Pipe Repair Problem

Instructor's Copy

Behavioral Research Aspects of Safety
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[1] This exercise was developed and field tested under U. S. Bureau of Mines research Contract No. H0348040. Information about the design and characteristics of the exercise and the field test results are available in the project technical reports filed with the Bureau of Mines Research Center in Pittsburgh, PA. 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.

Contents

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 next section 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.[2] Answer sheets are consumable. One is needed for each small 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.

Type:	Invisible ink
Length:	Eleven questions (25 minutes for administration plus 30 for discussion)
Skills:	Recognizing and preventing hazards from falling equipment and material Procedures for securing a heavy overhead object before cutting it free Materials handling procedures in confined spaces Proper procedures for climbing to and working from structural beams and heavy pipes Proper use of gas welding equipment and related tools required for cutting out a heavy section of overhead pipe Dangering-off an area where falling materials might strike passers by
Location:	Coal preparation plant, third level, third shift
Problem:	A worn section of a large overhead coal slurry pipe must be removed and replaced before the prep plant can start up. You are a laborer. You have been assigned to help two prep plant maintenance workers make the repairs. As you prepare to do the job and complete the work, many hazards and potential problems are present. You must recognize the hazards and act to prevent accidents. Otherwise, you or others may be injured and property may be damaged.

[2] You can do this yourself if you have the proper equipment, or you may obtain copies of preprinted answer sheets from NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.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 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 a problem booklet, and each small group of 3 to 5 persons an 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 Pipe Repair Problem

Objective number	Capability verbs	Description of required performance and conditions under which it is to occur
1. HR/SW[3]	Assess Recognize	Hazards involved in climbing, lifting, pulling, cutting and welding while engaged in replacing a heavy overhead pipe section in a prep plant
2. HR/SW	Assemble Select	Tools and equipment required to perform a complex pipe repair task safely and efficiently
3. HR/SW	Restrict Prevent	Entry and access to areas where passers by could be struck by falling objects and materials
4. HR/SW	Recognize Select	Safe and effective methods to support a piece of heavy overhead pipe before cutting it loose
5. HR/SW	Recognize Prevent	Specific hazards of the work being performed, including tripping, stumbling, falling, fall of equipment and material, fire, explosion, and materials handling in a confined space
6. HR/SW	Recognize Select	Proper methods for climbing, placing, and securing ladders for personnel working in elevated postions on large pipes and structural steel members
7. HR/SW	Identify Recognize	Proper methods for tracing pipes to their pumps and for locking out and tagging the pump that supplies the pipe that is being worked on
8. HR/SW	Recall	That a heavy pipe section may be under strain that can be released suddenly when the pipe is cut
9. SW	Judge Evaluate	The relative costs of proper safe work practices against the potential costs of accidents, injuries, and lost production that may result from shortcuts and shoddy work

[3] Skill and knowledge domain abbreviations:
HR = hazard recognition
SW = safe work practices

Master Answer Sheet for Pipe Repair Problem

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 (Select as MANY as you think are correct.)

1. [You need to do something else first.]

2. [Correct! It is important to identify and avoid potential hazards, especially]
   [when a job is to be done in a hurry.]

3. [Correct! This usually saves time and makes the work easier and safer.]

4. [This is dangerous! It depends on one person watching and warning others]
   [when everyone in the area needs to be alerted to the possible hazards.]

Question B (Select as MANY as you think are correct.)

5. [Correct!]

6. [Correct!]

7. [Unnecessary.]

8. [Correct!]

9. [Correct!]

10. [Correct!]

11. [Unnecessary.]

12. [Correct!]

13. [Correct!]

14. [Correct!]

15. [Correct!]

16. [Correct!]

17. [Correct!]

18. [Unnecessary.]

19. [Correct!]

20. [Unnecessary.]

Question C (Select as MANY as you think are correct.)

21. [Correct! The pipe sections are very heavy.]

22. [Correct! The pump could be restarted by someone. Flash needs to trace the]
[line and lock-out and tag the pump switch before he works on the pipe.]

23. [If the tanks are handled properly this is very unlikely.]

24. [Correct! This is a danger even if the pipe is well supported. The old pipe]
[can move suddenly once it is cut. The new pipe can swing or tilt when lifted.]

25. [If you inspect and maintain your equipment this should not be a concern.]

26. [Correct! Alcohol is flammable and explosive, especially in the presence of]
[oxyacetylene flames and equipment. Methane could also be present.]

27. [Correct! This job requires climbing, lifting, and working from a high place.]
[Tools underfoot and the slippery floor can also lead to slips and falls.]

28. [This is not a hazard in this situation.]

29. [Correct! Flash needs to wear goggles while Pete, you, and others avoid the]
[hot metal sparks. Alcohol from the plastic line can also injure eyes.]

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

30. [This is risky. Try again!]

31. [This is risky. Try again!]

32. [There is a better way to help him. Try again!]

33. [Correct! Ladders should be much higher than the point to which the worker is]
[climbing. Do the next question.]

