

Advanced Skills Training (AST)

Activities for Coal Mine Rescue Teams



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Mine Safety and Health Administration

Instruction Guide Series
IG 7a

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Table of Contents

Introduction	1
Role of the Team Trainer	1
Team Performance Evaluation	2
What Do the Regulations Say?	3
Skills Covered in Each Area	4
Area 1 – Bench Exercise	5
Area 2 – Gas Detectors Exercise	13
Area 3 – Exploration Exercise	17
Area 4 – Smoke Room Exercise	23
Area 5 – Fire Hose Management Exercise	27
Area 6 – Firefighting Exercise	31
Area 7 – First Aid Exercise	35
Area 8 – Underground Anemometer and Smoke Tube Exercises	39
Area 9 – Differential Pressure Gauge (Magnehelic) Exercise	45
Area 10 – Reference Manual Exercise	49
What Mine Rescue Team Members Can Expect	51

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Introduction

Underground coal mine rescue team members must be trained according to the requirements under 30 CFR 49.18. Under § 49.18(b)(4), this training must consist of advanced mine rescue training and procedures, as prescribed by MSHA's Office of Educational Policy and Development (EPD). This guide is designed to be used with the material in IG 7, "Advanced Mine Rescue Team Training for Coal Mines," and both guides are needed to satisfy the advanced mine rescue training requirement.

This Instructional Guide (IG) provides exercises in ten prescribed areas for mine rescue team members to complete. Completing an exercise in each prescribed area is necessary training to assure teams can perform mine rescue duties.

The model exercises in this IG are designed to help trainers build the skills necessary for mine rescue teams to perform their duties effectively during an actual mine emergency.

Some of the model exercises focus on an individual team member's ability to perform essential skills, while others address the team's ability to work together under the direction of the Command Center to respond appropriately to realistic mine rescue situations and assignments.

Role of the Team Trainer

Your role as a trainer is vital. It is up to you to choose exercises that are appropriate for your team and to plan and structure these exercises to obtain the maximum benefit. For example, you can conduct training either on possible situations or on problems specific to the mines that your team covers. You can also develop new training exercises based on the ones described here, as long as an exercise is included for each prescribed area. Where an exercise encompasses another mine rescue training requirement in Part 49, such as the requirement to wear an apparatus while in smoke, you may credit the team members under each requirement.

When developing training exercises, be sure to consider how much time it will take to:

- Prepare and test apparatus (if used)
- Travel to the area where the activity will be held
- Prepare area for activity (if necessary)
- Complete activity
- Restore area to original condition after the activity (if necessary)
- Clean, recharge, and store apparatus (if used)
- Critique team's performance
- Answer questions and discuss the activity

Team Performance Evaluation

Evaluation is an extremely important part of the learning process. Time spent in thoughtful, careful, and specific evaluation is essential to the team's development and improvement.

With each activity in the guide, you will find an evaluation section that contains suggestions to help you evaluate the team's or team member's performance.

Follow these three steps to evaluate your team's performance:

- **Observe and record performance**
 - During the performance of each activity, you (or someone working with you) evaluate the team (or the individual team members) as appropriate to the activity.

NOTE TO TRAINER: Checklists are included in this guide to help you evaluate the training.

- **Review the observation results with the team**
 - Hold a review session as soon as possible after the team has completed the activity.
 - Go over both the positive and negative aspects of the team's performance.
 - Allow time for team members to ask any questions they might have about the activity or about the trainer's evaluation.

- **Recommend future training**
 - Based on your observations, you should be able to recommend areas in which the team needs more knowledge or experience.

For example, this might mean reviewing certain information from a module (e.g., team needs more knowledge of SO₂ gas), or it might mean altering a future activity to give the team more experience in a specific area (e.g., communication).

What Do the Regulations Say?

§ 49.18 Training for mine rescue teams.

- (a) Prior to serving on a mine rescue team each member shall complete, at a minimum, an initial 20-hour course of instruction as prescribed by MSHA's Office of Educational Policy and Development, in the use, care, and maintenance of the type of breathing apparatus that will be used by the mine rescue team.
- (b) Upon completion of the initial training, all team members shall receive at least 96 hours of refresher training annually, which shall include participation in local mine rescue contests and training at the covered mine. Training shall be given at least 8 hours every 2 months and shall consist of:
 - (1) Sessions underground at least once each 6 months;
 - (2) The wearing and use of the breathing apparatus by team members for a period of at least 2 hours while under oxygen every 2 months;
 - (3) Where applicable, the use, care, capabilities, and limitations of auxiliary mine rescue equipment, or a different breathing apparatus;
 - (4) Advanced mine rescue training and procedures, as prescribed by MSHA's Office of Educational Policy and Development;
 - (5) Mine map training and ventilation procedures; and
 - (6) The wearing of mine rescue apparatus while in smoke, simulated smoke, or an equivalent environment at least once during each 12-month period.
- (c) A mine rescue team member will be ineligible to serve on a team if more than 8 hours of training is missed during 1 year, unless additional training is received to make up for the time missed.
- (d) The training courses required by this section shall be conducted by instructors who have been employed in an underground mine and have had a minimum of 1 year experience as a mine rescue team member or a mine rescue instructor within the past 5 years, and who have received MSHA approval through:
 - (1) Completion of an MSHA or State approved instructor's training course and the program of instruction in the subject matter to be taught.
 - (2) Designation by the District Manager as approved instructors to teach specific courses, based on their qualifications and teaching experience outlined above. Previously approved instructors need not be re-designated to teach the approved courses as long as they have taught those courses within the 24 months prior to the effective date of this part.
- (e) The District Manager may revoke an instructor's approval for good cause. A written statement revoking the approval together with reasons for revocation shall be provided the instructor. The affected instructor may appeal the decision of the District Manager by writing to the Administrator for Coal Safety and Health. The Administrator shall issue a decision on the appeal.
- (f) Upon request from the District Manager, the operator shall provide information concerning the schedule of upcoming training.
- (g) A record of training of each team member shall be on file at the mine rescue station for a period of 1 year.

