directly affects you, your pay will not be reduced:

- For the balance of the shift
- Miners on the next shift are paid up to four hours if the order is not terminated
- If the withdrawal is because the operator does not comply with a standard, miners are to be paid for the time they are idled, up to one week.

CONTESTING ENFORCEMENT ACTIONS

You or your miners' representative have a right to a copy of citations and orders that MSHA issues, and the right to ask for a conference about them. You have 30 days to notify MSHA if you want to challenge the order, action, time of abatement, etc.

TRAINING

Under Section 115 of the Act and Part 48 of 30 CFR, you have the right to obtain training:

- 40 hours for new underground miners
- 24 hours for new surface miners
- Refresher training (8 hours annually)
- Hazard training
- Task training

Training has to be done during normal working hours. You are to be paid at your regular rate while receiving training. The operator must provide you with a copy of your training certificate when each training program is completed.

HEALTH

The Act provides you with certain health protection rights such as:

- Medical examinations and the right to request studies if you are exposed to toxic materials or harmful agents.
- Chest X-Rays for underground coal miners.
- Black lung transfer rights for underground coal miners.

MSHA publishes all proposed standards and regulations and sends copies of them to your representative and the mine operator. The operator must post copies of the proposed standards & regulations on your mine's bulletin board.

INFORMATION

You and your representative can get copies of most records, information, reports, findings, citations, notices, orders and decisions that the Act calls for from MSHA or the Secretary of Health and Human Services.

General access is given for the following:

- Records of all exposure to toxic/harmful agents
- Records of accidents and investigations
- Notice of any proposed civil penalty
- Any required posted documents at a mine

LEGAL RESPONSIBILITIES

You can be fined if you smoke or carry smoking materials in violation of safety standards. You can be fined or imprisoned if you knowingly make a false statement orally or in writing, or make a false certification in documents required to be kept or filed with MSHA.

SUPERVISOR RESPONSIBILITIES

If you are a supervisor or other responsible person:

- You have the responsibility to take appropriate action to address the safety and health issues and concerns.
- You are prohibited from interfering with, hindering, or delaying any inspection or investigation carried out under the Act.
- You must admit an aurthorized representative (MSHA inspector or investigator) into a coal or metal/nonmetal mine for the purpose of an inspection or investigation.
- All during an inspection or investigation.

RULES TO LIVE BY

MSHA created the Rules to Live By as an initiative to prevent fatalitites in mining. MSHA analyzed the 623 fatalities that occurred between the 2000-2009 calnder years to determine the conditions and practices that contributed to them, safety standards violated, root causes, and abatement practices. The responsibilty of the mine operators is to comply with safety and health standards. However, we are all responsible to understand why these accidents happen and how to prevent them. More information can be found at: http://www.msha.gov/S&HINFO/minersrights/minersrights.asp

MINERS' RIGHTS QUIZ

1. Name two of your rights under the Federal Mine Safety and Health Act of 1977 on the lines below.

2. Which section of the 30 CFR can you find training requirements?

3. What are your responsibilities under the Federal Mine Safety and Health Act of 1977 Act? Select all that apply.

    a. Provide truthful statements and representations during inspections or investigations.
    b. Protect others against discrimination
    c. Comply with all Federal and State laws and regulations.
    d. Notify the operator, supervisor or other responsible person when refusing to work in unsafe or unhealthy conditions.

INTRODUCTION TO COMMUNICATION

See 30 CFR 46.5(b)(2); 48.5(b)(3); 48.5(b)(5); and 48.25(b)(3).
Applicable to: Sand and Gravel, Underground, and Surface.

Communication is an important part of all organizations. To function efficiently clear lines of communication must be established to maintain a connection between all areas of the site. Most importantly the information you are conveying must be understood by all parties. A failure in communication can lead to loses in production, downtime, or injuries/fatalities.

Signage, cell phones, and flagging are all different forms of communication. They not only describe how to perform one's job but also illustrate any potential hazards in the area. Mine employees must receive training regarding the site's communication systems (30 CFR 46.8(c), 48.5-8). All mine operators are required to post emergency phone numbers at appropriate phones and have a suitable communication system in the event of an emergency (30 CFR 57.18012-3, 75.1600-2).

HANDHELD COMMUNICATION DEVICES

With the convenience of cell phones and portable handheld communication devices, it is easier than ever to have a means of communication on your person. Proper rules regarding these devices must be followed so that they are handled responsibly for both personal safety and mining operations. Every company and site may have its own specific policies for cell phone use – be sure to know and abide by your company's policy.

Basic Radio Use Tips

- Keep conversations to a minimum
  - Keep the line clear for others
  - For detailed information utilize other means of communication
- Use for business purposes only
- Conversations must be conducted
  - In English only
  - With no profanity
- Obtain clearance from equipment operators before passing
- Radio silence must occur
  - Prior to blasting and until a "shot" has been cleared
  - During MAYDAY situations

Cell Phone Usage Tips

- Never place or receive a call on your cellular phone while driving.
- Do not text, email, or surf web while driving.
- If you must answer your phone, pull safely off the road.
- In an emergency, pull safely off the road to call for assistance.

SIGNAGE

Many different forms of signs exist at a mine site to declare immediate or potential hazards. Recognizing the signs and their proper meaning will remind us of the appropriate precautions to take. These signs exist to direct, warn, and inform the reader. All signs must be properly anchored, legible, and visible. Adhereing to all signage will keep not only the reader safe but also fellow employees.

Areas where hazards exist that are not immediately obvious to the employee must be barricaded and/or have warning signs posted at all approaches.

Immediate hazards should never be left unattended or unguarded. If one is found, mark the area if possible and call your supervisor, so that the hazard can be corrected as soon as possible.

Signage can indicate hazards or restrictions

- Blasting (yellow cones)
- Chemical hazards
- Confined spaces
- Drill patterns
- Electrical hazards
- Haul truck
- Hazardous work areas
- Lock Out, Tag Out, Try Out (LOTOTO)
- Open Holes
- Personal Protective Equipment (PPE) requirements
- Respirator requirements
- Scaffolding
- Shovel & crane swing radius
- Trenching and excavation
- Unsafe work platform

NON-VERBAL COMMUNICATION

While many types of communication are verbal, that is not always possible in noisy or dark enviroments. Be familiar with your company's policies regarind the following forms of communication:

- Signals
- Barricades
- Light
- Sirens, Horns
- Written
- Head lamps
    - Side to side
    - Up and down
    - Circle motion

FLAGGING AND TAGGING

Flagging and tagging off areas is used to warn other workers of a hazard, inform them of the type of hazard present, and direct them to use a different route.

FLAGGING

The color of flagging often corresponds to the level of danger accompanying the hazard. Flagging is used as a warning to the observer of an unsafe condition and to isolate the area. Proper tagging must accompany flagging to describe the nature of the hazard present and any associated information. Where serious safety hazards exist, physical guarding, such as handrails and barricades, must be used along with flagging to protect the employees. It is the individual's responsibility to familiarize themselves with the hazards related to the flagging and the company's policy.

TAGGING

Tagging is employed to eliminate a worker's exposure to hazards. Tags are placed on flagging and temporary guardings so the warning is visible from all areas surrounding the hazard. Tagging may also be used to label equipment that is no longer in use or those that in process of being repaired or destroyed. Proper tagging will identify the hazard and clearly state that item in question should not be used. (30 CFR 57.5066, 75.511).

Tags shall be identified by:

- Employee *name*
- Employee supervisor
- Employee *department*, or company if contractor
- *Hazard* or condition that is flagged or guarding
- *Time and date* the flagging or guarding was installed

REMOVING FLAGGING AND TAGGING

The area and/or equipment should be inspected prior to the removal of any flagging and tagging. You must confirm that the all hazards have been eliminated and that the equipment is working appropriately. Only then may the flagging and tagging be removed from the area.

INCIDENT MANAGEMENT

It is important to be aware of emergency alarms, procedures, numbers, evacuation routes, and the common name of the area. All events must be reported to management as soon as possible. These events include near misses, property damage, first aid incidents, and medical treatments.

A near miss is a health or safety incident that could have resulted in an occupational exposure, injury, fatality or property damage, but did not. A hazardous condition by itself should not be interpreted as a near miss unless an action or behavior of a person interacts with the condition and results in a close call. If there is an immediate hazard, you should never put yourself in danger and leave the area as soon as possible

EMERGENCY ALARMS

Alarm systems provide audible and visual warnings of alarming conditions. An alarm system is necessary because not all workers can be reached via page phone or radio transmissions. Alarm lights often strobe and flash specific colors, based on the emergency. Be familiar with your site's color and strobe signals to ensure you know the proper steps to take during an emergency.

COMMUNICATING EMERGENCIES

If an emergency incident does occur in your area, it is important to familiarize yourself with your area's emergency procedures and note the steps that need to be taken.

Steps to take during an emergency:

1. Stay calm.
2. Stay safe. Never put yourself in danger. Leave the area if there is an immediate hazard.
3. Report the Emergency. Call for help immediately and learn your site's emergency number/radio procedure and be prepared to:
   - Provide the location of the emergency
   - Identify yourself
   - Nature of emergency
   - Never use the victim's name
4. Control the hazard. If a hazard still exists, try to control it without putting yourself in harm's way.
5. Secure the scene. If the hazard cannot be controlled, secure the scene and ensure that no one else accesses the area where there is a hazard.
6. Provide aid. If any individual needs assistance, do not endanger yourself in an attempt to rescue that individual. Never go beyond your level of training.

If you are using a Radio or Page Phone:

- Call "Mayday, Mayday, Mayday"
- Large mine equipment stops immediately
- All radio usage should immediately stop
  - This allows for emergency response coordination
- Do not say names or equipment numbers over the radio during a Mayday

DETERMINING EMERGENCY RESPONSE

Sometimes it is not clear whether an event is a medical emergency and requires a full mayday response, or if simply reporting an incident to your supervisor is sufficient.

What constitutes a medical emergency?
The below items constitute a medical emergency. Get help immediately if you or your co-workers experience:

- Chest pains (any)
- Difficulty breathing
- Altered mental status/unconsciousness
- Seizures
- Severe bleeding
- Major trauma

If you are in doubt, it is best to call for a full mayday response.

This list is not all-inclusive, use your best judgment and always err on the side of caution. If any one of the following criteria is met, it is advised to contact a member of the emergency response team to determine the correct response. Determine the safest mode of transport to the clinic with the help of the emergency response team member, if a person is:

- Vomiting and may become dehydrated
- Experiencing neck/back pain from a recent injury
- Severely bleeding
- Experiencing complications from a personal medical condition, which may require medications or medical attention (allergies, diabetes, etc.)
- Showing signs of dehydration, which may require further treatment.
- For all other situations, it is up to the supervisor's discretion and determination.

When in doubt, contact an emergency response team member for guidance.

OTHER NON-EMERGENCY PROCEDURES

If involved in a medical situation, which does not constitute a full mayday response, it is still wise to call the emergency response team and let them know that you have a non-emergency situation. It is at the discretion of the individual/supervisor whether to activate an emergency response.

COAL MINE MAPS

Types of Coal Mining: an underground coal mine map will appear differently based on the type of mining used at the a site.

- Room and Pillar mining: the white areas typically indicate the 'rooms' where coal has been mined out, while the blue shaded areas show the pillars that remain. Entire areas

that have been outlined in bold and highlighted orange show ‘retreat’ mined areas. This means that some or all of the pillars have been removed.
- Longwall mining: areas highlighted in orange with hatching indicate longwall panels.

Text and Markings on the Map: most mine operators use words and numbers to communicate different things on a coal mine map.

- Line hatching: can be used to show the limit of the retreat mining, and is usually on the side of the line that was retreat mined.
- Letter Code: placed on the retreat portion of a map to show the date the retreat mining occurred.
- Survey date: a date placed on the edge of the drawn map, near the survey point, usually indicates the date that the operator drove the mine entry to that point.
- Elevation: the coal seam elevation is written on pillar spaces on the map, and is usually listed to the nearest tenth of a foot (i.e. 1,146.6 ft). The elevation represents the feet above mean sea level.

Surface Features: some underground maps also show the location and conditions of operations on the surface.

- Yellow highlighting: surface roads.
- Red highlighting: structures, such as sheds, dwellings, or other buildings.
- Purple highlighting: oil or gas wells located on a solid pillar of coal.
- Light blue highlighting: water, such as ponds and streams
- Blue lines: coal seam elevation contours

Note that specific markings or examples may vary from mine to mine, and it is every worker’s responsibility to become familiar with and learn their site’s maps.

COMMUNICATION QUIZ

1. Name two forms of communication used at a mine site.

2. Mark is a mechanic at an underground coal mine. His supervisor, Gerry, has asked him to take a look at a continuous miner that stopped running inside the mine at around 14:00 hours. To perform his work, he will likely enter and exit his work area multiple times to get tools and communicate with his supervisor via page phone. In order to properly alert other workers to this hazard and his work, he should:
    a. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair.
    b. Be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.
    c. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 14:00 hours.
    d. Flag the area, but does not need to tag it.
    e. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 200' level.
    f. Flag it, and be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.

3. As defined earlier, which of the following situations do NOT constitute a medical emergency (select all that apply):
    a. Chest pains (any)
    b. Broken bone
    c. Difficulty breathing
    d. Altered mental status/unconsciousness
    e. Seizures
    f. Neck/back pain
    g. Severe bleeding
    h. Major trauma

INTRODUCTION TO TRANSPORTATION

See 30 CFR 46.5(b)(2); 48.5(b)(3); and 48.25(b)(3).
Applicable to: Sand and Gravel, Underground, and Surface mining.

At some point, every employee will need to use a vehicle. Whether it is a small pick-up truck to pick up supplies or a heavy-duty truck for hauling a trailer, it is important to understand that each vehicle requires a pre-use inspection. While this section will help you to understand how to inspect a light vehicle, other pieces of equipment must follow additional specific procedures. Some examples of other equipment include:

- Dozers
- Shovels
- Haul trucks
- Motor graders
- Roof bolters (Underground)
- Scoops (Underground)
- Longwall machines (Coal)
- Continuous miners (Coal)

Task training is required before you use any vehicle. Never operate any piece of equipment unless you have been properly trained and the training has been documented. If you feel unsure and have questions regarding safety concerns, stop, seek solutions and ensure that the job is always being done safely.

LIGHT VEHICLE INSPECTIONS

The inspection items listed in this section reflect requirements of 30 CFR 56.14100(a). Excellence is the standard for all of us, and our vehicle inspections must reflect that level of integrity and commitment. If you find defects or discrepancies during a vehicle inspection, note them on your inspection sheet and make sure they are addressed *immediately*. If a defect will influence safety performance in any way, do not operate the vehicle. Instead, contact your supervisor, remove the key and tag the vehicle out so that someone else will not inadvertantly use it.

Different types of vehicles will have different types of inspection sheets. Make sure you are using the right sheet for your inspection and ensure you are completely filling it out.

EXTERIOR CONDITIONS

As you approach your vehicle, look for obvious signs of damage or wear. During your initial walk-around, look for:

- Broken lights
- Broken glass
- Fluid leaks
- Scratches

- Dents

LIGHTS

Ask a co-worker to help ensure the following work as expected:

- Back-up lights
- Hazard lights
- Turn signals
- Headlights
- Brake lights

WINDSHIELD WIPERS

Even though you may not be in a particularly rainy environment, your safety depends on your ability to see clearly. Always check the windshield and windshield wipers. Any cracks that are in your line of vision must be fixed immediately.

DOORS AND WINDOWS

Imagine what could happen if a door handle was broken. Each occupant must have unrestricted access. Even though you may not anticipate carrying any passengers, it is required that these items work normally. During an emergency, occupants will need to be able to safely exit the vehicle.

- Door handles, both inside and out, must be in good working order.
- Window controls must operate as well.

TIRES

Visually check tire pressure on all tires. If the vehicle is equipped with tire pressure sensing equipment, make sure it is functional. Watch for signs of premature wear due to operation on mining roads.

HOUSEKEEPING

Your vehicle should be as clean as reasonably possible. Regardless of working conditions, there is no reason why trash should build up in the bed or cargo area. Housekeeping doesn't apply to our work areas alone; it also applies to vehicles. If you routinely transport tools and equipment, ask for a toolbox or other storage methods to be installed in the vehicle.

- Properly secure ladders, hoses, tubing, etc.
- Remove trash and debris
- Store tools in their proper place

MOVING AND BACKUP ALARM

Some vehicles are equipped with backup alarms. If your vehicle has a backup alarm, it must work properly and be able to be heard above other area noises. If your light vehicle does not

have a backup alarm, make sure you signal other drivers with your horn. **(The horn MUST ALWAYS be functional)**

Check the horn, and remember:

- One blast prior to starting the engine
- Two for moving forward
- Three for reverse

GAUGES

Prior to starting the vehicle, place it in pre-start and observe lights to ensure operation.

FIRE EXTINGUISHERS

If your vehicle contains a fire extinguisher, it must be installed in a rack or secured to ensure it does not roll around inside the vehicle.

Inspect:

- Monthly and annual inspection tag
- Pressure gauge
- Tamper seal
- Operating mechanism
- General condition

SEATBELTS

Each occupant will be required to use their seatbelt. Before you start, look at all the seat belts to make sure they all work and will hold if needed.

Failure to wear your seat belts is a serious safety hazard. If an accident occurred without the use of a seatbelt, you or your co-worker could be killed.
It is unacceptable for any employee to operate or occupy a company vehicle without their seat belt fastened..

Part of the pre-operational inspection of mobile equipment is to ensure the seat belts are operational and in good condition. If you check them, it will remind you to use them. Use of seat belts should be a matter of routine and should never be something any employee needs to be reminded of.

MSHA Rule to Live By § 56.14131(a) Seat belts shall be provided and worn in haul trucks:
"(a) Seat belts shall be provided and worn in haulage trucks. (b) Seat belts shall be maintained in functional condition, and replaced when necessary to assure proper performance."

- When you inspect a haul truck, check whether seat belts are provided for all seats.
  - If there is a passenger seat, a seat belt must be present.
- Persons in a haul truck are required to wear the provided seat belt.

SAFE OPERATING SPEEDS AND CONTROL OF EQUIPMENT

Fatal accidents result from equipment operators failing to control their equipment and operating at an unsafe speed. Many times this standard is violated in conjunction with other standards (i.e. seat belts not worn). By eliminating conditions involving unsafe speed or failure to control equipment, these fatal accidents can be eliminated.

MSHA Rule to Live By §56.9101 Operating speeds and control of equipment
"Operators of self-propelled mobile equipment shall maintain control of the equipment while it is in motion. Operating speeds shall be consistent with conditions of roadways, tracks, grades, clearance, visibility, and traffic, and the type of equipment used."

PARKING PROCEDURES AND BRAKE PERFORMANCE

Before operating any piece of equipment, ensure that the parking brake works properly. This can be done on a slight grade. Before testing, always ensure that there are no other potential hazards that could endanger anyone in the immediate area if the brake fails during the test.

PARKING BRAKE

- All company vehicles must have their parking brake set anytime they are parked.
- When inspecting your vehicle, check to make sure the parking brake operates properly. Find a small grade, set your brake and put your vehicle in neutral to test your brake.
- Parking brakes must be capable of stopping and holding with its typical load on the maximum grade it travels.

MSHA Rule to Live By §56.14101(a) Brake performance
"(a)Minimum requirements. (1) Self-propelled mobile equipment shall be equipped with a service brake system capable of stopping and holding the equipment with its typical load on the maximum grade it travels. This standard does not apply to equipment which is not originally equipped with brakes unless the manner in which the equipment is being operated requires the use of brakes for safe operation. This standard does not apply to rail equipment.
(2) If equipped on self-propelled mobile equipment, parking brakes shall be capable of holding the equipment with its typical load on the maximum grade it travels.
(3) All braking systems installed on the equipment shall be maintained in functional condition."

Parking brakes are required to be in working order. If the brake does not stay engaged, or does not hold the equipment, it must be repaired IMMEDIATELY. If you are unable to have the vehicle repaired right away, tag it out so that others do not accidentally operate a defective piece of equipment.

WHEEL CHOCKS

- Vehicles rated at one ton and above must have their wheels chocked in addition to having their parking brake set.
- All mobile equipment must have the brake set and the wheels chocked or wheels into a bank or berm when parked on a grade.
- Ditches or windrows may be used in lieu of wheel chocks.

Note: *Some sites require the use of wheel chocks at all times; ensure that you are familiar with your area's requirements.*

MSHA Rule to Live By §56.14207 Parking procedures for unattended equipment
"Mobile equipment shall not be left unattended unless the controls are placed in the park position and the parking brake, if provided, is set. When parked on a grade, the wheels or tracks of mobile equipment shall be either chocked or turned into a bank."

Failure to follow proper parking procedures has resulted in fatalities. Mobile equipment left unattended without following the proper parking procedures has moved, unexpectedly striking miners. These procedures need to be followed regardless of the length of time the mobile equipment is left unattended.

Note: *Remember that a proper vehicle inspection reflects your commitment to safety. Each item must work as expected or be fixed before the vehicle is placed into service. When you allow substandard conditions to be present in your vehicle, you are threatening not only your own safety, but the safety of your passengers and other vehicle operators and motorists. Do not assume that other people would accept anything less than excellence when you make decisions that may affect them.*

TRANSPORTATION QUIZ

1. Anytime vehicles rated at 1 ton or higher are left unattended, they (select all that apply):
    a. Must be set to 'Park'
    b. May need to have their headlights turned on for safety
    c. May need to be chocked, unless parked into a parking windrow or ditch.
    d. Must have the wheels turned into berm or bank when parked on a slope.

2. When operating a piece of equipment, operators shall:
    a. Work as fast as their machine will go
    b. Maintain control of the equipment
    c. Utilize operating speeds that are consistent with travel way conditions and the type of equipment
    d. All of the above
    e. B&C

3. You do not need to wear a seat belt in a company vehicle when:
    a. You are operating a piece of equipment
    b. Are driving a haul truck
    c. Are a passenger in a haul truck
    d. None of the above

INTRODUCTION TO HEALTH AND HAZARD COMMUNICATION

See 30 CFR 46.5(b)(4); 48.5(b)(13); and 48.25(b)(12).
Applicable to: Sand and Gravel, Underground, and Surface mining.

Health is something we must protect for a lifetime. We all strive for the health of our families and friends. We are not always diligent about how our everyday activities affect our own health. Health plays a role in how we breathe, how we hear, how we see, how we feel and ultimately the quality of our lives.

When most people think of safety, they typically think of injuries, but not necessarily about health and illness. Industrial hygiene is the field that is dedicated to addressing these issues and to ensuring that you leave with the same health that you come to work with. These experts monitor and test health hazards to determine the extent of exposure and ways to reduce them. Your company has an expert and they should be consulted if you have questions regarding any specific health topics.

The key to preventing accidents is awareness. Once the hazards are known, the risk of an accident may be reduced significantly by using safe work practices and by controlling the hazards through the Hierarchy of Controls.

As discussed earlier, the decisions you make in your work areas should be based on an objective analysis of the hazards by utilizing:

- Consequence thinking
- Standard Operating Procedures (SOPs)
- Job Safety Analysis (JSAs)
- Risk assessments

Rather than merely the perception of the risks involved.

HEARING PROTECTION

If engineering or administrative controls fail to reduce noise exposure in the areas where you work below 85 dB for an 8-hour TWA, or where there are super high levels of noise for short periods, you must wear hearing protection to ensure you do not experience any loss. The purpose of hearing protection is to reduce the amount of sound transmitted to the middle and inner ear.

The number of decibels or amount of sound reduced by the protector is called or noise reduction rating (NRR). All earplugs or earmuffs will have a noise reduction rating (NRR) listed in decibels for each model. The right hearing protection, correctly worn, can reduce noise levels by 20 to 30 dB. This is a crucial difference for your ears.

However, when worn in the field, hearing protection usually does not provide the same amount of noise reduction as listed by the manufacturer. This may be from not wearing it properly or from it being the wrong size. Also, the noise reduction may lessen as hearing protection becomes older.

If you have any questions regarding hearing protection and noise exposure levels, contact your area's health and safety representative or industrial hygienist.

Hearing loss from noise exposure is normally a gradual process but it is real and it is permanent. The following information is about the impact of noise on hearing and the noise levels which require hearing protection as well as basic information about selecting and caring for hearing protection.

Q How do we hear?

The ear is a complex structure, sound waves are captured by the outer ear and travels down the ear canal to the middle ear. These sound waves are then transmitted by the eardrum and tiny bones to the inner ear. Where a snail shaped organ, called the cochlea, contains tiny hairs that transmits vibrations to nerves which send a signal to the brain. There they are translated into the sensation of hearing or sound.

Too much noise gradually damages these tiny hairs, causing noise-induced hearing loss. Once damaged, our hair cells cannot grow back.

Cochlea - part of the inner ear, showing the tiny hairs that transmit noise signals to the brain

Hair cells – hair that lines the inside of the cochlea, when severely damaged these hairs do not return.

HEALTH EFFECTS

Noise induced hearing loss can be caused by a one-time exposure to an intense "impulse" sound, such as an explosion, or by continuous exposure to loud sounds over an extended period of time such as noise generated in a shop or by a piece of equipment.

The damage may not be noticeable at first, but once it occurs, the hearing loss is permanent. The louder the sound the more likely that damage will occur but the distance between you, the sound, and the amount of time you're exposed to the sound matters as well.

Noise-induced hearing loss limits your ability to hear high frequency sounds, understand speech, and seriously impairs your ability to communicate. The effects of hearing loss can be profound as it can interfere with your ability to enjoy socializing with friends playing with your children or grandchildren or participating in other social activities.

- Noise-induced hearing loss is cumulative, invisible, and permanent:

- It's cumulative because the damage can start when we are young and get worse over time.
- It's invisible because it can happen without our even noticing it, until it's too late.
- It's permanent because, unlike a broken arm that gets better over time, we can't "heal" our hearing and once it's damaged, it's damaged for good.

Q How loud is too loud?

Decibels	**Sound Source**
165	12-Gauge Shotgun
130	Stock Car Races
125	Noise above this level causes pain
120	Ambulance Siren
110	Jackhammer
110	Chain Saw
105	Bulldozer
103	Impact Wrench
98	Hand Drill
93	Belt Sander
90	Lawn Mower
85-60	Vacuum Cleaner
80	Electric Coffee Grinder
60	Normal Conversation
80	Electric Coffee Grinder
60	Normal Conversation
40	Refrigerator Humming
30	Whisper
20	Ticking Wrist Watch
0	Weakest Sound Heard

Q How do you know if your hearing is damaged?

Hearing loss is painless and gradual. It usually develops over several years you might not even notice the loss during those years. Sometimes, overexposure to loud noise can trigger ringing or other sounds in your ears, called tinnitus. While tinnitus may be a symptom of damaged hearing, it can also be caused by infections, medications, and earwax. The only way to know for sure if noise has damaged your hearing is to have a hearing examination by a certified audiometric technician or a physician.

MONITORING NOISE EXPOSURE

As with any health hazard, it is extremely important to determine the extent of the noise or hearing hazard and to identify affected employees. Monitoring of your work areas and noisy tasks is done on a regular basis to identify employees overexposed to noise.

Q How is sound measured?

Sound is measured in units called decibels (dB). The softest sound that healthy ears can hear is 0 decibels- near total silence. By comparison, a whisper measures 30 decibels, normal conversation measures 60 decibels and an idling bulldozer is 85 decibels.

Unprotected prolonged exposure to any noise above 85 decibels can cause gradual hearing loss and exposure of more than one minute at 110 decibels can cause permanent hearing loss. Because of this hearing protection, such as earplugs or earmuffs, need to be worn when we are exposed to noise at or above 85 decibels for a prolonged period.

Q How can you identify an area with hazardous noise?

As a rule of thumb if you must raise your voice to communicate with someone an arm's length away, the noise exposure is above 85 dB and protection is needed. For example, if something sounds as loud as a lawnmower you need hearing protection.

Although being aware of decibel levels is an important factor in protecting one's hearing, distance from the source of the sound and duration of exposure to the sound are equally important. A good rule of thumb is to avoid noises that are "too loud" and "too close" or that last "too long."

Q Where does the majority of noise in the mines and production areas come from?

Noise in mines is mostly produced by machinery, equipment, and hand tools. Trucks and other vehicles such as: graders, front-end loaders, and dozers can be very loud. Cranes and pile-driving machinery, air compressors, and hand tools (for example sawzalls, drills, and grinders) can all create noise problems.

Q Can noise-induced hearing loss be caused by things off the job?

It is important to realize that occupational noise is not the only cause of noise-induced hearing loss. There are other sources of noise exposure when away from work. Examples of leisure activities that produce high levels of noise are: quads, motorcycles, loud music (especially stereo headphones), guns, and even movies. Some movies have been recorded at 110 dB.

AUDIOMETRIC TESTING

If you are working in areas where sound levels exceed 85 dB, measured as an 8-hour time weighted average (TWA), then audiometric testing is required. These tests monitor your hearing over time to ensure your hearing is not being affected by your work environment. Testing will be completed annually and if there are problems with our hearing, it enables us to initiate protective measures before it gets any worse.

Note: *When selecting the best earplug for the type of job that you are performing, consider noise levels and your need to communicate with co-workers or hear warning signals on the job. There are specific types of radios and earmuffs that can be used in conjunction to ensure effective communication.*

HEARING CONSERVATION PROGRAM

Whenever hazardous noise exists in the workplace, measures have to be taken to protect our hearing. These controls can include engineering controls to contain noise or limit the amount of noise made. Springs installed on a pump to limit vibrations or barriers around crushers are just one example.

Administrative controls for hearing conservation include changes in the workplace that either reduce or eliminate the exposure to the noise.

For example:

- Operating noisy machines during shifts when fewer people are exposed
- Limiting the amount of time a person spends at a noise source
- Restricting access to a suitable distance away from noisy equipment

Personal Protective Equipment (earplugs and earmuffs) are a last resort and must be used properly.

To better understand the impact of hearing loss, the National Institute for Occupational Safety and Health (NIOSH) has created Hearing Loss Simulator software. The tool allows you to experience "the effects of noise exposure on hearing without experiencing an actual noise-induced hearing loss" (NIOSH 2015). The simluator can be accessed here: http://www.cdc.gov/niosh/mining/works/coversheet1820.html

SILICOSIS

Crystalline Silica (or quartz) is a serious health hazard that can be encountered in many mines. Any job that involves drilling, cutting or crushing of material containing silica can result in crystalline silica exposure. Sand blasting may also expose you to dust containing silica. Materials that contain crystalline silica include but are not limited to: concrete, brick, sand, refractory material, stone, earth and many natural materials. Since silicon is the most abundant material in the earth's crust, you can assume that most dust may contain some amount of silica.

Exposure to crystalline silica causes or contributes to many health hazards. These include: silicosis, COPD (chronic obstructive pulmonary disease) and lung cancers. Smokers exposed to crystalline silica are 300 times more likely to develop these health conditions as non-smokers exposed to the same hazard (one more reason to quit!). From 1968 to 2002, silicosis was the primary or contributing cause of 74 million people's deaths. During this time, metal mining had the highest mortality ratio of any industry.

Silicosis is the process of crystalline silica being trapped in the lungs and over time causing scar tissue to form. This scar tissue makes the lungs less elastic, making it much harder to breath. The scarring also makes it harder for your lungs to perform its role: gas exchange.

COPD (chronic obstructive pulmonary disease) can also be caused by silica dust and is most frequently also the result to smoking. COPD is characterized by coughing, shortness of breath, difficulty breathing and gets worse over time usually resulting in death or contributing to complications that lead to death.

Lung cancer is caused by irritation to the cells in the lungs by silica dust. When the irritation persists, cells can develop abnormalities that can turn into cancerous cells. Lung cancer is one of the most virulent types of cancer and is most often fatal. Again, smoking is another major contributing factor.

Mine operators must maintain personal, 8-hour exposures to crystalline silica to as low as reasonably achievable. The MSHA PEL for respirable silica exposures is based on the following formula:

> Crystalline quartz (respirable) = 10 mg/m3 / (%SiO2 + 2)
>
> Where the %SiO2 is the percentage of silica measured within each individual respirable dust sample.