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

34. [Correct! Pete and Flash cleaned up the floor while you were gone.]

35. [Correct! Pete and Flash put the brattice cloth down while you were gone.]

36. [Correct! This puts the ladder at the appropriate 75 degree climbing angle.]

37. [You always need to be alert to electrical hazards when working in a prep]
[plant. The ladder's rubber feet provide little or no insulation.]

38. [Flash glares at you and says, "Do you think I'm stupid!" Your remark has]
[angered him. This increases the risk for Flash.]

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

39. [Dangerous! Flash could reach and fall. You and Pete could be struck by]
[failing tools. Try again!]

40. [Dangerous! Flash and Pete may have to over-reach and might fall. Try]
[again!]

41. [Dangerous! The hoses could snag. Flash needs both hands for climbing]
[and getting out on the lower pipe. Try again!]

42. [Correct! This leaves both of his hands free for climbing and lets him get in]
[position without having to worry about other things. Do the next question.]

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

43. [He needs to do something else first. Anyway, barriers and signs should be]
[in place and the crew should have been warned already. Try again!]

44. [Not yet! Try again!]

45. [Not yet! Try again!]

46. [Correct! An eight foot fall can produce serious injuries or death. Do the next]
[question.]

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

47. [Not yet! Try again!]

48. [Not yet! Try again!]

49. [Correct! The pipe needs to be held in position while it is cut. Do the next question.]

50. [This should not be done until he is ready to cut. It will make it hard for him to see. Try again!]

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

51. [This could cause more damage to the pipe section and create a hazard for others. Try again!]

52. [Correct! Do the next question.]

53. [This is hazardous. Flash could be hurt or killed. Try again!]

54. [You and Pete don't have a ladder or a safe way to climb. This places you at risk. Try again!]

Question J (Select as MANY as you think are correct.)

55. [He was not handling rope after he lifted the tools up.]

56. [Correct!]

57. [There is little risk of electrocution from a well maintained arc welder that is properly used.]

58. [Correct! The pipe being cut was under strain. The sudden release of energy could have crushed his chest or head and made him fall.]

59. [Correct! If Flash had been hurt or killed, rescue or recovery and the investigation could have required several days.]

Question K (Select as MANY as you think are correct.)

60. [You probably have saved production time and money.]

61. [Correct! Poorly performed work almost always cost more in the end.]

62. [Correct! This job presented many opportunities to make serious and costly mistakes.]

63. [Not likely!]

64. [Correct! Companies with poor reputations for health and safety, often find it more difficult to market their coal and to employ good miners and mangers.]

Finding your score

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

30 minus number of incorrect answers you colored in = (2)_____

Add the numbers in blanks one and two to get your total score = (3)_____

Highest possible score = 64.

Lowest possible score = 0.

Instructor's Discussion Notes for Pipe Repair Problem

Use the information presented in the problem book, your own ideas and experience, and those of the workers 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 workers. After they have worked the exercise, class members 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 workers think about and remember basic knowledge and skills they may someday need to deal with an unstable piece of equipment, fall of material, materials handling hazards, and procedures for climbing and working from high places. 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 master answer sheet 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 to discuss with your class. Read through and think about the notes before the class. Don't read the notes to the class members. This would be boring and ineffective. Rather, incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion.

Question A - The correct answers are 2 and 3. It is important to inspect the work area for hazards before beginning work. Work is both more efficient and safer when workers think about the job and how to approach it, and gather the necessary tools beforehand. Many accidents result from failure to perform these tasks. All persons working in the area need to be alerted to the hazards of the job. It is impractical and dangerous to assign one person to "watch" all other persons and warn them if they move into a hazardous area.

Question B - Only answers 7, 11, 18, and 20 are incorrect. All of the other equipment and materials are needed to do the job safely and well. The colored tape or rope (5) and danger signs (6) are needed to danger-off the area while the pipe is being replaced. The pipe slings and come-along (8) are needed to hold the old pipe in place as it is cut, to lower the old pipe to the floor, and to raise the new pipe section into place while it is welded. The cutting and welding goggles and gloves (9) and the welding equipment are needed to cut out the old pipe section and weld the new section in place. Federal law requires that a methane check be made before welding in a prep plant (12). The padlock, key, and danger tag (13) are needed to lock out the pump motor for the slurry pipe. There are many pumps, lines, and other workers in the plant. If the pump is not locked out, the pipe could become pressurized and knock Flash from his position. A fire extinguisher (14) is required at the site of any cutting or welding. The ladder, twine, length of small rope (15), and safety belt (16) are required to climb and work safely from the lower pipe. The twine is for tying the ladder in place, and the rope is for lifting the tools up once Flash is in position on the pipe with his safety belt secured. The extension

cord and trouble light (17) are needed to properly inspect the work area before beginning work, and possibly to carry out the work. Prep plants tend to be dark, especially in the pre-daylight morning hours. The fire resistant brattice cloth, canvas, or similar material (19) should be placed as a large drop cloth under the work area to protect personnel and equipment on lower levels from sparks and hot metal fragments. The most likely errors for this question are failures to select materials and equipment that are needed to perform the job safely. In real life similar omissions are frequent for many reasons including the desire to finish a job in a hurry, the absence of appropriate equipment, or the difficulty involved in obtaining equipment that is needed.

