NEW MINERS

DEEP METAL/NONMETAL

GROUND CONTROL AND VENTILATION PLANS

1981

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DEEP METAL/NONMETAL

COURSE PLAN: GROUND CONTROL AND VENTILATION PLANS

I. GOAL: The goal of this module is to insure that the new miner can understand the necessity of and how to maintain a safe and healthful workplace with respect to ground control and ventilation.

II. BACKGROUND: There are a variety of hazards that are found only in underground mines, and statistics show that accidents do result from these hazards. In 1979 there were 589 accidents in underground metal/nonmetal mines related to falling, rolling or sliding material, as well as roof falls. Training in recognizing these hazards is critical to the development of safe work habits in the workforce.

III. OBJECTIVES

A. Trainers will do the following:

1. List the many causes of failure of the back and sides and describe the purposes of ground control.
2. Display pictures or drawings and/or otherwise describe the methods used to provide temporary and permanent support for the back and sides.
3. Describe responsibilities for ground control by management and miners.
4. Use the mine map and/or otherwise explain mine ventilation plans, including the pattern of air flow through the mine.
5. Describe hazards associated with ventilation.

B. Trainees will be able to do the following:

1. Describe the ground control plan and support method used at the mine.
2. Recognize possible ground control hazards in the mine.
3. Test and scale down hazardous materials in the mine.
4. Describe reasons for ventilation at the mine.
5. Show on the mine map the general air flow pattern at the facility. Describe operations appropriate for intake vs. return air.
6. Recognize devices used to produce and direct air flow.
7. Direct air flow in a particular fashion in the mine, when appropriate to the training situation.
8. Describe techniques for determining adequacy and quality of air flow. Describe procedures to follow when hazardous conditions exists.
9. Demonstrate proper use of respirator, where use is appropriate.

III. ACTIVITIES

A. On site - in conjunction with introduction to work environment

1. Testing back and barring down rock
2. Test of recognition of intake and return air
3. Examination of auxiliary air flow devices

IV. MATERIALS

A. Visual aids contained in the Lesson Guide and Materials

B. Company ground control and ventilation plans

V. EVALUATION

A. Demonstrate, describe, or identify:

1. Ground control plan and procedures
2. Ventilation techniques
3. Knowledge of intake and return air
4. Capability for testing roof and barring down rock

B. Self-checks

1. Any time hands on evaluation such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessry to fit your local mine situation.

VI. RESOURCES

A. Training and Enforcement Standards

1. CFR 30 Part 48.5-6
2. CFR 30 Part 57.5-3 Ground Control
3. CRF 30 Part 57.5 Air Quality, Ventilation, Radiation and Physical Agents

B. Company ground control and ventilation plans

C. Films

1. MSHA Film No. 807 - "Rock Bolting Safety."
2. DuPont - "The Right Way."

D. Applicable MSHA fatalgrams.

TOPICS COVERED

I. PURPOSE OF GROUND CONTROL

A. Minimum protection from ground failure

B. Time line for support of back

1. temporary support
2. permanent support

C. Causes of ground failure

1. loose rock
2. large boulders
3. roof arches
4. type of rock
5. sag of back
6. seeping water
7. rock bursts
8. adjacent blasting
9. adjacent caving
10. load redistribution on back
11. rock fractures or faulting
12. rock vibrations from adjacent work
13. failure of back support devices
14. gouging of back by mining equipment

II. METHODS OF GROUND CONTROL

A. Testing back and rib for loose rock

1. sounding of back and rib
2. barring or scaling back or ribs
3. safe work habits while barring down

B. Temporary supports

1. wooden posts
2. screw - type jacks
3. hydraulic jacks
4. spilling
5. forepoling
6. stulls
7. use of bearing surface
8. planned placements of roof supports
9. other temporary supports

C. Permanent supports

1. rock bolting
2. split set
3. resin bolts
4. concrete
5. shortcrete
6. timbering
7. lagging
8. cribbing
9. yieldable arches
10. advantages of rock bolting compared to timbering
11. advantages of timbering compared to rock bolting

III. RESPONSIBILITIES FOR GROUND CONTROL

A. Responsibility of management and supervision

1. routine inspections of back and ribs
2. testing torque of rock bolts

B. Responsibility of miners

1. identifying and reporting hazardous back
2. safe work habits

IV. MINE VENTILATION PLANS

A. Purpose of ventilation

1. supply oxygen
2. remove harmful contaminants

B. Producing and directing air flow

1. fans pushing or pulling air
2. directing from bulkheads, mine doors, and man doors

C. Air flow pattern in the mine

1. intake and return air
2. location of fan(s) and flow pattern
3. supplemental ventialtion

D. Ventilation hazards

1. Testing amount of oxygen in the air
2. miner reactions to loss of ventilation

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: GROUND CONTROL AND VENTILATION PLANS

I. PURPOSES AND POLICIES REGARDING GROUND CONTROL

A. Provide protection from ground failure.

B. Company policy for ground control at the mine.

INSTRUCTOR NOTE: PROVIDE A DESCRIPTION OF COMPANY POLICY FOR ROOF CONTROL METHODS AND PROCEDURES AT THE MINE.

II. Causes of ground failure

1. Loose rock
2. Large boulders
3. Back arches
4. Type of rock
5. Sagging of the back
6. Seeping water
7. Rock bursts
8. Adjacent blasting
9. Adjacent caving
10. Redistribution of the load on the back
11. Rock fractures or faulting
12. Rock vibrations from adjacent work
13. Failure of back support devices
14. Gouging of back by mining equipment

INSTRUCTOR NOTE: IF ANY OF THE ABOVE CAUSES ARE PROMINENT PROBLEMS AT THE MINE, DISCUSS THAT PROBLEM IN MORE DETAIL.

III. METHODS IN GROUND CONTROL

A. Testing back and side for loose rock

1. Loose rock gives off a hollow or dull sound when hit with a hammer or scaling bar, compared to a solid ring of a sound back. Loose rock is also detected by visual inspection of protruding rock, cracks, and deteriorating pillars. Skill in identifying loose rock requires practice.

INSTRUCTOR NOTE: DEMONSTRATE SOUNDING FOR THE STUDENTS DURING THE MINE TOUR.

2. The method of removing loose rock from the back or side is called barring down or scaling down. A metal pry bar called a scaling bar is used.

3. Safe work habits while barring down.

   a. Stand under a safe area, preferably one already tested for loose rocks.
   b. Do not stand directly beneath the loose rock which you are barring down. Pry away from you rather than toward you.
   c. Assure yourself a safe route of retreat. Do not put your back up against the side because you may become trapped.
   d. Often more rock will come down than you might expect.

VISUALS NOTE: SHOW VISUAL 21 ILLUSTRATING SAFE AND UNSAFE METHODS OF BARRING DOWN. POINT OUT THE UNSAFE CONDITIONS IN THAT DRAWING.

B. Time line for support of the back

1. Temporary support provides immediate support in an active working area for a relatively short period of time.
2. Permanent support provides support over a longer period of time. It is used in areas of high foot and/or equipment traffic or in long-life haulageways, shops, power distribution centers, storage areas, lunch rooms, and pump rooms.

C. Temporary supports

INSTRUCTOR NOTE: PICTURES OF THE TYPES OF SUPPORT USED IN YOUR MINE WILL BE HELPFUL HERE.

1. Wooden posts with cap blocks and wedges.
2. Screw-type jacks that extend as the handle is turned, along with cap blocks.
3. Hydraulic jacks that extend as the handle is pumped.
4. Spilling involves inserting rods into the sides and back at several points along a drift.
5. Forepoling involves insertion of poles into the face of a development drift or stope. The poles are either all wood or half wood and half metal. The wood section would eventually be mined out, leaving the metal section in the rock for support.
6. Stulls are thick wood posts used to support protruding rock. Wedges are used to secure the post against the rock.

7. A bearing surface (another wood post or square piece of wood) may be placed between the rock and the post or jack. This prevents the support from poking through the back by distributing the force over a larger area.
8. Temporary supports are installed a planned distance apart so that the weight of the rock is more evenly distributed. Supports are usually no more than five feet apart.
9. Other temporary supports.

INSTRUCTOR NOTE: DISCUSS OTHER TYPES OF TEMPORARY ROOF SUPPORT USED AT THE MINE.

D. Permanent supports

1. Rock bolts are metal rods at least four feet long which are installed in drilled holes in the back or side. The point anchor rock bolt consists of a long threaded bolt and an expansion shell that expands when the bolt is tightened to anchor the bolt in the rock. A bearing plate fits between the bolt head and the back to distribute the weight of the rocks. Bolts are tightened to a predetermined torque which is periodically checked. Rock bolts provide several methods of support:

   a. The beam method draws together several layers of rock, making a strong beam of supporting rock. Fully grouted resin bolts are used to make the beams.
   b. The suspension method passes rock bolts through weak layers of rock and tightens into a higher main rock layer with a point anchor expansion type bolt.
   c. Wire matting is held up by several rock bolts and is used to catch smaller pieces of rock that might fall between bolts.
   d. Trusses are metal plates or strips held up by several rock bolts. Trusses are bent to conform to the shape of the back.

2. Resin type bolts employ resin and hardening agent packed in sausage-like tubes. These tubes are placed in the drill hole. When the bolts are inserted and spun, the resin tubes break and the hardener is mixed with the resin. The bolt is then held tightly against the side or back until the resin sets enough to prevent the bolt from slipping out, usually about 30 seconds.

INSTRUCTOR NOTE: IF YOUR MINE USES RESIN BOLTS BE SURE YOU DESCRIBE THE MANUFACTURER'S RECOMMENDED TIMES FOR SPINNING AND HOLDING OF THE BOLTS.

3. The split set is similar to the rock bolt except that the bar is hollow with a one inch gap along its length. The bar is squeezed and inserted into the drill hole. As the bar attempts to spring back open its own force keeps it wedged in the hole. Split sets may be used with wire matting or trusses.

4. Concrete is used for back, side, and floor support in drifts, draw points, and ore passes. Forms are set and concrete laid to provide as much support as necessary.

5. Shotcrete (or gunite) is similar to concrete. It keeps moisture from the rock and helps prevent sloughing off, but does not have the same strength as concrete.

6. Timbering is also known as the conventional method of ground control. Timbers or posts are placed between the back and floor, usually against the sides. Crossbars span the posts along the roof, forming a three-piece set. This supports a wide area, such as a haulageway. Wedges are used to tighten the fit between the post and back or floor.

7. With a three-piece set of timber, lagging may be used to join posts placed on the same side to prevent loose rock from falling into the haulageway.

8. With a three-piece set of timber, cribbing involves placing smaller three-piece sets above one another to fill unsupported space. Timber then contacts the entire width of the back, and can support a very heavy load.

9. Yieldable arches use four steel braces, two against the sides and two curved to fit the arch of the back. The back-side braces are joined by a friction clamp. Increased back pressure is compensated for by slippage through these clamps. In addition, the distance between the floor and connections between the two back braces indicates rock sag.

INSTRUCTOR NOTE: SUPPLEMENT THIS DISCUSSION WITH DRAWINGS AND SLIDES FROM THE MINE SHOWING RELEVANT METHODS OF BACK CONTROL. EMPHASIZE METHODS OF GROUND CONTROL USED AT THE MINE. A BRIEF INTRODUCTION TO THE OTHER METHODS WILL HELP MAKE THE MINER AWARE OF THEM FOR POSSIBLE FUTURE NEEDS.

10. Advantages of rock bolting relative to timbering

    a. More suitable for uneven backs and high cave areas.
    b. Do not get in the way of mine equipment
    c. No restriction to ventilation

d. Quicker to install and last longer.
e. Less of a fire hazard
f. Less likely to be knocked out accidently
g. Use less space for storage, requires less manpower to install, and simpler skills are required for rock bolters.

11. Advantages of timbering compared to rock bolting

a. Does not require special machinery for installation.
b. Early indication of back problems by visual deformation and snaps you can hear.
c. Provides greater support of the back.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER ONE. STUDENTS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN PURPOSES AND METHODS OF GROUND CONTROl.

IV. RESPONSIBILITIES FOR BACK AND GROUND CONTROL

A. Responsibility of management and supervision

1. Routine inspections of the back to identify hazards.

2. Routine testing of torque on rock bolts.

B. Responsibility of miners.

1. Identifying hazardous ground conditions and reporting these to supervision.

2. Follow safe work habits and follow proper installation and inspection procedures when rock bolting.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER TWO. STUDENTS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN GROUND CONTROL AND RESPONSIBILITIES FOR ROOF AND GROUND CONTROL.

V. OVERVIEW OF MINE VENTILATION PLANS

A. Purpose of ventilation

B. Procedures of ventilation

C. Ventilation hazards

VI. PURPOSE OF VENTILATION

A. Ventilation has a direct effect on the health and safety of miners. Good clean air is essential for physical comfort and a safe work area. People work best in areas where oxygen represents at least 20% of the air they breathe.

B. Ventilation is necessary for diluting, rendering harmless, and carrying away all hazardous and harmful contaminants, including:

1. Gases from explosives
2. Equipment exhaust fumes
3. Dust
4. Smoke and carbon monoxide
5. Gases produced in the mine

VII. PRODUCING AND DIRECTING AIR FLOW

A. Ventilation is produced by fans located on the surface. Fans either push or blow air into the mine, or pull air through it by exhaust suction.

1. Temperature and humidity effect ventilation. On a very hot, humid day, outside air will lose its moisture when it meets the cooler surfaces of the mine. This moisture will condense on equipment and rock surfaces, causing rust and decay.

2. The speed of air through the mine is slowed as it drags across a rough back, sides or floor. This is known as mine resistance.

B. The direction of ventilation is controlled by several methods. These methods channel fresh air to all work areas and close off non-production areas.

1. Mine door is a large hinged door closing off a mine passageway
2. Bulkhead is an airtight wall built across an older non-production area.
3. Man door built into a bulkhead permits miners to go from one area to another. As with the mine door, man doors should always be closed to maintain correct ventilation.

VISUALS NOTE: SHOW VISUAL 22 ILLUSTRATING A MINE DOOR, BULKHEAD, AND MAN DOOR. POINT OUT THESE FEATURES DURING THE MINE TOUR.

C. Air flow pattern in the mine.

1. Fresh air brought into the mine is called intake. Air that has passed through the mine and contains contaminants is called return air.

2. Locations of fans and flow patterns permit fresh air to all areas in the mine.

VISUALS NOTE: SHOW ON THE MINE MAP THE VENTILATION PATTERN IN THE MINE, AS WELL AS THE LOCATIONS OF FANS.

3. Maintaining an adequate flow of fresh air to each work area may require booster fans to supply supplemental ventilation.

VIII. VENTILATION HAZARDS

A. Federal regulation part 57.5-15 requires mine air to contain at least 19.5% oxygen. Oxygen tests are routinely made accordingly.

B. Any major change in ventilation that you discover should be reported to your supervisor who will investigate for possible open doors or other ventilation obstructions.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER THREE. STUDENTS MAY ANSWER INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE MINE VENTILATION PLAN.

SELF CHECK #1: SOLUTIONS

1. Possible answers: loose rock, large boulders, back arches, type of rock, sagging of the back, seeping water, rock bursts, adjacent blasting, adjacent caving, redistribution of the load on the back, rock fracture, rock vibrations from adjacent work, failure of back support devices, and gouging of the back mining equipment.

2. hollow or dull sound (compared to a solid ring of sound rock.)

3. a. Stand under a safe area
   b. Pry away from you - don't stand directly beneath loose rock you're barring down.

   c. Assure yourself a safe route of retreat.

4. a. t
   b. t
   c. p

d. t
e. p
f. t
g. p
h. t
i. p
j. p

5. a. III
b. V
c. IV
d. II
e. I

SELF CHECK #2: SOLUTIONS

1. a. S
b. M
c. M
d. S
2. a
3. b

SELF CHECK #3: SOLUTIONS

1. true
2. false
3. false
4. true
5. true
6. true
7. air intake
8. closed

Self Check: Ground Control and Ventilation Plans

Self Check: #1: Purposes and Methods of Roof Control

1. Name at least 8 causes of ground failure

   a. e.

   b. f.

   c. g.

   d. h.

2. Describe the sound loose rock gives off when hit with a hammer.

3. Three safe work habits while barring down are:

   a.

   b.

   c.

4. Place the proper letter in front of the following types of supports to indicate: T: temporary supports, and P: permanent supports.

_____	a.	screw type jacks	_____	f.	stulls
_____	b.	hydraulic jacks	_____	g.	suspension method
_____	c.	beam method	_____	h.	forepoling
_____	d.	spilling	_____	i.	trusses
_____	e.	wire matting	_____	j.	concrete

5. Match column A with the correct column B response.

_____	a.	split set	I. keeps moisture from the rock
_____	b.	yieldable arches	II. place smaller 3-piece sets of timber above one another
_____	c.	lagging	III. a hollow bar with 1 inch gap is squeezed into drill hole
_____	d.	cribbing	IV. 2 steel braces against the ribs and 2 curved to fit arch of roof
_____	e.	shortcrete	V. used to join posts on same side of the rib.

Self Check #2: Responsibilities for Ground and Roof Control

1. Place the proper letter in front of the following tasks to indicate: S responsibility of supervision and management, or M responsibility of miner.

   _____a. Routine inspections of roof to identify hazards

   _____b. Identifying hazardous roof conditions and reporting these to supervision.

   _____c. Follow proper installation procedures when roof bolting.

   _____d. Routine testing of torque on roof bolts.

(Circle correct letter for proper answer)

2. You notice one of the timbers is beginning to sag. You should:

   a. report it to your foreman
   b. realize that the foreman will see it on his weekly inspection 6 days from now.

3. You and your buddy Frank are using resin bolts when you realize it's almost quitting time. It will take 5 minutes to finish and you'll probably miss the man trip. You should:

   a. stop immediately so the shift boss won't get mad about your being late.
   b. finish this bolt according to proper procedure just like the others you've been inserting all afternoon.
   c. stop immediately but tell your foreman about the unfinished bolt.

Self Check #3: Mine Ventilation

(Circle the right answer)

1. Ventilation dilutes, renders harmless, and carries away gasses, dust, exhaust fumes, and smoke and carbon monoxide. (true, false)

2. Mine resistance refers to the reluctance of miners to return to work after lunch. (true, false)

3. Man doors remain open while mine doors are kept closed. (true, false)

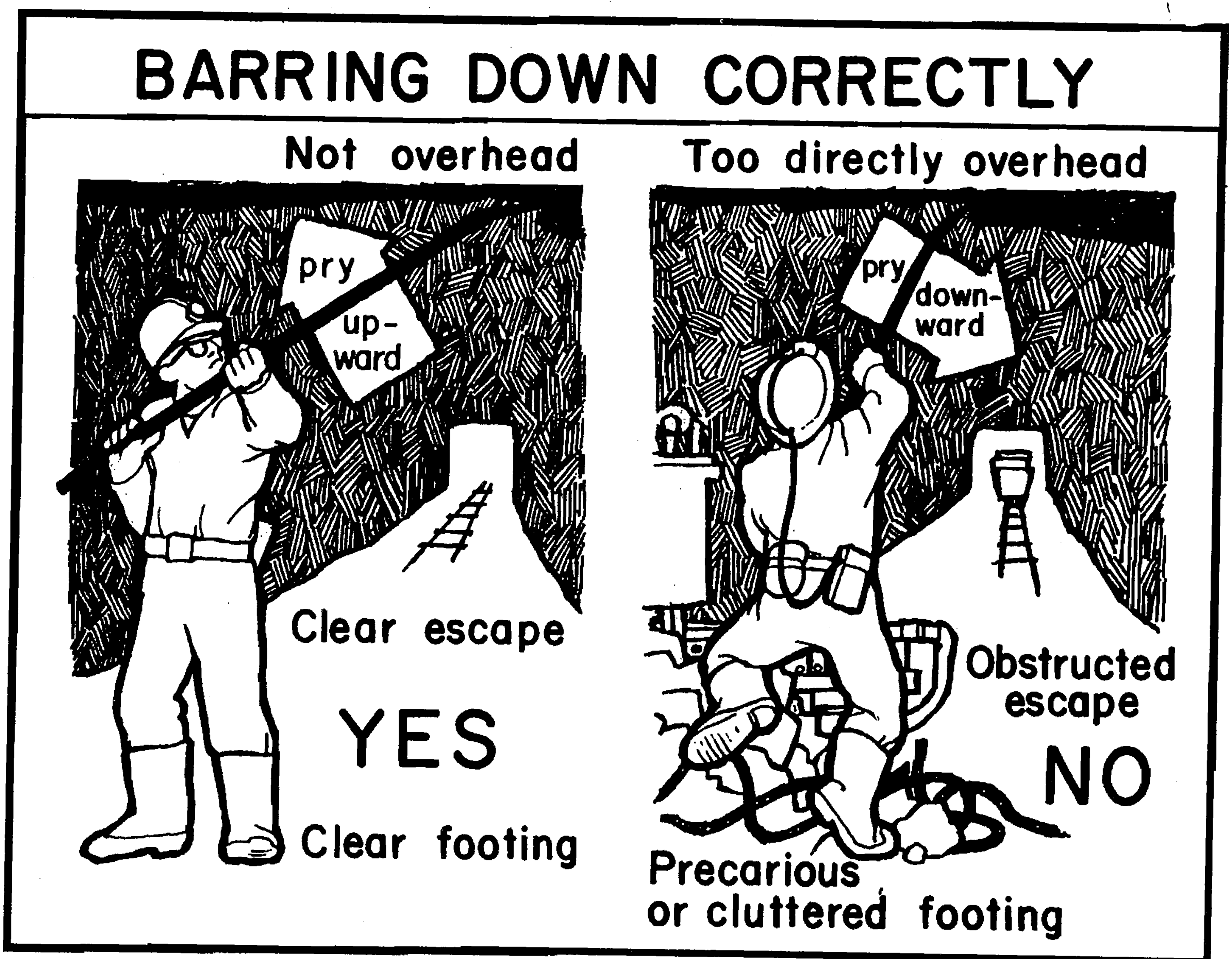
4. Intake refers to fresh air brought into the mine. (true, false)

5. Booster fans may be required to supply supplemental ventilation to each work area. (true, false)

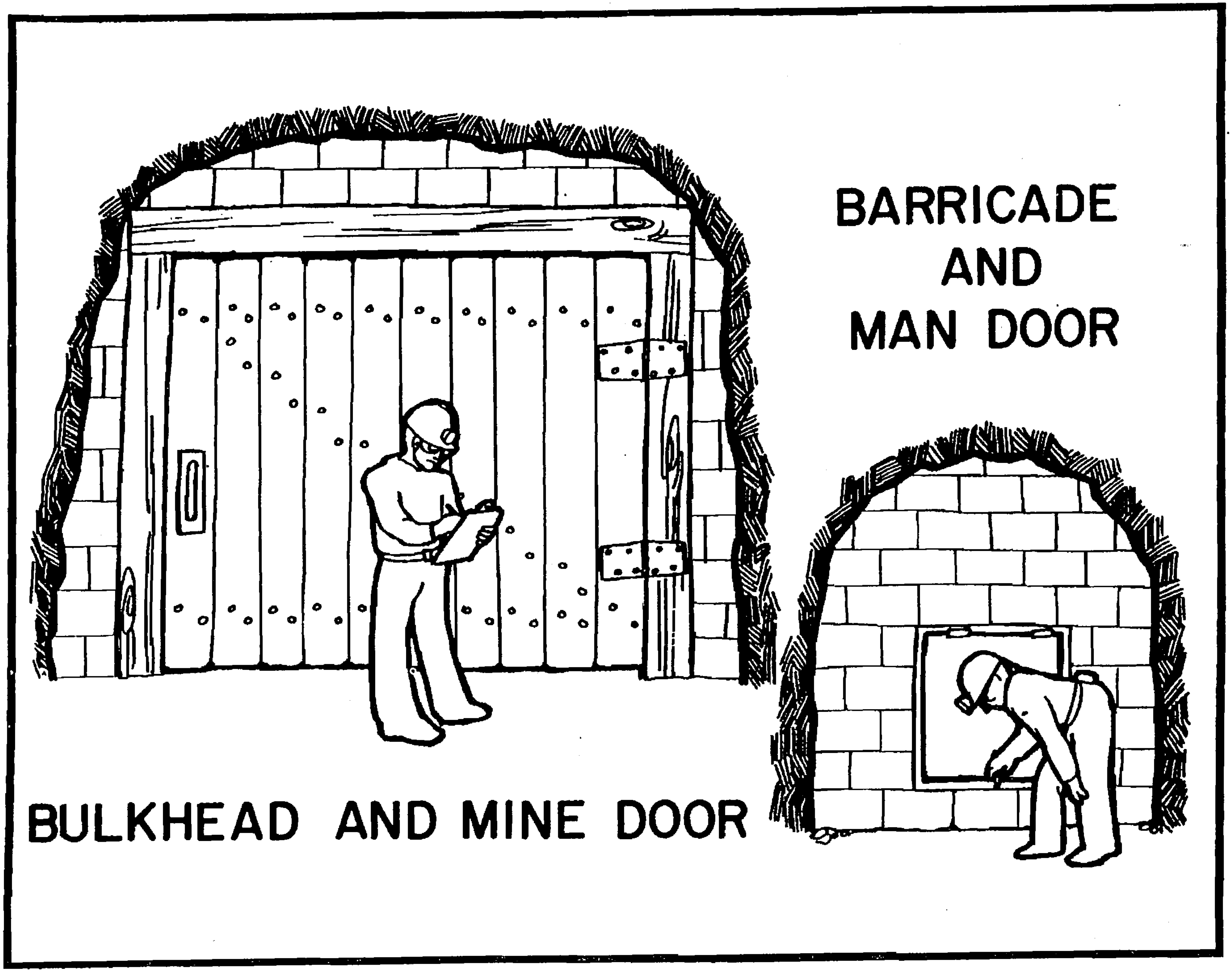
6. Major changes in ventilation may be caused by open doors or obstructions, and should be reported to your supervisor. (true, false)

7. In case of a mine fire you would head for (return air, air intake).

8. Man doors and mine doors generally stay (open, closed).


BARRING DOWN CORRECTLY
Not overhead
pry
up-
ward
Clear escape
YES
Clear footing
Too directly overhead
pry
down-
ward
Obstructed
escape
NO
Precarious
or cluttered footing

VISUAL 21



VISUAL 22

NEW MINERS

DEEP METAL/NONMETAL

HEALTH

1981

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DEEP METAL/NONMETAL

COURSE PLAN: HEALTH

I. GOAL: The goal of this module is to enable miners to recognize health hazards which may exist in their working environment and to take appropriate precautions to avoid being affected by these hazards.

II. BACKGROUND: It is generally recognized that mining is one of the most hazardous occupations in America. Many hazards to health are brought about by underground operations, including loud noises from equipment and machinery, toxic materials used in the work area, and danger to lungs from airborne particles. Miners training on recognition of these hazards will help them safeguard their own health.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe types of airborne particles in mine air and their effects on health.
2. Demonstrate methods for controlling and measuring airborne particles, including their tolerance limits.
3. Identify sources of noise and describe the effects of noise on health.
4. Describe or demonstrate measurement instruments and protective equipment for noise control.
5. Describe toxic materials used in the mine and their effects on health.
6. Present health provisions contained in the Federal Mining Safety and Health Act of 1977.

B. Trainee will be able to do the following:

1. Describe airborne particles and their effects on health.
2. Describe controls and measurement of airborne particles.
3. Discuss effects on of noise on health.
4. Describe and use noise control measurement instruments and protective equipment.
5. Avoid hazards of toxic materials used in the mine.

IV. ACTIVITIES

A. Classroom

1. Proper wearing of personal protective equipment, e.g. respirator

2. Proper use of measuring devices which may be used by miners.

V. MATERIALS

A. Visual aids

B. Personal protective equipment

C. Devices for measurement of health hazards

D. Company health control plan

VI. EVALUATION

A. Demonstrate, describe, or identify:

1. Types of airborne particles occurring in the mine and their effects
2. Tolerance levels for particles and noise.

B. Self-checks.

1. Anytime hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. Training standards

1. CFR 30 Part 48.5-7
2. CFR 30 Part 57.5-1
3. CFR 30 Part 57.5-50
4. CFR 30 Part 57.5-34, 57.5-37 through 47.

B. Textual materials

1. Hearing and Noise in Industry by William Burns
2. Gravimetric Mass Respirable Dust Sampling - Metal and Nonmetal Mining Industry. MESA Instruction Guide Number 33. Available from MSHA Technical Support Group.
3. Noise Training Course of Metal & Nonmetal Mine Inspectors. Manual prepared by the Noise Section of the Denver Technical Support Center.

C. Films

1. MSHA Film No. 826 - Protection Against Radioactivity in Uranium Mines
2. MSHA Film No. 845 - Breath and Live: Ventilation in Metal and Nonmetal Mines

D. Applicable MSHA fatalgrams.

TOPICS COVERED

I. Types of airborne particles and effects on health

1. Nuisance respirable dust

2. Fibrogenic respirable dust

    a. Effects on lungs
    b. major, minor, and benign pneumoconiosis

3. Radon and thoron daughters

4. Gamma and x-ray exposure

5. Factors that determine harmfulness of dust

    a. Composition
    b. Concentration
    c. Particle size
    d. Exposure time

II. Control and measurement of airborne particles

1. Control measures for airbone particles

    a. Ventilation
    b. Respiratory devices
    c. Water sprays

2. Methods of measurement for airborne particles

    a. Respirable gravimetric dust sampling
    b. Radon daughter measurement by air sampling or counting equipment
    c. Gamma radiation measurement
    d. Time schedule for measurement

3. Threshold limit values

    a. Federal regualtion concerning asbestos dust (Part 57.5-1b).

b. Federal regulation concerning use of silica sand (Part 57.5-16)
c. Federal regulation concerning radon daughter concentrations (Part 57.5-38,39)
d. Federal regulation concerning gamma radiation exposure (Part 57.5-47c).

III. Noise and its effects on health

1. Types of noise

a. Impact noise
b. Continuous noise
c. Impulsive noise

2. Hearing loss

a. Temporary loss
b. Nerve deafness
c. Conductive loss

IV. Noise control

1. Measurement instruments

2. Personal protection equipment

3. Federal regulations on allowable noise (Part 57.5-50)

V. Toxic materials

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HEALTH

INSTRUCTOR'S NOTE: THIS MODULE COVERS SEVERAL HEALTH-RELATED TOPICS. YOU MAY WANT TO DISCUSS EACH TOPIC THOROUGHLY OR FOCUS ON TOPICS OF MOST RELEVANCE TO YOUR MINE.

I. TYPES OF AIRBORNE PARTICLES AND THEIR EFFECTS ON HEALTH.

A. Respirable and nonrespirable dust.

1. Nonrespirable dust is less dangerous; larger particles are filtered out by the nose and throat.
2. Respirable dust is more dangerous; particles are invisible to the eye.

B. Nuisance respirable dust.

1. Little effect on lungs.
2. Any reaction is potentially reversible.

C. Fibrogenic respirable dust (e.g., asbestos, quartz)

1. Small particles enter lower lungs. Accumulations of particles cause scar tissue to be formed. Scar tissue interferes with transfer of oxygen and carbon dioxide through the lungs.
2. Silicosis is lung fibrosis caused by prolonged inhalation of silica dust.
3. Pneumoconiosis is a generic term describing several types of respiratory ailments, one of which is coal workers' pneumoconiosis.

a. Major pneumoconiosis - lung disorder developed over a prolonged time causing disabling symptoms, is irreversible, and shortens life expectancy. Includes silica dioxide dusts, such as asbestos, quartz, and coal.
b. Minor pneumoconiosis - dust causes little or no inflammation and no major fibrosis, but can cause mechanical irritation of the lungs. Includes micas, clays, feldspars, and anthracite.
c. Benign penumoconiosis - similar to minor pneumoconiosis. Includes calcium from limestone, marble, or cement; graphite; titanium dioxide; stannic dioxide; ferric oxide; and barium sulfate or oxide.

D. Radon and thoron daughters are found in uranium and thorium ores. Daughters attach to dust particles and are inhaled into the lungs.

VISUALS NOTE: SHOW VISUALS 94 and 96 TO AID YOUR DISCUSSION OF RADON DAUGHTERS

1. Excessive exposure to radon and thoron daughters can cause lung cancer.
2. Exposure measured in a unit known as the Working Level Month (WLM). Relevant formulas are:

   Exposure = radiation level x time

   Given that: radiation level is the working level, time is in months,

   Then: exposure is working level months,

   Or: Working Level Months = Working Level X Months

   a. Formulas indicate miners should not spend prolonged time in excessively contaminated areas. Low levels of radiation are safe work areas.
   b. The law states that no miner can be exposed to more than 4 WLM in any one year.

3. Smoking increases the risk of radiation causing lung cancer by a factor of ten.

E. Gamma and X-ray exposures.

1. Not considered dangerous in most uranium mines.
2. Use film badges to measure exposure around high grade uranium ore.

II. CONTROL AND MEASUREMENT OF AIRBORNE PARTICLES

A. Control measures for airborne particles.

1. Ventilation dilutes the concentration of dust and carries it out of the mine.
2. Respirators that filter dust.
3. Water sprays

B. Methods of measurement for airborne particles.

1. Respirable dusts

   a. Gravimetric sampling.
   b. Time schedule for sampling.

DEMONSTRATION NOTE: YOU MAY WANT TO DEMONSTRATE THE EQUIPMENT USED TO TEST RESPIRABLE DUSTS AND EXPLAIN HOW THEY FUNCTION. ADVISE TRAINEES THAT IT IS TO THEIR BENEFIT TO COOPERATE WITH MANAGEMENT OR STATE AND FEDERAL EMPLOYEES TAKING MEASUREMENTS.

2. Radon and thoron daughters.

   a. Air sampling
   b. Counting equipment
   c. Time schedule for sampling

DEMONSTRATION NOTE: YOU MAY WANT TO DEMONSTRATE THE EQUIPMENT USED TO TEST FOR RADON AND THORON DAUGHTERS IF APPLICABLE IN YOUR MINE.

3. Gamma radiation

   a. Scintillation countes.
   b. Time schedule for sampling.

DEMONSTRATION NOTE: YOU MAY WANT TO DEMONSTRATE THE EQUIPMENT USED TO TEST GAMMA RADIATION.

C. Threshold limit values

1. Part 57.5-1b states that miners shall not be exposed to asbestos dust exceeding 10 fibers longer than 5 micrometers per milliliter of air.
2. Part 57.5-16 states that silica sand shall not be used as an abrasive substance in abrasive blasting cleaning operation.
3. Part 57.5-38 and 39 state that the maximum exposure to radon daughters in any calendar year is 4 WLM, and 1.0 WL in active workings.
4. Part 57.5-47c states that annual individual gamma radiation exposure shall not exceed 5 rems.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN TYPES OF AIRBORN PARTICLES AND THEIR CONTROL AND MEASUREMENT.

III. NOISE AND ITS EFFECTS ON HEALTH

A. Types of noise

1. Impact noise from an object striking another object.
2. Continuous noise over a prolonged period of time.
3. Impulsive noise from an explosion.

VISUALS NOTE: SHOW VISUAL 37, THE ILLUSTRATION COMPARING AVERAGE NOISE LEVELS FOR DIFFERENT SOURCES OF NOISE. HAVE MINERS IDENTIFY WHICH ARE IMPACT, CONTINUOUS, OR IMPULSIVE NOISES.

B. Hearing loss

1. Temporary loss at certain sound frequencies but hearing recovers after a period of time. Can also result from a cold or ear infection.
2. Permanent loss

    a. Nerve deafness involves damage to the nerve cells of the inner ear resulting from exposure to high continuous noise levels. This damage can rarely be corrected.

    b. Conductive loss comes from infection, fractures or fusing of small bones, or a perforated eardrum resulting from impulsive or impact noises. Hearing is still possible, especially with the use of hearing aids.

3. Long exposure to noise over 90 dB may eventually harm hearing.
4. Noises over 130 dB may begin to cause pain.

IV. NOISE CONTROL AND MEASUREMENT

A. Control measures for noise

1. Engineering controls

    a. Mufflers
    b. Insulation
    c. Baffles
    d. Grease on movable parts

2. Personal protection equipment.

    a. Ear plugs

        i. Reduce noise by 25-30 dB in the higher and more harmful frequencies, so that they give ample protection against sound levels of 115 to 120 dB.

ii. Plugs do not hinder hearing conversation in noisy surroundings.
iii. Cotton is much less effective than rubber and plastic types.

b. Ear muffs

i. Reduce noise 35-45 dB so they provide protection against sound levels of 130-135 dB.
ii. Liquid - or grease - filled cushions give better noise suppression than plastic or foam rubber types.

c. Combinations of plugs and muffs give an additional 3-5 dB more protection. Total noise reduction seldom exceeds 50 dB because conduction through the skull around the ear cannot be prevented.

B. Methods of measurement for noise

1. Dosimeter
2. Sound level meter

C. TLV's

Duration per day, hours of exposure	Sound level in decibels
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

DEMONSTRATION NOTE: YOU MAY WANT TO SHOW HOW A SOUND LEVEL METER FUNCTIONS TO YOUR TRAINEES.

1. No exposure shall exceed 115 decibels.
2. Impact or impulsive noises shall not exceed 140 decibels, peak sound pressure level.

VISUALS NOTE: SHOW VISUAL 38, THE ILLUSTRATION DISPLAYING THE RELATIONSHIP BETWEEN TIME OF EXPOSURE AND PERMISSIBLE SOUND LEVELS.

V. HAZARDS FROM TOXIC MATERIALS

A. Types of toxic, caustic or noxious substances used in the mine.

B. Procedures for handling toxic, caustic or noxious substances.

INSTRUCTOR'S NOTE: YOUR DISCUSSION OF TOXIC MATERIALS SHOULD COVER HEALTH AND SAFETY PROBLEMS WITH TOXIC, ALL OR NOXIOUS MATERIALS USED IN YOUR MINE OR MILL. MAKE A LIST OF SUCH ITEMS e.g., SOLVENTS, SPRAY PAINT, CLEANERS, ACIDS, RESINS, RAT POISONS, ETC. USED IN YOUR MINE AND REVIEW MANUFACTURER'S HANDLING AND ANTIDOTE PROCEDURES.

VI. HEALTH PROVISIONS CONTAINED IN THE FEDERAL MINE SAFETY AND HEALTH ACT OF 1977 (CFR 30 PART 55 OR 56).

A. Regulations prescribe health and safety standards for the purpose of protecting life, promoting health and safety, and preventing accidents.

B. Violations of these regulations may be cited by MSHA inspectors.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN NOISE AND ITS CONTROL AND TOXIC MATERIALS.