Skills Covered in Each Area

Area	Apparatus	Surface Organization	Mine Gases	Mine Ventilation	Exploration	Fires, Firefighting, and Explosions	Rescue Survivors, Recover Bodies	Mine Recovery
#1 Bench Exercise	✓							
#2 Gas Detectors Exercise	✓		✓					
#3 Exploration Exercise	✓		✓		✓			
#4 Smoke Room Exercise	✓			✓	✓			
#5 Fire Hose Management Exercise	✓					✓		
#6 Firefighting Exercise	✓					✓		
#7 First Aid Exercise	✓				✓		✓	
#8 Underground Anemometer and Smoke Tube Exercises				✓	✓			✓
#9 Differential Pressure Gauge (Magnehelic) Exercise				✓	✓			✓
#10 Reference Manual Exercise	✓	✓	✓	✓	✓	✓	✓	✓

Area 1

Bench Exercise

Objectives

Team members will demonstrate correct skills for benching the Self-Contained Breathing Apparatus (SCBA). Each team member will (within 30 minutes if possible):

- Disassemble an apparatus to the point where it can be disinfected
- Fill the chemical cartridge
- Re-assemble the apparatus according to manufacturers' recommendations
- Install a fully-charged oxygen cylinder
- Test the apparatus
- Test the face mask

Materials

- SCBA used by the team
- Carbon dioxide absorbent
- Apparatus testing equipment
- Checklists for inspecting and testing the apparatus
- Cleaning solutions, water, dryer
- Handouts, checklists, and other technical information for the apparatus used by the team

Training Methods

- Instructor-led, group training in classroom
- Demonstrations
- Hands-on benching of the SCBA

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

NOTE TO TRAINER: Ensure that there is enough room at the staging area for each team member's apparatus and testing equipment.

- Have each team member bench their apparatus.
- You may want to have members work in teams of two or three so that the team member benching the apparatus does not miss any steps.
- Make sure each team member correctly and successfully completes all the steps necessary to bench and test the apparatus.
- To assure no steps are missed, use the checklist provided below or one that has been provided by the SCBA manufacturer.
- **ALWAYS** follow the manufacturer's recommendations.

Benching Checklist for BG-4

VISUAL APPARATUS CHECKS		HAND TIGHT CONNECTIONS	
✓	Check if OK		Cap on Drain Valve
	FRAME/HARNESS ASSEMBLY		Drain Valve to Breathing Bag
	Switchbox/Sentinel/Sealing Rings/O ₂ Reg		Minimum Valve to Breathing Bag
	Backcover		Minimum Valve to O ₂ Supply Line
	BREATHING BAG		Cylinder Connection
	Sealing Surfaces		Regenerative Canister Connections
	Manipulate or Massage (pliability)		Relief Valve to Regenerative Canister
	Minimum Valve & Drain Valve		Cooler to Breathing Bag
	Lever		Distribution Hose
	Springs		Breathing Hoses (Once Testing)
	CYLINDER TEST		Hose Adapter on RZ-25 or Test-It 6100
	Hydrostatic Test Date	TEST APPARATUS	
	Cylinder Pressure on Gauge	✓	Check if OK
	Pressure Rating on Cylinder		ZERO ADJUSTMENT ON TESTER
	REGENERATIVE CANISTER		LOW PRESSURE WARNING TEST
	Check for Defects		INHALATION VALVE TEST
	Sealing Surfaces		EXHALATION VALVE TEST
	Expiration Date or Screens/Filler Mats/Seal		DRAIN VALVE TEST
	Seal Strap with Tension Spring Hook		LEAK TEST with POSITIVE PRESSURE
	RELIEF VALVE		RELIEF VALVE TEST
	Check for Defects		State Opening Pressure
	Valve/O-Ring		HIGH PRESSURE LEAK TEST
	COOLER		CONSTANT METERING VALVE TEST
	Check for Defects		State Final Reading
	Sealing Surfaces		MINIMUM VALVE TEST
	HOSES		State Opening Pressure
	Sealing Edges		BYPASS VALVE TEST
	Stretching of Hose for Pliability		LOW PRESSURE WARNING TEST
	COUPLING		State Warning Reading
	Sealing Surfaces		BATTERY TEST
	Valve Discs	VI	C
	FACE PIECE TEST		VISUAL APPARATUS
	Head Strap Assembly		
	Mask Body		
	Sealing Edges		
	Speaking Diaphragm		
	Lens		
	Wiper		TEST APPARATUS
	Defog Mask (Simulate)		

Benching Checklist for Bio 240S

VISUAL APPARATUS CHECKS		TEST APPARATUS		
✓	<i>Check if OK</i>		CONNECTIONS	
	UPPER HOUSING		Vent Valve Secondary Body - Hand Tight	
	LOWER HOUSING		Vent Valve Primary - Hand Tight	
	Harness Assembly		Diaphragm Worm Gear - Wrench Tight	
	External Gage		Constant Add Restrictor - Wrench Tight	
	O ₂ Regulator		Breathing Hose Worm Gear - Wrench Tight	
	Warning Whistle		Tube Quick Disconnect Fittings - Hand Tight	
	BREATHING CHAMBER		End Cap to Coolant Canister - Hand Tight	
	Diaphragm		Cylinder Connection - Hand Tight	
	O-Ring and Sealing Edges		Hose to Hose Adapters - Hand Tight	
	CYLINDER TEST		Hose Adapter to Facepiece - Hand Tight	
	Hydrostatic Test Date		Test Fixture Connections - Hand Tight	
	Cylinder Pressure on Gauge	✓	<i>Check if OK</i>	
	Pressure Rating on Cylinder		HIGH PRESSURE LEAK TEST	
	CARBON DIOXIDE SCRUBBER		Leak-Tec for One Minute	
	Dents / Defects		CONSTANT FLOW TEST	
	Lubrication of O-Ring		Flow Between 1.64 and 2.4 Lpm	
	Foam Pad Thickness / Coverage		State Final Reading	
	COOLANT CANISTER ASSEMBLY		LOW PRESSURE LEAK TEST	
	Examine for defects		45 Degree for 2 Minutes	
	Check O-Ring for damage		Remove Key	
	FACE PIECE TEST			
	Head Strap Assembly			
	Mask Body			
	Sealing Edges			
	Speaking Diaphragm			
	Lens			
	Wiper or Anti-Fog Insert	VI	C	VISUALS
	Defog Mask (Simulate)			
	HOSE			
	Sealing Edges			
	Stretching of Hose for Pliability			
				TEST APPARATUS