Question C - Only answers 23, 25, and 28 are incorrect. Oxygen and acetylene tanks are very strong and will not explode if they are used properly (23), and the hose connections at the torch will not fail if the equipment is inspected and maintained daily (25). Blackdamp and other gases are not likely to be present in amounts sufficient to present a hazardous atmosphere (28). Prep plants tend to be well ventilated. All of the other answers are hazards which the workers need to recognize and avoid.

Question _D -The correct answer is 33, getting a longer ladder. Workers should not climb to or work from the top step of a step ladder or other ladder. The top of the ladder should extend at least half a body length beyond the area where the worker will stand or climb from the ladder. Failure to use ladders of the proper size and failure to place them securely and at the proper climbing angle is a leading cause of serious industrial accidents.

Question E - The correct answers are 34, 35, and 36. The floor where the ladder feet will sit should be uncluttered, clean, and, if possible, dry. The spilled floc material must be cleaned up because it is very slippery and the ladder feet could slide. The brattice drop cloth should be in place to prevent hot metal sparks from falling to lower levels. If possible, ladders should be set at approximately a 75 degree climbing angle. When a worker stands erect on the bottom rung of the ladder he or she should be able to extend both arms fully, and grasp the rung at shoulder height with both hands. This ladder placement rule is used by firefighters. The top of the ladder should also be tied securely to a strong structure. The rubber feet on an aluminum ladder are designed to prevent slipping. They provide little electrical insulation, especially when moisture and dirt are present in the area where the ladder sits (37). Teasing Flash about being afraid of heights (38) is unwise because the remark can create anger, or self-doubt. Flashes' co-workers need to be supportive, not negative. Perhaps the remark was intended to be humorous. Appropriate humor can help complete a difficult job. Wrongly stated or ill timed humor, can distract and anger creating an additional hazard.

Question .E - The correct answer is 42. Flash should take a tightly coiled rope with him placed over one shoulder. This leaves both hands free for climbing the ladder, securing, his safety belt, and moving out on to the lower pipe. Tossing the tools up to him (39) is dangerous because he may over-reach and fall, and the tools may fall and strike the persons tossing them up. Having Pete climb half way up the ladder and pass the tools to Flash (40) is better, but still not wise. Flash will be out on the pipe. Both he and Pete will have to lean and reach. If Flash slings the welding hoses over his shoulder, and fastens the torch to his belt, carries his tools, and climbs up (41), he will be exposed to

several hazards. First, the hoses can become snagged and he can be jerked from the ladder or pipe as he steps up. Second, his hands will be fall and not fully available for climbing. Third, when he gets to the lower pipe, he won't have his hands free to secure his safety belt. Fourth, it is distracting to attempt to keep track of a bunch of tools, not drop them, and climb at the same time. Can you think of other hazards?

Question G - The correct answer is 46. The first thing he should do is secure his safety belt. Safety belts or harnesses are required when working at heights above 7 feet. The pipe on which Flash will be standing is round, probably wet, and easy to fall from. There should be little need to warn other workers in the area below (43) because the area already should have been dangered-off with the colored tape and signs, and the other workers should have been alerted to the dangers. Making the methane check (44) and pulling up his tools (45) should not be attempted until his safety belt is secured. During the discussion of this question would be a good time to demonstrate the proper positioning and wearing of safety belts and safety harnesses. Fatalities have resulted from safety belts that were improperly worn, when the safety rope was too long, and when the safety rope was improperly secured.

Question H - The correct answer is 49. The section of pipe that is to be cut must be secured before work begins. When the pipe is cut, it could move or fall if it were not supported. The methane check (48) should be made just before lighting the torch. Flash should not place his cutting goggles over his eyes (50) until he is ready to make the cut. It is dark and the goggles will reduce visibility adding another hazard.

Question I - The correct answer is 52. Flash needs to climb down, move the ladder to the other end of the pipe, inspect that end of the pipe and continue with his work. Immediately lowering the cut end of the pipe to the floor with the come-along (51) could kink or otherwise damage a good section of the pipe. It could also result in the pipe section falling if the weak section near the left hanger broke. Flash should not walk along the lower pipe to inspect the left end of the bad pipe section (53). Although the come-along and slings are in place, Flash cannot be sure the pipe section is balanced. There may be coal slurry material in the pipe. The weak section of pipe near the left hanger could break or bend and the whole pipe section could move or swing suddenly knocking Flash off the lower pipe. Telling Pete and you to climb up and inspect the other end of the bad pipe section (54) would endanger them, since they have no safe way to climb.