SELF CHECK #1: SOLUTIONS

1. Nonrespirable dust is less dangerous. Larger particles may be filtered out by nose and throat. Respirable dust is more dangerous, being invisible to the eye.
2. true
3. a, b, and d
4. ventilation, respirators that filter dust, and water sprays
5. water sprays
6. true
7. c

SELF CHECK #2: SOLUTIONS

1. ear plugs
2. 50dB
3. ear plugs
4. nerve deafness
5. ear muffs and ear plugs
6. nerve deafness
7. 90dB
8. 130dB
9. answers will vary according to individual mines.
10. life, health and safety, and accidents

Self Checks: Health

Self Check #1 Airborne Particles

1. Describe the difference between respirable dust and nonrespirable dust. Which is more dangerous?

2. Asbestos or quartz dust is dangerous because when inhaled it can accumulate in the lungs and cause scar tissue, which interfers with oxygen and carbon dioxide through the lungs. (True, False)

3. (Circle all appropriate answers.)

   Major pneumoconiosis is a lung disorder which:

   a. causes disabling symptoms.
   b. shortens life expectancy.
   c. causes little or no inflammation of the lungs.
   d. is irreversible.

4. Name three ways of controlling airborne particles.

   ____

   ____

   ____

5. Which of the 3 answers in question #4 controls dust most effectively?

6. The law states that silica sand shall not be used as an abrasive substance in blasting cleaning operations. (True, False)

7. If you wear a dust sampling device you should keep it on:

   a. Just while you are on the working section.
   b. Only when you are wearing a respirator.
   c. All the time-from portal to portal
   d. Just when you are entering or leaving the mine.

Self Check #2: Noise and Its Control, Toxic Materials, and the Health Provisions Contained in the Act of 1977.

Use the following words to fill in the blanks below. Words may be used more than once. Some words may not be used at all.

ear plugs	cotton	50 dB	health & safety
permanent	conductive loss	nerve deafness	injuries
130 dB	90 dB	temporary	accidents
ear muffs	accidents	toxic spills	100 dB

1. ____________ reduce noise by 25 to 30 dB in the higher and more harmful frequencies.

2. Due to the conduction of sound through the skull close to the ear you won't be able to reduce noise more than __________.

3. ____________ does not/don't hinder conversation in noisy surrounding.

4. ____________________ involves damage to the nerve cells of the inner ear.

5. To gain an additional 3-5 dB more protection, you might wear a combination of ____________ and __________.

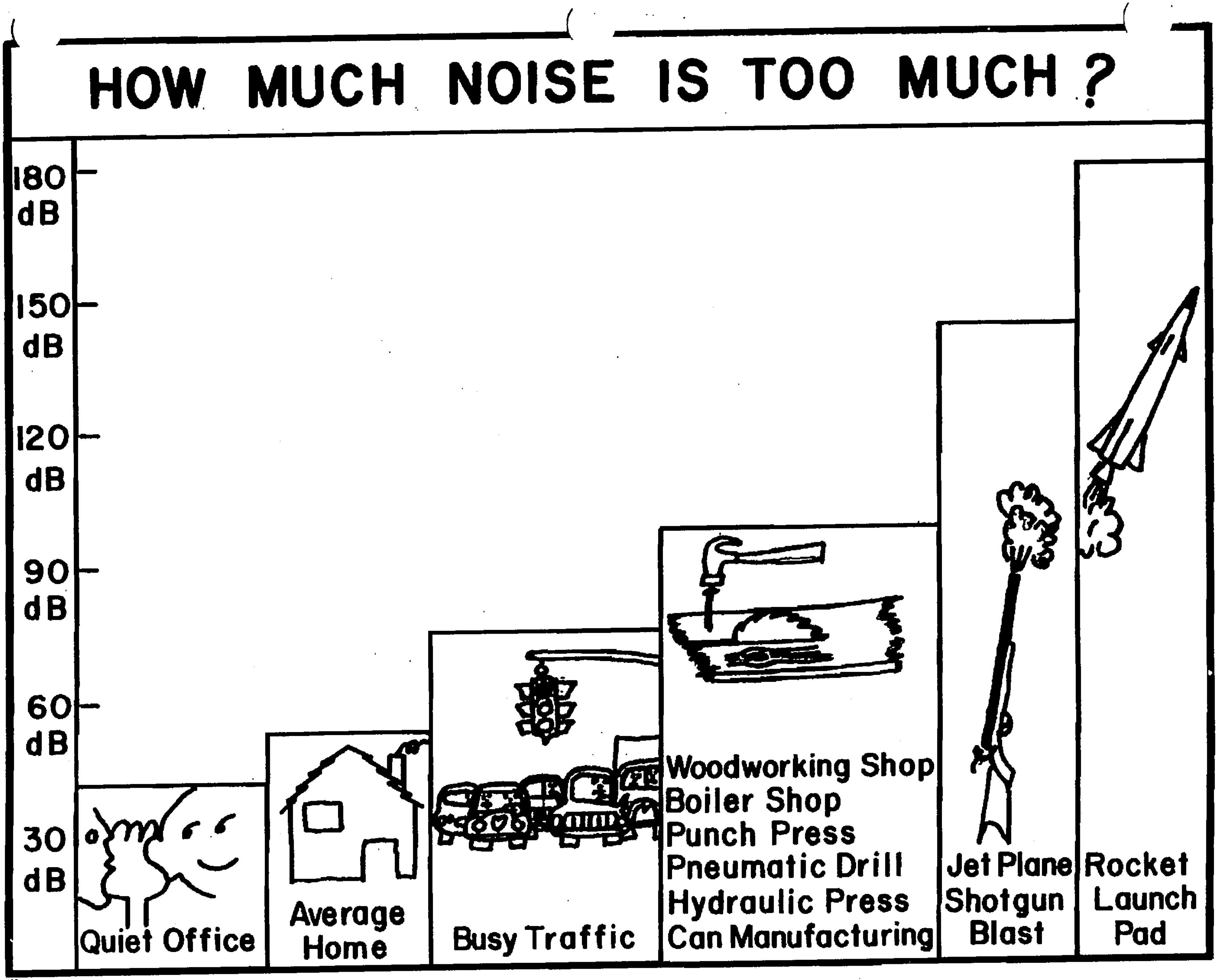
6. ______________ is damage to the ear that can rarely be corrected.

7. Long exposure to noises over ___________ may eventually harm hearing.

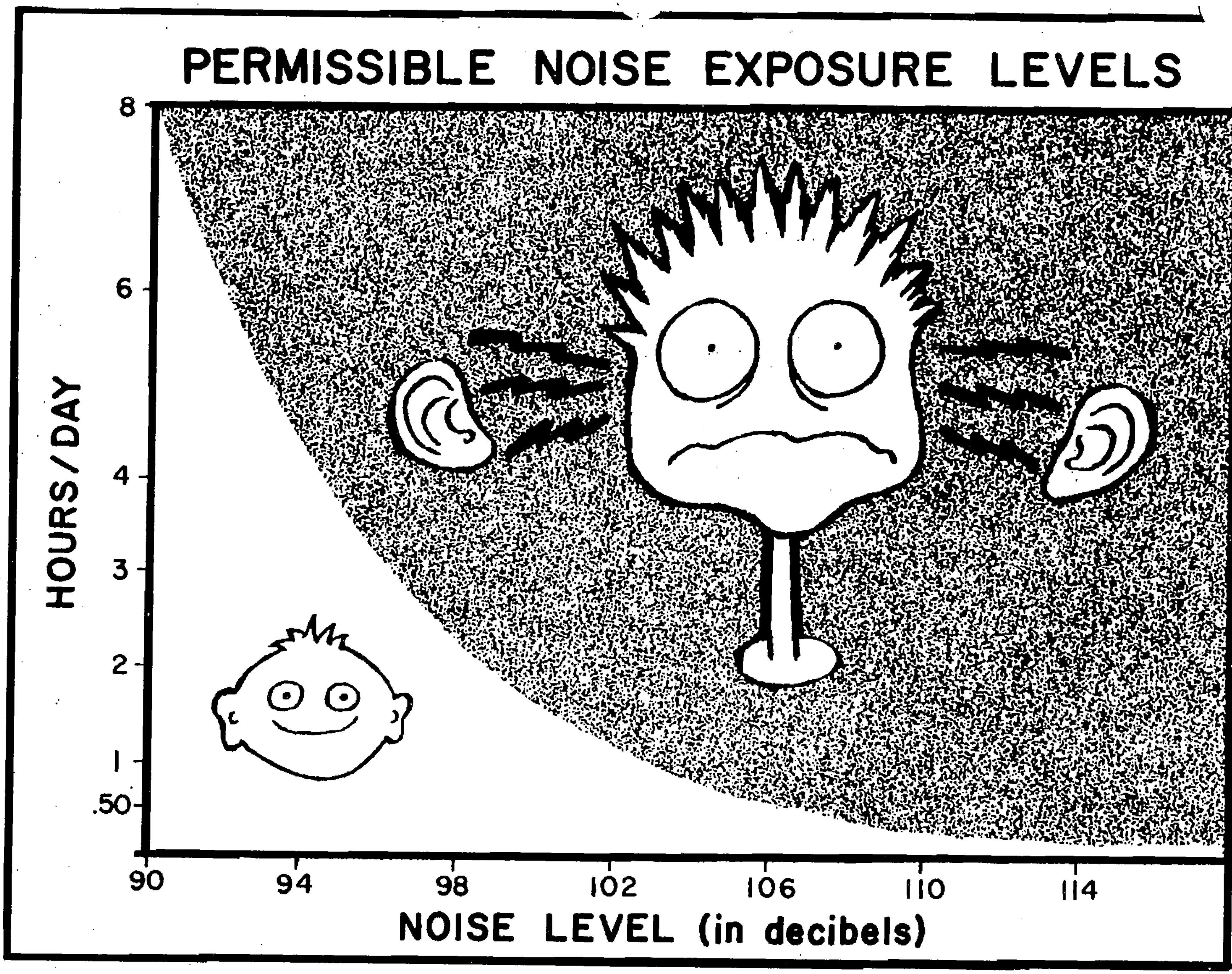
8. Noises over ____________ may begin to cause pain.

9. List any of the toxic materials or substances used in your mine and possible hazards to your health.

10. Regulations in the MSHA Act of 1977 are designed to protect ________, promote __________, and prevent _______________.


HOW MUCH NOISE IS TOO MUCH?
180 dB
150 dB
120 dB
90 dB
60 dB
30 dB
Quiet Office
Average Home
Busy Traffic
Woodworking Shop
Boiler Shop
Punch Press
Pneumatic Drill
Hydraulic Press
Can Manufacturing
Jet Plane
Shotgun Blast
Rocket Launch Pad

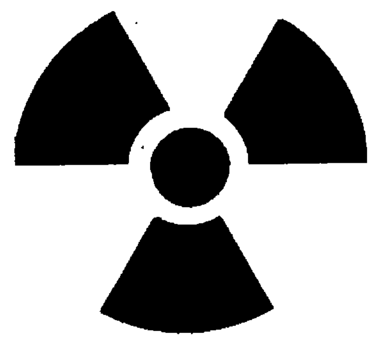
VISUAL 37


PERMISSIBLE NOISE EXPOSURE LEVELS
HOURS/DAY
8
6
4
3
2
1
.50
90
94
98
102
106
110
114
NOISE LEVEL (in decibels)

VISUAL 38

DECAY TIMES FOR RADIOACTIVE SUBSTANCES

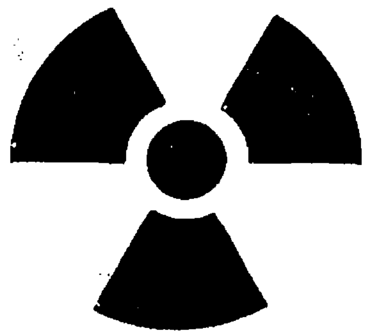
RADIOACTIVE SUBSTANCE	HALF-LIFE
Radium	1620 years
Radon gas	3.8 days
Radon daughters Radium A, B, C, C', D, E, and F	Ranging from 1.6 ten thousandths of a second to 22.3 years



Compare these to:

Carbon 14 (used to date the age of archeaological discoveries)	5730 years
Lead 204 (98.5 % of natural lead is not radioactive)	140 million trillion years

HALF LIVES OF RADON DAUGHTERS



Radium A	3.1	minutes
Radium B	26.8	minutes
Radium C	19.7	minutes
Radium C'	1.6	ten thousandths of a second
Radium D	22.3	years
Radium E	5.0	days
Radium F	138.4	days
Radium G	stable – does not decay (lead 206)	

NEW MINERS

DEEP METAL/NONMETAL

CLEANUP AND HOUSEKEEPING

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

DEEP METAL/NONMETAL

COURSE PLAN: CLEAN-UP AND HOUSEKEEPING

I. GOAL: The goal of this module is to explain the importance of maintaining a clean and orderly workplace and to encourage the miner to do so on his or her job.

II. BACKGROUND: In 1979 there were a total of 973 accidents in metal/nonmetal mines involving slips and falls, striking and bumping, and stepping or kneeling on objects. 572 of these accidents resulted in days lost from the job, and 1 resulted in a death. The high cost of personal adjustment to injury as well as production costs of days lost make close attention to good housekeeping habits a necessity to the health and safety of today's miner.

III. OBJECTIVES:

A. Trainer will do the following:

1. Describe the effects associated with disorderly work places and travelways including potential for accidents.
2. Discuss Federal regulations concerning maintenance of clean work places and disposal of toxic materials.
3. Discuss housekeeping procedures used at the mine for maintaining clean work places.
4. Discuss hazards of rock spillage at draw points, or passes, and any other locations and clean-up procedures appropriate for removal of rock spillage.

B. Trainees will be able to do the following:

1. Answer questions about hazards associated with disorderly work places and travelways. Given pictorial representation showing a disorderly work place the student should recognize pertinent hazards.
2. Indicate knowledge of Federal regulations regarding the acceptable level of clean workplaces.
3. Describe housekeeping procedures used at the mine and practices for good housekeeping.
4. Describe hazards resulting from rock spillage and where such hazards are most likely to be encountered.
5. Describe procedures for clean-up of rock spillage.

IV. MATERIALS:

A. Visual aids

1. Slides or pictures of common spills, etc.
2. Slides or pictures of accidents which occur as a result of failure to clean-up.

V. EVALUATION:

A. Demonstrate, describe or identify:

1. Effects of unclean workplaces.
2. Procedures for clean-up and disposal of toxic materials.

B. Self Check

1. Anytime hands on evaluation such as operation equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessary to fit your local mine situation.

VI. RESOURCES:

A. Training Standards - Part 48.5 (6) 8 Cleanup.

B. Health and Safety Standards - Part 57.4-50 and Part 57.20-3, 11, 12 and 13

C. Pictures or slides showing unclean workplaces and their potential effects.

D. Films

1. National Coal Board - "Tidy Why."
2. Salenger Educational Media - "Good Housekeeping Prevents Accidents."

E. Applicable MSHA fatalgrams.

<u>TOPICS COVERED</u>

I. IMPORTANCE OF CLEAN-UP AND GOOD HOUSEKEEPING

A. Unsafe conditions contributing to accidents.

B. Slows down work.

C. Fire protection.

II. APPLICABLE FEDERAL REGULATION

A. Maintenance of clean work places.

1. Part 57.20-3. General clean-up of mine areas.
2. Part 57.20-11. Warning signs of hazards ahead.

B. Disposal of toxic materials

1. Part 57.4-50. Fire hazards of flammable wastes
2. Part 57.20-9. Testing of potentially dangerous gases
3. Part 57.20-12. Labeling of toxic materials
4. Part 57.20-13. Covers provided for scrap/waste barrels

III. HOUSEKEEPING PROCEDURES

A. Useful organization of work procedures.

B. Storing work and scrap/waste materials.

C. Handling tools, supplies, and equipment.

IV. SPILLAGE HAZARDS

A. Locations of rock spillage

1. Draw points
2. Ore passes
3. Grizzly or crusher
4. Haulageways
5. At transfer from ore pass or muck car to haulage truck or ore car
6. Along belt lines and their transfer points

B. Hazards associated with rock spillage

1. Safety hazards to miners and equipment
2. Increased resistance to ventilation

C. Clean-up of rock spillage

METAL/NONMETAL

LESSON GUIDE AND MATERIALS: CLEAN-UP AND HOUSEKEEPING

I. IMPORTANCE OF CLEAN-UP AND GOOD HOUSEKEEPING

A. Reduces the number of unsafe conditions which contribute to accidents. Oily rags, empty or uncovered grease and oil containers, tangled hoses, and discarded trash are examples of such hazards.

B. A messy workplace slows down work. If tools are laying about unorganized, more time is required to find them.

C. Cleaning-up during work is a good fire prevention technique. Areas around fuel and explosive supplies should be kept free of any flammable materials and trash.

II. APPLICABLE FEDERAL REGULATION

A. Maintenance of clean work places.

1. The law states that workplaces, passageways, storerooms, and service rooms must be kept clean and orderly, and water drainage must be provided where practicable (Part 57.20-3)

2. The law states that any health and safety hazard that is not immediately obvious must be labeled with a warning sign. This sign must "be readily visibly, legible, display the nature of the hazard, and any protective action required" (Part 57.20-11).

B. Disposal of toxic materials.

1. The law states that flammable and combustible wastes should not accumulate and become a fire hazard. (Part 57.4-50).

2. The law states that potentially dangerous gases should be tested, and control measures taken as appropriate. (Part 57.20-9).

3. The law states that toxic materials should be clearly labeled and safe handling procedures identified. (Part 57.30-12).

III. HOUSEKEEPING PROCEDURES

A. Organize your work ahead of time so you have all the equipment you need where you need it. Make cleaning-up part of your work.

B. Clean up spills whenever and wherever they occur.

C. After you are finished with equipment and no longer plan on using it for awhile, put it away such as in a supply room or other designated area. Park vehicles properly. Keep oily rags in closed containers and remove them from the mine daily.

VISUALS NOTE: SHOW AND DISCUSS VISUAL 45 ENTITLED "CLEAN UP ALL SPILLS".

D. When handling tools, supplies, or equipment, use caution in how you handle them. Avoid hurting yourself, others, or the equipment itself. If a piece of equipment or a tool is broken, get it fixed or serviced rather than leaving it and letting another miner discover its condition when it may be for an emergency. The next time the tool could be needed in an emergency you could be the victim.

IV. SPILLAGE HAZARDS

A. Rock spillage is found to varying degrees at a number of locations.

1. Draw points
2. Ore passes
3. Grizzly or crusher
4. Haulageways
5. At transfer points from ore pass or muck car to haulage truck or ore car.
6. Along belt lines and their transfer points.

B. Hazards associated with rock spillage.

1. Rock spillage poses safety hazards to miners and equipment. Miners can trip over rocks which is a leading cause of accidents and equipment has less room to operate and maneuver when crowded by spillage. Uneven floors caused by spillage is a major contributing cause of haulage accidents.

2. Substantial rock spillage increases resistance to ventilation. Spillage cuts down the volume of air passing by.

C. Rock spillage should be cleaned-up wherever it poses a health and safety hazard. Depending on the size of the spillage, either shovels or loaders should be used in clean-up.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN CLEAN-UP AND HOUSEKEEPING.

SELF CHECK #1 SOLUTIONS

1. a, b, and c
2. Cleaning up as you work
3. Should
4. a.
5. Rock spillage
6. Possible answers included: nails exposed from boards; loose wires ready to entangle an unsuspecting miner; food possibly contaminated by chemical container; fire extinguisher hidden and hard to reach; pry bar ready to fall and injure a miner; nails, nuts, and bolts could puncture miners' skin; possible attraction of rodents; and oily rags, oil can, and overflowing garbage create a fire hazard.

Self Check: Clean-up and Housekeeping

Self Check #1 Housekeeping Procedures, Federal Regulations, and Hazards

1. Unsafe conditions which contribute to accidents include:
   (circle all correct answers)

   a. Oily rags
   b. Open grease and oil containers
   c. Tangled hoses and discarded trash
   d. Tools in proper place

2. (Cleaning up as you work, cleaning up at the end of your shift) is the best way to maintain a safe working environment.

3. The law states that toxic materials (should, should not) be clearly labeled and safe handling procedures identified.

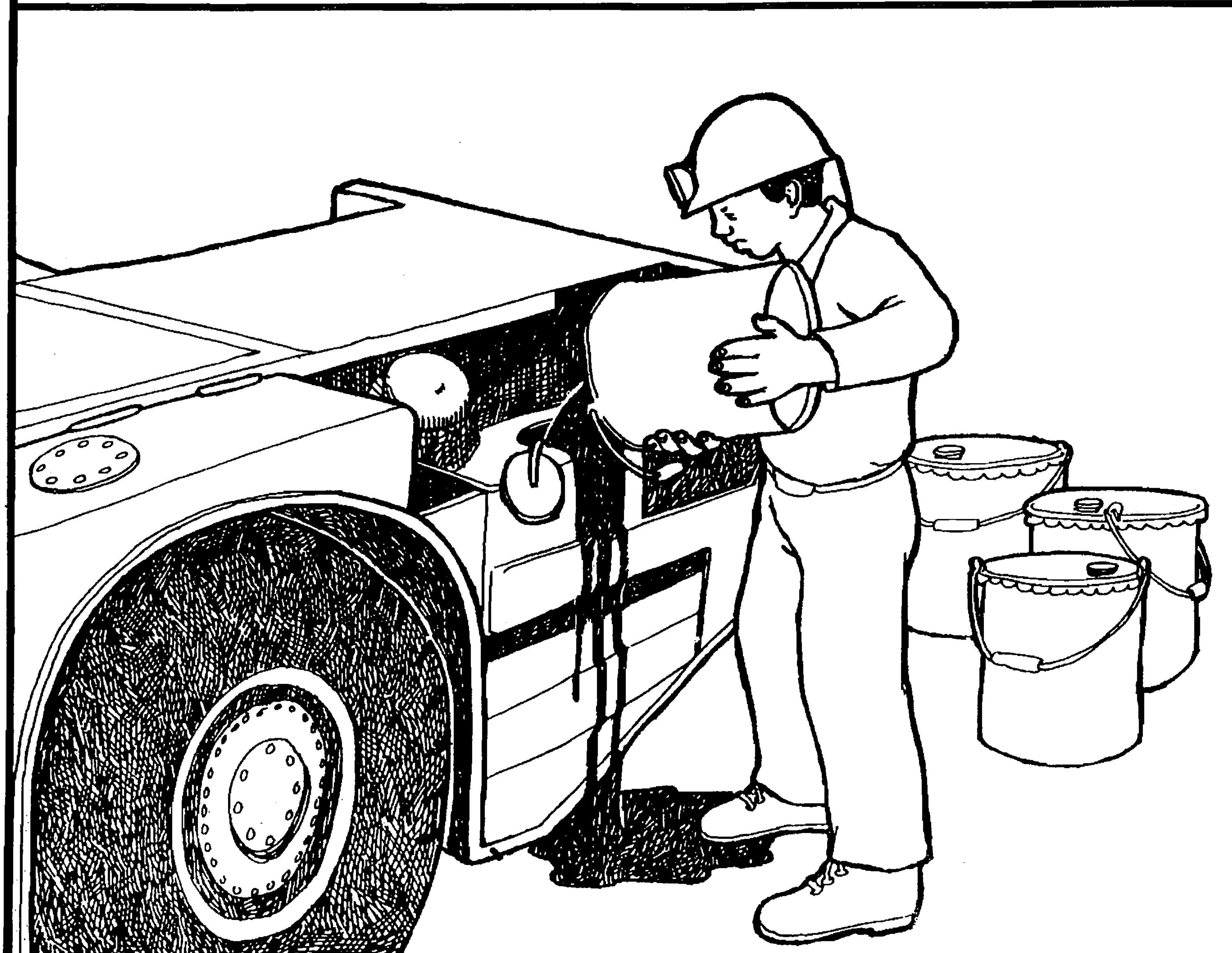
4. If equipment or tools are broken during use:

   a. Get it serviced or fixed
   b. Put it away so no one gets hurt
   c. Let the next miner fix it
   d. Leave it where it was broken so you can show it was an accident.

5. ________________ ________________ is a leading cause of miners tripping, is a major contributor to haulage accidents, cuts down the volume of air passing by, and should be cleaned up by either shovels or muckers.

6. Look at visual 44 shown on the overhead projector or passed out to you and write at least 5 possible hazards you see.

CLEAN UP ALL SPILLS



NEW MINERS

DEEP METAL/NONMETAL

HAZARD RECOGNITION

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

DEEP METAL/NONMETAL

COURSE PLAN: HAZARD RECOGNITION

I. GOAL: The goal of this module is to assure that miners will recognize hazards in the mine and know the appropriate steps to take for the elimination of hazards and reduction of accidents.

II. BACKGROUND: One of the primary concerns of the Federal Mine Safety and Health Act of 1977 was the prevention of mining accidents. Training in hazard recognition is important to the prevention of accidents because it shows miners what the hazards are in the mine and how to recognize and avoid them before they turn into an accident.

III. OBJECTIVES

A. Trainer will do the following:

1. Present a descriptive analysis of accidents and contributing factors, including unsafe acts and conditions.
2. Describe the most common types of accidents in metal and nonmental mines.
3. Discuss the most common accidents at your operation.

B. Trainees will be able to do the following:

1. Describe accidents and factors contributing to their occurrence.
2. Name and describe the most common types of accidents occurring in underground metal/nonmetal mines.
3. Recognize hazards on the mine tour and describe ways to avoid accidents relating to those hazards.

IV. ACTIVITIES

A. On Site - in conjunction with introduction to work environment

1. Recognizing ground hazards
2. Barring down rock

B. In classroom - correct identification in slides or drawings of contributing hazardous factors resulting in accidents.

V. MATERIALS

A. Visual Aids

1. Illustrations contained in the Lesson Guide and Materials.
2. Illustrations of accidents shown in MSHA Fatalgrams.

B. Company accident records, first aid records, and results of MSHA inspections at the mine.

C. List of hazards relevant to your mine.

VI. EVALUATION

A. Demonstrate, describe or identify:

1. An accident and common accidents in metal/nonmetal mines.
2. Procedures for correcting unsafe conditions and unsafe acts, and proper procedures to follow when hazards exist.
3. Hazards in slides and illustrations of accidents, and identify procedures that might have prevented these accidents from occurring.

B. Self-checks contained in the Lesson Guide and Materials.

1. Any time hands-on evaluation such as operating equipment is possible it should be used.
2. Eliminate the use of self-check if inappropriate for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. Training Standards CFR 30 Part 48.5-9

B. Health and Safety Standards contained in CFR 30 Part 57.7-53, 57.13-19, 20, 21.

C. Textual Materials

1. MESA Safety Manual No. 4 - Accident Prevention.
2. National Safety Council - Accident Prevention Manual for Industrial Operations
3. MSHA Programmed Instruction Workbook - Accident Prevention.
4. National Safety Council, Supervisors Safety Manual. 444 North Michigan Ave., Chicago, IL, 60611

D. Films

1. National Audio-Visual Center - "Prevention of Heat Casualties." "It Can't Happen to Me - Anatomy of an Accident".
2. Salenger Educational Media - "Good Housekeeping Prevents Accidents".

3. National Film Board of Canada - "Eyes." "Feet." "Hands." "Slips and Falls." "Striking against Objects."
4. Bureau of National Affairs - "The Big Lift."
5. Mine Safety Appliance - "Dust You Can't See."
6. National Coal Board - "A Sense of Responsibility." "Tidy Why."
7. MSHA Film Number 836 - "Conveyor Belts - Be Careful".
8. MSHA Film Number 860 - "In Search of the Facts: Accident Investigations in Metal and Nonmetal Mining Operations".

E. Applicable Fatalgrams

TOPICS COVERED

I. ANALYSIS OF ACCIDENTS AND CONTRIBUTING FACTORS

A. Definition of an accident

B. Causes of accidents

1. Basic causes

a. Management safety policy and decisions
b. Environmental factors
c. Personal factors

2. Indirect causes

a. Unsafe acts

i. Operating equipment at excessive speeds
ii. Operating equipment without authorization or training
iii. Using equipment or tools improperly
iv. Using defective equipment
v. Removing or damaging safety devices on equipment
vi. Not using personal protective equipment when appropriate
vii. Not warning others of hazardous conditions
viii. Failure to secure equipment and block tires
ix. Improper lifting, loading, or placement of equipment, tools, or supplies
x. Servicing equipment in motion
xi. Horseplay
xii. Use of alcohol or drugs (review company policy)
xiii. Working in confined spaces

b. Unsafe conditions.

i. Sliding or falling material at bins, hoppers, and dump points
ii. Pressure lines and vessels
iii. Inadequate supports or guards
iv. Poor housekeeping
v. Poor illumination
vi. Fire and explosion hazards
vii. Defective tools, equipment, or supplies
viii. Congestion of work place
ix. Inadequate warning systems
x. Possible inundation from cutting into old workings that are flooded
xi. Excessive noise
xii. Slippery or rough haulage and walkways

3. Direct causes: Unplanned release of energy.

C. Distinction between health and safety concerns in the mine

D. Miner's responsibility

II. MOST COMMON TYPES OF ACCIDENTS IN METAL/NONMETAL MINES

A. Materials handling

1. Frequency of occurrence in mines
2. Accident characteristics
3. Prevention of materials handling accidents

B. Powered haulage

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of powered haulage accidents

C. Machinery

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of machinery accidents

D. Slips and falls

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of machinery accidents

E. Hand tools

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of accidents with hand tools

F. Hazards specific to your mine.

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HAZARD RECOGNITION

INSTRUCTOR NOTE: THE LISTING OF HAZARDS AND ACCIDENTS INCLUDED IN THIS MODULE ARE THOSE MOST COMMONLY FOUND IN METAL/ NONMETAL MINES BASED ON 1979 ACCIDENT RECORDS. IF OTHER HAZARDS NOT INCLUDED IN THIS LIST ARE RELEVANT TO YOUR MINE THEY SHOULD BE ADDED AND DISCUSSED IN THE TRAINING SESSION.

I. ANALYSIS OF ACCIDENTS AND CONTRIBUTING FACTORS

A. Definition of an accident.

1. Any unplanned and unanticipated event that results in personal injury and/or in property damage.
2. An analysis of accidents must consider a number of contributing factors, which must at least include the accident type (falls, being struck by object), energy source (electricity, machinery), unsafe acts or conditions, nature of the injury, and the affected part or parts of the body.

B. Causes of accidents

VISUAL NOTE: DURING THE FOLLOWING DISCUSSION YOU MAY WANT TO PASS OUT VISUAL 7, ILLUSTRATING RELATIONSHIPS BETWEEN CAUSES IN THE ACCIDENT SEQUENCE.

1. Basic causes of accidents may be one or more elements in the following lists.

a. Management safety policy and decisions

i. Production and safety goals
ii. Communications
iii. Inspection procedures
iv. Maintenance
v. Housekeeping

b. Environmental factors

i. Weather
ii. Dusts, gases and vapors
iii. Noise
iv. Illumination

c. Personal factors

   i. Safety motivation and awareness
   ii. Knowledge and training
   iii. Physical and mental state
   iv. Reaction time

2. Indirect causes

   a. Unsafe acts

      i. Operating equipment at excessive speeds
      ii. Operating equipment without authorization or training
      iii. Using equipment or tools improperly
      iv. Using defective equipment
      v. Removing or damaging safety devices on equipment
      vi. Not using personal protective equipment when appropriate
      vii. Not warning others of hazardous conditions
      viii. Failure to secure equipment and block tires
      ix. Improper lifting, loading, or placement of equipment, tools, or supplies
      x. Servicing equipment in motion
      xi. Horseplay
      xii. Use of alcohol or drugs

   b. Unsafe conditions.

      i. Sliding or falling material at bins, hoppers, and dump points
      ii. Pressure lines and vessels
      iii. Inadequate supports or guards
      iv. Poor housekeeping
      v. Poor illumination
      vi. Hazardous highwalls, spoil banks, and water pools
      vii. Fire and explosion hazards
      viii. Defective tools, equipment, or supplies
      ix. Congestion of work place
      x. Inadequate warning systems
      xi. Excessive noise
      xii. Slippery or rough haulage and walkways

3. Direct causes: Unplanned release of energy and/or hazardous material such as falls of rock or materials, failing brakes, or removal of air hose without first bleeding the line.

C. Distinction between health and safety concerns in the mine

1. Health refers to proper functioning of the body

   a. Health is affected by substances which interfere with normal functioning.
   b. Health problems while slow in occuring may be permanently disabling.

2. Safety refers to avoiding accidents by following safe work procedures and recognizing and correcting unsafe conditions.

D. Miner's responsibility

   1. Reporting hazards
   2. Tagging unsafe equipment
   3. Eliminating known hazards
   4. Warning others
   5. Avoiding areas of hazards

II. MOST COMMON TYPES OF ACCIDENTS IN METAL/NONMETAL UNDERGROUND MINES

VISUAL NOTE: SHOW AND DISCUSS THE PIE CHART, VISUAL 9, WHICH GIVES PERCENTAGES OF COMMON MINE ACCIDENTS.

INSTRUCTOR NOTE: DISCUSS BRIEFLY ALL COMMON TYPES OF ACCIDENTS, BUT FOCUS ON THOSE MOST FREQUENT IN YOUR LOCAL MINE.

VISUAL NOTE: YOU MAY WANT TO USE VISUAL 49 TO TAILOR THIS UNIT TO YOUR SPECIFIC MINE. YOU'LL NEED TO RESEARCH ACCIDENT RECORDS FOR YOUR MINE FOR THE PAST YEAR. FILL IN THE BLANKS ON A TRANSPARENCY YOU'VE MADE OR REPRODUCE COPIES OF THIS VISUAL AND ASK TRAINEES TO FILL IN THE BLANKS. ONE SUGGESTION IS TO HAVE TRAINEES GUESS FIRST AT THE NUMBER OF EACH TYPE OF INJURY AND THEN TELL THEM THE EXACT NUMBER.

A. Handling materials is a common activity related to accidents (lifting, pulling, pushing or shoveling packaged or loose material).

   1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 31% occurred during handling of materials.

2. Accident characteristics

   a. Of all accidents in underground mines involving materials handling, 62% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 12 to 164 days.

   b. Most frequent parts of body injured in accidents.

      Fingers - 24%
      Back - 24%
      Hand - 7%
      Eye - 6%
      Foot - 5%
      All others - 34%

   c. Most frequent nature of injury.

      Strain or sprain - 33%
      Cut or puncture - 22%
      Contusion or bruise - 14%
      Fracture - 11%
      All others - 20%

3. These accidents may often be avoided by using correct procedures for handling materials.

   a. Use proper lifting, lifting with the legs rather than the back.
   b. Wear gloves.
   c. Do not allow your vision to be obscured by the load and be careful when passing through entrances.
   d. Do not attempt to carry a load which is too heavy, and coordinate your moves with those assisting you.
   e. Be careful of sharp edges or protruding sides of the materials you are carrying.
   f. When setting materials down, make sure you have sufficient clearance from your toes.

VISUAL NOTE: PASS OUT ILLUSTRATIONS, VISUALS 1, 2 & 8 OF LIFTING AND CARRYING. THESE MATERIALS WILL BE HELPFUL TO SHOW THE PROPER TECHNIQUES.

CLASSROOM ACTIVITY: DEMONSTRATE LIFTING TECHNIQUES WITH LIGHT LOADS, THEN HEAVY MATERIALS. INVOLVE STUDENTS IN LIFTING INDIVIDUALLY AND IN PAIRS.

B. Powered haulage activities are another source of accidents (conveyors, front-end loaders, haulage trucks, locomotives and railroad cars, and personnel conveyances).

1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 8% occurred around powered haulage.

2. Accident characteristics

a. Of all accidents in underground mines involving powered haulage, 74% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 30-210 days.

b. Most frequent parts of body injured in accidents.

Back - 13%
Multiple parts of body - 12%
All others - 75%

c. Most frequent nature of injury.

Contusion or bruise - 26%
Strain or sprain - 18%
Fracture - 15%
Multiple injuries - 13%
All others - 28%

d. Some of the sorts of haulage accidents which occur are as follows:

i. Collisions with other vehicles or stationary objects
ii. Being struck, run over by or squeezed between vehicles
iii. Striking arms, legs, or other body parts against protruding objects while riding in mine transportation
iv. Slipping or falling while mounting vehicle

INSTRUCTOR NOTE: A QUESTION ABOUT PROCEDURES FOR PREVENTING ACCIDENTS MAY PRODUCE SOME OF THE FOLLOWING RESPONSES.

3. Haulage accidents may be reduced by using the rules as follows:

a. Never exceed the vehicle's capabilities for speed, stopping, and turning.

b. When on foot watch out for all vehicles and let operators know you are near.
c. Never get on or off of moving vehicles of any kind.
d. Keep limbs and head within the riding area.
e. Make frequent inspections of vehicle's brakes, lights, steering, and other devices related to safety.
f. Don't work on moving conveyor belts or attempt to cross or mount them.
g. Don't wear loose clothing or long hair around moving conveyor belts or machinery which has exposed moving parts.
h. When shoveling onto a moving belt, always shovel in the direct the belt is moving.

C. Another major source of accidents is the use of machinery (drills, slushers, power shovels, and compressors).

1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 17% occurred around machinery.

2. Accident characteristics

a. Of all accidents in underground mines involving machinery, 64% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 18 to 194 days.

b. Most frequent parts of body injured in accidents.

Finger - 20%
Eye - 17%
Hand - 8%
Back - 6%
Foot - 6%
All others - 43%

c. Most frequent nature of injury

Cut or puncture - 29%
Contusion or bruise - 16%
Fracture - 11%
Dust in eye - 9%
Strain or sprain - 9%
All others - 26%

d. The sorts of accidents which occur are as follows:

i. Being caught between a machine and the highwall during a slide.

ii. Being struck by a moving boom or bucket or blade
iii. Being struck or crushed by falling or overturning equipment.
iv. Being struck by flying objects.

VISUAL NOTE: ILLUSTRATIONS OF TYPES OF ACCIDENTS AND DANGEROUS CONDITIONS WILL BE HELPFUL HERE. CHOOSE THOSE THAT BEST FIT YOUR MINE FROM AMONG VISUALS 10-18.

3. Many accidents of this nature can be avoided by following safe work procedures.

   a. When working near equipment in operation, be sure operator knows you are there.
   b. Avoid the area included in the circle of movement of booms and loaders. Never walk under raised equipment.
   c. Never leave equipment unattended in raised position.
   d. Be sure equipment is securely blocked before attempting any repair or maintenance with it in raised position.
   e. Never attempt to defeat or override the safety devices built into equipment.

D. Another source of accidents is slips and falls (while getting on or off machinery and haulage equipment which is not moving, and while servicing or repairing equipment or machinery).

1. Frequency of occurrence - Of all accidents in 1979 for underground mines, 13% resulted from slips and falls.

2. Accident characteristics

   a. Of all accidents in underground mines resulting from slips and falls, 73% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 21 to 210 days.

   b. Most frequent parts of body injured in accidents.

      Back - 17%
      Ankle - 13%
      Knee - 12%
      Multiple parts of body - 7%
      All others - 51%

   c. Most frequent nature of injury.

