Responding to a Mine Emergency

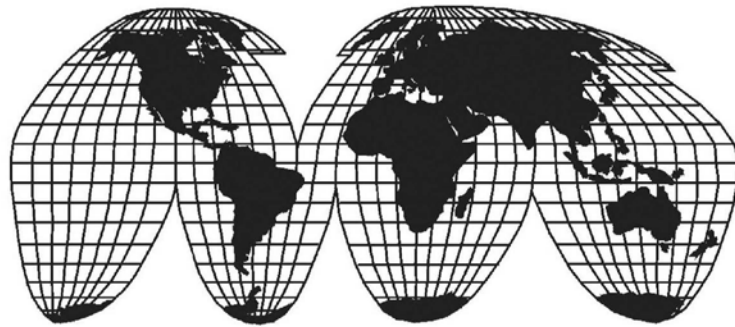## Training Responsible Persons at Underground Coal Mines

U.S. Department of Labor
Mine Safety and Health Administration

Instruction Guide Series
IG 110

2008

Visit the Mine Safety and Health Administration website at

www.msha.gov

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U.S. Department of Labor
Elaine L. Chao
Secretary

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Scope

30 CFR Part 75.1501

(a) For each shift that miners work underground, there shall be in attendance a responsible person designated by the mine operator to take charge during mine emergencies involving a fire, explosion, or gas or water inundation.

(1) The responsible person shall have current knowledge of the assigned location and expected movements of miners underground, the operation of the mine ventilation system, the location of the mine escapeways, the mine communications system, any mine monitoring system if used, locations of firefighting equipment, the mine's Emergency Response Plan, the Mine Rescue Notification Plan, and the Mine Emergency Evacuation and Firefighting Program of Instruction.

(2) The responsible person shall be trained annually in a course of instruction in mine emergency response, as prescribed by MSHA's Office of Educational Policy and Development. The course will include topics such as the following:

    (i) Organizing a command center;
    (ii) Coordinating firefighting personnel;
    (iii) Deploying firefighting equipment;
    (iv) Coordinating mine rescue personnel;
    (v) Establishing fresh air base;
    (vi) Deploying mine rescue teams;
    (vii) Providing for mine gas sampling and analysis;
    (viii) Establishing security;
    (ix) Initiating an emergency mine evacuation;
    (x) Contacting emergency personnel; and
    (xi) Communicating appropriate information related to the emergency.

(3) The operator shall certify by signature and date after each responsible person has completed the training and keep the certification at the mine for 1 year.
(b) The responsible person shall initiate and conduct an immediate mine evacuation when there is a mine emergency which presents an imminent danger to miners due to fire or explosion or gas or water inundation. Only properly trained and equipped persons, essential to respond to the mine emergency may remain underground.

(c) The mine operator shall instruct all miners of the identity of the responsible person designated by the operator for their workshift. The mine operator shall instruct miners of any change in the identity of the responsible person before the start of their workshift.

(d) Nothing in this section shall be construed to restrict the ability of other persons in the mine to warn of an imminent danger which warrants evacuation.

Training Overview

Mine emergencies such as fires, explosions, and gas or water inundations require prompt action and efficient management of emergency operations.

Responsible persons (and others who are training to become responsible persons) will need to know how to perform and delegate a variety of tasks during a mine emergency.

This Instructional Guide (IG) is designed to be used in conjunction with the mine's Emergency Response Plan (ERP), associated plans, and procedures required during a mine emergency.

The materials in this guide must be tailored with the mine's existing plans to create an effective program of site-specific instruction that will provide the mine's responsible persons with the knowledge to act quickly, effectively, and appropriately in the event of a mine emergency.

This guide is divided into eleven sections which correspond with the training topics as prescribed in 30 CFR Part 75.1501. These sections are arranged in the following order:

- Initiating an Emergency Mine Evacuation
- Contacting Emergency Personnel
- Organizing a Command Center
- Establishing Security
- Communicating Appropriate Information Related to the Emergency
- Coordinating Firefighting Personnel
- Deploying Firefighting Equipment
- Coordinating Mine Rescue Personnel
- Deploying Mine Rescue Teams
- Establishing a Fresh Air Base
- Providing for Mine Gas Sampling and Analysis

It is suggested that these training topics be integrated into regularly scheduled training activities, safety talks, and mine managers' meetings if possible. This additional training will benefit the responsible person, as well as other personnel at the mine.

Since regulations, policy, and mining technology can change, it is important that mine operators keep their Mine Emergency Response Training current and up-to-date. Visit MSHA's website at http://www.msha.gov for additional information.

Course Training Objectives

Responsible persons must demonstrate a working knowledge of the following:

- Initiating an Emergency Mine Evacuation
- Contacting Emergency Personnel
- Organizing a Command Center
- Establishing Security
- Communicating Appropriate Information Related to the Emergency
- Coordinating Firefighting Personnel
- Deploying Firefighting Equipment
- Coordinating Mine Rescue Personnel
- Deploying Mine Rescue Teams
- Establishing a Fresh Air Base
- Providing for Mine Gas Sampling and Analysis

Materials and Instructional Resources

In addition to this Instruction Guide, use the following to conduct this training:

- 30 CFR
- Pencils, notepads, notebooks, highlighters, etc. for participants.
- Audiovisual aids: PowerPoint, projectors, whiteboards, blackboards, flipcharts or handouts are all examples of effective instructional aids.
- The mine's:
  - Emergency Response Plan (ERP)
  - Emergency Notification Plan
  - Emergency Evacuation and Firefighting Plan
  - Mine Maps – with ventilation system and escapeway systems
  - Information or training materials for mine-specific Atmospheric Monitoring System (AMS), if applicable
  - SCSR Storage Plan
  - Ventilation Plan
- Any other site-specific training plans, materials, and/or policies related to mine emergency preparedness and readiness training.

Training Assessments

Review and assessment will both improve retention of the material and allow and show areas needing improvement.

- Review Questions
- Discussion/Feedback/Q&A (if applicable.

Section 1

Initiating an Emergency Mine Evacuation

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of their mine's emergency evacuation plans and procedures including all necessary duties associated with initiating an emergency mine evacuation.

Mine-Specific Training Materials

In addition to this Instruction Guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP)
- Mine Emergency Evacuation and Firefighting Program of Instruction
- Mine Maps (with ventilation system, escapeway systems, and location of firefighting equipment)
- AMS mine-specific system (if applicable)
- SCSR Storage Plan
- Ventilation Plan
- Any other applicable mine-specific plans and/or policies

Introduction

30 CFR Part 75.1501(a)

For each shift that miners work underground, there shall be in attendance a responsible person designated by the mine operator to take charge during mine emergencies involving a fire, explosion, or gas or water inundation.

In accordance with this regulation, responsible persons designated by the mine operator may be required to initiate an immediate mine evacuation in the event of a mine emergency.

NOTE: Refer to **Appendix B "Critical Item Checklist for Mine Emergencies"** (make copies as handouts, if needed).

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Responsible persons must maintain current knowledge of the mine's Emergency Response Plan (ERP), Emergency Evacuation and Firefighting Plan, and the mine's notification protocols.

NOTE: Federal regulations state that the mine operator shall instruct all miners of the identity of the responsible person designated for their workshift. Miners on all working sections of the mine and on the surface should be instructed to **immediately** contact the responsible person in the event of an emergency.

An up-to-date list of responsible persons must be posted in obvious locations. Any changes shall be promptly reviewed with all mine personnel prior to the start of their shift.

Evacuation Plans

Evacuation plans provide the road map which miners must use during an emergency. The mine should have evacuation plans for working sections and outby areas.

Responsible persons (and all miners) must know the location of escapeways and should be aware of their surroundings during evacuation. Responsible persons need to:

- ☐ Know the mine's ERP, notification plan, and evacuation procedures.

- ☐ Be familiar with the mine maps, areas of the highest and lowest elevations.

- ☐ Know the locations of SCSR storage units, refuge alternatives, and mine phones.

- ☐ Know the location of primary and secondary escapeways from all assigned work areas.

- ☐ Know the locations of emergency response materials if applicable.

- ☐ Know the approximate travel time to working sections (walking and mantrip).

- ☐ Have a check in/out system to track personnel.

- ☐ Have a plan to debrief evacuated personnel to obtain critical information.

- ☐ Be prepared to delegate duties to other competent personnel.

Escapeways and Evacuation Drills

Responsible persons must be familiar with primary and secondary escapeways at the mine. Maps designating these escapeways should be displayed on each working section and at surface facilities.

It is extremely important that **all** miners know how to get out of the mine using the most direct escapeway. Evacuation drills help to familiarize miners with escapeway routes, even if filled with smoke. Practice prompt and efficient evacuation procedures when drills are conducted to reinforce the instruction outlined in the plan.

Emergency Evacuation Warning Systems

Responsible persons need to know the location of miners working underground, and they need to have a working knowledge of the mine's monitoring and evacuation warning systems.

Such systems include Atmospheric Monitoring Systems (AMS), voice pager systems, Personal Emergency Device (PED) systems, and other types of warning signals which are essential to an effective mine evacuation. Responsible persons need to be trained and knowledgeable in the particular system used at the mine.

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The ideal system would notify all miners simultaneously so that they can immediately begin their evacuation. If miners working in remote areas away from the main communications system do not receive the warning to evacuate at the same time as others, these miners could be placed at risk.

Evacuation Procedures

A responsible person may have to initiate an evacuation when a mine emergency occurs. In addition to knowing the location of miners working underground, the responsible person must also have current knowledge of how to initiate, conduct, and/or delegate the following required duties:

- ☐ Ensure that all underground and surface personnel are notified and made aware of an emergency as soon as possible.
- ☐ Initiate the mine's emergency notification plan.
- ☐ Account for all underground miners.

□ Gather miners not dealing directly with the emergency at strategic locations.

□ Verify that electrical power has been deenergized to the affected area (when the situation warrants).

□ Determine the number of miners in the group and the evacuation route to be traveled.