Benching Checklist for Bio 240R

VISUAL APPARATUS CHECKS		TEST APPARATUS		
✓	<i>Check if OK</i>		CONNECTIONS	
	UPPER HOUSING		Vent Valve Assembly - Hand Tight	
	LOWER HOUSING		Diaphragm Worm Gear - Wrench Tight	
	Harness Assembly		Flow Restrictor - Wrench Tight	
	External Gage		Breathing Hose Worm Gear - Wrench Tight	
	O ₂ Regulator / Seal		Add / Constant Fittings – Hand Tight	
	RMS		Center Section Lid - Hand Tight	
	CENTER SECTION ASSEMBLY		Center Section Push Pins - Hand Tight	
	Diaphragm		Cylinder Connection - Hand Tight	
	O-Ring and Sealing Edges		Adapter to Facepiece - Hand Tight	
	Demand Valve Assembly		Test Fixture Connections - Hand Tight	
	Moisture Pads	✓	<i>Check if OK</i>	
	PCM		CONSTANT FLOW TEST	
	CARBON DIOXIDE SCRUBBER		Flow Between 1.6 and 2.4 Lpm - State Reading	
	Defects / Damage		DEMAND VALVE TEST	
	Gasket		EMERGENCY BYPASS TEST	
	Expiration Date		VENT VALVE TEST	
	CENTER SECTION LID ASSEMBLY		At or below 2 inches wg - State Reading	
	Examine for defects / damage		LOW PRESSURE LEAK TEST	
	Check O-Ring for damage / lubrication		RMS GAUGE AND TRIM TEST	
	Ice Canisters		Observe lights/gauges +/- 10% - State Reading	
	Coolant Lids		HIGH PRESSURE LEAK TEST	
	CYLINDER TEST		LOW PRESSURE ALARM TEST	
	Hydrostatic Test Date		Alarm 650-1000 psig – State Reading	
	Cylinder Pressure on Gauge		Power down below 25 psig	
	Pressure Rating on Cylinder	VI	C	
	HOSES			
	Sealing Edges			
	Stretching of Hoses for Pliability			
	Adapter Assembly / Gasket			
	FACE PIECE TEST			
	Head Strap Assembly	VI	C	TESTER
	Mask Body / Nose Cup			
	Sealing Edges			
	Speech Diaphragms			
	Lens / Anti-Fog Insert			
	Defog Mask (Simulate)			

Evaluation of Bench Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did the team member:	#1	#2	#3	#4	#5	#6
1. Disassemble the apparatus to where it could be disinfected?						
2. Fill the chemical cartridge?						
3. Re-assemble the apparatus according to the manufacturer's recommendations?						
4. Install a fully-charged oxygen cylinder?						
5. Test the apparatus?						
6. Test the face mask?						

Bench Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

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Area 2

Gas Detectors Exercise

Objectives

Team members will demonstrate proper procedures for testing and using portable gas detectors. Each team member will:

- Correctly perform preoperational checks of gas detectors used by the team
- Demonstrate the proper procedures for taking gas readings with portable gas detectors used by the team
- Perform gas tests, take readings
- Accurately report findings from gas readings

NOTE TO TRAINER: Follow the manufacturers' recommendations for gas detectors.

Materials

- Gas detectors used by the team
- Gas cylinders for testing
- Checklists for inspecting and testing the detector(s)
- Handouts and other technical information for the detector(s)
- Complete calibration kit
- Manufacturers' operations manuals

Training Methods

- Instructor-led, group training in classroom
- Demonstrations

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

NOTE TO TRAINER: Training on the proper procedures for obtaining gas samples using bags, syringes, pumps, or other means, for analysis by a gas chromatograph is critical for confirming instrument readings.

- Perform gas detector calibrations per manufacturers' operations manuals.
- Have team members perform tests for the gases that may be present in the mines they serve and for an oxygen-deficient atmosphere.
- If possible, have each team member practice operating the testing devices. Follow the manufacturer's instructions for the proper use of each device.

Evaluation of Gas Detectors Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.						
Did team member:	#1	#2	#3	#4	#5	#6
1. Perform a proper visual examination of the gas detector(s)?						
2. Correctly perform a battery test?						
3. Correctly zero the unit?						
4. Correctly calibrate the unit?						
5. Perform a proper bump test?						
6. Use the correct tubes/chips to identify common gases (if applicable)?						
7. Employ proper procedure in taking the gas reading (proper height, according to specific gravity, and proper use of instrument)?						
8. Correctly perform gas tests or take gas readings using gas cylinder?						
9. Accurately report their findings?						

Gas Detectors Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

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Area 3

Exploration Exercise

NOTE TO TRAINER: Before you start the exploration exercise, hold a discussion with the team about the key, critical factors of mine rescue and recovery exploration. Be sure to allow for questions and comments from team members.

Objectives The team will carry out a realistic exploration assignment. Team members will:

- Receive a briefing stating the nature of the assignment
- Properly prepare their apparatus and gather equipment
- Receive and review a map of the area to be explored
- Report to the Fresh Air Base:
 - Check equipment
 - Get under oxygen
- Explore and map the assigned area
- Debrief back-up team and Command Center Group on return

Materials

- All required team equipment
- Self-Contained Breathing Apparatus (SCBA)
- Gas detectors
- Communication equipment
- ERP of mine(s) covered by team
- Map of mine section

Training Methods

- Exploration exercise (at mine site or training facility)

Training Assessments

- Communications/feedback during exploration exercise
- Proficiency knowledge checks
- Review of performance during exploration exercise
- Debrief

Activity Description:

NOTE TO TRAINER: This exploration assignment should be conducted as if this were an actual mine emergency (at one of the mines covered by the team).

