

## **Low Coal Fire Exercise**

### **Instructor's Copy**

Behavioral Research Aspects of Safety and Health Group (BRASH)  
Institute for Mining and Minerals Research (IMMR)  
University of Kentucky, Lexington, Kentucky<sup>1</sup>

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<sup>1</sup> This exercise was developed and field tested under U. S. Bureau of Mines research contract no. H0348040. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or the U. S. Government.

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## Introduction

This document contains most of the materials needed to use the exercise. The main part of the document is the instructor's copy. It tells how to use the exercise, presents the objectives, the master answer sheet, the scoring key, and discussion notes to be used following the exercise. The last part of this document is three appendices. Appendix A is the exercise problem booklet. This booklet can be duplicated locally. The booklets are reusable. One is needed for every person in the classroom. Appendix B is the answer sheet. Copies of this answer sheet must have the invisible ink answers that appear in Appendix C printed on them<sup>2</sup>. Answer sheets are consumable. One is needed for each group of 3 to 5 persons who work the exercise.

## Exercise Summary

Read this section first. It determines if the exercise is appropriate for your classes. If you choose to use the exercise, examine the table of contents and review the remainder of this document.

<u>Type</u>	Invisible ink
<u>Length:</u>	Nine questions (30 minutes administration plus 30 minutes for discussion)
<u>Skill:</u>	Choosing routes through smoke to designated assembly point Deciding when to use a primary or secondary escapeway Deciding when and for what purposes to use filter self-rescuers and self-contained self-rescuers Deciding how to best help a missing buddy
<u>Location:</u>	Underground
<u>Problem:</u>	You are the driller and helper working in the #5 intake air entry at the face of a five entry system. The coal height is 28 inches. Heavy smoke suddenly sweeps down on you from the intake air entries. You must decide what to do to warn others, to get to the assembly point, and to get out. The problem becomes more complicated when one of the miners is not accounted for.

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<sup>2</sup> You can do this yourself if you have the proper equipment, or you may obtain copies of preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to [lord-mary@msha.gov](mailto:lord-mary@msha.gov).

## HOW TO USE THIS EXERCISE

1. Look at the performance objectives. Decide if the exercise is relevant for your mine training class.
2. Work through the exercise with the developing pen and score your responses.
3. Read the master answer sheet for the exercise. Look at all the answers.
4. Read the "Instructor's Discussion Notes" for the exercise.
5. Become thoroughly familiar with the problem so that you can present it to your class without reading it. Put the maps or illustrations on an overhead projector so you can use these to help explain the problem.
6. When you present the exercise to the class:
  - Give each person an exercise booklet, and each group of 3 to 5 one answer sheet and a developing pen.
  - Demonstrate how to select and mark answers using the developing pen.
  - Go over the instructions for doing the exercise with the whole group.
  - Explain the problem making sure everyone understands the problem situation.
  - Have the class members work the exercise.
  - When the class members finish, have them figure up their score using the instructions at the end of the exercise.
  - When everyone has finished, discuss the exercise. Let class members discuss the merits of each answer. Add your own ideas.

### Performance Objectives for Low Coal Fire Exercise

Objective number	Capability verb(s)	Description of required performance and conditions under which it is to occur
1. EE/MG <sup>3</sup>	Recall Judge	When donning the FSR and SCSR is indicated and the performance capabilities and limitations of each apparatus
2. EE/MG	Anticipate Estimate Select	The pathway and approximate rate of smoke and gas diffusion from a mine fire given a map of the section, its ventilation plan, and the fire location
3. EE/MG	Generate Identify Select	Procedures by which to minimize smoke in escapeways from a mine section given a map of the section ventilation and the fire location
4. EE/MG	Recall Identify Select	Typical designated assembly points and emergency procedures for the evacuation of a mine section and the logical reasons for these given a specific problem and section map
5. EE/MG	Identify Evaluate Select	Escape routes from smoke on a mine section given the section map, fire location, and other basic information
6. EE/MG	Recognize Discriminate Select	Primary and secondary escapeways from a mine section given a section map and details of the ventilation, fire location, and related facts
7. EE/MG	Assess Understand Evaluate	The risk to individuals and to the group when miners do not comply with emergency evacuation procedures in a mine fire
8. EE/MG	Recognize Identify	Improper practices and violations of state and federal laws given a problem situation, a section map, and details of mine ventilation, production, and emergency procedures

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<sup>3</sup> Skill and knowledge domain abbreviations:  
 EE = emergency evacuation and escape  
 MG = mine gases

**Master Answer Sheet for Low Coal Fire Exercise**

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you make a selection. Otherwise you may not get the information you need.

**Question A** (Choose only ONE unless you are told to "Try again!")

1. [ A bad move. This would waste time and might kill them. Try again! ]
2. [ A bad move. Would waste time and probably kill them. Air in #4 entry is also ]  
[ fouled. Try again! ]
3. [ Correct. Is important to warn others. This also puts them nearer to a good ]  
[ escape route. Do the next question. ]
4. [ Takes too long. Smoke gets too thick to see. This would waste time. This ]  
[ action would force smoke through brattices into the belt entry. Try again! ]
5. [ This route does not allow them to warn others on the section about the smoke. ]  
[ Try again! ]

**Question B** (Choose only ONE unless you are told to "Try again!")

6. [ A poor choice. Air is fouled and they can't see. Try again! ]
7. [ Correct. The belt air is clean. The driller and helper know the fire is in the #5 ]  
[ intake entry. Do the next question. ]
8. [ A poor choice! Air is bad, visibility poor. Shot firer may need help but the ]  
[ miners should not travel through smoke to search for him. Try again! ]
9. [ A poor choice! Return air in the #2 entry is fouled. Smoke is moving about ]  
[ 4 times faster than the miners can crawl (about 100 ft/min compared to ]  
[ 420 ft/min. for the air). Try again! ]

**Question C** (Choose only ONE unless you are told to "Try again!")

- 10. [ Not smart. Smoke would foul #3 entry inby. The belt is moving. The door and regulator are too small to short circuit well. Try again! ]
- 11. [ Not smart. Smoke is traveling 420 ft/sec. This would be dangerous and waste time. Try again! ]
- 12. [ A good idea if he got to the fire early. But it is too big and too smoky now. This would waste time. There is a more critical first step. Try again! ]
- 13. [ Filter self-rescuers are not designed for searching. He should not go inby the fire, even with his FSR on. Try again! ]
- 14. [ Not smart and not legal. A dangerous move. Heavy smoke in the returns would foul the air in the escapeway. The ventilation change would confuse the miners at the face. Try again! ]
- 15. [ Correct. Now he can call in to warn the others and he can get help from others on the surface. Do the next question. ]