Both the cristobalite and tridymite forms, or polymorphs, are reported by using half the value of the quartz content.

Controls for silica exposure include: wet methods, increased ventilation, enclosed vehicle cabins, job rotation, training, and respirators.

CHEMICAL HAZARDS

Many chemicals are used or produced in the mining process. Accidents with hazardous chemicals can happen quickly and may be quite severe. Before using any chemical a Material Safety Data Sheet (MSDS), a Safety Data Sheet (SDS), or other appropriate resources should be reviewed to determine what conditions of use might pose a hazard.

The following information will help to inform you about chemical hazards in the workplace and assist you in determining the best way to protect yourself and what to do in case of an emergency. As an employee, you have a right to know about the chemical hazards where you work and the responsibility to know about the chemical hazards in your work area.

The company should keep detailed records of the hazardous chemicals used in facilities. The materials are covered in the HazCom portion of a company's Industrial Hygiene plan. These plans are in alignment with both OSHA 1910.1200 and MSHA 30 CFR Part 47 Hazard Communications standards which are available to a worker at any time.

Before anyone brings a new chemical onto a site, it is very important that they notify their health and safety and/or environmental department. This allows a chemical to be tracked to ensure that the hazards are evaluated and guarantee that any new chemical hazards introduced into your work area are properly communicated to you and your co-workers.

Q First, what is a chemical?

All matter is made up of a pure chemical called an element. Mixtures of these elements form the building blocks for different chemicals. If you can hold it in your hand, put it in a jar, buy it in the store and even breathe it in, it's either an element, such as Copper (Cu), Mercury (Hg), or a mixture of chemicals such as Water (H2O).

FORMS OF CHEMICALS

Hazardous chemicals come in many different forms:

- **Dusts-** finely divided particles and are formed whenever solid material is broken down into tiny particles, often produced during sanding and grinding operations.
- **Fumes-** even smaller particles usually formed when solid metal is heated and vaporized, and then condensed as tiny particles.
- **Fibers-** similar to dusts but are of an elongated shape (i.e. asbestos and fiberglass).
- Mists and Sprays- very small droplets of liquid material suspended in the air. They are often produced by spray and coating operations.
- **Vapors-** substances that are created when a solid or liquid material evaporates. When flammable or combustible liquids produce enough vapors at their flash point, they can be ignited.
- **Gases-** substances that are normally airborne at room temperature. A vapor is the gaseous phase of a substance which is normally a liquid or solid at room temperature.
- **Solids-** metal, treated wood, plastic.
- **Liquids-** the most common form in the workplace.

BASIC TOXICOLOGY

The health effects of hazardous chemicals are often less clear than the physical hazards. How much, how often and how long you are exposed typically influences the amount of a chemical or energy that enters the body, which is called the dose. This influences the energy or materials poisonous or toxic effects.

No matter how toxic a material may be, there is little risk involved unless it enters or touches the body. By understanding the different ways you may be exposed to a chemical, this will help you to determine what protective measures to take.

With proper handling, even highly toxic chemicals can be used safely. Alternatively, if you are mishandling a less toxic chemical it can be extremely dangerous.

ROUTES OF EXPOSURE

There are Four Ways that Chemicals Can Enter the Body:

1. Inhalation- breathing the chemical (i.e. gases, vapors, fumes)
2. Absorption- chemicals soaking in through the skin (i.e. liquids, dusts)
3. Ingestion- swallowing the chemical
4. Injection- if the skin is penetrated or punctured by a contaminated object (i.e. hydraulic fluid)

INHALATION (BREATHING)

The most common route of exposure to chemicals in the workplace is through breathing. Contaminants in the air can be inhaled and can settle in both the nose and throat or continue deeper into the lungs, where they can be either absorbed directly into the bloodstream or remain in the airways and cause damage over time.

Examples:

- Silica dust
- Solvent vapors
- Welding fumes

ABSORPTION (SKIN AND EYE CONTACT)

Skin is one of the largest organs of the body and protects us from external hazards, like bacteria, fibers, dirt and chemicals. However, chemical exposures can occur quite rapidly if the skin is cut or scraped. Many chemicals can still be absorbed through intact skin.

Examples:

- Mercury
- Solvents
- Many processing chemicals

Some chemicals including many solvents and metals can cause a rash or allergic reactions. Other chemicals such as acids, may burn the skin. Avoid the use of solvents for washing as they can remove the skin's naturally occurring protective oils and can cause irritation and inflammation. In some cases washing with certain solvents may facilitate absorption of a toxic chemical or pass directly into the skin.

By wearing gloves and other protective clothing you can minimize chemical skin exposure. See the Personal Protective Equipment section for more information.

Chemical contact with eyes can be particularly dangerous, resulting in painful injury or loss of sight. Wearing safety glasses, goggles or a face shield can reduce the risk of eye contact. Eyes that have been in contact with chemicals should be rinsed immediately with water continuously for at least 15 minutes. Contact lenses should be removed while rinsing. Do not delay rinsing to remove the lenses. Notify your supervisor immediately if any chemical or dust gets into your eyes.

INGESTION

Chemicals that are swallowed are absorbed into the digestive tract. Although direct ingestion of a chemical is unlikely, exposure may occur as a result of ingesting: contaminated food, drinks or tobacco products, touching the mouth with contaminated fingers, or swallowing inhaled particles which have been cleared from the lungs.

Residue from handling chemicals or dust from your work areas can contaminate your gloves and hands. Food, cigarettes or tobacco products can pick up this residue and then transfer it to your mouth. Never eat, drink or smoke while wearing your work gloves.

Even if you were wearing gloves while working, the most important thing to remember is to wash your hands thoroughly with soap and water before eating, drinking or smoking. Never bring any tobacco or food product into a regulated area. Example: metal dusts or solvents.

INJECTION

It is important to note that injection through the skin into deeper tissue may also provide a route of exposure to a chemical. Injection effectively bypasses the protection provided by intact skin and provides direct access to the bloodstream, thus, to internal organs. An injection injury occurs if the skin is penetrated or punctured by a contaminated object or if a material is under a high enough pressure, such as hydraulic fluid, when released is pushed directly into a worker's body.

If injection has occurred, wash the area with soap and water and contact your supervisor. This is especially true when dealing with hydraulic fluid.

TOXIC EFFECTS OF CHEMICALS

It is important to understand that some exposures to chemicals/energy can lead to both short-term and long-term health problems. Some of these exposures occur at low concentrations and are unnoticeable, but if you are exposed for a long enough time or to a high enough concentration, they can be hazardous to your health.

These exposures are referred to as either acute or chronic exposures which in turn can have either acute or chronic health effects.

TYPES OF HEALTH EFFECTS FROM EXPOSURES TO TOXIC CHEMICALS

ACUTE EXPOSURE

Short term exposure (minutes, hours, days) to, usually, relatively high levels of chemical

Acute exposure may result in acute effects which can range from relatively mild (eye irritation) to extreme (death)

ACUTE EFFECTS

- Results from a single, short exposure
- Effects usually appear quickly

- Often reversible

Examples:
- Metal fume fever
- Heat stroke
- Chemical burns

CHRONIC EXPOSURE

Long term exposure (months, years, lifetime) to, usually, relatively low levels of chemical

Chronic exposure may result in chronic effects (cancer, chronic obstructive pulmonary disease, neurological problems, etc.)

CHRONIC EFFECTS

- Results from repeated exposure over a long period of time
- Effects are usually delayed and gradual, often take years before they appear
- May be irreversible

Examples:
- Silicosis
- Lead
- Mercury poisoning
- Cancer

Some chemicals can have both acute and chronic health effects. An example of this is alcohol. The acute effect of alcohol ingestion is intoxication, while the chronic effect is cirrhosis of the liver. Acute and chronic effects are distinguished in Material Safety Data Sheets (MSDS), typically with more information about acute exposures than chronic.

CHEMICAL LABELS

Labels always contain immediate warnings about a chemical's most serious hazard and should be the first thing referenced before beginning work. A label is an employee's first source of information about a chemical.

The manufacturer's label must be kept intact. If any chemical delivered to the mine is missing a label, or a label is lost or damaged, let your supervisor, global sourcing representative or health and safety professional know immediately so that it may be replaced.

Portable containers on MSHA Sites must be labeled with at least the common name of the chemical.

Portable Containers on OSHA Sites must be labeled with the following:
- Name of the chemical.
- Any appropriate hazard warnings that the chemical may pose.

MATERIAL SAFETY DATA SHEET OR SAFETY DATA SHEETS

Material Safety Data Sheets or "MSDS" or the new universal format called Safety Data Sheets "SDS" are information sheets designed to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. Either one of these forms must be accessible to all personnel during their work hours. These terms may be used interchangeably but the SDS format will have additional pictographs to aid in chemical hazard identification.

MSDSs or SDSs are the next place you should go for information when working with chemicals. They provide you with valuable information regarding the chemical's different properties and ways that you can protect yourself from injury.
Data sheets contain information on:

- Storage
- First aid
- Disposal
- Reactivity
- Physical data
- Health effects
- Spill/leak procedures
- Protective equipment

Q Where do you find MSDSs/SDSs?

Data Sheets are traditionally found in MSDS binders in high traffic areas. Many of these binders are still available, but chemical information sheets may also be located in online databases. From there, you can access up-to-date chemical information instantly.

It is important that you printout and keep MSDS or SDS with your work orders as you begin your tasks. That way you will know how to safely work with the chemicals you use and be able to respond appropriately if there's an emergency.

Example MSDS:

MATERIAL SAFETY DATA SHEET

CM0484900
13 00

DATE OF PREPARATION
Nov 29, 2015

SECTION 1 — PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER
CM0484900
PRODUCT NAME
Corrosion Resistant Epoxy Primer, Light Green
MANUFACTURER'S NAME
THE SHERWIN-WILLIAMS COMPANY
101 Prospect Avenue N.W.
Cleveland, OH 44115

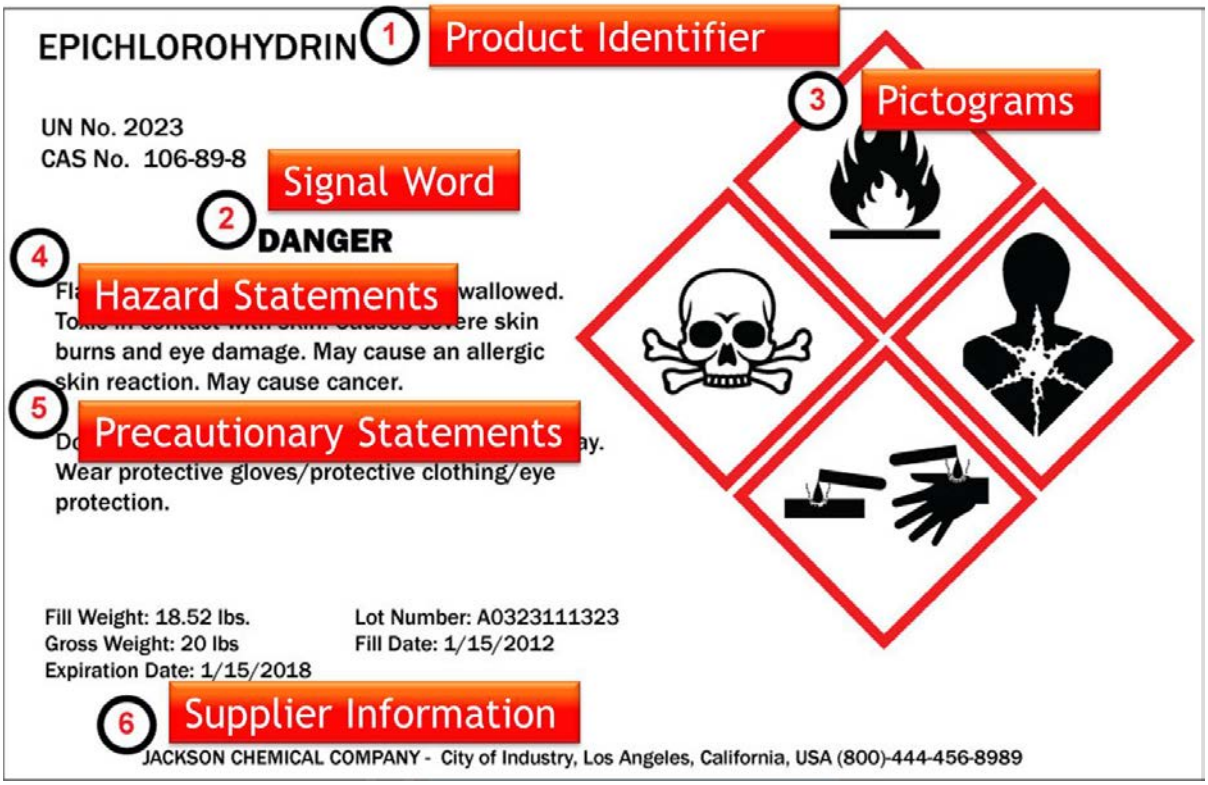
Telephone Numbers and Websites

Product Information	www.sherwin-williams.com/aerospace
Regulatory Information	(216) 566-2902
Medical Emergency	(216) 566-2917
Transportation Emergency*	(800) 424-9300
**for Chemical Emergency ONLY (spill, leak, fire, exposure, or accident)*	

SECTION 2 — COMPOSITION/INFORMATION ON INGREDIENTS

% by Weight	CAS Number	Ingredient	Units	Vapor Pressure
13	108-88-3	**Toluene**		
		ACGIH TLV	20 PPM	22 mm
		OSHA PEL	100 ppm (Skin)	
		OSHA PEL	150 ppm (Skin) STEL	
3	67-63-0	**2-Propanol**		
		ACGIH TLV	200 PPM	33 mm
		ACGIH TLV	400 PPM STEL	
		OSHA PEL	400 PPM	
13	78-83-1	**2-Methyl-1-propanol**		
		ACGIH TLV	50 PPM	8.7 mm
		OSHA PEL	50 PPM	

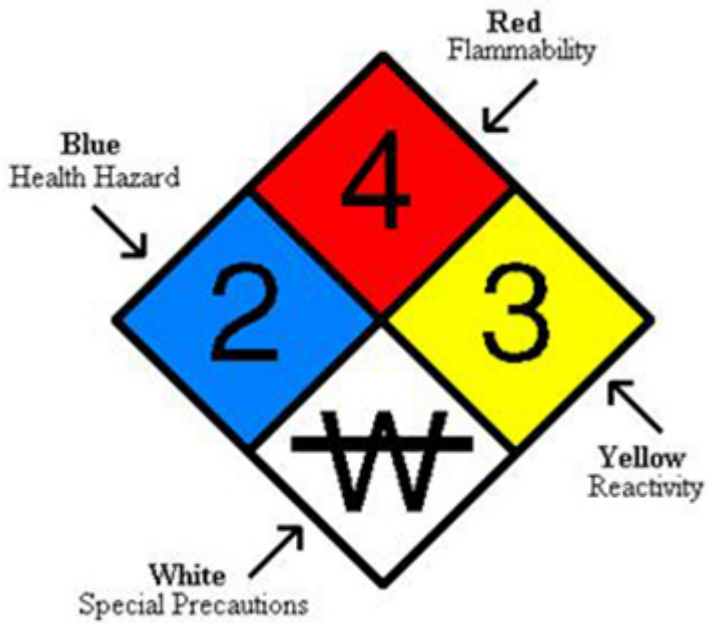
Warning Labels:



http://oshaguard.com/wp-content/uploads/2014/03/GHS-Label1.jpg

NFPA 704 HEALTH DIAMOND

The NFPA fire diamond is subdivided into four general categories: Health (blue), Flammability (red), Reactivity (yellow) and Special hazards (white). This diamond is designed for emergencies when information about the immediate (acute) effects of the chemical is needed.



http://duotechservices.com/wp-content/uploads/2015/06/nfpa-704-fire-diamond.jpg

HMIS AND HMIS III

The HMIS and HMIS III color bars are not for use in an emergency and convey broader health warning information. The number ratings range from 0-4, with 0 representing a minimal hazard and 4 signifying a severe hazard. The four bars are color coded, with blue indicating the level of health hazard, red for flammability, the HMIS follows the NFPA standard and yellow represents reactivity, orange is used with the HMIS III and signifies physical hazards, white indicates personal protective equipment.

An asterisk (*) may be used at times to represent that a long-term (chronic) health effect may result from continued exposure. The PPE section of the HMISs will contain an alpha-numeric value. This value can be referenced to assist in determining the proper personal protection equipment. This information will also be covered in Section 8) Exposure Controls/Personal Protection in the MSDS.

Q What kind of information does an SDS provide?

Generally, The Globally Harmanized System of Labeling Chemicals or Safety Data Sheets (SDS) can be broken down into 16 different sections.

1. Chemical Product and Company ID
2. Hazards Identification
3. Composition/Information on Ingredients
4. First Aid Measures
5. Fire Fighting Measures
6. Accidental Release Measures
7. Handling and Storage
8. Exposure Controls/Personal Protection
9. Physical and Chemical Properties
10. Stability and Reactivity
11. Toxicological Information
12. Ecological Information
13. Disposal Considerations
14. Transport Information
15. Regulatory Information
16. Other Information

The following sections are taken directly from the Sulfur Dioxide SDS. Each chemical has different properties and their SDSs will look slightly different. Ensure that you are accessing SDSs whenever you are working with a chemical you are not familiar with.

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

This section gives the name and address of the manufacturer and an emergency phone number where questions about toxicity and chemical hazards can be directed.

- Product Name: commercial or marketing name.
- Synonym: approved chemical name and/or synonyms.
- Chemical Family: group of chemicals with related physical and chemical properties.

THE HAZARDS IDENTIFICATION SECTION

- Health hazard data
- Acute (short-term exposure)
- Chronic (long-term exposure)
- Routes of exposure
- Absorption
- Inhalation
- Ingestion
- Organs affected
- Signs and symptoms of exposure

CORROSIVES

Corrosive substances can cause severe or serious damage to tissue at the point of contact.

Capable of damaging:

- Eyes
- Skin
- Respiratory system

A chemical burn can result from a brief exposure to a corrosive substance. Acids and bases are common corrosive chemicals.

Examples:

- Sulfuric acid
- Lime

CARCINOGEN (CANCER CAUSING)

Some chemicals found in the workplace contain cancer-producing substances (carcinogens). When these come in contact with the body, a malignant tumor may form at the site of contact or elsewhere.

Examples:

- Formaldehyde
- Arsenic
- Solvents

MUTAGENS/ REPRODUCTIVE TOXINS

Some chemicals cause genetic mutations, which may result in sterility, cancer or produce birth defects (Reproductive Toxin) or other problems in following generations.

Example: Lead

IRRITANTS

Some chemicals are non-corrosive and cause reversible damage or inflammation in or on the body. These chemicals are known as irritants.

Examples:

- Fiberglass
- Soaps
- Oils/cutting fluids
- Solvents

SENSITIZERS

Chemical exposure may cause a person to become unusually sensitive to that chemical or a group of chemicals. Reactions may occur from exposure to very small amounts of the substance.

Once sensitized, a person will suffer an allergic reaction when exposed to that chemical with smaller and smaller exposures causing the reaction and the reactions can become more severe. The only way to deal with this problem is to prevent any further exposure or contact with the chemical.

COMPOSITION/INFORMATION ON INGREDIENTS

This section lists the chemical ingredients of the material and describes the percent composition of the substance and CAS number.

FIRST AID MEASURES

Based on the toxicity of the product, degree of exposure and route of contact (eye, skin, inhalation, ingestion, and injection), emergency and first aid procedures are recommended in this section.

FIRE FIGHTING MEASURES

This section includes information regarding the flammability and explosion hazards data for the chemical. This information is especially useful when first responders, local fire departments, and hazmat teams are needed to respond to an emergency. Appropriate fire-fighting procedures, equipment, appropriate extinguishing agents and methods will also be listed for limiting hazards encountered in fire situations.

ACCIDENTAL RELEASE MEASURES

Information regarding the procedures that should be used if the product spills or leaks, including environmental precautions and appropriate waste disposal methods for safety and environmental protection will be made available to you.

HANDLING AND STORAGE

Basic precautions to take whenever you are handling and storing chemicals will be made available to you.

EXPOSURE CONTROLS/PERSONAL PROTECTION

This section contains information regarding exposure controls and proper personal protective equipment (PPE) necessary to handle the product in a manner that will minimize contact. Ventilation practices are also listed in this section.

CHEMICAL EXPOSURE LIMITS

Many chemicals have exposure limits, or allowable amounts of a chemical in the air. These limits are often called "Permissible Exposure Limit" (PEL) or "Threshold Limit Value" (TLV). They are based on 8-hour average exposure or ceiling or peak levels. Levels must be kept below these limits for safety.

IDLH- Immediately Dangerous to Life and Health

This term refers to atmospheric levels of a chemical that can:

- Cause death
- Permanent health effects
- Prevent escape

PHYSICAL AND CHEMICAL PROPERTIES

This section provides physical data about the material that can be utilized for proper identification. Included are specifics such as color, odor, specific gravity (weight), vapor pressure and boiling point.

The information may be used to determine conditions for exposure. For example, one can determine whether or not a chemical will form a vapor (vapor pressure), whether this vapor will rise or fall (vapor density) and what the vapor should smell like (appearance and odor). This could help determine where to use a monitor or where to place ventilators.

The following information is usually included:

% Volatile by Volume: percentage of a liquid or solid, by volume, that evaporates at a temperature of 70°F.

Appearance/Odor: color, physical state at room temperature, size of particles, consistency, odor, as compared to common substances. Odor threshold refers to the concentration required in the air before vapors are detected or recognize.

Auto-ignition Temperature: the approximate temperature at which a flammable gas-air mixture will ignite without spark or flame. Vapors and gases will spontaneously ignite at lower temperatures in oxygen than in air.

- **Boiling Point:** temperature at which liquid form of the substance begins to become a vapor.

- **Evaporation Rate:** usually expressed as a time ratio with ethyl ether = 1, unless otherwise specified.

- **Flammable Limits:** the lower explosive limit (LEL) and upper explosive limit (UEL) define the range of concentration of a gas or vapor in air at which combustion can occur. For instance, an automobile carburetor controls this mixture - too lean (not enough chemical) or too rich (not enough air, as when you flood your engine), will not ignite.

- **Flashpoint:** the temperature at which a liquid or solid gives off a vapor that can form a flammable mixture with the air.

- **Formula:** chemical formula, if applicable; i.e., the conventional scientific definition for a material.

- **Melting Point:** temperature at which the solid form of the substance begins to change into a liquid.

- **Other Pertinent Physical Data:** information such as freezing point is given, as appropriate.

- **Specific Gravity (water = 1):** ratio of volume weight of material to equal volume weight of water.

- **Solubility in Water:** percentage of material that will dissolve in water, usually at ambient temperature. Since much of the human body is made of water, water soluble substances more readily absorb and distribute.

- **Vapor Density (air=1):** weight of a gas or vapor compared to weight of an equal volume of air. Density greater than 1 indicates it is heavier than air, less than 1 indicates it is lighter than air. Vapors heavier than air can flow along just above ground, where they may pose a fire or explosion hazard.

- **Vapor Pressure:** a measure of how volatile a substance is and how quickly it evaporates.

STABILITY AND REACTIVITY

This section contains information on the reactivity of the product. It lists other chemicals that when mixed with the product, will result in a chemical reaction. If a product is water reactive, it will be noted. Also included in Section 6 is information on hazardous decomposition products, such as carbon monoxide and other hazardous gases, which are formed and emitted during chemical reactions or fires. It is imperative that this section be carefully noted by both in house and local firefighters.

This section includes information regarding the stability of the material and any special storage or use considerations.

- **Stability:** unstable indicates that a chemical may decompose spontaneously under normal temperatures, pressures, and mechanical shocks. Rapid decomposition produces heat and may cause fire or explosion. Conditions to avoid are listed in this section.
- **Incompatibility:** certain chemicals, when mixed may create hazardous conditions. Incompatible chemicals should not be stored together.
- **Hazardous Decomposition Products:** chemical substances which may be created when the chemical decomposes or burns.
- **Hazardous Polymerization:** rapid polymerization may produce enough heat to cause containers to explode. Conditions to avoid are listed in this section.

TOXICOLOGICAL INFORMATION

This section provides additional information on the toxicity of the substance. Results of animal studies are most often given.

- **LD50 (lethal dose 50):** The dose of a substance which will cause the death of half the experimental animals.

- **LC50:** The concentration of the substance in air which will cause the death of half the experimental animals

ECOLOGICAL INFORMATION

Environmental related concerns are listed here.

DISPOSAL CONSIDERATIONS

Appropriate waste disposal methods are provided here.

TRANSPORT INFORMATION

Appropriate transportation information is provided for shipping the material.

REGULATORY INFORMATION

This section outlines applicable regulatory information.

OTHER INFORMATION

This section provides other pertinent information regarding hazardous conditions in handling, storage, mixtures and recommended equipment.

UTILIZING A CHEMICAL DATABASE

Typically you will know either the common name or manufacturer of the product you are looking up. There is also a section to search by specific ingredient included in the product or you may also search by a chemical's CAS.

A CAS or Chemical Abstracts Service Registry Number is a unique identifier for chemical substances. It can be found on the labels of most products and enables you to search for a specific chemical ingredient even if you do not have the correct spelling of the chemical name.

Example: You are working in an acid plant and need to look up the MSDS for sulfur dioxide; you can search either by this common name and/or its CAS number, which is 7446-09-5.

Once you have entered this information a search results screen will appear allowing you to select the chemical that best fits your results. Since both the common name and the CAS # were used, only one chemical is shown. If you do not have this type of information several different chemicals may be shown.

Now that you know some of the basic information regarding chemicals, and where to find specific health data from MSDSs/SDSs, always make sure you are referencing these sheets for the specific hazards of reagents or contaminants that may be found in your work areas.

Chemicals in the workplace can have more than one hazardous attributes. For example, a corrosive chemical can be explosive, and react explosively with other chemicals. Regardless of these characteristics, it is important to note that the amount of damage that chemicals do is almost always related to the amount of time your tissues (skin, eyes, mouth, lungs etc.) are exposed.

Speed is essential in reducing injury if you are exposed to a chemical. Before starting work in any area, know where the emergency showers and eyewashes are located and the best route to access them. Also, understand the types of Personal Protective Equipment (PPE) that you need and ensure that they are all working correctly.

Remember it is your right to have access to the previous type of information. It is also your responsibility to stop work and seek it out if you are working with an unfamiliar chemical or hazard.

PERSONAL HYGIENE

Good personal hygiene can help lower your potential risks to chemical and dust exposures. It can also lower exposures to our families as well. Showers and coveralls are provided in facilities where there is potential to bring these hazards home. This process can sometimes seem time consuming and you see no immediate effects to yourself or the other adults in your household. However, children are very sensitive to specific chemicals, especially to lead exposures, and there is potential to harm them simply by not showering and changing clothes before entering your home.

HEALTH & HAZARD COMMUNICATION QUIZ

1. How _____, how _____, and how _____ you are exposed typically influences the amount of a chemical or energy that enters the body, which is called the _____.

2. The four ways that chemicals can enter the body are:

3. Will is a mine contractor who has been tasked with applying an epoxy to a drop-chute at an iron mill. Before working with the chemical what should he do so that he understands the hazards? Select all that apply.
    a. Read the epoxy's Material/Safety Data Sheet.
    b. Read the health effects listed for it on Wikipedia.
    c. Read the hazard label on the epoxy container.
    d. Smell the epoxy.
    e. Read about others' experience with it on a discussion forum.

INTRODUCTION TO HAZARD RECOGNITION

See 30 CFR 46.5(b)(2); 46.5(b)(7); 48.5(b)(9); and 48.25(b)(8).
Applicable to: Sand and Gravel, Underground, and Surface mining.

Every day we are exposed to hazards at home and at work. We are surrounded by risks every day. How we manage these hazards determines the outcome. Subsequently we are all constantly assessing these risks, whether consciously or sub-consciously when we decide to pull out onto the highway, cross the road, or to eat healthy. We continually make judgments about hazards and assess the risks before taking action.

CONSEQUENCE THINKING

This process is summarized as something we call consequence thinking. Consequence thinking is taking the time to think through a task, identifying and controlling all energy sources and behaviors so that injury to others or yourself will not occur. It's not something that is an option: it needs to be part of our work and everything we do.

The steps in Consequence thinking:

1. Identify the hazards involved.
2. Evaluate the risks involved.
3. Determine the controls to reduce the risk of injury.

IDENTIFYING AND EVALUATING HAZARDS AND RISKS

Hazard control begins with recognition. A hazard is: "any condition or practice that could cause an injury, illness or property damage." Throughout your training you will be introduced to many different hazards that you will encounter in the workplace.

Some hazards are easy to spot and are known by almost everyone in the workplace. These would include slips, falls, and vehicle or mechanical hazards. Chemicals hazards however, are not so easy to identify.

There are so many different hazards in your workplace that it is difficult to be fully knowledgeable about all of them. This is why it is so important that you are always asking questions of your co-workers, supervisors, safety professionals and all other area subject matter experts.

BROAD CATEGORIES OF HAZARDS

Some broad categories of hazards that you may encounter in your work areas include:

- Chemicals- vapors, gases, dusts, fumes and mists (i.e. acids, bases, carcinogens, toxins, flammables, and explosives)
- Physical- noise, temperature extremes, working surfaces, lighting, radiation, vibration, altitude
- Biological- blood borne pathogens, MRSA, wildlife, etc.
- Ergonomic- lifting, reaching, stretching, pushing, twisting
- Fire/Explosion Risks
- Infrastructure and Equipment
- Motorized Equipment

IDENTIFYING HAZARDS

Always consider the following when identifying hazards in your workplace:

- What could happen if conditions change (weather, emergency situations, etc.)?
- Have you and your co-workers been trained to perform all the tasks you've been given? (Never perform any task you haven't been trained to complete safely.)
- Are there hazards that could originate from outside your work area? (For example dust or gas that may migrate into the work area from adjacent processes, even vehicle exhaust.)
- Are your work activities creating hazards to you and others in the areas? For example, are you opening any open-holes, welding above an area where people are walking, using chemicals that could splash or need specific gloves or equipment to handle?

AREA INSPECTIONS

Area and workplace inspections and daily safety inspections are required before beginning work in any area. They are typically outlined on a simple form that is easy to use as you walk through your area to ensure a safe workplace.

STANDARD OPERATING PROCEDURES (SOPS)

Standard Operating Procedures (SOPs) are the most common tool at your disposal and are established procedures that are to be followed for routine tasks in your areas. These procedures outline potential safety hazards and the steps needed to address them. SOPs are typically developed by the different areas or site that cover: the Purpose, Safety Hazards, Controls, Scope, Definitions, Policy, Responsibilities, and Procedures.

It is important to remember that site and department SOPs may vary and if you transfer within the company or even within a site that you familiarize yourself with their procedures.

JOB SAFETY ANALYSIS

A Job Safety Analysis (JSA) is a tool that can help walk you through typical hazards encountered in your work areas. They come in many different forms and are called many different things; some can be very detailed others can be checklists but they all do one thing- help to ensure hazards are identified.

Every department is a little different in that some require them to be filled out for every job; while others only require them to be used with non-routine tasks. Check with your supervisor before you start working to see what your department requires. Once a JSA has been completed, ensure everyone on the team knows what the hazards of the job are and how to control them. After the task has been completed JSAs are typically filed with either the supervisor or area planner.

HAZARD IDENTIFICATION, RISK ASSESSMENT AND DETERMINATION OF CONTROLS (HIRADC)

Hazard Identification, Risk Assessment and Determination of Controls (HIRADC), also known as Risk Assessments, Risk Registers, or Task Registers are a formalized systematic approach to consequence thinking that identifies and evaluates risk associated with specific tasks and the controls needed to ensure the safety of everyone involved. Each site has conducted its own and is accessible to you at any time.

A sub-committee typically does this with specific tasks evaluated in terms of the likelihood that a problem may occur and the consequence it would cause if such an event did occur is called a "risk rating." A Risk Matrix is used to determine this risk rating for each of these tasks in the terms high, medium and low. The adequacy of existing controls is also taken into account and these controls are then followed up on a regular basis to ensure they are working properly.