Team Briefing:

- Prepare an exploration briefing. Choose conditions that will coordinate with the situation you describe to the team in the briefing.
- Use the following checklist to assist you in creating your team's particular exploration assignment briefing statement. You may modify this list as appropriate.
 - Nature of the emergency if known (fire, explosion, inundation, roof fall, unknown).
 - Known conditions and all current gas readings.
 - Number of miners missing or unaccounted for.
 - Whether Company, State, and Federal authorities have been notified.
 - Whether Command Center (simulated) is established and will be directing mine rescue teams.
 - You are the first team underground or you are the back-up team to be briefed on conditions already encountered.
 - Condition of ventilation system.
 - Gas conditions at returns.
 - Availability of back-up team.
 - Time limit is ___ hour(s)?
 - Status of mine's communication system.
 - Power (on or off?).
 - Is diesel or battery-powered equipment or a charging station in the affected area?
 - What other equipment is in the affected area?
 - Location and/or condition of air and water lines.
 - Location of firefighting equipment underground.
 - Location of tools and supplies underground.
 - Could there be storage areas for oil, oxygen, acetylene tanks, or explosives in the area to be explored?
- Have the team prepare their apparatus, gather their equipment together, and report to you.
- Give the team's map person a map of the area to be explored and brief the team on their assignment. Be sure to give them a time limit.

- Tell the team they will be evaluated on how they function as a team and how they perform their individual duties (such as mapping, gas testing, roof and rib testing, and communications).
- When the team is ready, let them begin their assignment. You should accompany the team to observe and evaluate their performance.
- The individuals staying at the Fresh Air Base should stand by, ready to perform their duties.
- As the team progresses through the mine, team members assess conditions, make gas tests, map findings, locate any missing miners, and bring live miners to the Fresh Air Base.

Command Center:

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 could have on the entire operation. A hasty or wrong decision could mean disaster and the loss of life.

Methods of Exploration:

Where applicable, have the team to practice the two commonly used methods for exploration:

1. Advance, tie across and behind:

This method of exploration has been successfully used by mine rescue teams when smoke is encountered and/or when using a voice activated (hardwired) communication system.

- The team will advance a set number of crosscuts in a single entry, then across to the left or right to the solid rib or other designated location.
- The team will explore the adjacent entries in the outby direction.
- The team returns to the entry they are advancing in and then travels to the opposite side and across and behind.

- When the team members complete exploration of an area using this method, they will need to await further instructions from the Command Center before proceeding.

2. Simultaneous advancement in several entries or areas (Shotgunning):

This method of exploring requires the use of handheld radio communications between the team, Fresh Air Base, and Command Center.

- The team can be divided and assigned to travel in adjacent entries, while staying in constant communication with the other team members and the Fresh Air Base/Command Center.
- A team member can travel alone in a single entry if they are in sight (through a crosscut) of another team member in an adjacent entry.
- When visual obstructions are in the crosscuts between the entries (such as a permanent stoppings, equipment or material), at least two team members should travel in these entries.
- These two team members must be able to maintain communications with the rest of the team.
- Using this method, it is common for the team members to travel one crosscut, then communicate information (via radio) to the Fresh Air Base, then on to the Command Center, which will instruct the team how to proceed.
- When using this method to explore, maintain **CONSTANT** radio communication between the team members.
- If radio communication is interrupted, exploration **stops** until communication is reestablished.
- It is recommended that this method of exploration only be attempted in areas that are clear of smoke.

NOTE TO TRAINER: If you are training two teams, you can alter the activity to use both teams. For example, have the second team run the Fresh Air Base and/or Command Center while the first team is exploring. When the first team returns to the Fresh Air Base, have them brief the second team and/or the Command Center. Then, have the second team explore while the first team runs the Fresh Air Base/Command Center.

Evaluation of Exploration Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did the team:	#1	#2	#3	#4	#5	#6
1. Ask appropriate questions in response to the assignment?						
2. Perform correct apparatus/team checks before going inby the Fresh Air Base?						
3. Perform correct apparatus/team checks <i>soon after</i> going inby the Fresh Air Base?						
4. Perform correct apparatus/team checks at designated team stops?						
5. Check O ₂ supply for each apparatus at designated team stops?						
6. Demonstrate the correct, applicable exploration procedure(s)?						
7. Tie in so each team member is never inby unexplored area?						
8. Correctly demonstrate how to mark the route of travel?						
9. Captain demonstrate correct roof and rib testing?						
10. Perform routine gas checks in the correct areas?						
11. Properly mark areas tested?						
12. Communicate clearly with each other?						
13. Communicate clearly and accurately with Fresh Air Base/Command Center?						
14. Thoroughly and accurately map all areas explored?						
15. Thoroughly report their findings to backup team(s), Fresh Air Base, and Command Center?						

Exploration Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 4

Smoke Room Exercise

Objectives

Using their exploration and mapping skills, team members will successfully explore a smoke-filled area of a simulated mine. The team will:

- Systematically explore while in smoke
- Accurately map all items found
- Accurately report to the Briefing Officer the location of all items found

Materials

- Self-Contained Breathing Apparatus (SCBA)
- Maps for team (blank)
- Trainer's map (with items to be mapped already marked)
- Lifeline
- All required team equipment
- Mapping items (see suggested list)
- Gas detectors
- Communication equipment
- Theatrical smoke generator(s) (recommend water-based generators)

Training Methods

- Instructor-led
- Hands-on

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Discussion – Exploring in Smoke:

- Exploring in smoke always presents difficulties for a mine rescue team. Therefore, the team must work systematically. The smoke may be light enough that it limits your visibility only slightly, like a light fog or mist. But it can also be so dense as to completely obscure everything.