Question J - The correct answers are 56, 58, and 59. For reasons explained in the previous section, the pipe section could have fallen after the first cut was made. The pipe was also under strain, and when the first cut was completed the pipe jumped to the side. It could also have jumped up. Pipes, timbers, and structural steel members are often under load or stain when they are part of a complex structure. Workers should always assume the possibility of the sudden release of this energy when they are dismantling equipment. This rapid and uncontrolled release of energy could result in a serious injury or a fatality. An accident can easily hold up production for a few days or longer depending upon the circumstances and the judgments of federal and state inspectors (59). Use the discussion of this question to review safe work procedures for

immobilizing components prior to their removal when they are believed to be under strain.

Question K - The correct answers are 61, 62, and 64. Safe work practices and jobs well done are cost effective in the long run. It might have been quicker to work unsafely in this situation and get the prep plant in operation on time. But in the long run such approaches are risky because the result in damaged equipment, injuries, and fatalities. The costs of these types of accidents are many times more than the cost of three workers' overtime wages and three fourths of an hour of lost production time.

References

Leonard, J. W. (Editor). (1979). Coal preparation. New York: The American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.

Mine Safety Associates. (1985): Federal coal mine safety standards, pocket edition. Price, UT: Author.

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

Scoring Key for Pipe Repair Problem

The correct answers are marked with an asterisk.[4]

Question	Answer Number							
A	1	2*	3*	4				
B	5*	6*	7	8*	9*	10*	11	12*
	13*	14*	15*	16*	17*	18	19*	20
C	21*	22*	23	24*	25			
	26*	27*	28	29*				
D	30	31	32	33*				
E	34*	35*	36*	37	38			
F	39	40	41	42*				
G	43	44	45	46*				
H	47	48	49*	50				
I	51	52*	53	54				
J	55	56*	57	58*	59*			
K	60	61*	62*	63	64*			

[4]This page may be duplicated 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 NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.gov.

Pipe Repair Problem

Problem Booklet

Instructions

Read the problem situation described on the next page. Study the diagram on page 4 until you understand the location of the workers and equipment in the problem. Next, answer each of the 11 questions. Do them one at a time. Don't jump ahead, but you may look back to earlier questions and answers. Some questions ask you to select all of the answers that you think are correct. Other questions ask you to select only one answer unless you are told to "Try again!" Follow the directions for each question.

After you have selected a choice to a question, look up its number on the answer sheet. Select your answer(s) 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

You are a prep plant tipple cleaner. You have been assigned to help two mechanics, Flash and Pete, replace a badly worn section of a 10 inch steel slurry pipe in the prep plant.

You are working third shift and it is 4:45 A.M.

A 3/8 inch plastic line is hung under the pipe section you are to replace. The line carries denatured alcohol to the froth cells.

The pipe is 12 feet above the expanded metal floor on the third level of the plant.

The pipe section is above the main walkway on this level.

Two large holes and several smaller holes are worn through the section of pipe near the left hanger. (See Figure 1.)

Five other workers are doing maintenance on levels below and above your position, and have been working on the vibrator on your level.

The pipe is empty now, but it has been leaking and the floor is wet and slippery where someone has spilled floc material. (See Figure 1.)

The prep plant shop and supply room are on the ground level and are well equipped.

A pager and a small first aid kit are located near the stairs on each level of this plant.

A new section of pipe and two collars are on the floor near the worn pipe.

Problem

The foreman tells Flash, Pete, and you to hurry up and get the pipe section replaced so the plant can start up at 7:00 A. M. This job was supposed to have been finished yesterday. Other work has prevented your working on the pipe until now. The foreman says the plant superintendent chewed him out for not having the pipe fixed earlier. Flash says he will cut out the worn section and weld the new section in place.