**Question D** (Choose only ONE unless you are told to "Try again!")

- 16. [ Correct. This increases the flow of fresh air into the belt entry. It reduces the air flow in the #4 and #5 entries, slowing the fire and smoke. Air at the face in entries 1 & 2 improves slightly. Do the next question. ]
- 17. [ Dangerous! Visibility poor. Safer options exist. Try again! ]
- 18. [ This would reduce smoke flow to the face area but not improve conditions. If the shot firer tries to come out the #3 entry he may think the fire is on the belt. He might try" to go out the intake air entries (#4 or #5), and might die. Try again! ]
- 19. [ Smoke is too thick to see to operate the scoop. Might run over the shot firer before they spot him. Try again! ]

**Question E** (Select as MANY as you think are correct.)

- 20. [ Correct. When he first saw thicker smoke, the shot firer might have put on his filter self-rescuer and gone out the #1 entry. It would be wise to check on this. You learn he is not outside. ]
- 21. [ Correct. Unless the fire is fought, it may soon be out of control. ]
- 22. [ Correct. Would want to make sure the SCSRs are operable. ]
- 23. [ This would be foolish and waste time! There is no reason to barricade. ]
- 24. [ Correct. SCSRs are not made for searching for others in heavy smoke, only for self-rescue and escape. ]

**Question F** (Choose only ONE unless you are told to "Try again!")

- 25. [ Correct. SCSRs are not designed for search and rescue, only self-rescue and escape. Color in the box under answer 29. ]
- 26. [ This is not a good choice, although it is good to stay together when you must travel in smoke. Try again! ]
- 27. [ This is a dangerous choice. It should not be attempted. Try again! ]
- 28. [ This route is the most complete, but it is very dangerous. It should not be attempted. Try again! ]
- 29. [ This is a very dangerous route and should not be attempted. Try again! ]

<p>[ All the routes are dangerous. The miners would likely become lost in the thick smoke. Crawling in low coal might keep squeezing the SCSR breathing bags and dump oxygen through the relief valve. They could run out of oxygen and die. They should get help. Mine rescue equipment is needed to search for the shot firer. Do the next question. ]</p>
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**Question G** (Choose only ONE unless you are told to "Try again!")

30. [ Try again! ]
31. [ Correct. An intake airway that is separate from neutral or return air splits is ]  
[ required by law. Color in the box under answer 33. ]
32. [ The neutral air entry is usually the secondary escapeway. Try again! ]
33. [ These are the return airways. A fire anywhere in the mine will soon foul the ]  
[ air in the returns. In this problem traveling out the returns would likely be fatal ]  
[ unless the miner wore a FSR or SCSR. Even then, visibility would be poor. ]  
[ Try again! ]

[ The neutral air entry is usually the secondary escapeway. Here it was used ]  
[ because a fire in the intake airway made the primary escapeway impassable. ]  
[ Do the next question. ]

**Question H** (Choose only ONE unless you are told to "Try again!")

- 34 [ Even with his FSR on, his action is dangerous. Try again! ]
35. [ Correct. Color in the box under answer 37. ]
36. [ The return air will get worse as fast as the fire develops. The smoke will ]  
[ move about four times faster than he can and will soon overtake him. ]  
[ He won't be able to see. His action is dangerous. Try again! ]
37. [ He should not wait for the face boss! He must make his own decision. ]  
[ However, going out the #1 entry is wrong. Try again! ]

[ The shot firer's action is dangerous to the others. SCSRs should not be used ]  
[ for exploration, but the others might try to find and help their buddy. Mines ]  
[ are required to have escape plans and routes that are posted and known by ]  
[ the miners and to have fire drills. A designated assembly point should be ]  
[ part of the plan. Everyone should meet there if they can. The shot firer should ]  
[ have gone to the dinner hole to be in good air and to be accounted for. ]  
[ Do the next question. ]

**Finding your score**

Number of "Correct" answers you colored in = (1) \_\_\_\_\_

26 minus number of incorrect answers you colored in = (2) \_\_\_\_\_

Add blanks one and two to get your total score = (3) \_\_\_\_\_

Highest possible score = 37

Lowest possible score = 0

## Instructor's Discussion Notes for Low Coal Fire Exercise

Use the information presented in the problem book, your own ideas and experience and those of the miners in your class, to discuss the exercise after it is completed. Group discussion can strengthen knowledge and skills, correct errors, and relate the exercise content to the experiences of the miners. After they have worked the exercise, miners enjoy discussing the problem. They frequently think of better ways to respond to a problem than those listed among the answers. The purpose of the exercise is to help miners think about and remember basic knowledge and skills they may someday need to deal with a mine fire or smoke. The discussion following the exercise can contribute to this goal and tailor the exercise content to the needs of the training group.

It is helpful to show overhead transparencies of the exercise questions during the discussion. This allows you to lead the group through the exercise and to disclose and discuss all the answers to each question. Most of the information about why particular answers are correct or incorrect is given on the master answer sheet.

The following notes provide additional information for you to discuss with your class. Read through and think about the notes before the class. Incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion.

**Problem statement** - The face boss made an initial error by allowing a non-permissible scoop to continue working in the face area. He made a second error by sending the scoop out by the crew, especially in the intake airway. He should have moved the miners into fresh air free of smoke right away. This would also have allowed the miners to prevent or fight the fire. When the #2 scoop stopped on the way out, the operator should have gone through the #6 crosscut mandoor and called out to the mechanic using the pager. This would have been much faster than crawling all the way outside. It would also have helped the operator to return quickly to the scoop where he could have observed and fought the fire with rock dust when it first started.

**Question A** - The correct answer is 3. The FSRs would protect the miners from carbon monoxide and smoke. Without the FSRs, the miners would be overcome quickly. Many miners select answer 4, pinning the #5 entry line curtain against the rib to keep the smoke out of the face area. However, in coal mines the leakage of air through the brattices averages 50% and is sometimes as high as 70 or 80%. (See Hartman, Mutmanský, & Wang, 1982, p. 389, and MSHA, 1984, p. 70.) Blocking off the intake air in the #5 entry would quickly foul the air in the #3 belt entry in by #6 crosscut. All the other answers are incorrect for the reasons given on the master answer sheet.