- Smoke so dense that it conceals the roof, ribs, and other reference points you normally use to guide you from place to place can cause you to experience what is known as spatial disorientation. When spatial disorientation occurs, you lose your sense of “which end is up.” You may bump into things and perhaps even completely lose your balance and fall down.
- When rescue teams travel in smoke, all team members must be linked together by means of a linkline. The captain can use a walking stick as an aid in checking the area in front of the team for roof falls and other obstructions.
- If smoke is so dense as to make visibility poor, you may need to keep in constant physical contact with a rail, a compressed air or water line, or the rib in order to “feel” your way along. There is a good chance the team will need to crawl when exploring in smoke.

Activity Description:

NOTE TO TRAINER: As accurately and realistically as possible, design your team’s exploration exercise based on the layout, environment, and/or conditions of an actual mine covered by the team. This exercise should be designed so that team members have to locate physical items or placards. The items or placards can be located on the floor, ribs, and/or roof.

- A team will consist of five working members (under apparatus) and a Briefing Officer stationed at the Fresh Air Base.
- Since this exploration/mapping exercise is conducted in smoke, the team members need to be on a linkline.
- Give the team two blank maps of the area to be explored and mapped (one map for the exploration members and one for the Briefing Officer).

NOTE TO TRAINER: The trainer’s map should have the exact location of all items the team should map and report to the Fresh Air Base/Command Center. Items to be mapped in this exercise should be those found or seen in an underground mine, such as:

CRIB BLOCKS	CINDER BLOCKS	BODY/LIVE PERSON	FLEXIBLE VENT TUBING
ROOF BOLTS	ROOF BOLT PLATES	WEDGES	POWER CENTER
POGO STICKS	1½-INCH FIRE HOSE	2½-INCH FIRE HOSE	CHALK DATES
TIMBERS	SLATE BAR	METHANE MONITOR	EQUIPMENT
MINE PHONE	OXYGEN MONITOR	AXE	FIRST AID BOX
HAMMER	SAW	LINE CURTAIN	PLACARDS WITH LETTERS
ROCK DUST	GREASE BUCKET	SPRAY PAINT	PLACARDS WITH NUMBERS
SPLICE KITS	FIRE EXTINGUISHERS	SCSRs	METHANE DETECTOR
LIFE LINE	ROOF CONTROL PLAN	ESCAPEWAY MAP	

- Instruct the team to explore the specified area of the mine or entry in a specific amount of time (for example, 30 to 45 minutes); the team will locate, report, and map all items found.
- As part of this exercise, also have the team perform duties such as crawling, building cribs, extinguishing fires, or rescuing a person.
- When the specified time for working the exercise is expired, collect the maps from the team and the Briefing Officer at the Fresh Air Base.
- Compare maps, conduct debrief, and discuss the results of the exercise with the team.

Evaluation of Smoke Room Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.						
Did the team:	#1	#2	#3	#4	#5	#6
1. Follow proper procedures while going under oxygen?						
2. Systematically explore the mine intersection by intersection, including crosscuts prior to moving inby to the next intersection?						
3. Complete assigned duties and locate objects/persons placed in the exercise?						
4. Follow written instructions of the problem design?						
5. Demonstrate correct lifeline signals?						

Smoke Room Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 5

Fire Hose Management Exercise

EXCEPTION: This training is not prescribed for mine rescue teams for anthracite coal mines that have no electrical equipment at the face or working section.

NOTE TO TRAINER: Where possible, this exercise should be conducted at a firefighting training center which can facilitate conditions expected at an actual mine fire. This training should be conducted under the direction of (or with the assistance of) someone with underground mine fire experience.

Objectives

Team members will work together to control and manage pressurized fire hoses. The team will correctly:

- Employ fire hose hook-up procedures
- Roll out and roll up hoses
- Flush the Y connector and hoses
- Install the nozzle and charge the hose
- Maneuver an object with the water stream on a fire pad

Materials

- Apparatus
- Fire hoses and nozzles
- Y connectors
- Pelican case or other type of box
- All other required team equipment

Training Methods

- Instructor-led
- Hands-on

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

- The goals of this exercise are:
 - To enable your team to work together to control the pressurized hose, and
 - To direct the water to the desired location.
- The exercise should be conducted on a concrete pad which is divided into two parts by a line in the middle.
 - The first half of the pad should be marked with ordinary traffic cones in a Z-type pattern.
 - The second half of the pad is open (no cones) with a set of “goal posts” at the end of the pad.
- Separate the six-person mine rescue team into two three-person teams:
- The first three-person team will move a hard plastic case or box with water pressure around the cones through the Z pattern until they reach the mid line of the pad; then they will move the box with water pressure down the rest of the pad through the goal posts.

NOTE TO TRAINER: Instruct the team to not step on the concrete pad while maneuvering the box through the Z pattern; they must manage the hose from the sides of the pad.

- Once the box breaks the plane of the mid-line, instruct all three of the team members that they can then step on the concrete pad; remain behind the mid-line; and continue moving the box with hose pressure, until it breaks the plane between the “goal posts.”
- The second three-person team will move the box back in the opposite direction through the Z pattern and then through the goal posts located at the original starting point.

Fire Hose Hook-Up Procedures:

1. Flush the team fire hydrant (Y connectors) before connecting any fire hose.
2. Roll out fire hose joints (hand-tighten).
3. Flush the fire hose before attaching the nozzle.
4. Install the nozzle (hand-tighten).

NOTE TO TRAINER: All six team members should assist with hose preparation and testing.