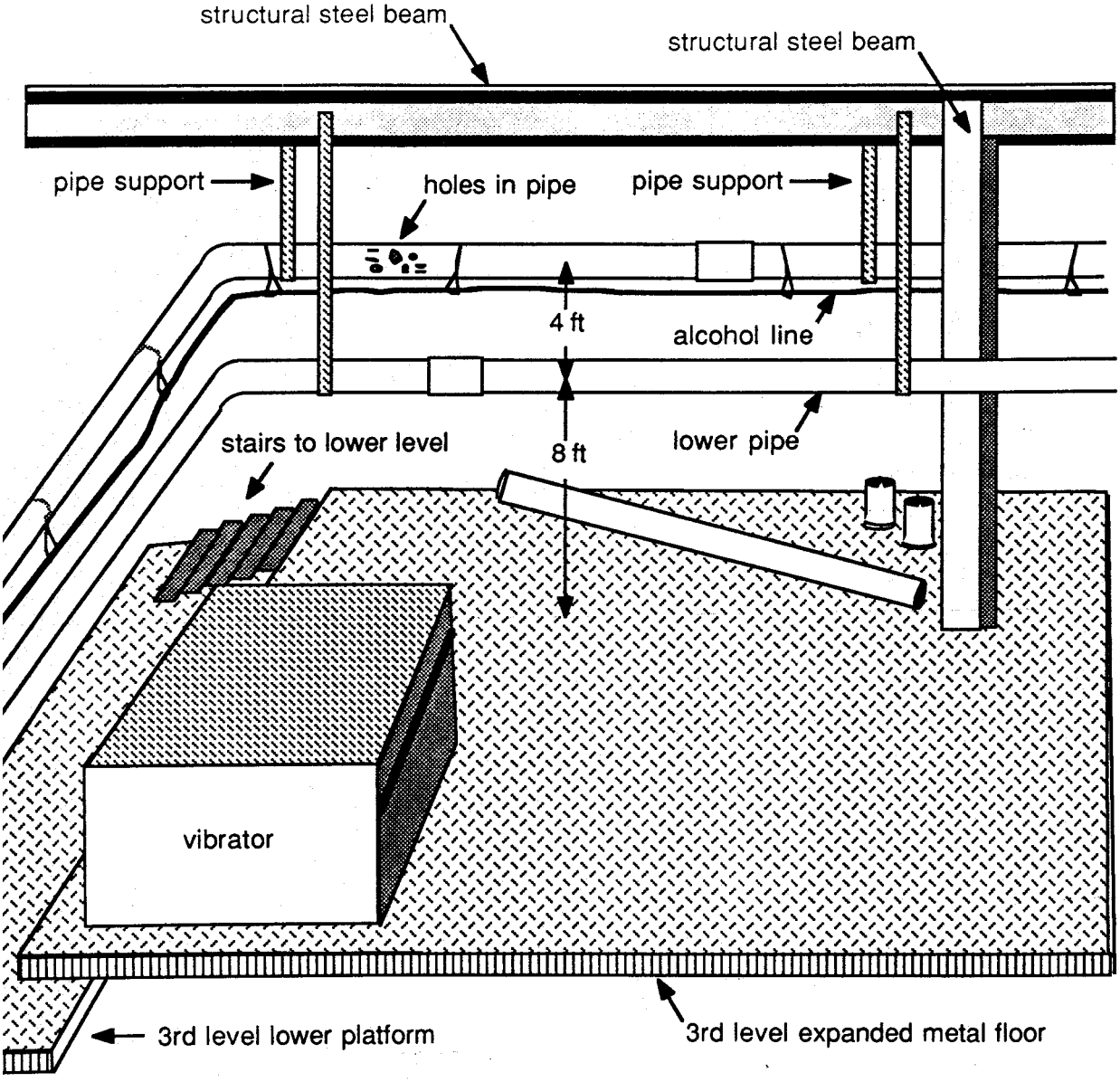

Figure 1: Position of pipe section to be repaired

Question A

What should the three of you do to get this job done safely and quickly? (Select as MANY as you think are correct.)

1. Get the tanks and torch and get Flash up there and start cutting the pipe.

2. Inspect the work area to determine what hazards are present and think about how you will deal with these.

3. Check to see that you have all the tools and equipment needed to complete the job properly.

4. Assign one person in your crew to watch out for the other maintenance workers so they can be warned if they get into a hazardous position.

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

Question B

The three of you check to see you have all the equipment that is needed to do the job properly and safely. In addition to your usual personal protective equipment, what other things will you need? (Select as MANY as you think are correct.)

5. Forty or 50 feet of colored plastic tape (or equal length of small rope).
6. Signs that say "Danger ", "Keep Out", or that warn of falling materials.
7. A portable radio.
8. Two pipe slings and a one ton come-along.
9. Cutting and welding goggles and gloves.
10. Acetylene and oxygen welding tanks, hoses, and torch.
11. Notebook and pencil to write down the time you started and finished this job.
12. Methane detector.
13. Padlock, key, and danger tag.
14. Fire extinguisher.
15. Ladder, several lengths of heavy twine, and a 20 to 30 foot section of small rope.
16. Safety belt.
17. Extension cord and trouble light.
18. First aid kit at the immediate work area.
19. Large piece of fire resistant brattice cloth, canvas, or similar material.
20. Empty 55 gallon drum with the top removed.

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

Question C

Flash, Pete, and you will be exposed to some potential hazards as the pipe section is cut, removed, and replaced. With which of these hazards should you be most concerned? (Select as MANY as you think are correct.)

21. Sprains and strains from lifting and pulling.
22. Water pressure in the 10 inch slurry pipe.
23. Bursting of the oxygen or acetylene tanks.
24. Falling or rapidly moving heavy materials and objects.
25. Fire at the hose connections on the torch.
26. Fire, explosion, burns and toxic fumes.
27. Trips and falls.
28. Being overcome by blackdamp and gases coming out of the pipe.
29. Eye and skin injuries.

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

Question D

The only available ladder on the third level is a 6 foot wooden step ladder. Flash sets this up under the lower pipe and prepares to climb up. (See Figure 2.) What should you do now? (Choose only ONE unless you are told to "Try again!")