**Question B** - Answer 7 is correct. The belt tailpiece is probably the designated assembly point. The visibility in either of the intake air entries could be a foot or less. It would be easy to become disoriented and lost.

**Question C** - The only good option listed is answer 15. If the scoop operator had gone to the pager first and called outside to the mechanic, and then returned promptly to his scoop, he could probably have prevented the fire or at least fought it with the rock dust. But the fire became too large while he was gone. Now he should go outside and then call in on the pager to warn the others. He doesn't know what the air is like in the #3 entry. The stoppings could be leaking. This way he would be sure to get out to warn others and call for help. Many miners select answer 10 (short circuiting the smoke). But it would not help and would foul the belt entry air in by the mandoor. Many miners also say it would be a good idea to reverse the fan (14), but this would foul the air in the #3 entry all the way out and confuse the miners who were inside. It is also illegal to do this. (See 30 CFR 75.322 and MSHA (1984), Coal Mine Ventilation Awareness Program, p. 16.)

**Question D** - Answer 16 is correct because it has the effect of making the belt entry into an intake airway. This action would not be as effective if there were a box check outby on the belt, but it would still help. All the other answers are wrong for the reasons indicated.

**Question E** - Only answer 23 is wrong. There is no reason to barricade and no good place to do so. Even under worse conditions, all of the miners should be able to come out the belt entry using their FSRs and/or SCSRs. Some miners point out they do not select answer 22 because the seals and pressure gauges on SCSRs should be frequently inspected, perhaps even daily. Still, it would take little time to do and would be wise.

**Question F** - The experts disagree on this question. Most experienced mine rescue team members say the correct answer is to not search for the shot firer, that the smoke is too thick to do so, and that the results of searching could well be two dead would-be rescuers. SCSRs are not designed for search and rescue of others. These experts say that only a properly equipped mine rescue team should search in heavy smoke. It would be better for the miners to go out, call a mine rescue team, and fight the fire. The face boss and the pinner should stay near the #1 scoop for awhile and yell for the shot firer. If he were on his way out it might help him find his way. However, even this could be dangerous if the stoppings are leaking. Other mine rescue experts say that it would be O. K. for the face boss and the pinner to do a search right away with the SCSRs, but that they should follow Route C or they might not find the shot firer. These experts argue that if the boss and pinner search at all, they should do a thorough search. Experts of the opposite opinion argue that if the face boss and pinner did find the shot firer, they would not be able to bring him out quickly or easily. They say a good way to simulate the visibility in smoke is to cover the goggle lenses with a single sheet of waxed paper. They argue it would be easy to run out of the SCSR oxygen supply during the search. Because the boss and pinner would be crawling and frequently squeezing the breathing bag between themselves and the mine floor, they would dump oxygen from the bag through the relief valve. The hour supply would be used up rapidly and they might easily become disoriented because of the poor visibility and the many turns. Both miners could become lost and die. All the experts agree answers 26 and 28 are wrong. What do you think? (You might wish to line a pair of SCSR goggles with waxed paper, have a miner or two put them on, and try to carry out a search

pattern something like the one in answer 27. You could use the hallway and rooms around the training room to simulate the section. The task would be more difficult in low coal while wearing an SCSR) After discussing this matter, most experts think answer 25 is the correct choice.

**Question G** - The correct answer is 31. The intake air entry must be separate from neutral or return air splits by law. (See 30 CFR 75.1704.) You may wish to show Figure 30 and 32 from the MSHA (1984) Coal Mine Ventilation Awareness Program. Figure 30 (see pages 14 and 15 of these notes) shows the primary and secondary escapeways and summarizes other basic requirements for a five entry single split system. Figure 32 (see page 15 of these notes) shows the same information for a double split system. It would be a good idea to show a map of the section on which your class members work and have them identify assembly points, escape routes, and basic requirements and procedures. You might also ask the class members how the Low Coal Fire problem would be different if the mine used a blowing ventilation system with the fan outside the #5 entry intake airway. This makes a different problem and requires different responses.

**Question H** - The correct answer is 35. Be sure to discuss the information in the invisible ink portions of this question with the class members. The information in the brackets at the bottom of the page is especially important. It calls attention to the requirements for escape plans, routes, assembly points and fire drills. (See 30 CFR 75.1704-2(e).)

**Question I** - Some of the violations and poor practices noted by miners who have completed this exercise include:

- a. Failure to remove unsafe equipment from service immediately (CFR 75.1725).
- b. Inadequate firefighting equipment on the section, no water line, no fire extinguishers (CFR 75.1100-1, -2, -3).
- c. Possible inadequate instruction and failure to hold practice drills for every miner in the use of escapeways (CFR 75.1704 2[a-e]).
- d. Possible insufficient number of SCSRs for each miner underground (CFR 75.1714).
- e. Belt air may not be sufficiently regulated (CFR 75.326).
- f. Scoop should have been parked out and repaired early and miners moved to clean air on the intake side of the scoop.
- g. The smoking scoop should not have been trammed out the intake air.
- h. Scoop operator should have called out to the mechanic and not left the #2 scoop when it was smoking.
- i. For efficiency and safety, the dumping point could be brought closer to the face. This would put the SCSRs closer to the face and also increase production. A two-way dump could further enhance productivity.
- j. Should be a check curtain in #3 entry between #9 and #10 crosscut.
- k. Some miners suggest that the line curtains at the face in Figure 1 should be hung near the right rib on a blowing system. Following each shot this would rapidly clear smoke and dust from the face.