While there are many ways of identifying hazards, a judgment needs to be made about the risk. This is the probability of a hazard resulting in an emergency event and the severity of the consequences if the situation did happen. In the field, you will be evaluating risks on a consistent basis in order to determine the best way to control the hazards.

Incidents rarely, if ever, are the result of one isolated event. They usually follow a series of smaller, seemingly less significant events. If you notice a domino effect of smaller incidents (unsafe acts, near misses, cut corners, etc.) it's time to stop, regroup and rethink the process.

REDUCING RISK – HIERARCHY OF CONTROLS

Once you have identified a hazard, you must determine the best way to control it. There are five levels of hazard control strategies used to mitigate risks. They are listed below in the order of their effectiveness called the Hierarchy of Controls. In the following pages, we will review examples of how to utilize these controls with the hazards identified in your work areas.

HAZARD CONTROL STRATEGIES

The five levels of hazard control strategies to be considered in reducing an identified risk, ordered from the most effective (elimination) to the least effective (use of personal protective equipment [PPE]).

- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment (PPE)

ELIMINATION AND SUBSTITUTION

Elimination and substitution are the most effective ways to reduce a hazard. Sometimes they are also the most difficult to implement.

These controls are sometimes grouped together. Through substitution you are removing the first substance or eliminating the hazard from the workplace. The goal is to choose a new chemical or process that is less hazardous than the original. By removing the hazard in your workplace or changing the source of the hazard, you eliminate any risk involved.

Example: If you have a cleaning job to complete inside of a tank and the chemical you are using gives off hazardous fumes, either removing the need for the cleaning process or utilizing a different chemical, which is not hazardous, would be the most effective solution.

Unfortunately, changing a process can be difficult, and sometimes there are no other options available for substitution. At this point, we consider using an Engineering Control.

ENGINEERING CONTROLS

Engineering controls actually focus on eliminating or reducing employees' exposure to the hazard. The basic concept behind this control is to block access to the hazard through some form of barrier. These controls do not have to be expensive or complicated.

Example: If you have a moving machine part, the best way to control the hazard is to cover it so that it can't be accessed by anyone accidentally.

ENGINEERING CONTROLS ARE BASED ON THE FOLLOWING:

- Enclose the hazard to prevent exposure, such as guarding
- If complete enclosure is not feasible, a barrier (handrail) or ventilation can be used to reduce exposure to the hazard

ADMINISTRATIVE CONTROLS

Administrative controls involve changing how or when employees do their jobs and control exposure to a hazard by implementing "rules."

These can include:

- Policies and procedures
- Standard Operating Procedures (SOPs)
- Training
- Restricted access
- Equipment maintenance
- Housekeeping
- Personal hygiene practices

Administrative controls have many limitations because the hazard itself is not actually removed or reduced.

Example: In some tank houses, lead is used in copper production. This is a concern as lead is harmful and could be taken into a lunchroom by contaminated work boots. Since lead cannot be taken out of the process, rules are in place (Administrative Control) requiring work boots to be removed before entering a lunchroom.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) protects us from hazards in our work environments. These items include:

- Hardhats
- Protective clothing
- Gloves
- Face shields
- Safety glasses
- Safety boots
- Respirators

While PPE seems like a simple solution to a hazard, it is important to note that any system that relies on behavior is inherently unreliable. It is estimated that 88% to 95% of all workplace incidents are due to behavior. Both Administrative controls and PPE methods have proven to be less effective than other measures, requiring significant effort by everyone involved.

Q What could happen if risk isn't controlled?

To illustrate this point, let's look at some disastrous real world examples where hazards were not controlled (share photos of hazards).

HAZARD RECOGNITION QUIZ

1. What are the three steps in Consequence Thinking?
   a._____
   b._____
   c._____

2. What should you do if you are not familiar with the safety issues concerning your current task?
   a. Report to your supervisor and discuss ways to safely complete the work
   b. Continue working
   c. Leave the job unfinished
   d. Allow someone else to complete the job

3. Mike is an experienced continuous miner operator who is concerned he is beginning to experience hearing loss, and begins to think about ways to prevent himself from being exposed to noise. He is aware of the following potential controls: a) Enclosed cabins, b) Hearing protection, c) Remotely controlled equipment, d) Job task rotations, e) New equipment with bits that produce less noise. Match each control with its corresponding control category, and in order of effectiveness, by writing it on the lines below.

Most effective	_____	Elimination
More Effective	_____	Substitution
Somewhat Effective	_____	Engineering
Less Effective	_____	Administrative
Least Effective	_____	Personal

INTRODUCTION TO FIRST AID SAFETY

See 30 CFR 46.5(c)(2); 48.5(b)(11); and 48.25(b)(10).
Applicable to: Sand and Gravel, Underground, and Surface mining.

First aid is the immediate and temporary care given to the sick and injured. The purpose of first aid is to provide basic life support to injured individuals on mine property until advanced medical care can be obtained according to MSHA 56.1080. All mine operators are required to have appropriate first aid equipment on mine property to treat most injuries that may take place. You as an employee need to know the location of this equipment as well as your local emergency numbers to contact advanced medical care.

Each mine shall have designated persons each shift that can provide first aid to injured individuals. This first aid shall include control of bleeding, splinting and CPR. It is the responsibility of the mine operator to designate these people and update their training annually as required. It is YOUR responsibility to know where your First Aid materials are on property. If you use the materials, you need to let Mine Management know so that the items can be replenished. In addition, any person who renders first aid and who does not exceed their scope of training will be protected from legal action from the injured individual. The main thing is that you do not go beyond your scope of training.

Q What are the steps you should take if there is an incident? (Class question)

- Initiate Mine Emergency Response Plan. GET HELP!!!
- Notify supervisor
- Protect the scene
- Make sure the other workers are safe from hazards
- Assure first aid is administered to injured individual
- If you are a supervisor, make sure you have notified local, state, and federal authorities (as necessary)

SCENE SAFETY

Some of the factors that should be considered are personal safety, safety of fellow workers and safety of the patient. In ensuring personal safety, you should don protective gloves, glasses, and gown, as well as guard against environmental hazards. Furthermore, you should be aware of external hazards such as ground conditions, electrical hazards, chemical hazards, air quality, and access problems.

EMERGENCY RESPONSE

The three “A”s of how to respond to an emergency are:

- Assess – survey the scene, look for life threatening conditions
- Alert

- Attend

In attending an injured individual, you should first check for responsiveness. Is the individual unconscious or conscious?
If the individual is unconscious, these are the steps you should follow:

- Call EMS
- Check circulation
- Check airway and signs of breathing
- Provide CPR or rescue breathing
- Control bleeding
- Care for shock

If the individual is conscious:

- Introduction and request consent
- Control bleeding
- Head to toe exam
- Provide first aid
- Care for shock
- Call EMS if necessary

CONSENT

Before providing care to someone who is conscious, you should first identify yourself and tell them that you are trained. It is also important to ask the person if they want help. In cases where the individual is unconscious or is a minor (without their parent present), consent is implied.

Q In what emergency situations should EMS be called right away

- Unconscious individual
- Chest pain
- Difficulty breathing
- Passing blood
- Head, neck and back injuries
- Poisoned
- If you have any doubts, it's always good practice to call

Now that you are administering care, when would it be appropriate to stop?

- Relieved by another person
- They are pronounced dead
- Patient revives
- You become exhausted

TRIAGE

If there are multiple victims, they should be prioritized based on the severity of the injury. Those who are critical should be tended to first, with those who are in serious condition, tended to second. The walking wounded should be given attention next, and finally, those who are fatally injured or dead.

Moving victims should only be done if they are in a life threatening location and with extreme care. The "log roll" should be utilized, where the victim is rolled as a single unit, protecting the head and neck from a twisting motion.
The following acronym "S.A.M.P.L.E." should be kept in mind when gathering information about the victim and their circumstances:

- S = signs and symptoms
- A = allergies
- M = medication
- P = pre-existing medical history
- L = last meal
- E = events

Victims should be examined head-to-toe, starting with the head and neck, chest, abdomen, pelvis, and finally, the extremities.

PERSONAL SAFETY

Whenever there is a potential to come in contact with bodily fluids, you need to take appropriate measures to guard against accidental contact. Most communicable diseases we deal with today are curable, however; HIV and some forms of Hepatitis are not. Direct contact with bodily fluids such as blood, amniotic fluid, bodily wastes, and other fluids is still the number one leading cause of individuals accidentally contracting communicable diseases. When cleaning up bodily fluids, remember to wear appropriate PPE. Use cleaners such as a bleach/water solution (1:10) in order to mitigate these hazards. The cardinal rule when working with bodily fluids: If it's west and not yours, don't touch it!!

BLEEDING

The adult body holds six quarts of blood and rapid loss of one quart or more can lead to shock and death. There are three different types of bleeding: capillary, venous, and arterial. Capillaries are the smallest and most numerous blood vessels. Bleeding is slow and the body should naturally be able to control this bleeding. This type of bleeding should be cleaned with warm water and dressed with a bandage. Venous bleeding is dark red and flows steadily. This bleeding must be controlled by external factors and 911 should be called. Arterial bleeding is the bright red and flow of blood is under pressure, wherein an individual can bleed to death in one minute or less. It is imperative to call 911. In attending to a victim, assure there is an adequate pulse rate.

Q What is the average adult range?

Sixty to 100 beats per minute

Q What steps can be taken to control bleeding?

Direct pressure- if blood soaks through, apply more dressings. Do not remove the previous dressings.

- Elevation- above the level of the heart, unless a fracture is present.
- Pressure points- arm, wrist, leg. Apply for a maximum of two minutes and release for 30 seconds. Some pressure points include: temporal, sub-clavian, carotid, brachial, femoral, dorsalis pedis.

Keep in mind that airway and breathing will always take priority over major bleeding. Once the bleeding has been controlled, dress and bandage the wound appropriately.

OTHER INJURIES

Closed wounds include bruises and internal bleeding. If the victim has been penetrated by an object, it should not be removed, but rather, stabilized, and 911 should be called immediately. When attending to a victim of amputation, bleeding should be controlled. The body part that has been amputated should not be scrubbed nor placed directly on ice. To salvage the body part, it should be wrapped in clean cloth, placed in a sealed bag and put on ice.

Fractures should be stabilized in the position they were found. If a splint needs to be applied, it should be done at the joint above and below the fracture site. Do not over-tighten the splint as the fracture will swell and needs room to expand. If in doubt, wait for advanced medical care.
Eye injuries can be categorized into three types: chemical, particle, and penetrating injury. Chemical injuries should be flushed for 20 minutes. Particle injuries should be flushed and bandaged. Penetrating injuries should be treated by stabilizing the object in place with bulky dressings and both eyes should be bandaged.

SHOCK

All patients are in shock regardless of their condition. Treatment includes: opening the airway, controlling the bleeding, stabilizing fractures, elevating the feet 10-18 inches unless a fracture is present, maintaining the patient's normal body temperature, and talking with the patient. Shock is a life threatening condition that unless managed, will lead to death in even the simplest cases. During shock, the body fails to deliver adequate supply of blood and as such, all injuries should be treated for shock.

Q What are some signs of shock? (Class question)

- Anxiety and daze
- Altered consciousness
- Rapid pulse
- Pale, cool, moist skin
- Thirst and nausea

BURNS

There are different levels of severity and accompanying treatments when dealing with burn victims:

- First degree burn- red color to the skin, only the upper layer of the skin is affected. To treat, cool the burn and wrap in moist dressings. Medical attention should be sought.
- Second degree burn- red color to skin with blisters. To treat, cool skin and warp in clean, dry, sterile dressings and seek medical attention. Do not break the blisters.
- Third degree burn- black charred skin or gray leather type appearance. To treat, wrap in dry sterile dressing and seek medical attention immediately
- Chemical burn- considered third degree. To treat, flush for 20 minutes and wrap in dry sterile dressings. Remove all contaminated clothing when flushing the affected area. Do not expose yourself!!

FIRST AID SAFETY QUIZ

1. First aid is the _____ and _____ care given to the sick and injured. The purpose of first aid is to provide _____ to injured individuals on mine property until _____ can be obtained.

2. Suzie works at a coal mine crushing facility as a shift supervisor. One of her crew members is seriously injured when a piece of equipment's hydraulic system fails, and his arm is crushed beneath it. When she responds to the scene she remembers the acronym SAMPLE, and that she needs to ask him about any (M) medications he may be taking. What other information should she gather while they wait for the emergency response team? Select all that apply.
    a. What his last meal was
    b. Any allergies he has
    c. How much pain he is experiencing
    d. His pre-existing medical history
    e. Any events that might be important for medical personnel to be aware of
    f. Any signs and symptoms he has or feels
    g. If he feels nauseous or in shock

3. The three steps that can control bleeding are:

EVACUATION PLANS & FIRE SAFETY

See 30 CFR 46.5(b)(3); 48.5(b)(5); and 48.25(b)(5).
Applicable to: Sand and Gravel, Underground, and Surface mining.

During any given time on a minesite, a situation may arise where an emergency evacuation is warrented. It is important as an employee to know the plans on site during an emergency. It is vital to note that is not only your life that is in jeopardy in these situations. Knowing and practicing emergency evacuations can help save the lives of all those on site.

MINE PLANS

Mines are required to develop an escape and evcuation plan and have them available to the Secretary or his authorized representative. The plan must be set in written form and show the assigned responsibilities of all key personnel in the event of an emergency. Any revisions to the plan must be made available to the secretary or his representative within 45 days of promulgation.
Copies of the plan and revisions shall be posted at locations convenient to all persons on the surface and underground. The plan must be updated as necessary and shall be reviewed jointly by the operator and the Secretary or his authorized representative at least once every six months from the date of the last review.
The plan shall include:

- **A.** Mine Maps and Diagrams (Underground)
    - Shows directions of principal air flow and locations of escape routes, existing telephones, primary fans, primary fan controls, fire doors, ventilation doors, and refuge chambers. Appropriate portions of such maps or diagrams shall be posted at all shaft stations and in underground shops, lunchrooms, and elsewhere in working areas where persons congregate
- **B.** Emergency Notification Procedures
    - To show how the miners will be notified of emergency
- **C.** An escape plan for each working area
    - For each working area in the mine to include instructions showing how each working area should be evacuated. Each such plan shall be posted at appropriate shaft stations and elsewhere in working areas where persons congregate
- **D.** A fire fighting plan
- **E.** Surface emergency procedures
    - To follow in an emergency, including the notification of proper authorities, preparing rescue equipment, and other equipment which may be used in rescue and recovery operations
- **F.** A statement of emergency availability
    - For emergency communication and transportation facilities, emergency power and ventilation and location of rescue personnel and equipment

UNDERGROUND EMERGENCY EVACUATION

Gases can be placed in the underground ventilation system to quickly warn miners of an emergency evacuation. Ethyl mercaptan, or stench gas, is released into the fresh air system and compressed air system. Once the gas has been sensed, miners know to evacuate the mine or go to a refuge chamber. This will depend upon the mine's evacuation procedure.

It is important to choose a leader when in a group. He or she can lead the discussions, make decisions, and keep the goupr together during the evacuation. It is important that discussions are not too long as crises can escalate in a matter of seconds. One may also run into smoke that will increase your travel time. Remember your self rescurer is good for 1 hour. Keep in mind the flow of the ventilation throughout the mine and try to stay in fresh air during your escape. Evacuees should proceed to fresh air by the quickest means possible even if it means they have to go up or down different levels by manways.

If a fire is encountered and it is small enough to extinguish with a fire extinguisher, or with the fire suppression system, an attempt to do so is advised. If the fire is beyond your control, do not attempt to extinguish the fire. Exit the mine by using the escape route to the surface. Do not turn off any fans that are blowing fresh air into the mine. Once on the surface, report the fire to your supervisor, project superintendent, or any Pogo Mine representative immediately. Never forget to tag out.

BARRICADING

If all escape routes are blocked and you can't even get to a refuge chamber you may have to protect yourself from fire, heat, and/or gases. Barricading requires building airtight bulkheads to enclose a large quantity of fresh air while keeping out any poisonous gases. This should only be done as a last resort. Most mines have refuge chambers that you may enter in an emergency.

REFUGE CHAMBERS

Refuge chambers were created to provide mine workers access to clean air, food, and water until they can be rescued. It is important to not that entering a refuge chamber during an evacuation may not be the safest course of action. Adhereing to the mine evacuation procedures will provide the safest alternative.

UNDERGROUND EVACUATION DRILLS

At least once every twelve months, all persons who work underground will be instructed in the escape and evacuation plans and procedures and fire warning signals in effect at the mine. Whenever a change is made in escape and evacuation plans and procedures for any area of the mine, all persons affected will be instructed in the new plans or procedures. Whenever persons are assigned to work in areas other than their regularly assigned areas, they willll be instructed about the escape way for that area at the time of such assignment. However, persons who normally work more than one area of the mine shall be instructed at least once every twelve months about the location of escape ways for all areas of the mine in which they normally work or travel.

FIRE SAFETY

Fire Safety, at its most basic, is based upon the principle of keeping fuel sources and ignition sources separate.
Fires need four elements in order to occur:

- Fuel - Any combustible material - solid, liquid or gas. Most solids and liquids become gas or vapor before they will burn.
- Oxygen - The air we breathe is about 21 percent oxygen. Fire only needs 16 percent oxygen to burn.
- Heat - The energy that causes the fuel to produce vapors which, in turn, allows ignition to take place.
- Chemical Reaction - When fuel, oxygen and heat come together in the proper amounts and under the right conditions, a chemical chain reaction takes place causing rapid oxidation to occur. This rapid oxidation results in fire.

Removing one of these from the equation can prevent a fire from starting or assist in putting out a fire. Inspect your work area to ensure that combustible items, such as wood, grasses, paper, cardboard, rubber, greasy rags and some metal dusts, are stored or disposed of properly.

Flammable and combustible liquids may also play a role in starting and sustaining fires or explosions. Always read product labels and Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDSs) to determine if the chemicals you are using are flammable or combustible.

General categories for liquids that can ignite:

- **Flammable liquids:** have flash points below 100° F
  - **Examples:** gasoline, acetone, toluene, turpentine, styrene, isopropanol, methanol, ethanol, etc.

- **Combustible liquids:** have flash points at or above 100° F
  - **Examples:** kerosene, pine oil, diesels, oils, etc.

FUEL CLASSIFICATIONS

- **Class A:** Wood, paper, cloth, trash, plastics—solids that are not metals. Works by cooling the fire.
- **Class B:** Flammable liquids—gasoline, oil, grease, acetone. Includes flammable gases. Works by blanketing the fuel.
- **Class C:** Electrical—energized electrical equipment. As long as it's "plugged in." Works by displacing oxygen, smothering fire.
- **Class D:** Metals—potassium, sodium, aluminum, magnesium. Requires Metal-X, foam, and other special extinguishing agents.
- **Class K:** Combustible fats or cooking oils—in well insulated cooking appliances in commercial kitchens.

FIRE PREVENTION

Class A - Ordinary Combustibles

- Keep storage and working areas free of trash and unnecessary clutter.
- Place oily rags in covered containers. Make sure the lid is replaced securely.
- Keep combustibles and fibrous materials such as wood, paper or cloth well away from a source that could cause them to ignite.

Class B - Flammable Liquids or Gases

- Use flammable liquids only in well-ventilated areas.
- Keep flammables away from any spark-producing source.
- Store flammables in tightly-sealed, self-closing, spill-proof containers. Pour only what you need from storage containers.
- Do not refuel gasoline-powered equipment while it's still hot.

Class C - Energized Electrical Equipment

- Check wiring and electrical fittings for wear or damage. Report any hazardous conditions to supervisor.
- Investigate any unusual odors coming from an electrical device.
- Prevent electrical equipment from overheating by keeping it clean and in good working condition.
- Do not overload electrical outlets.
- Never install a higher-rated fuse than what is specified for a circuit.
- Keep areas around electrical outlets or other spark-producing devices free of combustible materials such as paper, cloth or dust.
- Make sure utility lights have a guard over the bulbs to prevent them from coming into direct contact with combustible materials.

Class D - Combustible Metals

- Handle all combustible metals, such as magnesium, potassium, titanium and sodium, in accordance with the specific guidelines provided in the manufacturer's MSDS's.

FIRE EXTINGUISHERS

Many fire extinguishers have multiple ratings:

- BC - Class-B fires or Class-C fires
- ABC - Class-A, Class-B or Class-C fires

Class A and Class B extinguishers also have a rating indicating how large a fire can be extinguished by an experienced person. Class C extinguishers only have a letter rating indicating that the extinguishing agent will not conduct electricity. Class D extinguishers also have only a letter rating and an indication of their effectiveness on specific metals.

PASS METHOD OF USING A FIRE EXTINGUISHER

- P - Pull the pin.
- A - Aim the nozzle at the base of the flames.
- S - Squeeze the trigger while holding the extinguisher upright.
- S - Sweep the extinguisher from side to side covering the area of the fire.

FIGHTING FIRE

In the event of a fire, remember your personal safety is most important. Fire extinguishers are provided in your areas to assist in your escape if a fire occurs, or to quickly extinguish a small fire in the early stages if it can be done safely.

If all of the following conditions are met, you may choose to use a fire extinguisher against the fire. If you have even the slightest doubt about your personal safety, do not fight the fire, exit the area immediately, and notify emergency personnel.

Before deciding to fight a fire, be certain that:

- The fire is small and contained and not spreading**.**
  - A fire can double in size within seconds
- The fire won't block your exit if you can't control it.
  - Know your escape route
  - Fight the fire with your back to the exit
- You have the proper fire extinguisher for what is burning.
- You know how to use your fire extinguisher.

Never fight a fire if:

- The fire is spreading beyond the point where it started.
- The flames are threatening to block your path of escape.
- You don’t have the proper or adequate equipment to extinguish the fire.
- If you are in any of these situations, do not fight the fire yourself. Call for help and escape immediately.

EMERGENCY ACTION PLAN

Before work begins on any site, you should know exactly what to do when an alarm is sounded. You should be aware of the primary and secondary escape routes. Proceed calmly but quickly during an evacuation. Remember to treat each drill as if it were an actual emergency.

EVACUATE A BURNING BUILDING

If a fire alarm is sounded in your facility, proceed to the nearest exit outlined in your Emergency Action Plan. Close, but do not lock, the door behind you if you are the last to leave your area. Use stairs to exit to the ground floor of multi-level buildings. Never use elevators in a fire drill or emergency. Stay close to the floor to avoid smoke or toxic gases that may be present. If possible, cover your nose and mouth with a damp cloth to aid breathing. Once you are safely outside, report immediately to a predetermined area.

If you become trapped inside:

- Do not panic.
- Try a locate a phone. Call for help and give your exact location.
- Feel closed doors with the back of your hand before opening. If hot, do not open. Seal the cracks around door with anything available.
- Stay close to the floor to avoid smoke and toxic gases.
- If possible, open a window to ventilate the air and to make breathing easier.

STOP, DROP, & ROLL

If you are to catch fire, it is important to remember never to run. This will only fan the flames potentially causing serious injuries. The correct response is to Stop, Drop, and Roll on the ground to extinguish the flames. Cover your face with your hands to protect your face and lungs. If one of your colleagues catches fire, panics, and starts to run, tackle him or her and smother the flames.

UNDERGROUND FIRES

Before going underground, all persons should be aware if the fire is spreading or a possible explosion can occur. Before sending teams underground make sure that:

- The main fan is running
- Tests are being made at main returns for any mine gases
- SCBA's are worn
- Turnouts are worn

Use information given by mine officials and workers where smoke, fumes or heat was last seen to locate the fire. Be aware of the amount of afterdamp gases. These could determine what is burning and how much is burning. Gas readings near the fire area may determine if the atmosphere is potentially explosive. Don't forget to check on ventilation controls for damage. The back must continually be evaluated since heat will weaken the strata.

When nearing the fire, it is important to assess the situation and note the following:

- Do not make any sudden changes in mine ventilation without IC direction.
- Determine location of battery or diesel operated equipment.
- Determine location of explosives, oil and grease, diesel fuel, bottled gas.
- Cut off if possible electric power to affected area(s), to prevent arcing starting additional fires and safety to mine rescue teams.

EVACUATION PLANS & FIRE SAFETY QUIZ

1. Rob is a surface mine mill operator, and entrance to the mill requires the use of earplugs. Despite current noise controls, Rob has noticed that his hearing has been fading over time. What could be causing this? Select all that apply.

   a. Rob needs to learn how to better insert his earplugs.
   b. Rob has extra-ordinarily large ear canals and the standard earplugs just don't fit properly.
   c. Rob has extra-ordinarily small ear canals and wearing earplugs is uncomfortable, so he usually doesn't wear them.
   d. He doesn't usually wear his earplugs because they tend to get dirty and he gets concerned about hygiene.

2. Face shields must be used with _____ or _____.

3. This type of respirator uses a fan to blow air through the filter to the user.
   a. Full-face respirator
   b. Half-mask respirator
   c. Supplied air respirator
   d. Powered air-purifying respirator
   e. Self-contained breathing apparatus

INTRODUCTION TO PERSONAL PROTECTIVE EQUIPMENT (PPE)

See 30 CFR 46.5(b)(4); 48.5(b)(7); 48.5(b)(13); and 48.25(b)(7); 48.25(b)(12).
Applicable to: Sand and Gravel, Underground, and Surface mining.

Personal Protective Equipment or PPE is special gear worn that protects us from contact with chemical, physical, thermal, biological and radiological hazards. PPE creates a physical barrier which travels with the individual and can include a variety of devices and garments that protect your head, eyes, face, ears, body, arms, legs, feet and hands.

Your site and department supervision will provide you with the proper PPE and ensure that you are aware of your area's specific requirements. It is important that you must always understand and ask questions about any chemicals/materials/hazards you are working with. This way, you can ensure that you know what other precautions to take and how to manage emergency situations.

PERSONAL PROTECTIVE EQUIPMENT (PPE) BASICS

Remember PPE should always be chosen as a last resort. Whenever a hazard is identified, always apply the hierarchy of controls to eliminate it. If we are still unable to completely remove a hazard, PPE may be used.

Despite the protections PPE offers, it has one major drawback - the effectiveness of PPE depends on people using it and using it correctly.

When the boom of a 26-year-old Arkansas tree-trimmer's bucket was struck by a falling limb, he was catapulted skyward. He then slammed into the boom attached to the bucket and fell hard to the ground. Although he was wearing his safety harness, it was not fastened to the bucket and he died the next day.

Harnesses cannot prevent you from a fall if you are not using them correctly. Earplugs will not protect your hearing when they are left in your pocket and your safety glasses will not protect your sight if you are not wearing them. Just having PPE is not enough; you have to wear it the right way for as long as you're exposed to a hazard.

Whenever you are entering any production or maintenance areas or when a hazard is present, the following basic PPE is required:

- Safety glasses
- Hard hats
- Steel toe boots

In some areas additional PPE may be required:

- Gloves
- Ear plugs

- Respirators
- Reflective vests
- Other special equipment

SELECTION AND FIT

One size does not fit all. To be effective and allow you to perform your job, PPE has to fit properly. Most PPE comes in different sizes. It's important that your gear fits you well enough so there are no dangerous gaps in protection. In addition, you have to be able to move comfortably while wearing it. If your PPE does not fit properly, speak up immediately before entering areas where it is required.

Q What are the basics of PPE use?

- Always select the PPE that will best protect you from the hazard.
- Inspect your PPE before use.
- Clean your PPE after you are done and before you use it.
- If your PPE is damaged:
    - Do not use it
    - Contact your supervisor
- PPE is inexpensive compared to your safety
- Wear your PPE properly.
- If you are not using your PPE correctly, then you are not protected.

Note: *If your PPE does not fit properly, speak up immediately before entering areas where it is required. If you have questions about wearing or using or caring for your PPE, ask a supervisor.*

PPE CONDITION AND INSPECTION

If PPE is going to protect you, it must be in good condition. Before you put on gloves, goggles, clothing or any piece of PPE, inspect it carefully. If an item is damaged, DO NOT USE IT! Notify your supervisor immediately, get new protective gear and dispose of the damaged equipment. PPE is inexpensive compared to your safety.

Inspect your PPE before use to ensure it does not have any:

- Rips
- Tears
- Disintegration
- Other damage

DONNING AND REMOVING PPE

It is important that you understand the correct way to put on and remove your PPE. The chief concern when putting on your PPE is to get a good fit and make sure it's in good condition and correct for the hazard or task you are performing. Make sure that you fasten all the fasteners and are wearing each piece of equipment that's necessary for your protection.

There is a need for caution when you remove PPE. Be especially careful with PPE that has been contaminated by hazardous chemicals. You don't want to spread the contamination to your body, other people or clean areas. To avoid that risk, remove contaminated PPE one piece at a time, from the top down. Keep your gloves on while you remove the protective clothing so that your bare hands are not exposed to contamination.

Once the PPE is off, you need to clean it and ensure that it is still in good condition. Again, contaminated clothing is a special concern. Place it in specially assigned containers for disposal or cleaning. Your area supervision will communicate these proper methods depending upon the hazard and PPE used.

The key point is to take good care of your personal protective clothing and equipment so it can protect you.

If your area uses PPE make sure you know:

- What the hazards are
- When PPE is needed
- What PPE is needed
- How to properly
- Put on
- Wear
- Adjust
- Take off
- The useful life and limitations of your PPE
- How to properly care for, maintain and dispose of your PPE

EYE PROTECTION

Many occupational eye injuries occur because workers are not wearing any eye protection. Others result from wearing improper or poorly fitting eye protection.

It is estimated that each day (CDC/NIOSH, “Eye Safety”):

- More than 20,000 workers suffer eye injuries.
- 100 of these injuries result in temporary or permanent vision loss.

Statistics show that the proper use of eye protection could have reduced the number and severity of these eye injuries in 90% of these accidents.

Q What are some of the causes of eye injuries?

- Dust and other flying particles such as metal shavings or debris.
- Molten metal that might splash.
- Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
- Radiant energy created by welding.

Q How do you select the most suitable type of eye and face protection?

Always take into consideration your eye protection's ability to protect against specific workplace hazards.

Eye wear should always:

- Protect against your specific workplace hazards.
- Fit properly and be reasonably comfortable to wear.
- Provide unrestricted vision and movement.
- Allow unrestricted functioning of any other required PPE.

SAFETY GLASSES

- Shield eyes from a variety of moderate impact hazards.
- Available in prescription.
- Contact your local Health & Safety Representative for more information.
- Must meet ANSI Z87.1 standards and have side shields.

Limitations:

- Do not protect against impacts to the face

SAFETY GOGGLES

Protect against:

- Impact
- Dust
- Chemical splashes
- Some goggles fit over corrective lenses

Limitations:

- Fog easily restricts vision
- Does not protect face

FACE SHIELDS

Provide additional protection against:

- Splashes or sprays of hazardous liquids.
- High energy impact hazards.

Limitations:

- Do not provide adequate protection alone.
- Must be used in combination with goggles or safety glasses.

WELDING SHIELDS

Filtered lens protects eyes from burns caused by infrared or intense radiant light. Protect face and eyes when welding, brazing, soldering and cutting from:

- Flying sparks
- Metal spatter
- Slag chips

Limitations:

- Limited vision
- Some models do not accommodate use of respirators
- Ensure you select proper Filter Lens Shade:
- #5 for Gas Welding
- #10 for Arc Welding

HEARING PROTECTION

There are two types of hearing protectors: earplugs and earmuffs. They're the next line of defense against noise when you can't reduce exposures with engineering or administrative controls. While many times the type needed will be selected for you, if you have any issues or questions or are working in a new area where it has not yet been determined if you must wear protection. Consult your Health and Safety professional or Industrial Hygienist.

DISPOSABLE AND REUSABLE EARPLUGS

Formable or disposable earplugs are made of expandable foam and usually come in one size. These are the most popular earplugs and those most commonly found on the job site. Reusable plugs are pre formed to fit the ear. They usually are made of flexible rubber or silicon and can be flanged or cone shaped. Some are joined by a cord so they are not easily lost; others may be on a headband. The headband ensures uniform pressure on your ears.

Earplugs roll up, fit inside the ear canal, and then expand to form a seal. They furnish good hearing protection when properly inserted, so make sure to follow the manufacturer's directions. Also, clean your hands before inserting the plugs because dirt and germs can be transferred from your hand to the plugs and cause ear infections. Replace disposable plugs as soon as they become damaged or dirty, reusable earplugs should be washed in lukewarm water using hand soap, rinsed with clean water, and dried before using.