30. Steady the ladder while he climbs up.

31. Ask him to wait a minute while you tie the top of the ladder to the nearest beam.

32. Tell him to be careful when he steps from the ladder to the lower pipe.

33. Ask Flash to wait while you go to the supply room and get a longer ladder.

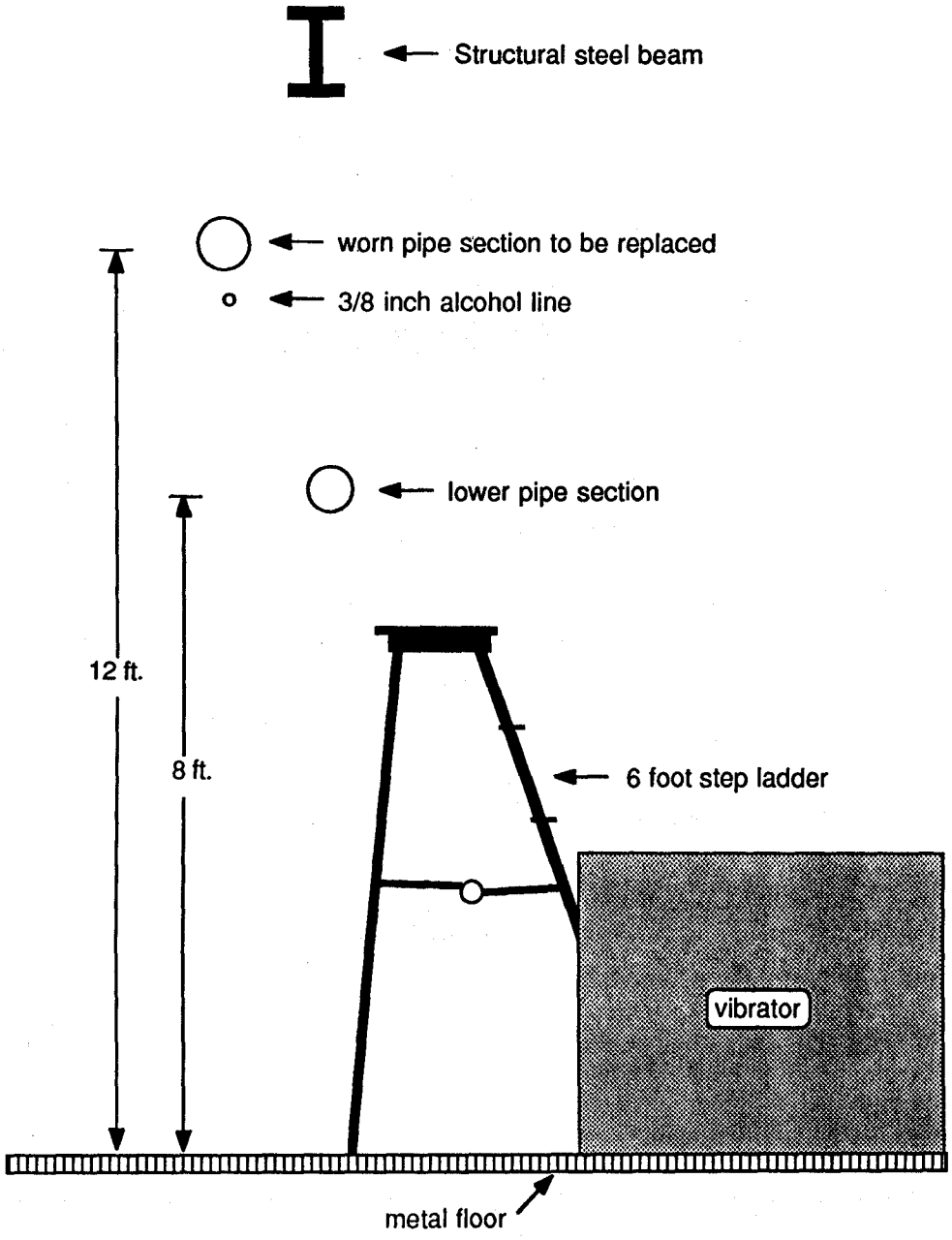

Figure 2: Position of step ladder and pipes as Flash prepares to climb up (side view)

Question E

Flash grumbles, "We won't get this job done if we keep fooling around!" But he agrees to wait until you get the ladder. In about 10 minutes you come back with a 24 foot aluminum extension ladder. The ladder is new and has rubber feet. What concerns should you have as you help Flash set up the ladder so he can work? (Select as MANY as you think are correct.)

34. Check to see that the floor is clean and not slippery where the ladder feet will sit.

35. Check to see that the fire resistant brattice cloth is in place to protect lower levels from stray sparks.

36. Set the ladder so the rung at shoulder height is one full arm length in front of you when you stand on the bottom rung with your shoulders square.

37. Don't be too concerned about electrical hazards because the ladder has rubber feet and Flash is using gas welding equipment.

38. Joke with Flash by saying you heard he is afraid of heights and he shouldn't climb up and do this job.

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

Question F

You and Flash set the ladder securely and at the proper 75 degree angle. Using lengths of heavy twine, Pete ties both sides of the ladder securely to a beam near the top rung. Flash gathers his tools and gets ready to climb up and work. How should he get his tools to the work area where he will stand on the lower pipe? (Choose only ONE unless you are told to "Try again!")