□ To the extent possible, the responsible person should help determine the safest and quickest route to the surface.

NOTE: Only trained and equipped persons, essential to respond to the mine emergency may remain underground.

Personnel evacuating the mine should stay in contact with the surface if possible. Give regular updates concerning:

□ Transportation means being used (travel by mantrip or utilize other equipment for transportation if at all possible)

□ Location

□ Conditions encountered

□ Status of miners

NOTE: If miners have donned their SCSRs, they <u>MUST NOT</u> remove their mouthpieces to communicate.

✎ **Log all activities and information related to the emergency.**

Maintain a log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.

Monitor Atmospheric Conditions

Responsible persons need to ensure that mine atmospheric conditions are continuously monitored for oxygen deficiency, methane content, and elevated carbon monoxide levels.

Gas testing and sampling provide critical information to mine rescue teams and the Command Center during rescue/recovery operations. Accurate gas-trending information is extremely important during a mine emergency. Responsible persons must conduct and/or delegate the following:

☐ Instruct personnel evacuating the mine and others **not to make ventilation changes**.

☐ Initiate sampling of mine gases from mine fans, boreholes, and other locations.

☐ Continue to monitor the fans and returns for mine gases, during and after evacuation.

☐ Make every attempt to record the date, time, and locations of gas readings – indicate the type of gas detectors used.

☐ Do not permit the fan to be stopped, reversed, or speed to be changed.

☐ Debrief persons coming out of the mine to obtain and log information on the conditions underground.

☐ Collect all notes and maps from miners when they have reached the surface.

Mines Using Atmospheric Monitoring Systems (AMS)

If a mine has an Atmospheric Monitoring System (AMS), the responsible persons at that mine needs to be knowledgeable in the functions and capabilities of the system. The AMS will provide the responsible persons with valuable information concerning the event and provides mine rescue personnel critical information needed for effective mine emergency operations.

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Responsible persons should be knowledgeable of the properties of the mine gases that may be present during the operation and how these mine gases will react under certain conditions

   NOTE: Refer to **Appendix D** "Gas Detection Chart."

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Who at the mine needs to know the identity of the responsible person during any given shift?

2) Discuss the types of emergency evacuation warning system(s) that are in place at the mine.

3) Discuss the evacuation procedures at the mine.

4) Discuss the importance of accurately logging of activities; list a few of the activities that should be logged in the event of an emergency at the mine.

NOTE: Instructors may want to add other topics or training scenarios.

Section 2

Contacting Emergency Personnel

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of their mine's emergency notification plans and procedures for contacting emergency personnel, in the event of a mine emergency.

Mine-Specific Training Materials

In addition to this Instruction Guide, an instructor will need the following mine-specific materials to conduct this training:

- Mine Emergency Notification Plan – on-site and off-site
- Notification lists
- Any other applicable mine-specific plans and/or policies

Notification Plan

As part of the mine's emergency response procedures, the responsible person is required to contact all emergency personnel.
The mine is required to have an Emergency Notification Plan and procedures for notifying necessary personnel when there is an emergency at the mine. This plan lists the various mine management personnel, administrators, government officials, and other key personnel who must be notified.

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> **The responsible person may need to delegate to other personnel on the surface the responsibility of contacting key emergency response personnel and officials.**

On-Site Notification

If an emergency occurs at the mine, the responsible person will immediately establish contact with:

☐ Personnel in the affected area

☐ Personnel inby the affected area who may be in danger

☐ Personnel in outby areas (mine-wide evacuation) as conditions warrant

☐ Personnel on the surface responsible for notification of key personnel off-site

Off-Site Notification

An up-to-date list of emergency contact phone numbers and key personnel must be readily available and visible at specified locations at the mine. This list must include telephone numbers of:

☐ MSHA **(Toll Free Number: 1-800-746-1553)**

☐ State Mine Regulatory Agency

☐ Appropriate Mine Management Personnel

☐ Mine Rescue Teams

☐ Fire Brigades (if applicable)

☐ Readily-available suppliers of mine emergency and rescue equipment

☐ Local Emergency Responders:

- Emergency Services
- Local Hospital
- Fire Department
- Police (local, county, and state)

Also notify any adjoining, or adjacent mines, when necessary, and local telephone company to provide additional communication lines.

✍ **Log all activities and information related to the emergency.**

> **Record and log all calls. Maintain an accurate log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.**

Local Coordination

Familiarize local emergency response personnel with the services and activities that they may be called upon to provide during a mine emergency, such as security, medical assistance, staging locations, logistics, traffic control, supplies, and the layout of surface facilities, etc.

Mine Emergency Response Development (MERD) Exercise.

A well-defined MERD exercise provides additional training opportunities for mine management personnel, mine rescue teams, government officials, and local emergency responders. Try to arrange in advance for rescue and response personnel to take part when the mine is conducting a MERD or any other mine emergency training activities.

NOTE: Refer to **Appendix B "Critical Item Checklist for Mine Emergencies**" (make copies as handouts, if needed).

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the emergency notification plan in place at the mine.

2) Discuss plans for local coordination in the event of an emergency at the mine.

3) List the key officials who must be notified if necessary in the event of a mine emergency.

NOTE: Instructors may want to add other topics or training scenarios.

Section 3

Organizing a Command Center

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of organizing a Command Center in the event of an emergency at the mine.

Mine-Specific Training Materials

In addition to this Instruction Guide, an instructor will need the following mine-specific materials to conduct this training:

- Any mine-specific plans regarding surface layout and facilities required for establishing a Command Center
- Inventory of available equipment and resources necessary for Command Center operations
- Any other applicable mine-specific plans and/or policies

Introduction

It is extremely important that responsible persons have a general knowledge of the structure, functions, and duties of the Command Center during mine rescue and recovery efforts. The Command Center is an essential and integral part of the Mine Emergency Command System.

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The Mine Emergency Command System is based on the standardized Incident Command System (ICS) which has been adopted by fire departments, search and rescue organizations, and other government agencies. The Mine Emergency Command System establishes a common framework and practical procedures for controlling all aspects of a mine emergency.

NOTE: Refer to **Appendix A** "Mine Emergency Command System."

Command Center Operations

The Command Center, an integral part of the Mine Emergency Command System, is typically staffed and controlled by the Mine Emergency Command Group. This group is generally comprised of mine management personnel, federal and state officials, and union representatives.

The Command Center, which receives a tremendous amount of information, will require secure communications equipment connected to underground phones and to other surface phones which will enable the Command group to communicate vital information during the rescue/recovery operations.

All decisions concerning the mine rescue teams (scheduling, assignments, tracking, rotations, and methods of exploration or firefighting are made by the Command Center.

The decision process of the Command Center is sometimes time-consuming, but it is important to understand the impact a single decision will have on the entire operation. A hasty or wrong decision could mean disaster and the loss of life.

> **NOTE:** When MSHA issues a 103(k) Order, all rescue and recovery plans must be submitted to MSHA and the state agency for review and approval. Modifications to the plan must also be approved.

Duties and Functions of the Command Center

Many of the following duties may be delegated at the discretion of the responsible person and/or authorized personnel from the Command Center group.

- ☐ Gather and disseminate information from:

  - o Persons at the mine-site
  - o Persons directly involved in the event
  - o Other creditable sources such as engineering and technical support.

- ☐ Maintain a flow of clear, concise, and accurate information between the Command Center group, mine rescue teams, and all other persons involved in the effort.

□ Direct mine rescue personnel (initiate and track an accurate team deployment schedule):

- o Establish a work schedule utilizing available resources and designated persons at the mine site.

- o Direct mine rescue/recovery work to be undertaken, as conditions dictate.

- o Know the number of available teams, which can be adjusted as conditions dictate.

- o Know the availability of additional teams and resources.

- o Ensure the availability of resources required by the teams and other essential personnel involved in the effort (food, water, facilities for rest/sleep, sanitary, medical needs, etc.).

Requirements for Efficient Command Center Operations

Secure Location for Command Center
(Consider the mine site's existing facilities and capabilities)

□ Secure against unauthorized entry.

□ Law enforcement should be contacted for assistance, if needed.

□ The Command Center should be as close as possible to the mine rescue team staging area to allow access to the teams.

□ The location must accommodate Command Center personnel and their equipment (computers, printers, fax, additional telephone lines, etc.).

□ The Command Center should be isolated from outside interference.

Authorized Command Center Personnel (Mine Emergency Command Group)

□ Designated Company Personnel

□ MSHA Representatives

□ State Regulatory Representatives

□ Miner's Representative(s)

Procurement of Items Needed in the Command Center

☐ Telephone(s) and additional lines (if available)

☐ Availability of secure communications with fresh air base (FAB)

☐ Electrical outlets for laptop computers, printers, copiers, plotters, etc.

☐ Current mine and ventilation maps

☐ Current escapeway maps

Command Center Communications

☐ Designate Command Center phone number for the teams and FAB.

☐ Identify backup communications available during the emergency operations.

☐ Designate an outside line for Command Center use only.

☐ Control entrance and exit of Command Center personnel.

☐ Designate an individual who will communicate information to and from the Command Center.

☐ Relay accurate information to the Command Center concerning the event and all mine rescue/recovery activities.

☐ Ensure all communications to and from the Command Center remain protected from outside monitoring.

☐ Restrict personal outside calls.

☐ Prohibit or restrict use of cell phones and Blackberries.

☐ Restrict phone/speaker systems access except to persons designated by the Command Center to receive information.

☐ Notify adjacent mining companies and alert them to any possible dangers and request assistance if needed.

☐ Notify mine safety personnel at other mines and arrange for possible backup duty.

☐ Advise public relations official regarding any new developments or news occurring at the mine site.

☐ Do not allow the release of the names of any miners who may be trapped or injured until it has been determined that the families are notified.

☐ Identify family liaisons.

☐ Select a media spokesperson to communicate with the news media.

☐ Ensure the spokesperson is thoroughly briefed concerning information to be released to the media.