Steps to properly inserting ear plugs

1. Roll entire earplug into a crease-free cylinder
2. Pull back ear by reaching over head with free hand, gently pull top of ear up and out
3. Insert earplug well into ear canal and hold until it fully expands

Q What are the pros of earplugs?

- Comfortable for extended use
- Disposable earplugs available
- Cooler in hot/humid environments

Q What are the cons of earplugs?

- Noise reduction highly dependent upon good fit
- Hygiene issues in dirty environments

EARMUFFS

Earmuffs look like stereo headphones and have soft plastic cushions that are filled with foam or liquid that provides a seal around the entire ear. To be effective, the earmuff seal must not be interrupted. Wearing a respirator, a hard hat, or eyeglasses, or having longer hair, can prevent a good seal. As a result, you may need to wear another type of hearing protector.

Q What are the pros of earmuffs?

- Easy to get proper fit
- Good for intermittent noise
- Radio & electronic options

Q What are the cons of earmuffs?

- Can feel hot/heavy with extended wear
- Can't always be used with other PPE

Note: *Report any problems with your hearing protection or noise control devices straight away. Let your supervisor or safety representative know. If you have any ear trouble, report it right away.*

HEAD PROTECTION

A head injury can injure you for life or it can be fatal. Wearing a hard hat is one of the easiest ways to protect yourself from a head injury. Due to the nature of the mining industry, hard hats must be worn at all times as required by your specific site and must meet ANSI Z89.1 standards.

HARD HATS

Protect against:

- Burn hazards
- Falling objects
- Electrical shock
- Contact with electrical conductors
- Bumping head against fixed objects
- Contact with exposed beams or pipes

There are two primary classes of hard hats commonly used on mine sites:

1. Class G- General (formerly Class A) ANSI Z89.1-1997
    - General service (mining, building construction, shipbuilding, lumbering, and manufacturing)
    - Good impact protection
    - Limited voltage protection

2. Class E- Electrical (formerly Class B)
    - Electrical work
    - Protect against falling objects, high-voltage shock/burns

Periodic cleaning and inspection will extend the life of your hard hat. Ensure that your headgear fits properly. Daily inspect the hard hat shell, suspension system and other accessories for damage that might compromise the protective value.

Hard hats with any of the following defects should be replaced:

- Cracks
- Perforation
- Deformity of the brim or shell
- Loss of surface gloss, chalking or flaking
- Indication of exposure of the brim or shell to
- Chemicals
- Excessive heat
- Ultraviolet light and other radiation

FOOTWEAR

Different footwear protects in different ways depending upon the type of hazard. Keep in mind that each site may have more requirements than those listed.

Safety Footwear must:

- Have a six inch top
- Have a hard protective toe
- ANSI and/or ASTM approved
- Be appropriate for the job and hazards
- Have Metatarsal guards, if falling objects are of concern
- Must have a well-defined heel, if your work requires any use of ladders

STEEL TOE BOOTS

Protect against:

- Hot, wet, or slippery surfaces
- Molten metal that might splash on the foot
- Objects falling on or rolling against the foot
- Exposure to nails or other sharp objects that might pierce the foot

CHEMICAL RESISTANT BOOTS

Protect against:

- Oils
- Solvents
- Corrosives

Made of rubber, neoprene, polyvinyl alcohol, vinyl, when selecting chemical resistance clothing be sure to consult the manufacturers' recommendations.

METATARSAL GUARDS

Metatarsal guards are made of aluminum, steel, fiber or plastic.

Can be:

- External and strapped on outside of boot
- Internal part of boot

Protect against:

- Impact
- Compression

Are made of aluminum, steel, fiber or plastic

Limitations:

- Cumbersome
- Heavy

Q How should you care for your protective footwear?

Employees should follow the manufacturers' recommendations for cleaning and maintenance of protective footwear. As with all protective equipment, safety footwear should be inspected prior to each use.

Look for:

- Cracks or holes
- Separation of materials
- Broken buckles or laces
- Wear on the tread of the footwear itself
- Pieces of metal or other embedded items in the soles that could present electrical or tripping hazards.

HAND AND ARM PROTECTION

With so many different hazards in the workplace to be aware of, it is easy to overlook hand injuries. Glove selection should be based on performance characteristics of the gloves, conditions, duration of use and the hazards present.

Q What are some of the potential injuries from hand and arm hazards?

Potential Hazards include:

- Skin absorption of harmful substances
- Chemical or thermal burns
- Electrical dangers
- Bruises
- Abrasions
- Cuts
- Punctures
- Fractures and amputations

Some of the causes:

- Intense heat, hot liquids, or hot gases
- Impact from tools, machinery, or materials
- Scraped against materials, machinery, or tools
- Struck against or by sharp objects
- Contact with pointed objects
- Struck by machinery or materials
- Heavy materials
- Hazardous chemicals

LEATHER GLOVES

Protect against:

- Abrasions
- Cuts
- Blisters

Limitations

- Not chemical resistant
- Not resistant to cuts

KEVLAR GLOVES

Protect against:

- Abrasions
- Cuts
- Slashes

Limitations:

- Not resistant to cuts
- Not as durable as other gloves
- Not chemical resistant

ALUMINIZED GLOVES

- Made of aluminized fabric
- Insulate hands from intense heat
- Commonly used when working with molten materials

Limitations:

- Bulky
- Not chemical resistant

CHEMICAL RESISTANT GLOVES

Made of rubber, neoprene, polyvinyl alcohol or vinyl

Protect against:

- Oils
- Solvents
- Corrosives

Limitations

- Bulky
- Not resistant to cuts
- Do not allow hands to breathe

When selecting chemical resistance gloves, be sure to consult the manufacturers' recommendations.

EXAM GLOVES

- Comfortable
- Does not limit dexterity
- Provides barrier between skin and dirt, grease

Limitations

- Easily cut or torn
- False sense of security
- Limited protection against chemicals

Ensure you read MSDS as chemical protection varies between glove material and chemical product.

REMOVING CONTAMINATED GLOVES

There are many ways that you can remove contaminated gloves. Below is a simple example, but the most important thing is that you do not expose your skin, clean garments and areas exposed to contaminated PPE.

1. Grasp one of the gloves by the cuff and pull it part of the way off.
2. The glove will turn inside out.
    - It is important to keep the first glove partially on your hand before removing the second glove. This protects you from touching the outside of either glove with your bare hands.
3. Leaving the first glove over your fingers, grasp the second glove near the cuff and pull it part of the way off.
4. The glove will turn inside out.
    - It is important to keep the second glove partially on your hand to protect you from touching the outside surface of the first glove with your bare hand.

5. Pull off the two gloves at the same time, being careful to touch only the inside surfaces of the gloves with your bare hands.
6. Dispose of the gloves by following area specific environmental rules.

RESPIRATORS

Respirators are personal protective devices that are worn on the face. They are among the most important pieces of personal protective equipment when working in a hazardous environment. Remember PPE should only be used as a last resort when controlling a hazard and all other hierarchy of control measures should be utilized before relying on respirator protection.

Respirators work in two ways by either, removing contaminates (Air- Purifying), or providing clean air from an outside source (Supplied Air). They are used to protect us from many different types of hazardous and contaminated atmospheres such as gases, fumes and dust particulates.

Q What types of activities generate air contaminants?

- Welding
- Off gases
- Hot metal fumes
- Spraying operations
- Degreasing metal parts

MONITORING HARMFUL AIRBORNE CONTAMINANTS

When working in a department, you may be asked to wear monitors which sample airborne contaminants to ensure that working conditions are safe. If levels reach certain concentrations, then respirator usage is required. This information will be shared through the health and safety department.

BEFORE WEARING A RESPIRATOR

There are several different steps that must be completed before you wear a respirator.

Select the right type of respirator:

- This will be noted in area training, SOPs, and signage
- If you have questions or are performing a non-routine task, consult with area supervision and health and safety

Speak with the health and safety department

- Provides a Medical Evaluation
- Provides Fit Testing

TRAINING

- Ensure you know how to properly wear your respirator
- Never wear a new type of respirator without being fit tested
- Ensure you understand the hazard the respirator is protecting you from
- Reference MSDSs and Labels
- Consult with Supervision and Health and Safety
- Ensure you understand the manufacturer's requirements for respirator
- Inspection
- Cleaning
- Storage

SELECTING THE TYPE OF RESPIRATOR

Respirators must be selected for protection against a specific hazard. The cautions, limitations and restrictions of use provided by the manufacturers must be strictly followed. Determining when to wear a respirator and selecting the right respirator requires an assessment, which identifies the hazard and its airborne concentrations.

This assessment should be done by experienced safety personnel or by an industrial hygienist.

If you have any questions regarding when to use a respirator speak with your Supervisor or Health and Safety Representatives.

Some departments that may require respiratory protection are:

- Conveyor systems
- Crushers
- Screening plants
- Milling plants
- Loading/unloading haulage equipment
- Smelting operations
- SX/EW plants

If a respirator is needed due to normal operating conditions department personnel or Health and Safety professionals will ensure you have the proper training and are provided with the correct size and type of respirator.

TYPES OF RESPIRATORS

Respirators are classified by the two ways they work:

- Removing contaminates (Air- Purifying)
- Providing clean air from an outside source (Supplied Air)

AIR-PURIFYING RESPIRATORS (APRS)

Respirators that remove contaminants from the air are called air-purifying respirators (APRs).

These types of respirators include:

- Disposable Particulate Respirators (N95s)
- Escape Respirators
- Cartridge Respirators
- Half Mask Respirators
- Full Face Mask Respirators
- Powered Air Purifying Respirators

DISPOSABLE PARTICULATE RESPIRATORS (N95S)

Disposable Respirators should only be used in areas with low levels of dust. These types of respirators provide very limited protection and need to be replaced on a regular basis according to the manufacturers' specifications.

- Capture particles in the air
- Low levels of dusts
- Must be replaced when they become discolored, damaged, or clogged.

DO NOT USE WITH:

- Vapors that contain oil
- Gases
- Asbestos
- Sandblasting

ESCAPE RESPIRATORS

Escape respirators are designed to be used only in an emergency, and only to escape from a dangerous area to a safe area. There are many different types of escape respirators on the market. These respirators must be selected for protection against a specific hazard and are designed for one-time use/ for a short period of time (15 minutes to an hour). Limitations and restriction provided by the manufacturer must be strictly followed.

- Used with known contaminants
- Come in many different sizes and shapes
- Carried for protection during an escape in emergency situations
- Need to be inspected on regular basis to ensure sealed pouches are intact

DO NOT USE

- With unknown chemical hazards
- As an everyday respirator (emergency use only)

CARTRIDGE RESPIRATORS

Cartridge Respirators are sometimes referred to as reusable respirators or gas masks. These types of respirators include a face piece, mask or helmet that can be cleaned and reused. They are equipped with cartridges or canisters that are discarded or replaced when they become unsuitable for further use. These cartridges may also have filters (to remove particles), charcoal (to remove certain chemicals), both, or an entirely different feature.

HALF-MASK RESPIRATOR

- Replaceable chemical/dust cartridges
- Light weight

Limitations

- Lower protection level
- Should not be used if contaminant can be
- Irritating or damaging to eye
- Absorbed by eye tissue

FULL-FACE RESPIRATOR

- Replaceable chemical/dust cartridges
- Higher levels of protection

Limitations

- Heavy
- Reduced visibility

POWERED AIR-PURIFYING RESPIRATOR (PAPR)

Powered air-purifying respirators use a fan to blow air through the filter to the user. They are easier to breathe through, but need a fully charged battery to work properly. They use the same filters as gas masks; therefore it is necessary to know what the hazard is and how much of it is in the air, in order to select the proper filters/cartridges.

- Fan blows air through the filter to the user
- Replaceable chemical/dust cartridges
- Extremely high levels of protection
- Different styles available
- Half-mask
- Full-face
- Helmet

Limitations

- Heavy
- Restricted movement
- Reduced visibility (Depending upon style)

CARTRIDGE RESPIRATORS

Cartridge respirators are only effective if used with the correct cartridge or filter for a particular chemical substance. There are cartridges available that protect against more than one hazard, but there is no "all-in one" cartridge that protects against all substances. It is important to know what hazards you will face in order to be certain you are choosing the right filters/cartridges. Whenever selecting respirator cartridges, always consult with area Health and Safety representatives.

SUPPLIED AIR RESPIRATORS

Supplied air respirators work differently from air-purifying respirators as they provide clean air rather than filtering out contaminants from dirty air. They provide higher levels of protection, but can be bulky and restrict movement.

Jobs that may require supplied air respirators:

- Asbestos abatement work
- Certain spray-painting operations
- Chlorine operations
- Confined Space entries
- Work with high levels of specific chemicals

Some examples of these types of respirators include:

- Supplied Airline Respirators
- Supplied Air Escape Respirators
- Self-Contained Breathing Apparatus (SCBA)

SUPPLIED AIRLINE RESPIRATORS

- Connected by a hose to an air compressor or series of large air tanks
- Provides unlimited supply of air as long as the compressor operates
- Protect against extremely high concentrations of dangerous chemicals
- Different styles available
- Half-mask
- Full-face
- Helmet

Limitations

- Air intakes must be located away from exhaust pipes of combustion engines
- Tied to a location
- Need an attached escape bottle for emergency conditions
- Require specialized filtration systems

SUPPLIED AIR ESCAPE RESPIRATORS

- Carried for protection during an escape in emergencies
- Used in situations where chemical releases might occur, but the air is normally uncontaminated
    - Come in many different sizes and shapes
    - Contain 5-10 minutes supply of air, enough time to exit a room or building where there has been a major chemical leak or spill

Limitations:

- Bulky
- For emergency use only
- Cannot be used for entry

SELF-CONTAINED BREATHING APPARATUS (SCBA)

- Provide clean air from a portable air tank
- Commonly used by firefighters
- Does not use filters
- Protects against extremely high concentrations of dangerous chemicals
- Different styles available
- Half-mask
- Full-face
- Helmet

Limitations:

- Very heavy (30 pounds or more)
- Extensive training required
- High maintenance
- Limited air supply (typically 30-60 minutes)
- Restricted movement
- Reduced visibility (Depending upon style)

WEARING A RESPIRATOR

Like shoes, respirators come in different shapes, styles and sizes. They can fit differently from one person to the next, as no two people are alike. A respirator has to fit well to provide protection. Respirator size and shape should be selected to fit snugly but comfortably. When you shake your head, the respirator must stay in place.

If the mask does not make a tight seal all the way around your face when you inhaling, there is a possibility that contaminated air could leak around the edges. Anything that prevents the face mask from fitting tightly against your face, such as a beard or long sideburns, may cause leakage.

Not everyone can wear a respirator as breathing through a respirator is harder than breathing in open air. People with lung diseases such as asthma, emphysema, etc. may have trouble breathing. Before wearing a respirator you must take a short medical evaluation to determine if you can safely use it. This is especially important for smokers, people with heart or lung trouble, and anyone who has difficulty breathing.

FIT TESTING

You must be "fit tested" before using any type of respirators. This test will determine how much the respirator leaks around the face, and what size respirator to select.

A fit test should be done anytime:

- a new model of respirator is being used
- you have significant weight loss or gain
- you can taste or smell gasses through your existing respirator

Area Industrial Hygienist or Health and Safety professionals will keep on file the appropriately selected respirator size for you.

STEPS TO PUTTING ON A HALF-MASK RESPIRATOR

These general steps can assist you in donning a half-mask respirator. Never wear a respirator for which you have not been fit tested or trained to use. Always ensure you understand why you are wearing the respirator (the hazards) and what other precautions you might need to take. Always follow any manufacturer guidelines.

Note: *These steps can be utilized when donning a full-face respirator as well.*

STEP 1

- Remove your protective eyewear and hard hat
- Grab the front of the respirator with one hand and the upper strap with the other hand
- Place the portion of face piece containing the exhalation valve under the chin

STEP 2

- Position the narrow portion of the respirator on the nose-bridge
- Place the cradle suspension system on the head and the bottom strip rests above the ears, on the back of the head
- Hook the bottom headband strap behind the neck, below the ears
- Adjust the position of the face piece on the face for best fit and comfort

STEP 3

- The lengths of the headband straps are adjustable; tighten or loosen by holding the respirator body of headband yoke with one hand and pulling on the elastic material in the appropriate direction with the other hand

Note: *For a comfortable fit, the headband straps must be adjusted equally on both sides of the respirator.*

STEP 4

- Position the face piece so that the nose section rests as low on the bridge of the nose as is comfortable
- Tighten the upper headband strap on both sides just tight enough so that the respirator does not slide down on the nose
- Do not over tighten (If the respirator pinches the nose, loosen the upper strap slightly.)

Note: *Straps should never be worn on top of hardhat.*

SEAL CHECK

As you work always monitor how well your respirator is working. You will know that your respirator is not working when:

- you can smell or taste the contaminant
- breathing becomes difficult; you become dizzy or sick feeling
- the manufacturer's recommended service life of the filters or cartridges expires
- the respirator is damaged

After you have put on your respirator you need to ensure that you have a proper seal. Follow the steps below for both half-mask and full-face cartridge respirators.

POSITIVE SEAL CHECK

1. Cover the exhalation valve with the palm of your hand.
2. Inflate the mask slightly by exhaling gently.
3. Wait a few seconds.
4. If air leaks out and the mask deflates, check the valves, adjust the straps and try again.
5. If the face seal holds the air and the mask stays inflated, it has passed the positive face seal check.

NEGATIVE SEAL CHECK

1. Cover the filters so that air cannot be drawn through them.
2. Collapse the mask against your face by inhaling gently.
3. Hold your breath for 10 seconds.
4. If air leaks in and the mask reflates, check the valves, adjust the straps and try again.
5. If air does not leak in and the mask stays collapsed against your face, it has passed the negative face seal check.

INSPECTING, CLEANING AND STORING RESPIRATORS

Before and after each use, respirators must be inspected. The following procedures are simple highlights of inspection items for a half-mask respirator. For other than half-mask respirators, follow the respirator manufacturer's instructions.

INSPECTION

FACE PIECE

- No excessive dirt or chemicals
- No cracks, tears, holes or distortion
- For rubber or plastic face pieces, face piece is soft, flexible and pliable
- No broken or cracked holders for cartridges or canisters
- No missing seals or gaskets
- No broken or cracked valves

AIR PURIFYING ELEMENTS (CARTRIDGES, CANISTERS)

- Cartridge, canister, or filter is appropriate for the hazard
- Connections are tight, with no cross threading
- Cartridge or canister not cracked, damaged, or missing
- Cartridge or canister not expired; shelf life and service life conditions not exceeded. For example, cartridges that are to be used for only one shift are discarded at the end of the shift
- Proper cartridge, canister manufacturer, and model for respirator

VALVES

- No dust, dirt, or debris in or under seals
- No cracked, torn, perforated, distorted, or missing valves, valve membranes, or valve covers
- Valves inserted and seated properly in face piece

HEAD STRAPS

- No breaks, tears or missing straps
- No loss of strap elasticity
- No broken or malfunctioning strap buckles

CLEANING A RESPIRATOR

Always ensure that your respirator is cleaned before and after use. This can prevent infection and/or contamination. Each manufacturer will have different criteria for cleaning procedures that must be followed. Typically warm soap water may be used on full-face and half-mask respirators, after the cartridges have been removed. Always ensure that respirators have been thoroughly dried before reuse.

RESPIRATOR STORAGE

Respirators must be stored in a manner so as to protect them from dust, sunlight, heat, excessive cold or moisture or damaging chemicals. All of the above items can damage your respirator. By storing them in a dry, clean protected area, you are guaranteeing that they will not be contaminated. Typically, respirators are stored in plastic or nylon bags. Make sure that they are completely dry before placing them in an air tight container.

Respiratory protection is effective only if:

- the correct respirator is used
- it's available when you need it
- you know when and how to put it on and take it off
- you have stored it and kept it in working order
- you maintain it according to the manufacturer's instructions

PERSONAL PROTECTIVE EQUIPMENT (PPE) QUIZ

1. Rob is a surface mine mill operator, and entrance to the mill requires the use of earplugs. Despite current noise controls, Rob has noticed that his hearing has been fading over time. What could be causing this? Select all that apply.

    a. Rob needs to learn how to better insert his earplugs.
    b. He has extra-ordinarily large ear canals and the standard earplugs just don't fit properly.
    c. Rob has extra-ordinarily small ear canals and wearing earplugs is uncomfortable, so he usually doesn't wear them.
    d. He doesn't usually wear his earplugs because they tend to get dirty and he gets concerned about hygiene.

2. Face shields must be used with _____ or _____.

3. This type of respirator uses a fan to blow air through the filter to the user.

    a. Full-face respirator
    b. Half-mask respirator
    c. Supplied air respirator
    d. Powered air-purifying respirator
    e. Self-contained breathing apparatus

SELF-RESCUE & RESPIRATORY DEVICES

See 30 CFR 46.5(c)(1); 48.5(b)(2); and 48.25(b)(2).
Applicable to: Sand and Gravel, Underground, and Surface mining.

When working in hazardous situations, it may necessary to use a respiratory device. These devices are designed to either remove contaminants or provide clean air from an outside source. When working with these devices, it is important to not only understand how to operate them but also hot to properly maintain them.

RESPIRATORS

Certain breathing conditions are hazardous to life and lung. The air can be contaminated with dusts, mists, fumes, or toxic vapors. The air may even have too little oxygen to sustain life. Remembering the following can help limit one's exposure to these elements:

- Fit testing of all employees required to wear respiratory devices.
- Training employees in the proper use of respiratory devices.
- Making sure employees understand the hazards of dust and the importance of respirator use.
- Regular checking and cleaning of non-disposable respirators.

AIR PURIFYING RESPIRATORS

Air purifying repirators have filters, cartridges, or canisters that remove contaminants from the air by passing the ambient air through the air-purifying element before it reaches the user. The APR is used where there is enough oxygen present, but the air in the area is contaminated with gases, vapors, and dust. These respirators filter out dangerous materials or divert air through a chemical filter. However, they do not produce oxygen.

Cost: Approximately $50.

http://www.homedepot.com/catalog/productImages/400/a3/a3c276a8-ebb1-4194-aabb-71c10f8a6d18_400.jpg

ATMOSPHERE-SUPPLYING RESPIRATORS

These are used when there is a lack of oxygen or when the hazard is unknown or is undetectable by smell or taste. They supply clean air directly to the user from a source other than the air surrounding the user.

SUPPLIED-AIR RESPIRATORS

The SAR is used whenever there is not enough oxygen and the concentration of the airborne substances present is not Immediately Dangerous to Life & Health (IDLH). All respirators must be approved for the contaminant for which the employee is exposed too. Approval is done jointly by the Mine Safety and Health Administration of the Department of Labor and the National Institute for Occupational Safety and Health (NIOSH) of the Department of Health and Human Services.

Cost: Approximately $1000.

https://www.fhmsafety.com/store/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/m/s/msa-premaireescape_w_5_min_alum_cyl_1174057_2.jpg

SELF-CONTAINED BREATHING APPARATUS (SCBA)

SCBA uses a source of breathable air carried by the wearer. This greatly enhances the mobility of the wearer but limits the duration of protection. At a moderate work rate, using approximately 40 liter minute volume, most SCBA units have a rated duration of 30-60 minutes. SCBA consists of the following: Face piece, Breathing tube, Air supply tube, Regulator, Exhalation valve, Air Cylinder and valve.

Cost: $2000-$3000.

http://img.diytrade.com/cdimg/1426864/20300012/0/1311568500/Supply_Self_Contained_Breathing_Apparatus_SCBA.jpg

PHYSICAL REQUIREMENTS

Respirator use places a strain on the wearer's cardiovascular system. All workers must exert a greater degree of effort to inhale and exhale when wearing a respirator. Some people are claustrophobic and cannot wear respirators. It is suggested that anyone assigned a task requiring the use of respirators be examined and certified as being able to safely wear the respirator. Furthermore, the worker and supervisor must have a basic understanding of respirator selections, operations, fitting, limitations and maintenance.

FIT TEST

The proper fitting of a respirator is determined by a fit tests and seal checks. Fit tests can be "Qualitative" or "Quantitative".

QUALITATIVE FIT TESTING

- Required upon issue
- Irritant smoke or banana oil can be used
- Usually required to recite a passage
- Has a subjective response

QUANTITATIVE FIT TESTING

- Measures concentration inside mask

- Port drilled into mask
- Takes approximately 1 hour
- Requires expensive equipment and trained personnel
- Ensures correct fit for model

CARTRIDGE RESPIRATORS

Air movement is controlled by rubber inhalation and exhalation valves. The adjustable straps are used to keep the respirator snug on the face. The single exhalation valve prevents outside air from bypassing the cartridges through the exhalation port. The two inhalation valves prevent moist exhaled air from going out through the cartridges. Too much moisture will reduce the effectiveness of the cartridges. The valves must be in good condition at all times to prevent contaminated air from entering the respirator. If they are cracked, ripped or warped, they must be replaced.

Cost: Approximately $500.

http://www.cgindustrialsafety.com/uploads/images/cache/North_5400-250x250.jpg

MAINTENANCE

Respirators must be cleaned, inspected and maintained regularly. Cleaning is especially important in dusty areas. They must be cleaned in warm, soapy water and allowed to dry thoroughly before storing or using. Respirator disinfecting can also be done with a mild bleach solution or with special wipes provided by respirator vendors. Respirator cartridges cannot be washed. Cartridge respirators should not be shared or exchanged with other employees for sanitary reasons and because they may not fit. Notify your supervisor or the respirator administrator if you notice your respirator is noticeably dirty between cleanings.

Respirators do not last forever. Particulate (dust) filtering respirators should be changed when the breathing resistance gets high. Toxin filtering respirators should be changed per manufacturer recommendation.

SELF-RESCUER (UNDERGROUND)

The self-rescuer is a small gas respirator designed to protect you against carbon monoxide, a deadly poisonous gas found in mine air after an explosion or fire. The filter self-rescuer (FSR) is made of durable metal enclosed in a corrosion-resistant stainless steel case. It is a ***single-use*** unit, that is, it cannot be reused. Once the seal on the device has been broken, it must be used immediately and then discarded. The self-rescuer should be used immediately at the first indication of a fire or explosion even though no smoke is visible. Carbon monoxide is odorless and colorless, so you could breathe a fatal amount of the gas before smoke is present. Use the self-rescuer only for the purpose of escape or self-rescue from atmospheres containing CO. It is not to be used for such tasks as exploration or as a substitute for conventional respiratory equipment, such as masks or a self-contained breathing apparatus. Under moderate to heavy work, the rescuer can last 60 minutes or longer. When the user is sitting, resting, and relaxed, life support may last 4 to 5 hours.

Cost: Approximately $40.

https://internationalsafety.s3.amazonaws.com/uploads/product_image/image/1408/thumb_VV.png

REGULATORY REQUIREMENTS

- You must carry the self-rescuer on your belt or within reach at all times, unless wearing or carrying it is hazardous to you.
- In that case, the law says that your self-rescuer may be located at a distance no greater than 25 feet away from you.
- Should you remove your belt, light, and self-rescuer while you work, leave the light turned on. Should a loss of power occur you will have no trouble finding the self-rescuer.

DISCARD CONDITIONS

It is important to ensure that your self-rescuer is in working condition prior to going out in the field. A nonfunctioning or out of date self-rescuer may not assist in the event of an emergency.

DISCARD CONDITIONS WITHIN IN-SERVICE DATE

The unit MUST be discarded when:

- the date of manufacture is illegible, or
- 15 years have elapsed from the date of manufacture, or
- 10 years have elapsed since the in-service date

DISCARD CONDITIONS WITHOUT IN-SERVICE DATE

The unit MUST be discarded when:

- the date of manufacture is illegible, or
- 10 years have elapsed from the date of manufacture, or
- its serial number begins with one letter followed by a number

DISCARD CONDITIONS UPON PERIODIC INSPECTION

MSHA requires that operators examine FSRs (both assigned to individuals as well as those still "on the shelf") at intervals not exceeding 90 days. The unit must be discarded if any one of the following conditions is found:

- solder seal for red lever is broken or missing
- device has a crushed or deeply dented case
- a dent or abrasion which may have produced a hole
- device has dents or damage around the seal area
- device has a broken seal or has lost its vacuum seal
- the unit fails the 'airtightness' tests

One 'airtightness' test is conducted by immersing the unit in warm water, looking for escaping air bubbles.

DISCARD CONDITIONS UPON WEIGHING

The other 'airtightness' test is accomplished by weighing the FSR. As part of the periodic inspection mandated by MSHA, weighing is extremely important because it is the most reliable test in determining the serviceability of the self-rescuer. Using a balance having a capacity of at least 1,100 grams and with an accuracy of ±1 gram, follow these steps to determine if a unit should be discarded:

- Remove the protective boot, if so equipped.
- Clean the device, that is, scrape or wipe off debris with a damp cloth.
- Place it on the balance or scales.
- Compare the current weight of the device with the manufacturer's weight that is imprinted on the FSR case.

Discard any unit if it has increased more than 10 grams in weight over the as-shipped weight marked on the bottom of the unit. MSHA recommends that the every-90-days airtightness test be conducted on any and all W-65 devices in stock or storage the same as assigned units.

DISCARD CONDITIONS UPON DAILY INSPECTION

Each unit must be inspected daily, if it is going to be carried, for signs of damage or any other condition which might mean the unit has been compromised and is no longer effective.
Before each shift, examine the following segments of the unit and discard the unit if any one of the conditions is found:

- Check the solder seal for the red lever to see if it is broken or missing.
- Check the case for damage -- dents, abrasions, holes, cracks.
- See if the as-shipped weight is illegible or missing.
- Run the "airtightness" -- immersion -- test on the unit.

Should the self-rescuer be damaged while underground, it may not be possible in cases of emergency to remove the device from the container. In the event the device will not pull free, the wearer can still breathe with the filter in the container. The space between the filter and the inner wall of the container is sufficient to allow near-normal breathing.

OPERATION OF THE SELF-RESCUER

1. If the protective boot is covering the device, remove it.
2. Release locking device by pressing thumb under red release lever, push up hard until canister seal is broken.
3. Grip red release lever between thumb and forefinger; pull up hard. This should break the seal and loosen the cover.
4. Remove cover from the container and discard it.
5. Grip head harness of the respirator and pull it from the container.
6. Pull nose clip away from the mouthpiece.
7. Insert mouthpiece lugs into mouth, bite lugs firmly, close lips around the mouthpiece.
8. Pull pads of the nose clip apart; position pads over the nostrils to seal nasal passage.
9. Remove hardhat, pull the head harness over the head. Place the lower strip behind the head; place the upper band on top of the head. Then replace the hardhat.
10. Remain calm, breathe ONLY through the self-rescuer. Breathing resistance, similar to breathing through a dust respirator, will be experienced. This is normal -- DO NOT PANIC!!! The self-rescuer is functioning properly. Go to fresh air immediately.
11. Do not remove self-rescuer until you are absolutely sure you are in fresh air.

SELF-RESCUE & RESPIRATORY DEVICES QUIZ

1. T/F I can wear a respirator that has just been handed to me, as long as it passes a positive and negative seal check.

2. Terry is an underground metal miner who needs to inspect his self-rescuer to be sure it is still in working condition. He checks the expiration date, and it has been 9 years since the date of manufacture, there is no in-service date listed. He cleans the device off and it weighs 843 grams – the manufacturer as-shipped weight reads 831 grams. The unit has is slightly dented, away from the seal. It does not appear to have caused a hole. Can Terry continue to use his SCSR?

3. It is important to have a functioning self-rescue device in an emergency. In order to maintain a functioning device follow proper _____ procedures.

INTRODUCTION OF DUST CONTROL

See 30 CFR 46.5(b)(4); 48.5(b)(7); and 48.25(b)(7).
Applicable to: Sand and Gravel, Underground, and Surface.

MSHA defines dust as, "Finely divided solids that may become airborne from the original state without any chemical or physical change other than fracture."