Evaluation of Fire Hose Management Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did the team:	#1	#2	#3	#4	#5	#6
1. Flush the Y connector prior to connecting the fire hose?						
2. Correctly and safely roll out the fire hoses?						
3. Correctly and safely flush the fire hoses?						
4. Correctly install nozzles?						
5. Correctly and safely charge the fire hoses?						
6. Correctly control the movement of the box with hose pressure (Z pattern)?						
7. Employ proper fire hose management skills according to instructions given?						
8. Correctly roll up fire hoses (tight, street roll)?						
9. Properly place or store equipment to its original location?						

Fire Hose Management Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 6

Firefighting Exercise

EXCEPTION: This training is not prescribed for mine rescue teams for anthracite coal mines that have no electrical equipment at the face or working section.

NOTE TO TRAINER: Where possible, MSHA strongly recommends this exercise be conducted at a firefighting training center or coordinated with a local fire department. This training should ONLY be conducted under the direction of (or with the assistance of) an experienced fire trainer.

Objectives Team members work together to cut off inby progression of a fire and advance on the fire from outby to surround and extinguish the fire.

Materials

- Apparatus
- Fire hoses and nozzles
- Y connectors
- Firefighting clothing
- All other required team equipment

Training Methods

- Instructor-led
- Hands-on

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

This exercise has two components:

1. The team will install a lance inby the fire to prevent the fire from spreading, and
2. The team will advance on the fire from outby to push back heat and smoke to extinguish the fire.

NOTE TO TRAINER: This activity requires the team to follow the standard hose management and hook-up procedures described in the previous hose management activity.

Fire Hose Hook-Up Procedures

- Flush the team fire hydrant (Y connectors) before connecting any fire hose.
- Roll out fire hose joints (hand-tighten).
- Flush the fire hose before attaching the nozzle.
- Install the nozzle (hand-tighten).

Installation of the Lance

- Divide the six-person mine rescue team into two separate three-person teams:
- Three persons (hose crew) will use the hose to push back heat and smoke to protect the lance crew.
- Three persons (lance crew) move in behind the hose crew and installs lance.
- All six persons then retreat behind the protection of the hose crew.

NOTE TO TRAINER: As the team enters the building or fire tunnel (inby crosscut), they should complete roof/rib exams and gas checks.

Extinguishing the Fire

- Once the lance is installed, the two three-person teams become two separate hose crews.
- The two hose crews advance simultaneously on the fire from outby.
- The hose nozzles will be set to a fog pattern for each team.
- Instruct each team member to stay to the inside of the hose (never get between a charged hose and the rib).
- The teams advance on the fire and extinguish the fire.
- The teams retreat simultaneously without turning their backs to the fire.
- After the fire is extinguished, all six team members roll up fire hoses and return all equipment to its original location

Evaluation of Firefighting Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did the team:	#1	#2	#3	#4	#5	#6
1. Correctly and safely follow the steps of fire hose hook-up procedures?						
2. Correctly and safely charge the fire hoses?						
3. Conduct roof/rib/gas checks before entering the area?						
4. Correctly and safely install the lance inby the fire?						
5. Correctly and safely advance on the fire from outby to extinguish it?						
6. Correctly adjust the nozzle to push back heat and smoke?						
7. Correctly and safely retreat from the fire?						
8. Correctly roll up fire hoses (tight, street roll)?						
9. Properly return equipment to its original location?						

Firefighting Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 7

First Aid Exercise

Objectives Team members will demonstrate how to properly administer emergency first aid to an injured patient (underground) and transport the patient safely to the Fresh Air Base.

Materials

- Apparatus
- First aid materials
- Stretcher
- All other required team equipment
- First aid manual

Training Methods

- Instructor-led
- Hands-on

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Discussion:

Your team may need to administer immediate, emergency first aid during exploration, firefighting, or other work at or inby the Fresh Air Base. First aid treatment may be necessary for injuries to team members, rescued persons that are being transported, or injuries that a rescued person has when found by the team.

- First aid treatment inby the Fresh Air Base addresses **life threatening injuries** or injuries that could become life threatening during transport to the Fresh Air Base.
- **Non-life threatening injuries** should be treated by the team after immediate transport to the Fresh Air Base (“Load and Go”).

Activity Description:

- While wearing and using an apparatus, the team members will find an injured patient during exploration in by the Fresh Air Base.
- Instruct the team to carefully make initial assessments of the patient's injuries.
- After making initial assessments, the team members will then perform emergency first aid and treat all immediate life-threatening injuries, as needed.
- The team will stabilize the patient and then safely transport the patient back to the Fresh Air Base to complete required first aid treatment for transport to a hospital.

First Aid Discussion Points:

Body Substance Isolation (BSI)

- Protection of all mine rescue personnel is **critically important**. Basic first aid procedures may expose rescue workers to potential biological hazards such as blood borne pathogens. Caution should be taken through the use of Body Substance Isolation precautions (**BSI**).
- The first line of protection for BSI is through the use of effective protective gloves by the rescue workers. Gloves provide a barrier between the hands and contamination.

NOTE TO TRAINER: Always use fresh, clean or sterile gloves immediately before touching the patient's mucous membranes. Latex-free personal protective equipment should be available for the team members.

Rescue Breathing

- Team members should be trained and able to perform rescue breathing for persons that are not breathing or that need assistance breathing (several options for this are in place and are available).
- If the person is located in a **respirable** atmosphere (where team members can be bare-faced), methods such as mouth-to-mouth, mouth-to-nose, etc. are available and can be successful.

NOTE TO TRAINER: Team members must protect themselves by using a barrier device such as a pocket face mask with a one way valve. These masks are soft, collapsible, and small enough to be carried in a pocket.

- If the injured person is discovered in an **irrespirable** atmosphere (where team members must remain under oxygen), a handheld rescue breathing resuscitator or similar device can be used.

NOTE TO TRAINER: It is critically important that team members be trained in the use and care of this type of device.

- Other options for rescue breathing have been used in the past and are still available, such as a Self-Contained Self-Rescuer (SCSR) or a Self-Contained Breathing Apparatus (SCBA).

NOTE TO TRAINER: These devices are only effective on persons that are breathing on their own.