☐ Set up scheduling for regular briefings for family members and the media.

NOTE: Adequate space is needed to accommodate Command Center personnel and necessary equipment

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss some of the functions and duties of the Command Center.

2) Discuss some of the requirements for efficient Command Center operations, based on the mine's existing facilities and resources.

3) Discuss some important requirements for secure and efficient Command Center communications.

NOTE: Instructors may want to add other topics or training scenarios.

Section 4

Establishing Security

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of plans and procedures for establishing security in the event of an emergency at the mine.

Mine-Specific Training Materials

In addition to this Instruction Guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP), if applicable
- Mine Emergency Notification Plan (off-site)
- Notification Lists
- Any other applicable mine-specific plans and/or policies

Introduction

Establishing security at the mine is essential in order to keep the roads open for mine or emergency personnel, and to ensure that curious bystanders do not hinder rescue efforts.

Incoming traffic on the roads leading to the mine property should be controlled by authorized personnel to keep unnecessary vehicles off the roads, and keep these roads open for essential personnel, needed supplies, and emergency vehicles.

When establishing security, ensure the following:

☐ Enlist local law enforcement personnel for security.

☐ Post company and/or public safety personnel at main and alternate entrances to the operation to coordinate and limit access to the site.

☐ Provide company personnel with photo identification cards, if possible.

☐   Maintain log of any visitors arriving at or departing the site.

☐   Limit or remove from mine property those persons not actively involved in the rescue or recovery operations.

☐   Designate and area (press information center) for reporters.

☐   Direct all reporters to the designated press information center regarding questions concerning the emergency.

☐   Establish secure staging areas for mine emergency response personnel (EMTs, ambulance, and equipment, i.e., drilling rig)

☐   Establish secure communication line between security and Command Center.

☐   Establish and secure a designated location for family members**.**

NOTE: Add any other items that will be necessary based on the mine's location and existing facilities. Refer to **Appendix B** "Critical Item Checklist for Mine Emergencies

✍ **Log all activities and information related to the emergency.**

> **Record and log all calls. Maintain an accurate log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.**

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

    1) Discuss established procedures for security in the event of an emergency at the mine.

    2) List some of the local officials you would contact in the event of a an emergency at the mine.

NOTE: Instructors may want to add other topics or training scenarios.

Section 5

Communicating Appropriate Information
Related to the Emergency

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of communicating appropriate information related to a mine emergency.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP), if applicable
- Mine Emergency Notification Plan
- Notification Lists
- Any other applicable mine-specific plans and/or policies

Introduction

Communicating relevant information is **crucial** in the event of a mine emergency. Responsible persons must be knowledgeable and familiar with their mine's Emergency Response Plans (ERP), notification plans, and communication protocols in order to respond appropriately to a mine emergency.

It is essential that appropriate information related to an emergency is accurate and reported timely to the necessary personnel and regulatory agencies. The mine's listing of emergency contacts must be kept up-to-date.

Communication Protocol

One of the most important elements of an emergency plan is a communication protocol that includes notification of key officials—and especially responders—**immediately** after discovery of an emergency.

A good communication protocol is essential to responsible persons at the mine, since they will have to relay valuable information during mine emergency operations.

> **Training Suggestion: Communication, protocol, and leadership skills can be taught. Assessing those skills occurs either through simulated practice or real events.**

First Response Communications

Miners who first encounter an emergency situation will have to assume their expected duties in dealing with the emergency, based on a pre-arranged plan of action.

Responsible persons need to be knowledgeable of first response procedures, as well as the capabilities, skills, and expected duties of the miners who may be first to encounter an emergency situation. In carrying out their respective assigned duties, these first responders will also need clear and concise direction on how to proceed.

> **Remember, TIME IS YOUR ENEMY in the initial phase of responding to an emergency such as a mine fire. The key is to minimize the time it takes to respond. Emergency preparedness and readiness training will benefit responsible persons, first responders, as well as *all* personnel at the mine.**

Communicating with Emergency Response Personnel

In the event of a mine emergency, responsible persons must be prepared to relay information concerning the extent and nature of the emergency. It is essential that appropriate information related to an emergency is accurate and reported timely to emergency response personnel and regulatory agencies.

> **NOTE:** Effective and functional communications systems and related equipment must be in place at the mine to send and receive instructions and information related to the emergency.

The checklist below contains some of the questions that may be asked regarding the emergency. This list emphasizes the importance of keeping an accurate log of events.

(**NOTE:** Additional information may be needed depending on the specific mine and nature of the emergency. Use the list for emergency response preparedness training or other training scenarios at the mine):

- ☐ When did the event occur?
- ☐ When was the responsible person notified?
- ☐ What was the cause and nature of the emergency?
- ☐ Are all miners accounted for?
- ☐ Is the evacuation complete?
- ☐ Are any miners missing? If so, how many and what are their possible locations?
- ☐ Are any miners trapped?
- ☐ Are there injuries or fatalities?
- ☐ Have federal and sate officials been notified?
- ☐ Have all representatives of mine management been notified?
- ☐ Is the ventilation system operating?
- ☐ Is it an intake or exhaust system?
- ☐ Are attendants posted at the surface ventilation controls?
- ☐ Have air samples been taken? If so, what are the results?
- ☐ What conditions are known to exist underground (roof conditions, water, gas, etc.)?
- ☐ Is the mine's communication system operating? Is it being monitored?
- ☐ Is power to the affected area on or off?
- ☐ Is there battery-powered or diesel equipment or a charging station in the affected area?
- ☐ Have mine rescue teams or fire brigades been dispatched?
- ☐ Are guards stationed at all mine entrances?
- ☐ What type of equipment is in the area? Where is it located?
- ☐ Are the mine maps up-to-date?
- ☐ Are mine phones located on the mine maps?
- ☐ Where are compressed air and/or water lines located? Are they in operation?
- ☐ Are valves known to be open or closed?
- ☐ What type of firefighting equipment is located underground? Where is it accurately located on the mine map?
- ☐ What tools and supplies are available underground? Where are they?
- ☐ Are there storage areas for oil or oxygen, acetylene tanks, or explosives in the area to be explored? What are the locations?
- ☐ Are there any gas wells, adjacent mine workings above, below or parallel to the seam being mined?
- ☐ Where are any pumps and compressors located?

NOTE: Refer to **Appendix C** "Communicating and Relaying Critical Information."
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Mine Rescue Teams

Mine rescue teams must receive accurate, concise, and reliable briefing information from the Command Center to perform rescue/recovery duties in a safe, timely, and efficient manner.

Develop a standardized method of reporting gas readings and other critical information to the Command Center and the FAB.

Mine rescue teams will need:

☐ Up-to-date mine maps for exploration underground (ensure that extra copies are made)

☐ Standardized system for mapping to coordinate with the command center (for example, numbering entries and lettering crosscuts)

☐ Air readings and gas-trending data

NOTE: Communications between the fresh air base and the mine rescue teams must be maintained at all times.

✎ **Log all activities and information related to the emergency.**

Maintain an accurate log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the mine's plans and protocols for communicating appropriate information to emergency personnel in the event of an emergency.

2) List and discuss some of the questions that a responsible person may be asked related to a mine emergency.

3) Discuss some of the items mine rescue teams will need to have.

NOTE: Instructors may want to add other topics or training scenarios.

Coordinating Firefighting Personnel

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of plans and procedures associated with coordinating firefighting personnel in the event of a mine fire.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP)
- Mine Emergency Evacuation and Firefighting Program of Instruction
- Mine Maps (with ventilation system, escapeway systems, and location of firefighting equipment)
- AMS mine-specific system (if applicable)
- Ventilation Plan
- Any other applicable mine-specific plans and/or policies

Introduction

At the first indication of a fire, everyone in the mine must be made aware that a fire exists and the responsible person may need to initiate a mine-wide evacuation. It is essential that a responsible person be knowledgeable in the mine's emergency evacuation and firefighting program of instruction and the mine's firefighting capabilities.

The responsible person needs to know:

- ☐ The types, locations, and capacities of the mine's firefighting equipment
- ☐ Water sources
- ☐ Location of pumps
- ☐ Power source for pumps

In the event of a mine fire, the responsible person should ensure the following duties are carried out:

☐ Obtain air quality (gas readings) at or near the fire area and returns near the fire area as soon as possible.

☐ Test and evaluate the mine roof prior to approaching a fire area.

☐ Plan to approach a fire area from the intake air side, if possible (air moving from you toward the fire area).

✎ **Log all activities and information related to the emergency.**

> **Maintain a log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.**

Fire Brigades

Responsible persons may be required to direct underground fire brigades in the event of a fire at the mine. Fire brigades are sometimes composed of specially trained and equipped miners that work at the mine site and can rapidly respond to a fire.

☞

> If a mine does not have a fire brigade, mining companies should also consider additional, more in-depth fire fighting training for their rescue team members. This includes training in fighting conveyor belt and other large structure and equipment fires using fire hoses, nozzles, and other related equipment.

Hazards of Direct Firefighting

During direct firefighting, there are certain hazards that may be encountered of which the responsible person should be aware. These hazards include electric shock and electrocution, toxic and asphyxiating gases, oxygen deficiency, explosive gases, and heat, smoke, and steam.

Electric Shock and Electrocution

Electric shock and electrocution are hazards to firefighters using water, foam, or other conductive agents to fight a fire. For this reason, **ensure that the power to the fire area is cut off regardless of the type of fire.**

Toxic and Asphyxiating Gases

The extremely toxic gas, carbon monoxide, is produced by all fires because of the in-complete combustion of carbon materials during the burning process.

Carbon dioxide is also produced by fires, though it is a product of **complete** combustion. Carbon dioxide is an asphyxiate. Breathing large amounts of carbon dioxide causes rapid breathing and insufficient intake of oxygen. Too much of it in the bloodstream can cause unconsciousness and even death.