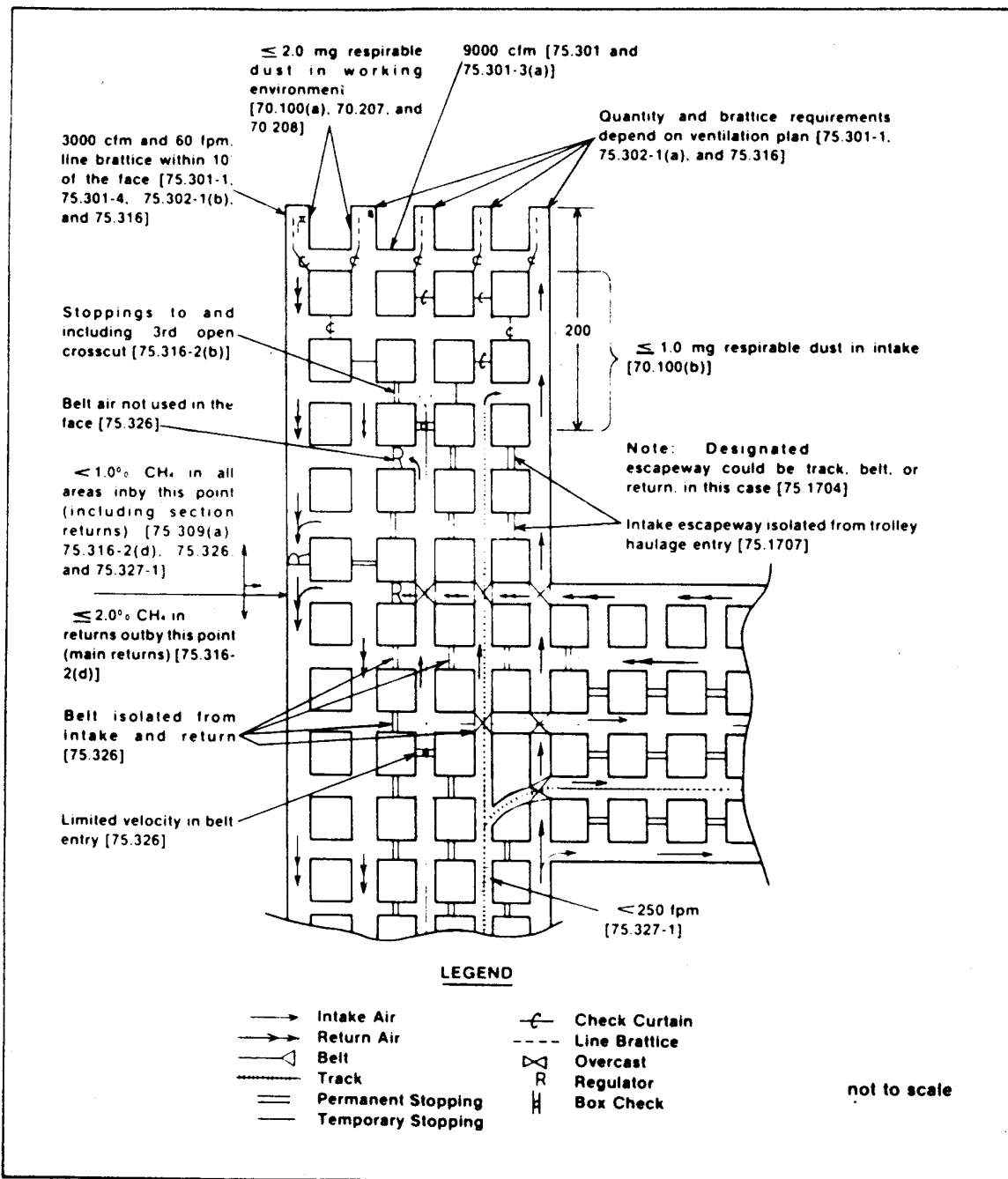


Figure 3: Summary of ventilation-related requirements for a single split coal mine ventilation system

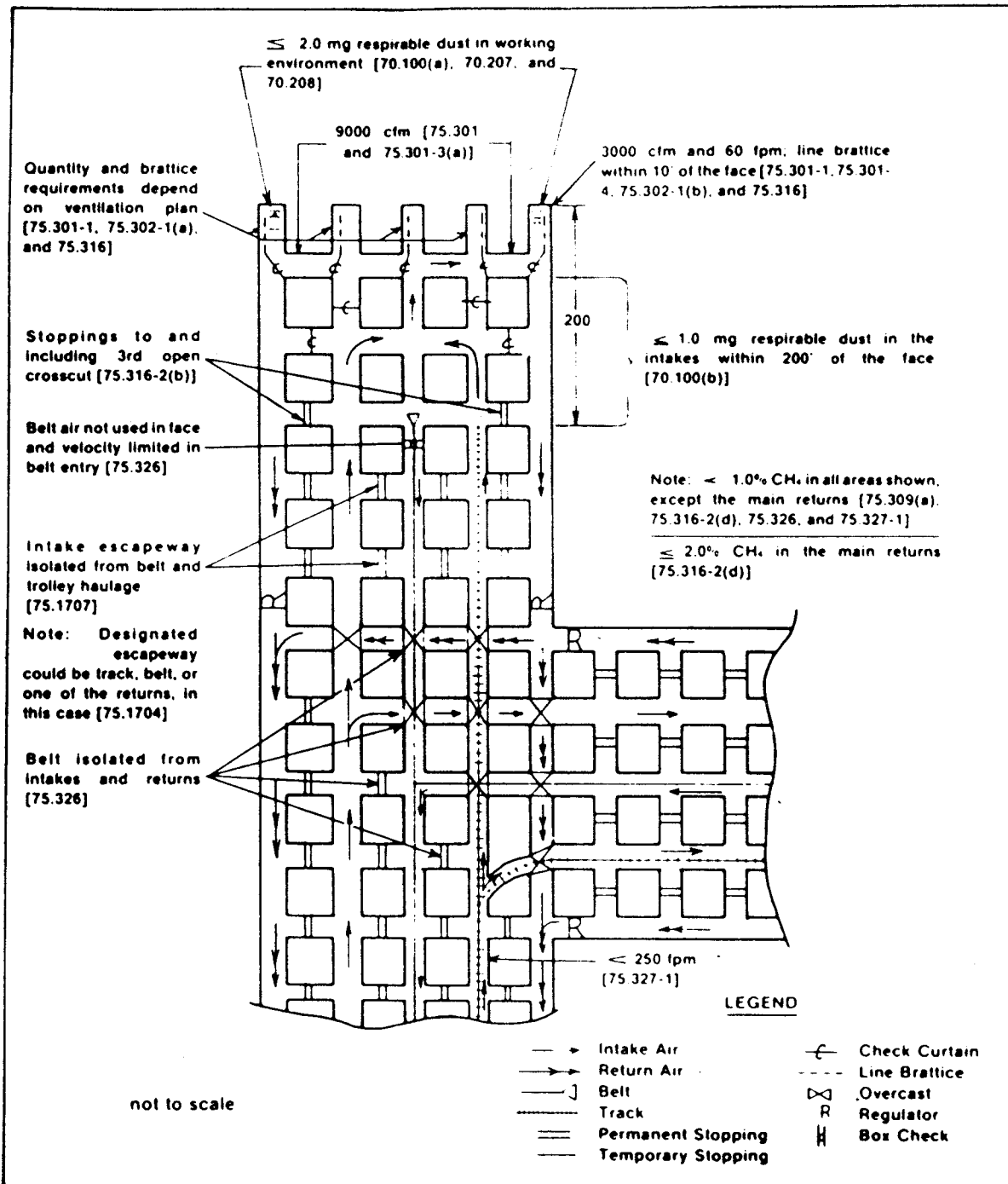


Figure 4: Summary of ventilation-related requirements for a double split coal mine ventilation system

## References

Hartman, H. L., Mutmansky, J. M., & Wang, Y. J. (1982). Mine ventilation and air conditioning (2nd ed.). New York: Wiley.