      Strain or sprain - 38%
      Contusion or bruise - 18%

Fracture - 16%
Cut or puncture - 12%
Multiple injuries - 7%
All others - 9%

3. Some rules which will prevent slips and falls are as follows:

   a. Wear proper footwear.
   b. Always watch where you are going. Don't allow material being carried to block your visibility.
   c. Use both hands when climbing up or down a ladder. Never jump from rung to rung or try to slide down the ladder.
   d. Clean up any spills that might cause someone to slip.
   e. Never lean over equipment without stable footing.
   f. Use a safety belt to catch any fall from a high place, or when working in a hole or trench.

E. An additional major source of accidents is the use of hand tools (nonpower assisted tools)

1. Frequency of occurrence - Of all accidents in 1979 for underground mines, 11% resulted from use of hand tools.

2. Accident characteristics

   a. Of all accidents in underground mines resulting from use of hand tools, 45% resulted in lost work days for nonfatally injured miners. The average severity of these accidents was lost time ranging from 11 to 125 days.

   b. Most frequent parts of body injured in accidents.

   Fingers - 32%
   Hand - 9%
   Back - 8%
   All others - 51%

   c. Most frequent nature of injury.

   Cut or puncture - 42%
   Contusion or bruise - 17%
   Strain or sprain - 14%
   Fracture - 12%
   All others - 15%

3. The following are procedures which will help in avoiding these accidents.

   a. Use the right tool for the job.

b. Keep tools in their place when they are not being used. Don't leave them around as hazards to safety.
c. Be sure you have clearance from other workers and machinery when using hammers and sledges.
d. Always wear safety glasses to protect your eyes from flying material.
e. Follow recommended safety procedures in the use of special tools and equipment.

VISUAL NOTE: PASS OUT VISUAL 48, THE ILLUSTRATION OF PROPER AND IMPROPER USE OF TOOLS. YOU MAY WISH TO CREATE TRANSPARENCIES FROM VISUALS 19, 20 & 47 TO POINT TO WHILE DISCUSSING TOOL USE.

F. The final major source of accidents is falls of the back or sides. This includes falls while barring down or placing props, as well as pressure bumps and bursts. This does not include accidents due to equipment gouging the rock.

1. Frequency of occurrence of all accidents in 1979 for underground mines, 10% resulted from falls of the back or sides.

2. Accident characteristics

a. Of all accidents in underground mines resulting from falls of the back or sides, 65% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 12 to 600 days.

b. Most frequent parts of body injured in accidents.

Multiple parts of body - 14%
Fingers - 11%
Foot - 9%
Hand - 7%
Shoulders - 6%
Others - 46%

c. Most frequent nature of injury.

Cut or puncture - 34%
Contusion or bruise - 28%
Fracture - 15%
Multiple injuries - 12%
All others - 11%

3. These accidents may often be avoided by observing some of the following safety rules.

   a. While barring down always follow safe procedures and keep a path for escape open. When scaling, always wear safety glasses and work under supported roof.

   b. If you suspect weak rock, report it to supervision.

   c. Test the rock periodically with a hammer to assess its soundness.

   d. Never violate the mine's roof control plan.

   e. Look for stress cracks or rocks protruding from the back or sides.

   f. Look for formerly dry areas that suddenly become wet.

   g. Look for the falling of small chips that might signal larger falls.

   h. Look for rock bolts showing signs of stress.

   i. Never assume someone else has made tests in the area.

III. SOURCES OF HEALTH HAZARDS

A. Toxic fumes and gases

1. Toxic gases produce specific ill effects.

2. Asphyxiating gases cause suffocation by reducing the quantity of oxygen available.

B. Respirable dust is more hazardous than nonrespirable dusts as the latter are filtered out before reaching the lungs.

C. Exposure to noise can cause discomfort and loss of hearing, especially at high noise levels.

D. The above hazards are the most common, but are not all the possible hazards. Each miner is responsible for watching for and reporting hazards specific to their work area.

EVALUATION NOTE: HAVE MINERS ANSWER SELF CHECK NUMBER ONE, INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE ANALYSIS OF ACCIDENTS AND THEIR CAUSES, AS WELL AS THE MOST COMMON TYPES OF ACCIDENTS IN UNDERGROUND MINES.

SELF CHECK #1: SOLUTIONS

1. handling materials, haulage activities, use of machinery, slips and falls, and use of hand tools.

2. a, b, & d.

3. True

4. a. turning with one hand or while eating
   b. safety motivation and awareness
   c. Hal should not drive with the bucket raised

5. fingers

6. Always leave your vision clear when carrying materials. Store tools when not in use.

7. a. Use wrench only with square-shanked screwdriver.
   b. Use tools with handles in good condition
   c. Carry tools in a shoulder bag or tool belt when climbing
   d. get a longer wrench
   e. hold nail near the head
   f. use the right tool for the right job.

Self Check: Hazard Recognition

Self Check #1: Analysis and Causes of Accidents, and Common Types of Accidents in Underground Mines.

1. List the 5 main types of accidents.

   a.

   b.

   c.

   d.

   e.

2. (circle each correct answer,) An accident is:

   a. any unplanned event that may result in property damage

   b. an unanticipated event that sometimes results in personal injury

   c. always management's fault

   d. sometimes the result of unsafe acts

3. Indirect causes of accidents are unsafe acts and unsafe conditions. (true, false).

4. Hal is new to mining. One day he drives his front end loader down the drift with the bucket of ore raised. Because he's eating a sandwich he steers wide on the curve and runs the bucket into a rib. He breaks the bucket and hits his head on the canopy.

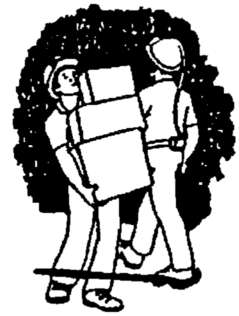
   a. What is the indirect cause of this accident?

   b. What is the basic cause?

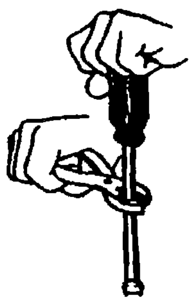
   c. How could this powered haulage type of accident be prevented?

5. Which body parts are most frequently injured in mining accidents?

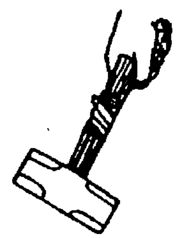
What rules are not being followed here?



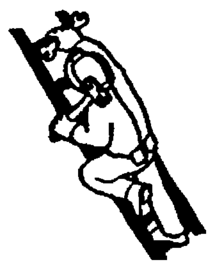
7. On each line below tell what hand tool rule is not being followed.



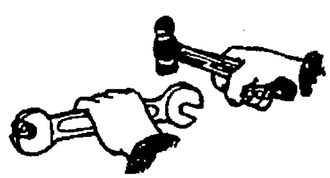
a.



b.

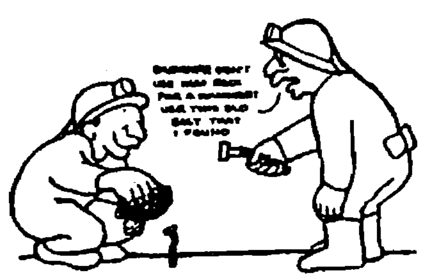


c.

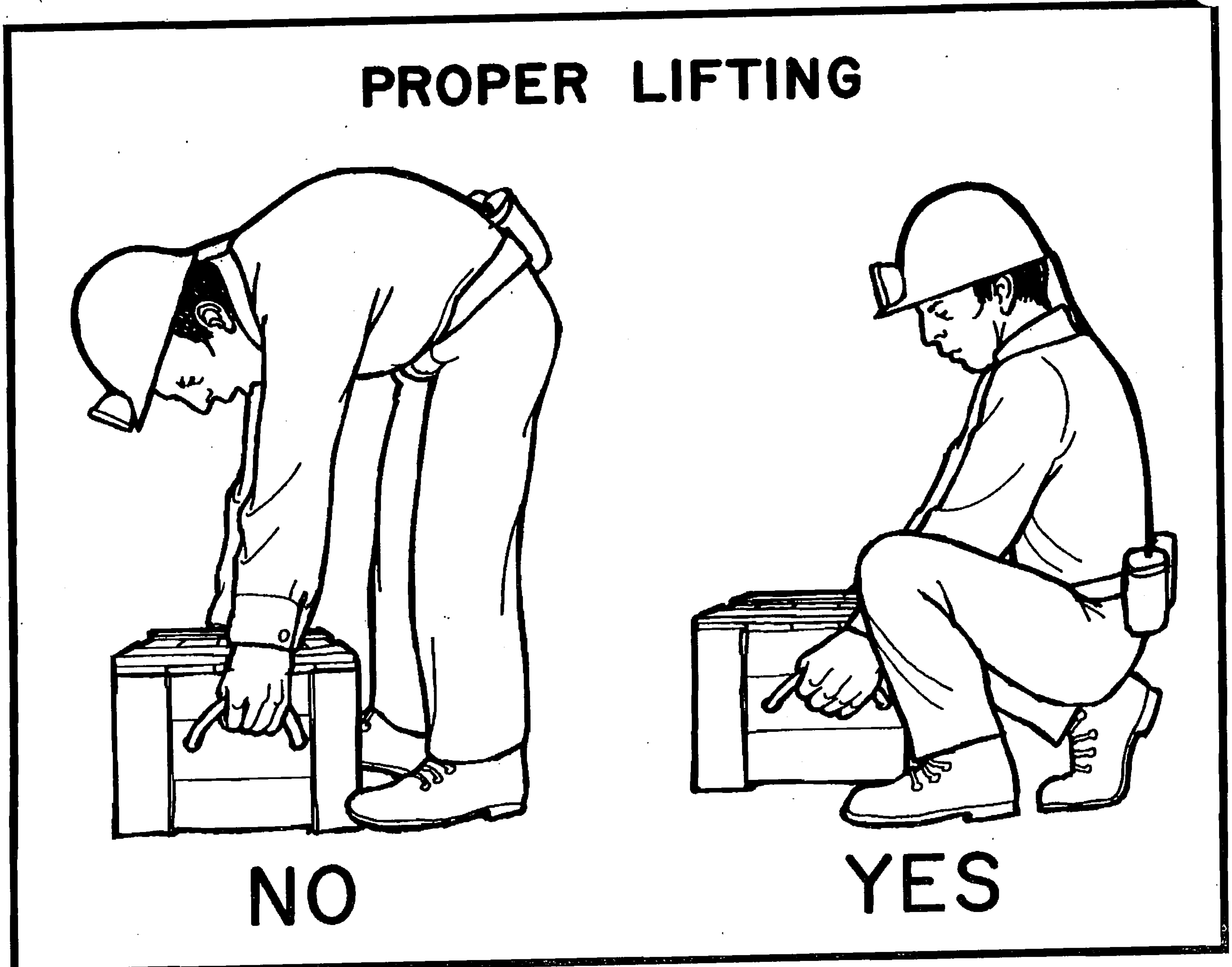


d.

e.



f.



VISUAL 1

IF THE LOAD IS TOO HEAVY:

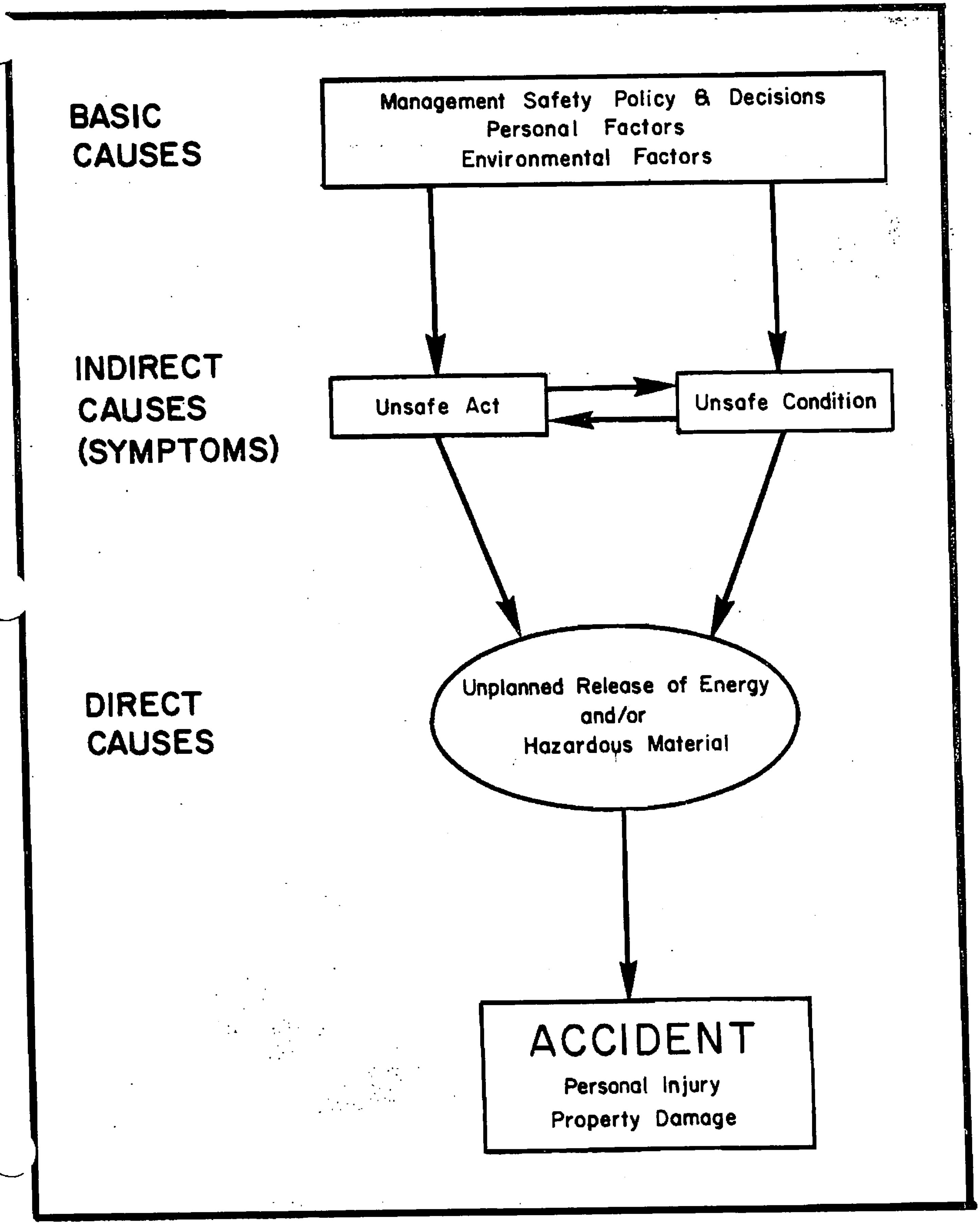
GET HELP! Both face in direction of travel.

LIFTING IN CONFINED AREAS

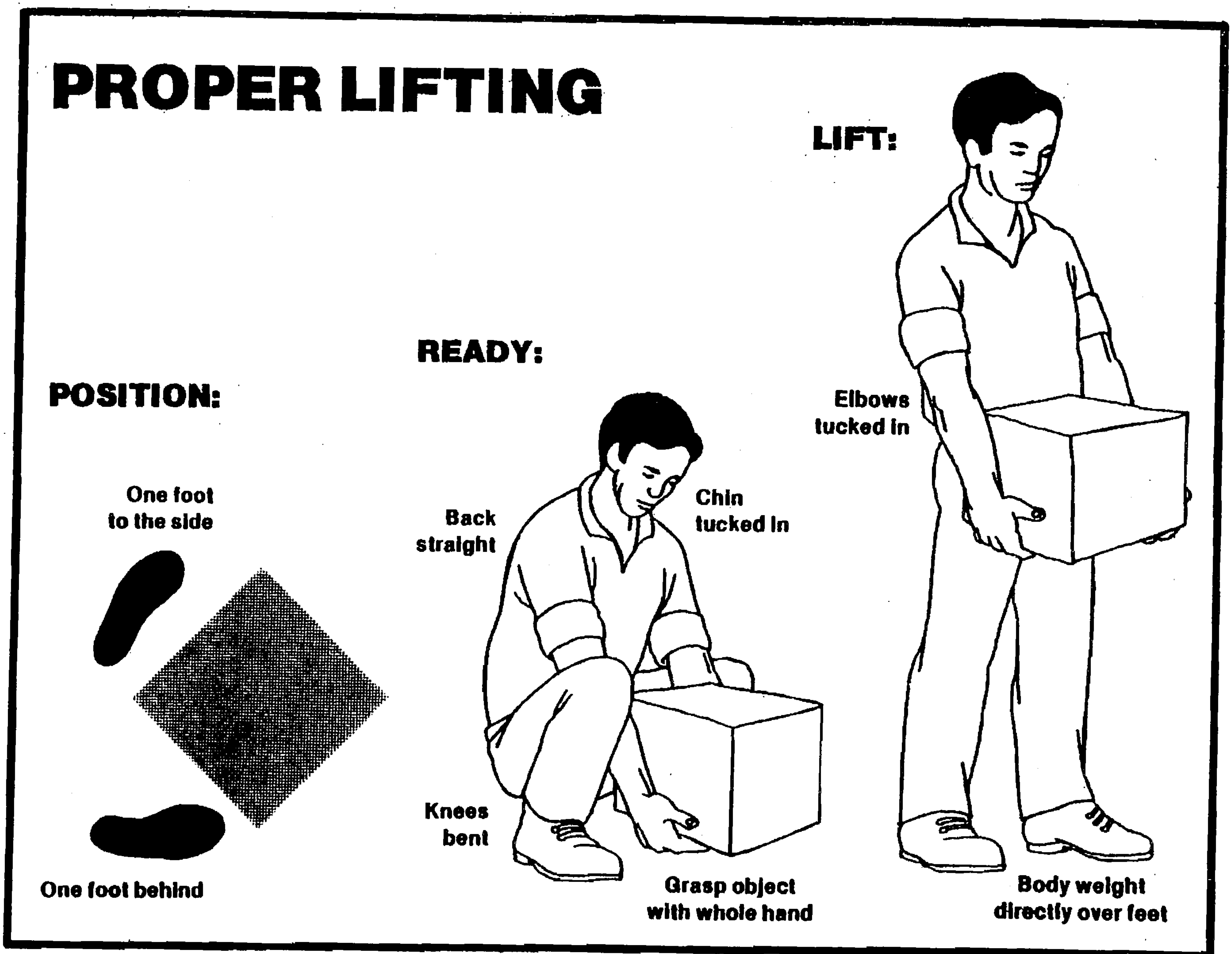
ON HANDS AND KNEES:

Lift object with one hand,
balance with the other.

VISUAL 2

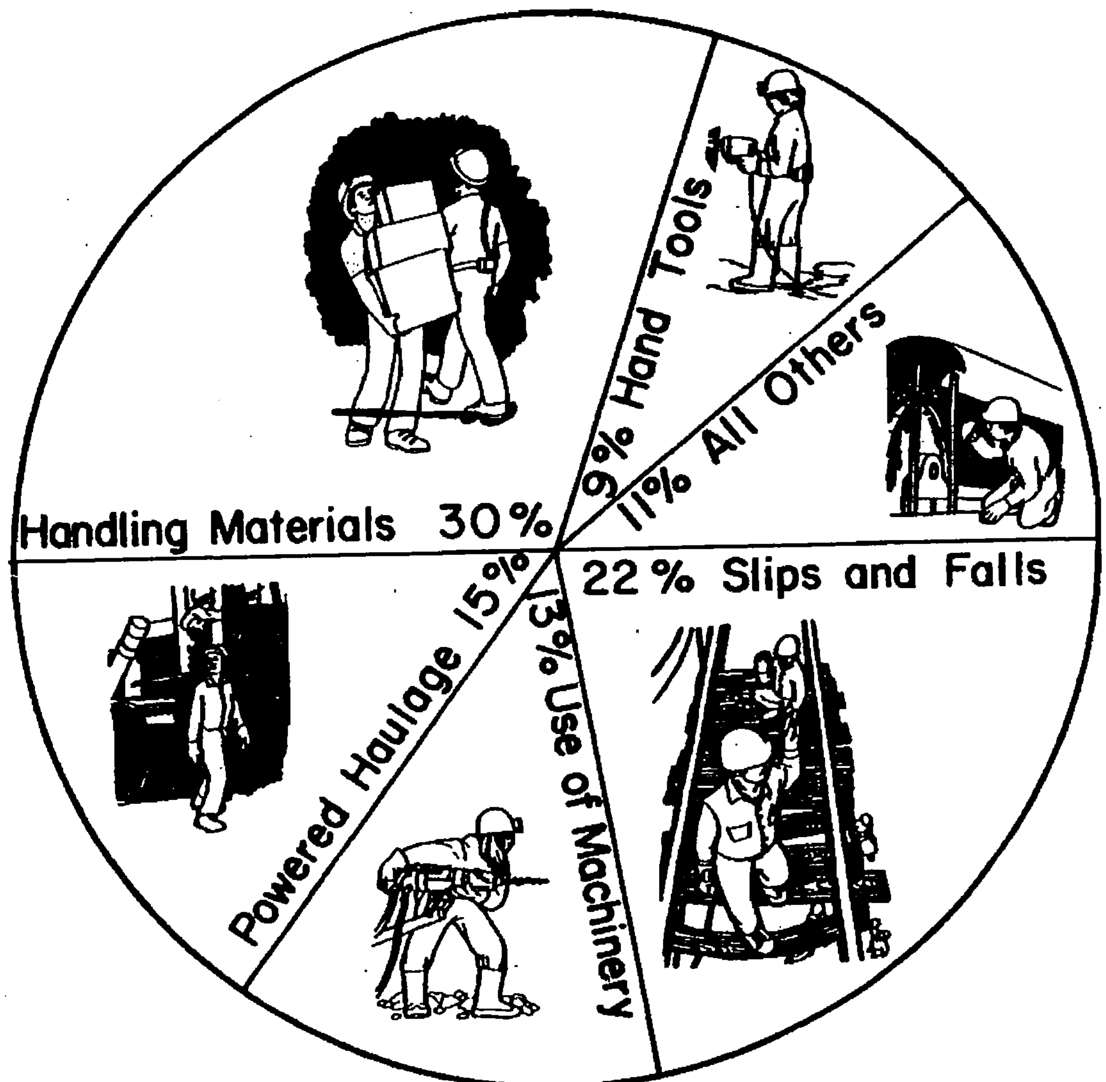

BASIC CAUSES
Management Safety Policy & Decisions
Personal Factors
Environmental Factors
INDIRECT CAUSES (SYMPTOMS)
Unsafe Act
Unsafe Condition
DIRECT CAUSES
Unplanned Release of Energy and/or Hazardous Material
ACCIDENT
Personal Injury
Property Damage

VISUAL 7


PROPER LIFTING
POSITION:
One foot
to the side
One foot behind
READY:
Back
straight
Chin
tucked in
Knees
bent
Grasp object
with whole hand
LIFT:
Elbows
tucked in
Body weight
directly over feet

VISUAL 8

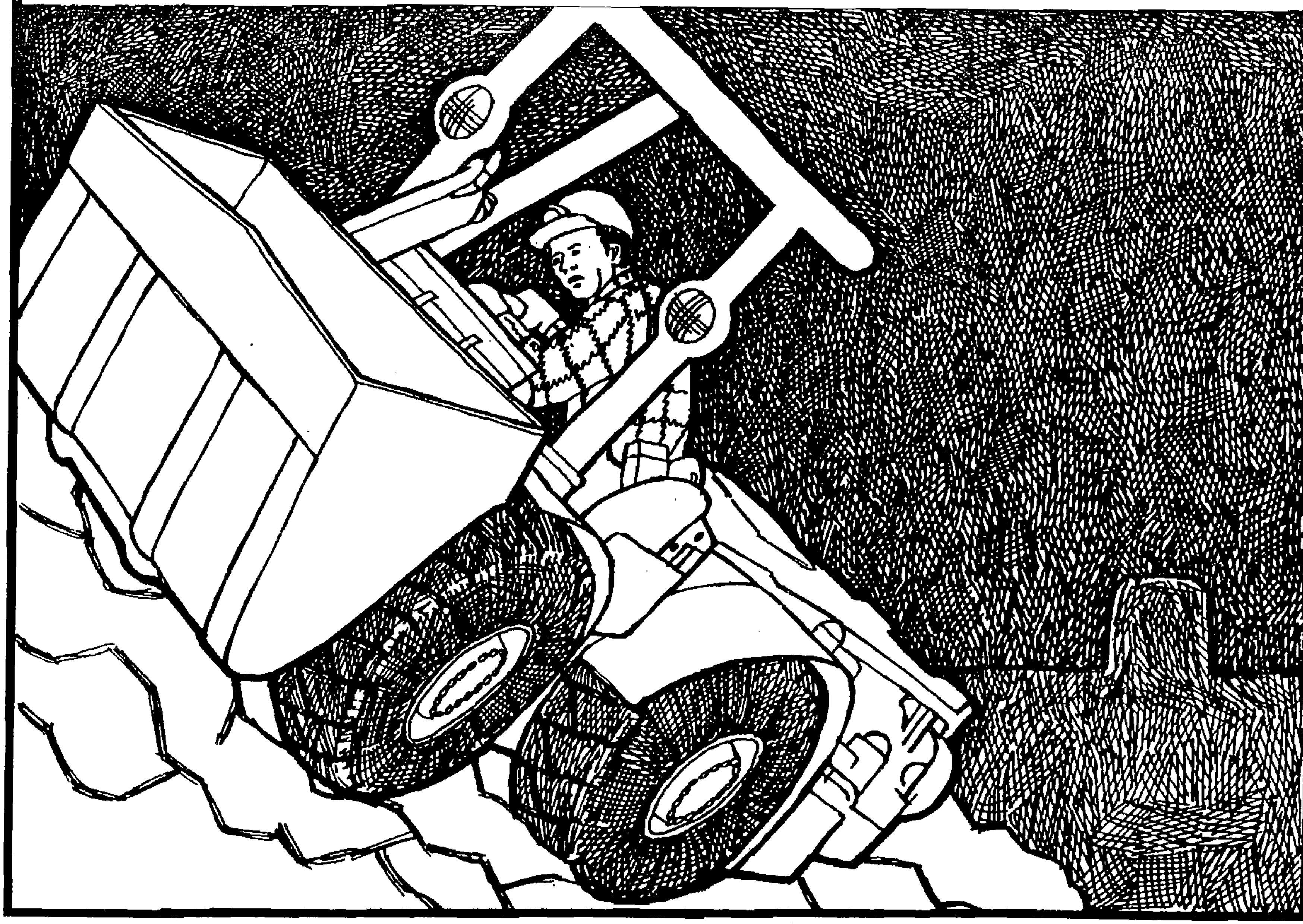
HAZARD RECOGNITION



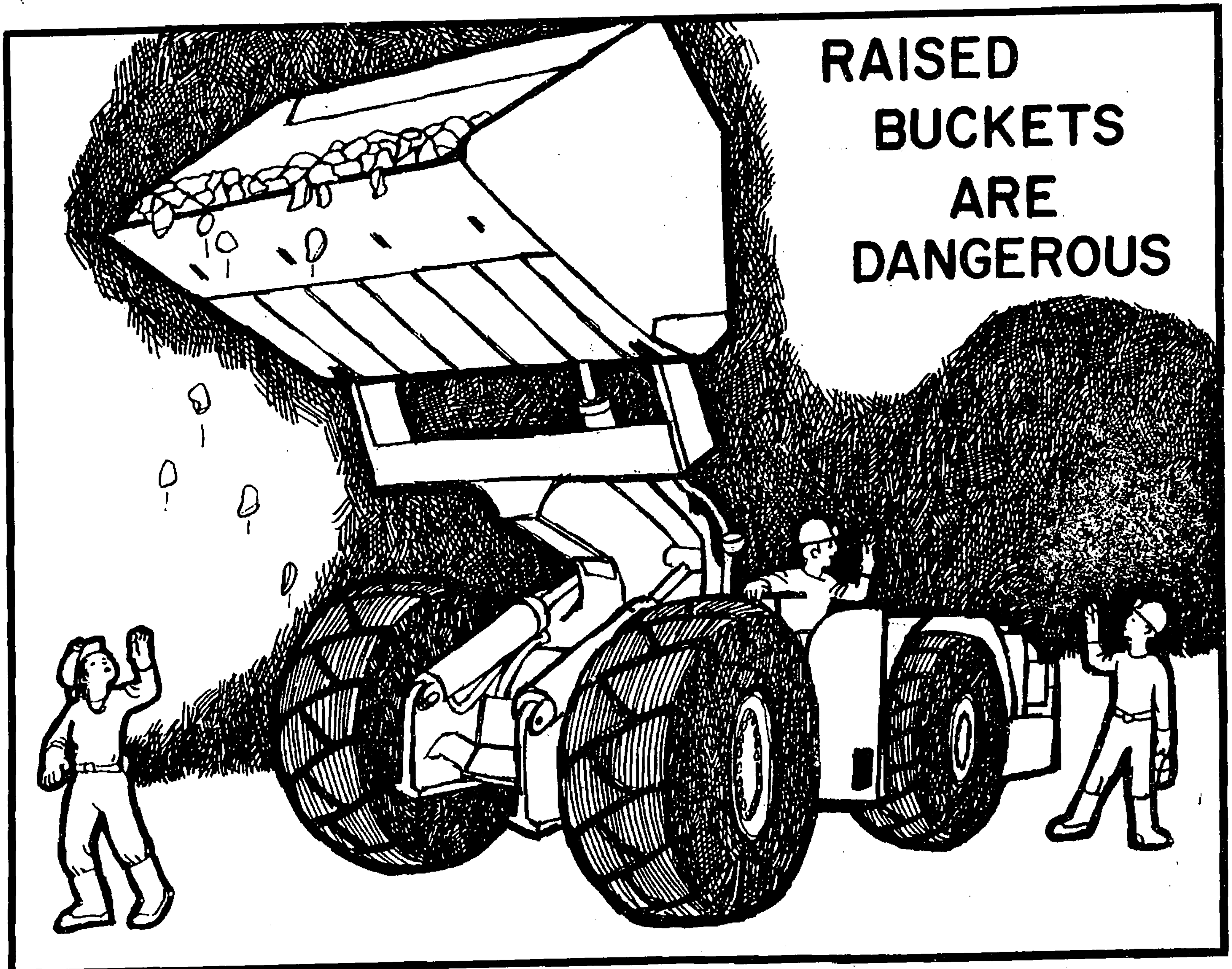
Common Types of Accidents
and Their Percentages

VISUAL 9

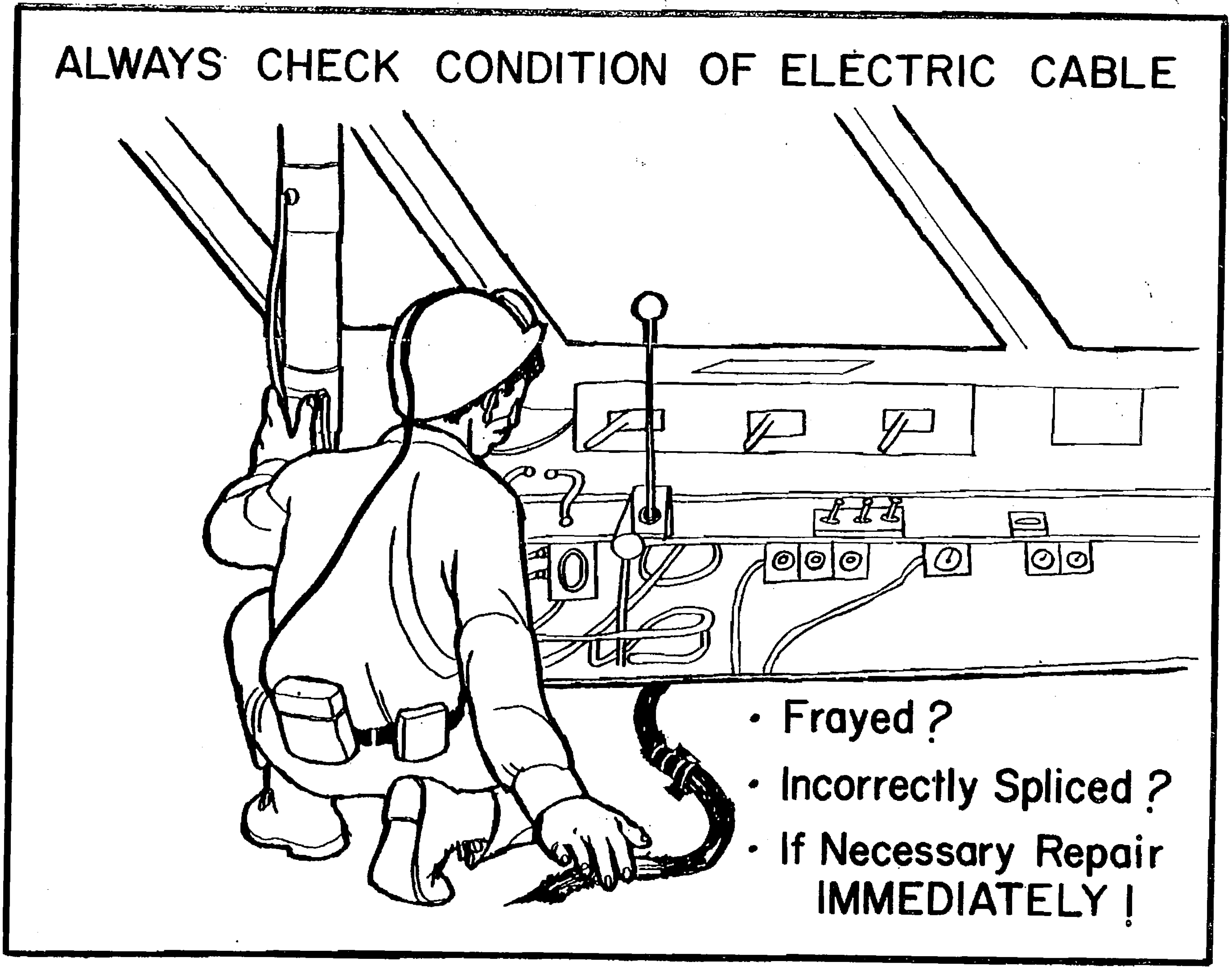
AVOID SIDEHILLS



VISUAL 10



VISUAL 11


ALWAYS CHECK CONDITION OF ELECTRIC CABLE
• Frayed?
• Incorrectly Spliced?
• If Necessary Repair IMMEDIATELY!