Other gases such as hydrogen sulfide are even more toxic than carbon monoxide. Some toxic gases are produced by burning rubber, neoprene, or polyvinyl chloride (PVC). These materials are frequently found in electrical cables, conveyor belts, or tires on ma-chinery. Even small fires that involve burning rubber, neoprene, or PVC can be extremely toxic.

Because all of these gases are harmful, it is extremely important that breathing apparatus is worn at all times when dealing with underground fires.

Explosive Gases

The buildup of explosive gases, such as methane and hydrogen, are very real hazards for teams during direct firefighting. That is why it is so important to maintain a sufficient and consistent flow of air over the fire area.

> **NOTE:** Refer to **Appendix E "**Gas Detection Chart" (make copies as handouts, if needed).

Heat, Smoke, and Steam

Heat, smoke, and steam are other hazards of direct firefighting and will determine how close firefighters can get to a fire and how long they can work. Working in a hot, smoky, or steamy atmosphere can be extremely uncomfortable and dangerous.

Keep in mind that during firefighting, smoke and steam will be less dense near the floor of the mine and worse near the roof of the mine. Adequate ventilation over the fire area should help to carry the smoke, heat, and steam away from the team.

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the hazards when fighting a mine fire directly.

2) Discuss the importance of ventilation during firefighting.

NOTE: Instructors may want to add other topics or training scenarios.

Deploying Firefighting Equipment

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of the deployment of firefighting equipment in the event of a mine fire.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP)
- Mine Emergency Evacuation and Firefighting Program of Instruction
- Atmospheric Monitoring System (AMS): mine-specific system (if applicable)
- Ventilation Plan
- Any other applicable mine-specific plans and/or policies

Introduction

Responsible persons need to know that fires in underground mines are particularly hazardous not only because they produce toxic gases and heat, but also because they produce smoke, pose an explosion hazard, and create oxygen-deficient atmospheres.

Detection

Initial detection of an emergency such as a mine fire is often by miners or by mine-wide detection systems. Responsible persons should be knowledgeable in the type of fire detection systems in place at the mine. If the mine uses an Atmospheric Monitoring System (AMS), the responsible person should have a thorough working knowledge of the system.

Types of Firefighting Equipment

The following is a general overview of most types of firefighting equipment at found at mines. Responsible persons should also have a thorough knowledge of the types of firefighting equipment used at their mine.

Dry Chemical Extinguishers

Dry chemical extinguishers put out fires by stopping the chemical reaction between the fuel and oxygen (which produces the flame). The dry chemical agents work to inactivate the intermediate products of the flame reaction, resulting in a decreased combustion rate (rate of heat evolution) and thus extinguishing the fire.

There are basically two sizes of dry chemical extinguishers: hand-held extinguishers and larger wheeled extinguishers. Hand-held extinguishers range in size from about 2 to 55 pounds.

Wheeled extinguishers can weigh from 75 to 350 pounds. These extinguishers consist of a large nitrogen cylinder, a dry chemical chamber, and a hose with an operating valve at the nozzle.

Multi-purpose dry chemical extinguishers contain monoammonium phosphate, and are effective on Class A, B, or C fires.

Hand-Held Extinguishers

Hand-held extinguishers may be available at the mine. Responsible persons should instruct miners to use the appropriate extinguisher for the fire they may be fighting. Using the wrong type of extinguisher could result in spreading a fire rather than extinguishing one.

Rock Dust

Rock dust is a fire extinguisher material that is readily available in most areas of the mine. It is used to put out a fire by smothering it or by eliminating oxygen from the fire. Rock dust can be used on Class A, B, or C fires and is most successfully used to fight a fire by applying it by hand to the fire or by shoveling it onto the fire.

NOTE: It is not recommended that rock dusting machines be used to fight any type of mine fire. Rock dusting machines generate air to disperse the rock dust, and the air could then move over the fire area to possibly increase the fire's intensity.

Water

Water can also be used to put out fires. Water acts to cool the fire, removing heat from the fire triangle. Water is an effective extinguishing agent on Class A fires.

Waterlines

Waterlines are required to extend to each section loading point and to be equipped with enough fire hose to reach each working face.

Fire Cars

Fire cars (or water cars or chemical cars) are available in some mines. These may be mounted on tires or flanged wheels and can be pushed or pulled to the fire area. The components of a fire car can vary from a water tank, pump, and hose to a more elaborate version that contains a wider selection of firefighting equipment such as water, large chemical extinguishers, hand tools, brattice cloth, and rock dust.

High Expansion Foam

High expansion foam is used mainly to contain and control fire by removing two legs of the fire triangle—oxygen and heat. The tremendous volume of the foam acts to smother and cool the fire at the same time. Foam is useful only in fighting Class A or B fires. Because the foam is light and resilient it can travel long distances to a fire without breaking down. High expansion foam is normally used just to control a fire. Once conditions permit, teams are usually sent in to fight the fire more directly. It is generally recommended not to travel through foam-filled areas.

Foam Generators

The high expansion foam is made by mixing water, air, and a foam concentrate or de-tergent in a foam generator. Foam generators are portable and come in different sizes with different foam-producing capacities. The smaller models may be hand-carried by two people or wheeled into position. Larger models may be mounted on rubber tires or may be transported on a track-mounted mine car.

Inert Gas Generators

Coal fires can be extinguished by depriving them of oxygen. Flooding the mine with inert gases such as nitrogen (in sufficient quantities) can suffocate and extinguish the fire.

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the types of fire detection and firefighting equipment in place at the mine.

2) Discuss how the equipment would be deployed in the event of a fire.

NOTE: Instructors may want to add other topics or training scenarios.

Section 8

Coordinating Mine Rescue Personnel

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of coordinating mine rescue personnel in the event of a mine emergency at the mine.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP)
- Contact list for mine rescue teams and mine emergency personnel
- Any other applicable mine-specific plans and/or policies

Introduction

Responsible persons may be required to direct many persons who will be performing various tasks during rescue/recovery operations during a mine emergency.

It is important to establish a clear chain-of-command so that all emergency operations can be well coordinated and handled efficiently. Under the direction of a responsible person, employees assigned specific duties in the event of an emergency must know in advance what their duties and responsibilities are, to whom they report, and who reports to them.

> **NOTE:** Refer to **Appendix A** for details on the "Mine Emergency Command System" and its associated functions**.**

Responsible persons need to ensure the following:

- ☐ Evaluate mine conditions and determine how many teams are necessary to complete the operation.

- ☐ Continue to check return air for mine gases and smoke.

- ☐ Make preparations for communicating with multiple teams or fresh air base (FAB).

- ☐ Designate the primary underground communications system to be used by mine rescue teams and the FAB.

- ☐ Identify backup communications available during the emergency.

- ☐ Designate an individual who will communicate with mine rescue teams and the Command Center.

- ☐ Consider team safety at all times.

- ☐ Teams need enough rest to resume activities during their next scheduled shift.

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the mine's plans for coordinating mine rescue personnel in the event of a mine emergency.

2) List and discuss some of the activities a responsible person may have to coordinate during a mine emergency.

NOTE: Instructors may want to add other topics or training scenarios.

Deploying Mine Rescue Teams

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge deploying mine rescue teams in the event of an emergency at the mine.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Emergency Response Plan (ERP)
- Mine Maps
- Ventilation Plan
- Inventory list of supplies and equipment for mine rescue teams at the mine
- Any other applicable mine-specific plans and/or policies

Introduction

Responsible persons need to be knowledgeable in the proper procedures of mine rescue team deployment. The primary purposes of a mine rescue team are to rescue survivors or recover a mine in the event of a mine emergency. However, the first priority is the **safety** of the mine rescue team members.

Mine rescue teams are called upon to provide a variety of functions that may include:

- ☐ Firefighting
- ☐ Exploration
- ☐ Removing or isolating ignition sources
- ☐ Building ventilation structures
- ☐ Setting roof support
- ☐ Implementing ventilation plans
- ☐ Providing air quality and quantity readings to the Command Center

In addition, teams often have skilled first-aid providers (often certified Emergency Medical Technicians) and firefighters, who may also perform their associated functions.

Mine Rescue Exploration

Before any team begins exploration in a mine where an explosion has occurred, or is suspected of having occurred, make sure that the mine is relatively safe to enter and that as many hazards as possible have been eliminated.

> **NOTE:** When a team goes into a mine to explore or fight a fire, it must be concerned with two main things—spreading of the fire and the possibility of an explosion. Before going underground, the team should make sure that the **main fan is running and is being monitored for gases**.

- ☐ Designate the primary underground communications system to be used by mine rescue teams, the fresh air base (FAB), and the Command Center.

- ☐ Ensure mine rescue teams have certifications.

- ☐ Teams should have a thorough briefing from the Command Center.

- ☐ Provide the team with a current copy of the mine map of areas to be explored.

- ☐ Provide any special supplies for the mine rescue team.

- ☐ Provide the teams a copy of the approved plan of their phase of operation.

- ☐ Make sure a backup team is at the FAB.

- ☐ Make sure a backup team is standing by on the surface.

- ☐ Ensure adequate communications before teams travel inby the FAB.

- ☐ Follow established procedures.

- ☐ Compare map with the FAB coordinator.

- ☐ Share information with the backup team

NOTE: This list is not intended to be exhaustive and should be expanded upon, if necessary.

> **Ensure that the mine rescue teams have facilities and adequate accommodations for preparing and benching their apparatus.**

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss plans for deploying mine rescue teams in the event of an emergency at the mine.

2) List some of the functions a mine rescue team may be required to carry out.

NOTE: Instructors may want to add other topics or training scenarios.
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Section 10

Establishing a Fresh Air Base (FAB)

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of establishing a fresh air base should it become necessary during an emergency at the mine.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Mine Map (with ventilation system and escapeway systems)
- Ventilation Plan
- Inventory list of materials at the mine required to establish a fresh air base
- Any other applicable mine-specific plans and/or policies

Introduction

Responsible persons will have to be knowledgeable in the procedures of establishing a fresh air base (FAB). Usually, the FAB is established somewhere underground, and then advanced as the exploration proceeds. But if underground damage is extensive, it may be necessary to establish the initial fresh air base on the surface.