Evaluation of First Aid Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.						
Did the team:	#1	#2	#3	#4	#5	#6
1. Properly and safely assess the scene of where the patient was found?						
2. Make all the appropriate safety checks before assessing the patient?						
3. Communicate all relevant information to the Fresh Air Base?						
4. Follow all necessary steps for assessing the patient (initial assessment)?						
5. Perform required first aid based on correct assessment?						
6. Stabilize the patient for transport to Fresh Air Base?						
7. Safely transport the patient to the Fresh Air Base?						
8. Complete required first aid at the Fresh Air Base so that the patient was stabilized for transport to a hospital?						

First Aid Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 8

Underground Anemometer and Smoke Tube Exercises

Objectives Team members will demonstrate proper procedures and skills in taking air measurements with an anemometer and practice working together as a team while under oxygen.

Materials

- Anemometer
- Smoke tubes and aspirator bulbs
- Timing device
- Measuring tape
- Pencil and paper
- Apparatus

Training Methods

- Instructor-led, group training
- Demonstrations

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

- Tell the team that they will be going underground to take readings with an anemometer. Emphasize the following in describing this activity:
 - Proper procedure in taking a reading.
 - Consider the correction factor for the reading.
 - Reporting the findings correctly.
 - Working under oxygen.
- Have team members prepare their apparatus and get under oxygen.

- Have the captain take the team underground to a pre-arranged site to take air readings with an anemometer and to measure the cross-sectional area of the airway.
 - Have each team member take a reading.
 - Have the team members calculate the airflow in cubic feet per minute.

NOTE TO TRAINER: You should accompany the team so that team members can report their findings to you as though they were reporting to the Command Center.

Anemometer Exercise

When conducting an anemometer exercise, assure team members complete the following:

- Properly describe the device and how it works
- Take air reading for one minute
- Turn off device
- Read dials (use manufacturer's table of corrections)
- Take area measurements and report the velocity

Smoke Tube Exercise

When conducting a smoke tube exercise, assure team members complete the following:

- Measure off a distance (can be determined by mine rescue contest rules)
- Person(s) stationed with smoke tube at the upwind point of measured distance.
- Person(s) stationed at the downwind point of the measured distance with a timing device
- Release smoke cloud in each quarter point within the airway
- Person(s) downwind will time each smoke cloud to the downwind point
- Team members will determine:
 - Average area
 - Velocity
 - Calculation of cubic feet per minute
 - Report findings

Evaluation of Underground Anemometer Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did team member:	#1	#2	#3	#4	#5	#6
1. Hold anemometer correctly?						
2. Stand so as to keep air resistance to a minimum?						
3. Traverse airway properly to get an average reading?						
4. Take measurement for one minute?						
5. Read dials correctly?						
6. Consider the correction factor for the reading?						
7. Accurately report their findings?						

Evaluation of Smoke Tube Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did team:	#1	#2	#3	#4	#5	#6
1. Measure off a distance?						
2. Station someone with smoke tube at the upwind point of measured distance?						
3. Station someone with a timing device at the downwind point of the measured distance?						
4. Release smoke cloud in each quarter point within the airway?						
5. Time each smoke cloud to the downwind point?						
6. Determine the average area and velocity and calculate cubic feet per minute?						
7. Report findings accurately?						

Underground Anemometer and Smoke Tube Exercises

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

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Area 9

Differential Pressure Gauge (Magnehelic) Exercise

Objectives Team members will demonstrate how to correctly use a Magnehelic differential pressure gauge.

NOTE TO TRAINER: Follow manufacturer's guidelines for use of gauge.

Materials

- Magnehelic gauge
- Tubing
- Necessary port hoses and fittings
- Manufacturer's guide
- Other team equipment

Training Methods

- Instructor-led, group training
- Demonstrations

Training Assessments

- Demonstration
- Proficiency checks
- Review of performance

Activity Description:

- Instruct team members on the purpose and use of the Magnehelic differential pressure gauge as it applies to principles of ventilation.
- Have team members take Magnehelic readings across doors and through regulators to determine total pressure at various points, thereby establishing pressure relationships.
- Select a location free from excessive vibration and where the ambient temperature will not exceed 140 degrees F.

NOTE TO TRAINER: Long tubing lengths will not affect accuracy, but will increase response time slightly.

- Have team members zero the Magnehelic gauge with the diaphragm held in the vertical position for maximum accuracy.
- Zero the gauge by setting the indicator pointer exactly on the zero mark, using the external adjust screw on the cover (bottom).

NOTE TO TRAINER: The zero check or adjustment can only be made with the high and low pressure taps both open to the atmosphere.

Operation of the Magnehelic Gauge:

- *Positive Pressure:*
Connect tubing from the source of pressure to the high-pressure port. Vent low pressure port to atmosphere.
- *Negative Pressure:*
Connect tubing from source of vacuum or negative pressure to low pressure port. Vent one or both high-pressure ports to atmosphere.
- *Differential Pressure:*
Connect tubing from the greater of two pressure sources to high-pressure port and the lower to low pressure port.

NOTE TO TRAINER: When one side of the gauge is vented in dirty, dusty atmosphere, the manufacturer suggests an A-331 Filter Vent Plug be installed in the open port to keep the inside of the gauge clean.

- During this exercise, team members should:
 - Give a brief description of the device and its purpose
 - Demonstrate how to zero the device
 - Take a pressure reading from the intake or return side of a stopping or an exhaust or blowing fan ventilation system
 - Report findings

Evaluation of Differential Pressure Gauge (Magnehelic) Exercise: Use the checklist to evaluate each team member's performance. Be sure to list any problems the team encountered.

Did team member:	#1	#2	#3	#4	#5	#6
1. Demonstrate a clear understanding of differential pressure applied to ventilation principles?						
2. Correctly zero the Magnehelic gauge?						
3. Correctly and accurately take differential pressure readings with the Magnehelic gauge?						
4. Accurately report their findings?						