VISUAL 12

VISUAL 13

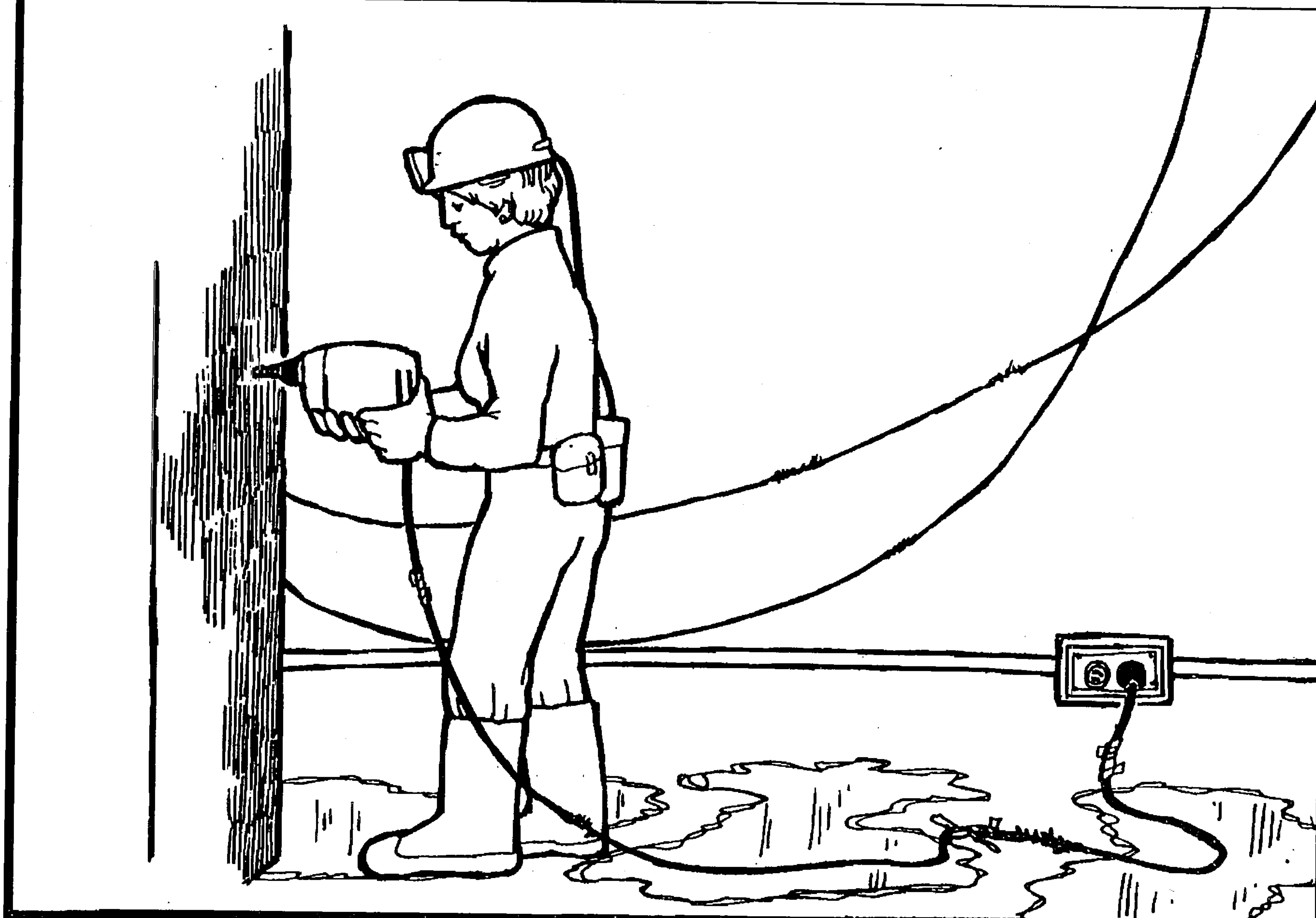
BEWARE WHILE SERVICING MOVING MACHINERY

VISUAL 14

AVOID SLIPS AND FALLS

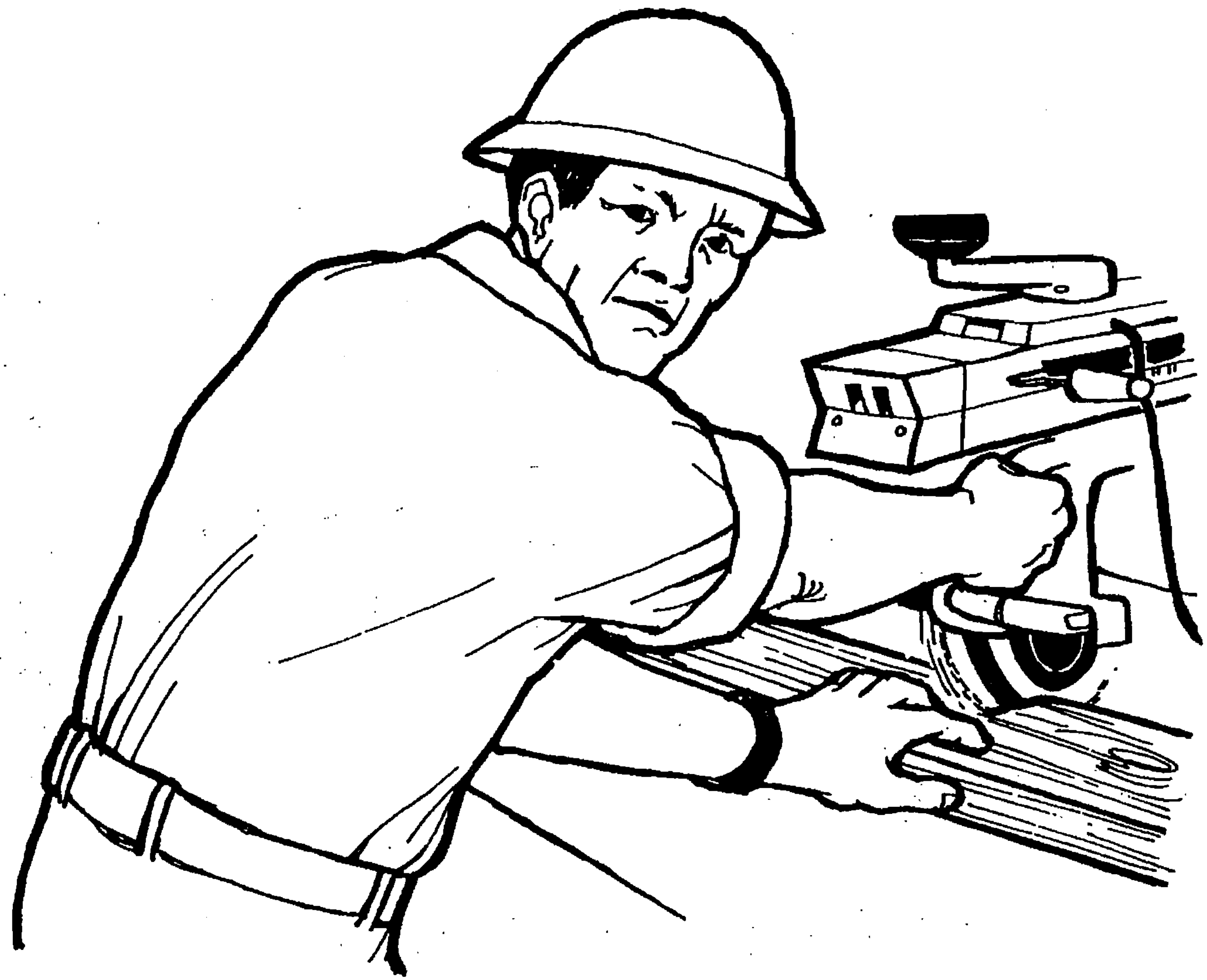
VISUAL 15

INSPECT HAND TOOLS BEFORE USE



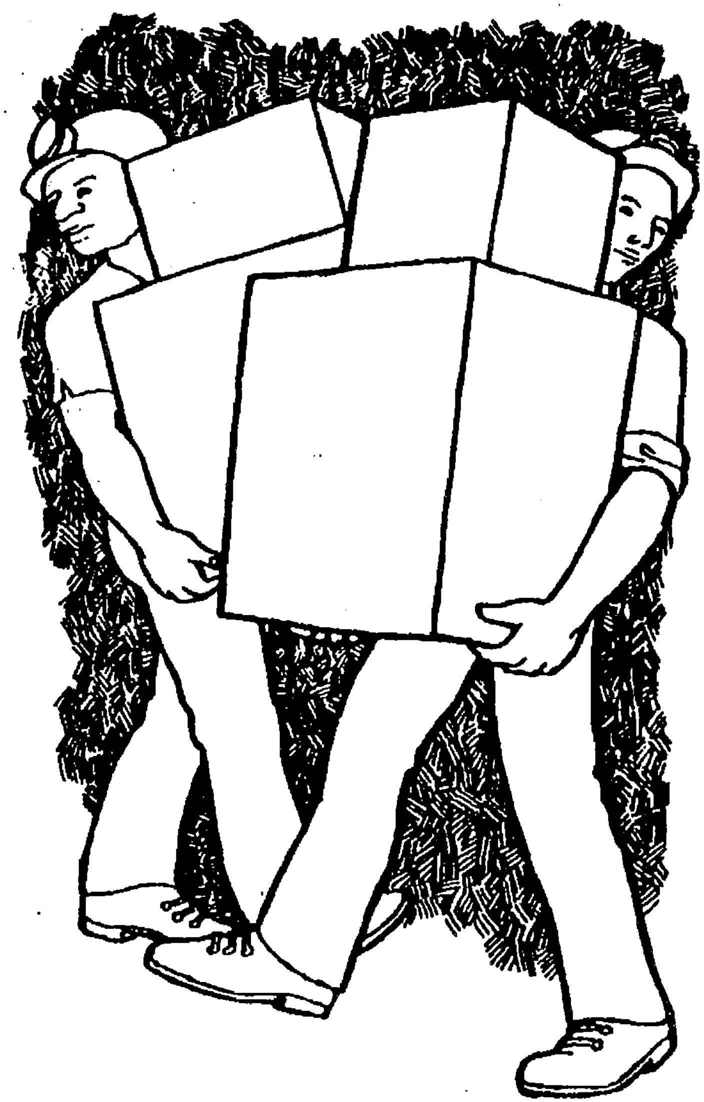
VISUAL 16

USE EQUIPMENT PROPERLY

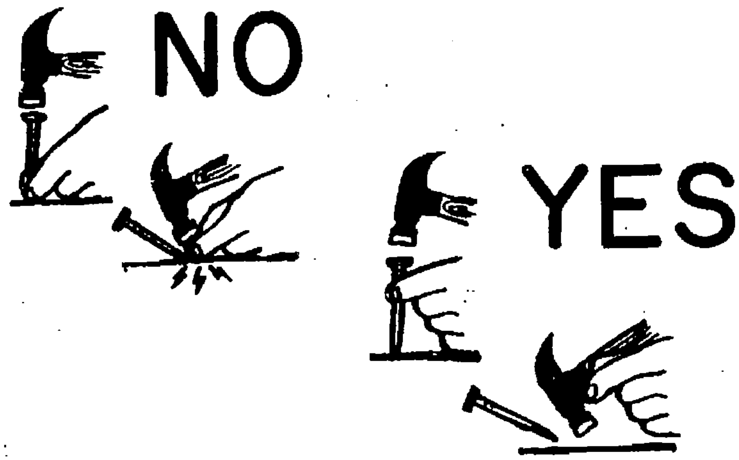


VISUAL 17

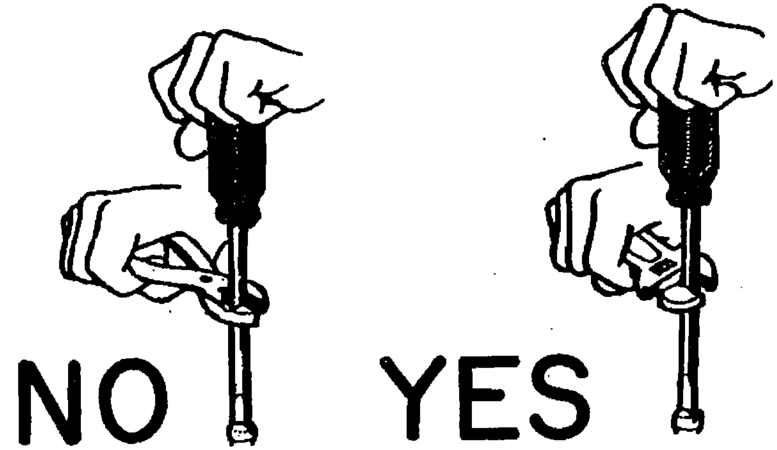
HANDLING MATERIALS



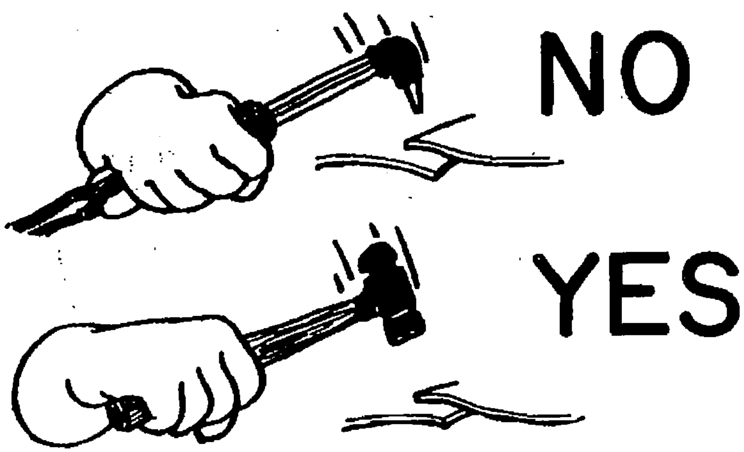
VISUAL 18



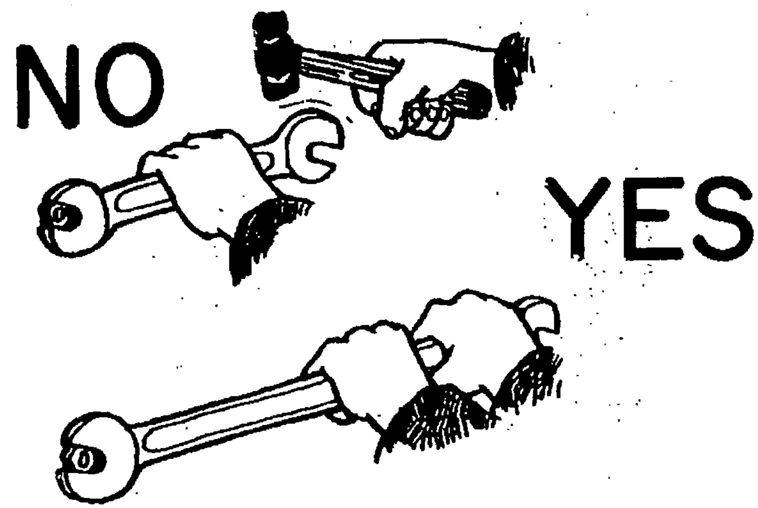
Hold the Nail Near the Head,
Not Near the Point



NEVER Use Pliers on a
Screwdriver. Use a Wrench ONLY
on Square-Shanked Screwdriver.

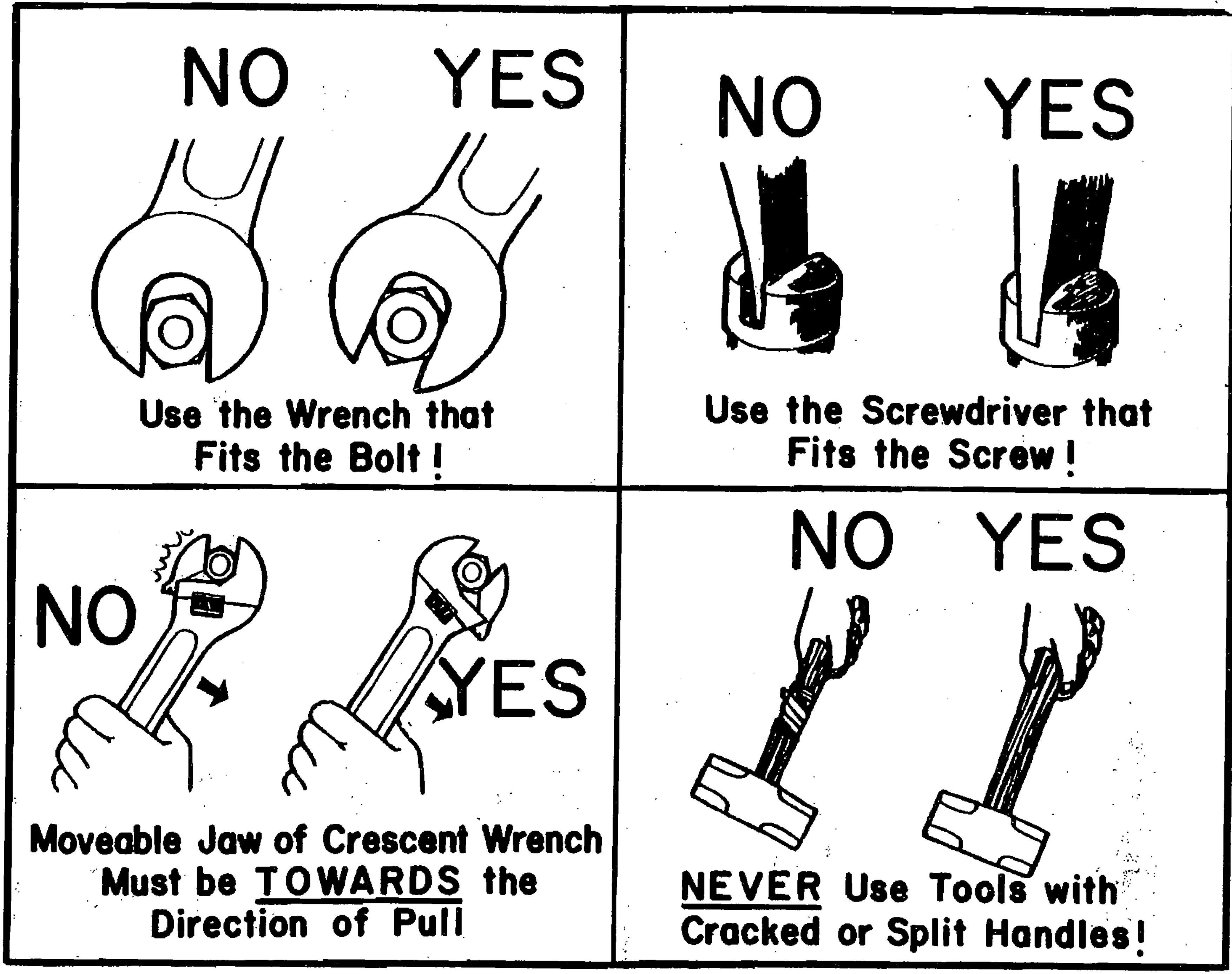


NEVER Use the Torch as a
Hammer!

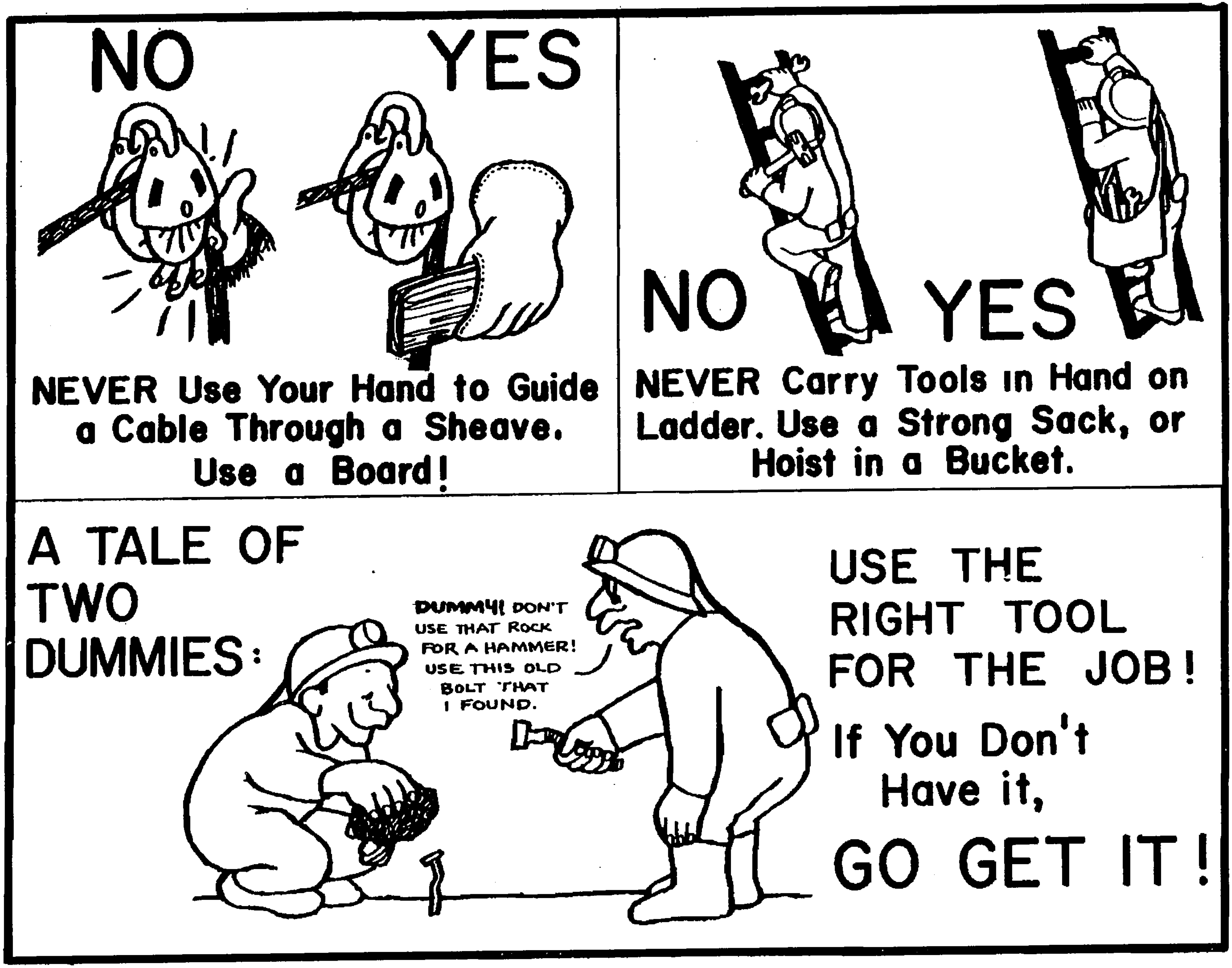


NEVER Force a Wrench with a
Hammer — Get a Longer Wrench!

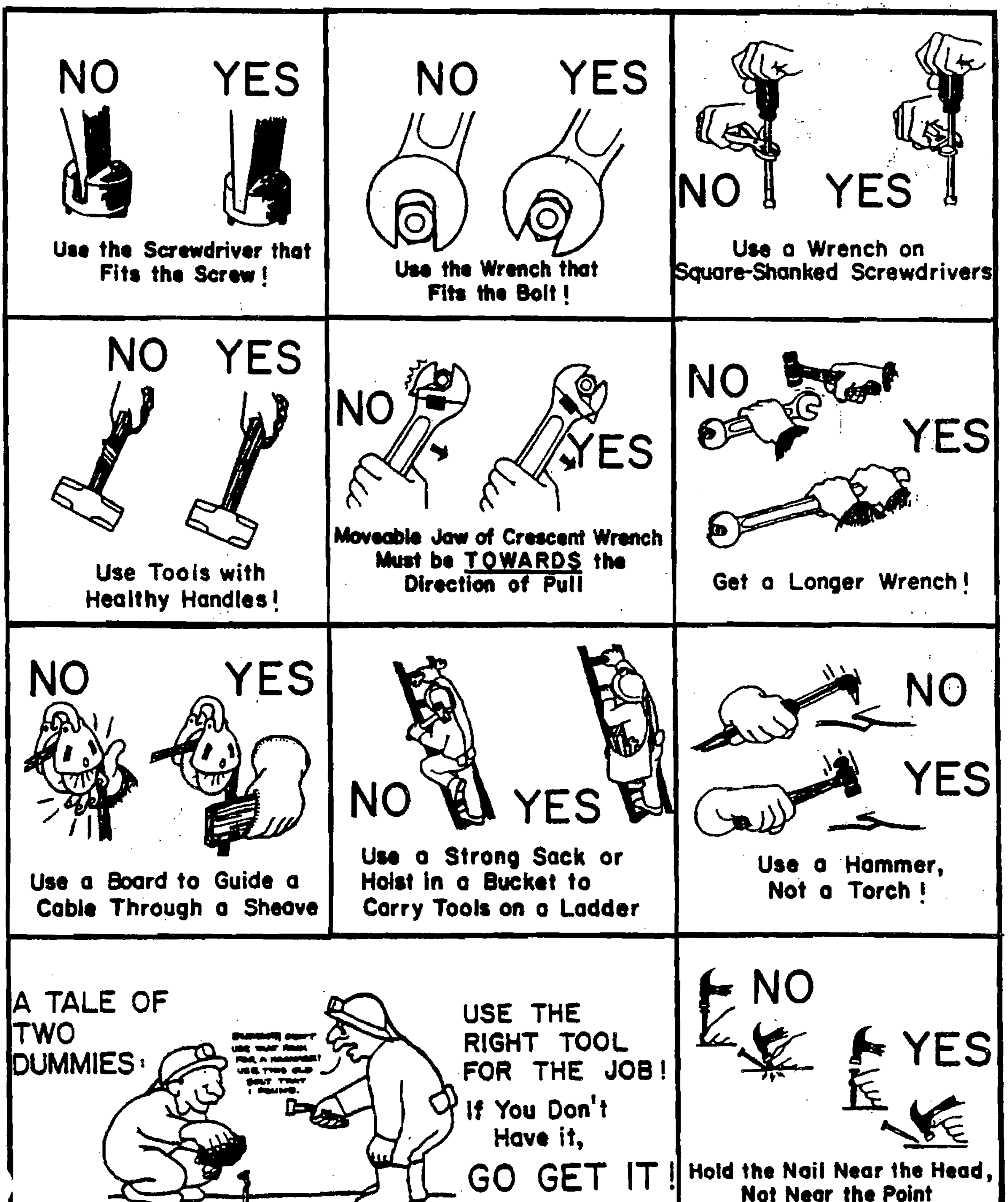
VISUAL 19


NO
YES
Use the Wrench that
Fits the Bolt!
NO
YES
Use the Screwdriver that
Fits the Screw!
NO
YES
Moveable Jaw of Crescent Wrench
Must be TOWARDS the
Direction of Pull
NO
YES
NEVER Use Tools with
Cracked or Split Handles!

VISUAL 20

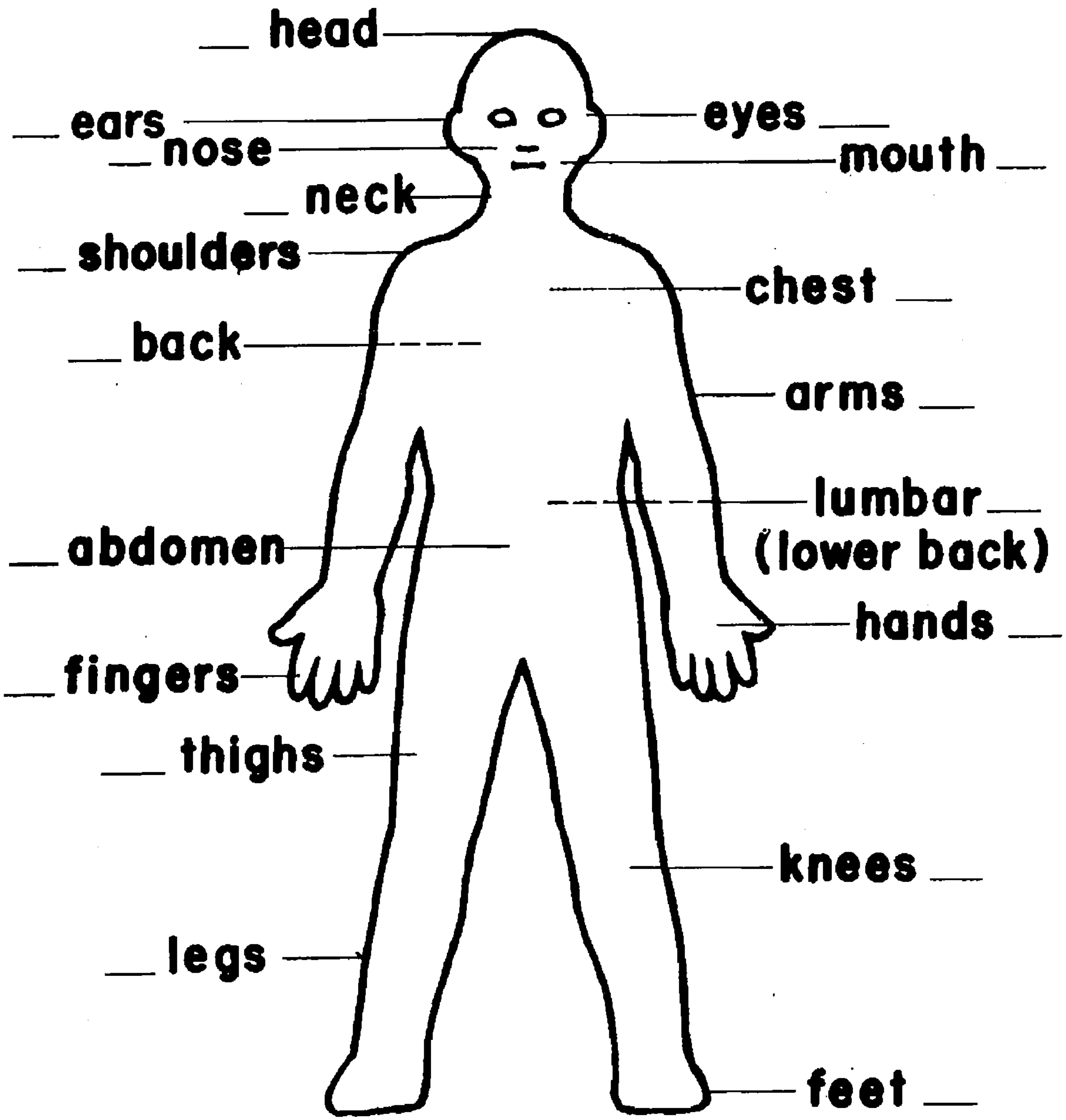

NO
YES
NEVER Use Your Hand to Guide a Cable Through a Sheave. Use a Board!
NO
YES
NEVER Carry Tools in Hand on Ladder. Use a Strong Sack, or Hoist in a Bucket.
A TALE OF TWO DUMMIES:
DUMMY! DON'T USE THAT ROCK FOR A HAMMER! USE THIS OLD BOLT THAT I FOUND.
USE THE RIGHT TOOL FOR THE JOB!
If You Don't Have it,
GO GET IT!

VISUAL 47


NO YES
Use the Screwdriver that Fits the Screw!
NO YES
Use the Wrench that Fits the Bolt!
NO YES
Use a Wrench on Square-Shanked Screwdrivers
NO YES
Use Tools with Healthy Handles!
NO YES
Moveable Jaw of Crescent Wrench Must be TOWARDS the Direction of Pull
NO YES
Get a Longer Wrench!
NO YES
Use a Board to Guide a Cable Through a Sheave
NO YES
Use a Strong Sack or Hoist in a Bucket to Carry Tools on a Ladder
NO YES
Use a Hammer, Not a Torch!
A TALE OF TWO DUMMIES:
USE THE RIGHT TOOL FOR THE JOB!
If You Don't Have it,
GO GET IT!
NO YES
Hold the Nail Near the Head, Not Near the Point

VISUAL 48

BODY PARTS INJURED AT ______ MINE IN ______



VISUAL 49

NEW MINERS

DEEP METAL/NONMETAL

ELECTRICAL HAZARDS

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

DEEP METAL/NONMETAL

COURSE PLAN: ELECTRICAL HAZARDS

I. GOAL: The goal of this module is to increase both miners' skills in recognizing electrical hazards in underground mines and their knowledge of appropriate procedures to avoid and correct them.

II. BACKGROUND: Based on 1979 statistics, the frequency of occurrence of electrical accidents in metal/nonmetal mines was not as high as other types of accidents (handling materials or machinery). However, because of the usually high voltages with which miners accidently come into contact, these accidents frequently result in a large percentage of serious injury. In 1979, 5% of electrical accidents resulted in fatalities, and another 76% resulted in serious injury where miners lost days from work. As the use of electrical equipment increases so does the exposure of miners to its hazards. Many of those injured or killed are miners who do not work routinely with electrical equipment. Consequently all miners should be aware of electrical hazards.

III. OBJECTIVES:

A. The instructor will do the following:

1. Describe fundamentals of electricity, including conductors, resistance, insulators and circuit breakers.
2. Describe the effects of electricity on humans including the relationship between severity of electrical shock and amount of current.
3. Name common electrical accidents in general, and specific electical accidents at the mine in particular.
4. Demonstrate rescue techniques for an electrocuted miner.
5. Inform trainees about which employees are permitted to perform electrical work, and about who to notify when electrical hazards are discovered.
6. Demonstrate lock-out and tag-out procedures.
7. Identify mine equipment that is battery operated and discuss safe procedures when working with batteries and battery chargers.

B. Trainees will be able to do the following:

1. Answer questions concerning fundamentals of electricity.
2. Describe the effects of electricity when in contact with the human body.

3. Describe the relationship between the amount of current and the severity of injuries in electrical accidents.
4. Point out contributing factors to electrical accidents during mine tour or otherwise recognize them.
5. During a classroom simulation rescue an electrocuted miner or otherwise demonstrate knowledge of rescue techniques.
6. Write or call out names of miners permitted to perform electrical work at your mine; also procedures for reporting electrical hazards.
7. Discuss reasons for and company policy regarding lock-out and/or tag-out procedures.
8. Demonstrate safe procedures when working with batteries and battery chargers on site.
9. Point out mine equipment which uses battery power in the mine.

IV. ACTIVITIES

A. In classroom

1. Performance of procedures for removing person from hot wire.
2. Performance of correct lock-out and tag-out procedures on simulated circuit breaker.

B. On site: Determine location of switches that might be thrown in emergencies.

V. MATERIALS

A. Visual aids-Illustrations from the Lesson Guide and Materials.

B. Electrical equipment, circuit breakers, locks, and tags

VI. EVALUATION

A. Describe, demonstrate or identify hazards in the mine

B. Self-checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES:

A. Training standards: CFR 30 Part 48.5-10

B. Applicable Federal regulations CFR 30 Part 57.12

C. Textual materials

1. NMHSA-CE-005 Electrical Hazards Workbook.
2. MESA Safety Manual No. 9 - Electrical Hazards.
3. Analysis of Electrical Fatalities at Metal/Nonmetal Mines, 1/1/72 to 8/31/77. MSHA yellowjacket, MSHA Informational Service Library, Lakewood, Colorado 200.266.
4. Chironis, N. P. Training Manual For Miners, Volume 1: Underground Mining. New York: McGraw-Hill, 1980.

C. Films

1. MSHA Training Film No. 835 - "Electrical Equipment - Master or Servant"
2. MSHA Training Film No. 864 - "Electrical Lock-Out Procedures"
3. International Firm Bureau - "Contact".

TOPICS COVERED

I. INTRODUCTION TO PRINCIPLES OF ELECTRICITY

A. Electrical terms

1. Electrical circuit
   a. Comparison with water system
   b. Need for complete circuit
   c. Grounding
2. Insulation and resistance
3. Circuit breakers and fuses
4. AC and DC current

B. Sources of electricity

1. Transmission lines
2. Generators
3. Transformers
4. Batteries

C. Uses of electricity in mine

1. Pumps
2. Illumination
3. Battery chargers
4. Detonation of explosives
5. Conveyor belts
6. Electric drives on haulage trucks
7. Shop equipment including hand tools

8. Hoists and skips
9. Slushers
10. Electric locomotives

D. Power distribution centers

II. EFFECTS OF ELECTRICITY ON HUMANS

A. Human as electrical conductor

1. Conduction to ground
2. Relative resistance of human compared with groundwire
3. Need for insulation

B. Water as conductor of electricity

1. Increases human conductance
2. Increases current through human

C. Effects of electricity on health

1. Shock
2. Burns
3. Eye injury
4. Death

III. FACTORS CONTRIBUTING TO ELECTRICAL ACCIDENTS

A. Unsafe conditions

1. Faulty insulation
2. Faulty connections and splices
3. Faulty grounding

B. Unsafe acts

1. Failing to lock-out equipment being worked on
2. Working near energized conductor
3. Operating equipment or working near energized transmission lines or trailing cables
4. Use of improperly maintained equipment
5. Unauthorized work on electrical equipment
6. Not using personal protective clothing
7. Motor Startup

C. Patterns of electrical fatalities in metal/nonmetal mines.

IV. RESCUE TECHNIQUES FOR PERSON IN CONTACT WITH ELECTRICAL WIRE

A. Shut off current

B. Use insulation in removal from wire

C. First aid procedures

V. SPECIAL FACTORS RELATED TO BATTERIES AND BATTERY CHARGES

A. Description of batteries

B. Battery Acid

C. Explosive nature of gases from charging

VI. PERFORMANCE OF ELECTRICAL WORK

A. Who is authorized – company policy

B. Miners responsibility for reporting malfunctions

VII. LOCK-OUT AND TAG-OUT PROCEDURES

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: ELECTRICAL HAZARDS

INSTRUCTOR NOTE: THE FOLLOWING SECTION IS DESIGNED TO GIVE THE MINERS SOME BACKGROUND IN THE BASICS OF ELECTRICITY. THIS IS NOT INTENDED TO BE A COMPLETE EXPLANATION OF ELECTRICITY, BUT RATHER SERVES TO ORIENT MINERS TO SUBSEQUENT DISCUSSIONS OF ELECTRICAL HAZARDS, ELECTRICAL ACCIDENTS, AND SAFE WORK PROCEDURES.

I. INTRODUCTION TO PRINCIPLES OF ELECTRICITY

A. Electrical terms

VISUALS NOTE: DURING THE FOLLOWING DISCUSSION SHOW VISUAL 30, THE DRAWINGS OF AN ELECTRICAL CIRCUIT AND A WATER PUMP AS A COMPARABLE ILLUSTRATION. POINT OUT KEY FEATURES OF THE DRAWINGS DURING YOUR PRESENTATION.

1. Electrical circuit

a. An electrical circuit can be compared to a closed water system. The water system consists of a water pump, a piece of equipment called the load that uses the water pressure created by the pump, two sections of pipe connecting the pump with the load, and a shut off valve. The pump pushes water into one section of pipe with a certain amount of force. As water flows through the pipe it reaches the closed shut off valve, and eventually fills the entire section of pipe between the pump and valve. The pump maintains the water at a constant pressure against the valve. When the valve is opened, it can drive the load with a certain amount of pressure. The second section of pipe returns the used water from the load to the pump, but the water is not under pressure. The larger the pump, the greater the volume and rate of flow of water in the pipe. The size of the pipe influences the volume of water that is pumped through it.

In the electrical circuit, each of these features has a comparable part. The electrical circuit consists of a generator, a piece of equipment called the load (such as a light bulb or a dragline), two sections of wire connecting the generator with the load, and a switch. The generator activates millions of electrons and forces them onto the conductor or wire with a certain pressure or voltage. The electrons travel along the conductor until they reach the shut off switch. When the switch is turned "on" the electricity drives the electrical equipment. Used electrons are returned to the generator by the second wire, or through a ground, thereby completing the circuit.

b. A complete circuit consists of a conductor connecting the power source to the electrical equipment, and another conductor either returning electrons to the power source or serving as a ground. Current cannot flow unless the circuit is complete.

c. Electricity takes the path of least resistance. Grounding takes advantage of this by connecting the circuit with the earth, which is a good conductor. If a piece of equipment is grounded, should a short circuit occur the current will travel through the ground wire into the earth. Without this ground wire, should a piece of equipment short circuit, any miner who would touch the equipment would serve as the ground. That is, electrons would travel from the equipment through the body into the earth, and this could result in the miner being electrocuted.

2. Insulation materials have high resistance such that electricity is unable to flow along them. Dry wood, rubber, plastic and glass are good insulators. However, these materials lose their insulating ability when they become wet because water is a conductor of electricity.

3. Circuit breakers and fuses

   a. Fuses and circuit breakers are used to prevent overloading circuits. An overload occurs when so much electricity attempts to travel to the piece of equipment that it would cause the equipment to overheat and possibly blow-up. As the current increases the fuse blows or the circuit breaker trips, interrupting the flow and the equipment thereby shuts down.

   b. When a circuit is broken, it is usually a result of an overload or a short in a piece of equipment. A qualified person should inspect the equipment before resetting a circuit breaker or replacing a fuse.

4. Electrical power can be of two types, AC and DC.

   a. DC represents direct current, meaning that the current flows in only one direction. Many kinds of hoists and battery chargers use DC.

b. AC represents alternating current, meaning that the current can change direction along the wires. Home electricity and hand tools are AC.
c. Most equipment runs on only one type of current, either AC or DC. Damage can result to equipment if you try to run it on the wrong type of current.

INSTRUCTOR NOTE: THIS IS A GOOD POINT TO ASK A GENERAL QUESTION REGARDING THE DEFINITIONS OF ONE OR MORE OF THESE ELECTRICAL TERMS.

VISUAL NOTE: YOU MAY WISH TO SHOW VISUAL 46, THE ILLUSTRATION ENTITLED "ELECTRICITY - THE PATH FROM PRODUCTION TO MINE USE" DURING THE FOLLOWING DISCUSSION.

B. Sources of electricity

1. Electric power may be purchased by the mine from a utility company and brought to the mine on transmission lines.
2. Another source of electricity is the gas or diesel driven generator. Generators produce voltage or electrical pressure.
3. Transformers increase or decrease voltage traveling through lines to match the power requirements of different equipment.
4. Batteries are also used to power some equipment used in mines. Batteries vary in physical size and voltage. Some mine batteries contain many cells connected in series to produce up to 300 volts.

C. Uses of electricity in the mine

1. Water pumps
2. Lights
3. Battery chargers
4. Electric drives on haulage trucks
5. Detonation of explosives
6. Conveyor belts
7. Shop equipment including hand tools
8. Hoists and skips
9. Slushers
10. Electric locomotives
11. Ventilation fans
12. Communications
13. Air compressors
14. Electric drills - auger type
15. Electric motors on drills or cutters
16. Crushers and other processing machinery.

D. Power distribution centers are similar to transformers which change the voltage in an AC power cable. These distribution centers have connections to hook-up cables from various pieces of machinery and equipment that run on electricity.

VISUAL NOTE: POINT OUT THE LOCATIONS OF GENERATORS, POWER DISTRIBUTION CENTERS, ETC. ON THE MINE MAP. VISUAL 33 MAY BE OF HELP TO YOU HERE.