Group Discussion: *Smaller particles are more dangerous to human health. In your teams, discuss why you think this might be the case. Also discuss and list the mechanisms the body has for preventing entry or clearing medium and large particles from the body.*

Respirable dust is defined as dust particles small enough to penetrate the nose, the upper respiratory system, and deep into the lungs.

- Stay in the body because they are too deep to be eliminated by the body's natural mechanisms
- Most dangerous because can collect in the lungs
- 10 microns or smaller

Inhalable dust is defined as dust that is trapped in the nose, throat, and upper respiratory tract.

- 100 microns or smaller, but can be eliminated by the body

Total dust is defined as all the dust particles in the air, regardless of size or composition.

- Includes both inhalable and respirable fractions

Nuisance dust is defined as total dust in the air, but defined by OSHA as dust that contains less than one percent quartz.

- Not considered harmful when exposure is kept below limits set by regulating agencies

Health Risks

- Black lung: a lung disease caused by exposure to coal dust particles. An example is coal worker's pneumoconiosis (CWP)
- Silicosis: a lung disease caused by exposure to the dust of quartz and other silicates. Silicosis is an irreversible disease that progresses even if you are removed from the silica exposure.
- Asbestosis: an irreversible lung disease caused by asbestos fibers
- Irritation to eyes, ears, nose, throat, and skin
- Emphysema
- Bronchitis, an inflammation of the airways to the lungs
- Chronic obstructive pulmonary disease (COPD), a progressive disease that makes it hard to breathe. Coughing produces large amounts of mucus, wheezing, shortness of breath, chest tightness, and other symptoms.

Q Which of these health effects is reversible?

Irritation, bronchitis

BLACK LUNG (COAL)

The National Institute for Occupational Safety and Health (NIOSH) reports that cases of black lung are increasing among coal miners, according to recent data. Even younger miners are showing evidence of advanced lung disease caused by dust exposure. According to Dr. Lee Petsonk, professor of medicine at West Virginia University, in 2003 statistics started to show an increase in CWP with miners who had fewer than 20 years' experience. Petsonk said miners used to have to spend at least 15 years underground before any evidence of black lung appeared

Why Might Black Lung be on the Rise?

- "Easy" coal has been mined
    - Drilling more difficult seams, through more rock
    - Drilling rock unleashes silica dust, which is 20 times more toxic than basic coal dust
- Longer shifts and extended work weeks increase exposure
    - Shorter time between shifts gives less time for lungs to expel dust
- Better equipment accesses more coal, creates finer particles

SURFACE RISKS

While the biggest risk is still underground, especially for those close to the face and extracting coal, surface miners and processing plant workers are also at risk for black lung.

SILICOSIS

Silicosis is an irreversible disease caused by exposure to respirable silica (often quartz), found in most of the earth's surface. Exposures are caused when rock is cut, crushed or transported – creating fine dusts. For those with silicosis, their lungs can't fully expand.

DUST STANDARD

Per MSHA, the average concentration of respirable dust in the coal mine atmosphere during each shift to which each miner must be at or below 1 mg/m^3. The average concentration of respirable dust within 200 feet outby the working faces of each section in the intake airways must be at or below 0.5 mg/m^3. If the air sample contains more than 5 percent quartz, the dust standard is further reduced. This is to prevent the development of silicosis. Miners are required to wear continuous person dust monitors to check their exposure throughout the shift.

MINE OPERATORS' RESPONSIBILITIES

Mine operators must keep dust levels below standard on each shift, using environmental controls. They should use and maintain all dust controls in the ventilation plan on every

production shift, and perform on-shift examinations to ensure all required controls are in use and working properly. The must also conduct dust sampling under typical operating conditions by:

- Properly maintaining sampling equipment, including cleaning and inspecting sampling head assemblies
- Following the regulatory requirements for proper collection of dust samples
- Taking dust samples bimonthly and submitting the required number of samples for testing
- Submitting samples that reflect dust conditions under normal work activities
- Not altering, opening, or tampering with dust samples
- Posting sample results on the mine bulletin board for 31 days

In addition, operators should make NIOSH-approved respirators available when excessive dust levels are present, and report to MSHA any status changes that affect dust sampling within three days. They should emphasize the importance of participating in the NIOSH X-ray program, and train miners, at least annually, on:

- The health hazards of breathing respirable coal mine dust
- The purpose of effective dust sampling and dust controls
- The mandatory health standards that apply to their mine
- The health provisions of the mine safety and health act
- The dust control portion of the approved ventilation plan

DUST CONTROLS

There are three major types of dust controls:

- Prevention
- Control systems
- Ventilation

LONGWALL MINING (COAL)

INTAKE ROADWAYS

- Limit support activities during production shifts
- Apply water or hydroscopic compounds to control road haulage dust
- Use surfactants (soaps and detergents)

BELT ENTRY

- Maintain belt
- Wet the coal during transport
- Clean belt by scraping and washing
- Use a rotary brush to clean conveying side of belt
- Wet dry belts

HEADGATE ENTRY, INCLUDING STAGELOADER/CRUSHER

- Fully enclose the stageloader/crusher
- Wet the coal in the crusher and stageloader area
- Use scrubber technology in the stageloader/crusher area
- Use high pressure water-powered scrubber
- Install and maintain a gob curtain
- Position shearer operators outby as the headgate drum cuts into the headgate entry
- Install a wing or cutout curtain between the panel side rib and the stageloader

SHEARER AND SHIELD

- Ventilate the face
- Use drum-mounted water sprays
- Use directional water spray systems
- Keep the headgate splitter arm parallel to the top of the shearer
- Take advantage of shearer deflector plates
- Spray systems

CONTINUOUS MINING (COAL)

CONTINUOUS MINING MACHINE

- Water spray systems
- Flooded bed scrubbers
- Bit type and wear
- Modified cutting method
- Blowing face ventilation
- Exhausting face ventilation

ROOF BOLT OPERATORS

- Maintain the dust collector system
- Clean the dust box
- Use dust collector bags
- Remove and replace the canister filter
- Clean the discharge side of the collector
- Install a sock on precleaners
- Use dust hog bits
- Work upwind
- Consider wet drilling/mist drilling
- Route miner-generated dust to the return via collapsible tubing

INTAKE

- Demonstrate good housekeeping to keep intake entries free of debris, equipment, and supplies
- Perform activities such as supply delivery, scoop activity, construction, and rock dusting during nonproduction shifts
- Keep haulage roadways damp
- Park equipment in crosscuts to keep main airways obstruction free

SURFACE MINING

- Maintain an effective dust collection system for drill dust, which is generated by compressed air flushing the drill cuttings from the hole
- Maintain the enclosed cab filtration system in place for most operators of mobile equipment
- Treat haul roads
- Increase the distance between vehicles traveling the haul road
- Enclose the primary hopper dump
- Use water sprays to suppress the dust in the enclosure
- Use a water spray system to prevent dust from rolling back under the dump vehicle

MONITORING DUST

- Mine operator must take one valid respirable dust sample from each designated area in the mine during a production shift once every two months
- If sample exceeds standard, operator must take five samples within a 15-day period from the designated area
- Citations can follow until the violations are abated
- The designated sampling areas are indicated on the mine's ventilation plan

CONTINUOUS PERSONAL DUST MONITOR

- Monitor is not real time, but a sample of what you've been exposed to over last 30 minutes
- Shows accumulation over shift

DUST CONTROL SAFETY QUIZ

1. Order these dust sizes from smallest to largest, and circle the most dangerous size:
    - Inhalable
    - Total
    - Respirable

2. What is the MSHA exposure limit for respirable coal dust in surface and underground mines?
    a. 2.0 mg/m^3
    b. 1.5 mg/m^3
    c. 1.0 mg/m^3
    d. 0.5 mg/m^3

3. What are the three main types of dust controls?

GROUND CONTROL

See 30 CFR 48.5(b)(6); and 48.25(b)(6).
Applicable to: Underground, and Surface mining.

As large amounts of overburden and material are transported through the mining process, spoil embankments, highwalls, slopes, and pits are created. If they are not properly monitored and maintained, they may cause serious and/or fatal injuries. Ground control safety issues underground include improving roof support performance, maintaining safe tailgate escapeways from longwalls, optimizing pillar design for retreat mining, controlling multiple seam interactions, predicting roof conditions during extended cuts, and preventing massive pillar collapses. With underground mining having one of the highest fatality rates, it is important to be aware of the potential hazards that may exist.

SURFACE

SPOIL EMBANKMENTS

Spoil Embankments are typically covered with material that contains no marketable material, called overburden or spoil. The overburden must be moved in order to expose the desired minerals. It may sometimes be stockpiled in large piles and can create significant safety risks if not properly managed.

HIGHWALL HAZARDS

Benches are formed as ore and overburden are removed in successive layers. Benches are typically the primary level of operation for material removal and provide access routes throughout the mine. They also function as a platform for catching rocks and other sliding material and assist in reducing the angles and length of slopes. The walls of these benches and other straight vertical cliffs or gently sloped hills that rise above our heads are called highwalls.

Highwalls are composed of rock which may contain breaks or gaps filled with looser material forming joints. This loose material poses a structural weakness, and unexpected conditions can cause movement of the joints resulting in falling or sliding material and even massive highwall failures. There are multiple factors that can contribute to highwall instability overtime. These can include:

- Wind
- Tree roots
- Groundwater
- Freeze-thaw cycles
- Precipitation (rain, snow)
- Burrowing animals
- Weathering and decomposition

- Seismic activity- including blasting, equipment vibration and mining along the toe (base) of the slope

SIGNS OF POTENTIAL SLOPE FAILURE

Before beginning any task, always perform a pre-shift inspection of your work area. Stay alert for subtle signs of slope failure and stay out of positions where you would be vulnerable if a failure does occur.

RAVELING

- Rocks rolling from the bank

CRACKS

- Potential sign of instability
- Not all cracks are a sign of impending slope failure
- May result from
    - Settling
    - Drying out
    - Notify management to investigate
- Important to frequently inspect from a variety of vantage points
    - Upper benches/crests dump areas, highwalls, berms
    - Highwall surface, slope face
- Overhanging or undercut material
- Concentrated water seepage

BULGING

Bulging occurs at the base of the highwall. The weight of the material is not supported by its base and the potential to displace the energy is increased. Bulging ensues when the material expands by taking the path of least resistance.

APPROACHING HIGHWALLS

- Never work outside of your vehicle between a highwall and machinery.
    - A landslide could pin you between a wall of falling earth and the equipment.
- Keep heavy equipment away from the highwall/bench edge as a soft shoulder can easily give way.
- Always wear your seat belt when operating equipment on a mine site.
- When working at the bottom of a highwall, be aware that someone could be working at the top. Rocks, tools or even equipment could come sliding down the hill.
- Good housekeeping is essential at all mine sites
    - Clutter on highwalls exacerbates problems if rocks begin to slide.
    - Loose material needs to be moved a minimum of 10 feet from top of bench edges.
    - In order for a bench to be an effective catch basin, they must be kept clean
- Evaluate the stability of the ground prior to operating equipment near any drop off or edge.

- Use equipment (i.e. excavator) that can perform the work from a safe distance away from the edge of a pond or area where the stability of the ground may be unknown.
- Appropriate supervisors or other qualified or competent personnel should examine and test ground conditions in areas where work is to be performed prior to work commencing.

WATER HAZARDS

Water can cause many different hazards in your work area. Electrocutions, loosening of rock or soil, slippery walking/driving conditions, flooding, and drowning are only a few examples of what you may experience.

Walking and driving conditions can be adversely affected by runoff, flooding, and rainy conditions. These conditions increase the possibility of vehicle accidents, or slips, trips and falls. Never operate vehicles in washes when large rain events are expected or in saturated ground. Be aware fo your surroundings and follow proper housekeeping procedures to ensure tripping hazards are removed before weather conditions make them worse.

Drowning can occur when working near water. Life vests are required to be worn when working or driving around open bodies of water, if the possibility of falling into the water is present. Areas requiring life vests need to be posted.

Best practices to prevent fatalities

- Always wear a life jacket where there is a danger of falling into the water
- Safe access must be provided in all work areas
- Ensure the life jacket is maintained and in serviceable condition
- If there is no life jacket in your area, stop the work and contact your supervisor until one is provided for you

SEEPAGE

Seepage is the the process by which a liquid escapes through a porous substance. It is often a contributing factor to highwall failures. Different pieces of equipment in a mine are powered by trailing electrical cables. If anyone contacts a pool of water that has been energized by faulty electrical wiring, they may be electrocuted. Avoid walking through or putting electrical cables and cords in standing water. All outlets outside or within 10 feet of a water source, must be protected by GFCIs.

Water can loosen rock in a highwall or cause spoil embankments and other loosely consolidated material to collapse. Watch for ground water seepage or washouts in highwalls and benches. Communicate these hazards throughout the mine and if it is safe, barricade and/or tape off the area to prevent access.

BERMS, GUARDRAILS, AND TRAVELWAYS

A berm or guardrail must exist if there is a drop-off or hazard that could endanger any employee along a roadway. They must be at least mid-axle height of the largest vehicle that travels that roadway.

Berms or guardrails must be:

- Provided wherever a drop off exist that could endanger individuals
- Mid-axle height of largest vehicle traveling road
- Effective in controlling fall/rollover hazards

ILLUMINATION AND NIGHT WORK

Most of us will be exposed to shift work at one time or another. One of the hazards facing us at night is insufficiently lighted work areas. It is important to make sure that dark areas that require lighting have it bfeore beginning any work. Vehicles should have proper lights to negotiate the darkened roads. When performing a workplace exam, inspect your areas for lighting and continually make sure it is well maintained.

HOUSEKEEPING

Effective housekeeping and storage prevents accidents and injuries. Housekeeping combines cleanliness and organization to contribute to getting a job done safely and properly. Good housekeeping is also a basic element of fire prevention because it reduces unnecessary amounts of clutter and removes potential fire hazards.

Housekeeping begins at the individual level. Each one of us needs to take ownership of his/her work area and equipment. By paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance, you are contributing to safe and organized work area.

Remember to:

- Clean up as work proceeds
- Clean up spills and leaks immediately
- Put tools and material away when not in use
- Keep areas around equipment free of debris
- Keep travel areas clear of material
- Secure loose material on roofs and open floors
- Never let material fall from any level
- Remove tripping hazards
- Fix or report burnt out lighting
- “Police” your work area by reporting all job hazards as quickly as possible or by removing them

UNDERGROUND

SCALING

Scaling invovles the taking down of loose material from the roof, face and rib in hard rock mining. Remember to:

- Perform a work place inspection without exposing yourself to unsupported ground
- Look at all rock bolts and fixtures to make sure they are not taking weight
- Select the proper length scaling bar and one that is not bent or broken. The bar should be of enough length to allow the removal of loose material without exposing the miner performing the work to injury and held chest high to shoulder high while contacting the rock at a 45^0 to 60^0 angle.
- Constantly look at were barred down material will land.
- Always start scaling from the back down the rib. This will keep you from scaling down a rock that has loose material on top of it causing a slabbing effect.
- Clean up and/or remove material that has been scaled down to the base of a rib.

Performing any of the following may cause serious injury or fatality:

- Never bar loose material down while standing directly underneath it.
- Never bar from bad ground to good ground – always position yourself under stable ground.
- Do not bar down loose material if it will land on top of another miner, equipment, electrical equipment, pipes, blasting lines or other items that could be damaged by the material.
- Do not stand at the downward side of any decline, incline or ramp. Always position yourself so that the barred material will fall or roll away from you. This will keep the potential for injury at the lowest possible minimum.
- Do not hold on to the bar if material starts to roll down the bar. Let go and get out of the way.
- Never stand between the scaling bar and the rib. You could be pinned against the rib.
- Never bar on or close to the high voltage cable located on the back.
- Never give up on scaling a rock out if loose.

UNDERGROUND COAL

In many underground coal mines, the 'Room and Pillar' mining technique is used. In these mines, 'pillars' of coal are left in a grid-like fasion to provide support while the coal within the 'room' spaces in extracted. Some important hazards to be aware of include:

- Looking and listen for cracks, joints or loose pieces
- Being alert to weight on the pillars, roof and supports
- Looking for bulges at the pillars' base
- Recognizing when rock composiiton changes
- Rockbursts
- Floor heaves
- Wet conditions

Roof and Rib

- Any stress cracks in the roof, floor or rib
- Abnormal rock formations such as kettlebottoms and clay veins
- A wet place that was formerly dry
- Any moisture or cracks that appear in the roof after being supported

Supports

- Heavy pressure casuing bent crossbars, timbers or posts
- Signs of stress on rock bolt bearing plates
- Cap pieces that are squeezed down and over posts
- Decayed timbers
- Small chips or bark around support timbers

UNDERGROUND METAL

Rock bolting is used to stabilize rock excavations. It transfers load from the unstable exterior surface to the interior of the rock mass.

Types of Bolts:

- Friction bolts
- Cable bolts
- Resin bolts
- Mechanical bolts

Roof mats and wire mesh are used to increase stabilization between the rock bolts. Implementing them in the bolting process dramatically increases roof coverage and decreases injuries due to rock fall.

Timber sets may also be implemented in a mine for roof support. They can be used in place or in in supplement to rock bolting.

GROUND CONTROL QUIZ

1. Berms or guardrails must be (select all that apply):
    a. Made of a mixture of gravel and dirt
    b. Provided wherever a drop off could endanger individuals
    d. Effective in controlling fall/rollover hazards
    e. Mid-axle height of the largest vehicle traveling the road

2. Scaling involves the _____ of loose material from the roof, face and rib in hard rock mining.

3. Harry has been tasked with performing a visual inspection of the roof and ribs at the underground coal mine where he works. What should he look for? Select all that apply.
    a. Looking for bulges at the pillars' base
    b. Any stress cracks in the roof, floor or rib
    c. Abnormal rock formations such as kettlebottoms and clay veins
    d. A wet place that was formerly dry

INTRODUCTION TO MINE GASES

See 30 CFR 48.5(b)(12).
Applicable to: Underground mining.

Mine gases are a constant hazard, particularly in underground mining. Gases can be emitted from a variety of sources, including:

- Fires
- Engines
- Blasting
- Diffusion
- Mineral processing

In an effort to limit exposure to certain gases, MSHA and other governmental organizations have published occupational exposure limits (OEL). The following list gives more details about OELs.

OEL	Organization	Description
Permissible Exposure Limit (PEL)	MSHA	Allowable exposure over an 8-hour shift
Action Limit (AL)	MSHA	Level where action must be taken (50% of PEL)
Short-term Exposure Limit (STEL)	MSHA, ACGIH*	Allowable exposure over a short period (15 min)
Ceiling (C)	MSHA	At no point should concentration reach level
Threshold Limit Value (TLV)	ACGIH*	Recommended exposure over an 8-hour shift
Recommended Exposure Limit (REL)	NIOSH**	Recommended exposure over an 8-hour shift
Immediately Dangerous to Life and Health	NIOSH**	Point at which exposure can cause death

*ACGIH = American Conference of Governmental Industrial Hygienists
**NIOSH = National Institute for Occupational Safety and Health

GAS CONCENTRATION

Often, gas concentrations are calculated using the unit parts per million, or ppm. This measure represents the number of parts of contaminant per million parts of air. Another unit commonly used is milligrams per cubic meter, or mg/m^3. This value represents a measured mass or weight of contaminant per volume of air.

GAS PROPERTIES

One way to compare gas' weights to air and each other, a ratio is sometimes taken of their weight to air. This ratio is called specific gravity (SG). For example, a gas that is twice as heavy

as air will have a SG of 2.0, while a gas whose weight is half that of air will have a SG of 0.5. Generally, the higher the SG, the slower the gas will diffuse, while a low SG usually increases the rate of diffusion.

GAS TYPES

As part of this training, we will discuss three types of gases:

- Noxious: Asphyxiant, displaces oxygen
- Toxic: Poisonous, can be short or long-term exposure
- Explosive: Combustible, rapid expansion

Q What is an example of each of these gas types?

Components of Air

Oxygen (O_2) and Nitrogen (N_2) are the two largest components of air. When at sea level, pure dry air is made of:

- 78.09% Nitrogen
- 20.94% Oxygen
- 0.94% Argon
- 0.03% Carbon Dioxide

EFFECTS OF NOXIOUS GASES

When the concentration of oxygen is around 21%, breathing is easy. However, as the concentration decreases, people experience progressively serious symptoms.

- 17% Breathing becomes faster and deeper
- 13-16% Dizziness, bussing noise, rapid pulse, headache and blurred vision
- 9% Unconsciousness
- 6% Convulsing, breathing stops and shortly after, the heart stops

CARBON DIOXIDE (CO_2)

The SG of CO2 is 1.5189.

Q Does that make it lighter or heavier than air?

It is heavier than air and tends to flow into low-lying areas. The TLV for CO2 is 5,000 ppm, and the STEL is 15,000 ppm. It is found in the air, soil, and in many rocks. In mining, it is formed by humans, fires, and explosions.

TOXIC GASES

- Carbon Monoxide (CO)
- Carbon Monoxide has a SG of 0.967.

Q Where would you find CO compared to air?

Because its SG is very close to that of air, it mixes with air instead of separating. CO is colorless, odorless, and tasteless. It often comes from incomplete combustion in diesel and gasoline engines. The problem with CO is that it is 300 times more attracted to your red blood cells (hemoglobin) than oxygen. Once it enters the blood stream it forms carboxyhemoglobin and prevents oxygen from binding. The body's cells suffocate, even though you're able to breathe. The TLV for CO is 50 ppm, while the Ceiling limit is 200 ppm. The IDLH is 1,500 ppm.

SYMPTOMS OF CO POISONING

Blood Saturation	Symptom
• Up to 10%	None
• 20%	Tightness across the forehead, slight headache
• 30%	Headache, throbbing temples
• 40%	Severe headache, weakness, nausea & collapse
• 50%	Same as at 40%, but more intense
• 60%	Coma
• 80%	Death

NITROGEN DIOXIDE (NO_2)

Nitrogen Dioxide has a SG of 1.589. It has a burnt powder smell and is reddish brown in high concentrations. It typically comes from the after-products of explosives and diesel exhaust. When inhaled, NO_2 forms nitric acid in the lungs, which causes pulmonary edema. The TLV is 1 ppm, while the Ceiling is 3 ppm and the IDLH is 50 ppm.

Q After blasting at the breast of a drift, would the NO_2 settle at the floor or ceiling?

SULFUR DIOXIDE (SO_2)

The SG of Sulfur Dioxide is 2.264, so it is very heavy compared to air. It has a strong sulfur odor and is produced from burning sulfide ores, and in diesel exhaust. SO_2 combines with moisture in the lungs to produce sulfuric acid. The TLV for SO_2 is 5 ppm, the Ceiling is 10 ppm, and the IDLH is 100 ppm.

HYDROGEN SULFIDE (H_2S)

Hydrogen Sulfide has a SG of 1.191. It is colorless, but has a sweet taste and rotten egg smell. It is produced when sulfur dissolves in water. H2S can cause paralysis of the respiratory system, and has a TLV of 10 ppm, a Ceiling of 15 ppm, and an IDLH of 300 ppm.

EXPLOSIVE GASES

UPPER AND LOWER EXPLOSIVE LIMITS

Every explosive chemical has an upper (UEL) and lower explosive limit (LEL). Below the LEL, the mixture of chemical with the air is too lean for combustion, and while above the UEL, the mixture is too rich for combustion. Combustion can only occur between the two limits.

Group Exercise: *Consider three different chemicals with varying upper and lower explosive limits. Chemical #1 has an LEL at 3% and UEL at 13%. Chemical #2 has an LEL at 12% and UEL at 86%. Chemical #3 has an LEL at 8% and UEL at 23%.*

Q Based on the size of explosive range, which one is most dangerous? Discuss in your teams.

Answer:

Q Based on how quickly an explosive concentration could be reached, which is most dangerous? Discuss in your teams.

Answer:

METHANE (CH_4)

Methane has a SG of 0.5537.

Q Where will CH_4 settle compared to air?

he LEL for CH4 is 5.0%, while its UEL is 15.0%. It has an ignition temperature of 1,110 degrees F. It is odorless, colorless, and tasteless. It is commonly found in underground coal mines. Mines are classified by the amount of methane in the ore body and are required to operate in accordance with the applicable standards.

HYDROGEN (H_2)

The SG for Hydrogen is 0.0695.

Q Because it is extremely light, what gas can it substitute to give buoyancy?

It has an LEL of 4.1% and a UEL of 74%. Its ignition temperature is 1,030 degrees F, and is commonly found in batteries and is produced when water is sprayed on super-hot fires.

CONTROLS

The best engineering controls for mine gases include ventilation, ventilation, and more ventilation. Proper protocols, adequate training, and appropriate signage are also very important for controlling mine gases.

MINE GASES QUIZ

1. Match the occupational exposure limit with its definition:

a. Permissible exposure limit	1. Recommended exposure over 8-hr shift
b. Short-term exposure limit	2. Level that is 50% of PEL
c. Action limit	3. Allowable exposure over 15 minutes
d. Threshold Limit value	4. Point at which exposure can cause death
e. Recommended exposure limit	5. Allowable exposure over 8-hr shift
f. Immediately dangerous to life and health	6. Recommended exposure over 8-hr shift

2. Name 4 toxic gases that are encountered in mining:
   a. _____
   b. _____
   c. _____
   d. _____

3. What is the best engineering control for mine gases?

INTRODUCTION TO MINE VENTILATION

See 30 CFR 48.5(b)(6).
Applicable to: Underground mining.

Mine ventilation has multiple purposes. It supplies fresh and conditioned air to mine workers, and exhausts and dilutes harmful or explosive contaminants from the mine workings.

PRINCIPLES OF AIRFLOW

Airflow in a mine is induced by pressure differences between intake and exhaust openings. The pressure difference is caused by imposing some form of pressure at one point or a series of points in the ventilating system. The pressure created must be great enough to overcome frictional resistance and shock losses.

FRICTION PRESSURE

Friction pressure losses are caused by the resistance of the walls on the air stream. Friction losses therefore depend upon the conditions and roughness of individual wall surfaces and velocity of air. Shock pressure losses are caused by abrupt changes on the velocity of air movement.

SHOCK LOSS

Shock losses are the result of changes on air direction or of airway areas, obstructions, and regulation. Passageways, both intake and returns must be provided to conduct airflow. Airflow follows a square-law relationship between volumes and pressures, that is, twice the volume requires four times the pressure.

Mine ventilation pressures, with respect to atmospheric pressures, may be either positive (blowing) or negative (exhausting).

- Total Pressure = Static Pressure + Velocity Pressure
- Static Pressure is the pressure exerted in all directions. Tire pressure is static pressure. Can be negative or positive.
- Velocity pressure is directional pressure. You feel velocity pressure when you feel the wind. VP is always positive.
- Exhausting fans are generally rated on Static Pressure.
- Blowing fans are generally rated on Total Pressure.

Air always flows from a point of higher to lower pressure. Blowing fans create a high pressure point immediately next to the fan. Air travels from this high point through the mine to the surface. Exhausting fans create a low pressure point immediately next to the fan. Air travels from the surface through the mine to this low pressure point.

BLOWING FAN

- Neutral flows to outside. Smoke will not travel to face area.
- Gobs are “pressurized”. Less influx of contaminants from gobs until fan stops.

- Harder to maintain required LOC quantities.
- Best for mining near OLD WORKS.

EXHAUSTING FAN

- Neutral flows toward face. Smoke will travel toward face area.
- Gobs are "under suction". Contaminants flow from gobs until fan stops.
- Easier to maintain required LOC quantities.
- Worse for mining near OLD WORKS.

FACE VENTILATION

BLOWING

- Higher velocity at face
- Good for gas
- Bad for dust

EXHAUSTING

- Lower velocity at face
- Bad for gas
- Good for dust

MINIMUM VENTILATION REQUIREMENTS

There are several MSHA standards that regulate the minimum ventilation requirements for underground mining activities and machines. These requirements apply to the working face, last open crosscut, mechanized mining unit, cutting sequences, and more. Many of these requiremnts are meant to limit the concentrations of dust and methane that is often produced during coal mining operations. In addition, contaminant concentrations from diesel equipment, such as carbon monoxide (CO) and nitrogen dioxide (NO_2), must be diluted to safe levels.

Q Why might blowing ventilation be bad for removing dust but good for gases?

AIRFLOW MEASUREMENT

There are three categories of airflow measurements: low velocity (0 to 120 fpm), medium velocity (120 to 200 fpm), and high velocity (>200 fpm). Medium air velocity is usually measured with a weather vane anemometer, while a high speed anemometer must be used for high air velocities.

To take air velocity measurements with an anemometer, be sure to:

- Zero the dial (analog) or reading (digital)
- Hold the anemometer so air flow enters the back
- Press lever to start dial movement
- Take reading for 1 minute

- Press lever to stop
- For precise measurements, use an extension rod to minimize effects of hand, arm, and body
- Traverse the whole entry
- Take care to record the correct dial reading (analog)
- Correct the reading using a correction chart or factor
- Take multiple height measurements for an irregular roof
- Measure flow upstream of obstructions, if possible
- Estimate gobs and other areas of obstruction

SMOKE READINGS

Taking smoke readings requires two people. It is best for the upstream person (smoker) to look down the path of smoke with their light.

- Measure how long it takes smoke to travel over a pre-determined distance.
- Divide distance traveled by time required to get the velocity. Multiply by 60 to get fpm.
- Divide the entry into quadrants to take smoke readings. The number of quadrants is flexible.
- An alternative to quadrants is to take the centerline reading and multiple by 0.9.

MINE VENTILATION PLAN

Plans adopted by the mine operator and approved by the district manager define minimum safety and health requirements for the mine. A proper ventilation plan is essential to maintaining enough ventilation and respirable dust control in the mine.

A good plan includes information that supervisors and miners need to be aware of to have effective ventilation in their working environment. The plan adopted by the mine operator and approved by the district manager should define minimum requirements for the mine.

MINE VENTILATION QUIZ

1. What are the 2 main functions of mine ventilation?

2. What are 2 ways in which you can measure the airflow within the mine?

3. The pressure created by the fan and ventilation system must be great enough to overcome _____ and _____.
    a. positive; negative pressure
    b. frictional resistance; shock losses
    c. the outside wind; air generated by equipment
    d. shock losses; positive pressure

INTRODUCTION TO GENERAL ELECTRICAL SAFETY

See 30 CFR 46.5(b)(2); 48.5(b)(10); and 48.25(b)(9).
Applicable to: Sand and Gravel, Underground, and Surface mining.

The average worker is not well prepared to recognize potential electrical hazards. Special training is required before anyone can work on electrical equipment. The following material does not provide you with this qualification, the ability to lock-out machinery and equipment, or the ability to operate switches and breakers. It is only designed to inform you of potential electrical hazards in your work areas.

GENERAL ELECTRICAL SAFETY

Electricity is essential to modern life, both at home and on the job. Electrical hazards, while only responsible for a fraction of total workplace injuries, are more likely to result in death than injuries from other causes.

Electricity has long been recognized as a serious workplace hazard, exposing employees to:

- Electric shock
- Electrocution
- Burns
- Fires/Explosions

Some employees, such as engineers, electricians, electronic technicians, and power line workers, work with electricity directly. Non-electricians work with it indirectly.

We all have a basic understanding of electricity. This module won't go into any specific details but the definitions below will help orient you.

CONDUCTOR

A conductor is something that allows electricity to flow through it easily. Examples: metals, water, etc.

INSULATOR

An insulator is the opposite of a conductor and does not allow for easy flow of electricity. Examples: porcelain, rubber, glass, etc.

CURRENT

Current is how quickly an electrical charge moves, or the flow of electrons. Measured in amperage (amps) or the amount of current, it is the killing factor in electrical shock.

VOLTAGE

Voltage is the "push" behind the current. It is the amount of work per electric charge that an electric source can do.

DANGERS OF ELECTRICAL SHOCK

Q What causes shocks?

Electricity travels in closed circuits, normally through a conductor. Sometimes a person's body (an efficient conductor of electricity) mistakenly becomes part of the electric circuit and the electrical current then passes through the body.

A shock occurs when a person's body completes the current path

- One wire of an energized circuit and the ground.
- A metal part that accidentally becomes energized.
- Another “conductor" that is carrying a current.

When a person receives a shock, electricity flows between parts of the body or through the body to the ground or the earth.