The fresh air base also functions as a base of communications for the operation linking the team, the Command Center, and all support personnel.

Whether the FAB is underground or on the surface, the fresh air base should be located as close as possible to the affected area of the mine, but situated where it's assured a supply of fresh air.

Fresh Air Base Operations

The fresh air base is the base of operations from which rescue and recovery work advances into irrespirable atmospheres. This is where rescue/recovery crews begin their exploration of the affected area.

When the FAB is set up underground, near a contaminated environment, an air lock must be built to isolate it from the unexplored area beyond it. The air lock allows the team to enter and exit the unexplored area without contaminating the air at the fresh air base.

Supplies

Ensure that secure and reliable communications are established between the FAB and the Command Center.

Ensure that mine rescue teams have up-to-date mine maps of the areas to be explored. The fresh air base is normally outfitted with supplies and other equipment to be used during the operation. For example, a typical fresh air base is equipped with gas testing devices, equipment for detecting oxygen deficiency, and firefighting equipment.

There should also be first aid supplies such as oxygen therapy equipment and a stretcher at the fresh air base, as well as tools and replacement parts for self-contained breathing apparatus.

If possible, the fresh air base should be supplied with benches, canvas, or brattice cloth on which the backup team can set their apparatus.

Key Points to Remember:

- ☐ Designate the primary underground communications system to be used by mine rescue teams and fresh air base (FAB).

- ☐ The exploration teams must be able to communicate with the FAB at all times.

- ☐ Efficient operation of the FAB is essential to the operation. Teams will be entering into and exiting from irrespirable atmospheres at the FAB. Teams will be arriving from and exiting to the surface from the FAB.

- ☐ The backup team(s) must be stationed at the FAB, and it is recommended that the backup team(s) remain prepared to enter an irrespirable atmosphere at all times when a team or teams are inby the FAB.

- ☐ When a backup team prepares to enter an irrespirable atmosphere each member should have apparatus on their back, (oxygen and facepiece off) communications ready, and gas detecting instruments ready for use.

- ☐ The backup team must remain at the FAB and not venture away while they are in the backup position. With so much activity in and around the FAB, congestion and confusion can easily interrupt the operation.

Location of the Fresh Air Base

If the fresh air base is located underground, ensure that it has positive ventilation and a fresh air travelway to the surface. This travelway will be used to safely move people and supplies to and from the fresh air base. If possible, there should also be transportation available.

The location should be:

☐ Situated where it can be linked to the command center by means of a communication system.

☐ Large enough to accommodate all the people who will be using it and allow enough space for them to work efficiently.

Recordkeeping and Tracking

The importance of accurate recordkeeping at the fresh air base cannot be overstated. A person should be assigned at the fresh air base to record and track the activities of the teams as they explore the mine. An example would be the "briefing officer" of the team that may be exploring inby the FAB.

✍ **Log all activities and information related to the emergency.**

> **Maintain a log to track all times, conditions, activities, locations of personnel, and any other information which is crucial during mine emergency operations.**

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss plans for establishing a FAB in the event of an emergency at the mine.

2) Discuss the necessary supplies required to establish a FAB.

3) Discuss the location of a FAB.

4) Discuss the key points for safe and efficient FAB operations.

NOTE: Instructors may want to add other topics or training scenarios.

Providing for Mine Gas Sampling and Analysis

Training Objective

Using the information in this section as a guide, responsible persons will demonstrate knowledge of mine gas sampling and analysis.

NOTE: Refer to **Appendix** for Mine Gases Charts.

Mine-Specific Training Materials

In addition to this instructional guide, an instructor will need the following mine-specific materials to conduct this training:

- Gas detectors used at the mine
- Gas sampling bottles, bags, and syringes
- Any other mine-specific materials relating to gas sampling and analysis
- Any other applicable mine-specific plans and/or policies

Gas Sampling and Analyzing Equipment

Responsible persons should be knowledgeable of mine gas properties and how mine gases will react under certain conditions.

Gas testing and sampling provide critical information to mine rescue teams and the Command Center during rescue and recovery operations.

Accurate information is extremely important in the decision making process of all parties involved. Inaccurate information can have adverse effects on the teams and the entire operation.

Hand-Held Detectors

> **NOTE:** Persons expected to use hand-held detectors should be trained in the proper use of the detector.

- Proper calibration and charging of the instruments before using them cannot be overemphasized. An improperly calibrated instrument can result in incorrect information being communicated to the command center.

- A faulty gas detector, when used in a potentially explosive atmosphere, **can serve as an ignition source**.

Procedures for Gas Testing

Make sure that safety procedures are followed to ensure the safety of the person taking the readings.

- ☐ Ensure that the instruments used are properly charged and calibrated.

- ☐ Ensure that the correct locations are being tested; this includes the correct physical location *of the detector* when testing for a particular gas, as well as the correct location(s) as requested by the Command Center.

- ☐ Ensure that the correct instruments are tested and used correctly.

- ☐ It is recommended that more than one hand-held detector be used to take the readings. This method will allow comparison of gas readings among detectors and will lessen the chances of inaccurate gas readings being reported to the FAB or Command Center.

Gas Analysis

Throughout the operation, mine rescue personnel must deploy gas analysis equipment. The responsible person may need to direct personnel to install gas sample tubing underground, at mine fans, and bore holes. These personnel should be trained in the proper procedures for such installations.

Responsible persons will be expected to have a general knowledge in gas sampling and analysis and should ensure that competent persons collect and deliver samples to the appropriate locations. Associated duties may include:

- ☐ Installing sample lines and associated equipment in support of the gas analysis team

- ☐ Setting up Gas Chronograph and associated components

- ☐ Setting up Infrared Analysis and associated components

- ☐ Establishing procedures for collecting valid gas samples using equipment such as bags, bottles, and syringes

- ☐ Ensuring that competent persons are collecting the samples and delivering the samples to the correct location(s)

NOTE: Refer to **Appendix E** "Mine Gas Detection Chart" (make copies as handouts, if needed).

Training Assessment

Using the topics listed below as a guide, discuss the materials covered in the training. (Make copies for each participant, if necessary). Encourage questions and ask for feedback from participants. Ensure that each participant demonstrates knowledge of the topics covered in this section.

1) Discuss the importance of gas sampling and analysis during mine emergency operations?

2) Discuss the correct procedures for gas testing.

3) Why is it recommended that gas readings be taken with more than one detector?

NOTE: Instructors may want to add other topics or training scenarios.

Appendix

Appendix A – The Mine Emergency Command System

Appendix B – Critical Item Checklist for Mine Emergencies

Appendix C – Communicating and Relaying Critical Information

Appendix D – Mine Gas Chart

Appendix E – Gas Detection Chart

Appendix F – Oxygen Chart

Appendix G – Carbon Dioxide Chart

Appendix H – Carbon Monoxide Chart

Appendix I – Nitrogen Dioxide Chart

Appendix J – Hydrogen Chart

Appendix K – Hydrogen Sulfide Chart

Appendix L – Sulfur Dioxide Chart

Appendix M – Methane Chart

Appendix A

The Mine Emergency Command System

A comprehensive, mine-specific emergency preparedness and response system is critical to effective rescue/recovery operations.

> The Mine Emergency Command System establishes a common framework and practical procedures for controlling all aspects of a mine emergency.

Based on the standard Incident Command System (ICS), which has been adopted by fire departments, search and rescue organizations, and other government agencies,

A Mine Emergency Command System:

- Is an organizational structure designed to respond to any mine emergency.

- Establishes a common framework based on the ICS.

- Creates controls in dealing with:

    - Personnel
    - Facilities
    - Equipment
    - Communications

- Can be established and expanded depending upon the changing conditions of the emergency.

- Is staffed and operated by qualified personnel from a variety of agencies.

NOTE: Refer to **Figure 1** which illustrates the structure of the Mine Emergency Command System.