II. EFFECTS OF ELECTRICITY ON HUMANS

A. Human as an electrical conductor

1. Electric shock occurs when the human becomes part of the electric circuit. Touching a bare electric wire or cable, or a piece of short-circuited equipment would result in shock if your body offered the least resistance to the ground.

INSTRUCTOR NOTE: SHOW VISUAL 52. POINT OUT THE MINER IS DOING ELECTRICAL WORK ON AN ENERGIZED CONDUCTOR, OR IS WORKING TOO NEAR AN ENERGIZED CONDUCTOR.

2. Under most circumstances, a properly attached groundwire provides the path of least resistance to the earth. Contact with a grounded wire can result in a shock, but this would only be slight in nature.
3. Whenever working with electrical equipment you should wear protective clothing. Rubber boots and rubber gloves should be in good condition with no holes or tears. Additional protection is provided by insulated platforms, rubber mats and belts, dry timbers, and other dry wooden poles and slats.

B. Water as a conductor of electricity.

1. The human body is a good conductor of electricity because of the large percentage of water in it.
2. Any pool of water through which an exposed electrical conductor passes is just as hazardous as the wire or cable itself. Any miner making contact with the water will result in electrocution unless the miner is wearing rubber boots.

C. Effects of electricity on health

1. Shock results when people come into contact with electricity. The stronger the current the worse the shock to the electrocuted miner.

INSTRUCTOR'S NOTE: RATHER THAN GO THROUGH THIS LISTING OF INCREASED INJURY WITH INCREASED CURRENT WHICH MAY CONFUSE SOME OF YOUR MINERS, YOU MAY WANT TO SIMPLY STATE THE GENERAL HAZARD FROM INCREASED CURRENT.

VISUALS NOTE: SHOW VISUAL 32, THE GRAPH LISTING THE EFFECTS OF INCREASED CURRENT ON HEALTH

a. currents of 1 mA or less are safe. You probably couldn't feel anything at all.
b. 1 mA to 8 mA produces a shock but it isn't very painful. 5 mA is considered the maximum harmless current intensity.
c. 8 mA to 15 mA are dangerous currents. It produces a painful shock, but your muscular control would not be effected.
d. 15 mA to 20 mA produces a painful shock. Normal muscular control would be overridden because of the strong current, and you probably would not be able to let go of the wire. Your hand muscles would not respond.
e. 20 mA to 50 mA results in a very painful shock. Muscles would contract severely. Your respiratory system could be paralyzed and breathing would be very difficult.
f. 100 mA to 200 mA causes the heart to stop its beat and it twitches or contracts without control. This is called ventricular fibrillation. This is fatal unless immediate cardiac arrest procedures are followed.
g. 200 mA and over leads to severe burns. Muscular contractions become so bad that chest muscles clamp down on the heart and stop it from beating for however long the shock lasts. Death often results.

2. Electric burns - As electricity travels through the conductor it generates heat. Electric burns can be caused by touching an overheated conductor, just as you would touch an overheated stove. In some cases enough heat is generated to produce incandescence, such as in a lamp filament, or will result in a ground melting a fuse or setting fire to materials in contact with the over-heated conductor.
3. Electric flash - even though the miner may not come into physical contact with an electric arc, the bright flash of light from the arc can cause eye injury due to inflammation of the retina. This kind of light occurs during electric welding, short circuiting, and

opening or closing circuits. An electric arc will melt or destroy practically all substances or materials exposed to it, including flesh, muscles, nerves and bones. Contact with arcs results in extensive third-degree burns and often results in death.

4. Electrical currents should always be treated with respect. Low voltage electricity, as low as 27 volts, is still powerful enough to be lethal when there is low resistance or high current.

EVALUATION NOTE: HAVE THE TRAINEES ANSWER SELF CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY ANY INCORRECT ANSWERS. THESE QUESTIONS CONCERN PRINCIPLES OF ELECTRICITY, AND EFFECTS OF ELECTRICITY ON HEALTH.

INSTRUCTOR NOTE: YOU MAY WANT TO PRESENT THE FOLLOWING MATERIALS AS A LIST OF SAFE WORK HABITS TO FOLLOW WHEN DOING ELECTRICAL WORK OR WORKING NEAR ELECTRICAL EQUIPMENT.

III. FACTORS CONTRIBUTING TO ELECTRICAL ACCIDENTS

A. Unsafe conditions

1. Whenever using rubber boots or gloves for insulation, check for holes or tears through which your skin could contact the wire or cable.
2. Make sure your connections to power distribution centers and electrical equipment are tight. Splices should be checked for complete connections.
3. Assure that grounds are complete to minimize chances for electrocution. Never take out a ground fault wire from a piece of equipment.

B. Unsafe acts

1. Always lock-out equipment before beginning work on it.
2. Working very near an energized conductor may be an unsafe act if it is possible that you could accidently come into contact with it. Always shut the power off before beginning work near electrical lines and equipment.
3. Always be aware of your location relative to energized lines.
4. Never use faulty equipment. Electric hand tools should not have frayed wires.
5. Only authorized personnel are permitted to work on electrical equipment
6. Use insulated protective clothing when working with electrical equipment.

7. Before starting motors make sure everyone is clear so they will not be injured or caught from any sudden unexpected movement of the machine.
8. Avoid driving mobile equipment over unbridged power conductors or dragging loads (such as barrels or bags) over such unprotected cables.

C. Patterns of electrical fatalities in metal/nonmetal mines

1. Profile of the typical victim

   a. Less than 3 years of job experience
   b. Less than 5 years of mining experience
   c. Killed while performing assigned tasks. 22% of the fatalities from 1972 to 1977 involved electricians and electrical helpers. 78% of the fatalities occurred to other occupations.

2. Profile of typical causes shows 84% of the fatalities result from unsafe acts. These acts were:

   a. Performing electrical work on or near an energized conductor.
   b. Operating equipment or working too near energized lines.
   c. Inadequate frame grounding.
   d. Defective insulation or splice.

3. Conclusions

   a. High frequency of nonelectrical worker fatalities explains why there are so many injuries from the lack of proper frame grounding and defective insulation and splices. Only qualified electricians or their helpers should do electrical work.
   b. People should not hesitate de-energizing lines when there work brings them close to a power line.

IV. RESCUE TECHNIQUES FOR PERSON IN CONTACT WITH AN ELECTRICAL WIRE

1. Your goal in rescuing the miner is to remove him from the circuit as quickly as possible. Do not touch the person or you too will become part of the circuit. One way to do this is to disconnect the power to the circuit by turning off the switch or pulling the plug. Disconnecting the power is the safest way to remove a person from electrical contact.

2. Another rescue technique is to use an insulator (dry wood, rope, shovel, jacket) to remove the person from the wire or cable. You may have to strike the person fairly hard to break him from the current. Time is critically short, so your first reactions are very important.

VISUALS NOTE: SHOW VISUAL 34, THE DRAWINGS OF THESE TWO RESCUE TECHNIQUES. AGAIN EMPHASIZE THAT THE TRAINEE SHOULD NOT DIRECTLY TOUCH THE MINER IN THE CIRCUIT.

3. Following rescue appropriate first aid measures, especially CPR, will probably be required to restore heart beat or breathing and to protect wounds. In many cases, victims may be saved by prompt application of artificial respiration since that part of the nervous system which controls breathing often fails as a result of an electrical accident.

INSTRUCTOR NOTE: THIS WOULD BE A GOOD POINT TO REVIEW CPR METHODS AND FIRST AID TREATMENT FOR BURNS.

VISUAL NOTE: SHOW VISUAL 35, THE GRAPH OF THE CURVE FOR POSSIBILITY OF SUCCESS PLOTTED AGAINST ELAPSED TIME BEFORE START OF ARTIFICIAL RESPIRATION.

V. SPECIAL PROBLEMS ASSOCIATED WITH BATTERIES

A. Batteries are used in mines to power electric motors, to start diesel engines, and to power lights. Physical size is the only basic difference between an automobile battery and the large mining batteries. Automobile batteries have a voltage output of 12 volts, but in the mines, many cells are connected in series. A common tray voltage output is 300 volts.

VISUALS NOTE: SHOW VISUAL 53, THE DRAWING OF A MINE BATTERY TRAY.

B. The acid in battery cells consists of a water-sulfuric acid mixture. This mixture will cause severe skin burns and eye damage if allowed to remain in contact. Plenty of clean water dilutes the acid, or a baking soda-water solution will neutralize the acid.

C. The energy used from a battery has to be restored frequently. Mining batteries are recharged by battery chargers. During the recharging cycle and use cycle, the chemical reaction produces hydrogen gas which can be very explosive. Charging stations and battery compartments can have explosive concentrations of hydrogen gas. Ventilation is used to dilute and remove hydrogen gas and is important at charging stations and in battery trays. This is one reason why the law requires that charging stations be on a separate split of air. To minimize fire hazards, the tops of batteries must be kept clean of grease and dirt. This is accomplished by cleaning with the water-baking soda solution mentioned above.

INSTRUCTOR NOTE: YOU MAY WANT TO ASK YOUR TRAINEES AFTER THE FOLLOWING SECTION IF THEY HAVE ANY QUESTIONS REGARDING MINE POLICY FOR WHO IS AUTHORIZED TO PERFORM ELECTRICAL WORK, AND THEIR RESPONSIBILITY FOR REPORTING MALFUNCTIONING ELECTRICAL EQUIPMENT.

VI. PERFORMANCE OF ELECTRICAL WORK

A. Only qualified electricians are permitted to work on electrical equipment in the mine.

B. All miners are responsible for reporting to their supervisors any malfunctioning electrical equipment. Report any unsafe work condition to your supervisor. Discuss any unsafe act with the miner to reduce hazardous behavior.

VII. LOCK-OUT AND TAG-OUT PROCEDURES.

1. Whenever work is done on electrical components or equipment, the power to these units must be disconnected or turned off. By locking out the power, the electrician is assured that no one will accidentally flip the power on while he is working on the unit. The disconnects may be blade switches or plug-receptacle combinations. If two mechanics or electricians are working on a piece of equipment, two locks shall be placed on the circuit breaker box. This will prevent one electrician from energizing the circuit and electrocuting the other person.
2. In addition to the lock-out, a tag-out will permit quick visual observation by others that someone is working on a particular unit. This danger tag means that a circuit is dead or de-energized and should not be turned on. Locks and tags should be removed once the work is completed.

VISUALS NOTE: SHOW VISUALS 31 AND 54, THE TWO DRAWINGS ILLUSTRATING LOCK-OUT AND TAG-OUT PROCEDURES FOR BLADE SWITCHES AND PLUG-RECEPTACLE COMBINATIONS.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY ANY INCORRECT ANSWERS. THESE QUESTIONS CONCERN

FACTORS CONTRIBUTING TO ELECTRICAL ACCIDENTS, RESCUE TECHNIQUES, PERFORMANCE OF ELECTRICAL WORK, LOCK-OUT AND TAG-OUT. PROCEDURES, AND BATTERIES AND BATTERY CHARGERS.

SELF CHECK #1: SOLUTIONS

1. e
2. f
3. a
4. c
5. b
6. d
7. c
8. d
9. c – best answer
10. b

SELF CHECK #2: SOLUTIONS

1. rubber
2. connections
3. complete
4. unsafe
5. operating
6. authorized
7. a. board
   b. jacket
   c. rope
   d. dry wooden-handled shovel
8. Answers will vary according to mine.
9. a. transformer
   b. transmission line
   c. battery charging station
10. c

NEW MINERS

DEEP METAL/NONMETAL

MINE GASES

1981

THE BENDIX CORPORATION
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DEEP METAL/NONMETAL

COURSE PLAN: MINE GASES

I. GOAL: The goal of this module is to assure that the miner will recognize and be able to appropriately respond to the presence of hazardous mine gases or toxic materials.

II. BACKGROUND: Mine gases have always been a major cause of disasters and death in mining. Modern ventilation and detection techniques have reduced the threat from mine gas. Continual vigilance and understanding of controls is required to make these measures effective.

III. OBJECTIVES

A. The trainer will do the following:

1. Present the need for oxygen
2. Describe properties of gases
3. Demonstrate methods of testing for gases
4. Describe control of mine gas hazards

B. Trainees will be able to do the following:

1. Explain factors related to need for oxygen.
2. Describe properties of various gases to aid in their recognition.
3. Demonstrate or describe procedures for testing of mine gases.
4. Describe techniques used in the control of mine gases.

IV. MATERIALS

A. Visual aids

B. Permissible gas detectors and measuring devices

V. EVALUATION

A. Demonstrate, describe, or identify types of gases and their control and measurement.

B. Self-checks.

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessary to fit your local mine situation.

VI. RESOURCES

A. Training Standards

1. CFR 30 Part 48.5-12
2. CFR 30 Part 57.5-1 through 6, Part 57.5-10, Part 57.5-15, 16
3. CFR 30 Part 57.5-34, 37, 41, 44-47 (Uranium)

B. Textual Materials

1. MESA Safety Manual No. 2 - Mine Gases
2. NMHSA-CE-002 Mine Gases
3. Mine Gases, Mining Extension Service, West Virginia University, Study Guide Series, No. 13.

C. Applicable MSHA fatalgrams

TOPIC OUTLINE

A. Need for oxygen

1. Oxygen is necessary to sustain life
2. Harder work requires increased consumption of oxygen
3. Properties of oxygen

B. Properties of air

1. Composition of mine air
2. Oxygen deficient air

C. Properties of mine gases and dusts (source, properties, and effects on health)

1. Nitrogen
2. Carbon dioxide
3. Carbon monoxide
4. Oxides of nitrogen
   a. Nitric oxide
   b. Nitrogen dioxide
5. Sulfur dioxide
6. Hydrogen sulfide
7. Hydrogen
8. Acetylene
9. Gas mixtures
10. Smoke
11. Silica dust

12. Asbestos dust
13. Radon and thoron daughters
14. Methane

D. Methods of testing for gases

1. Testing for amount of oxygen
2. Testing for amount of carbon monoxide
3. Testing for amounts of other gases

E. Control of mine gas hazards

1. Adequate ventilation
2. Emergency response to hazardous gas conditions

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: MINE GASES

I. COURSE OVERVIEW

A. Human need for oxygen

B. Properties of mine gases

C. Methods of testing for gases

D. Control of mine gas hazards

II. NEED FOR OXYGEN

A. Oxygen is important because it supports life. The air we breathe contains both oxygen and carbon dioxide, as well as a variety of other gases. As part of the respiration process, blood cells pick up carbon dioxide while passing through the body and exchange it for fresh oxygen in the lungs. Thus, while normal air contains about 20.95% oxygen and 0.03% carbon dioxide, the air we exhale from our lungs contains only 16% oxygen but 4% carbon dioxide.

B. The amount of oxygen consumed by miners depends on the rate at which they work. Harder work requires increased consumption of oxygen.

VISUALS NOTE: SHOW VISUAL 23, THE DRAWING ILLUSTRATING DIFFERENT PER CENTAGES OF OXYGEN AND CARBON DIOXIDE ENTERING AND LEAVING THE LUNGS, AND VISUAL 25, THE DRAWING ILLUSTRATING INCREASED CONSUMPTION OF OXYGEN WITH INCREASED WORK ACTIVITY. GIVE SOME EXAMPLES OF WORK ACTIVITIES YOU CONSIDER TO INVOLVE MODERATE AND VIGOROUS EXERCISE.

C. Properties of oxygen are that it is colorless, odorless, and tasteless, and slightly heavier than air.

III. PROPERTIES OF AIR

A. Normal mine intake air is a mixture of a variety of gases. Normal air consists of 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.03% carbon dioxide, and 0.01% other gases.

VISUALS NOTE: SHOW VISUAL 24, THE DRAWING ILLUSTRATING THIS COMPOSITION OF AIR.

B. Mine intake air can become deficient in oxygen due to several causes. Oxygen deficiency makes breathing more difficult and can be fatal when other gases dilute the amount of oxygen below tolerable limits. Causes of oxygen deficiency are as follows.

1. Dilution of air by gas blowers and feeders.
2. Dilution of air from increase in gases and dust due to blasting or accidental explosions.
3. Use of oxygen by miners or diesel engines, especially in confined or poorly ventilated areas.
4. Removal of oxygen through fires or flames and subsequent dilution of air from carbon monoxide and other gases.
5. Decay of timbers or cracks in rocks.

C. People usually breathe air with about 21% oxygen. Federal Regulation Part 57.5-15 requires that air in active workings contain at least 19.5% oxygen.

D. People experience hard breathing when air contains 16% oxygen. At 10% most people become unconscious, and at 6% the heart ceases to function.

IV. PROPERTIES AND EFFECTS OF MINE GASES AND DUSTS

A. Nitrogen

1. Released from the detonation of explosives and gas blowers
2. It is colorless, odorless and tasteless
3. Excessive amounts of nitrogen produce an asphyxiating oxygen-deficient atmosphere that will not support life.

B. Carbon dioxide

1. Produced by people, fires, and explosions. Due to its role in breathing, the body can tolerate only small amounts in the surrounding air.
2. Carbon dioxide is colorless, odorless and tasteless
3. Carbon dioxide is not poisonous at smaller concentrations, but at 3% breathing is faster, and at 12% people lose consciousness.

C. Carbon monoxide

1. Produced by fires, explosions, and diesel engines. Gases remaining after an explosion or fire always contain carbon monoxide.

2. Carbon monoxide is colorless, odorless and tasteless
3. Carbon monoxide kills by limiting the oxygen-carrying capacity of the blood. The harder the miner is breathing the faster carbon monoxide acts in contaminating the blood. Symptoms of increased carbon monoxide poisoning are:

   a. Slight tightening across forehead
   b. Throbbing temples and headache
   c. Severe headache and dizziness
   d. Rapid pulse and flushed color
   e. Unconsciousness and death

VISUALS NOTE: SHOW VISUAL 26, THE DRAWINGS ILLUSTRATING EFFECTS OF INCREASED PERCENTAGES OF CARBON MONOXIDE IN THE AIR ON HEALTH AND WORK ACTIVITY.

D. Oxides of nitrogen are nitric oxide and nitrogen dioxide

   1. Produced by diesel engines, electrical discharges, and detonation of explosives
   2. Both have an irritating odor. Nitrogen dioxide has a brick red color at higher concentrations.
   3. They are extremely toxic in small amounts because they form very corrosive acids when mixed with moisture in the lungs.

E. Sulfur dioxide

   1. Formed in fires or detonation of explosions in mines containing iron pyrite.
   2. Detected by its irritating sulfur smell

F. Hydrogen sulfide

   1. Produced when blasting for sulfide ores and occurs in some natural gas, oil, and coal fields. Forms flammable mixtures (with air) over the concentration range of 4- to 44- volume percent.
   2. Colorless but has an odor of rotten eggs
   3. Very toxic

      a. Irritation of eyes and nose at lower concentrations
      b. Prolonged exposure dulls the sense of smell.
      c. Eye inflammation and intense pain at higher concentrations.

G. Hydrogen

1. Not normally found in mine air, but is produced during the charging of batteries or from a fire or explosive.
2. Colorless, odorless and tasteless.
3. Flammable at concentrations of 4% and greater. Tends to rise to the roof of an enclosed area.

H. Acetylene

1. Used for lighting purposes in non-gassy mines as well as welding
2. Smells like geraniums, but no color or taste.
3. Not poisonous, but combustible in small concentrations.

I. Gas mixtures

1. Rock gas consisting of nitrogen and carbon dioxide creates an oxygen-deficient atmosphere and enters the mine from adjacent rock strata. Also known as blackdamp.

2. Fire damp consists of methane and possible trace amounts of other gases in air.

3. Afterdamp consists of smoke and such gases as carbon monoxide, carbon dioxide, water vapor, nitrogen, oxygen, hydrocarbons, and hydrogen.

J. Smoke consists of small particles of soot and tars. These particles irritate the nose and throat, but are not poisonous unless mixed with carbon monoxide and other poisonous fumes.

K. Silica dust

1. Is part of ore being mined
2. Results in lung disease known as silicosis, contraction of which depends on the length of exposure and the free silica content in the ore
3. Suppressed by dust control measures and ventilation

L. Asbestos dust

1. Is part of the ore being mined
2. Contributes to the development of lung cancer
3. Suppressed by dust control measures and ventilation.

M. Radon and thoron daughters

1. Released from radon and thoron gases in uranium ore.
2. Excessive exposure results in lung cancer, especially among tobacco smokers.

3. Controlled by ventilation and monitoring of miner exposure.

N. Methane

1. Found in coal, gassy salt mines, and in rocks that contain combustible materials.
2. Works as an asphyxiant by causing oxygen-deficient air in the mine.
3. Methane gas is colorless, odorless, tasteless, and rises to the back because it is lighter than air.
4. Forms a flammable or explosive mixture when mixed in the range of 5- to 15- volume percent in the air. Flames produce toxic products including carbon monoxide which result in oxygen-deficient atmospheres, and can ignite flammable dust, timbers, coal, and other combustibles.
5. Other hydrocarbon gases such as ethane and propane may also be found in small amounts coming from adjacent oil and gas fields.

INSTRUCTOR NOTE: A MORE DETAILED DISCUSSION OF SILICA AND ASBESTOS DUSTS, AS WELL AS RADON AND THORON DAUGHTERS, IS CONTAINED IN THE MODULE ON HEALTH.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE NEED FOR OXYGEN AND PROPERTIES OF MINE GASES.

INSTRUCTOR NOTE: THE FOLLOWING SECTION CONCERNS COMPANY POLICY FOR AIR QUALITY. THIS SECTION STARTS WITH A REVIEW OF THAT POLICY, INCLUDING THE SCHEDULE FOR AIR TESTING WHICH YOU SHOULD PRESENT NOW.

V. METHODS OF TESTING FOR GASES

A. The level of oxygen is tested with various liquid absorption devices, fuel cells, or the flame safety lamp.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE OXYGEN TEST DEVICE AND HOW IT WORKS.

B. The level of carbon monoxide is tested with a detector tube. The tube contains a chemical which changes color in relation to the amount of carbon monoxide in the air.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE CARBON MONOXIDE TEST DEVICE AND HOW IT WORKS.

C. The levels of sulfur dioxide, hydrogen sulfide, and oxides of nitrogen are measured with indicator tubes. The tube contains a chemical which changes color in relation to the amount of gas in the air.

D. The level of methane is tested with a flame safety lamp, a methanometer, or optical methane detector. The flame safety lamp is also used to detect oxygen-deficient mine air.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE METHANE TEST DEVICE AND HOW IT WORKS.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE INDICATOR TUBE TEST DEVICE AND HOW IT WORKS.

VI. CONTROL OF MINE GAS HAZARDS

A. The best defense against accumulation of toxic gases is adequate ventilation to dilute and carry away the gases. Regularly scheduled testing of mine air helps determine the adequacy of current ventilation to prevent gas accumulating.

B. Hazardous gas conditions call for emergency responses, such as:

1. Warning other miners of the danger
2. Use your self-rescuer and keep it on to prevent carbon monoxide poisoning.
3. Move to fresh intake air because the ventilation system will move the poisonous gases toward the return air.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO. TRAINEES MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW CORRECT ANSWERS AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN METHODS FOR TESTING GASES AND CONTROL OF MINE GAS HAZARDS.

SELF CHECK #1: SOLUTIONS

1.	false	6.	false
2.	true	7.	true
3.	false	8.	true
4.	false	9.	false
5.	true	10.	false

SELF CHECK #2: SOLUTIONS

1. Answers will vary depending on your mine situation
2. a. warn other miners.

   b. use your self rescuer if you suspect carbon monoxide is in the air.

   c. move to fresh intake air.
3. Carbon monoxide and afterdamp should be checked.
4. Cannot
5. By not receiving an accurate reading you would be risking explosion or asphyxiation.

SELF CHECK: MINE GASES AND TOXIC MATERIALS

SELF CHECK #1: NEED FOR OXYGEN, EFFECTS OF GASES, AND PROPERTIES OF MINE GASES

Answer true of false

_______ 1. A miner consumes the same amount of oxygen regardless of how hard he is working.

_______ 2. Oxygen-deficient air can be caused by the presence of increasing amount of non-toxic gases.

_______ 3. Oxygen-deficient air is solely caused by inadequate ventilation through the mine.

_______ 4. Although the law requires at least 19.5% oxygen in mine air, miners have no difficulty in working in areas with much smaller amount of oxygen.

_______ 5. One reason gases such as nitrogen, carbon dioxide, carbon monoxide, are hazardous is because they decrease the oxygen content in the air.

_______ 6. A slight tightening across the forehead, dizziness, and a severe headache are symptoms of increased poisoning from methane.

_______ 7. Hydrogen, hydrogen sulfide, acetylene, and methane are all dangerous combustible gases that may be found in mine air.

_______ 8. Dust control measures & ventilation are effective measures in suppressing silica dust and asbestos dust, and radon and thoron daughters.

_______ 9. Rock gas consists of nitrogen and carbon dioxide and is hazardous because it is combustible in small amounts.

_______ 10. The sources of most hazardous mine gases are limited to electrical discharges, the ore itself, and diesel engines.

SELF CHECK #2: METHODS FOR TESTING GASES, CONTROL OF MINE GAS HAZARDS & TOXIC MATERIALS IN THE MINE

1. Name the device used to test for the levels of the following gases:

   a. Oxygen

   b. Cargon monoxide

   c. Sulfur dioxide

   d. Hydrogen sulfide

   e. Oxides of nitrogen

   f. Methane

2. Name 3 emergency actions you should take under hazardous gas conditions.

   a.

   b.

   c.

3. Place a check beside those gases from which your self-rescuer protects you.

   a. Methane ______

   b. Rock gas ______

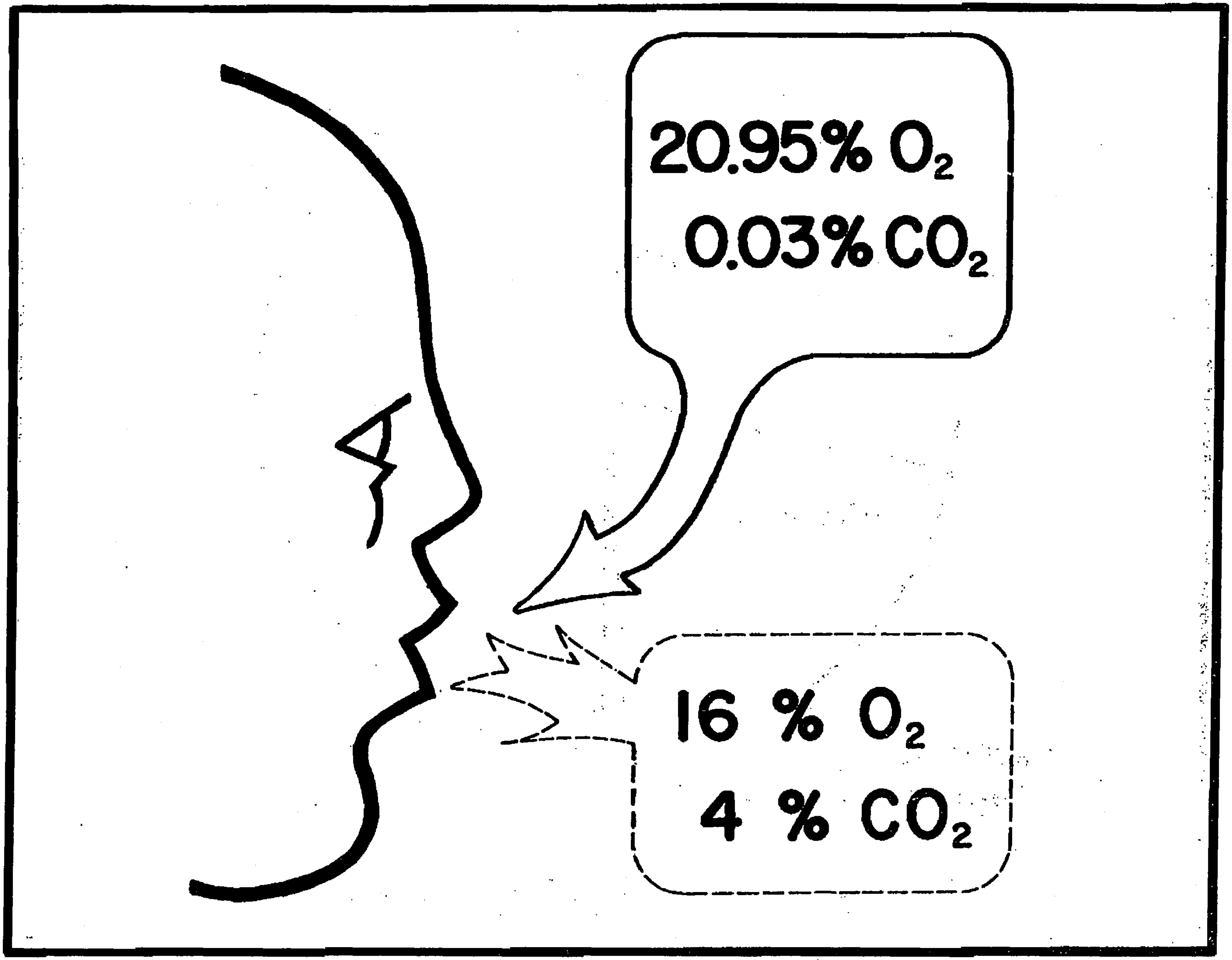
   c. Carbon monoxide ______

   d. Afterdamp ______

   e. Oxides of nitrogen ______

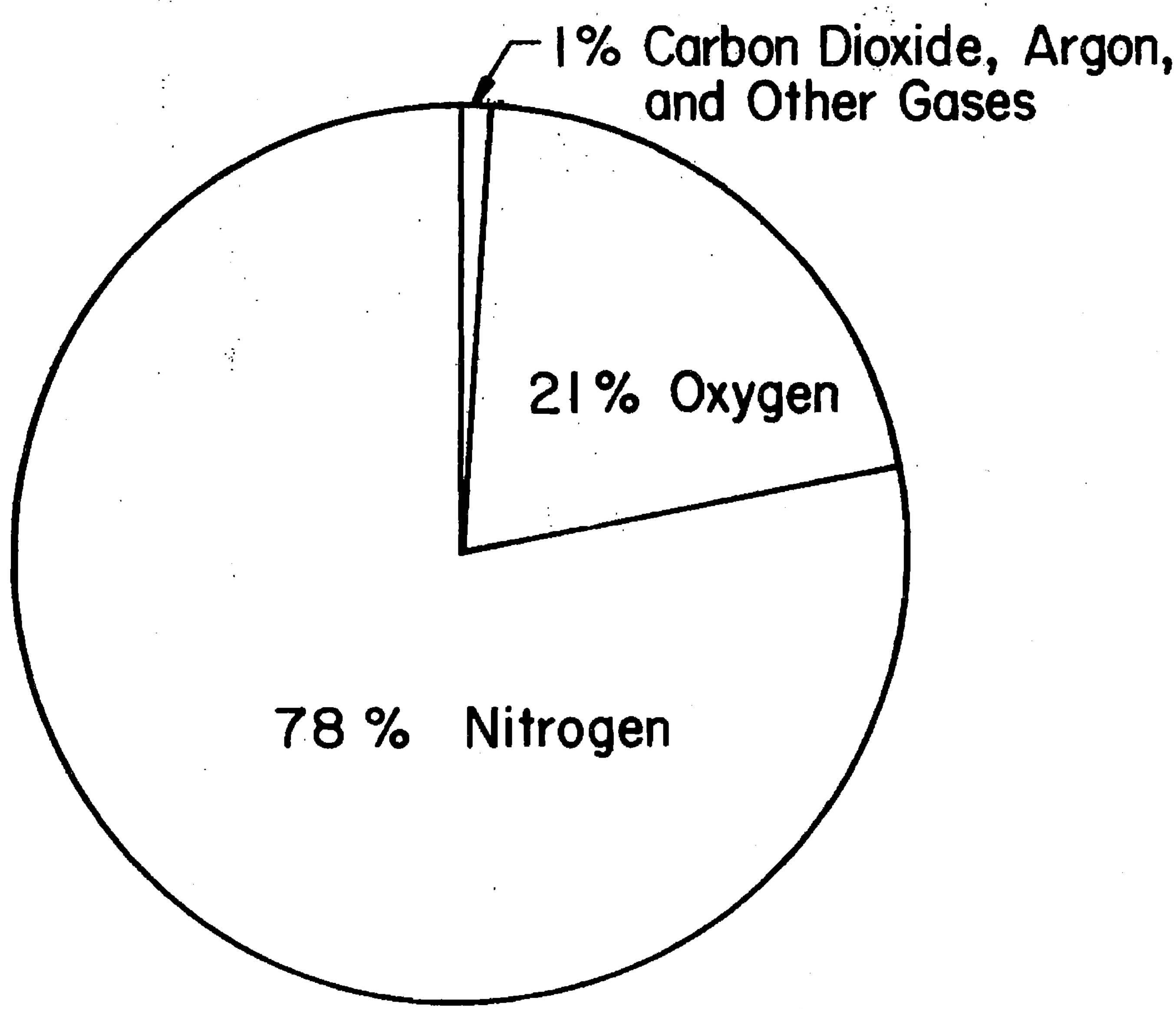
4. You (can, cannot) share a self rescuer with another miner.

5. Why would it be dangerous to tamper with testing devices?

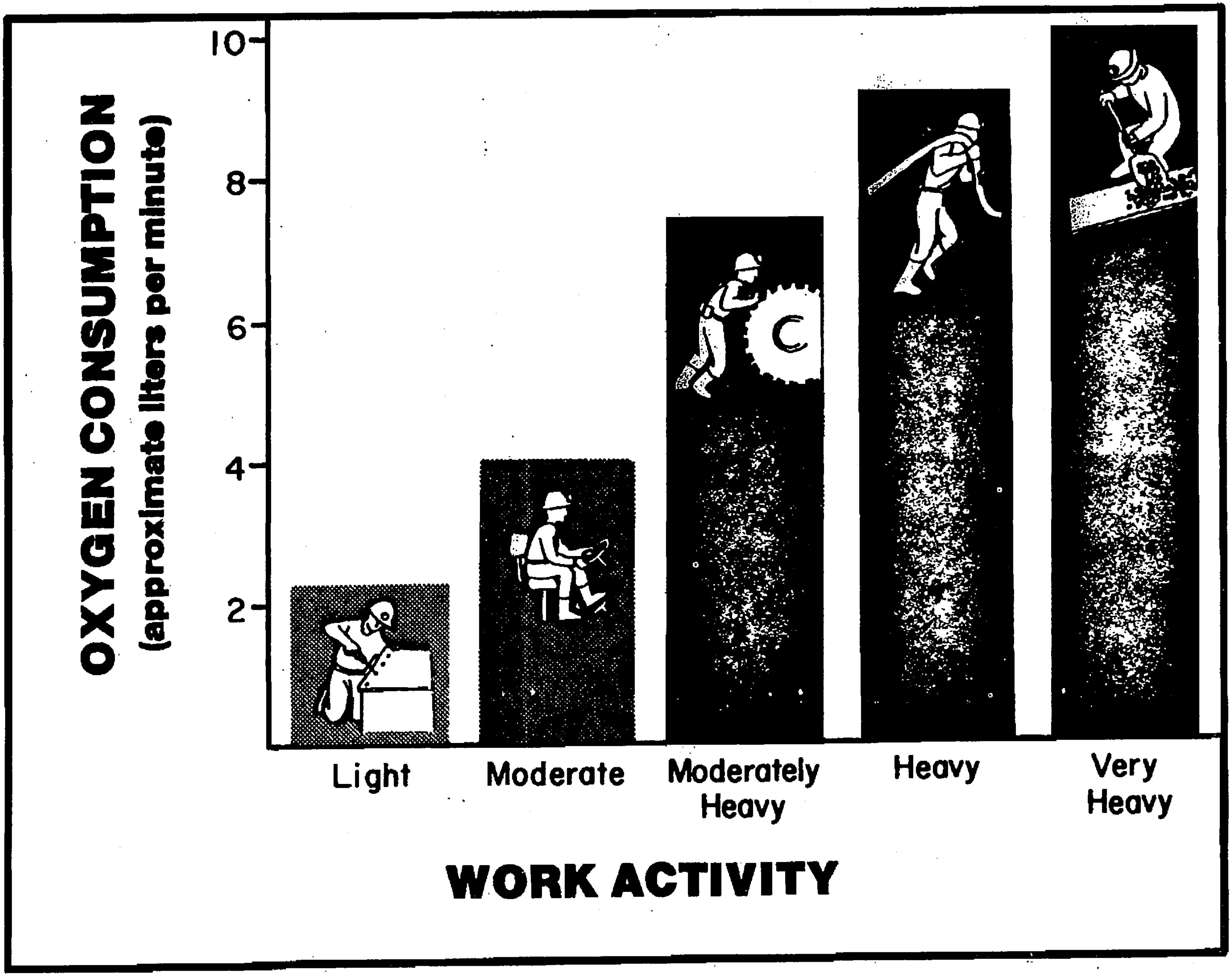


VISUAL 23

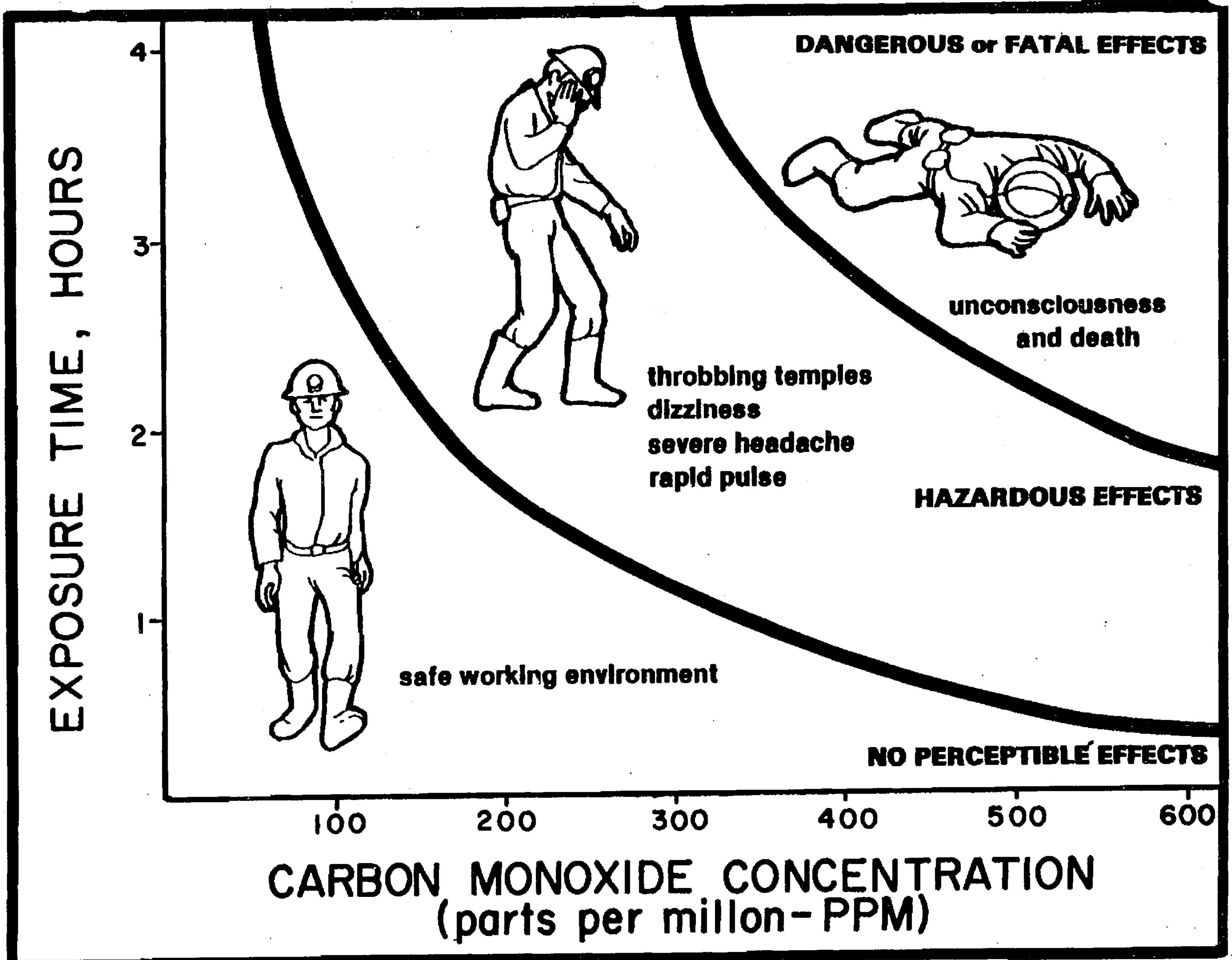
COMPOSITION OF AIR



VISUAL 24


OXYGEN CONSUMPTION
(approximate liters per minute)
10
8
6
4
2
Light
Moderate
Moderately Heavy
Heavy
Very Heavy
WORK ACTIVITY

VISUAL 25


DANGEROUS or FATAL EFFECTS
unconsciousness
and death
throbbing temples
dizziness
severe headache
rapid pulse
HAZARDOUS EFFECTS
safe working environment
NO PERCEPTIBLE EFFECTS
EXPOSURE TIME, HOURS
1
2
3
4
100
200
300
400
500
600
CARBON MONOXIDE CONCENTRATION
(parts per millon-PPM)

VISUAL 26

NEW MINERS

DEEP METAL/NONMETAL

HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
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303-922-6394

DEEP METAL/NONMETAL

COURSE PLAN: HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

I. GOAL: The goal of this module is to assure that the miner understands specific health and safety hazards of the job to which he or she is assigned and can take appropriate precautions when performing that job.