Q What effect do shocks have on the body?

An electric shock can result in anything from a slight tingling sensation to death.

The severity depends on the following:

- Path through body
- Amount of current
- Duration of shock

An electric shock can injure you by stopping the heart or lungs from working, cause severe burns where the electricity enters or exits the body and/or cause you to strike something or have some other accident because of your response to the shock.

Q Why do people sometimes “freeze" when they are shocked?

When a person receives an electrical shock, sometimes the electrical stimulation causes the muscles to contract. This “freezing" effect makes the person unable to pull free of the circuit. It is extremely dangerous because it increases the length of exposure to electricity.

The longer someone is exposed to an electrical shock, the greater the risk of serious injury. Longer exposures at even relatively low voltages can be just as dangerous as short exposures at higher voltages. Low voltage does not imply low hazard.

Q How can you tell if a shock is serious?

A severe shock can cause considerably more damage than meets the eye. It is possible for a shock victim to be seriously injured and not realize it. A victim may suffer internal injuries to their heart, nerves and other tissues that are not readily visible. If you or a co-worker receives even a minor shock, report the incident immediately to your supervisor so that emergency medical assistance can ensure there is no permanent injury.

ELECTRICAL BURNS

The most common shock related, nonfatal injury is a burn. Electrical burns can result when a person touches electrical wiring or equipment that is not used or maintained properly. Typically such burns occur on the hands. Electrical burns are one of the most serious injuries you can receive. They need to be given immediate attention. Clothing may catch fire and additional burns may result from the heat of the fire.

Q What should you do if someone is shocked or burned by electricity?

- If someone in the workplace contacts a live electrical line:
- Shut off the current immediately
- If this is not possible and the employee is "frozen"
- Use any non-conducting material to safely push or pull the person away from the contact
    - Example: boards, poles, sticks made of wood, etc.
- While you do this, have someone else call for help
- Get the aid of trained electrical personnel, if possible
- Do not leave the victim unless there is absolutely no other option
- If the victim is not breathing, someone trained in CPR should begin artificial breathing

It's important to act quickly. Do not touch the victim yourself, if he or she is still in contact with an electrical circuit! Protect yourself from electrocution or shock, before assisting!

ELECTRICAL FIRES/EXPLOSIONS

In addition to shock and burn hazards, electricity poses other dangers. These dangers include both fires and arc flashes. An arc flash is usually caused by a short circuit of energized conductors.

Defective or misused electrical equipment is a major cause of electrical fires. If a small electrical fire occurs, use only a Class C or multipurpose (ABC) fire extinguisher. Using any other type of extinguisher could make the problem worse. All fire extinguishers are marked with letters that indicate the types of fires they can extinguish.

When an arc flash occurs, a massive amount of energy can be released. This energy can rapidly vaporize the metal conductors involved, blasting molten metal and expanding plasma outward with extreme force. This can destroy equipment, start fires, and injure not only the worker but

also nearby individuals. Just the heat alone from an arc flash can cause severe skin burns or have lethal consequences.

ARC FLASH

- A dangerous release of energy created by an electrical fault
- Arcs are the hottest things on earth
- Approximately four times hotter than the sun
- Can ignite flammable gases or explosive dust

ELECTRICAL FIRES

Electrical fires should only be extinguished with Class C Fire or Multi-Purpose Fire Extinguishers.

RECOGNIZING ELECTRICAL HAZARDS

The first step toward protecting yourself is the ability to know where to look for electrical hazards. To do this, you must know which situations can place you in danger, understand the risks and learn how to prevent them, in order to save your life.

The leading categories of on-the-job electrical deaths and injuries include:

- Contact with overhead power lines
- Contact with electrical components
- Wiring, transformers or other
- Contact with electric current of machine, tool or light fixture

OVERHEAD POWER LINE HAZARDS

As many as 100 workers are killed each year by inadvertent power line contacts. Most people do not realize that overhead power lines are usually not insulated. More than half of all electrocutions are caused by direct worker contact with energized power lines because they failed to maintain proper work distances.

LEADING CAUSES OF CONTACTS

- Long handled tools and hand carried items
- Ladders, pipes, scaffolds, metal siding, metal poles, etc.
- Work vehicles
- Cranes, man baskets, man lifts, dump trucks, back hoes, drilling rigs, etc.

Always maintain at least a minimum of ten-foot clearance from any overhead lines. Utilize a spotter to ensure that you maintain this safe working distance. If your work requires you to be closer, ensure that the lines have been de-energized and grounded by qualified electricians.

Note: *This distance increases if the voltage is more than 50,000 volts.*

When working with larger pieces of equipment

- Identify overhead electrical hazards
- Always maintain a minimum of 10' from overhead lines
- When moving equipment, the boom should be down, especially where overhead hazards exist
- Use spotters to ensure you maintain the required distance

ELECTRICAL WIRING, COMPONENT HAZARDS AND INSPECTIONS

A break in an electrical cord's insulation can cause a tool or machine's metal parts to conduct electricity. Touching these energized parts can result in an electrical shock, burn or electrocution. By noting defects and immediately reporting them when completing your general work area inspections, hazards can be found before anyone is injured.

Q What do you do if you discover an electrical hazard while working?

- Assume that all exposed wiring is energized until proven otherwise
- Immediately remove item from service
- Tag it ensuring no one will use it until it has been repaired or replaced
- When placing a red tag on equipment, on the tag describe the defect found, detail with your name and the date.
- Some equipment may not be repairable. If this is the case, it must be destroyed
- If you are unable to remove the hazard
- Stop
- Protect the area
- Use barricading, flagging or other means must to immediately to control the hazards
- Contact supervision

GROUND-FAULT CIRCUIT INTERRUPTER (GFCI)

Q What do GFCIs do?

Protect workers from electrocution by opening the circuit "tripping", when electrical equipment is not working correctly

Q Where should a GFCI be in place?

- On any outlet located within six feet from a source of water
- On any outlets located outdoors

Q When should a GFCI be tested?

Before each use

Q How do you test them?

- Push the test button to verify power is disconnected
- Do not use if damaged or defective in anyway
- Repeated resetting not allowed

Q What should you do if a GFCI does not pass the test, continues to trip, or is damaged?

- Stop use
- Tag-out
- Contact the Electrical Dept.

ANNUAL CORD INSPECTIONS

Every year every electrical cord on working sites must be inspected by an electrician.

- Different color tape applied to each cord indicates the inspection year.
- Test looks for faults and shorts within wiring.
- Cords are tagged "out of service" when they have not been tested for the current year. They remain tagged until inspected.

FUSES AND BREAKERS

Fuses and circuit breakers protect equipment, not people

- Breakers and fuses must be properly labeled
- Disconnects, fuse and breaker boxes must have clear access route
- Keep 3'6" area clear around electrical boxes
- Higher voltages require more space
- Frequently tripping breakers indicate problems with wiring and/or equipment
- Only qualified and authorized personnel are allowed to reset breakers and replace fuses
- If circuit breakers or fuses trip:
- Do not reset or replace them!
- Contact the electrical department to troubleshoot and reset

HAND TOOLS

Hand-held electric tools pose a potential danger because they make continuous contact with the hand. Appropriate and properly maintained tools help protect workers against electrical hazards. Check each tool before using.

Tools must:

- Always have 3 prongs and be plugged into a grounded receptacle

Note: Never use tools with 3 prong plugs that are missing the ground prong

ELECTRICAL CORDS

- Don't cause tripping hazards or create pinch points with cords
- If a cord must run temporarily across the floor, cover the cord appropriately
- Remove the cord from the electrical power source before inspecting
- Inspect plug
- Grounding prong must be present
    - Examine for:
- Cuts, Breaks, Abrasions
- Defects in insulation
- Damage/Deformities
- Only use extension cords on a temporary basis

Remove these items immediately from your work area and contact your supervisor.

CLUES THAT ELECTRICAL HAZARDS EXIST

- Wires or other electrical parts are exposed
- Covers are removed from a wiring or breaker box
- Electrical terminals in motors, appliances and electronic equipment are exposed
- Physical damage to jackets, conduit, etc.
- Electrical/Extension cords are worn, frayed or damaged
- Insulation inside an electrical tool or appliance is damaged
- Exposed metal parts may become energized if a live wire inside touches them
- Circuit breaker trips or fuse blows
- GFCI shuts off a circuit

SHOVEL CABLES

Shovel cables are used to provide power to the shovel. Operation around the shovel can congested with a variety of vehicles as well as pedestrian traffic. Proper placement and handling of these cables will reinforce safe operation in the vicinity.

- Do not run over cable with vehicles or equipment
- Electric cables should be moved with a cable tong (hot stick) or rope
- LOTOTO is required to couple or uncouple a pot heads

Note: *Do not touch cable with hands while energized.*

GENERAL ELECTRICAL SAFETY QUIZ

1. Name 4 steps that should be taken if you discover an electrical hazard while working:
   a. _____
   b. _____
   c. _____
   d. _____

2. Hand-held tools can pose an electrical hazard. How can this hazard be minimized?
   a. properly maintain the piece of equipment
   b. always have 3 prongs
   c. wear gloves
   d. make sure the equipment is plugged into a grounded receptacle
   e. a, b, and c
   f. a, b, and d

3. What are the leading categories of on-the-job electrical death and injuries (circle all that apply)?
   a. contact with overhead power lines
   b. contact with electrical components
   c. contact with electric current of machine, tool or light fixture
   d. dropping tools in pools of water
   e. wiring and transformers

INTRODUCTION TO EXPLOSIVES & BLASTING

See 30 CFR 48.5(b)(9); and 48.25(b)(11).
Applicable to: Underground and Surface metal/non-metal mining.

Not all miners are required to use explosives. Unless you are assigned to a blasting crew, you will most likely never handle blasting components. Explosives are stored, handled, and used in mining operations, therefore we must ensure that all miners are informed about the dangers.

EXPLOSIVES AND BLASTING

Mineral deposits are naturally buried beneath overburden, waste earth and rock, which must be removed before mining of the grade-bearing ore can begin. Blasting breaks up this overburden and ore so that it can be easily loaded into trucks by shovels. Without blasting, we would tear up our shovels.

DRILL HOLES

After engineers have determined where blasting should occur, and the site has been properly prepped, drilling begins. The drilling creates a series of drill holes called a drill pattern. The drill pattern is made up of a series of drill holes. These drill holes are filled with a mixture of bulk material that is not explosive until mixed.

WHEN APPROACHING DRILLS

- Prior to entering the drill area contact the operator
- Do not park near drills as they have limited visibility
- Do not drive over power cables
    - Extensive damage and electrical shock can occur

BLASTING EQUIPMENT

There are many different pieces of tools and equipment used in blasting operations. While the majority of us will not be working with these materials, it is important that we have the ability to recognize them. If you notice these items in unusual areas, contact your supervisor to ensure they have not been misplaced and left in unsecured areas.

BLASTING CAPS

Ignition source of cast booster, and the most sensitive item in blast hole. They can be detonated by shock and must be protected.

CAST BOOSTER

Detonates mixed bulk material.

AMMONIUM NITRATE AND FUEL OIL (ANFO)

One type of bulk product that may be used.

DETONATING CORD

A thin, flexible plastic tube filled with an explosive core that detonates at four miles per second.

VEHICLES CARRYING EXPLOSIVES

Any vehicle carry explosives must have signs, flags visible from all angles, be equipped with fire extinguishers, and will not be passed at any time.

SIGNAGE

Signage must be visible from every approach to the vehicle and identify that it's carrying explosives, as it is important for emergency response personnel to know what it is carrying.

BLASTING PERIMETER

When explosives are brought to a drill area, the area is then considered a blast site and must be demarcated. One of the greatest challenges a blaster faces is to accurately determine the bounds of this blast area and to ensure the area is clear of personnel. From 1978-2003, blast area security accounted for 50% of the 1,131 blast related injuries reported by the mine industry (Blasting Safety – Revisiting Site Security; Bajpayee, Verakis, & Lobb).

Yellow cones, barricades and support equipment are used to block access routes and indicate blast site perimeters. These routes are manned by guards who communicate clearance and prevent unauthorized access. It is critical that anyone who must go through the cones to perform any type of work ask permission from the powder crew so that they can guide the individuals through the pattern.

All employees must be cleared from the blast area and moved to a safe location prior to any scheduled blasting. Several accidents were caused because a blaster or a crew member was within the bounds of the blast area when the shot was fired.

BLAST WARNING

Radio and/or alarm warnings will be given prior to a blast commencement. While sites vary slightly in the periods of warnings, the minimal warnings begin five minutes and then a one minute follow-up warning. After the one minute warning, radio silence and all work stoppage is required to ensure perimeter blasting guards and the blasting supervisors have clear uninterrupted communication. A radio generated tone will sound during the radio silence period.

After a blast has occurred, an all-clear will be broadcast on the radio and mine communications and travel will return to normal.

EXPLOSIVE HAZARDS

There are three major hazards of blasting besides the explosion itself. These are flyrock, unexploded (misfired) material, voids, and gases.

There have been instances where a blast created enough energy to expel material from the immediate area and send flying debris into other areas called **flyrock**. While rare due to mining methods, such occurrences are possible. All equipment in the blast area should be removed or protected from fly-rock damage, if possible.

A **misfire** is the incomplete detonation of explosive products. A misfire can include the failure of an entire pattern to detonate or the failure of a small portion of product in a blast hole to detonate.

Always wait for areas to be released by the blasting personnel. If you notice misfired material in a muck pile, immediately contact the area's blast crew and evacuate the area.

Voids, or spaces with no material, may be encountered when blasting near old workings. Their location and size should be identified before blasting occurs.

Underground Only: The blasting process can leave residual gases from explosives, such as nitrogen dioxide. Your site should have a designated protocol that ensures the area has been properly ventilated before anyone can enter.

FLYROCK

Flyrock occurs when drill holes are improperly loaded with explosives. The main focus of the blast needs to be directed into the ground. Stay alert during blasting operations.

BLASTING OPERATIONS GENERAL CODE OF SAFE PRACTICES

- Unauthorized personnel/equipment are not permitted within 50 feet of blasting material or operation.
- Smoking and open flames not allowed within 50 feet of blasting area or operation.
- Yellow cones will be set up to designate a loading zone.
    - Only authorized personnel are allowed to enter or remove cones and signs.
- Blasting guards/blockers protecting a blast or clearing an area prior to a blast must be obeyed promptly and without question.
- Observe radio silence when requested prior to the blast.
- A siren will sound over the mine radio frequency.
- All work in a blast area will immediately cease.
- Employees will be cleared of the area without hesitation when notified by blasting personnel of impending lightning.

- Only authorized blasting personnel will perform handling misfires.
- After a blast, traffic will be cleared to enter a blast area only after authorization by blasting personnel.

Note: *For most miners, our task is to avoid any contact with explosives or the effects of explosives. There are safeguards in place for those who are required to travel in the mine. You must have training before driving on haul roads, and you must be familiar with the mine layout. Do not drive in the mine or on haul roads unless you have had the training. If you follow the rules of the mine, you will never find yourself in the vicinity of a blast.*

EXPLOSIVES & BLASTING QUIZ

1. Unauthorized personnel/equipment should not be within ____ of blasting material or operation.
    a. 50 feet
    b. 100 feet
    c. 200 feet
    d. 250 feet

2. Vehicles carrying explosives must (choose all that apply):
    a. have signs
    b. be painted bright yellow
    c. have flags visible from all angles
    d. have fire extinguishers
    e. not be passed at any time

3. _____ will be given prior to a blast commencement. The minimal warnings begin _____ minutes and then a one minute follow-up warning. After the one minute warning, _____ and _____ are required to ensure there is clear uninterrupted communication.
    a. Radio and/or alarm warnings; five; radio silence; work stoppage
    b. Sirens; five; radio silence; loud music
    c. Radio and/or alarm warnings; ten; radio silence; work stoppage
    d. Sirens; ten; turning off your radio; work continuance

INTRODUCTION TO WORKING AT HEIGHTS (GENERAL HAZARD AWARENESS)

See 30 CFR 46.5(b)(4); 48.5(b)(13); and 48.25(b)(12).
Applicable to: Sand and Gravel, Underground, and Surface mining.

In 2010, almost 700 people were killed and thousands more were injured as a result of work place falls in the United States alone. Falls continue to be the third leading cause of all workplace fatalities in general industry, and the second leading cause of fatalities in mining.

Many of these tragedies were due to short cuts that were taken which ended a life. When working with fall hazards, your life can literally be on the line. Safety for you and your co-workers must be your number one priority at all times regardless of production pressures.

WORKING AT HEIGHTS

We need to recognize the hazards associated with falling and ensure that everyone goes home safely.

If at any time you have a question, in this class or while you are working in the field, it is your responsibility to stop and seek clarification.

Preventing a hazard from existing is the primary method of ensuring safety.

Q What types of falls can occur in the workplace?

There are two types of falls that you can be exposed to during your work.

1. Falls from same level- Account for 60% of falls in the workplace
    - Slips
    - Trips
2. Falls from heights- Account for 40% of falls in the workplace

The construction of the Empire State Building was considered very safe for the time period and project complexity, six workers died.

During planning stages of construction the death toll was estimated to be one worker per floor, or over 100 workers overall. This way of thinking is unacceptable by today's standards.

FALLS FROM THE SAME LEVEL

Falls from same level account for 60% of all fall related incidents, resulting from slips and trips. These incidents can be related to too little traction or friction between the shoe and walking

surface, or when a person's foot contacts an object or drops to a lower elevation unexpectedly, causing that person to be thrown off-balance.

WAYS TO PREVENT SLIPS AND TRIPS

- Housekeeping
- Maintain clear, tidy work areas
- Keep walkways free of clutter and well-lit
- Clear walkways of slippery materials such as grease, oil, water, snow/ice
- Store materials and equipment in a neat, orderly manner
- Correct conditions that cause spills
- Remove debris and accumulations of spilled materials
- Report hazards promptly and ensure they are corrected
- Keep your eyes on the path you are traveling
- Do not run
- Maintain three points of contact when descending or ascending
- Ladders
- Steps Stairs
- Use caution when entering/exiting vehicles and equipment

FALLS FROM HEIGHTS

While falls from the same level occur on a more regular basis, unguarded falls from an elevation typically result in a serious incapacitating injury or death. Where a fall hazard exists adequate fall protection must be used. Before using fall protection you must be trained in its proper use.

Never use any PPE for which you have not been adequately trained.

Q What should you do if you discover a fall hazard in your work area?

- Remove yourself from the hazard
- Contact your supervisor immediately

Never leave a fall hazard unguarded without an attendant who has been properly trained. Guarantee that others are protected from the hazard by ensuring the area is properly guarded.

MSHA Rule to Live By § 56.15005 Safety belts and lines
"Safety belts and lines shall be worn when persons work where there is danger of falling; a second person shall tend the lifeline when bins, tanks, or other dangerous areas are entered."

Note: *If a fall hazard cannot be removed without exposing employees, fall protection must be used.*

Before using fall protection, you must take the applicable Fall Protection Course. Never use any Personal Protective Equipment without being properly task trained and signed off in its usage.

WORKING FROM LADDERS

Employees climbing ladders of 20 feet or less may do so without fall protection as long as they maintain three points of contact at all times.

Employees working on ladders may work without fall protection as long as:

- Their feet are not more than six feet from the ground
- The ladder steps are dry and clean
- The ladder is placed on a level surface
- The employee has effectively controlled remaining risks

Fall protection shall be used when working from ladders at any height if the employee is required to place himself in an off balanced position, increasing the fall potential.

Evaluate each situation using consequence thinking to minimize fall hazards and associated risks.

OPEN-HOLES IN WALKWAYS

An open-hole can be present in many different areas within different departments. Some may be easily recognizable because they have barricading, flagging and tagging in accordance with company policy. Not all open-holes may have been identified and due to the nature of mining, the landscape is constantly changing.

By following the proper procedures laid out for you in your training, and asking questions if you are unfamiliar with specific tasks, work performed around open-holes can be made safe. If at any time you have a question, either in class or while you are working in the field, it is your responsibility to stop and seek clarification. Never proceed with any job you are unfamiliar with.

OPEN-HOLE DEFINITIONS

- Opening (horizontal)- an opening measuring 12 inches or more in its least dimension in any floor, walkway or platform through which a person may fall to a lower level.
- Opening (vertical)- a gap or void 30 inches or more high and 18 inches or more wide in a wall, partition, or handrail, through which a person can fall to a lower level.

Q Is work around an open-hole always necessary, or is it possible to complete the task with the hole repaired/covered?

You should ask yourself this prior to starting any work involving an open-hole. If possible, repair/cover the open-hole. Every consideration should be given to completing the task as safely as possible without exposing yourself to a hazard.

REASONS FOR WORKING NEAR AN OPEN-HOLE

There are many reasons why work might be performed around an open-hole and it is vital that you understand and follow all safety precautions and procedures in an effort to eliminate fall hazards.

Where it is not practical to install a standard handrail around an open-hole, as may be the case in some short term work or an extremely small opening, it is permissible to properly guard the open-hole on each side as long as it meets the requirements of the previous Guarding/Barricading section for integrity and protection.

If you must remove grating or a handrail thus creating a fall hazard, the following extra safety precautions are required:

- Work permit
- The following formats meet this requirement
- Job Safety Analysis (JSA)
- Risk Analysis
- Open-hole Permit or equivalent method
- Must be completed prior to creating the hazard
- Must be communicated to all personnel involved with the job
- Must be readily available or displayed in a visible location at the workplace
- Prior to removing grating, handrails or exposing a hole, safe work practices designed to eliminate the fall hazard must be:
- Identified
- Approved by the supervisor
- Described on the work permit
- Attendant
- Competent person
- Designated by the supervisor
- Responsible for ensuring that all personnel within the exposed un-guarded areas are wearing the proper PPE (fall protection)
- Must wear fall protection if exposed to fall hazard
- Must be present until
- Fall hazard eliminated
- Barricading
- Red or Red/White Danger flagging
- Tagging (Displaying the nature of the hazard and protective action is required)

OPEN-HOLE PERMIT

Applies to all personnel working within a flagged off area (including Attendant) where an open-hole exists.

Anybody entering a red flagged area must read and sign the open-hole permit prior to entering.

Upon completion of open-hole work, file the permit with the work packet with your supervisor or area planner.

Q What should be done before removing all flagging and barricading around an open-hole?

Prior to removal of flagging or barricading, the following site pre-release inspection shall take place:

- Ensure all work associated with the exposure is complete
- Attendant and personnel with proper fall protection are to re-install grating, handrails and/or cover floor openings prior to removing flagging and/or barricading
- Remove tagging and ensure the work area is safe for re-entry

BARRICADING/GUARDING

Barricading/Guarding is used to physically prevent access to significant hazards and must be installed when falls or other serious hazards exist.

- When installing barricading, ensure
- Every open-sided floor or platform where a fall hazard exists that could result in injury, shall be guarded by a standard railing on all open sides except where there is entrance to a ramp, stairway, or fixed ladder.
- Where there is a danger below a working surface, where employees could be exposed to falling materials, proper warning signs, barricades and/or flag persons shall be used.
- Every ladder way, floor opening or platform shall be guarded by a standard railing with standard toe board on all exposed sides (except at entrance to opening).
- Passage through railing shall be provided either with a swinging gate, chains or so offset that a person cannot walk directly into the opening.
- Barricades shall be tagged to describe the nature of the hazard.
- Floor openings shall be covered with appropriate material or guarded.
- Barricading for fall prevention must be capable of withstanding 200 pounds of force.

HANDRAIL SPECIFICATIONS

Made up of vertical rails, top rails, mid rails and toe board
Top rail must be between 39" – 45" high
Must withstand 200 lbs. of force in a downward or an outward direction
Posts spaced no more than 8' apart
Wire rope guardrails need high visible flagging every 6'
No projection hazard at rail ends
Toe-board a minimum of 3 ½ inches high
Mid-rails must be 21" high
Thickness of all rails must be at least ¼"

Group Discussion: *Your team is to install new ductwork on three different levels of a processing facility. The fall hazards range from 9' to 12' on the second and third levels. In addition, much of the second and third levels are simply supporting structures and beam, rather than walled and floored areas. The first level of the facility is on concrete grade so there is no major fall hazard.*

In your teams, list the fall hazards present and identify what safe work practices can be used to prevent risk of falling.

WORKING AT HEIGHTS (GENERAL HAZARD AWARENESS) QUIZ

1. Name 4 ways in which slips and trips can be prevented:
    a. _____
    b. _____
    c. _____
    d. _____

2. Under certain circumstances, employees working on ladders may work without fall protection when:
    a. Their feet are not more than six feet from the ground
    b. The ladder is placed on a level surface
    c. They feel confident and comfortable with the task that they are working on
    d. a & c
    e. a & b

3. How many pounds of force must barricading for fall prevention be capable of withstanding?
    a. 100 pounds
    b. 200 pounds
    c. 250 pounds
    d. 400 pounds

INTRODUCTION TO CONFINED SPACE (GENERAL HAZARD AWARENESS)

See 30 CFR 46.5(b)(4); 48.5(b)(13); and 48.25(b)(12).
Applicable to: Sand and Gravel, Underground, and Surface mining.

A confined space can include a wide range of areas which you could encounter in your different departments. Some are easily recognized like storage tanks, pits, silos, vats, boilers, ducts, sewers, manholes, furnaces, and pipelines. It is important for you to be able to recognize a confined space on the chance that they have not been identified.

There are many reasons why confined space entry is necessary. Some of these functions may include cleaning, painting, repairing, inspecting, or other similar activities. These entries may be done on a routine or non-routine basis, regardless of the reason for entering a confined space it must be well planned and the hazards must be identified and controlled.

It is important to note that this module is for awareness only and that you should never enter a confined space until you have been certified by a Confined Space Entry course.

Note: Never enter a confined space until you have been properly trained. Confined space entry is restricted to those individuals who have been trained and are familiar with the job requirements and associated hazards. If you are asked to enter a confined space and have not yet received this training, speak up and do not proceed with the job. Your life is on the line.

CONFINED SPACES

Q What is a confined space?

The term "confined space" refers to a space which by design has specific characteristics that may create additional hazards to workers.

The specific characteristics of a confined space are:

1. Space is large enough and so configured that an employee can bodily enter and perform assigned work; and
2. Space has limited or restricted means of entry or exit , and
3. Space is not designed for continuous employee occupancy.

In order to be considered a confined space, the space must meet all three of the criteria above.

Confined spaces include but are not limited to: storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

THE THREE CRITERIA

Q What three characteristics make up a confined space?

1. Large enough to enter, and
2. Limited or restricted means of entry or exit, and
3. Not designed for continuous occupancy.

By definition a confined space must meet all three of the conditions above.

LARGE ENOUGH TO ENTER

A confined space must be large enough for you to be able to enter with your whole body.

Q What is the smallest opening and employee can fully bodily enter?

It depends on the size of the employee.

LIMITED OR RESTRICTED MEANS OF ENTRY OR EXIT

Confined spaces have limited access that could prevent you from escaping or being rescued in a hazardous situation. For example, tanks, vessels, sewers, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited or restricted means of entry or exit, and in the case of an emergency this restriction may make evacuation and rescue difficult.

A space is considered to have limited or restricted means of entry or exit whenever the entrants ability to escape in an emergency situation would be hindered. This includes any time the entrant cannot walk through the access standing upright and unimpeded, or must bend, stoop, crawl or climb (i.e. ladders) in order to access the space. This can also apply to areas with two exits if both of them are hard to get through, or if one is blocked by construction or debris.

If you cannot stand fully upright while walking through the opening, such as through an unobstructed doorway, there is limited or restricted means of entry or exit which could hinder your escape or rescue.

NOT DESIGNED FOR CONTINUOUS OCCUPANCY

Confined spaces are not normally designed for you to work there; while a tank may have an access door, the presence of a door does not necessarily mean that the space is not a confined space. For example, an office building is designed for human occupancy, and has ventilation, illumination, fire protection, and other life safety features as part of the design. Meanwhile a storage bin is designed to contain material, and does not provide any worker protection in its design. Spaces that are designed for continuous employee occupancy include offices, rooms, work areas, buildings, walkways, etc. but tanks, silos, bins, etc. are not specifically designed for you to work inside them for long periods of time.

Group Discussion: *In your teams, discuss the following places and decide whether or not you think they are confined spaces.*

- *Storage tanks*
- *Boilers*
- *Silos*
- *Motor Control Cabinets*
- *Pit or ditch*

A confined space can include a wide range of work areas which you could encounter in your different departments.

Some confined spaces are easily recognized like:

- Ducts
- Sewers
- Manholes
- Bins
- Sewers
- Vats
- Vaults
- Storage hoppers

Others may be more difficult to identify, especially as working conditions change on a routine basis. Therefore it is important for you to be able to recognize a confined space that has not been previously identified or properly labeled: Confined Spaces.

Q What is a Confined Space "entry"?

A confined space entry is considered to have occurred when any part of a person's body crosses the plane of an opening into the space.

A confined space "entry" shall not occur until all confined space procedures have been followed.

WARNING SIGNS

Confined spaces must be labeled to ensure that employees or contractors do not enter a confined space unknowingly. It is important that these areas have proper signage. If you recognize that signage has deteriorated or been removed from a confined space, notify your supervisor, and/or a health and safety professional immediately.

CONFINED SPACE (GENERAL HAZARD AWARENESS) QUIZ

1. A confined space (select all that must apply):
   a. Is large enough, and so configured that, an employee can enter bodily and perform work.
   b. Has only one entrance/exit.
   c. Has limited or restricted means of entry or exit.
   d. Is not designed for continuous human occupancy.

2. T/F One enters a confined space when any part of their body has broken the space's plane.

3. A Non-Permit Required Confined Space is a confined space that does not contain or have the potential to contain any _____ capable of causing _____ or serious _____.

POST TEST

Miners' Rights

1. Name two of your rights under the Federal Mine Safety and Health Act of 1977 on the lines below.

2. Which section of the 30 CFR can you find training requirements?

3. What are your responsibilities under the Federal Mine Safety and Health Act of 1977 Act? Select all that apply.

    a. Provide truthful statements and representations during inspections or investigations.
    b. Protect others against discrimination
    c. Comply with all Federal and State laws and regulations.
    d. Notify the operator, supervisor or other responsible person when refusing to work in unsafe or unhealthy conditions.

Communication

1. Name two forms of communication used at a mine site.

2. Mark is a mechanic at an underground coal mine. His supervisor, Gerry, has asked him to take a look at a continuous miner that stopped running inside the mine at around 14:00 hours. To perform his work, he will likely enter and exit his work area multiple times to get tools and communicate with his supervisor via page phone. In order to properly alert other workers to this hazard and his work, he should:

    a. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair.
    b. Be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.
    c. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 14:00 hours.
    d. Flag the area, but does not need to tag it.
    e. Flag the area, and tag it. The tag should look something like this: Mark; Gerry; Mine Maintenance; Machine repair; 10/02/2019; 200' level.
    f. Flag it, and be sure to let all the workers in the area know that he will be performing work, and that they must go around his work area.

3. As defined earlier, which of the following situations do NOT constitute a medical emergency (select all that apply):
    a. Chest pains (any)
    b. Broken bone
    c. Difficulty breathing
    d. Altered mental status/unconsciousness
    e. Seizures
    f. Neck/back pain
    g. Severe bleeding
    h. Major trauma

Transportation

1. Anytime vehicles rated at 1 ton or higher are left unattended, they (select all that apply):
    a. Must be set to 'Park'
    b. May need to have their headlights turned on for safety
    c. May need to be chocked, unless parked into a parking windrow or ditch.
    d. Must have the wheels turned into berm or bank when parked on a slope.

2. When operating a piece of equipment, operators shall:
    a. Work as fast as their machine will go
    b. Maintain control of the equipment
    c. Utilize operating speeds that are consistent with travel way conditions and the type of equipment
    d. All of the above
    e. B&C

3. You do not need to wear a seat belt in a company vehicle when:
    a. You are operating a piece of equipment
    b. Are driving a haul truck
    c. Are a passenger in a haul truck
    d. None of the above

Health and Hazard Communication

1. How _____, how _____, and how _____ you are exposed typically influences the amount of a chemical or energy that enters the body, which is called the _____.