Mine Emergency Command System Structure

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                         ┌─────────────────────┐
                         │      Command        │
                         │                     │
                         │   Mine Emergency    │
                         │   Command Group     │
                         └─────────┬───────────┘
              ┌────────┬───────────┼──────────────────────┐
         ┌────┴───┐ ┌──┴────────┐                    ┌─────┴────┐
         │Liaison │ │Information│                    │  Safety  │
         └────────┘ └───────────┘                    └──────────┘
         ┌──────────┬────────────┼──────────────┐
    ┌────┴─────┐ ┌──┴─────┐ ┌────┴────┐ ┌────────┴─┐
    │Operations│ │Planning│ │Logistics│ │ Finance  │
    └────┬─────┘ └────────┘ └─────────┘ └──────────┘
    ┌────┴──────┐
┌───┴────┐ ┌────┴────────┐
│ Search │ │Firefighting │
│  and   │ │             │
│ Rescue │ │             │
└────────┘ └─────────────┘
```

The Mine Emergency Command System establishes a common framework and practical procedures for controlling all aspects of a mine emergency.
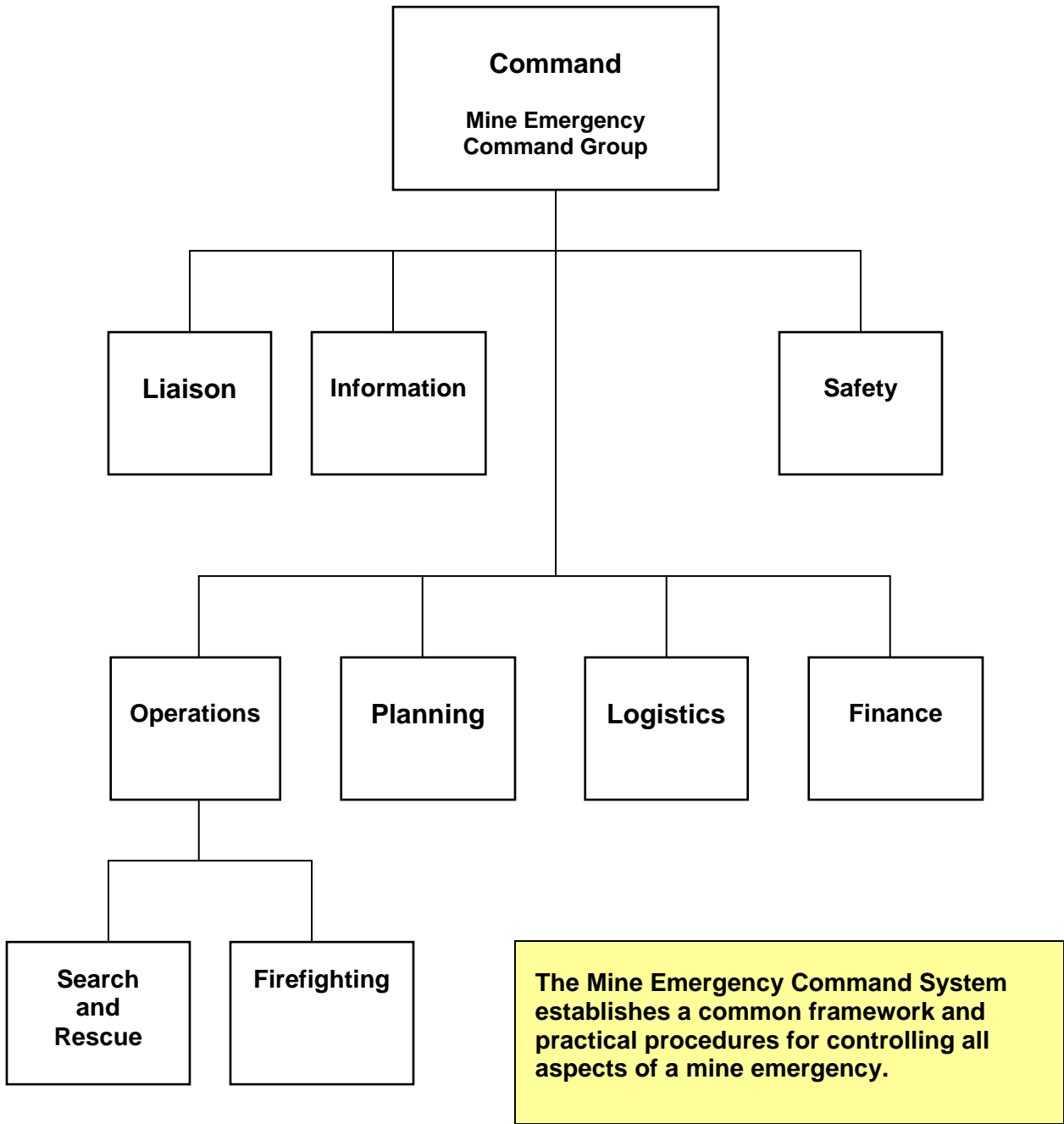
Command Function

The command function is performed and staffed by the Mine Emergency Command Group which usually includes:

- Designated Mine Company Personnel

- MSHA Representatives

- State Representatives

- Miners' Representatives

Some of the primary responsibilities of the Mine Emergency Command Group are to:

- Identify the scope of the emergency and the problems associated with it.

- Determine an overall strategy.

- Order and deploy necessary resources.

- Develop an organizational structure that meets the needs of the emergency.

- Ensure the safety of all emergency response personnel.

- Effectively utilize available "outside" resources.

- Provide appropriate information to the news media and other concerned parties.

Safety Function

The safety function includes identifying, monitoring, and assessing hazardous and potentially unsafe situations and developing practical solutions for ensuring the safety of all emergency response personnel both on the surface and underground.

Operations Function

The operations function encompasses deployment, direction, and coordination of all resources engaged in the emergency operations which may include:

- Search and Rescue

- Firefighting

- Medical Treatment

- Control of Hazardous Materials

- Gas Sampling

- Building In-Mine Structures (Seals and Barricades)

- Surface Operations

The operations function also serves to establish and supervise staging areas used for controlling resource deployment (both personnel and equipment).

Information Function

The information function serves to:

- Collect vital information required by the Mine Emergency Command Group.

- Distribute the information throughout the organization.

- Establish a single point-of-contact for releasing information to the media.

- Maintain an accurate log of all activities during the mine emergency operations.

Liaison Function

The liaison function is related to the information function in that it serves to maintain a point-of-contact between the Command Group and other concerned parties such as:

- Family Members
- Mining Company Representatives
- Legal Representatives
- Local Officials
- Property Owners
- News Media

The information and liaison functions are interrelated and should be carried out according to the organizational structure established by the company and the Command Group. **It is crucial that information related to the emergency be controlled, communicated, and disseminated appropriately.**

Logistics Function

The logistics function serves to provide facilities, services, and materials in support of the mine emergency operations which may include:

- Food and lodging for mine rescue teams and firefighters
- Special rescue equipment and supplies
- Drill rigs and other heavy equipment
- Gas analysis
- Seismic detection/locations systems

Planning Function

Planning is crucial to mine emergency preparedness and readiness. The planning function is also a key factor in the Mine Emergency Command System because of the uncertainty and potential complexities of any mine emergency operations and the possibility of a sustained operation for a prolonged period.

During emergency operations, the planning function serves mine rescue personnel in gathering and analyzing information for making informed and safe decisions, determining the effectiveness of strategy, and developing alternate strategies in managing the emergency operations.

Finance Function

Depending on its severity, a mine emergency can have a great financial impact on the mining company, the labor force, and other entities. The finance function serves to handle all financial aspects of a mine emergency operation including:

- Allocating monies as needed for resources required for the operation
- Tracking expenses
- Financial recordkeeping
- Post-operation audits

Activating the Mine Emergency Command System

The Mine Emergency Command System is activated for any type of emergency like a fire, explosion, gas or water inundations. Ideally, the system should be activated in three logical stages:

Stage 1

First responders (trained, on-the-job miners) report the incident to supervisory personnel; first responders may be directed to attempt to control the situation (depending on severity); evacuation of unaffected areas may be initiated; responsible persons initiate mine's emergency response and notification plans;

Stage 2

Second responders (fire brigade and/or mine rescue teams) are summoned; mine-wide evacuation likely ordered; the Mine Emergency Command Group is fully staffed (Stage 2 expands to Stage 3).

Stage 3

Full-scale mine emergency operations; all functions of the Mine Emergency Command System are activated.

Critical Item Checklist for Mine Emergencies

NOTIFICATION

- ☐ Activate Notification Procedures for Emergency Contacts.
- ☐ Notify MSHA Officials.
- ☐ Notify State Officials.
- ☐ Notify Key Mine Officials.
- ☐ Notify Miners' Representatives.
- ☐ Notify Police.
- ☐ Notify Fire/Rescue Organizations.
- ☐ Notify Neighboring Mines.
- ☐ Notify Family Members.
- ☐ Notify Medical Support Personnel.

SHUTDOWN OPERATION

- ☐ Assemble Employees.
- ☐ Debrief Witnesses.
- ☐ Account for All Persons Known to Be at the Mine.
- ☐ Assign Employees to Tasks.

SECURITY AND SITE MONITORING

- ☐ Establish Security - All Access Roads.
- ☐ Establish Check-in/Check-out System for All Authorized Persons.
- ☐ Assign Site Monitors and Shift Rotation Schedule.
- ☐ Establish Parking Area and Staging Area.

COMMAND CENTER

- ☐ Follow Mine Emergency Response Plan.
- ☐ Set up a Mine Emergency Command System.
- ☐ Staff Emergency Organization.
- ☐ Delegate Authority and Assign Duties.
- ☐ Give Appropriate Orders.
- ☐ Brief Arriving Personnel.
- ☐ Review ALL Mine Maps and Coordinate Reference Points on ALL Maps.
- ☐ Make Extra Copies of Maps