Mine Safety Associates. (1985). Federal coal mine safety standards. 30 CFR 75. Pocket edition. Price, UT: Author.

MSHA (1984). Coal mine ventilation awareness program. Beckley, WV: National Mine Health and Safety Academy.

Office of the Federal Register. (July 1984). Code of federal regulations. 30. (parts 0 to 199). Washington, DC: U.S. Government Printing Office.

Wala, A. (1985). Mine ventilation. In F. Cameron (Ed.), The Kentucky underground coal mine guidebook (pp. 100-119). Lexington, KY: The Kentucky Mining Institute.



## Scoring Key for Low Coal Fire

The correct answers are marked with an asterisk.<sup>4</sup>

Question	Answer Number					
A	1	2	3*	4	5	
B	6	7*	8	9		
C	10	11	12	13	14	15*
D	16*	17	18	19		
E	20*	21*	22*	23	24*	
F	25*	26	27	28	29	
G	30	31*	32	33		
H	34	35*	36	37		

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<sup>4</sup> This page is printed in large type so that it may be copied and used as an overhead transparency.

## **Appendix A: Problem Booklet**

Duplicate this copy of the problem booklet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable.

You may obtain a copy of the problem booklet from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to [lord-mary@msha.gov](mailto:lord-mary@msha.gov).

**Low Coal Fire  
Problem Booklet**

## **Instructions**

Read the problem situation described on the next page. Study the map until you understand the location of the miners and equipment in the problem. Next, answer each of the 9 questions. Do them one at a time. Don't jump ahead, but you may look back to earlier questions and answers. For some of the questions, choose only one answer unless you are told to "Try again!". Other questions ask you to select as many answers as you think are correct. Follow the instructions for each question.

After you have selected a choice to a question, look up its number on the answer sheet. Select your answer to each question by rubbing the developing pen between the brackets on the answer sheet. A hidden message will appear and tell you if you are right. When you have finished, you will learn how to score your performance.

## **Background**

Low coal, 28 inches high

Shooting from solid

5 entries, 20 ft wide

Pillars: 40 ft x 60 ft (60 ft x 80 ft on center)

Roof control: 30 inch bolts, 4 ft centers

Face 10 breaks from portal (about 850 ft)

Exhausting ventilation, 420 linear ft/min. air velocity in mains

#2 scoop: old, arcing and smoking and soon to be scrapped

2 bags of rock dust on the #2 scoop, but no fire extinguisher

No water line present

## **Problem**

Scoop #2 has been arcing and smoking all shift. The face area gets smoky. The face boss tells the operator to tram the scoop outside for repairs after #3 entry has been loaded out. On the way out the scoop stalls just outby #6 crosscut. The operator leaves and crawls outby 5 breaks (500 ft) to the outside to get the mechanic to work on the scoop. While he is gone, the scoop's hydraulic oil and a tire catch on fire. Heavy black smoke travels rapidly down the #4 and #5 entries toward the face.

After studying the map on page 4, turn the page and answer the first question.