2. The four ways that chemicals can enter the body are:

3. Will is a mine contractor who has been tasked with applying an epoxy to a drop-chute at an iron mill. Before working with the chemical what should he do so that he understands the hazards? Select all that apply.
    a. Read the epoxy's Material/Safety Data Sheet.
    b. Read the health effects listed for it on Wikipedia.
    c. Read the hazard label on the epoxy container.
    d. Smell the epoxy.
    e. Read about others' experience with it on a discussion forum.

Hazard Recognition

1. What are the three steps in Consequence Thinking?
    a._____
    b._____
    c._____

2. What should you do if you are not familiar with the safety issues concerning your current task?
    a. Report to your supervisor and discuss ways to safely complete the work
    b. Continue working
    c. Leave the job unfinished
    d. Allow someone else to complete the job

3. Mike is an experienced continuous miner operator who is concerned he is beginning to experience hearing loss, and begins to think about ways to prevent himself from being exposed to noise. He is aware of the following potential controls: a) Enclosed cabins, b) Hearing protection, c) Remotely controlled equipment, d) Job task rotations, e) New equipment with bits that produce less noise. Match each control with its corresponding control category, and in order of effectiveness, by writing it on the lines below.

Most effective	_____	Elimination
More Effective	_____	Substitution
Somewhat Effective	_____	Engineering
Less Effective	_____	Administrative
Least Effective	_____	Personal

First Aid

1. First aid is the _____ and _____ care given to the sick and injured. The purpose of first aid is to provide _____ to injured individuals on mine property until _____ can be obtained.

2. Suzie works at a coal mine crushing facility as a shift supervisor. One of her crew members is seriously injured when a piece of equipment's hydraulic system fails, and his arm is crushed beneath it. When she responds to the scene she remembers the acronym SAMPLE, and that she needs to ask him about any (M) medications he may be taking. What other information should she gather while they wait for the emergency response team? Select all that apply.

   a. What his last meal was
   b. Any allergies he has
   c. How much pain he is experiencing
   d. His pre-existing medical history
   e. Any events that might be important for medical personnel to be aware of
   f. Any signs and symptoms he has or feels
   g. If he feels nauseous or in shock

3. The three steps that can control bleeding are:

Evacuation Plans and Fire Safety

1. What does P.A.S.S. stand for?
   P_____
   A_____
   S_____
   S_____

2. Carlos is an underground coal mine operator with ten years of experience. For the first time that he has been at the site, the emergency evacuation alarms begin blaring, and most of his crew members begin running towards their vehicles. He remembers that there are mine maps available at a nearby underground shop. What 1) should the map show that 2) could be helpful as his crew attempts to evacuate? Select all that apply.

   a. Fire doors
   b. Refuge chambers
   c. Locations of escape routes
   d. Principal air flow
   e. Ventilation doors
   f. Existing telephones

3. You come across a small electrical fire and it is blocking your means of escape. Prior to beginning work you performed a preshift and you know your fire extinguisher is capable of working to help you escape. So you reach for a _____ fire extinguisher to put the fire out.

Personal Protective Equipment (PPE)

1. Rob is a surface mine mill operator, and entrance to the mill requires the use of earplugs. Despite current noise controls, Rob has noticed that his hearing has been fading over time. What could be causing this? Select all that apply.
    a. Rob needs to learn how to better insert his earplugs.
    b. Rob has extra-ordinarily large ear canals and the standard earplugs just don't fit properly.
    c. Rob has extra-ordinarily small ear canals and wearing earplugs is uncomfortable, so he usually doesn't wear them.
    d. He doesn't usually wear his earplugs because they tend to get dirty and he gets concerned about hygiene.

2. Face shields must be used with _____ or _____.

3. This type of respirator uses a fan to blow air through the filter to the user.
    a. Full-face respirator
    b. Half-mask respirator
    c. Supplied air respirator
    d. Powered air-purifying respirator
    e. Self-contained breathing apparatus

Self-Rescue and Respiratory Devices

1. T/F I can wear a respirator that has just been handed to me, as long as it passes a positive and negative seal check.

2. Terry is an underground metal miner who needs to inspect his self-rescuer to be sure it is still in working condition. He checks the expiration date, and it has been 9 years since the date of manufacture, there is no in-service date listed. He cleans the device off and it weighs 843 grams – the manufacturer as-shipped weight reads 831 grams. The unit has is slightly dented, away from the seal. It does not appear to have caused a hole. Can Terry continue to use his SCSR?

3. It is important to have a functioning self-rescue device in an emergency. In order to maintain a functioning device follow proper _____ procedures.

Dust Control

1. Order these dust sizes from smallest to largest, and circle the most dangerous size: Inhalable, Total, and Respirable.

2. What is the MSHA exposure limit for respirable coal dust in surface and underground mines?
    a. 2.0 mg/m^3
    b. 1.5 mg/m^3
    c. 1.0 mg/m^3
    d. 0.5 mg/m^3

3. What are the three main types of dust controls?

Ground Control

1. Berms or guardrails must be (select all that apply):
    a. Made of a mixture of gravel and dirt
    b. Provided wherever a drop off could endanger individuals
    d. Effective in controlling fall/rollover hazards
    e. Mid-axle height of the largest vehicle traveling the road

2. Scaling involves the _____ of loose material from the roof, face and rib in hard rock mining.

3. Harry has been tasked with performing a visual inspection of the roof and ribs at the underground coal mine where he works. What should he look for? Select all that apply.
    a. Looking for bulges at the pillars' base
    b. Any stress cracks in the roof, floor or rib
    c. Abnormal rock formations such as kettlebottoms and clay veins
    d. A wet place that was formerly dry

Mine Gases

1. Match the occupational exposure limit with its definition:

a. Permissible exposure limit	1. Recommended exposure over 8-hr shift
b. Short-term exposure limit	2. Level that is 50% of PEL
c. Action limit	3. Allowable exposure over 15 minutes
d. Threshold Limit value	4. Point at which exposure can cause death
e. Recommended exposure limit	5. Allowable exposure over 8-hr shift
f. Immediately dangerous to life and health	6. Recommended exposure over 8-hr shift

2. Name 4 toxic gases that are encountered in mining:
    a. _____
    b. _____
    c. _____
    d. _____

3. What is the best engineering control for mine gases?

Mine Ventilation

1. What are the 2 main functions of mine ventilation?

2. What are 2 ways in which you can measure the airflow within the mine?

3. The pressure created by the fan and ventilation system must be great enough to overcome _____ and _____.
    a. positive; negative pressure
    b. frictional resistance; shock losses
    c. the outside wind; air generated by equipment
    d. shock losses; positive pressure

General Electrical Safety

1. Name 4 steps that should be taken if you discover an electrical hazard while working:
    a. _____
    b. _____
    c. _____
    d. _____

2. Hand-held tools can pose an electrical hazard. How can this hazard be minimized?
    a. properly maintain the piece of equipment
    b. always have 3 prongs
    c. wear gloves
    d. make sure the equipment is plugged into a grounded receptacle
    e. a, b, and c
    f. a, b, and d

3. What are the leading categories of on-the-job electrical death and injuries (circle all that apply)?
    a. contact with overhead power lines
    b. contact with electrical components
    c. contact with electric current of machine, tool or light fixture
    d. dropping tools in pools of water
    e. wiring and transformers

Explosives and Blasting

1. Unauthorized personnel/equipment should not be within ____ of blasting material or operation.
    a. 50 feet
    b. 100 feet
    c. 200 feet
    d. 250 feet

2. Vehicles carrying explosives must (choose all that apply):
    a. have signs
    b. be painted bright yellow
    c. have flags visible from all angles
    d. have fire extinguishers
    e. not be passed at any time

3. _____ will be given prior to a blast commencement. The minimal warnings begin _____ minutes and then a one minute follow-up warning. After the one minute warning, _____ and _____ are required to ensure there is clear uninterrupted communication.
    a. Radio and/or alarm warnings; five; radio silence; work stoppage
    b. Sirens; five; radio silence; loud music
    c. Radio and/or alarm warnings; ten; radio silence; work stoppage
    d. Sirens; ten; turning off your radio; work continuance

Working at Heights

1. Name 4 ways in which slips and trips can be prevented:
    a. _____
    b. _____
    c. _____
    d. _____

2. Under certain circumstances, employees working on ladders may work without fall protection when:
    a. Their feet are not more than six feet from the ground
    b. The ladder is placed on a level surface
    c. They feel confident and comfortable with the task that they are working on
    d. a & c
    e. a & b

3. How many pounds of force must barricading for fall prevention be capable of withstanding?
    a. 100 pounds
    b. 200 pounds
    c. 250 pounds
    d. 400 pounds

Confined Spaces

1. A confined space (select all that must apply):
    a. Is large enough, and so configured that, an employee can enter bodily and perform work.
    b. Has only one entrance/exit.
    c. Has limited or restricted means of entry or exit.
    d. Is not designed for continuous human occupancy.

2. T/F One enters a confined space when any part of their body has broken the space's plane.

3. A Non-Permit Required Confined Space is a confined space that does not contain or have the potential to contain any _____ capable of causing _____ or serious _____.

GLOSSARY OF COMMON MINING TERMS

A

Abutment	In coal mining, (1) the weight of the rocks above a narrow roadway is transferred to the solid coal along the sides, which act as abutments of the arch of strata spanning the roadway; and (2) the weight of the rocks over a longwall face is transferred to the front abutment, that is, the solid coal ahead of the face and the back abutment, that is, the settled packs behind the face.
Acid deposition or acid rain	Refers loosely to a mixture of wet and dry "deposition" (deposited material) from the atmosphere containing higher than "normal" amount of nitric and sulfuric acids. The precursors or chemical forerunners of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur and nitrogen oxides resulting from fossil fuel combustion.
Acid mine water	Mine water that contains free sulfuric acid, mainly due to the weathering of iron pyrites.
Active workings	Any place in a mine where miners are normally required to work or travel and which are ventilated and inspected regularly.
Adit	A nearly horizontal passage from the surface by which a mine is entered and dewatered. A blind horizontal opening into a mountain, with only one entrance.
Advance	Mining in the same direction, or order of sequence; first mining as distinguished from retreat.
Agglomeration	A family of processes which can be used to concentrate valuable minerals (including coal) based on their adhesive properties.
Air split	The division of a current of air into two or more parts.
Airway	Any passage through which air is carried. Also known as an air course.
Anemometer	Instrument for measuring air velocity.
Angle of dip	The angle at which strata or mineral deposits are inclined to the horizontal plane.

Angle of draw	In coal mine subsidence, this angle is assumed to bisect the angle between the vertical and the angle of repose of the material and is 20° for flat seams. For dipping seams, the angle of break increases, being 35.8° from the vertical for a 40° dip. The main break occurs over the seam at an angle from the vertical equal to half the dip.
Angle of repose	The maximum angle from horizontal at which a given material will rest on a given surface without sliding or rolling.
Anthracite coal	Of the four types of coal, anthracite is the hardest and contains the highest heat value. It is almost pure carbon and is used mainly for home heating and cooking. In some developing countries, it is also used for industrial purposes.
Anticline	An upward fold or arch of rock strata.
Aquifer	A water-bearing bed of porous rock, often sandstone.
Arching	Fracture processes around a mine opening, leading to stabilization by an arching effect.
Area (of an airway)	Average width multiplied by average height of airway, expressed in square feet.
Auger	A rotary drill that uses a screw device to penetrate, break, and then transport the drilled material (coal).
Auxiliary operations	All activities supportive of but not contributing directly to mining.
Auxiliary ventilation	Portion of main ventilating current directed to face of dead end entry by means of an auxiliary fan and tubing.
Azimuth	A surveying term that references the angle measured clockwise from any meridian (the established line of reference). The bearing is used to designate direction. The bearing of a line is the acute horizontal angle between the meridian and the line.

B

Back	The roof or upper part in any underground mining cavity.
Backfill	Mine waste or rock used to support the roof after coal removal.

Barren	Said of rock or vein material containing no minerals of value, and of strata without coal, or containing coal in seams too thin to be workable.
Barricading	Enclosing part of a mine to prevent inflow of noxious gasses from a mine fire or an explosion.
Barrier	Something that bars or keeps out. Barrier pillars are solid blocks of coal left between two mines or sections of a mine to prevent accidents due to inrushes of water, gas, or from explosions or a mine fire.
Beam	A bar or straight girder used to support a span of roof between two support props or walls.
Beam building	The creation of a strong, inflexible beam by bolting or otherwise fastening together several weaker layers. In coal mining this is the intended basis for roof bolting.
Bearing	A surveying term used to designate direction. The bearing of a line is the acute horizontal angle between the meridian and the line. The meridian is an established line of reference. Azimuths are angles measured clockwise from any meridian.
Bearing plate	A plate used to distribute a given load. In roof bolting, the plate used between the bolt head and the roof.
Bed	A stratum of coal or other sedimentary deposit.
Belt conveyor	A looped belt on which coal or other materials can be carried and which is generally constructed of flame-resistant material or of reinforced rubber or rubber-like substance.
Belt idler	A roller, usually of cylindrical shape, which is supported on a frame and which, in turn, supports or guides a conveyor belt. Idlers are not powered but turn by contact with the moving belt.
Belt take-up	A belt pulley, generally under a conveyor belt and inby the drive pulley, kept under strong tension parallel to the belt line. Its purpose is to automatically compensate for any slack in the belting created by start-up, etc.
Bench	One of to or more divisions of a coal seam separated by slate or formed by the process of cutting the coal.

Beneficiation	The treatment of mined material, making it more concentrated or richer.
Berm	A pile or mound of material capable of restraining a vehicle.
Binder	A streak of impurity in a coal seam.
Bit	The hardened and strengthened device at the end of a drill rod that transmits the energy of breakage to the rock. The size of the bit determines the size of the hole. A bit may be either detachable from or integral with its supporting drill rod.
Bituminous coal	A middle rank coal (between subbituminous and anthracite) formed by additional pressure and heat on lignite. Usually has a high Btu value and may be referred to as "soft coal." A general term descriptive of coal intermediate in rank between sub-bituminous and anthracite and including metallurgical coals. Low and medium volatile bituminous coals are ranked by their carbon content, while high volatile bituminous coals are ranked by their heating value.
Black damp	A term generally applied to carbon dioxide. Strictly speaking, it is a mixture of carbon dioxide and nitrogen. It is also applied to an atmosphere depleted of oxygen, rather than having an excess of carbon dioxide.
Blasting agent	Any material consisting of a mixture of a fuel and an oxidizer.
Blasting cap	A detonator containing a charge of detonating compound, which is ignited by electric current or the spark of a fuse. Used for detonating explosives.
Blasting circuit	Electric circuits used to fire electric detonators or to ignite an igniter cord by means of an electric starter.
Bleeder or bleeder entries	Special air courses developed and maintained as part of the mine ventilation system and designed to continuously move air-methane mixtures emitted by the gob or at the active face away from the active workings and into mine-return air courses. Alt: Exhaust ventilation lateral.
Boiler	A tank in which water is heated or steam is generated.
Bolt torque	The turning force in foot-pounds applied to a roof bolt to achieve an installed tension.

Borehole	Any deep or long drill-hole, usually associated with a diamond drill.
Bottom	Floor or underlying surface of an underground excavation.
Boss	Any member of the managerial ranks who is directly in charge of miners (e.g., "shift-boss," "face-boss," "fire-boss," etc.).
Box-type magazine	A small, portable magazine used to store limited quantities of explosives or detonators for short periods of time at locations in the mine which are convenient to the blasting sites at which they will be used.
Brattice or brattice cloth	Fire-resistant fabric or plastic partition used in a mine passage to confine the air and force it into the working place. Also termed "line brattice," "line canvas," or "line curtain."
Break line	The line that roughly follows the rear edges of coal pillars that are being mined. The line along which the roof of a coal mine is expected to break.
Breaker	A machine which combines coal crushing and screening. Normally consists of a rotating drum in which coal is broken by gravity impact against the walls of the drum.
Breakthrough	A passage for ventilation that is cut through the pillars between rooms.
Bridge carrier	A rubber-tire-mounted mobile conveyor, about 10 meters long, used as an intermediate unit to create a system of articulated conveyors between a mining machine and a room or entry conveyor.
Bridge conveyor	A short conveyor hung from the boom of mining or lading machine or haulage system with the other end attached to a receiving bin that dollies along a frame supported by the room or entry conveyor, tailpiece. Thus, as the machine boom moves, the bridge conveyor keeps it in constant connection with the tailpiece.
Brow	A low place in the roof of a mine, giving insufficient headroom.
Brushing	Digging up the bottom or taking down the top to give more headroom in roadways.
Btu	British thermal unit. A measure of the energy required to raise the temperature of one pound of water one degree Fahrenheit.

Bug dust	The fine particles of coal or other material resulting form the boring or cutting of the coal face by drill or machine.
Bump (or burst)	A violent dislocation of the mine workings which is attributed to severe stresses in the rock surrounding the workings.
Butt cleat	A short, poorly defined vertical cleavage plane in a coal seam, usually at right angles to the long face cleat.
Butt entry	A coal mining term that has different meanings in different locations. It can be synonymous with panel entry, submain entry, or in its older sense it refers to an entry that is "butt" onto the coal cleavage (that is, at right angles to the face).

C

Cage	In a mine shaft, the device, similar to an elevator car, that is used for hoisting personnel and materials.
Calorific value	The quantity of heat that can be liberated from one pound of coal or oil measured in BTU's.
Cannel coal	A massive, non-caking block coal with a fine, even grain and a conchoidal fracture which has a high percentage of hydrogen, burns with a long, yellow flame, and is extremely easy to ignite.
Canopy	A protective covering of a cab on a mining machine.
Cap	A miner's safety helmet. Also, a highly sensitive, encapsulated explosive that is used to detonate larger but less sensitive explosives.
Cap block	A flat piece of wood inserted between the top of the prop and the roof to provide bearing support.
Car	A railway wagon, especially any of the wagons adapted to carrying coal, ore, and waste underground.
Car-dump	The mechanism for unloading a loaded car.
Carbide bit	More correctly, cemented tungsten carbide. A cutting or drilling bit for rock or coal, made by fusing an insert of molded tungsten carbide to the cutting edge of a steel bit shank.
Carbon Dioxide	A colorless, odorless, non-toxic radiative gas that is essential to plant

	and animal life. It is also emitted as a result of burning organic materials, including fossil fuels.
Cast	A directed throw; in strip-mining, the overburden is cast from the coal to the previously mined area.
Certified	Describes a person who has passed an examination to do a required job.
Chain conveyor	A conveyor on which the material is moved along solid pans (troughs) by the action of scraper crossbars attached to powered chains.
Chain pillar	The pillar of coal left to protect the gangway or entry and the parallel airways.
Charcoal	The residue, primarily carbon, from the partial combustion of wood or other organic matter.
Check curtain	Sheet of brattice cloth hung across an airway to control the passage of the air current.
Chlorofluorocarbons (CFCs)	Human-produced chemical compounds containing chlorine, fluorine and carbon which are thought to be responsible for ozone-layer depletion. CFCs also act as a radiative gas.
Chock	Large hydraulic jacks used to support roof in longwall and shortwall mining systems.
Clay vein	A body of clay-like material that fills a void in a coal bed.
Cleat	The vertical cleavage of coal seams. The main set of joints along which coal breaks when mined.
Clean Air Act Amendments of 1990	A comprehensive set of amendments to the federal law governing the nation's air quality. The Clean Air Act was originally passed in 1970 to address significant air pollution problems in our cities. The 1990 amendments broadened and strengthened the original law to address specific problems such as acid deposition, urban smog, hazardous air pollutants and stratospheric ozone depletion.
Clean Coal Technologies	A number of innovative, new technologies designed to use coal in a more efficient and cost-effective manner while enhancing environmental protection. Several promising technologies include: fluidized-bed combustion, integrated gasification combined cycle, limestone injection multi-stage burner, enhanced flue gas

	desulfurization (or "scrubbing"), coal liquefaction and coal gasification.
Coal	A solid, brittle, more or less distinctly stratified combustible carbonaceous rock, formed by partial to complete decomposition of vegetation; varies in color from dark brown to black; not fusible without decomposition and very insoluble.
Coal desulphurisation	Removal of sulphur from coal or coal gas.
Coal dust	Particles of coal that can pass a No. 20 sieve.
Coal Gasification	The conversion of coal into a gaseous fuel.
Coal mine	An area of land and all structures, facilities, machinery, tools, equipment, shafts, slopes, tunnels, excavations, and other property, real or personal, placed upon, under, or above the surface of such land by any person, used in extracting coal from its natural deposits in the earth by any means or method, and the work of preparing the coal so extracted, including coal preparation facilities. British term is "colliery".
Coal reserves	Measured tonnages of coal that have been calculated to occur in a coal seam within a particular property.
Coal washing	The process of separating undesirable materials from coal based on differences in densities. Pyritic sulfur, or sulfur combined with iron, is heavier and sinks in water; coal is lighter and floats.
Coke	A hard, dry carbon substance produced by heating coal to a very high temperature in the absence of air. Coke is used in the manufacture of iron and steel.
Collar	The term applied to the timbering or concrete around the mouth or top of a shaft. The beginning point of a shaft or drill hole at the surface.
Colliery	British name for coal mine.
Column flotation	A precombustion coal cleaning technology in which coal particles attach to air bubbles rising in a vertical column. The coal is then removed at the top of the column.
Combustion chamber	The part of a boiler in which fuel is burned.

Comminution	The breaking, crushing, or grinding of coal, ore, or rock.
Competent rock	Rock which, because of its physical and geological characteristics, is capable of sustaining openings without any structural support except pillars and walls left during mining (stalls, light props, and roof bolts are not considered structural support).
Contact	The place or surface where two different kinds of rocks meet. Applies to sedimentary rocks, as the contact between a limestone and a sandstone, for example, and to metamorphic rocks; and it is especially applicable between igneous intrusions and their walls.
Continuous miner	A machine that constantly extracts coal while it loads it. This is to be distinguished from a conventional, or cyclic, unit which must stop the extraction process in order for loading to commence.
Contour	An imaginary line that connects all points on a surface having the same elevation.
Conventional mining	The first fully-mechanized underground mining method involving the insertion of explosives in a coal seam, the blasting of the seam, and the removal of the coal onto a conveyor or shuttle car by a loading machine.
Conveyor	An apparatus for moving material from one point to another in a continuous fashion. This is accomplished with an endless (that is, looped) procession of hooks, buckets, wide rubber belt, etc.
Core sample	A cylinder sample generally 1-5" in diameter drilled out of an area to determine the geologic and chemical analysis of the overburden and coal.
Cover	The overburden of any deposit.
Creep	The forcing of pillars into soft bottom by the weight of a strong roof. In surface mining, a very slow movement of slopes downhill.
Crib	A roof support of prop timbers or ties, laid in alternate cross-layers, log-cabin style. It may or may not be filled with debris. Also may be called a chock or cog.
Cribbing	The construction of cribs or timbers laid at right angles to each other, sometimes filled with earth, as a roof support or as a support for machinery.

Crop coal	Coal at the outcrop of the seam. It is usually considered of inferior quality due to partial oxidation, although this is not always the case.
Crossbar	The horizontal member of a roof timber set supported by props located either on roadways or at the face.
Crosscut	A passageway driven between the entry and its parallel air course or air courses for ventilation purposes. Also, a tunnel driven from one seam to another through or across the intervening measures; sometimes called "crosscut tunnel", or "breakthrough". In vein mining, an entry perpendicular to the vein.
Cross entry	An entry running at an angle with the main entry.
Crusher	A machine for crushing rock or other materials. Among the various types of crushers are the ball mill, gyratory crusher, Handsel mill, hammer mill, jaw crusher, rod mill, rolls, stamp mill, and tube mill.
Cutter; Cutting machine	A machine, usually used in coal, that will cut a 10- to 15-cm slot. The slot allows room for expansion of the broken coal. Also applies to the man who operates the machine and to workers engaged in the cutting of coal by prick or drill.
Cycle mining	A system of mining in more than one working place at a time, that is, a miner takes a lift from the face and moves to another face while permanent roof support is established in the previous working face.

D

Demonstrated reserves	A collective term for the sum of coal in both measured and indicated resources and reserves.
Deposit	Mineral deposit or ore deposit is used to designate a natural occurrence of a useful mineral, or an ore, in sufficient extent and degree of concentration to invite exploitation.
Depth	The word alone generally denotes vertical depth below the surface. In the case of incline shafts and boreholes it may mean the distance reached from the beginning of the shaft or hole, the borehole depth, or the inclined depth.
Detectors	Specialized chemical or electronic instruments used to detect mine gases.

Detonator	A device containing a small detonating charge that is used for detonating an explosive, including, but not limited to, blasting caps, exploders, electric detonators, and delay electric blasting caps.
Development mining	Work undertaken to open up coal reserves as distinguished from the work of actual coal extraction.
Diffusion	Blending of a gas and air, resulting in a homogeneous mixture. Blending of two or more gases.
Diffuser fan	A fan mounted on a continuous miner to assist and direct air delivery from the machine to the face.
Dilute	To lower the concentration of a mixture; in this case the concentration of any hazardous gas in mine air by addition of fresh intake air.
Dilution	The contamination of ore with barren wall rock in stoping.
Dip	The inclination of a geologic structure (bed, vein, fault, etc.) from the horizontal; dip is always measured downwards at right angles to the strike.
Dragline	A large excavation machine used in surface mining to remove overburden (layers of rock and soil) covering a coal seam. The dragline casts a wire rope-hung bucket a considerable distance, collects the dug material by pulling the bucket toward itself on the ground with a second wire rope (or chain), elevates the bucket, and dumps the material on a spoil bank, in a hopper, or on a pile.
Drainage	The process of removing surplus ground or surface water either by artificial means or by gravity flow.
Draw slate	A soft slate, shale, or rock from approximately 1 cm to 10 cm thick and located immediately above certain coal seams, which falls quite easily when the coal support is withdrawn.
Drift	A horizontal passage underground. A drift follows the vein, as distinguished from a crosscut that intersects it, or a level or gallery, which may do either.
Drift mine	An underground coal mine in which the entry or access is above water level and generally on the slope of a hill, driven horizontally into a coal seam.

Drill	A machine utilizing rotation, percussion (hammering), or a combination of both to make holes. If the hole is much over 0.4m in diameter, the machine is called a borer.
Drilling	The use of such a machine to create holes for exploration or for loading with explosives.
Dummy	A bag filled with sand, clay, etc., used for stemming a charged hole.
Dump	To unload; specifically, a load of coal or waste; the mechanism for unloading, e.g. a car dump (sometimes called tipple); or, the pile created by such unloading, e.g. a waste dump (also called heap, pile, tip, spoil pike, etc.).

E

Electrical grounding	To connect with the ground to make the earth part of the circuit.
Electrostatic precipitator	An electrical device for removing fine particles (fly ash) from combustion gases prior to release from a power plant's stack.
Energy	The capacity to do work; more commonly used as an all-encompassing generic term describing fuel sources used to provide power.
Energy mix	The combination of sources used to provide energy at any given time and place. Energy sources include coal, oil, gas, water (hydro), uranium (nuclear), wind, sunlight, geothermal, and others.
Entry	An underground horizontal or near-horizontal passage used for haulage, ventilation, or as a mainway; a coal heading; a working place where the coal is extracted from the seam in the initial mining; same as "gate" and "roadway," both British terms.
Evaluation	The work involved in gaining a knowledge of the size, shape, position and value of coal.
Exploration	The search for mineral deposits and the work done to prove or establish the extent of a mineral deposit. Alt: Prospecting and subsequent evaluation.
Explosive	Any rapidly combustive or expanding substance. The energy released during this rapid combustion or expansion can be used to break rock.
Extraction	The process of mining and removal of cal or ore from a mine.

F

Face	The exposed area of a coal bed from which coal is being extracted.
Face cleat	The principal cleavage plane or joint at right angles to the stratification of the coal seam.
Face conveyor	Any conveyor used parallel to a working face which delivers coal into another conveyor or into a car.
Factor of safety	The ratio of the ultimate breaking strength of the material to the force exerted against it. If a rope will break under a load of 6000 lbs., and it is carrying a load of 2000 lbs., its factor of safety is 6000 divided by 2000 which equals 3.
Fall	A mass of roof rock or coal which has fallen in any part of a mine.
Fan, auxiliary	A small, portable fan used to supplement the ventilation of an individual working place.
Fan, booster	A large fan installed in the main air current, and thus in tandem with the main fan.
Fan signal	Automation device designed to give alarm if the main fan slows down or stops.
Fault	A slip-surface between two portions of the earth's surface that have moved relative to each other. A fault is a failure surface and is evidence of severe earth stresses.
Fault zone	A fault, instead of being a single clean fracture, may be a zone hundreds or thousands of feet wide. The fault zone consists of numerous interlacing small faults or a confused zone of gouge, breccia, or mylonite.
Feeder	A machine that feeds coal onto a conveyor belt evenly.
Fill	Any material that is put back in place of the extracted ore to provide ground support.
Fire damp	The combustible gas, methane, CH4. Also, the explosive methane-air mixtures with between 5% and 15% methane. A combustible gas formed in mines by decomposition of coal or other carbonaceous

	matter, and that consists chiefly of methane.
Fissure	An extensive crack, break, or fracture in the rocks.
Fixed carbon	The part of the carbon that remains behind when coal is heated in a closed vessel until all of the volatile matter is driven off.
Flat-lying	Said of deposits and coal seams with a dip up to 5 degrees.
Flight	The metal strap or crossbar attached to the drag chain-and-flight conveyor.
Float dust	Fine coal-dust particles carried in suspension by air currents and eventually deposited in return entries. Dust consisting of particles of coal that can pass through a No. 200 sieve.
Floor	That part of any underground working upon which a person walks or upon which haulage equipment travels; simply the bottom or underlying surface of an underground excavation.
Flue Gas Desulfurization	Any of several forms of chemical/physical processes that remove sulfur compounds formed during coal combustion. The devices, commonly called "scrubbers," combine the sulfur in gaseous emissions with another chemical medium to form inert "sludge" which must then be removed for disposal.
Fluidized Bed Combustion	A process with a high degree of ability to remove sulfur from coal during combustion. Crushed coal and limestone are suspended in the bottom of a boiler by an upward stream of hot air. The coal is burned in this bubbling, liquid-like (or "fluidized") mixture. Rather than released as emissions, sulfur from combustion gases combines with the limestone to form a solid compound recovered with the ash.
Fly ash	The finely divided particles of ash suspended in gases resulting from the combustion of fuel. Electrostatic precipitators are used to remove fly ash from the gases prior to the release from a power plant's smokestack.
Formation	Any assemblage of rocks which have some character in common, whether of origin, age, or composition. Often, the word is loosely used to indicate anything that has been formed or brought into its present shape.
Fossil fuel	Any naturally occurring fuel of an organic nature, such as coal, crude oil and natural gas.

Fracture	A general term to include any kind of discontinuity in a body of rock if produced by mechanical failure, whether by shear stress or tensile stress. Fractures include faults, shears, joints, and planes of fracture cleavage.
Friable	Easy to break, or crumbling naturally. Descriptive of certain rocks and minerals.
Fuse	A cord-like substance used in the ignition of explosives. Black powder is entrained in the cord and, when lit, burns along the cord at a set rate. A fuse can be safely used to ignite a cap, which is the primer for an explosive.