- ☐ Establish Gas Monitoring, Data Analysis, and Trend Analysis.
- ☐ Follow Appropriate Safety Precautions.
- ☐ Request/Dispatch Additional Persons to Mine as Required.
- ☐ Take Appropriate Actions Relative to Site Recovery.
- ☐ Establish a Shift Rotation Schedule for Command Personnel.

COMMUNICATIONS

- ☐ Relay Information to the Command Center.
- ☐ Establish External Communications (Corporate, MSHA, State, Miner's Representatives, Medical, Legal, Etc.).
- ☐ Monitor and Log All Communications.

MEDICAL ARRANGEMENTS

- ☐ Arrange for Ambulance and Medical Services.
- ☐ Set up Temporary Morgue (if required).

ACQUISITION OF EQUIPMENT, MATERIALS, AND SERVICES

- ☐ List All Equipment in the Mine and on the Surface.
- ☐ Locate and Check On-site Equipment for Possible Use.
- ☐ Arrange for Heavy Equipment if Required.
- ☐ Arrange for Portable Radios.
- ☐ Provide Transportation for Equipment.
- ☐ Obtain Personal Protective Equipment.
- ☐ Establish Waiting and Briefing Area for Family/Relatives (Provide Food and Sitting/Sleeping Area).
- ☐ Establish Press Briefing Area.

INFORMATION

- ☐ Appoint a Spokesperson for All Entities.
- ☐ Brief Family Members on a Regular Schedule.
- ☐ Brief the Press and Media on a Regular Schedule.

Appendix C

Communicating and Relaying Critical Information

In the event of a mine emergency, responsible persons should be prepared to relay accurate and up-to-date information concerning the nature of the emergency. The checklist below contains some questions that may be asked regarding the emergency.

- ☐ What was the cause and nature of the emergency?
- ☐ Are all miners accounted for?
- ☐ Is the evacuation complete?
- ☐ Are any miners missing? If so, how many and what are their possible locations?
- ☐ Have Federal and State officials been notified?
- ☐ Have all representatives of mine management been notified?
- ☐ Is the ventilation system operating?
- ☐ Is it an intake or exhaust system?
- ☐ Are attendants posted at the surface ventilation controls?
- ☐ Have air samples been taken? If so, what are the results?
- ☐ What conditions are known to exist underground (Roof conditions, water, gas, etc.)?
- ☐ Is the mine's communication system operating? Is it being monitored?
- ☐ Is power to the affected area on or off?
- ☐ Is there battery-powered or diesel equipment or a charging station in the affected area?
- ☐ Have mine rescue teams or fire brigades been dispatched?
- ☐ Are guards stationed at all mine entrances?
- ☐ What type of equipment is in the area? Where is it located?
- ☐ Where are compressed air and/or water lines located? Are they in operation?
- ☐ Are valves known to be open or closed?
- ☐ What type of firefighting equipment is located underground? Where is it accurately located on the mine map?
- ☐ What tools and supplies are available underground? Where are they?
- ☐ Are there storage areas for oil or oxygen, acetylene tanks, or explosives in the area to be explored? What are the locations?
- ☐ Are there any gas wells, adjacent mine workings above, below or parallel to the seam being mined?
- ☐ Where are any pumps and compressors located?

NOTE: It may be necessary to add other mine-specific items to the list.

Appendix D

Mine Gas Chart

Gas	Chemical Symbol	Specific Gravity	Explosive Range	Health Hazards	Solubility	Color	Odor	Taste
Air	---	1.0000	---	---	---	---	---	---
Oxygen	O_2	1.1054	Supports combustion	Oxygen deficiency: 17% panting; 15% dizziness and headache; 9% unconsciousness; 6% death.	Moderate	---	---	---
Nitrogen	N	0.9674	---	Asphyxiant (oxygen depletion).	Slight	---	---	---
Carbon Dioxide	CO_2	1.5291	---	Increases breathing rate. May cause death in high concentrations.	Soluble	---	---	Acid in high concentrations
Carbon Monoxide	CO	0.9672	12.5 to74.2%	Highly toxic. Can be an asphyxiant.	Slight	---	---	---
Nitrogen Dioxide	NO_2 N_2O_4	1.5894	---	Highly toxic. Corrosive effect on lungs. May be asphyxiant.	Only slight	Reddish brown	Blasting powder fumes	Blasting powder fumes
Hydrogen	H_2	0.0695	4.0 to 74.2% Highly explosive	Asphyxiant (oxygen depletion).	---	---	---	---
Hydrogen Sulfide	H_2S	1.1906	4.3 to 45.5%	Highly toxic. Can be an asphyxiant.	Soluble	---	Rotten eggs	Sweetish
Sulfur Dioxide	SO_2	2.2638	---	Highly toxic. Can be an asphyxiant.	Highly	---	Sulfurous	Acid (bitter)
Methane	CH_4	0.5545	5 to 15%	Asphyxiant (rare).	Slight	---	---	---
Ethane	C_2H_6	1.0493	3.0 to 12.5%	Asphyxiant (rare).	Slight	---	---	---
Propane	C_3H_8	1.5625	2.12 to 9.35%	Asphyxiant (rare).	Slight	---	"Gassy" in high concentrations	---
Butane	C_4H_{10}	2.0100	1.86 to 8.41%	Asphyxiant (rare).	Slight	---	"Gassy" in high concentrations	---
Acetylene	C_2H_2	0.9107	2.5 to 80%	Only slightly toxic. Asphyxiant (rare).	Only slight	---	---	Garlic
Radon	Rn	7.5260	---	Exposure to radiation	Highly	---	---	---

Gas Detection Chart
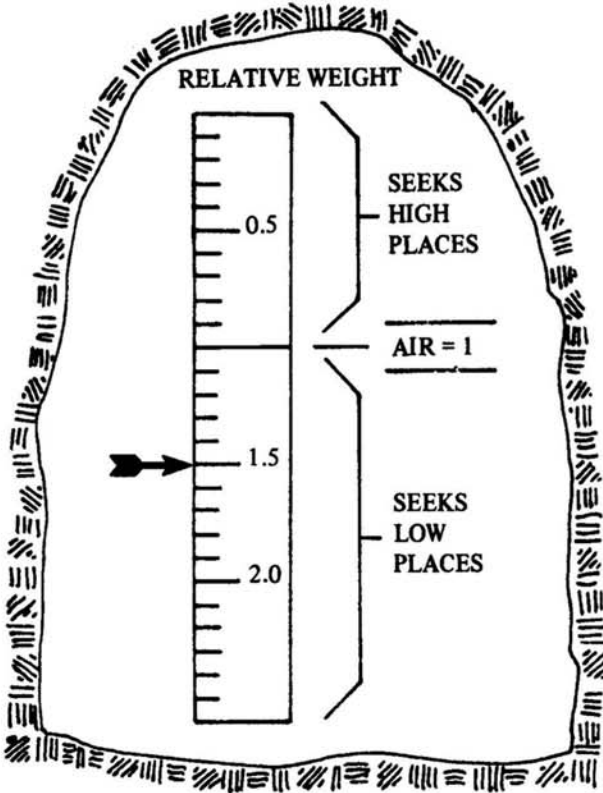
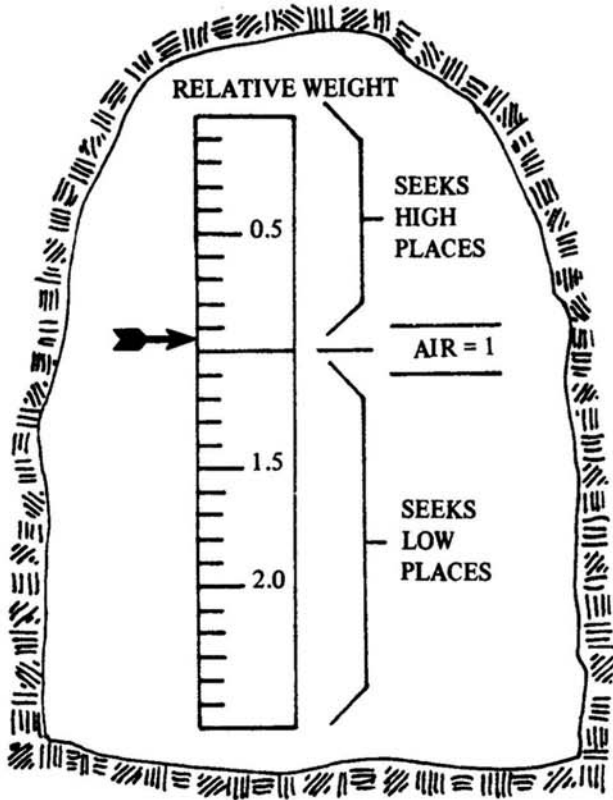| Gas	Detection Method	When to Test
Oxygen (O_2)	Oxygen indicator. Chemical analysis.	During any team exploration.
Nitrogen (N)	Chemical analysis.	When an oxygen deficient atmosphere is suspected. In mines where nitrogen issues from rock strata. In inactive areas where ventilation has been inadequate.
Carbon Dioxide (CO_2)	Carbon dioxide detector. Multi-gas detector. Chemical analysis.	After a fire or explosion. When entering abandoned areas. When reopening sealed areas.
Carbon Monoxide (CO)	Carbon monoxide detector. Multi-gas detector. Chemical analysis.	During any team exploration, especially when a fire is suspected.
Nitrogen Dioxide (NO_2)	Nitrogen dioxide detector. Multi-gas detector. Chemical analysis.	After mine fire or explosion. When diesel equipment is used. After detonation of explosives.
Hydrogen (H_2)	Multi-gas detector. Chemical analysis.	After mine fire or explosion. Near battery charging stations. When steam is produced by water, mist, or foam in fire-fighting.
Hydrogen Sulfide (H_2S)	Hydrogen sulfide detector. Multi-gas detector. Chemical analysis. Eye irritation.	In poorly ventilated areas. During unsealing operations. Following mine fires.
Sulfur Dioxide (SO_2)	Multi-gas detector. Chemical analysis. Odor, taste, and respiratory tract irritation.	When standing water is disturbed. After mine fire or explosion. When opening sealed areas after mine fire.
Methane (CH_4)	Methane detector. Chemical analysis.	During any team exploration. When normal ventilation is disrupted. When entering abandoned workings.
Heavy Hydrocarbons Propane (C_2H_6) Butane (C_3H_8) Acetylene (C_4H_{10})	Multi-gas detector. Chemical analysis.	Following fires or explosions when methane is present. Following accidental entry into adjacent oil or gas well casings.
Acetylene (C_2H_2)	Multi-gas detector. Chemical analysis. Odor	Following a methane explosion in air which is low in oxygen.
Radon (Rn)	Survey meter.	When normal ventilation is disrupted. During unsealing operations.

Oxygen Chart

Oxygen (O$_2$)

SPECIFIC GRAVITY: 0.1054

EXPLOSIVE RANGE: Supports combustion