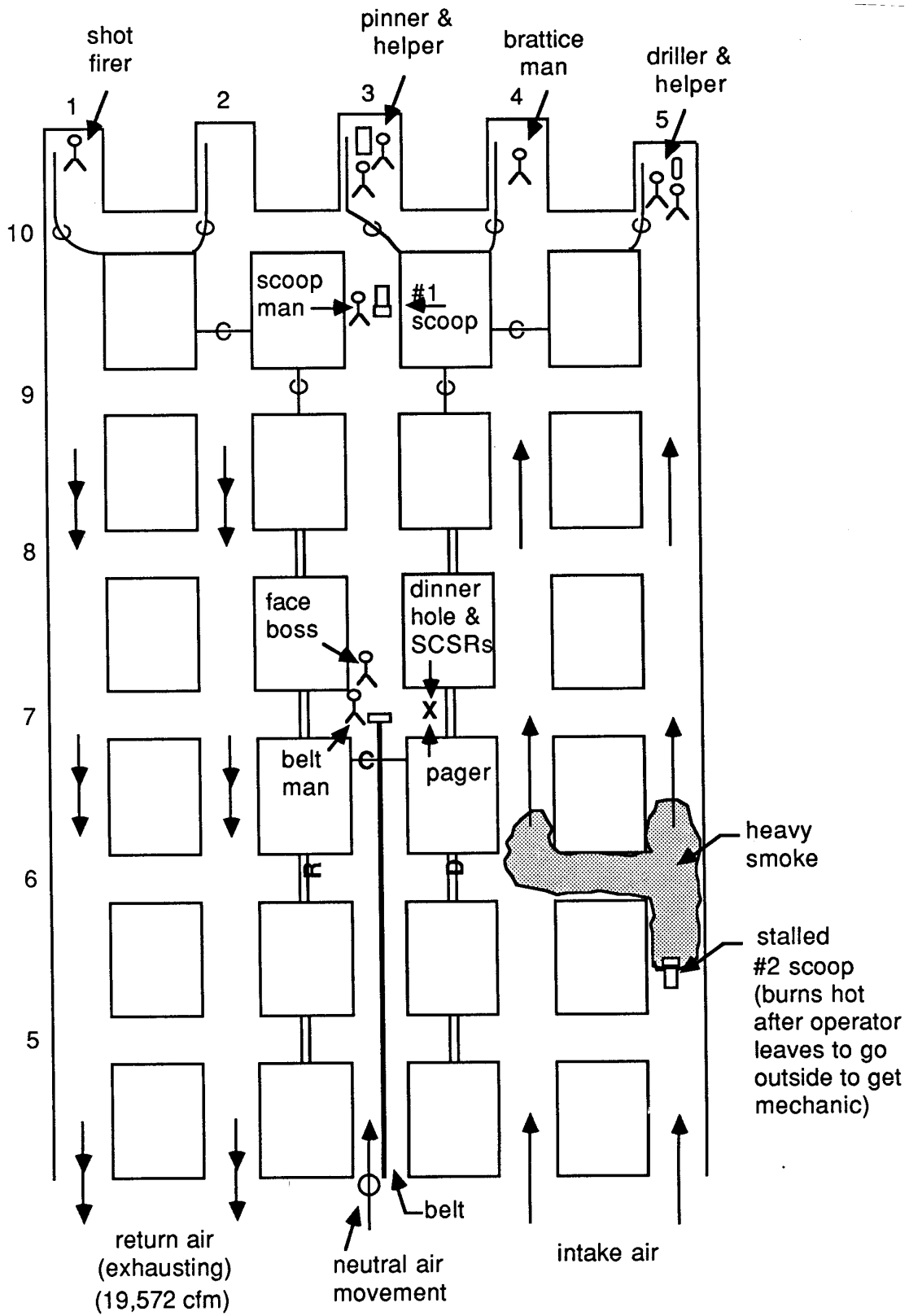


Figure 1: Section map

### Question A

After the #2 scoop leaves the face area on its way outside, the driller and helper in the #5 entry don't think much about the smoke. They know the scoop was smoking. However, the smoke soon becomes worse. When they look down the entry they see a cloud of thick black smoke rolling toward them. What should they do? (Choose only ONE unless you are told to "Try again!")

1. Move down the #5 entry to fight the fire.
2. Immediately move down the #4 intake entry toward the portal to get into fresh air. Don't waste time putting on the filter self-rescuer.
3. Put on their filter self-rescuers and move over to #4 and #3 entries to warn the brattice man and the pinner and his helper. Leave the curtains just as they are.
4. Curtain off the air in the #5 entry near the face by pinning the line curtain against the left rib.
5. Crawl down #5 entry. Turn right at crosscut #9. Then go through the check curtain into the #3 entry. Look for the face boss.

**Question B**

The driller and his helper leave the face. They turn right into the #10 crosscut. They go by the #4 and #3 faces and join up with the brattice man, the pinner, and his helper. The smoke is thick. All have put on their filter self-rescuers. What should they do now? (Choose only ONE unless you are told to "Try again!")

6. Move back into the #4 entry and go on out the intake air.
7. Move outby in the #3 entry to the dinner hole and prepare to go out the beltline.
8. All five miners should spread out and crawl over to the #2 and #1 entries looking for the shot firer.
9. All five miners should exit the mine by the #2 entry, looking for the shot firer on their way out.



### Question C

Meanwhile, the #2 scoop operator can't find the mechanic outside. He returns alone to try to start the stalled scoop. He finds it burning so badly he can't see the operator's compartment. The entire entry is filled with heavy black smoke. What should he do? (Choose only ONE unless you are told to "Try again!")

10. Put on his filter self-rescuer and go inby to the first mandoor. Prop the door open, cross the belt and open the regulator all the way to short circuit the smoke.
11. Put on his filter self-rescuer and crawl up the #5 entry to warn the face crew.
12. Fight the fire with the two bags of rock dust he has on the scoop.
13. Put on his filter self-rescuer and go inby in the #4 entry to the first mandoor. Go into the belt entry and move toward the face.
14. Go outside and reverse the fan.
15. Turn around and go out the #5 entry to the surface and get help.

**Question D**

Except for the shot firer, all the miners who were at the face join up with the #1 scoop man in the #3 entry just inby crosscut #9. They find the air to be cleaner but still a little smoky. The miners move toward the dinner hole. Soon they meet the face boss and the belt man coming inby with six unopened SCSRs. No one has seen the shot firer. What should the face boss do? (Choose only ONE unless you are told to "Try again!")

16. Tell the miners to move down to the tailpiece, stop the belt, take down the check curtain on the belt just outby the dumping point, make sure the mandoor is closed, and close the regulator all the way.
17. Tell all the miners to get into the scoop and tell the operator to tram outby in the #4 entry while the boss stays and looks for the shot firer.
18. Tell the miners to take down the check curtains between the belt entry and the #2 and #4 entries to short circuit the smoke.
19. Tell all the miners to crawl out the belt entry to the surface. The boss and the scoop man put on SCSRs and then tram inby looking for the shot firer.

**Question E**

The boss says he and the pinner will put on SCSRs, take an extra SCSR, and go into the #10 crosscut and over to entries #1 and #2, to look for the shot firer. The #1 scoop operator is to stay near the pager and wait for them to come back. All the others are to crawl out the belt entry to the surface. The scoop operator says it is too dangerous to search for the shot firer. What should the face boss do now? (Select as MANY as you think are correct.)

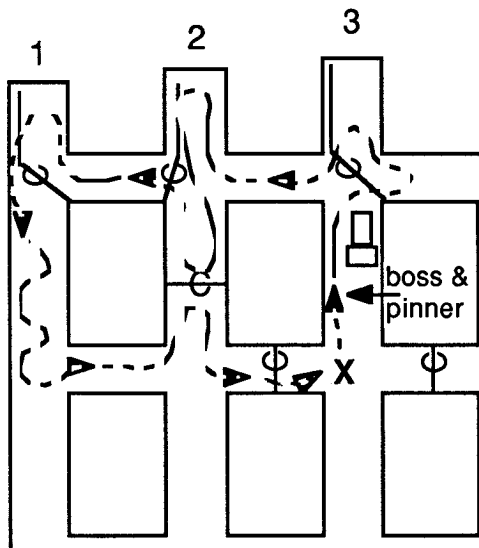
20. Immediately send one of the miners to call outside on the pager to see if the shot firer is outside.
21. Immediately have one of the miners call outside to report the fire, its location and intensity, and to notify the superintendent to get help to fight the fire.
22. Examine the seals and pressure gauges on the SCSRs.
23. Gather brattice material, nails, a hammer, and other supplies with which to barricade if needed.
24. Listen to the scoop operator as he reports the fire's location and intensity and reconsider the decision to search for the shot firer.