G

Gallery	A horizontal or a nearly horizontal underground passage, either natural or artificial.
Gasification	Any of various processes by which coal is turned into low, medium, or high Btu gases.
Gathering conveyor; gathering belt	Any conveyor which is used to gather coal from other conveyors and deliver it either into mine cars or onto another conveyor. The term is frequently used with belt conveyors placed in entries where a number of room conveyors deliver coal onto the belt.
Geologist	One who studies the constitution, structure, and history of the earth's crust, conducting research into the formation and dissolution of rock layers, analyzing fossil and mineral content of layers, and endeavoring to fix historical sequence of development by relating characteristics to known geological influences (historical geology).
Geotechnical engineering	The branch of engineering that specializes in assessing the stability and strength of soil and rock materials, as well as groundwater conditions. With regard to mining, geotechnical engineering principles are used to determine the appropriate design of mine features such as pit walls, tunnels, and earthen embankments.
Gob	The term applied to that part of the mine from which the coal has been removed and the space more or less filled up with waste. Also, the loose waste in a mine. Also called goaf.
Global climate change	This term usually refers to the gradual warming of the earth caused by the greenhouse effect. Many scientists believe this is the result of man-

	made emissions of greenhouse gases such as carbon dioxide, chlorofluorocarbons (CFC) and methane, although there is no agreement among the scientific community on this controversial issue.
Grain	In petrology, that factor of the texture of a rock composed of distinct particles or crystals which depends upon their absolute size.
Greenhouse effect	The natural phenomenon that occurs when certain atmospheric gases (see greenhouse gases) trap radiated heat in the atmosphere. The greenhouse effect keeps the atmosphere warm and makes life on earth possible.
Grizzly	Course screening or scalping device that prevents oversized bulk material form entering a material transfer system; constructed of rails, bars, beams, etc.
Ground control	The regulation and final arresting of the closure of the walls of a mined area. The term generally refers to measures taken to prevent roof falls or coal bursts.
Ground pressure	The pressure to which a rock formation is subjected by the weight of the superimposed rock and rock material or by diastrophic forces created by movements in the rocks forming the earth's crust. Such pressures may be great enough to cause rocks having a low compressional strength to deform and be squeezed into and close a borehole or other underground opening not adequately strengthened by an artificial support, such as casing or timber.
Gunite	A cement applied by spraying to the roof and sides of a mine passage.

H

Haulage	The horizontal transport of ore, coal, supplies, and waste. The vertical transport of the same is called hoisting.
Haulageway	Any underground entry or passageway that is designed for transport of mined material, personnel, or equipment, usually by the installation of track or belt conveyor.
Headframe	The structure surmounting the shaft which supports the hoist rope pulley, and often the hoist itself.
Heading	A vein above a drift. An interior level or airway driven in a mine. In longwall workings, a narrow passage driven upward from a gangway in starting a working in order to give a loose end.

Head section	A term used in both belt and chain conveyor work to designate that portion of the conveyor used for discharging material.
Heaving	Applied to the rising of the bottom after removal of the coal; a sharp rise in the floor is called a "hogsback".
Highwall	The unexcavated face of exposed overburden and coal in a surface mine or in a face or bank on the uphill side of a contour mine excavation.
Highwall miner	A highwall mining system consists of a remotely controlled continuous miner which extracts coal and conveys it via augers, belt or chain conveyors to the outside. The cut is typically a rectangular, horizontal cut from a highwall bench, reaching depths of several hundred feet or deeper.
Hogsback	A sharp rise in the floor of a seam.
Hoist	A drum on which hoisting rope is wound in the engine house, as the cage or skip is raised in the hoisting shaft.
Hoisting	The vertical transport coal or material.
Hopper	A bin or funnel that is loaded from the top and which discharges through a door or chute at the bottom.</b
Horizon	In geology, any given definite position or interval in the stratigraphic column or the scheme of stratigraphic classification; generally used in a relative sense.
Horseback	A mass of material with a slippery surface in the roof; shaped like a horse's back.
Hydraulic	Of or pertaining to fluids in motion. Hydraulic cement has a composition which permits it to set quickly under water. Hydraulic jacks lift through the force transmitted to the movable part of the jack by a liquid. Hydraulic control refers to the mechanical control of various parts of machines, such as coal cutters, loaders, etc., through the operation or action of hydraulic cylinders.
Hydrocarbon	A class of compounds containing hydrogen and carbon formed by the decomposition of plant and animal remains, including coal, mineral oil, petroleum, natural gas, paraffin, the fossil resins, and the solid bitumens occurring in rocks. Gasoline is a mixture of hydrocarbons.

I

Inby	In the direction of the working face.
Incline	Any entry to a mine that is not vertical (shaft) or horizontal (adit). Often incline is reserved for those entries that are too steep for a belt conveyor (+17 degrees -18 degrees), in which case a hoist and guide rails are employed. A belt conveyor incline is termed a slope. Alt: Secondary inclined opening, driven upward to connect levels, sometimes on the dip of a deposit; also called "inclined shaft".
Incompetent	Applied to strata, a formation, a rock, or a rock structure not combining sufficient firmness and flexibility to transmit a thrust and to lift a load by bending.
Indicated coal resources	Coal for which estimates of the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.
Inferred coal resources	Coal in unexplored extensions of the demonstrated resources for which estimates of the quality and size are based on geologic evidence and projection. Quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repletion of which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence.
In situ	In the natural or original position. Applied to a rock, soil, or fossil when occurring in the situation in which it was originally formed or deposited.
Intake	The passage through which fresh air is drawn or forced into a mine or to a section of a mine.
Intermediate section	A term used in belt and chain conveyor network to designate a section of the conveyor frame occupying a position between the head and foot sections.
Immediate roof	The roof strata immediately above the coalbed, requiring support during the excavation of coal.

Isopach	A line, on a map, drawn through points of equal thickness of a designated unit. Synonym for isopachous line; isopachyte.

J

Jackleg	A percussion drill used for drifting or stoping that is mounted on a telescopic leg which has an extension of about 2.5 m. The leg and machine are hinged so that the drill need not be in the same direction as the leg.
Jackrock	A caltrop or other object manufactured with one or more rounded or sharpened points, which when placed or thrown present at least one point at such an angle that it is peculiar to and designed for use in puncturing or damaging vehicle tires. Jackrocks are commonly used during labor disputes.
Job Safety Analysis (J.S.A.)	A job breakdown that gives a safe, efficient job procedure.
Joint	A divisional plane or surface that divides a rock and along which there has been no visible movement parallel to the plane or surface.

K

Kettle bottom	A smooth, rounded piece of rock, cylindrical in shape, which may drop out of the roof of a mine without warning. The origin of this feature is thought to be the remains of the stump of a tree that has been replaced by sediments so that the original form has been rather well preserved.
Kerf	The undercut of a coal face.

L

Lamp	The electric cap lamp worn for visibility. Also, the flame safety lamp used in coal mines to detect methane gas concentrations and oxygen deficiency.
Layout	The design or pattern of the main roadways and workings. The proper layout of mine workings is the responsibility of the manager aided by the planning department.
Lift	The amount of coal obtained from a continuous miner in one mining cycle.

Lignite	A low-rank coal with a relatively high moisture content and relatively low heat/energy content.
Liquefaction	The process of converting coal into a synthetic fuel, similar in nature to crude oil and/or refined products, such as gasoline.
Lithology	The character of a rock described in terms of its structure, color, mineral composition, grain size, and arrangement of its component parts; all those visible features that in the aggregate impart individuality of the rock. Lithology is the basis of correlation in coal mines and commonly is reliable over a distance of a few miles.
Load	To place explosives in a drill hole. Also, to transfer broken material into a haulage device.
Loading machine	Any device for transferring excavated coal into the haulage equipment.
Loading pocket	Transfer point at a shaft where bulk material is loaded by bin, hopper, and chute into a skip.
Longwall Mining	One of three major underground coal mining methods currently in use. Employs a steal plow, or rotation drum, which is pulled mechanically back and forth across a face of coal that is usually several hundred feet long. The loosened coal falls onto a conveyor for removal from the mine.
Loose coal	Coal fragments larger in size than coal dust.
Low Sulphur coal	Coal which has a sulphur content generally ranging from 0.1 per cent to 1.0 per cent. All western Canadian coal is low in sulphur.
Low voltage	Up to and including 660 volts by federal standards.

M

Main entry	A main haulage road. Where the coal has cleats, main entries are driven at right angles to the face cleats.
Main fan	A mechanical ventilator installed at the surface; operates by either exhausting or blowing to induce airflow through the mine roadways and workings.
Manhole	A safety hole constructed in the side of a gangway, tunnel, or slope in which miner can be safe from passing locomotives and car. Also called

	a refuge hole.
Man trip	A carrier of mine personnel, by rail or rubber tire, to and from the work area.
Manway	An entry used exclusively for personnel to travel form the shaft bottom or drift mouth to the working section; it is always on the intake air side in gassy mines. Also, a small passage at one side or both sides of a breast, used as a traveling way for the miner, and sometimes, as an airway, or chute, or both.
Measured coal resources	Coal for which estimates of the rank, quality, and quantity have been computed from sample analyses and measurements from closely spaced and geologically well-known sample sites, such as outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage.
Meridian	A surveying term that establishes a line of reference. The bearing is used to designate direction. The bearing of a line is the acute horizontal angle between the meridian and the line. Azimuths are angles measured clockwise from any meridian.
Metallurgical coal	The type of coal which is converted to coke for use in manufacturing steel; often referred to as coking coal.
Methane	A potentially explosive gas formed naturally from the decay of vegetative matter, similar to that which formed coal. Methane, which is the principal component of natural gas, is frequently encountered in underground coal mining operations and is kept within safe limits through the use of extensive mine ventilation systems.
Methane monitor	An electronic instrument often mounted on a piece of mining equipment, that detects and measures the methane content of mine air.
Mine development	The term employed to designate the operations involved in preparing a mine for ore extraction. These operations include tunneling, sinking, cross-cutting, drifting, and raising.
Mine mouth electric plant	A coal burning electric-generating plant built near a coal mine.
Miner	One who is engaged in the business or occupation of extracting ore,

	coal, precious substances, or other natural materials from the earth's crust.
Mineral	An inorganic compound occurring naturally in the earth's crust, with a distinctive set of physical properties, and a definite chemical composition.
Mining Engineer	A person qualified by education, training, and experience in mining engineering. A trained engineer with knowledge of the science, economics, and arts of mineral location, extraction, concentration and sale, and the administrative and financial problems of practical importance in connection with the profitable conduct of mining.
Misfire	The complete or partial failure of a blasting charge to explode as planned.
MSHA	Mine Safety and Health Administration; the federal agency which regulates coal mine health and safety.
Mud cap	A charge of high explosive fired in contact with the surface of a rock after being covered with a quantity of wet mud, wet earth, or sand, without any borehole being used. Also termed adobe, dobie, and sandblast (illegal in coal mining).

N

Natural ventilation	Ventilation of a mine without the aid of fans or furnaces.
Nip	Device at the end of the trailing cable of a mining machine used for connecting the trailing cable to the trolley wire and ground.
Nitrogen oxides (NOx)	Formed when nitrogen (N2) combines with oxygen (O2) in the burning of fossil fuels, from the natural degradation of vegetation, and from the use of chemical fertilizers. A significant component of acid deposition and photochemical smog. The primary source of nitrogen oxide emissions is automobile exhaust.

O

Open end pillaring	A method of mining pillars in which no stump is left; the pockets driven are open on the gob side and the roof is supported by timber.
Outby; outbye	Nearer to the shaft, and hence farther from the working face. Toward the mine entrance. The opposite of inby.

Outcrop	Coal that appears at or near the surface.
Overburden	Layers of soil and rock covering a coal seam. In surface mining operations, overburden is removed prior to mining using large equipment. When mining has been completed, it is either used to backfill the mined areas or is hauled to an external dumping and/or storage site.
Overcast (undercast)	Enclosed airway which permits one air current to pass over (under) another without interruption.
Ozone (O3)	A bluish, toxic gas, with a pungent odor, formed of three oxygen atoms rather than the usual two. Occurs in the stratosphere and plays a role in filtering out ultraviolet radiation from the sun's rays. At ground level ozone is a major component of photochemical smog.</b

P

Panel	A coal mining block that generally comprises one operating unit.
Panic bar	A switch, in the shape of a bar, used to cut off power at the machine in case of an emergency.
Parting	(1) A small joint in coal or rock; (2) a layer of rock in a coal seam; (3) a side track or turnout in a haulage road.
Peat	A dark brown or black deposit resulting from the partial decomposition of vegetative matter in marshes, swamps and bogs. One of the earliest stages of coal formation.
Percentage extraction	The proportion of a coal seam which is removed from the mine. The remainder may represent coal in pillars or coal which is too thin or inferior to mine or lost in mining. Shallow coal mines working under townships, reservoirs, etc., may extract 50%, or less, of the entire seam, the remainder being left as pillars to protect the surface. Under favorable conditions, longwall mining may extract from 80 to 95% of the entire seam. With pillar methods of working, the extraction ranges from 50 to 90% depending on local conditions.
Percussion drill	A drill, usually air powered, that delivers its energy through a pounding or hammering action.
Permissible	That which is allowable or permitted. It is most widely applied to mine

	equipment and explosives of all kinds which are similar in all respects to samples that have passed certain tests of the MSHA and can be used with safety in accordance with specified conditions where hazards from explosive gas or coal dust exist.
Permit	As it pertains to mining, a document issued by a regulatory agency that gives approval for mining operations to take place.
Piggy-back	A bridge conveyor.
Pillar	An area of coal left to support the overlying strata in a mine; sometimes left permanently to support surface structures.
Pillar robbing	The systematic removal of the coal pillars between rooms or chambers to regulate the subsidence of the roof. Also termed "bridging back" the pillar, "drawing" the pillar, or "pulling" the pillar.
Pinch	A compression of the walls of a vein or the roof and floor of a coal seam so as to "squeeze" out the coal.
Pinch	A compression of the roof and floor of a coal seam so as to "squeeze" out the coal.
Pinning	Roof bolting.
Pit Ponies	Small horses, mules, or ponies which were used to pull coal shuttle cars from underground mines during the 1800s.
Pitch	The inclination of a seam; the rise of a seam.
Plan	A map showing features such as mine workings or geological structures on a horizontal plane.
Pneumoconiosis	A chronic disease of the lung arising from breathing coal dust.
Portal	The structure surrounding the immediate entrance to a mine; the mouth of an adit or tunnel.
Portal bus	Track-mounted, self-propelled personnel carrier that holds 8 to 12 people.
Post	The vertical member of a timber set.

Preparation plant	A place where coal is cleaned, sized, and prepared for market.
Primary roof	The main roof above the immediate top. Its thickness may vary from a few to several thousand feet.
Primer (booster)	A package or cartridge of explosive which is designed specifically to transmit detonation to other explosives and which does not contain a detonator.
Prop	Coal mining term for any single post used as roof support. Props may be timber or steel; if steel--screwed, yieldable, or hydraulic.
Proximate analysis	A physical, or non-chemical, test of the constitution of coal. Not precise, but very useful for determining the commercial value. Using the same sample (1 gram) under controlled heating at fixed temperatures and time periods, moisture, volatile matter, fixed carbon and ash content are successfully determined. Sulfur and Btu content are also generally reported with a proximate analysis.
Pyrite	A hard, heavy, shiny, yellow mineral, FeS2 or iron disulfide, generally in cubic crystals. Also called iron pyrites, fool's gold, sulfur balls. Iron pyrite is the most common sulfide found in coal mines.

R

Raise	A secondary or tertiary inclined opening, vertical or near-vertical opening driven upward form a level to connect with the level above, or to explore the ground for a limited distance above one level.
Ramp	A secondary or tertiary inclined opening, driven to connect levels, usually driven in a downward direction, and used for haulage.
Ranks of coal	The classification of coal by degree of hardness, moisture and heat content. "Anthracite" is hard coal, almost pure carbon, used mainly for heating homes. "Bituminous" is soft coal. It is the most common coal found in the United States and is used to generate electricity and to make coke for the steel industry. "Subbituminous" is a coal with a heating value between bituminous and lignite. It has low fixed carbon and high percentages of volatile matter and moisture. "Lignite" is the softest coal and has the highest moisture content. It is used for generating electricity and for conversion into synthetic gas. In terms of Btu or "heating" content, anthracite has the highest value, followed by bituminous, subbituminous and lignite.
Reclamation	The restoration of land and environmental values to a surface mine site

	after the coal is extracted. Reclamation operations are usually underway as soon as the coal has been removed from a mine site. The process includes restoring the land to its approximate original appearance by restoring topsoil and planting native grasses and ground covers.
Recovery	The proportion or percentage of coal or ore mined from the original seam or deposit.
Red dog	A nonvolatile combustion product of the oxidation of coal or coal refuse. Most commonly applied to material resulting from in situ, uncontrolled burning of coal or coal refuse piles. It is similar to coal ash.
Regulator	Device (wall, door) used to control the volume of air in an air split.
Reserve	That portion of the identified coal or mineral deposit resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified resource designated as the reserve base or proven reserves.
Resin bolting	A method of permanent roof support in which steel rods are grouted with resin.
Resources	Concentrations of coal in such forms that economic extraction is currently or may become feasible. Coal resources broken down by identified and undiscovered resources. Identified coal resources are classified as demonstrated and inferred. Demonstrated resources are further broken down as measured and indicated. Undiscovered resources are broken down as hypothetical and speculative.
Respirable dust	Dust particles 5 microns or less in size.
Respirable dust sample	A sample collected with an approved coal mine dust sampler unit attached to a miner, or so positioned as to measure the concentration of respirable dust to which the miner is exposed, and operated continuously over an entire work shift of such miner.
Retreat mining	A system of robbing pillars in which the robbing line, or line through the faces of the pillars being extracted, retreats from the boundary toward the shaft or mine mouth.
Return	The air or ventilation that has passed through all the working faces of a split.

Return idler	The idler or roller underneath the cover or cover plates on which the conveyor belt rides after the load which it was carrying has been dumped at the head section and starts the return trip toward the foot section.
Rib	The side of a pillar or the wall of an entry. The solid coal on the side of any underground passage. Same as rib pillar.
Rider	A thin seam of coal overlying a thicker one.
Ripper	A coal extraction machine that works by tearing the coal from the face.
Rob	To extract pillars of coal previously left for support.
Robbed out area	Describes that part of a mine from which the pillars have been removed.
Roll	(1) A high place in the bottom or a low place in the top of a mine passage, (2) a local thickening of roof or floor strata, causing thinning of a coal seam.
Roll protection	A framework, safety canopy, or similar protection for the operator when equipment overturns.
Roof	The stratum of rock or other material above a coal seam; the overhead surface of a coal working place. Same as "back" or "top."
Roof bolt	A long steel bolt driven into the roof of underground excavations to support the roof, preventing and limiting the extent of roof falls. The unit consists of the bolt (up to 4 feet long), steel plate, expansion shell, and pal nut. The use of roof bolts eliminates the need for timbering by fastening together, or "laminating," several weaker layers of roof strata to build a "beam."
Roof fall	A coal mine cave-in especially in permanent areas such as entries.
Roof jack	A screw- or pump-type hydraulic extension post made of steel and used as temporary roof support.
Roof sag	The sinking, bending, or curving of the roof, especially in the middle, from weight or pressure.
Roof stress	Unbalanced internal forces in the roof or sides, created when coal is extracted.

Roof support	Posts, jacks, roof bolts and beams used to support the rock overlying a coal seam in an underground mine. A good roof support plan is part of mine safety and coal extraction.
Roof trusses	A combination of steel rods anchored into the roof to create zones of compression and tension forces and provide better support for weak roof and roof over wide areas.
Room and pillar mining	A method of underground mining in which approximately half of the coal is left in place to support the roof of the active mining area. Large "pillars" are left while "rooms" of coal are extracted.
Room neck	The short passage from the entry into a room.
Round	Planned pattern of drill holes fired in sequence in tunneling, shaft sinking, or stoping. First the cut holes are fired, followed by relief, lifter, and rib holes.
Royalty	The payment of a certain stipulated sum on the mineral produced.
Rubbing surface	The total area (top, bottom, and sides) of an airway.
Run-of-mine	Raw material as it exists in the mine; average grade or quality.
S	
Safety fuse	A train of powder enclosed in cotton, jute yarn, or waterproofing compounds, which burns at a uniform rate; used for firing a cap containing the detonation compound which in turn sets off the explosive charge.
Safety lamp	A lamp with steel wire gauze covering every opening from the inside to the outside so as to prevent the passage of flame should explosive gas be encountered.
Sampling	Cutting a representative part of an ore (or coal) deposit, which should truly represent its average value.
Sandstone	A sedimentary rock consisting of quartz sand united by some cementing material, such as iron oxide or calcium carbonate.
Scaling	Removal of loose rock from the roof or walls. This work is dangerous and a long bar (called a scaling bar)is often used.

Scoop	A rubber tired-, battery- or diesel-powered piece of equipment designed for cleaning runways and hauling supplies.
Scrubber	Any of several forms of chemical/physical devices that remove sulfur compounds formed during coal combustion. These devices, technically know as flue gas desulfurization systems, combine the sulfur in gaseous emissions with another chemical medium to form inert "sludge," which must then be removed for disposal.
Seam	A stratum or bed of coal.
Secondary roof	The roof strata immediately above the coalbed, requiring support during the excavating of coal.
Section	A portion of the working area of a mine.
Selective mining	The object of selective mining is to obtain a relatively high-grade mine product; this usually entails the use of a much more expensive stoping system and high exploration and development costs in searching for and developing the separate bunches, stringers, lenses, and bands of ore.
Self-contained breathing apparatus	A self-contained supply of oxygen used during rescue work from coal mine fires and explosions; same as SCSR (self-contained self rescuer).
Self-rescuer	A small filtering device carried by a coal miner underground, either on his belt or in his pocket, to provide him with immediate protection against carbon monoxide and smoke in case of a mine fire or explosion. It is a small canister with a mouthpiece directly attached to it. The wearer breathes through the mouth, the nose being closed by a clip. The canister contains a layer of fused calcium chloride that absorbs water vapor from the mine air. The device is used for escape purposes only because it does not sustain life in atmospheres containing deficient oxygen. The length of time a self-rescuer can be used is governed mainly by the humidity in the mine air, usually between 30 minutes and one hour.
Severance	The separation of a mineral interest from other interests in the land by grant or reservation. A mineral dead or grant of the land reserving a mineral interest, by the landowner before leasing, accomplishes a severance as does his execution of a mineral lease.
Shaft	A primary vertical or non-vertical opening through mine strata used for ventilation or drainage and/or for hoisting of personnel or materials; connects the surface with underground workings.

Shaft mine	An underground mine in which the main entry or access is by means of a vertical shaft.
Shale	A rock formed by consolidation of clay, mud, or silt, having a laminated structure and composed of minerals essentially unaltered since deposition.
Shearer	A mining machine for longwall faces that uses a rotating action to "shear" the material from the face as it progresses along the face.
Shift	The number of hours or the part of any day worked.
Shortwall	An underground mining method in which small areas are worked (15 to 150 feet) by a continuous miner in conjunction with the use of hydraulic roof supports.
Shuttle car	A self-discharging truck, generally with rubber tires or caterpillar-type treads, used for receiving coal from the loading or mining machine and transferring it to an underground loading point, mine railway or belt conveyor system.
Sinking	The process by which a shaft is driven.
Skid	A track-mounted vehicle used to hold trips or cars from running out of control. Also it is a flat-bottom personnel or equipment carrier used in low coal.
Skip	A car being hoisted from a slope or shaft.
Slack	Small coal; the finest-sized soft coal, usually less than one inch in diameter.
Slag	The waste product of the process of smelting.
Slate	A miner's term for any shale or slate accompanying coal. Geologically, it is a dense, fine-textured, metamorphic rock, which has excellent parallel cleavage so that it breaks into thin plates or pencil-like shapes.
Slate bar	The proper long-handled tool used to pry down loose and hazardous material from roof, face, and ribs.
Slickenside	A smooth, striated, polished surface produced on rock by friction.
Slip	A fault. A smooth joint or crack where the strata have moved on each

	other.
Slope	Primary inclined opening, connection the surface with the underground workings.
Slope mine	An underground mine with an opening that slopes upward or downward to the coal seam.
Sloughing	The slow crumbling and falling away of material from roof, rib, and face.
Solid	Mineral that has not been undermined, sheared out, or otherwise prepared for blasting.
Sounding	Knocking on a roof to see whether it is sound and safe to work under.
Spad	A spad is a flat spike hammered into a wooden plug anchored in a hole drilled into the mine ceiling from which is threaded a plumbline. The spad is an underground survey station similar to the use of stakes in marking survey points on the surface. A pointer spad, or sight spad, is a station that allows a mine foreman to visually align entries or breaks from the main spad.
Span	The horizontal distance between the side supports or solid abutments along sides of a roadway.
Specific gravity	The weight of a substance compared with the weight of an equal volume of pure water at 4 ° Celsius.
Split	Any division or branch of the ventilating current. Also, the workings ventilated by one branch. Also, to divide a pillar by driving one or more roads through it.
Squeeze	The settling, without breaking, of the roof and the gradual upheaval of the floor of a mine due to the weight of the overlying strata.
Steeply inclined	Said of deposits and coal seams with a dip of from 0.7 to 1 rad (40 degrees to 60 degrees).
Stemming	The noncombustible material used on top or in front of a charge or explosive.
Strike	The direction of the line of intersection of a bed or vein with the horizontal plane. The strike of a bed is the direction of a straight line

	that connects two points of equal elevation on the bed.
Stripping ratio	The unit amount of overburden that must be removed to gain access to a similar unit amount of coal or mineral material.
Stump	Any small pillar.
Sub-bituminous coal	Coal with an energy/heat value between lignite and bituminous.
Subsidence	The gradual sinking, or sometimes abrupt collapse, of the rock and soil layers into an underground mine. Structures and surface features above the subsidence area can be affected.
Sump	The bottom of a shaft, or any other place in a mine, that is used as a collecting point for drainage water.
Sumping	To force the cutter bar of a machine into or under the coal. Also called a sumping cut, or sumping in.
Support	The all-important function of keeping the mine workings open. As a verb, it refers to this function; as a noun it refers to all the equipment and materials--timber, roof bolts, concrete, steel, etc.--that are used to carry out this function.
Surface mine	A mine in which the coal lies near the surface and can be extracted by removing the covering layers of rock and soil.
Suspension	Weaker strata hanging from stronger, overlying strata by means of roof bolts.
Syncline	A fold in rock in which the strata dip inward from both sides toward the axis. The opposite of anticline.

T

Tailgate	A subsidiary gate road to a conveyor face as opposed to a main gate. The tailgate commonly acts as the return airway and supplies road to the face.
Tailpiece	Also known as foot section pulley. The pulley or roller in the tail or foot section of a belt conveyor around which the belt runs.
Tail section	A term used in both belt and chain conveyor work to designate that portion of the conveyor at the extreme opposite end from the delivery

	point. In either type of conveyor it consists of a frame and either a sprocket or a drum on which the chain or belt travels, plus such other devices as may be required for adjusting belt or chain tension.
Tectonic forces	Forces pertaining to, causing, or resulting from structural deformation of the earth's crust.
Tension	The act of stretching.
Tertiary	Lateral or panel openings (e.g., ramp, crosscut).
Thermal coal	A generic term used to describe coal which is used primarily to generate heat as opposed to metallurgical coal which is converted to coke for use in steel production. Sometimes referred to as steam coal.
Through-steel	A system of dust collection from rock or roof drilling. The drill steel is hollow, and a vacuum is applied at the base, pulling the dust through the steel and into a receptacle on the machine.
Timber	A collective term for underground wooden supports.
Timbering	The setting of timber supports in mine workings or shafts for protection against falls from roof, face, or rib.
Timber set	A timber frame to support the roof, sides, and sometimes the floor of mine roadways or shafts.
Tipple	Originally the place where the mine cars were tipped and emptied of their coal, and still used in that same sense, although now more generally applied to the surface structures of a mine, including the preparation plant and loading tracks.
Ton	A short or net ton is equal to 2,000 pounds; a long or British ton is 2,240 pounds; a metric ton is approximately 2,205 pounds.
Top	A mine roof; same as "back."
Torque wrench	A wrench that indicates, as on a dial, the amount of torque (in units of foot-pounds) exerted in tightening a roof bolt.
Tractor	A battery-operated piece of equipment that pulls trailers, skids, or personnel carriers. Also used for supplies.
Tram	Used in connection with moving self-propelled mining equipment. A

	tramming motor may refer to an electric locomotive used for hauling loaded trips or it may refer to the motor in a cutting machine that supplies the power for moving or tramming the machine.
Transfer	A vertical or inclined connection between two or more levels and used as an ore pass.
Transfer point	Location in the materials handling system, either haulage or hoisting, where bulk material is transferred between conveyances.
Trip	A train of mine cars.
Troughing idlers	The idlers, located on the upper framework of a belt conveyor, which support the loaded belt. They are so mounted that the loaded belt forms a trough in the direction of travel, which reduces spillage and increases the carrying capacity of a belt for a given width.
Tunnel	A horizontal, or near-horizontal, underground passage, entry, or haulageway, that is open to the surface at both ends. A tunnel (as opposed to an adit) must pass completely through a hill or mountain.

U

Ultimate analysis	Precise determination, by chemical means, of the elements and compounds in coal.
Undercut	To cut below or undermine the coal face by chipping away the coal by pick or mining machine. In some localities the terms "undermine" or "underhole" are used.
Underground mine	Also known as a "deep" mine. Usually located several hundred feet below the earth's surface, an underground mine's coal is removed mechanically and transferred by shuttle car or conveyor to the surface.
Underground station	An enlargement of an entry, drift, or level at a shaft at which cages stop to receive and discharge cars, personnel, and material. An underground station is any location where stationary electrical equipment is installed. This includes pump rooms, compressor rooms, hoist rooms, battery-charging rooms, etc.
Unit train	A long train of between 60 and 150 or more hopper cars, dedicated to the transport of a single commodity such as coal between a single mine and destination.

Universal coal cutter	A type of coal cutting machine which is designed to make horizontal cuts in a coal face at any point between the bottom and top or to make shearing cuts at any point between the two ribs of the place. The cutter bar can be twisted to make cuts at any angle to the horizontal or vertical.
Upcast shaft	A shaft through which air leaves the mine.

V

Valuation	The act or process of valuing or of estimating the value or worth; appraisal.
Velocity	Rate of airflow in lineal feet per minute.
Ventilation	The provision of a directed flow of fresh and return air along all underground roadways, traveling roads, workings, and service parts.
Violation	The breaking of any state or federal mining law.
Virgin	Unworked; untouched; often said of areas where there has been no coal mining.
Void	A general term for pore space or other reopenings in rock. In addition to pore space, the term includes vesicles, solution cavities, or any openings either primary or secondary.
Volatile matter	The gaseous part, mostly hydrocarbons, of coal.

W

Waste	That rock or mineral which must be removed from a mine to keep the mining scheme practical, but which has no value.
Water Gauge (standard U-tube)	Instrument that measures differential pressures in inches of water.
Wedge	A piece of wood tapering to a thin edge and used for tightening in conventional timbering.
Weight	Fracturing and lowering of the roof strata at the face as a result of mining operations, as in "taking weight".

White damp	Carbon monoxide, CO. A gas that may be present in the afterdamp of a gas- or coal-dust explosion, or in the gases given off by a mine fire; also one of the constituents of the gases produced by blasting. Rarely found in mines under other circumstances. It is absorbed by the hemoglobin of the blood to the exclusion of oxygen. One-tenth of 1% (.001) may be fatal in 10 minutes.
Width	The thickness of a lode measured at right angles to the dip.
Winning	The excavation, loading, and removal of coal or ore from the ground; winning follows development.
Winze	Secondary or tertiary vertical or near-vertical opening sunk from a point inside a mine for the purpose of connecting with a lower level or of exploring the ground for a limited depth below a level.
Wire rope	A steel wire rope used for winding in shafts and underground haulages. Wire ropes are made from medium carbon steels. Various constructions of wire rope are designated by the number of strands in the rope and the number of wires in each strand. The following are some common terms encountered: airplane strand; cablelaid rope; cane rope; elevator rope; extra-flexible hoisting rope; flat rope; flattened-strand rope; guy rope; guy strand; hand rope; haulage rope; hawser; hoisting rope; lang lay rope; lay; left lay rope; left twist; nonspinning rope; regular lay; reverse-laid rope; rheostat rope; right lay; right twist; running rope; special flexible hoisting rope; standing rope; towing hawser; transmission rope.
Working	When a coal seam is being squeezed by pressure from roof and floor, it emits creaking noises and is said to be "working". This often serves as a warning to the miners that additional support is needed.
Working face	Any place in a mine where material is extracted during a mining cycle.
Working place	From the outby side of the last open crosscut to the face.
Workings	The entire system of openings in a mine for the purpose of exploitation.
Working section	From the faces to the point where coal is loaded onto belts or rail cars to begin its trip to the outside.

Glossary used courtesy of rocksandminerals.com. Retrieved from: www.rocksandminerals.com/glossary.htm.