39. Have Pete and you toss the tools up to him one at a time.

40. Have Pete climb half way up and pass the tools up from you to Flash.

41. Carefully sling the welding hoses over his shoulder, secure the torch to his belt, and carry his other tools as he climbs the ladder and steps out onto the lower pipe.

42. Take a 20 foot section of a half inch rope with him, coiled snugly over one shoulder so he can lower the rope and pull his tools up when he gets in position.

Question G

When Flash gets up the ladder, he hangs the trouble light and inspects the lower pipe. He finds it to be strong and in good shape. What is the first thing Flash should do when he gets ready to step onto the lower pipe? (Choose only ONE unless you are told to "Try again!")

43. Warn the other maintenance workers to stay clear.

44. Make a methane check.

45. Lower his rope and begin pulling up his tools.

46. Hook his safety belt to a safe and secure place.

Question H

Flash hooks his safety belt onto the overhead I beam about 3 feet above the top pipe. Pete has drained and disconnected the alcohol line. Flash lowers his rope. You tie his tools on and he pulls them up and secures them. He checks to see if the area below the pipe is clear. Now what should Flash do? (Choose only ONE unless you are told to "Try again!")

47. Move out on the lower pipe and make the first cut at the right end of the bad section of the upper slurry pipe.

48. Make a methane check.

49. Hook the come-along to the overhead I beam, put the pipe slings in place around the bad pipe section, attach the come-along to the sling, and snug it up.

50. Put his cutting goggles in position over his eyes.

Question I

Flash hooks up the pipe slings and come-along. He makes a methane check. Then he lights the torch and makes the first cut at the right end of the bad pipe section. As he completes the cut, he stands back behind the right hanger away from the cut end of the old pipe section. When he is nearly finished, he notices the bad pipe section begins to shift slightly to one side. He moves further back, completes the cut, and the pipe breaks loose and jumps out to the front side about 18 inches. His careful work has saved him from injury. Now what should Flash do? (Choose only ONE unless you are told to "Try again!")

51. Ratchet the come-along out and lower the cut end of the pipe toward the floor.

52. Leave the pipe slings and come-along in place, climb down and prepare to move the ladder to a new position to the left of the hanger at the other end of the bad pipe section.

53. Walk along the lower pipe to the left to inspect the other end of the bad pipe section and prepare to make the second cut.

54. Tell you or Pete to climb up on the other end of the lower pipe and look at the bad section in the top pipe near the left hanger.

Question J

You and Pete help Flash move the ladder to the other end of the bad section of pipe. Soon you get the ladder up and tied to the I beam. You are careful to keep the ladder a couple of feet to the left of the hanger that is holding the section of old pipe with the holes worn through it. Flash sees the metal in the pipe is twisted, rusted, and thin around the holes. What problem(s) may have been prevented by the care Flash has taken when removing the old pipe section? (Select as MANY as you think are correct.)

55. Rope burns to Flash's hands.

56. After the first cut, the weak section of pipe might have broken and the pipe section fallen and damaged equipment or hurt people.

57. If he had used an arc welder, Flash could have been electrocuted.

58. Flash could have been struck and knocked off the lower pipe.

59. Production could have been held up for another shift or longer.

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

Question K

Working carefully, you, Pete and Flash get the old pipe section down, and lift the new section into place with the pipe slings and come-along. Then Flash welds it up. You don't finish until 7:45 and the plant start-up must wait for you. Have you saved the company money, or have you cost the company money? (Select as MANY as you think are correct.)

60. You have cost the company 45 minutes worth of production.

61. You have saved the company from more down time later on by doing a good job.

62. You may have saved the company thousands of dollars that could have resulted from lost time accidents, injuries, and insurance compensation claims.

63. You have cost the company money by working overtime.

64. You helped the company maintain its reputation for safety and this translates into continued company profits.

End Of Problem

Scoring your performance

1. Count the total number of responses you colored in that were marked "Correct." Write this number in the first blank on the answer sheet.

2. Count the total number of "incorrect" responses you colored in. Subtract this number from 30. 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 possible score of 64 results from selecting all the correct answers and no wrong answers.

The worst possible score of zero results from selecting all the wrong answers and no correct answers.

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 NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.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. These may be obtained from the A. B. Dick Company, P.O. Box 1970, Rochester, New York 14692, phone 1-800-225-4835.

Answer Sheet for Pipe Repair Problem

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 (Select as MANY as you think are correct.)

1. [ ]
2. [ ]
   [ ]
3. [ ]
4. [ ]
   [ ]

Question B (Select as MANY as you think are correct.)

5. [ ]
6. [ ]
7. [ ]
8. [ ]
9. [ ]
10. [ ]
11. [ ]
12. [ ]
13. [ ]
14. [ ]
15. [ ]
16. [ ]
17. [ ]
18. [ ]
19. [ ]
20. [ ]

Question C (Select as MANY as you think are correct.)