II. BACKGROUND: To the new miner the Federal regulations governing health and safety aspects of underground metal/nonmetal mining may appear to be confusing and complex. The experienced miner, however, knows how the regulations assure him of a safe work area. Training in the health and safety aspects of assigned tasks will give the miner knowledge and skills for following the regulations.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe specific duties of tasks to which each trainee is assigned

2. Point out health and safety hazards specific to assigned tasks

3. Discuss specific mandatory health and safety standards that apply to tasks assigned

4. Describe company policy that applies to the mandatory health and safety standards

B. Trainees will be able to do the following:

1. Describe duties and tasks to which assigned.

2. Perform assigned tasks.

3. Recognize and avoid health and safety hazards specific to those assigned tasks.

4. Describe applicable mandatory health and safety standards and company policy as it relates to themselves.

IV. ACTIVITIES

A. Demonstration of proper techniques for tasks assigned

B. Demonstration of proper precautionary measures for health and safety

V. MATERIALS

A. Visual Aids

B. Applicable mandatory standards

C. Applicable company policy

VI. EVALUATION

A. Demonstrate, describe or identify:

1. Duties and tasks

2. Health and safety hazards

3. Mandatory standards and company policy

4. Job techniques

5. Safety precautions

B. Self Checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessary to fit your local mine situation.

VI. RESOURCES

A. Training standards

1. CFR 30 Part 48.5-13

2. Company policy

B. Applicable MSHA fatalgrams.

TOPICS COVERED

I. DUTIES OF TASKS ASSIGNED

A. Work station

B. Tasks to perform

C. Tasks which must be performed by others, e.g. electrical repairs

II. HEALTH AND SAFETY ASPECTS OF ASSIGNED TASKS

III. SAFE WORK PROCEDURES ASSOCIATED WITH ASSIGNED TASKS

IV. MANDATORY FEDERAL HEALTH AND SAFETY STANDARDS

A. Purpose of the standards

B. Contents of the standards

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HEALTH AND SAFETY ASPECT OF TASKS TO WHICH ASSIGNED

INSTRUCTOR'S NOTE: THIS GUIDE CAN BE SPLIT INTO TWO PARTS. THE FIRST PART, WHICH INCLUDES, I, II, AND III, CALLS FOR THE TRAINING, AT THE WORK AREA GIVEN BY THE TRAINER, SUPERVISOR, OR EXPERIENCED EMPLOYEE. THE PERSON PROVIDING THE TRAINING SHOULD REVIEW THE GUIDE TO ASSURE THAT THE TRAINING WILL BE THOROUGH, THE SECOND PART, WHICH CONSISTS OF IV, SHOULD BE CONDUCTED IN THE TRAINING ROOM AS DESCRIBED THEREIN.

I. DUTIES OF ASSIGNED TASKS

   A. Work station

      1. Location(s) in the mine
      2. Transportation around the mine

   B. Tasks to be performed - skills training with equipment.

   C. Tasks which must be performed by qualified, certified, or competent persons.

      1. Electrical repairs.
      2. Equipment maintenance.
      3. Use of explosives.

II. HEALTH AND SAFETY ASPECTS OF ASSIGNED TASKS

   A. Haulage hazards - equipment operators, truck drivers, etc.

   B. Roof and ground control hazards - loader operator, drilling crew, etc.

   C. Electrical hazards - mechanics, electrical helpers, etc.

   D. Health hazards (dust, noise) - crusher operator, laboror, etc.

   E. Fire hazards - mechanics, electricians, equipment operators, etc.

   F. Mine gases (carbon monoxide, radon daughters) - all underground workers.

III. SAFE WORK PROCEDURES ASSOCIATED WITH

A. Use of Personal protective equipment

1. hard hat
2. respirators and self-rescuer
3. rubber gloves and boots for electrical repairs
4. safety glasses
5. ear plugs and muffs

B. Procedures to be learned during task training

IV. MANDATORY HEALTH AND SAFETY STANDARDS FOR METAL AND NONMETALLIC UNDERGROUND MINES - Part 57

Sections of Part 57

Section	Title
57.1	Purpose and Scope
57.2	Definitions
57.3	Ground control
57.4	Fire prevention and control
57.5	Air quality and physical agents
57.6	Explosives
57.7	Drilling
57.8	Rotary jet piercing
57.9	Loading, hauling, dumping
57.10	Aerial tramways
57.11	Travelways
57.12	Electricity
57.13	Compressed air and boilers
57.14	Use of equipment
57.15	Personal protection
57.16	Materials storage and handling
57.17	Illumination
57.18	Safety programs
57.19	Man hoisting
57.20	Miscellaneous

INSTRUCTOR'S NOTE: IN ORDER TO FAMILIARIZE MINERS WITH PART 57, YOU MAY WANT TO DISTRIBUTE COPIES OF PART 57 AND LEAD THEM THROUGH IT. AS AN AID, THERE ARE EXERCISES WITH THIS GUIDE DESCRIBING PROBLEM SITUATIONS FOR WHICH MINERS CAN LOCATE THE REGULATION THAT GOVERNS THE PROBLEM. YOU MAY WANT TO DEVELOP YOUR OWN EXERCISES BASED ON PARTICULAR SITUATIONS IN THE MINE.

EVALUATION NOTE: PASS OUT COPIES OF VISUAL 50 AND PAPER AND PENCILS IF YOU WISH. HAVE TRAINEES IDENTIFY HAZARDS THEY CAN FIND INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. THESE MAY BE WRITTEN DOWN OR CALLED OUT IN CLASS. REVIEW ANSWERS AND CLARIFY INCORRECT RESPONSES.

Visual 50: Solutions (as artist envisioned)

1. unconduited wires
2. cluttered, messy workplace
3. cluttered footing
4. sleepy, inattentive miners
5. miner smoking in a non-smoking area
6. miner without hardhat on
7. miners exposed to bare ends of wire
8. track cluttered with debris
9. fallen cables
10. no bumper stop to keep car from running too far forward
11. miners not wearing safety glasses.

Exercise Number 1

A burnt out fuse needs to be quickly replaced but the switch box is 100 yards away. The current may be weak, and the fuse could be replaced by hand without de-energizing the circuit. What should be done? (Answer: Part 57.12-36).

Exercise Number 2

A small crew of laborers in a salt mine are assigned to pick up fallen debris from the bases of pillars in one area. What ground tests should be done prior to beginning this work? (Answer: Part 57.3-22).

Exercise Number 3

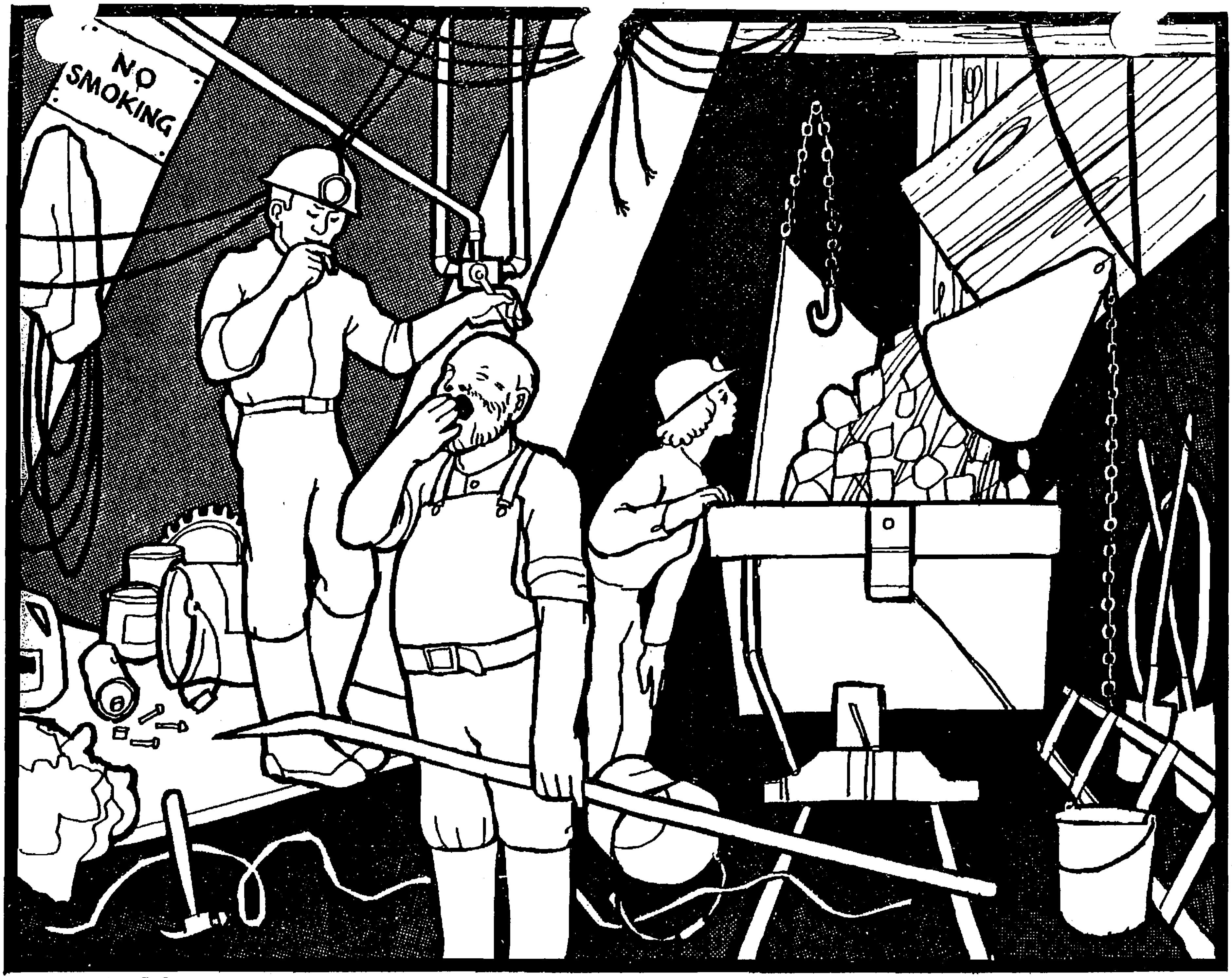
A miner is waiting for a ride on a boss buggy, and a front-end loader headed in the same direction passes by. Should the miner ask for a ride in the empty bucket? (Answer: Part 57.9-40a).

Exercise Number 4

An electrician must climb a twenty-foot ladder to replace a burnt out bulb. The bulb is large but can be handled with one hand. Should he carry it by hand or use some sort of bag? (Answer: Part 57.11-11)

Exercise Number 5

A new mechanics helper shows up for work wearing athletic shoes. Should he be permitted to work? (Answer: Part 57.15-3)



VISUAL 50

NEW MINERS

DEEP METAL/NONMETAL

EXPLOSIVES

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

DEEP METAL/NONMETAL

COURSE PLAN: EXPLOSIVES

I. GOAL: The goal of this module is to have the miner identify explosives and blasting accessories, recognize the hazards associated with blasting, and procedures to follow to make a safe work environment.

II. BACKGROUND: The use of explosives in underground metal/nonmetal mines presents a tremendous hazard to everyone. Although only specially trained experienced personnel are permitted to use explosives, the results from accidental misuse or misfiring of explosives are a serious problem for everyone. For this reason all employees shall be trained on the materials and hazards of explosives.

III. OBJECTIVES

A. Trainer will do the following:

1. Present those explosives and blasting accessories used at the mine (dummys available from the Institute of Makers of Explosives)
2. Describe hazards associated with explosives, such as transportation hazards and toxic fumes
3. List safe procedures to follow when working near the blasting area, or when finding an explosive.

B. Trainees will be able to do the following:

1. Identify fired and misfired non-electric blasting caps using dummys.
2. Identify by naming the types of explosives and blasting accessories used at your mine.
3. Name safe procedures to follow when guarding near blasting areas or when finding an explosive.
4. Move to a safe place in the mine as would be done during blasting while on the mine tour.

IV. ACTIVITIES

A. In the classroom identify the different types of blasting equipment used in the mine.

B. On site during the mine tour

1. Determine the locations of magazines.
2. Lead the miners through the procedures to be followed during blasting operations

V. MATERIALS

A. Visual aids contained in the Lesson Guide and Materials

B. Blasting Cap (dummy) Display available from the Institute of Makers of Explosives.

VI. EVALUATION

A. Demonstrate, describe, or identify:

1. Explosives and blasting accessories
2. Hazards with explosives
3. Safety procedures to follow

B. Review of performance

1. Identifying the responsibilities for guarding the blast area.

2. Finding the locations of magazines.

3. Following correct procedures when finding an undetonated explosive or cap.

C. Self-Check

1. Anytime hands on evaluation such as identifying different types of explosives or locating underground magazines is possible it should be used.

2. Eliminate the use of self-checks if it is too difficult for your class.

3. Changes written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. This unit is not required by law but may be useful in your training program.
B. Applicable Federal regulations CFR 30 Part 57.6.
C. Reading materials

1. Manufacturer's explosives manual
2. "Explosives and Blasting". West Virginia University Mining Extension Service, Study Guide Series, Number 5. Available at MSHA Informational Resource Library, Catalog Number 200-408.
3. Safety library publications from the Institute of Makers of Explosives

a. Number 1 Typical Storage Magazines
b. Number 2 American Table of Distances
c. Number 3 Suggested Code of Regulations
d. Number 4 Do's and Don't
e. Number 6 Recommended Industry Safety Standards
f. Number 12 Glossary of Industry Terms
g. Number 17 Safety in the Transportation, Storage, Handling and Use of Explosives
h. Number 20 Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Electric Blasting Caps.
i. Number 22 IME Standard for the Safe Transportation of Class C Detonators (Blasting Caps) in a Vehicle With Certain Other Explosives

4. "Primacord Detonating Cord - What it is and how to use it". Published by the Ensign Bickford Company, Simsbury, Conn., Ninth Printing.
5. "New non-electric explosive initiation systems". By Richard Dick of the U.S. Bureau of Mines. Appeared in Pit and Quarry, March, 1976, pages 104-106.

D. Films

1. ENT/Gates Films, Inc. - "Developing a Safe Rock Slope."
2. National Coal Board - "How Not to Keep a Head While Shot-Firing."

TOPICS COVERED

I. EXPLOSIVES AND BLASTING ACCESSORIES USED AT THE MINE

II. HAZARDS ASSOCIATED WITH EXPLOSIVES

A. Transportation hazards

B. Magazine hazards

C. Detonator hazards

D. Blasting hazards

III. SAFE WORK PROCEDURES WITH EXPLOSIVES

A. Task training
B. Clearing and guarding the blast area
C. Re-entering blasting area
D. Reporting finding an undetonated or misfired explosive

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: EXPLOSIVES

I. EXPLOSIVES AND BLASTING ACCESSORIES USED AT THE MINE

INSTRUCTOR'S NOTE: AT THIS TIME PRESENT THOSE EXPLOSIVES AND BLASTING ACCESSORIES USED IN YOUR MINE. THIS WILL ALLOW THE MINERS TO BECOME MORE FAMILIAR WITH THEM SO THAT WHEN ANY ARE SEEN IN THE MINE THEY WILL BE MORE QUICKLY RECOGNIZED. THE FOLLOWING VISUAL NOTES MAY BE HELPFUL.

VISUALS NOTE: SHOW VISUAL NUMBER 27 DISPLAYING THE CONTENTS OF AN ELECTRIC BLASTING CAP.

VISUALS NOTE: SHOW VISUAL NUMBER 55 ILLUSTRATING A NON-ELECTRIC BLASTING CAP

II. HAZARDS IN USE OF EXPLOSIVES

A. Transportation hazards

1. The vehicle used to transport explosives should be in good operating condition. If the vehicle were to get a flat tire or lose its brakes it would lead to a serious hazard for everyone. The cargo space in which the explosives are stored should be of non-sparking material. If the vehicle got into an accident with damage to the cargo area, you would want to minimize any sparks that could set off the explosives.
2. Detonators and explosives should be kept apart by at least four inches of hardwood, or transported separately. If a detonator were to accidently fire this would prevent it from setting off any explosives.
3. Explosives should be transported at times when the fewest number of people will be endangered. During shift change or before or after personnel are transported into or out of the mine is usually a good time to bring explosives into the mine.
4. Explosives should not be stacked higher than the sideboards of the vehicle. If the vehicle were to hit a bump some boxes could fall off the side.
5. No smoking is permitted on or near the vehicle. Hot ashes or flames pose a danger when mixed with powder.
6. If ANFO or any other powder is spilled it should be immediately cleaned up.
7. Do not ride on the cage when it is being used to transport explosive material.

8. Vehicles should be driven carefully and excessive speeds should be avoided. Do not drive over unbridged power cables.
9. Vehicles loaded with explosives should not drive into any maintenance area where sparks from welding or stray electric currents could set off explosives.

B. Detonator Hazards

1. Do not let leg wires and detonators come into contact with electrical equipment, wires or rails. These may carry enough of a current to set off the charge.
2. Caps can deteriorate and become more sensitive because of age. Caps may also become useless from such damage as being kinked, exposed to extreme heat, or contaminated with water. They should be properly disposed but only by experienced powdermen.

C. Magazine hazards

1. Magazines must be built in dry, isolated areas of the mine so as to be well ventilated, bullet-proof, locked, and have non-sparking material on the inside wall. It must be marked with a sign located in such a place that if a bullet were to be fired into it the bullet would not pass into the stored powder.
2. Flammable materials such as fuel or oil should not be stored near a magazine.
3. Smoking in and around a magazine is prohibited.
4. Detonators and explosives should not be stored together in the same magazine. Separate magazines for them should be at least 25 feet apart.
5. The magazine must be kept clean of trash, empty boxes, and paper at all times. They are both a fire hazard and a cause of slips and falls.
6. No electric wiring or open lights should be taken into a magazine.
7. Surplus or loose explosives should not be left in unsecured areas such as cuts, passes, or by the outside walls of the magazine.

VISUALS NOTE: PRESENT VISUAL NUMBER 29 SHOWING A LOST DETONATOR ON A HAULAGE TRACK. COMMENT ON SUCH HAZARDS AS THEY MAY EXIST IN YOUR MINE.

D. Blasting hazards

1. A misfire is a loaded hole that fails to fire. The procedure following firing a round is that the blaster or supervisor will inspect the muck pile for misfires. No one else is permitted to enter the area until the all-clear signal is given.

a. If the blaster finds a misfire he will attempt to re-wire and detonate it or flush it out of the drill hole with water and then dispose of it.

b. In the event the misfire is completely covered by rock, the blaster may not see it. This results in a very dangerous situation. Do not attempt to move it yourself. If you discover a misfire in the rock, work should stop immediately, the area should be cleared and guarded, and the supervisor should be contacted.

c. Toxic fumes may be found after detonation. You can avoid these fumes by remaining out of the blast area until ventilation dilutes the gases and carries them out of the mine.

   i. Carbon monoxide can be detected by observing one of the first symptoms of such poisoning - headache pain.

   ii. Explosives containing nitroglycerine or other nitro compounds may burn rather than detonate. One gas resulting from this is nitrogen dioxide which is extremely dangerous to your lungs in small amounts. It has a burned powder odor.

   iii. Wet ANFO will generate nitrous oxide fumes.

VISUALS NOTE: PRESENT VISUAL NUMBER 28 SHOWING A MINER FINDING A DETONATOR. COMMENT ON THE PROCEDURES HE SHOULD NOW FOLLOW.

d. After the blast the rock pile should be hosed down with water to keep the dust settled.

2. Overshooting results from either an excessive use of explosives, an improperly sized drill hole, or holes that are not properly placed according to the delay pattern. Undershooting is just the opposite. Overshooting weakens the remaining deposit making it susceptible to falls and may require use of supports. Undershooting results in an uneven face and creates haulage problems by having to move larger sized rocks.

3. Fly rock consists of pieces of rock blown from the shot area by the explosive force. This rock can be lethal because of its weight and velocity of travel. Flyrock is also caused by a blowout. When a blast hole is not drilled deep enough into the rock, the explosive force blows the rock out into the drift or work area.

4. Electrical hazards are present if the mine uses electric blasting caps.

   a. Natural sources like static electricity or lighting storms.

   b. Man-made sources like stray electricity and radio transmitters.

   c. Only special galvanometers should be used to test continuity. Regular galvanometers may set off the charge.

If you find a cap in the muck pile do not attempt to test the leg wires - only experienced powdermen are equipped to do such work.

d. Any power equipment with leaking current presents a hazard.

e. Static charge built up from pneumatic loading equipment.

5. Never drill into a bootleg - it could contain a charge of powder that might detonate when struck by the drill steel. Prior checks of the hole may have accidentally not detected the powder, so do not take any shortcuts.

III. SAFE WORK PROCEDURES WITH EXPLOSIVES

A. Task training is given to the powdercrew to increase their technical skills in the use of explosives. Only experienced people trained in use of explosives or working under close supervision should work with explosives. All other miners should stay out of the way while the powdercrew works unless assigned to the area.

B. Clearing the blast area is very important. Unless the area is secured, other people may unknowingly walk into a life threatening situation from either the blast itself or the toxic fumes that follow the blast.

1. The blasting crew will clear the area of all personnel, and then give a warning signal before setting off the round. Guards should be posted at all entrances to the area with specific instructions to keep everyone out. Guards should not leave their post even for a moment because someone could walk past without being seen. Guards must remain at their posts until specifically told to return to their regular work.
2. Equipment should be moved clear of the blast area to prevent damage.
3. Miners should stand clear of the blast area, such as behind equipment, to protect themselves from being hit by flyrock. Always give yourself enough room to stay clear.

C. Re-entering blasting area. Before resumption of work, a supervisor or blaster will inspect the blast area for misfires and fumes. No one should enter this area past the guards until the all-clear signal is given by this person.

D. Reporting undetonated or misfired explosives. Any miner who discovers an undetonated explosive near a magazine or along a haulageway, or a misfired explosive near their work area shall halt work, clear everyone out of the area and guard it, and notify a supervisor about the hazardous situation. Never attempt to move the explosive yourself because it may be very unstable and could go off in your hand.

EVALUATION NOTES: HAVE TRAINEES ANSWER THE SELF-CHECK QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN EXPLOSIVES AND BLASTING ACCESSORIES, HAZARDS IN USE OF EXPLOSIVES, AND SAFE WORK PROCEDURES.

SELF CHECK #1: SOLUTIONS

1. Answers will vary according to mine situation.
2. false
3. false
4. electric blasting cap
5. false
6. false
7. a. Vehicle should be in good condition, with cargo space of non-sparking material.
   b. Detonators and explosives should be seperated by at least four inches of hardwood or transported separately.
   c. Transportation should take place when fewest people would be endangered.
8. true
9. false
10. Sample answer: Magazine must be built in dry, isolated areas of the mine in order to be well ventilated, electrically grounded, bullet-proof, locked, and built with non-sparking material inside.
11. false
12. Instructor must check answers individually.

Self Check: Explosives

Self Check #1: Permissible Explosives and Firing Devices, Hazards in Use of Explosives, and Safe Work Procedures with Explosives

1. Name the kind of explosives used at your mine, and tell how they can be identified.

2. Using more explosives than necessary is one way of making sure the job is done right. (true, false).

3. Guards are allowed to move from their post once they hear the charge go off. (true, false).

4. An ______________________________ consists of a metal shell loaded with several explosive charges and an electrical ignition element attached to a pair of insulated wires.

5. Any miner can help an experienced blaster set a charge as long as the blaster observes his work. (true, false).

6. Miners may safely smoke around magazines as long as there is adequate ventilation. (true, false)

7. List 3 hazards in transporting explosives.

   a.

   b.

   c.

8. Miners should always take cover during blasting, even at long distances, because hard hats are not sufficient protection from fly rock. (true, false)

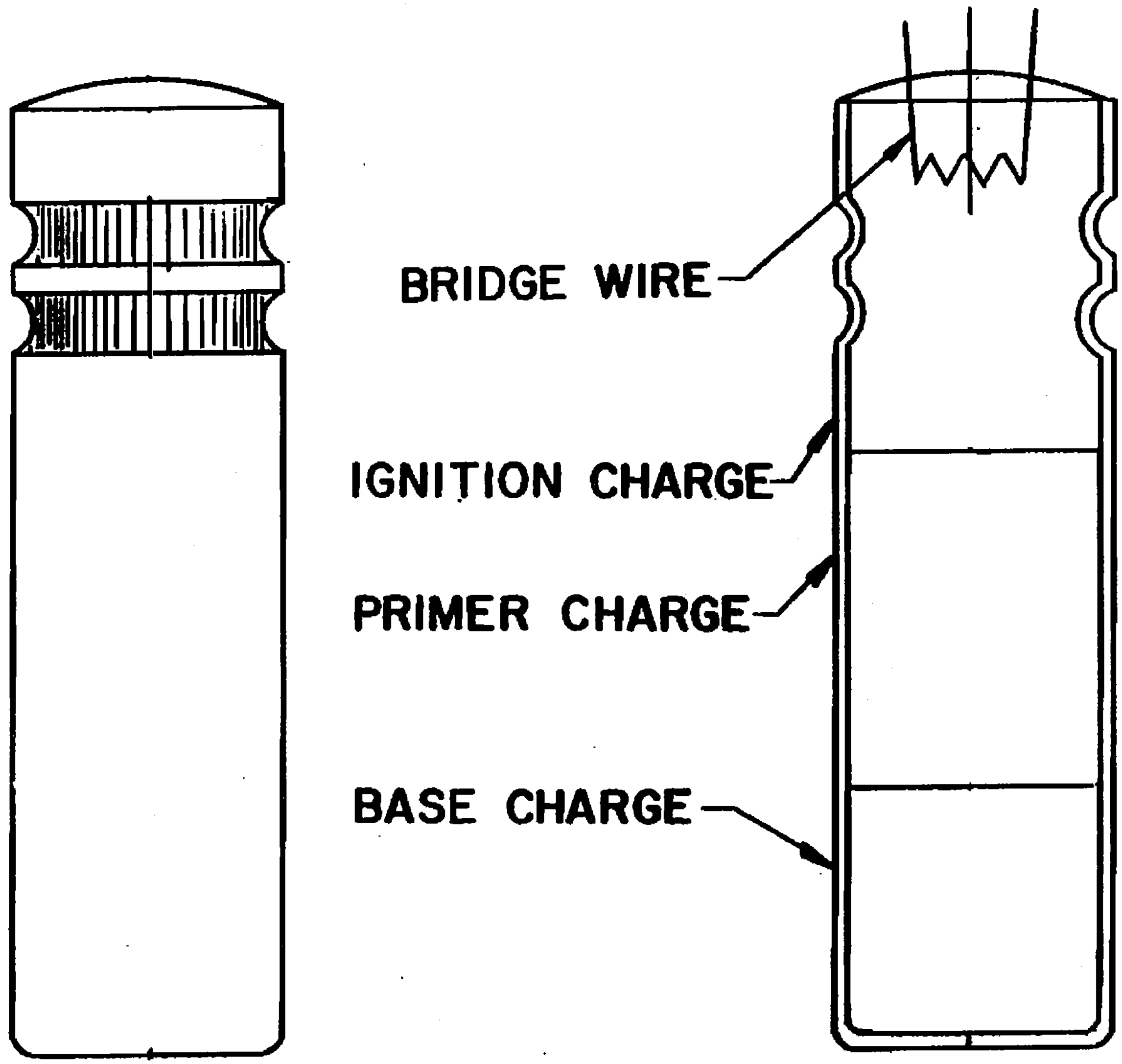
9. Electric blasting caps can safely be exposed to static electric charges. (true, false).

10. Describe a properly built explosives magazine.

11. A miner, having taken this course is qualified to return to a blast area and check for misfires. (true, false).

12. Name the person you would contact if you found an electric blasting cap in your drift ______________.

ELECTRIC BLASTING CAP

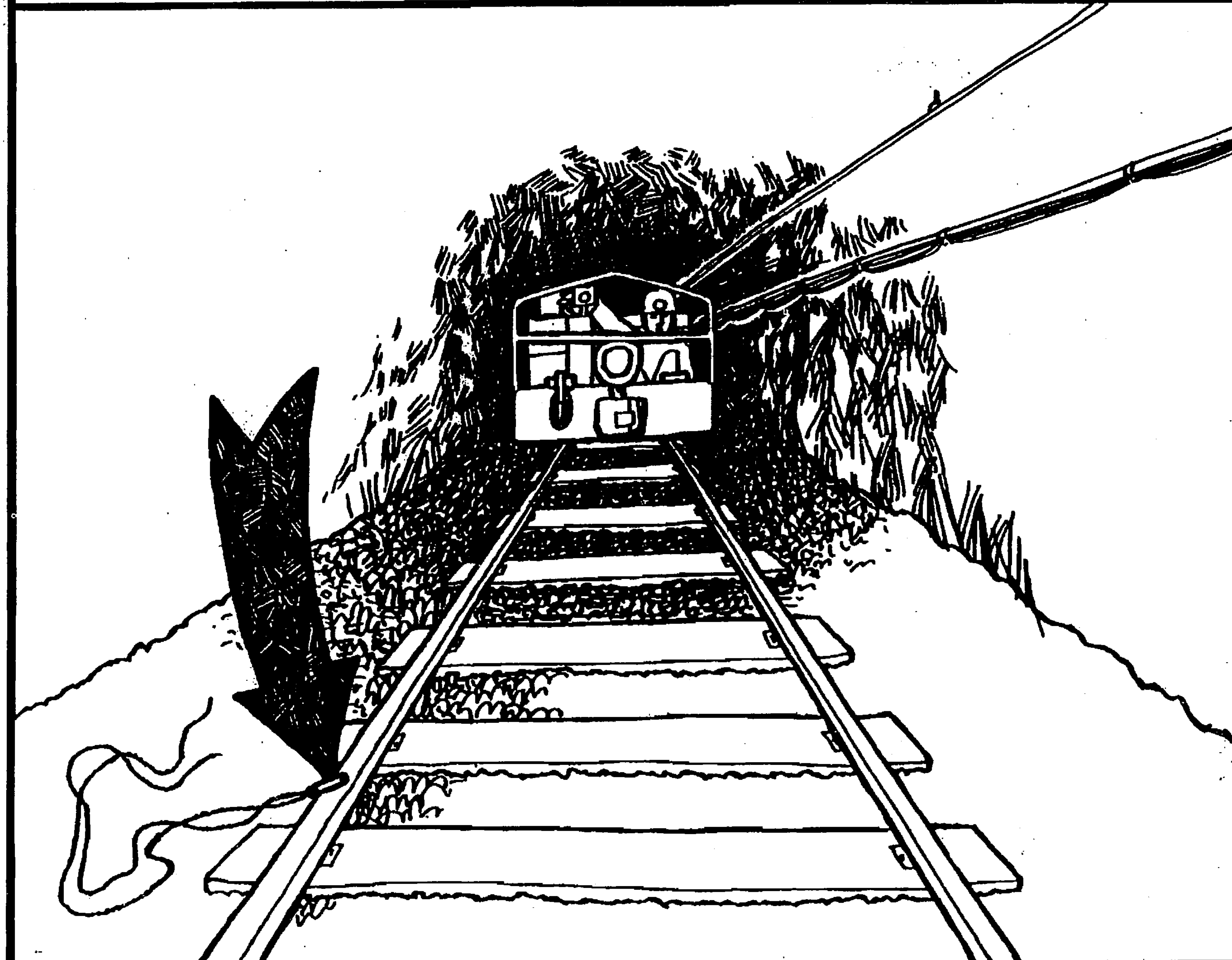


VISUAL 27

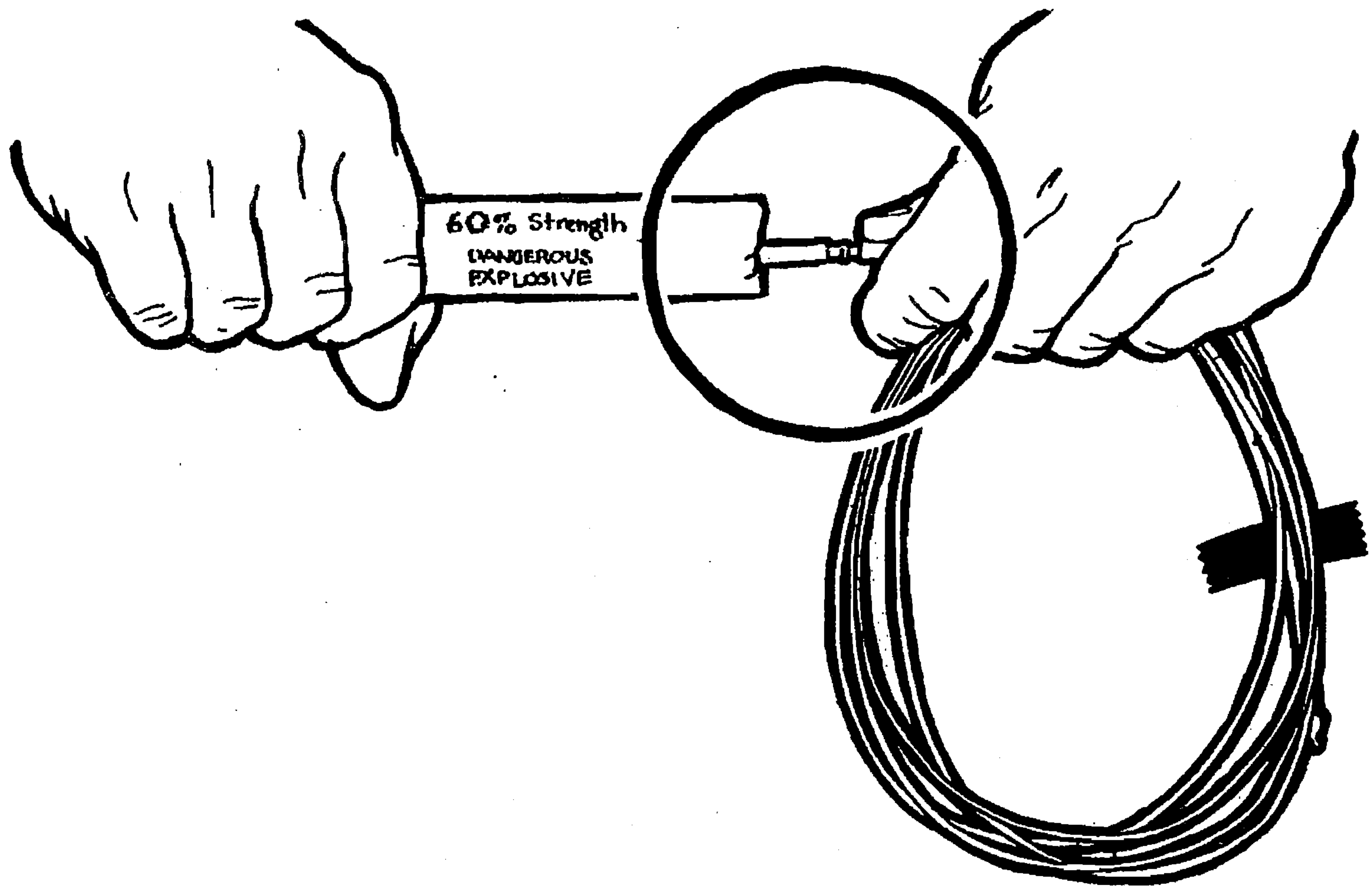
MISFIRES ARE DANGEROUS. AVOID MOVING THEM AND REPORT THEM IMMEDIATELY

VISUAL 28

LOOK OUT FOR LOST EXPLOSIVES



NON-ELECTRIC BLASTING CAP



DEEP METAL / NONMETAL

NEWLY EMPLOYED EXPERIENCED MINERS

PREPARED FOR THE U.S. BUREAU OF MINES

PITTSBURGH RESEARCH CENTER

UNDER CONTRACT #J0308011

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NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

INTRODUCTION TO THE WORK ENVIRONMENT

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: INTRODUCTION TO THE WORK ENVIRONMENT

I. GOAL: The goal of this module is to enable the miner to understand the components of the work environment and the procedures necessary to maintain a safe and healthful environment.

II. BACKGROUND: In 1979 there was a total of 5,501 accidents in deep metal/nonmetal underground mines, 2,429 resulting in personal injury and days lost from work, and 29 resulting in death. This module presents important information introducing miners to operations and hazards.