**When you have made your selection(s), do the next question.**

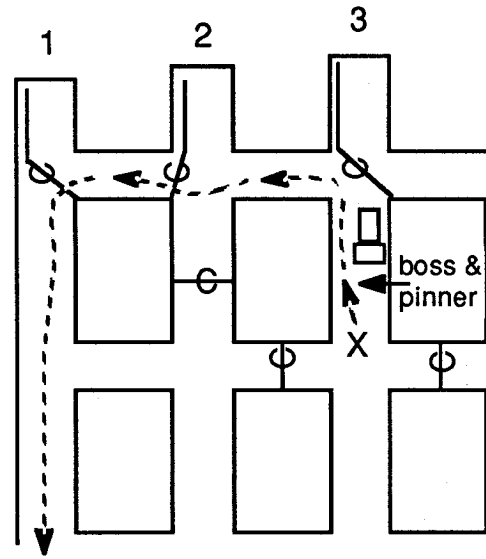
### Question F

The smoke in the last open crosscut is now very thick. The air in the belt entry is also getting smoky. The boss and the pinner talk about possible routes they can use. Even though the #1 scoop operator says it is too dangerous, the boss says he and the pinner will search for the shot firer anyway (see Figure 2 on page 11). Which route, if any, should they take? (Choose only ONE unless you are told to "Try again!")

25. None of the routes shown in Figure 2 is safe and none should be attempted.
26. **Route C** is best because the two miners will stay together and make only one pass. They will spend less time in the smoke.
27. **Route D** is best because the two miners can cover the same distance faster.
28. **Route A** is best because it is the most complete search and the most likely to locate the shot firer.
29. **Route B** is best because the two miners can stay together and they may find the shot firer if he is in the return airway.

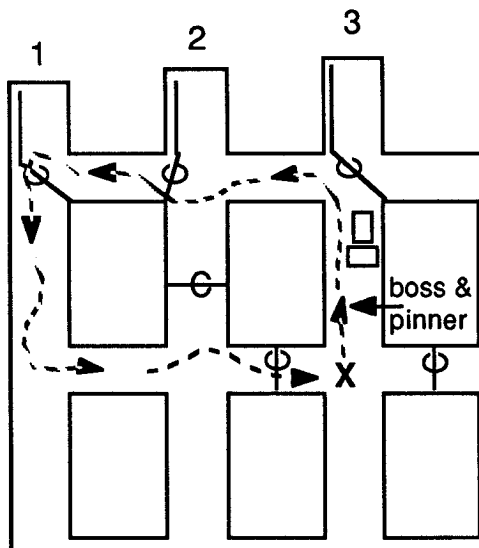


**Route A**

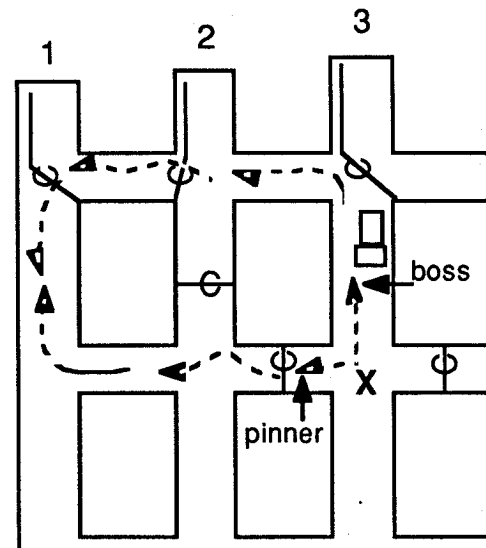


to surface

**Route B**



**Route C**



**Route D**

Figure 2: Possible routes for searching for the shot firer

**Question G**

See Figure 1 on page 4. What would be the usual designated primary escapeway in a mine like this one? (Choose only ONE unless you are told to "Try again!")

- 30. Number 6 crosscut.
- 31. Number 4 or 5 entries.
- 32. Number 3 entry because it is in neutral air.
- 33. Number 1 or 2 entries.

**Question H**

Suppose that when the shot firer first saw the smoke getting thicker, he became scared. He decided to go straight out the #1 entry, the shortest route outside. Is his decision risky for anyone beside himself? (Choose only ONE unless you are told to "Try again!")

- 34. No, not as long as he puts on his filter self-rescuer.
- 35. Yes, because the other miners won't know where he is.
- 36. No, as long as he moves out when the smoke first starts to get thicker he will be O.K. He will get out quickly.
- 37. Yes, because he should wait at the face until the boss arrives and tells him what to do.

### **Question I**

On the separate answer sheet, list all the violations of state and federal laws and your company rules that you can find in this problem.

### **Scoring your performance**

1. Count the total number of responses you colored in that were marked "Correct".
2. Count the number of "incorrect" responses you colored in. Subtract this number from 26. Write the difference in the second blank on the answer sheet.
3. Add the numbers on the first and second blanks. This is your score.

The best score is 37.

The worst score is 0.



## **Appendix B: Answer Sheet Blanks**

These are the answer sheet blanks. Copies of these blank answer sheets may be duplicated in the normal fashion. However, the answers that are found within the brackets must be printed on these blank answer sheets in invisible ink. These answers are found in Appendix C. If you have the capability to print invisible ink, make copies of the blank answer sheets. Make a master of the answers that appear in Appendix C. Then print the invisible ink on the blank answer sheets, being careful to make sure all pages print and that the appropriate answers line up with the appropriate blanks. The Master Answer Sheet shows all the answers in their proper places.

Most companies and trainers prefer to obtain copies of the preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to [lord-mary@msha.gov](mailto:lord-mary@msha.gov).

The exercise is designed to be used in small groups. You will need one answer sheet for each group of 3 to 5 persons in your class. The answer sheets are consumable. You will need a new set for each class.

A developing pen is also needed by each person who marks an answer sheet.

### Answer Sheet for Low Coal Fire Exercise

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you make a selection. Otherwise you may not get the information you need.