Differential Pressure Gauge (Magnehelic) Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

Area 10

Reference Manual Exercise

Objectives Team members will demonstrate an ability to identify and use appropriate reference materials for mine rescue training.

Materials

- 30 CFR
- IG 5
- IG 7
- IG 7a
- National Mine Rescue Rules
- First Aid manual
- Other required mine rescue reference materials
- Mine-specific reference materials from mines covered by team

Training Methods

- Instructor-led, group training
- Discussion

Training Assessments

- Verbal feedback
- Quizzes
- Written exams

Activity Description:

- Conduct a comprehensive evaluation with team members that includes Questions and Answers (Q&A's), verbal quizzes, and a written exam. The purpose of this exercise is to help team members identify and use the appropriate reference materials, which will help them expand their knowledge of mine rescue topics.

NOTE TO TRAINER: This classroom activity should be an “open book” exercise. Each team member should have copies of all required training materials for mine rescue training, including IG 5, IG 7, IG 7a, and any other mine rescue training materials that will enable team members to gain a thorough working knowledge of the topics covered.

You may use the “General Review” test questions in IG 7 for evaluating this training.

- Include the following topics for this activity:
 - Command Center and Related Activities on the Surface
 - Mine Gases and their Detection
 - The Self-Contained Breathing Apparatus (SCBA)
 - Mine Ventilation
 - Exploration Duties
 - Fires and Firefighting
 - First Aid
 - Rescue of Survivors/Body Recovery
 - Mine Recovery Methods

Activity Evaluation (Written Exam):

Conduct an open-book written exam to be taken by each team member. Grade the exam and discuss the correct answers with the entire group.

Reference Manual Exercise

REVIEW & SUMMARY

Did you:

- Review positive and negative aspects of the activity?
- Encourage team members to ask questions?
- Allow time for discussion?

Comments or Problems:

Recommendations for Future Training:

What Mine Rescue Team Members Can Expect

As a mine rescue team member, you can expect to do work that is both extremely difficult and exceedingly rewarding. Serving on a mine rescue team demands a personal commitment from you to study hard, work harder, practice often, and become the best team member you can possibly be. Mine rescue has no room for second best.

When called on to fulfill your responsibilities, you will be charged with the most important responsibility a person can have – saving lives. During a disaster or other emergency, miners and your fellow team members will put their lives in your hands. The lives of trapped miners, those of your fellow team members, and even your own life will depend on how well you do your job as a mine rescue team member.

What you can expect ...

There are major differences between traditional mine rescue training on practice fields and actual mine rescue work during mine emergencies. Team members need to be aware of these differences so they can make correct decisions quickly while under extreme stress in dangerous situations or conditions.

1. Cooperation, Coordination, and Trust

- A mine rescue and recovery operation does not simply consist of a team going into a mine to rescue survivors or to put out a fire. It consists of much more—a whole network of people and services to direct and support the entire operation, especially the mine rescue teams.
- When mine rescue teams arrive at a mine to begin work, the rescue and recovery operation will have already begun on the surface. Several government officials and mine personnel will have been called to the mine site to assume their duties in a chain-of-command.
- A Command Center and communications channels will be established or in the process of being established.
- At a mine emergency, teams could be made up of members from different companies. Trust team members who are more familiar with that particular mine.
- Team members will have man-to-man back-up at the Fresh Air Base and on the surface.

2. Unique Problems

- Every mine emergency presents unique problems depending on the nature of the event, the conditions in the mine, and other findings. Practices will always need to be modified to meet the situations encountered during mine rescue and recovery efforts.
- Mine rescue teams are not self-directed during explorations. They must follow directions from the Command Center. However, unexpected conditions or situations may be encountered that require immediate decisions and actions by the team.
- As a team member, you must be prepared to handle a wide variety of situations, even if you expect never to encounter them. Some examples of situations that mine rescue teams have encountered that required an immediate decision and action include:
 - gas trending
 - barometric pressure
 - lightning

3. Hazardous Conditions

- Expect strenuous physical activity in high temperatures and high humidity during rescue and recovery operations.
- Top and rib conditions may be degraded due to heat, humidity, and overburden and/or mining methods. Team members may need to participate in supporting and stabilizing the mine's entry as they advance into the mine.
- Items such as refuge alternatives, oxygen tanks, and SCSRs can present hazards after a fire or an ignition.
- Due to different products used underground, uncommon toxic gases can be generated or present during a rescue or recovery operation after a fire or an ignition.
 - Team members should be proficient in sampling with a variety of gas sampling devices, such as syringes, pumps, bags, etc.
 - Team members should be prepared with special gas detection devices and have analysis available for these gases.
- Expect that the team may need to administer immediate, life-saving first aid in by the Fresh Air Base, including a fellow team member injured while carrying out mine rescue duties.

- Team members administering basic first aid procedures may be exposed to potential biological hazards such as blood borne pathogens. Use Body Substance Isolation (BSI) procedures.
- Use established protocols for body recovery and decontamination of mine rescue team members and equipment.

4. Extra Precautions to Ensure Mine Rescue Team Member's Safety

- Check team members' blood CO and blood O₂ levels periodically due to possible exposure to elevated levels of CO.
- Physical and psychological stresses will affect all mine rescue responders. A Critical Incidence Stress Debriefing should be made available to team members following a rescue and recovery operation in which victims are encountered.

5. Mine Rescue Contest vs. Real Mine Emergency

- Although mine rescue contests are an invaluable training method, team members can expect very dangerous and unpredictable conditions at an actual mine emergency.
- Placards indicate hazardous conditions during mine rescue contests or other team training, whereas hazardous conditions at an actual mine emergency must be determined and reported by the team members. In other words, the team must call the shots during the real thing.
- An actual mine emergency is not a timed event; therefore, teams should proceed deliberately and safely, not necessarily as fast as they possibly can.
- Teams may experience considerable delays in their movement or exploration underground due to the time needed for communication to be relayed from the team through the Fresh Air Base to the Command Center and back.

NOTES