III. OBJECTIVES:

A. Information To Be Presented:

1. Explanation of operations and processes of mining used in obtaining, transporting and processing ore at the facility, and procedures for ground control.
2. Explanation of hazards particular to the specific operations and processes used and safety precautions to be taken.
3. Description of equipment used and explanation of the function of each piece of equipment.
4. Discussion of company safety policy and rule book.
5. A general description of the mine and the components of it. Tour showing locations of various components, both surface and underground with an emphasis on emergency equipment and first aid facilities. Description and observation of method of mining used.

B. Performance To Be Observed:

1. Verbal description by the miner of operations and processes employed in the mine. Given terms used the miner should state what each means.
2. Verbal descriptions by miner of hazards involved in operations and processes of the mine. Describe appropriate safety precautions.
3. Given pictures or drawings of equipment the miners should state name of equipment and explain its functions.
4. Miners should describe steps of obtaining, transporting and processing ore at the particular mine.
5. Given an operation the miner should state company safety policy pertaining to the operation.

6. When presented with terms used to describe components of the mine, the miners should state the general functions of the components. Should state location of various facilities in the mine. Verbal description by the miner of the method of mining used.

IV. ACTIVITIES:

A. Instructor completes questions asked in mine specific introduction (to be found at end of course plan).

B. On site

1. Tour of mine and surface facilities
2. Use checkin–checkout station
3. Locate emergency equipment and first aid station
4. Other activities associated with other courses

V. MATERIALS:

A. Visual aids

1. Mine map
2. Diagrams of mine processing steps
3. Photos, slides, etc. of equipment used in mine

B. Simulations or actual objects: Equipment used in mine

VI. EVALUATION:

A. Verbal descriptions

1. Mining method and major equipment used
2. Steps of mining process
3. Locations of first aid and emergency equipment

B. Self-Checks

1. Anytime hands on evaluation such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES:

A. Training standards: CFR 30 Part 48.6 b1

B. Textual materials: Company safety policy and rule book

C. Applicable MSHA fatalgrams.

TOPICS COVERED

I. MINING METHOD

A. Reaching the ore body

1. Shaft
2. Slope or incline
3. Outcrop or drift
4. Portal entries
5. Open pit

B. Extracting ore

1. Room and pillar
2. Stopes
3. Raises
4. Block caving
5. Open pit

C. Ground control

1. Timber
2. Rock bolts and split sets
3. Concrete and shotcrete

D. Haulage

1. Rubber tired
2. Track

E. Processing facilities

1. Grizzly and crusher
2. Mills

II. MINING HAZARDS AND ACCIDENT PREVENTION

A. Unsafe conditions

1. Ground hazards
2. Electrical hazards
3. Gas hazards
4. Explosives and fuel hazards

B. Unsafe acts

1. Taking risks in operating or maintaining equipment
2. Bending and lifting
3. Slips and falls

III. MINING EQUIPMENT AND THEIR FUNCTIONS

A. Equipment for reaching the ore body

1. Hoist
2. Boss buggy
3. Man trip
4. Walking

B. Equipment for extracting ore

1. Stoper drill
2. Jack-leg drill
3. Jumbos
4. Muckers

C. Equipment fo. ground control

1. Stoper drill
2. Jack-leg drill
3. Jumbo drill
4. Rock bolts and split sets
5. Timbers

D. Equipment for haulage

1. LHD
2. Slusher
3. Muckers
4. Youngbuggies
5. Locomotives and ore cars
6. Skip

IV. COMPANY SAFETY POLICY AND RULE BOOK

A. Management commitment to safety
B. Safety rules

V. MINE TOUR

A. Locations of mine portals
B. Methods and equipment for extracting ore
C. Methods and equipment for ground control
D. Methods and equipment for haulage of ore

E. Grizzly, crusher, and other ore processing done at the mine.
F. Escapeways, hazards, refuge centers, and first aid.
G. Check-in and check-out station

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: INTRODUCTION TO THE WORK ENVIRONMENT

I. MINING METHODS

A. Reaching the ore body can be accomplished by several methods. The method used at the mine depends upon the location of the ore body underground and the size of the mine.

INSTRUCTOR'S NOTE: ALTHOUGH ONLY ONE OR TWO OF THE FOLLOWING METHODS OF REACHING THE ORE BODY PERTAIN TO YOUR MINE, YOU MAY WANT TO MENTION THE OTHERS SO THE TRAINEES ARE AT LEAST AWARE OF THEM.

1. A vertical shaft is one way to reach the ore body. This tunnel runs from the surface, or is directly accessible from the surface, to most underground levels. The shaft transports miners and machinery into and out of the mine on a cage. A skip is used to haul ore out of the mine.

2. A slope or incline is a tunnel cut through rock that leads downward to reach the ore body. Although the grade of the slope may be steep at points, it always allows safe access for miners and machinery. Ore is hauled out of the mine by rubber tired or track haulage.

3. Ores found on the rock surface are called outcrops. Mining begins on the ore body at the outcrop, and follows it underground. The underground tunnel is called a drift. Miners and machinery move into and out of the mine along the drift. Ore is hauled out of the mine by rubber tired or track haulage.

4. Moving from the surface to underground means passing through an opening or entrace to the mine called a portal, portal entry or adit. Every underground mine has at least one portal, but larger mines may have several portals. Portals are assigned names or numbers to identify them.

5. An open pit mine is a large excavation and is used with a laterally extended ore body and shallow overburden. The overburden and waste rock is removed using a series of benches. The excavation leading down to or in the ore body is called the pit. The verticle part of the bench at the edge of the pit is called the wall or high wall. The pit is reached via access roads along the benches and ore

is removed by trucks along haul roads. Top soil and overburden waste rock is usually stored for use in recontouring the area after the ore is removed. The location, size and lay out of the pit, walls, benches and roadways will depend on the geological characteristics of the mine, and on the particular open pit methods and equipment being used.

B. Extracting ore is achieved by different kinds of mine development. The method of ore extraction used at the mine depends on the structure of the ore body.

INSTRUCTOR'S NOTE: ALTHOUGH ONLY ONLY ONE OR TWO OF THE FOLLOWING METHODS OF EXTRACTING ORE PERTAIN TO YOUR MINE, YOU MAY WANT TO MENTION THE OTHERS.

VISUAL'S NOTE: YOU MAY WANT TO SHOW AN ILLUSTRATION DISPLAYING THE METHOD(S) OF EXTRACTING ORE USED AT YOUR MINE. THE ILLUSTRATION IS INTENDED TO BE AS SIMPLE AS POSSIBLE TO CONVEY THE GENERAL CONCEPT. YOU WILL NEED TO DEVELOP YOUR OWN ILLUSTRATIONS HERE IN ORDER TO TAILOR THESE MATERIALS TO YOUR MINE.

1. Room and pillar extraction occurs with a flat-lying body of ore. The mined areas are rooms which are separated by pillars of approximately equal size. Pillars contribute some support to the roof.

2. Stopes are underground excavations made by extracting ore. Stopes may be considered the workshop of the mine because they are major production sites. After the ore is mined out, stopes resemble caverns in the rock. The more common stope methods include the following:

   a. Cut-and-fill stope permit breaking the ore material, taking it away and replacing it with backfill. The backfill is usually brought down a raise from the level above. Planks are laid on top of the fill, and then another slice of ore is blasted down on top of the planks. The ore is loaded off the planks into chutes.

   b. Shrinkage stope begins with enough ore being hauled out to allow working space in the stope for the next layer to be drilled and blasted. About one-third of the broken ore is hauled out, so that once a stope is started continuous production can be maintained. Backfill is seldom attempted.

c. Other stoping methods include sublevel stopes, open-stope mining in gently dipping veins, slice timbered stope, and top-slice stoping.

3. A raise is an underground opening driven upward through the rock from one level to another. Raises may be developed for exploration, to service a stope, to serve as ore passes or escapeways. There are a variety of methods of mining raises, including timber sets, stulls, and mechanical raise-climbing machines.

4. Block caving is used with ores that readily cave or collapse under its own weight, and the ore body contains sufficient tonnage.

   a. Caving is a large-production low-cost method.

   b. An opening is created above finger raises and then blasted. Systematic drawing of ore from the raises pulls ore away from the back of the stope, causing the back to crack and fall to the pile of broken ore. Because the ore increases in volume when broken, the broken ore fills up to the back, which in turn gives support to the back and stops the caving.

   c. Fingers must be carefully drawn to insure even caving action and to prevent overlying waste from coming through the fingers before all the ore is pulled out.

5. Open pit mining offers advantages associated with large-scale drilling, loading, and hauling operations. Open pit mines use one or more large draglines or power shovels to remove the overburden and usually smaller loaders and trucks to remove the ore.

C. The purpose of ground control is to provide a safe work place by supporting the back and ribs to prevent unintentional rock falls. The need for ground control measures in underground non-coal mines varies widely from mine to mine. Geological conditions, mining methods and the skill of the miners themselves are the primary determinants of the need for ground control.

INSTRUCTOR'S NOTE: METHOD OF GROUND CONTROL ARE MORE THOROUGHLY DISCUSSED IN THE MATERIALS ON GROUND CONTROL. YOU MAY WANT TO USE VISUALS FROM THOSE MATERIALS TO SUPPLEMENT THIS DISCUSSION.

1. Timbering is known as the conventional method of ground control. Timber serves both temporary and permanent support of the back. One hazard with timbers is that it is a fuel for underground fires.

2. Rock bolts and split sets are metal supports inserted in holes drilled into the back and ribs. Bearing plates, wire matting, and trusses are used to distribute the weight of the back on one or more supports.

3. Concrete and shotcrete provide support and keep moisture from the rock. They are used ... and around drifts, draw points, and ore passes.

D. Haulage or transportation of ore is done with a variety of rubber tired and track haulage machinery.

1. Rubber tired haulage equipment includes muckers and youngbuggys.

2. Track haulage equipment uses ore cars and electric or battery operated locomotives.

E. Ore goes through several stages in processing in order to obtain particular minerals. Equipment used in these stages are located at the mine or at the mill.

1. A grizzly is a steel grating placed over an ore pass or chute to stop overly large rocks from passing through. A miner uses a pick or sledge hammer to break up the rock. A crusher is a machine for crushing rock into small gravel.

2. Processing facilities located in mills are used for the recovery of valuable metals, or concentration of the valuable minerals into a smaller bulk for shipment to a smelter or other reduction works.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW CORRECT RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN ALL PHASES OF MINING METHODS.

II. MINING HAZARDS AND ACCIDENT PREVENTION

A. Unsafe conditions can cause accidents. These are conditions not under the direct control of miners. However, good accident prevention procedures, such as work place inspection and equipment maintenance, can minimize unsafe conditions. The following are common unsafe conditions.

1. Ground hazards include falls of back or rib.

2. Electrical hazards include faulty insulation, splices, and grounding.

3. Gas hazards include fumes from diesel-powered equipment, fires, batteries and blasting.

4. Hazards with explosives and fuels are always present but are minimized through safe work practices.

INSTRUCTOR'S NOTE: ALTHOUGH THESE UNSAFE CONDITIONS ARE MORE THOROUGHLY DISCUSSED IN OTHER MODULES, YOU MAY WANT TO ELABORATE MORE ON THEM NOW, AND USE VISUALS FROM THOSE SECTIONS TO AID YOU LECTURE.

B. Unsafe acts are usually the result of taking unnecessary risks and/or trying to take short cuts in proven safe work procedures. Your motivation to work safely will reduce the likelihood for accidents and injury by minimizing unsafe acts.

1. Taking risks in operating or maintaining equipment means that it is only a matter of time before an accident occurs. Always drive safely. Use your seat belt. Do not give rides in buckets or other areas not intended for transportation.

2. Much of a miner's work involves bending and lifting. Always follow safe procedures by bending your knees and using them, rather than your back, to lift. If the load is too heavy or awkward get help.

VISUALS NOTE 1 and 2: SHOW THE ILLUSTRATION DISPLAYING CORRECT PROCEDURES FOR LIFTING AND CARRYING LOADS.

3. Wet or oily surfaces, protruding objects, or inattention can cause slips and falls.

III MINING EQUIPMENT AND THEIR FUNCTIONS

INSTRUCTOR'S NOTE: THE FOLLOWING KINDS OF MINING EQUIPMENT ARE ORGANIZED ACCORDING TO THEIR FUNCTION. BRIEFLY DESCRIBE THOSE KINDS OF EQUIPMENT USED AT YOUR MINE.

A. Equipment for reaching the ore body

1. Hoist

2. Boss buggy
3. Man trip
4. Walking

B. Equipment for extracting ore

1. Stoper drill
2. Jack-leg drill
3. Jumbos
4. Muckers

C. Equipment for ground control

1. Stoper drill
2. Jack-leg drill
3. Jumbo drill
4. Rock bolts and split sets
5. Timbers

D. Equipment for haulage

1. LHD
2. Slusher
3. Loaders
4. Youngbuggies
5. Skip
6. Locomotive and ore cars
7. Conveyors

IV. COMPANY SAFETY POLICY AND RULE BOOK

INSTRUCTOR'S NOTE: YOU SHOULD PREPARE A DISCUSSION OF THE MINE'S SAFETY POLICY. YOU WILL ALSO NEED COPIES OF THE MINE'S SAFETY RULE BOOK FOR DISTRIBUTION TO STUDENTS, IF AVAILABLE.

A. Management is committed to safety. Unsafe conditions should be reported to supervision. Unsafe acts should be corrected.

B. The miner is responsible for himself and for other miners.

V. CHECK-IN AND CHECK-OUT STATION AND PROCEDURES.

INSTRUCTOR'S NOTE: MATERIAL IN THIS SECTION IS MORE THOROUGHLY DISCUSSED IN THE MODULE ON ENTERING AND LEAVING THE MINE.

A. Location of the check-in and check-out board at the mine.

B. Procedures for check-in and check-out.

   1. When entering the mine, check-in by placing brass tag on hook. When checking out of the mine, remove brass tag from hook.

   2. Check-in and check-out procedures are used as a record of all personnel and visitors in the mines at any time. This information is essential in the event of a mine emergency.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO. TRAINEES MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW CORRECT ANSWERS AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN MINING HAZARDS, MINING EQUIPMENT, THE COMPANY SAFETY POLICY, AND CHECK-IN AND CHECK-OUT PROCEDURES.

VI. MINE TOUR

INSTRUCTOR'S NOTE: THE TOUR OR WALK-THROUGH OF YOUR MINE CAN BE CONDUCTED IN CONJUNCTION WITH THIS TRAINING MODULE, OR AS A SEPARATE TRAINING EXERCISE. THE FOLLOWING MATERIALS ARE INTENDED TO COVER ALL ASPECTS OF THE TOUR REGARDLESS OF HOW IT IS ORGANIZED. THESE MATERIALS LIST EQUIPMENT AND LOCATIONS YOU SHOULD POINT OUT TO YOUR TRAINEES.

VISUALS NOTE: JUST PRIOR TO THE MINE TOUR, YOU SHOULD SHOW THE TRAINEES YOUR EXPECTED ROUTE OF TRAVEL ON THE MINE MAP. THIS WILL AID IN THEIR ORIENTATION TO THE LAYOUT OF THE MINE AND TO THE LOCATIONS OF UNDERGROUND FACILITIES.

A. Location of the mine portal, hoist, and skip.
B. Methods and equipment of extracting ore.
C. Methods and equipment for ground control.
D. Methods and equipment for haulage of ore.
E. Grizzly, crusher, and other ore processing done at the mine.
F. Escapeways, refuge centers, dinnerhole, and first aid stations. Abandoned work areas. Hazardous areas due to poor ventilation, ground control, or other conditions.
G. Check-in and check-out station.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF CHECK NUMBER THREE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE MINE TOUR AND THE INSTRUCTOR IS RESPONSIBLE FOR DEVELOPING SELF CHECK #3 SPECIFIC TO HIS/HER MINE. SUGGESTIONS APPEAR LATER IN THIS MODULE.

SELF CHECK #1 SOLUTIONS

1. Answers will vary
2. Answers will vary.
3. Geologic conditions, mining methods, and skill of the miners.
4. Timbering, rock bolts, and concrete or shotcrete
5. False
6. Answers will vary.

SELF CHECK #2 SOLUTION

1. Possible answers might include ground hazards, electrical hazards, bad weather, gas hazards, explosives, and fuel hazards.
2. Accident
3. Possible answer: One foot to the side, one foot behind, back straight, chin tucked in, grasp object with whole hand, and lift.
4. a. IV.
   b. II.
   c. IV.
   d. I.
   e. III.
   f. III.
   g. I.
   h. IV.
5. True

SELF CHECK #1: MINING METHODS

1. Name and describe the method(s) of extracting ore most often used at your mine.

2. What typ s of machinery are used to extract and remove ore from your mine

3. The need for ground control in your mine is determined primarily by

_______________________, ___________________________, and

__________________________________.

4. Name 3 common methods of ground control.

5. A grizzly is the name for a machine which crushes rock into small gravel. (True, False)

6. When working around a grizzly a miner: (Circle answers appropriate to your mine.)

   a. Uses a pick or sledge hammer.

   b. Wears a restraining belt.

   c. Works only when the crusher is off.

   d. Always wears a hardhat.

   e. Remains alert and safety conscious.

Self Check #2 Mining Hazards, Mining Equipment, Safety Policies, and Check-in and Check-out Procedures.

1. Name 4 unsafe conditions that can be minimized by work place conditions and equipment maintenance.

   a.

   b.

   c.

   d.

2. Taking unnecessary risks or short cuts in proven safe work procedures means it is only a matter of time before an ____________________ occurs.

3. Describe the safe procedure for lifting heavy objects.

4. Are the following pieces of equipment for I. reaching the ore body, II. extracting ore, III. ground control, or IV. haulage?

   ___ a. conveyor

   ___ b. muckers

   ___ c. skip

   ___ d. hoist

   ___ e. rock bolts

   ___ f. timbers

   ___ g. man trip

   ___ h. locomotive and ore cars

5. The miner is responsible for himself and other miners. (true, false)

Suggestions for Self Check #3

1. Pass out unlabeled mine maps. Ask trainees to write in any locations you feel necessary for the health and safety of your miners. These locations should be listed at the bottom of the map or on the back. Possibilities include:

   escapeways
   lunch room
   first aid stations
   abandoned work areas
   mine telephones
   fuel and explosive depots
   power station
   guard shack
   parking lot
   access roads
   shop and yard areas
   haulage roads and hazards
   lube bay
   bathhouse

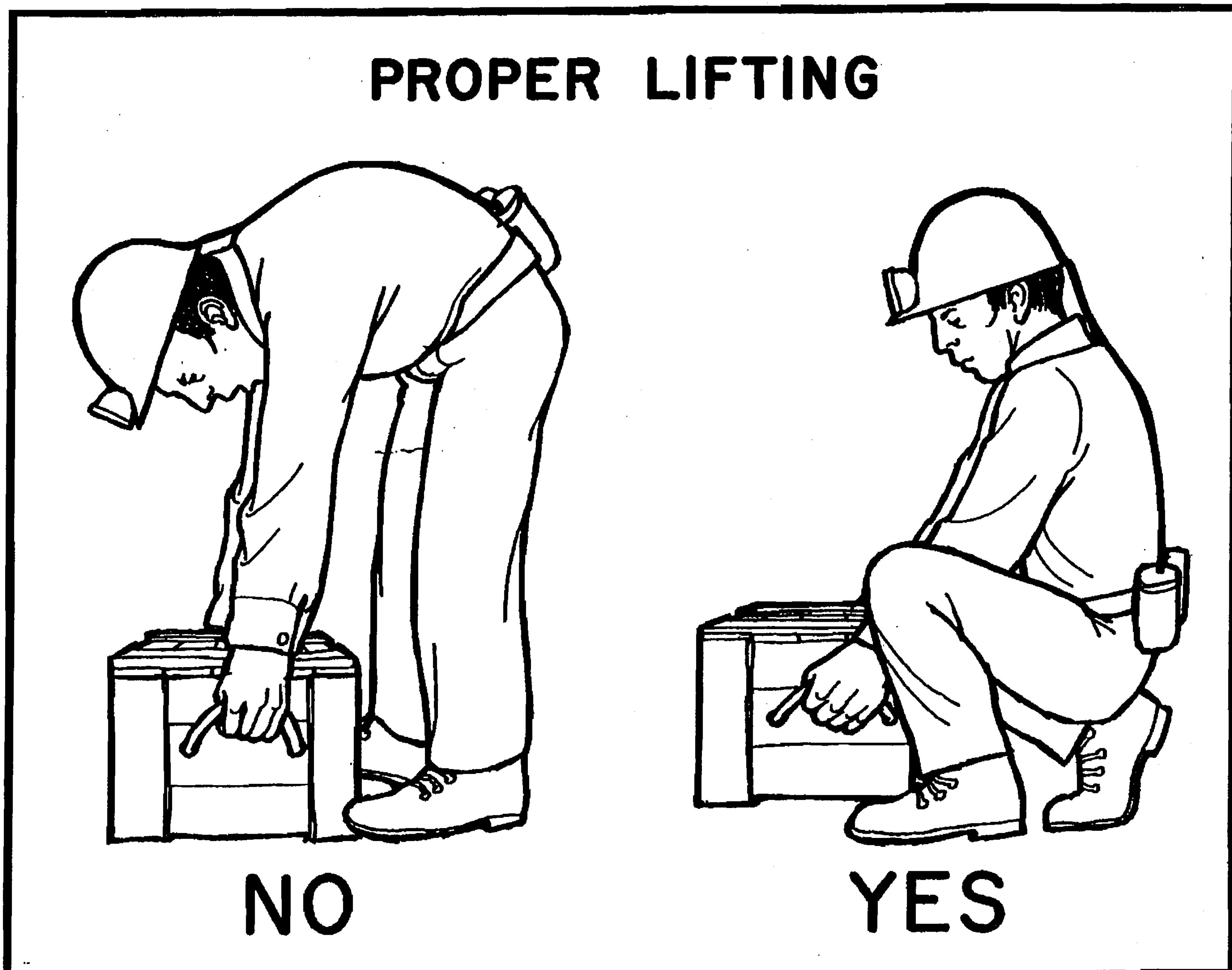
2. Ask miners to imagine themselves at a specific location in the mine. Direct them to tell how they would reach another specific location.

   Sample:

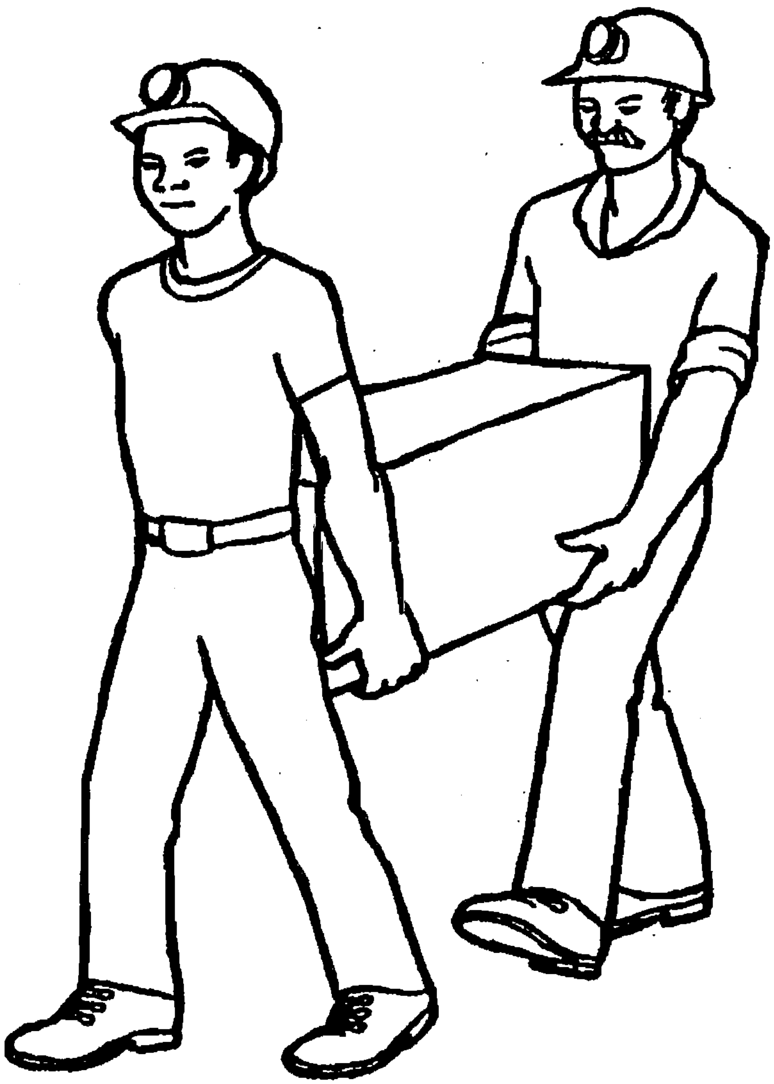
   A. You are at explosives depot A and smell fuel. Find the nearest telephone.
   B. You are on the main haulageroad and cut yourself badly on a broken thermos. Find the first aid station.
   C. Go from the power station to the repair shop.

3. Cite mine accidents, either actual or potential, and ask trainees to describe route to nearest help.

4. Have trainees verbally tell each other how to go from one location to another in your mine.


PROPER LIFTING
NO
YES

IF THE LOAD IS TOO HEAVY:



GET HELP! Both face in direction of travel.

LIFTING IN CONFINED AREAS

ON HANDS AND KNEES:

Lift object with one hand, balance with the other.

VISUAL 2

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
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303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

I. GOAL: The goal of this module is to assure that the miner understands specific health and safety hazards of the job to which he or she is assigned and can take appropriate precautions when performing that job.

II. BACKGROUND: To the new miner the Federal regulations governing health and safety aspects of surface metal/nonmetal mining may appear to be confusing and complex. The experienced miner, however, knows how the regulations assure him of a safe work area. Training in the health and safety aspects of assigned tasks will give the miner knowledge and skills for following the regulations. Even though the new experienced miner has had previous mining experience at another mine, he may not have had training unique to the task now assigned.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe specific duties of tasks to which each trainee is assigned

2. Point out health and safety hazards specific to assigned tasks

3. Discuss specific mandatory health and safety standards that apply to tasks assigned

4. Describe company policy that applies to the mandatory health and safety standards

B. Trainees will be able to do the following:

1. Describe duties and tasks to which assigned.

2. Perform assigned tasks.

3. Recognize and avoid health and safety hazards specific to those assigned tasks.

4. Describe applicable mandatory health and safety standards and company policy as it relates to themselves.

IV. ACTIVITIES

A. Demonstration of proper techniques for tasks assigned

B. Demonstration of proper precautionary measures for health and safety

V. MATERIALS

A. Visual Aids

B. Applicable mandatory standards

C. Applicable company policy

VI. EVALUATION

A. Demonstrate, describe, or identify:

1. Duties and tasks

2. Health and safety hazards

3. Mandatory standards and company policy

4. Job techniques

5. Safety precautions

B. Self Checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessary to fit your local mine situation.

VI. RESOURCES

A. Training standards

1. CFR 30 Part 48.6-2

2. Company policy

B. Applicable MSHA fatalgrams.

TOPICS COVERED

I. DUTIES OF TASKS ASSIGNED

A. Work station

B. Tasks to perform

C. Tasks which must be performed by others, e.g. electrical repairs

II. HAZARDS INVOLVED IN TASKS ASSIGNED

A. Potential accidents

1. struck by falling rock
2. burns from electrical equipment, fire, or hot metal
3. falls caused by uncleaned spills or debris
4. pinched or caught by machinery
5. premature explosion or flying debris

B. Potential health problems

1. respirable dust
2. toxic gases
3. radon daughters

C. Techniques for avoiding hazards

1. precautionary measures with equipment
2. precautions used in blasting
3. personal protective equipment to be worn

III. RESPONSES OF STUDENTS TO DUTIES AND THE HAZARDS ASSOCIATED WITH THEM

A. Verbal description of tasks assigned

B. Perform tasks properly

C. Verbal description of hazards and techniques for avoidance

D. Display appropriate precautions for tasks

IV. MATERIALS REQUIRED

A. Visual aids (if appropriate)

B. Company policy statement

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HEALTH AND SAFETY ASPECT OF TASKS TO WHICH ASSIGNED

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A DISCUSSION WHICH COVERS ALL MAJOR POINTS WITHIN THIS LESSON GUIDE. ONE VERY IMPORTANT ASPECT TO REMEMBER IN NEW EXPERIENCED MINER TRAINING IS THAT CONDITIONS, EQUIPMENT AND PROCEDURES WILL VARY FROM ONE MINE TO THE NEXT.

I. DUTIES OF ASSIGNED TASKS

   A. Work station

      1. Location
      2. Transportation

   B. Tasks to be performed

      1. Skills training with equipment.
      2. Safe work procedures.

   C. Tasks which must be performed by others.

      1. Qualified, certified, or competent persons.
      2. Electrical repairs.
      3. Equipment maintenance.
      4. Use of explosives.

INSTRUCTOR'S NOTE: THE FOLLOWING POINTS ARE INTENDED TO GUIDE YOUR DISCUSSION OF HEALTH AND SAFETY ISSUES. YOU SHOULD EXPAND UPON THOSE ISSUES OF MOST RELEVANCE TO YOUR MINE.

II. HAZARDS INVOLVED IN ASSIGNED TASKS

   A. Potential accidents

1. Struck by falling back or rib.
2. Electrical shock.
3. Burns from electrical equipment, fire, or hot metal
4. Slips and falls from uncleaned spills, debris, or equipment.
5. Fingers or arms pinched or caught by machinery.
6. Premature explosion or flying debris.

B. Potential health problems

1. Respirable dust

a. Nuisance dust has little permanent effect on lungs.
b. Fibrogenic dust such as asbestos (silica dioxide), quartz, and feldspar cause pneumoconiosis which can be fatal.

INSTRUCTOR'S NOTE: SEE THE MODULE ON HEALTH FOR SUPPLEMENTAL INFORMATION ON RESPIRABLE DUST

2. Toxic gases

a. Carbon monoxide from fires, explosions, and diesel engines.
b. Nitric oxide and nitrogen dioxide from diesel engines, electrical discharges, and explosives.
c. Sulfur dioxide from fires or explosions.

INSTRUCTOR'S NOTE: SEE THE MODULE ON MINE GASES FOR SUPPLEMENTAL INFORMATION ON TOXIC GASES.

3. Radon daughters

INSTRUCTOR'S NOTE: SEE THE MODULE ON HEALTH FOR SUPPLEMENTAL INFORMATION ON RADON DAUGHTERS.

C. Techniques for avoiding hazards.

1. Precautionary measures with equipment

INSTRUCTOR'S NOTE: REVIEW SAFETY HAZARDS ASSOCIATED WITH THE OPERATION OF PARTICULAR MINING EQUIPMENT.

2. Precautions used in blasting.

INSTRUCTOR'S NOTE: REVIEW SAFE WORK PROCEDURES ASSOCIATED WITH THE USE OF EXPLOSIVES.

3. Personal protective equipment

   a. hard hat
   b. respirators
   c. rubber gloves and boots for electrical repairs
   d. safety glasses
   e. ear plugs or muffs

IV. MANDATORY HEALTH AND SAFETY STANDARDS FOR METAL AND NONMETALLIC UNDERGROUND MINES Part 57

Sections of Part 57

Section	Title
57.1	Purpose and Scope
57.2	Definitions
57.3	Ground control
57.4	Fire prevention and control
57.5	Air quality and physical agents
57.6	Explosives
57.7	Drilling
57.8	Rotary jet piercing
57.9	Loading, hauling, dumping
57.10	Aerial tramways
57.11	Travelways
57.12	Electricity
57.13	Compressed air and boilers
57.14	Use of equipment
57.15	Personal protection
57.16	Materials storage and handling
57.17	Illumination
57.18	Safety programs
57.19	Man hoisting
57.20	Miscellaneous

INSTRUCTOR'S NOTE: IN ORDER TO FAMILIARIZE MINERS WITH PART 57, YOU MAY WANT TO DISTRIBUTE COPIES OF PART 57 AND LEAD THEM THROUGH IT. AS AN AID, THERE ARE EXERCISES WITH THIS GUIDE DESCRIBING PROBLEM SITUATIONS FOR WHICH MINERS CAN LOCATE THE

REGULATION THAT GOVERNS THE PROBLEM. YOU MAY WANT TO DEVELOP YOUR OWN EXERCISES BASED ON PARTICULAR SITUATIONS IN THE MINE.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE. TRAINEES MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW ANSWERS AND CLARIFY INCORRECT RESPONSES. QUESTIONS CONCERN HEALTH AND SAFETY ASPECTS OF ASSIGNED TASKS.

SELF CHECK #1: SOLUTIONS

1. a, c, d
2. Answers may include hard hat, respirator, rubber gloves and boots for electrical repairs, safety glasses, ear plugs and muffs, etc.
3. answers will vary
4. answers will vary

Exercise Number 1

A burnt out fuse needs to be quickly replaced but the switch box is 100 yards away. The current may be weak, and the fuse could be replaced by hand without de-energizing the circuit. What should be done? (Answer: Part 57.12-36).

Exercise Number 2

A crew of general laborers are instructed to clear some loose material like fallen trees and rubbish from the top of the highwall. How far from the edge should this material be cleared? (Answer: Part 57.3-2).

Exercise Number 3

A miner is waiting for a ride, but a front-end loader headed in the same direction passes by first, should the miner ask for a ride in the empty bucket? (Answer: Part 57.9-40a).

Exercise Number 4

An electrician must climb a twenty-foot ladder on a light pole to replace a bulb. The bulb is larger but can be handled with one hand. Should he carry it by hand or use some sort of bag? (Answer: Part 57.11-11)

Exercise Number 5

A new mechanics helper shows up for work wearing athletic shoes. Should he be permitted to work? (Answer: Part 57.15-3)

Self Check #1: Health and Safety Aspects of Assigned Ta*ks

1. Circle all of the situations below where you would call in a trained or certified person to repair something at your mine.

   a. You accidentally run over an electric cable with your forklift, cutting it almost in half.

   b. You trip over a can of motor oil while checking a dipstick.

   c. While warming up the engine you notice the temperature gauge is broken on your Euclid 100.

   d. You find a blasting cap near the powder magazine.

2. List all items of personal protective equipment used at your mine.

3. Circle each of the following that is a potential hazard at your mine.

   a. electrical shock

   b. burns from electrical equipment, fire, or hot metals

   c. premature explosion or flying debris

   d. slips and falls from uncleaned spills and debris

4. Discuss ways of avoiding hazards at your mine.

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

ENTERING AND LEAVING THE MINE, TRANSPORTATION, COMMUNICATION

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
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303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: ENTERING AND LEAVING THE MINE; TRANSPORTATION; COMMUNICATIONS

I. GOAL: The goal of this module is to insure that the miner can use the mine's transportation and communications systems safely and effectively.

II. BACKGROUND: Accidents related to motion of powered haulage transportation equipment and hoisting equipment in 1979 totaled 487 in underground metal/nonmetal mines. Eight of these resulted in fatalities and 354 resulted in days lost from the job. The frequency of these accidents established the importance of training on transportation controls and hoisting operations. Communications are critical to mine operations, equipment conditions, and emergency warnings.

Previous experience at another mine does not automatically insure that a mine will be familiar with the equipment and procedures at your mine.

III. OBJECTIVES

A. Trainer will do the following:

1. Demonstrate communications system used in mine.
2. Describe means of transportation used by miners and materials.
3. Demonstrate types of signals and signs used in the mine.
4. Discuss type of check-in and check-out system used in the mine and identification devices to be worn by miner.
5. Discuss company policy for entering and leaving mine and use of transportation systems.
6. Describe hazards involved in transportation systems.

B. Trainees will be able to do the following:

1. Demonstrate communications system and appropriate use of simulated communications system (or actual system).
2. Describe procedure for using transportation system including appropriate safety measures to be used.
3. Respond to correct meaning when presented with signs and signals used in mine.
4. Demonstrate check-in and check-out procedure and correct use of simulated (or actual) procedure used at mine.
5. Discuss company policy for entering and leaving mine and use of transportation system.
6. Identify each hazard involved in transportation and appropriate safety measures to be taken.

IV. ACTIVITIES

A. On site - in conjunction with introduction to work environments

1. Use checkin-checkout system
2. Have trainees take turns guiding the class through the transportation system
3. Practice with trainees in using the local mine signaling system

B. In classroom

1. Use model checkin-checkout system
2. Use model signal system

V. MATERIALS

A. Visual aids

B. Simulations (or actual objects)

1. Checkin-checkout system
2. Signaling system

C. Copies of company policy regarding entering and leaving the mine.

VI. EVALUATION

A. Describe, identify or demonstrate:

1. Communications system
2. Procedure for using transportation system, hazards, and appropriate safety measures

B. Performance

1. Use of checkin-checkout system correctly
2. Follow correct procedures on transportation system

C. Written evaluation - Self Checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. Training standards: CFR 30 Part 48.6-4

B. Company policies regarding entering and leaving mine and transportation

C. Applicable MSHA fatalgrams

TOPICS COVERED

I. CHECK-IN CHECKOUT PROCEDURES

A. Reason for system

1. locate miner who fails to return
2. eliminate need for search

B. Identification devices worn by miner

C. Procedures and company policy

II. TRANSPORTATION SYSTEM

A. Man trips

1. load limits
2. riding techniques

B. Materials trips

1. ore
    a. trucks
    b. ore cars
2. equipment
    a. machinery
    b. explosives
    c. other supplies used in the mine

C. Hazards involved in transportation system

1. objects protruding from ribs and roof
2. falling out of or off moving equipment
3. injury to body parts hanging out of trip and hitting rib or other object
4. flying objects when equipment stops suddenly, derails, or is involved in a collision
5. body parts touching electrical power sources

6. collison due to excessive speed
7. collision due to not seeing other vehicle or people walking
8. injury to eyes or lungs from dust
9. materials on the cage not being correctly secured

III. COMMUNICATION SYSTEM

A. Mine communications

1. phones
2. pull bottles

B. Equipment signals

1. backing-up signal
2. bells on motors
3. equipment status signals

C. Mine emergency warning signals

1. warning signals: stench canisters and alarms
2. Escapeway marking signs.

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: ENTERING AND LEAVING THE MINE; TRANSPORTATION; COMMUNICATION

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A DISCUSSION WHICH COVERS ALL MAJOR POINTS WITHIN THIS LESSON GUIDE. ONE VERY IMPORTANT ASPECT TO REMEMBER IN NEW EXPERIENCED MINER TRAINING IS THAT CONDITIONS, EQUIPMENT AND PROCEDURES WILL VARY FROM ONE MINE TO THE NEXT.

I. CHECK-IN AND CHECK-OUT PROCEDURES

A. The check-in and check-out system is used to keep a current record of all mine personnel and visitors present in the mine. This information is essential during a mine emergency. By law, this record is kept on the surface in a place safe from fire or other hazard.