**Question A** (Choose only ONE unless you are told to "Try again!")

- 1. [ ]
- 2. [ ]  
[ ]
- 3. [ ]  
[ ]
- 4. [ ]  
[ ]
- 5. [ ]  
[ ]

**Question B** (Choose only ONE unless you are told to "Try again!")

- 6. [ ]
- 7. [ ]  
[ ]
- 8. [ ]  
[ ]
- 9. [ ]  
[ ]  
[ ]

**Question C** (Choose only ONE unless you are told to "Try again!")

- 10. [ ]  
[ ]
- 11. [ ]  
[ ]
- 12. [ ]  
[ ]
- 13. [ ]  
[ ]
- 14. [ ]  
[ ]  
[ ]
- 15. [ ]  
[ ]

**Question D** (Choose only ONE unless you are told to "Try again!")

- 16. [ ]  
[ ]  
[ ]
- 17. [ ]
- 18. [ ]  
[ ]  
[ ]  
[ ]
- 19. [ ]  
[ ]

**Question E** (Select as MANY as you think are correct.)

20. [ ]  
[ ]  
[ ]

21. [ ]

22. [ ]

23. [ ]

24. [ ]  
[ ]

**Question F** (Choose only ONE unless you are told to "Try again!")

25. [ ]  
[ ]

26. [ ]  
[ ]

27. [ ]

28. [ ]  
[ ]

29. [ ]


**Question G** (Choose only ONE unless you are told to "Try again!")

30. [ ]

31. [ ]  
[ ]

32. [ ]

33. [ ]  
[ ]  
[ ]  
[ ]

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**Question H** (Choose only ONE unless you are told to "Try again!")

34 [ ]

35. [ ]

36. [ ]  
[ ]  
[ ]

37. [ ]  
[ ]

--

**Question I**

On your answer sheet, list all federal, state and mining company violations you can find in this problem.

### **Finding your score**

Number of "Correct" answers you colored in = (1) \_\_\_\_\_

26 minus number of incorrect answers you colored in = (2) \_\_\_\_\_

Add blanks one and two to get your total score = (3) \_\_\_\_\_

Highest possible score = 37

Lowest possible score = 0

### **Appendix C: Invisible ink Answers**

These pages contain the answers that must be printed in the blanks of the answer sheet in Appendix B. These answers are spaced and sequenced correctly so that they exactly match up with the appropriate blanks on the answer sheet blank.

Once the answers have been printed in the answer sheet blanks, the developing pen reveals the formerly invisible printed message.

You may obtain preprinted answer sheets or you may prepare your own copies. To learn more about these options, and to determine how many answer sheets and developing pens you will need, see the introductory section of the Instructor's Copy.

A bad move. This would waste time and might kill them. Try again!

A bad move. Would waste time and probably kill them. Air in #4 entry is also fouled. Try again!

Correct. Is important to warn others. This also puts them nearer to a good escape route. Do the next question.

Takes too long. Smoke gets too thick to see. This would waste time. This action would force smoke through brattices into the belt entry. Try again!

This route does not allow them to warn others on the section about the smoke. Try again!

A poor choice. Air is fouled and they can't see. Try again!

Correct. The belt air is clean. The driller and helper know the fire is in the #5 intake entry. Do the next question.

A poor choice! Air is bad, visibility poor. Shot firer may need help but the miners should not travel through smoke to search for him. Try again!

A poor choice! Return air in the #2 entry is fouled. Smoke is moving about 4 times faster than the miners can crawl (about 100 ft/min compared to 420 ft/min. for the air). Try again!



Not smart. Smoke would foul #3 entry inby. The belt is moving. The door and regulator are too small to short circuit well. Try again!

Not smart. Smoke is traveling 420 ft/sec. This would be dangerous and waste time. Try again!

A good idea if he got to the fire early. But it is too big and too smoky now. This would waste time. There is a more critical first step. Try again!

Filter self-rescuers are not designed for searching. He should not go inby the fire, even with his FSR on. Try again!

Not smart and not legal. A dangerous move. Heavy smoke in the returns would foul the air in the escapeway. The ventilation change would confuse the miners at the face. Try again!

Correct. Now he can call in to warn the others and he can get help from others on the surface. Do the next question.

Correct. This increases the flow of fresh air into the belt entry. It reduces the air flow in the #4 and #5 entries, slowing the fire and smoke. Air at the face in entries 1 & 2 improves slightly. Do the next question.

Dangerous! Visibility poor. Safer options exist. Try again!

This would reduce smoke flow to the face area but not improve conditions. If the shot firer tries to come out the #3 entry he may think the fire is on the belt. He might try" to go out the intake air entries (#4 or #5), and might die. Try again!

Smoke is too thick to see to operate the scoop. Might run over the shot firer before they spot him. Try again!

Correct. When he first saw thicker smoke, the shot firer might have put on his filter self-rescuer and gone out the #1 entry. It would be wise to check on this. You learn he is not outside.

Correct. Unless the fire is fought, it may soon be out of control.

Correct. Would want to make sure the SCSRs are operable.

This would be foolish and waste time! There is no reason to barricade.

Correct. SCSRs are not made for searching for others in heavy smoke, only for self-rescue and escape.

Correct. SCSRs are not designed for search and rescue, only self-rescue and escape. Color in the box under answer 29.

This is not a good choice, although it is good to stay together when you must travel in smoke. Try again!

This is a dangerous choice. It should not be attempted. Try again!

This route is the most complete, but it is very dangerous. It should not be attempted. Try again!

This is a very dangerous route and should not be attempted. Try again!

All the routes are dangerous. The miners would likely become lost in the thick smoke. Crawling in low coal might keep squeezing the SCSR breathing bags and dump oxygen through the relief valve. They could run out of oxygen and die. They should get help. Mine rescue equipment is needed to search for the shot firer. Do the next question.

Try again!

Correct. An intake airway that is separate from neutral or return air splits is required by law. Color in the box under answer 33.

The neutral air entry is usually the secondary escapeway. Try again!

These are the return airways. A fire anywhere in the mine will soon foul the air in the returns. In this problem traveling out the returns would likely be fatal unless the miner wore a FSR or SCSR. Even then, visibility would be poor. Try again!

The neutral air entry is usually the secondary escapeway. Here it was used because a fire in the intake airway made the primary escapeway impassable. Do the next question.

Even with his FSR on, his action is dangerous. Try again!

Correct. Color in the box under answer 37.

The return air will get worse as fast as the fire develops. The smoke will move about four times faster than he can and will soon overtake him. He won't be able to see. His action is dangerous. Try again!

He should not wait for the face boss! He must make his own decision. However, going out the #1 entry is wrong. Try again!

The shot firer's action is dangerous to the others. SCSRs should not be used for exploration, but the others might try to find and help their buddy. Mines are required to have escape plans and routes that are posted and known by the miners and to have fire drills. A designated assembly point should be part of the plan. Everyone should meet there if they can. The shot firer should have gone to the dinner hole to be in good air and to be accounted for. Do the next question.