21. [ ]

22. [ ]
    [ ]

23. [ ]

24. [ ]
    [ ]

25. [ ]

26. [ ]
    [ ]

27. [ ]
    [ ]

28. [ ]

29. [ ]
    [ ]

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

30. [ ]

31. [ ]

32. [ ]

33. [ ]
    [ ]

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

34. [ ]

35. [ ]

36. [ ]

37. [ ]
    [ ]

38. [ ]
    [ ]

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

39. [ ]
    [ ]

40. [ ]
    [ ]

41. [ ]
    [ ]

42. [ ]
    [ ]

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

43. [ ]
    [ ]

44. [ ]

45. [ ]

46. [ ]
    [ ]

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

47. [ ]

48. [ ]

49. [ ]
    [ ]

50. [ ]
    [ ]

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

51. [ ]
    [ ]

52. [ ]

53. [ ]

54. [ ]
    [ ]

Question J (Select as MANY as you think are correct.)

55. [ ]

56. [ ]

57. [ ]
    [ ]

58. [ ]
    [ ]

59. [ ]
    [ ]

Question K (Select as MANY as you think are correct.)

60. [ ]

61. [ ]

62. [ ]
    [ ]

63. [ ]

64. [ ]
    [ ]

Finding your score

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

30 minus number of incorrect answers you colored in = (2)_____

Add the numbers in blanks one and two to get your total score = (3)_____

Highest possible score = 64.

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.

You need to do something else first.

Correct! It is important to identify and avoid potential hazards, especially when a job is to be done in a hurry.

Correct! This usually saves time and makes the work easier and safer.

This is dangerous! It depends on one person watching and warning others when everyone in the area needs to be alerted to the possible hazards.

Correct!

Correct!

Unnecessary.

Correct!

Correct!

. Correct!

Unnecessary.

Correct!

Correct!

Correct!

Correct!

Correct!

Correct!

Unnecessary.

Correct!

Unnecessary.

Correct! The pipe sections are very heavy.

Correct! The pump could be restarted by someone. Flash needs to trace the line and lock-out and tag the pump switch before he works on the pipe.

If the tanks are handled properly this is very unlikely.

Correct! This is a danger even if the pipe is well supported. The old pipe can move suddenly once it is cut. The new pipe can swing or tilt when lifted.

If you inspect and maintain your equipment this should not be a concern.

Correct! Alcohol is flammable and explosive, especially in the presence of oxyacetylene flames and equipment. Methane could also be present.

Correct! This job requires climbing, lifting, and working from a high place. Tools underfoot and the slippery floor can also lead to slips and falls.

This is not a hazard in this situation.

Correct! Flash needs to wear goggles while Pete, you, and others avoid the hot metal sparks. Alcohol from the plastic line can also injure eyes.

This is risky. Try again!

This is risky. Try again!

There is a better way to help him. Try again!

Correct! Ladders should be much higher than the point to which the worker is climbing. Do the next question.

Correct! Pete and Flash cleaned up the floor while you were gone.

Correct! Pete and Flash put the brattice cloth down while you were gone.

Correct! This puts the ladder at the appropriate 75 degree climbing angle.

You always need to be alert to electrical hazards when working in a prep plant. The ladder's rubber feet provide little or no insulation.

Flash glares at you and says, "Do you think I'm stupid!" Your remark has angered him. This increases the risk for Flash.

Dangerous! Flash could reach and fall. You and Pete could be struck by failing tools. Try again!

Dangerous! Flash and Pete may have to over-reach and might fall. Try again!

Dangerous! The hoses could snag. Flash needs both hands for climbing and getting out on the lower pipe. Try again!

Correct! This leaves both of his hands free for climbing and lets him get in position without having to worry about other things. Do the next question.

He needs to do something else first. Anyway, barriers and signs should be in place and the crew should have been warned already. Try again!

Not yet! Try again!

Not yet! Try again!

Correct! An eight foot fall can produce serious injuries or death. Do the next question.

Not yet! Try again!

Not yet! Try again!

Correct! The pipe needs to be held in position while it is cut. Do the next question.

This should not be done until he is ready to cut. It will make it hard for him to see. Try again!

This could cause more damage to the pipe section and create a hazard for others. Try again!

Correct! Do the next question.

This is hazardous. Flash could be hurt or killed. Try again!

You and Pete don't have a ladder or a safe way to climb. This places you at risk. Try again!

He was not handling rope after he lifted the tools up.

Correct!

There is little risk of electrocution from a well maintained arc welder that is properly used.

Correct! The pipe being cut was under strain. The sudden release of energy could have crushed his chest or head and made him fall.

Correct! If Flash had been hurt or killed, rescue or recovery and the investigation could have required several days.

You probably have saved production time and money.

Correct! Poorly performed work almost always cost more in the end.

Correct! This job presented many opportunities to make serious and costly mistakes.

Not likely!

Correct! Companies with poor reputations for health and safety, often find it more difficult to market their coal and to employ good miners and mangers.