RELATIVE WEIGHT

— 0.5   SEEKS HIGH PLACES

AIR = 1

— 1.5   SEEKS LOW PLACES

— 2.0

OTHER PROPERTIES

Color: None

Odor: None

Taste: None

CAUSE

Air contains 21% oxygen. Oxygen is necessary for life. Oxygen deficiency is caused by humans breathing in confined spaces, insufficient ventilation, displacement by other gases, or consumption by fire or explosion.

HEALTH HAZARDS

Oxygen Deficiency: 17% — panting

15% — tightness in forehead, headaches, dizziness

9% — unconsciousness

6% — death

DETECTION

Use either oxygen indicator or chemical analysis.
Hold portable detectors at waist height. Test for oxygen deficiency as often as necessary during team exploration.
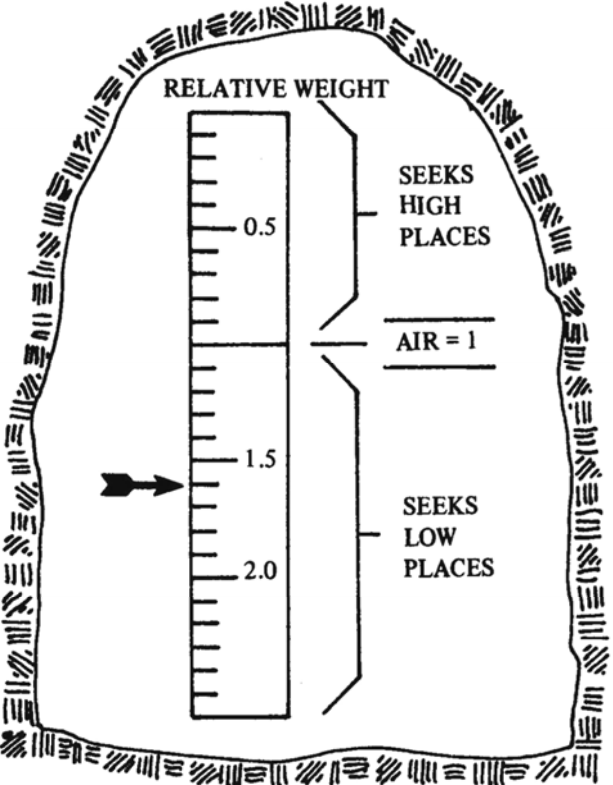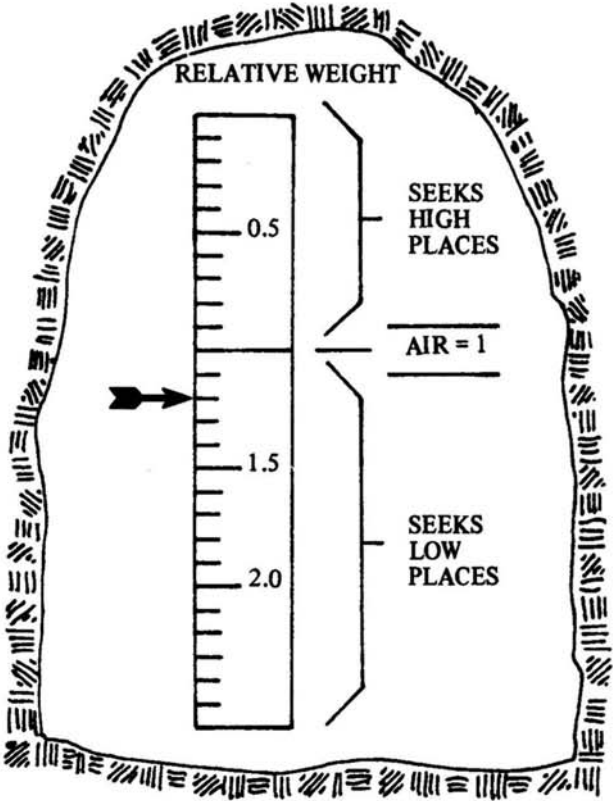
Carbon Dioxide Chart

Carbon Dioxide (CO_2)

SPECIFIC GRAVITY: 1.5291

EXPLOSIVE RANGE: Not explosive

RELATIVE WEIGHT

- 0.5 — SEEKS HIGH PLACES
- AIR = 1
- 1.5
- 2.0 — SEEKS LOW PLACES

OTHER PROPERTIES

Color: None

Odor: None

Taste: High concentrations can produce an acid taste

CAUSE

CO_2 is normal component of air. Product of complete combustion. Is also produced:

1. By oxidation.
2. By decaying timbers.
3. As a by-product of breathing.
4. During fires, explosions, and blasting.

HEALTH HAZARDS

In high concentrations, CO_2 increases breathing rate. Can cause death.

DETECTION

Use carbon dioxide detector, multi-gas detector, or chemical analysis. Hold detector low. Test after a fire or explosion and when entering an inactive area of the mine or reopening a sealed area.

Carbon Monoxide Chart

Carbon Monoxide (CO)

SPECIFIC GRAVITY: 0.9672

EXPLOSIVE RANGE: 12.5 to 74.2 percent in normal air

RELATIVE WEIGHT

SEEKS HIGH PLACES

0.5

AIR = 1

1.5

SEEKS LOW PLACES

2.0

OTHER PROPERTIES

Color: None

Odor: None

Taste: None

CAUSE

Produced by incomplete combustion of carbon materials. Produced by mine fires and explosions, burning or detonation of explosives, and internal combustion engines.

HEALTH HAZARDS

Extremely toxic even in low concentrations. Interferes with oxygen-carrying capacity of blood. First symptom: tightening across forehead. Effects cumulative over time. If exposed to high concentration, you experience few symptoms before losing consciousness.

DETECTION

Can be detected by means of CO detector, multi-gas detector, chemical analysis. Hold detector at chest level. Test as often as necessary during team exploration, especially if fire is suspected.

Nitrogen Dioxide Chart

Nitrogen Dioxide (NO_2)

SPECIFIC GRAVITY: 1.5894

EXPLOSIVE RANGE: Not explosive

RELATIVE WEIGHT

— 0.5

SEEKS HIGH PLACES

AIR = 1

— 1.5

— 2.0

SEEKS LOW PLACES

OTHER PROPERTIES

Color: Reddish brown

Odor: Blasting powder fumes

Taste: Blasting powder fumes

CAUSE

Can be produced:
1. By burning.
2. By detonation and burning of explosives.
3. By diesel engines.
4. In the presence of electrical arcs or sparks, nitrogen in the air combines with oxygen (oxidizes) to form oxides of nitrogen.

HEALTH HAZARDS

Very toxic, even small amounts will irritate throat. Mixes with moisture in lungs to form acids that corrode respiratory passages and cause them to swell. Exposure to .01 to .015% is dangerous. Exposure to .02 to .07% can be fatal.

DETECTION

Nitrogen dioxide detector, multi-gas detector, chemical analysis, color. Hold detectors low. Test following a fire or explosion and after the detonation of explosives. Test in areas where diesel equipment is found.

Hydrogen Chart

Hydrogen (H_2)

SPECIFIC GRAVITY: 0.0695

EXPLOSIVE RANGE: 4.0 to 74.2% in air with as little as 5% oxygen

RELATIVE WEIGHT

- 0.5 — SEEKS HIGH PLACES
- AIR = 1
- 1.5 — SEEKS LOW PLACES
- 2.0

OTHER PROPERTIES

Color: None

Odor: None

Taste: None

CAUSE

Can be produced:

1. By incomplete combustion of carbon materials during fires and explosions.
2. When water or steam comes in contact with hot carbon materials during firefighting.
3. During battery charging.

HEALTH HAZARDS

At high concentrations, hydrogen can replace oxygen in the air and act as an asphyxiant. Also, hydrogen is highly explosive.

DETECTION

Use multi-gas detector or chemical analysis. Hold detector high. Test after any fire or explosion and near battery-charging stations. Also test when water, water mists, or foam are used to fight fires.

Hydrogen Sulfide Chart

Hydrogen Sulfide (H$_2$S)

SPECIFIC GRAVITY: 1.1906

EXPLOSIVE RANGE: 4.3 to 45.5% in normal air

RELATIVE WEIGHT

— 0.5

SEEKS HIGH PLACES

AIR = 1

— 1.5

— 2.0

SEEKS LOW PLACES

OTHER PROPERTIES

Color: None

Odor: Rotten eggs

Taste: Slight sweetish taste

CAUSE

Produced when sulfur compounds decompose. Found in certain oil and gas fields and in some gypsum mines. Can be liberated:

1. From methane feeders.
2. When acid mine water corrodes metallic sulfides.
3. From mine water that contains the gas in solution.
4. When sulfides are heated in the presence of moisture.
5. When sulfide ores are blasted.

HEALTH HAZARDS

Extremely poisonous. .005 to .010% causes inflammation of eyes and respiratory tract. .02 to .07% can lead to bronchitis or pneumonia. .07 to .10% can cause rapid unconsciousness, cessation of respiration, and death. .10 to .20% or more can cause rapid death.

DETECTION

Use hydrogen sulfide detector, multi-gas detector, or chemical analysis. Hold detector low. Test in poorly ventilated areas of mine during unsealing operations, and following mine fires.

Sulfur Dioxide Chart

Sulfur Dioxide (SO$_2$)

SPECIFIC GRAVITY: 2.2638

EXPLOSIVE RANGE: Will not burn or explode

RELATIVE WEIGHT

SEEKS HIGH PLACES

0.5

AIR = 1

1.5

SEEKS LOW PLACES

2.0

OTHER PROPERTIES
Color: None

Odor: Sulfurous

Taste: Bitter, acid

CAUSE
Can be produced:
1. By blasting in sulfide ores and by fires containing iron pyrite.
2. During the burning of some diesel fuels.
3. By sulfide ore dust explosions.

HEALTH HAZARDS
Very toxic, dangerous in even small concentrations.

DETECTION
Use multi-gas detector or chemical analysis. Test in low places and near sumps, following fires or explosions and during unsealing operations. Also, because it's highly soluble in water, test when stagnant water is disturbed.

Methane Chart

Methane (CH_4)

SPECIFIC GRAVITY: 0.5545

EXPLOSIVE RANGE: 5 to 15% in air containing at least 12.1% oxygen

RELATIVE WEIGHT

SEEKS HIGH PLACES

0.5

AIR = 1

1.5

SEEKS LOW PLACES

2.0

OTHER PROPERTIES

Color: None

Odor: None

Taste: None

CAUSE

Can be liberated:

1. From the strata when carbonaceous shale is penetrated.
2. Occasionally when carbonaceous rock is contacted or in vicinity.
3. From feeders or some clay veins.
4. By the decomposition of timbers.
5. When water is removed from mine.

HEALTH HAZARDS

Nontoxic. May cause asphyxiation at high concentrations.

Most dangerous aspect is the fact that it's explosive.

DETECTION

Use methane detector or chemical analysis. Hold portable detectors high. Test as often as necessary during team exploration. Test when normal ventilation is disrupted and when entering abandoned workings.