1. In the event of an emergency, this system aids mine rescue in identifying and locating any miner who fails to return and check-out. Management can determine where the miner was working and thereby focus mine rescue efforts.

2. By checking-out of the mine when leaving, mine rescue teams will not waste time and risk their lives looking for someone who is not in the mine at all.

3. The system is also used to locate a miner in case of a personal emergency i.e. a sick or injured family member etc.

B. The check-in and check-out procedure uses an identification tag called brass. Brass has your name or some other identification number stamped on it. A second brass may also be permanently attached to your lamp belt.

VISUALS NOTE: SHOW A SLIDE OR DRAWING OF YOUR CHECK-IN AND CHECK-OUT STATION.

C. The company policy is that all miners follow check-in procedures when entering the mine. Place your brass on a hook at the station. When leaving the mine check-out by removing your brass from the hook. Keep brass for the next work day.

INSTRUCTOR'S NOTE: EXPAND YOUR DISCUSSION OF COMPANY POLICY ON CHECK-IN AND CHECK-OUT PROCEDURES AS NECESSARY.

II. MINE TRANSPORTATION SYSTEM

A. Man trips are rubber-tired or track vehicles or shaft cages designed to transport miners between the working areas of a mine and the dry room or bath house used to change clothes and clean-up.

1. Man trips are designed to carry a certain number of miners. Attempting to crowd more miners on a man trip than it is designed for is a safety hazard and should be avoided.

2. When boarding the man trips other than cages, both hands should be emptied of tools and lunch pail. You need your hands to assist getting into the man trip. Place your tools and lunch pail in the man trip before boarding.

3. Once in the man trip and underway, keep your head, arms and legs inside. You could accidently hit a rib or piece of equipment when leaning out. Also make sure that any equipment or tools such as picks, shovels or slate bars do not stick out of the car or cage.

B. Material trips are used for both ore and mining equipment.

1. Haulage of ore is done by rubber tired or track vehicles. Young buggies, ore cars, or muck cars are used to transport the ore from the drifts and stopes to belt lines and/or to the ore skip which hauls ore up the shaft to the mill.

2. Equipment trips are used to bring various supplies into the mine. These supplies include mining machinery, fuel and explosives.

3. Hazards involved in transportation system.

a. Objects protruding from the ribs or roof, such as rock, timber, or pipes.

b. Falling out of or off moving equipment due to recklessness, bumps, quick stops or horseplay.

c. Injury to head, arms, hand or legs, that are hanging out of the trip and hit a rib or other object.

VISUALS NOTE: SHOW VISUAL 4 ILLUSTRATING THE MINER'S HEAD CAUGHT BETWEEN A LOCOMOTIVE AND AN ORE PASS, AND/OR VISUAL 5 ILLUSTRATING THE MINER'S ARM CAUGHT BETWEEN MAN CAR AND RIB TIMBER.

d. Flying objects, such as lunch pails, tools, or rock, when the trip stops suddenly, derails, or is involved in a collision.

e. Body parts hanging out of trip and making contact with an electrical power source.

f. Collision of trip due to excessive speed and subsequent loss of control or brake failure.

g. Collision of trip with other vehicle or striking person due to poor visibility or inattention.

h. Injury to eyes or lungs from dust or small particles.

VISUALS NOTE: SHOW VISUAL 51 ILLUSTRATING THE SECURING OF LOOSE MATERIAL.

i. Materials on the cage not being secured correctly.

INSTRUCTOR'S NOTE: MENTION TO THE STUDENTS THE AVAILABILITY OF RESPIRATOR FILTERS FOR PROTECTION FROM DUST. USE OF FILTERS IS MORE THOROUGHLY DISCUSSED IN THE TRAINING MATERIALS ON SELF-RESCUE AND RESPIRATORY DEVICES.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN THE MINE TRANSPORTATION SYSTEM AND CHECK-IN AND CHECK-OUT PROCEDURES.

IV. MINE COMMUNICATION SYSTEM.

A. Mine communications are important for routine messages. Requests for supplies or assistance with operational problems save time when done over an efficient communications system. In the case of accident or other emergency, people in the mine must be able to tell people on the surface what happened so that proper measures can be taken quickly.

1. The law requires that two-way communication systems be provided at several locations in the mine. These include all levels of the main shaft and slopes, and between the surface and each working section. Phone systems are commonly used to provide two-way communcations.

INSTRUCTOR'S NOTE: DESCRIBE HOW TO USE THE PHONE SYSTEM AT YOUR MINE. INCLUDE USE OF KEYS AND PAGING IN YOUR DISCUSSION.

2. Communications with the hoistman is done by pull bottles located at each level of the shaft.

DEMONSTRATION NOTE: SHOW THE STUDENTS HOW TO COMMUNICATE WITH THE HOISTMAN USING A PULL BOTTLE. EXPLAIN THE PULL BOTTLE COMMUNICATION SYSTEM WITH THE NUMBER AND SEQUENCE OF PULLS.

B. Equipment signals are signals mounted on equipment to warn the operator or others of some particular condition of the vehicle.

   1. Backing-up signals warn others that the vehicle is in reverse gear and that they should immediately move out of its way.

   2. A bell may sound when a motor starts up.

   3. Equipment status signals inform the operator of critical status levels of various components of the equipment, such as low oil or hydraulic pressure.

C. Mine emergency warning signals alert miners to immediately initiate mine evacuation procedures.

   1. Warning signals inform miners of the emergency, and can be of two types.

      a. Stench canisters containing a smell of rotten eggs.
      b. Alarms located throughout the mine.

   2. Another important emergency signal is the escapeway marking signs located throughout the mine. Their directional information guides miners through the escapeways system.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO. TRAINEES MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW CORRECT ANSWERS AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN THE MINE COMMUNICATION SYSTEM.

SELF CHECK #1 SOLUTIONS

1. c
2. true
3. b
4. tools and lunch pail (hard hat should be worn)
5. e

SELF CHECK #2 SOLUTIONS

1. true
2. true
3. false
4. true
5. d

SELF CHECK: ENTERING AND LEAVING THE MINE; TRANSPORTATION; COMMUNICATION

SELF CHECK #1: CHECK-IN AND CHECK-OUT PROCEDURES AND TRANSPORTATION

1. The reason for wearing your brass identification tag is:

    a. adding one more thing to do

    b. the shine could be seen in an emergency

    c. in emergency situations, mine rescue teams can determine where a missing miner was working

2. Mine rescue teams will not waste time and risk their lives looking for someone who is not in the mine at all if workers have correctly used check-in and check-out procedures. (true, false)

3. Attempting to crowd more miners on a man trip than it is designed for

    a. helps save money & time by requiring fewer trips

    b. is a safety hazard and should be avoided

    c. encourages friendships

    d. both a. and c.

4. Place (yourself, tools and lunch pail, hard hat) in the man trip before boarding.

5. Hazards involved in transportation system include

    a. injury to head, arms, legs hanging out of the trip and hitting a rib or other object

    b. flying objects such as lunch pails, tools, or rock when trip is involved in derailment, sudden stops, or collision

    c. damage to eyes and lungs from dust in the air

    d. collision of trip with other vehicle or striking person due to poor visability or inattention

    e. all of the above

SELF CHECK #2: MINE COMMUNICATION SYSTEM

1. It is a legal requirement that a mine provide 2-way communications systems at several locations in the mine. (true or false)

2. Warning signals may be seen (flashing lights), heard (a bell sounding), or smelled (stench cannisters). (true or false)

3. Routine messages such as requests for supplies or assistance with operational problems should be handled by man trips or equipment trips. (true or false)

4. In emergency situations an efficient two-way communication system can tell people on the surface what has happened so that proper measures can be taken quickly. (true or false)

5. Upon hearing bells sounding, an equipment operator would check to see if:

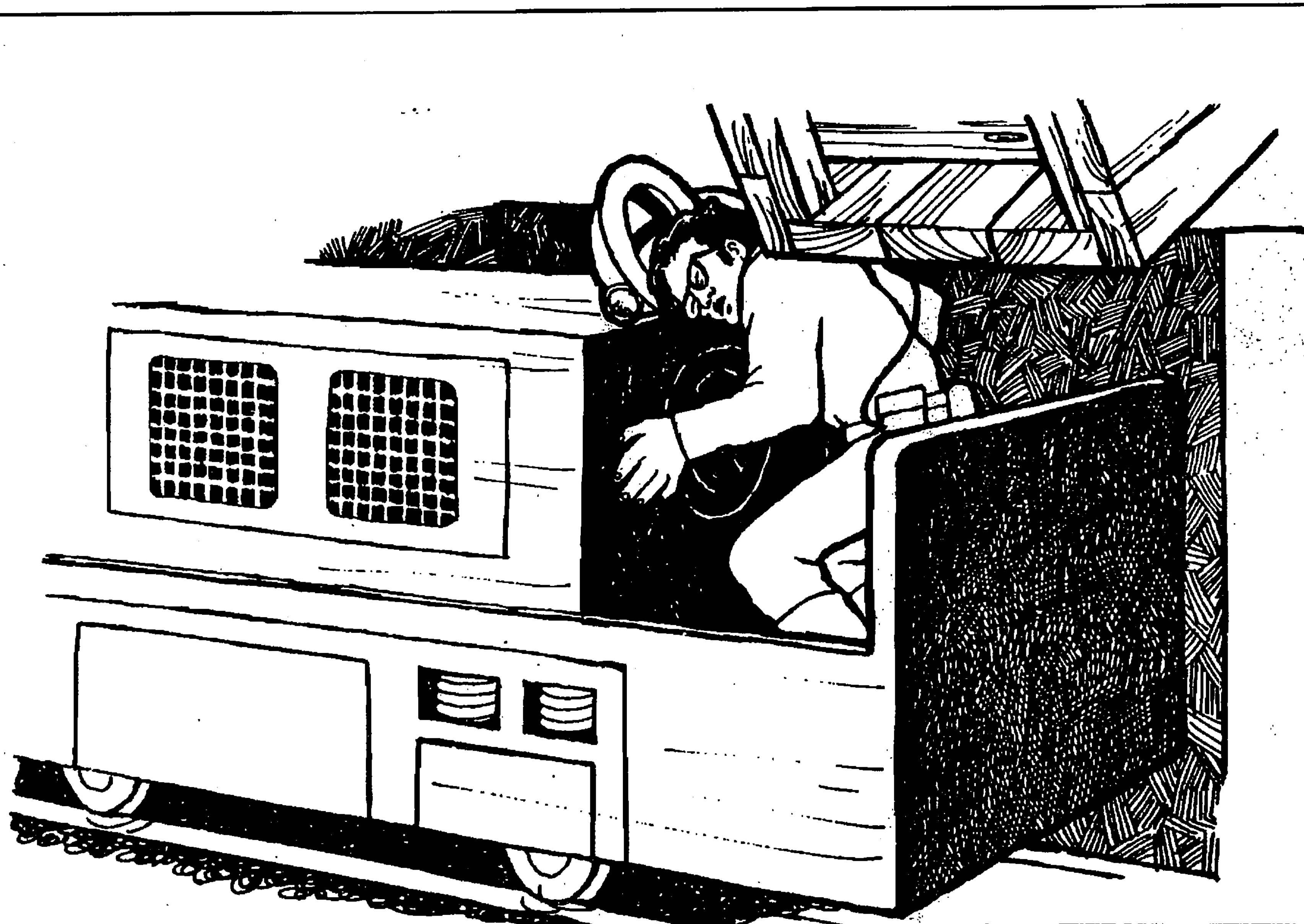
   a. his machine was low on oil or hydraulic pressure

   b. a motor was starting up

   c. another piece of equipment was in reverse gear and whether he needs to move his machine out of the way

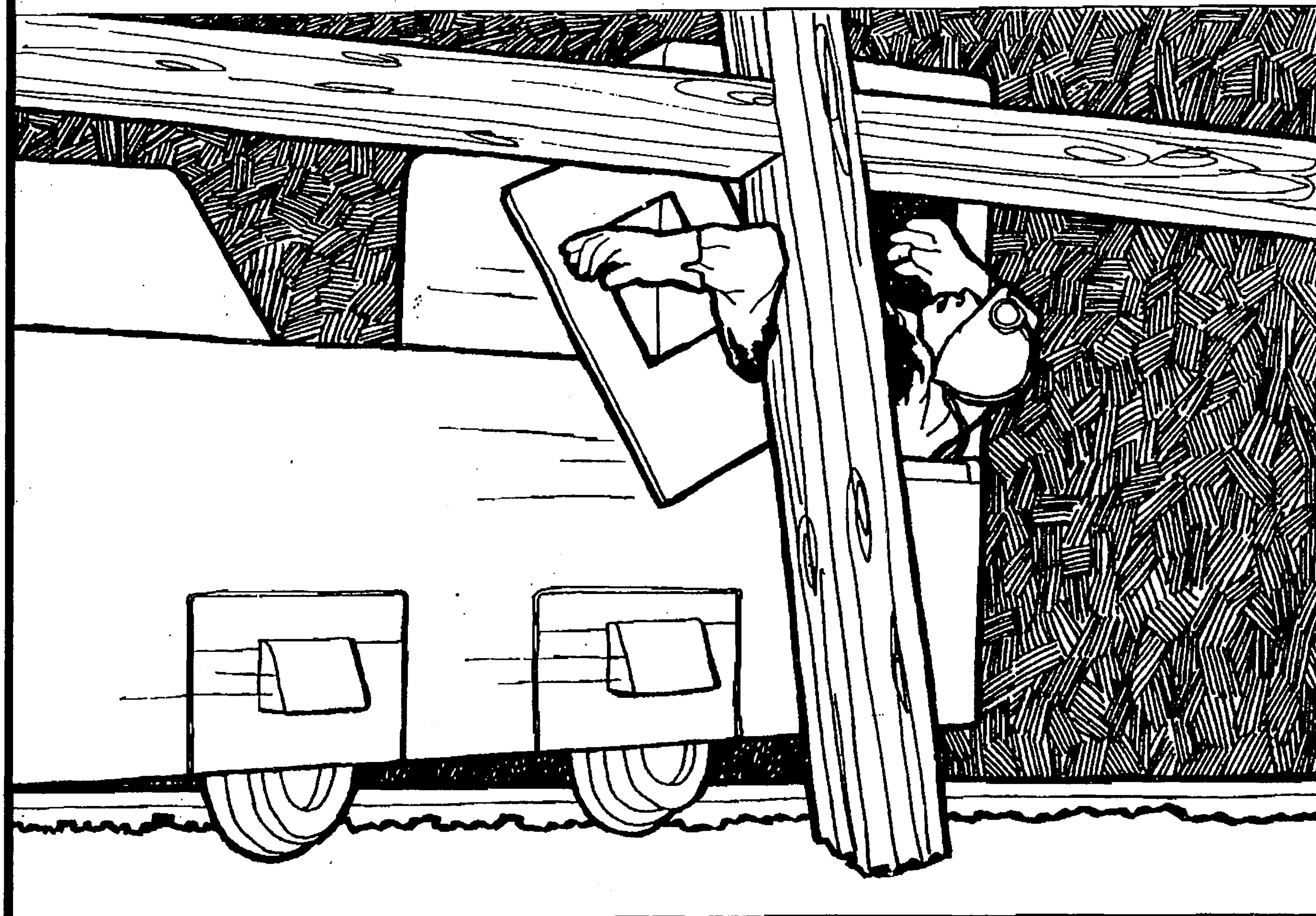
   d. all of the above

FACE IN DIRECTION OF TRAVEL



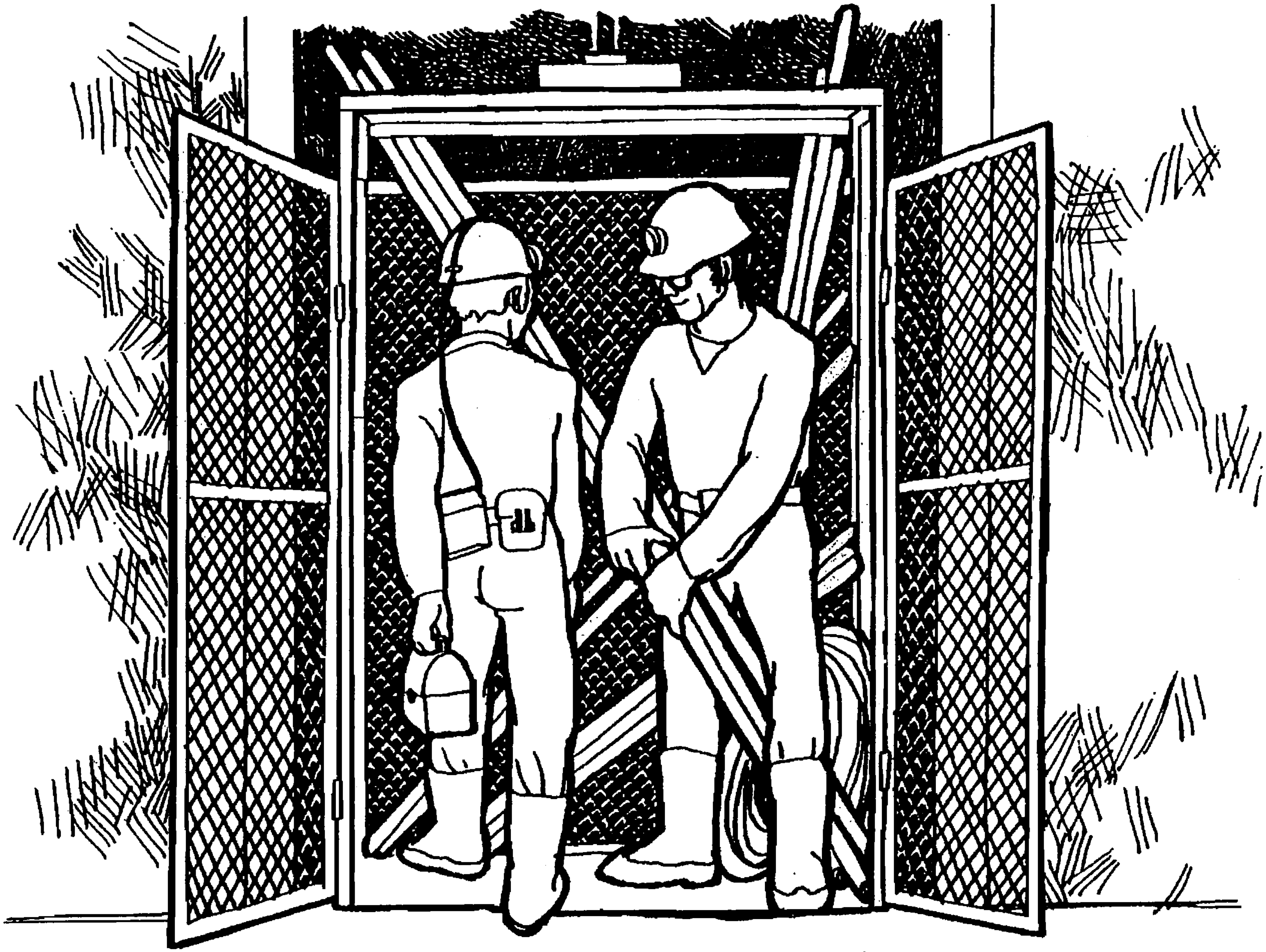
VISUAL 4

KEEP ARMS AND HEAD INSIDE



VISUAL 5

SECURE LOOSE MATERIALS



VISUAL 51

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

MINE MAP; ESCAPEWAYS; EMERGENCY EVACUATION; BARRICADING

1981

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303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: MINE MAP; ESCAPEWAYS; EMERGENCY EVACUATION; BARRICADING

I. GOAL: The goal of this module is to enable the miner to read mine maps, locate escapeways, identify potential emergencies, understand the proper response to these and know the procedures for emergency evacuation and barricading, if necessary. Fire prevention and fire fighting are also important goals of this topic area.

II. BACKGROUND: When a fire or other emergency condition exists in the mine it is important that everyone knows the routes of escape from the mine, or if escape is impossible then miners must know how to barricade. Although such mine disasters are relatively infrequent in underground metal/nonmetal mines, disasters such as at the Sunshine Mine show the importance of knowing how to quickly leave the mine. Each mine has its own unique features. Thus, each aspect of this module should be tailored accordingly.

III. OBJECTIVES

A. Trainer will do the following:

1. Present the mine map with an explanation of symbols
2. Describe possible causes of emergencies at the mine.
3. Discuss and demonstrate, if possible, emergency warning system and actions to take in response to emergency conditions.
4. Describe escapeways and emergency evaculation plans.
5. Display fire fighting equipment and discuss methods of fire prevention.
6. Explain when to barricade and procedures to follow

B. Trainees will be able to do the following:

1. Recognize symbols on the mine map and tell how the map is oriented.
2. Find escapeways in the mine either on the mine tour or on the mine map.
3. Respond appropriately to alarm signals and indicators of emergency conditions.
4. Communicate with appropriate person and take proper action given a scenario describing a simulated mine disaster.
5. Describe characteristics of escapeways and means of reaching them.

6. Locate refuges in the mine physically by using the map as a guide.
7. Extinguish a fire, set and controlled by trainer, using accepted techniques.
8. Describe barricading procedures and locate storage of barricading materials on the mine map, if pertinent.

IV. ACTIVITIES

A. In classroom: Students identify various map locations and features of the mine.

B. On site - in conjunction with Introduction to the Work Environment

1. Students going to specific locations using the map as a guide
2. Examine locations of emergency supplies, e.g. barricading materials

V. MATERIALS

A. Visual aids - illustrations contained in the Lesson Guide and Materials

B. The mine map and emergency evacuation plan

C. Fire fighting equipment, such as different kinds and sizes of extinguishers.

VI. EVALUATION

A. Demonstrate, describe or identify:

1. Indicators of mine emergencies
2. Characteristics of the mine map
3. Emergency evacuation procedures
4. Fire fighting techniques

B. Self-Checks

1. Any time hands-on evaluation is possible such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if they are not pertinent to your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. Training standards - Part 48.6-5

B. Applicable Federal regulations Part 57.11 - 50 through 59

C. Mine map and emergency evacuation plan

TOPICS COVERED

I. MINE MAP

A. Contents of the mine map

B. Uses of the mine map

II. CAUSES OF MINE EMERGENCIES

A. Accidental explosions

B. Fire

C. Toxic gases

D. Loss of ventilation

E. Inundation

III. MINE EMERGENCY WARNING SYSTEM

A. Types of warning systems

1. Emergency alarms and claxons
2. Stench canisters

B. Emergency responses of the miner

1. Immediately warn others
2. Use self-rescuer if necessary
3. Emergency assembly
4. Provide first aid
5. Follow supervisor or other leader
6. Use phone if available

IV. ESCAPEWAYS AND EMERGENCY EVACUATION

A. Locations of all exists and escapeways from the mine

B. Emergency evacuation plan

V. FIRE FIGHTING EQUIPMENT AND METHODS

A. Mine's fire prevention and fire fighting plan

B. Basics of fire

1. Class A fires
2. Class B fires
3. Class C fires
4. Class D fires

C. Locations of fire extinguishers

D. How to use fire extinguishers

VI. BARRICADES

A. When to barricade

B. How to barricade

1. Choosing a site
2. Materials for barricading
3. Sealing airways
4. Waiting inside barricade.

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: MINE MAP; ESCAPEWAYS; EMERGENCY EVACUATION; BARRICADING

INSTRUCTOR NOTE: AS A PRETEST; ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A DISCUSSION WHICH COVERS ALL MAJOR POINTS WITHIN THIS LESSON GUIDE. ONE VERY IMPORTANT ASPECT TO REMEMBER IN NEW EXPERIENCED MINER TRAINING IS THAT CONDITIONS, EQUIPMENT AND PROCEDURES WILL VARY FROM ONE MINE TO THE NEXT.

I. MINE MAP

A. **A mine map is a schematic drawing on paper of the mine workings, drawn according to scale and showing all important features of the mine. The mine map is designed by a competent engineer and is periodically updated to reflect all changes in the mine, such as new development areas, abandaned areas, or drill holes.**

VISUALS NOTE: DURING THE FOLLOWING SECTION YOU MAY WANT TO PRESENT YOUR MINE MAP. NOTE THAT NOT ALL FEATURES IN THIS LIST ARE RELEVANT TO YOUR MINE. POINT OUT ANY FEATURES ON YOUR MAP THAT ARE NOT INCLUDED IN THIS LIST.

B. The mine map shows all important features of the mine. The following list represents the kinds of features that might be shown on the map. The actual contents of the map depend on important features at the mine.

1. Name and address of the mine.
2. The scale and orientation of the map.
3. The property or boundary lines of the mine
4. The adit shafts, stops, drifts, tunnels, entries, rooms, crosscuts, and all other excavations of the ore bed being mined.
5. All drill holes that penetrate the ore bed being mined.
6. Dip of the ore bed.
7. Any outcrop of the ore bed within the bounds of the property.
8. The elevations of tops and bottoms of shafts and slopes.

9. The elevation of the floor at intervals of not more than two hundred feet for:

   a. At least one entry of each working section and one intersection.
   b. Developments advancing toward or adjacent to property or boundary lines or adjacent mines.

10. Contour lines passing through whole number elevations of the ore bed being mined.
11. Entries and air courses with the direction of air flow indicated by arrows, and location of fan controls.
12. The location of all mine ventilation fans.
13. Escapeways throughout all levels of the mine.
14. The known underground workings in the same ore bed on the adjoining properties within one thousand feet of such mine workings and projections.
15. The location and elevation of any body of water dammed in the mine or held back in any portion of the mine.
16. The abandoned portion or portions of the mine.
17. Mines above or below the mine workings.
18. The location of any streams or bodies of water on the surface.
19. Either producing or abandoned oil and gas wells located within five hundred feet of the mine.
20. The location of all high pressure pipelines, high voltage power lines and roads.
21. The location of railroad tracks and public highways leading to the mine and mine buildings of a permanent nature and showing identifying names.
22. Where the overburden is less than one hundred feet, any dwellings.
23. Major underground travelways and haulageways and ore passes at the mine.
24. Major underground facilities including lunchrooms, refuge areas, mine shafts, shops, storage facilities (explosives, fuel, supply), and locations of underground telephones.

II. CAUSES OF MINE EMERGENCIES

A. Accidental explosions

1. Dynamite
2. Fuel tanks
3. Electrical Equipment
4. Certain mine gases (hydrogen, methane, etc.)

B. Fire

1. Timber
2. Rubber tires

3. Electrical equipment, including batteries and battery chargers
4. Combustible metals, such as magnesium, titanium, zirconium, and sodium.
5. Rubbish
6. Petroleum products

C. Toxic gases

1. Gases from undetonated explosives
2. Gases from exploding batteries or other burning electrical equipment
3. Fumes from certain petroleum products
4. Gases from the ore itself

D. Loss of ventilation due to accidental failure of ventilation fans.

E. Inundation from water flooding into the mine.

III. MINE EMERGENCY WARNING SYSTEM

A. Types of warning systems

1. Emergency alarms and claxons that can be heard over the noise from most mining equipment.
2. Stench canisters that release a chemical smelling like rotten eggs. The odor is carried through the mine by ventilation fans.

B. Emergency responses of the miner

1. The first thing to do in a mine emergency is warn other miners of the situation. Tell everyone to pass the word along so as to assure that all miners are aware of the emergency situation.
2. Use your self-rescuer if the situation calls for it. In the event of a fire or explosion, put it on automatically in order to minimize your breathing carbon monoxide.
3. Gather together in designated places according to the mine's fire and evacuation plan. Stay together and remain calm.
4. Provide first-aid to any injured miners. If any miners are unable to walk, use a first-aid stretcher or build one using whatever materials (planks, rods, fencing) are available.
5. A supervisor should take charge of planning and organizing. Because of his experience and knowledge, you should respect and follow his orders. If no supervisor is present, one senior miner should take on the leadership of the group.
6. If the phones are working, report your situation, location, and intentions to the dispatcher or operator. He may have some helpful information. If you are wearing your self-rescuer, do not remove it. You could use a code system such as the hoist signal system to communicate with the dispatcher by lightly hitting the phone with a tool.

INSTRUCTOR NOTE: BRIEFLY REVIEW THE HOIST SIGNAL SYSTEM AND PROVIDE A FEW EXAMPLES ILLUSTRATING ITS USE IN COMMUNICATING WITH THE TELEPHONE DISPATCH.

IV. ESCAPEWAYS AND EMERGENCY EVACUATION

A. Your knowledge of the locations of all exits and escapeways from the mine is extremely important. If the main exit out of the mine is blocked, you must be familiar with the secondary route.

VISUALS NOTE: ON THE MINE MAP AGAIN POINT OUT THE LOCATIONS OF EXITS AND ESCAPEWAYS FROM THE MINE.

1. Part 57-11-50 states that: "Every mine shall have two or more separate, properly maintained escapeways to the surface from the lowest levels which are so positioned that damage to one shall not lessen the effectiveness of the others".
2. Escapeways are periodically inspected and maintained in acceptable condition. The law requires that escapeways be maintained in a safe and travelable condition, and that they be marked with conspicuous and easily read direction signs that clearly indicate the ways of escape. For your reference, a mine map is posted at all shaft stations, and at all underground shops, lunchrooms, and other areas where miners congregate. You should know where these locations are from your working area.
3. When an emergency occurs, you should attempt to reach fresh intake air above the fire or explosion. Air on the return side of the fire or explosion will contain carbon monoxide against which you should use your self-rescuer for protection.
4. The final leg of your escape from the mine may be travelling an emergency hoist to the surface. Try to remain orderly and calm while waiting for the hoist, and keep your self-rescuer on if you are using it. Follow your supervisor's orders, and let injured miners take the hoist first so that they can receive medical attention quickly.
5. After you reach the surface, contact a supervisor or the mine operator immediately so he will know you are out of the mine.

INSTRUCTOR NOTE: THE FOLLOWING SECTION CONCERNS THE MINE'S EMERGENCY EVACUATION PLAN. PRESENT THAT PLAN AT THIS TIME. THE FOLLOWING POINTS ARE ONLY AREAS FOR ADDED EMPHASIS.

B. Emergency evacuation plan

1. If you are going to evacuate, first try the route into the intake air so that you will be in fresh air. If that route is blocked, then try the secondary escapeway.
2. You should carry your lunch bucket because you may need food if you are trapped or if you are forced to barricade.
3. If the mine is full of dense smoke, use a rope if one is available to tie the miners in a line. Otherwise, keep close together so that no one gets lost from the group. Keep a look-out for fires or other hazardous conditions.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER ONE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY ANY INCORRECT ANSWERS. THESE QUESTIONS CONCERNING THE CONTENTS OF THE MINE MAP, CAUSES OF MINE EMERGENCIES, THE MINE EMERGENCY WARNING SYSTEM AND ESCAPEWAYS AND EMERGENCY EVACUATION.

INSTRUCTOR NOTE: THE FOLLOWING SECTION CONCERNS THE MINE'S FIRE PREVENTION AND FIRE FIGHTING PLAN. PRESENT THAT PLAN AT THIS TIME.

V. FIRE FIGHTING EQUIPMENT AND METHODS

A. The mine's fire prevention and fire fighting plan is designed to reduce the opportunity for a fire starting, and should one occur, to limit the extent of its destruction. The damage resulting from a fire can be minimized through adequate fire protection. Fire protection consists of monitoring and controlling fire hazards, available fire fighting equipment, especially portable fire extinguishers, and the personnel who are trained to use the equipment effectively in the event of a fire. The following are some good fire prevention techniques.

VISUALS NOTE: PASS OUT VISUAL 40 SHOWING A CHECKLIST OF VARIOUS FIRE PREVENTION POINTS. ADD ANY POINTS TO THE LIST THAT ARE RELEVANT TO YOUR MINE.

B. Basics of Fire

1. The necessary ingredients of a fire are fuel, oxygen, and heat. Fire fighting calls for removal of at least one of these ingredients. The fuel can be moved to a safer location. Oxygen can be sealed off from the fire, thereby suffocating it. Or the fire's heat can be reduced by cooling the fuel.
2. Fires have been classified into four types based on the kind of fuel involved in the fire. These different kinds of fires are

fought in different ways. In fact, using the wrong kind of chemical to extinquish the fire can even spread the fire further.

VISUALS NOTE: SHOW VISUAL 41 ILLUSTRATING THESE FOUR TYPES OF FIRE.

a. CLASS A fires - These fires occur with ordinary combustible material such as wood, pyritic ore, coal, cloth, paper or oil rags.

b. CLASS B fires - These fires are burning flammable liquids, such as gasoline, greases, hydraulic oil, diesel fuel, and lubricating oils.

c. CLASS C fires - These are electrical fires. Typical electric fires include electric motors (as used in fans), batteries, battery chargers, transformers, and circuit breakers.

d. CLASS D fires - These fires involve combustible metals such as magnesium, titanium, zirconium, and sodium.

C. When a fire is discovered, your immediate reaction in fighting the fire is crucial. Mere seconds are available for preventing the spread of the fire. For this reason you should know where the nearest fire extinguisher is located, and whether it is permissible for this type of fire. If you are uncertain about the contents of the extinguisher, read the main instructions on the body of the cannister.

VISUALS NOTE: DISTRIBUTE VISUAL 42 EXPLAINING THE CHARACTERISTICS OF PORTABLE FIRE EXTINGUISHERS.

VISUALS NOTE: DISTRIBUTE VISUAL 43 DESCRIBING FOUR TYPES OF FIRE EXTINGUISHERS.

INSTRUCTOR NOTE: BRIEFLY REVIEW LOCATIONS OF FIRE FIGHTING EQUIPMENT IN THE MINE (RUBBER TIRED EQUIPMENT, SHOPS, LUNCH ROOMS, ETC.)

D. For most portable fire extinguishers, you usually have to stand no more than 8 feet from the fire. Direct the stream at the base of the flame, not higher up at the smoke. A 30-pound extinguisher will normally last 18 to 25 seconds. Do not turn your back to a fire. When the fire is extinguished, back away from it and watch for any flare up.

VI. BARRICADES

INSTRUCTOR NOTE: THE TRAINER SHOULD WEIGH THE EMPHASIS ON BARRICADES IN LIGHT OF THE COMPANY EMERGENCY EVACUATION POLICY AS WELL AS THE PRACTICALITY OF BARRICADING AT HIS MINE. IN ANY GIVEN MINE BARRICADING MAY NOT BE A POSSIBLE OR EVEN DESIRABLE RESPONSE TO AN EMERGENCY. THE SAFETY AND TRAINING STAFF SHOULD EXPLORE THE UTILITY OF BARRICADING WITH OTHER COMPANY PERSONNEL AND WITH STATE AND FEDERAL MINE INSPECTORS TO FORMULATE AN APPROPRIATE EMERGENCY RESPONSE FOR THE MINE.

A. Under most circumstances when an evacuation of the mine is called for, all underground miners should be knowledgeable about how to escape. However, if an explosion or fire is serious enough, all escapeways may become blocked. If you find yourself trapped you must do something to protect yourself from the fire, heat, and gases which may eventually fill the entire area. When you are certain that all possible escapeways are closed off to you, you have no other choice but to build a barricade.

B. Barricading means building airtight bulkheads or stoppings to enclose a large quantity of relatively fresh air and to keep any poisonous gases out while you wait for rescue. It is important to remember that barricading is a last resort and should generally not be needed if escapeways and other emergency features are properly maintained. But it is important that you know how and where to build barricades when an emergency develops that cuts off all escape routes.

C. Some underground mines have refuge centers that double as lunch rooms. By closing off the center completely, you can seal the smoke out. Air and water valves may be available in the refuge center. Some mines have two air doors located close together. Located between these doors may be a red fire seal box containing burlap, nails, hammer, candles, matches, pipe wrench and an ax, all of which can be used to seal out smoke.

D. In choosing the best location for a barricade, a number of factors must be considered. Remember that the purpose of a barricade is to form an airtight refuge chamber that keeps fresher air in and smoke and gases out. The following is a list of factors to be considered in building a barricade.

   1. One of the first considerations is to keep the air in your chamber as free of contaminates as possible. Therefore, an important first step is to choose an area in which you can short-circuit the ventilation as soon as possible to keep noxious gases from entering the area. It may be necessary to open doors, destroy doors, or stopings, etc.

2. The size of the enclosed space determines the number of men the barricade will shelter and the length of time they can remain there safely. It is necessary to keep in mind that as much area as possible containing fresh air should be sealed off. In general, barricade as large a space as possible with the fewest barricades necessary. Often there may be only time to erect one permanent barricade which may take from 30 minutes to 2 hours to build, depending on conditions.
3. Try to barricade at any available borehole with materials which have been stored in the area for such a purpose. A good barricade at a borehole helps assure a safe refuge because air, food, and communications can pass through the borehole to the trapped miners.
4. Back-filled ground should not be used because gases are likely to pass right through it. Remember, for your chamber to be effective, all openings into it must be sealed.
5. Remember, in many instances there may be a general power failure. Water pumps and ventilating fans won't work, so don't barricade in areas where water might accumulate or where certain gases might settle.
6. It would be good if the area you choose to barricade also has air or water lines.
7. Do not build your barricade in an area connected or next to mined out or caved-in areas.

E. You should write on the outside of both the temporary and permanent barricades the date, time, and number of men inside the chamber. This will tell the rescue team what first aid and oxygen supplies they will need when they break through the barricade.

F. Waiting inside the barricade.

1. The leader should space the miners throughout the refuge area. You should rest to conserve oxygen. (You can use up more than ten times as much oxygen when you are active.) Keep your self-rescuer on.

2. Air in an enclosed space doesn't circulate and can get stale. Someone should periodically stir the atmosphere. This person should check the condition of each miner. Also, the barricade should be checked regularly for leaks.

3. You don't know how long you will have to wait to be rescued. So the leader should collect all lunch pails and then ration the food and water.

4. Remember, only the mine rescue party should open a barricade.

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECK NUMBER TWO INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY ANY INCORRECT ANSWERS. THESE QUESTIONS CONCERN FIRE FIGHTING EQUIPMENT AND METHODS AND BARRICADING.

Self Check #1: Solutions

1. Answers may vary.
2. A supervisor and a senior miner.
3. Answer according to your mine situation
4. Tell others.
5. false

Self Check #2: Solutions

1. oxygen, heat, fuel
2. a. Class A - ordinary combustible material - wood, cloths, etc.
   b. Class B - burning flammable liquids - gasoline, diesel fuel
   c. Class C - electrical fires
   d. Class D - combustible metals
3. 18 to 25 seconds
4. Answers will vary
5. Miner's immediate reaction to fighting the fire.
6. When you are certain all possible escapeways are closed off to you.

SELF CHECK: MINE MAPS; ESCAPEWAYS; EMERGENCY EVACUATION, BARRICADING

SELF CHECK #1: MAPS AND EVACUATION

1. Circle the following features on your company's mine map.

   a. Orientation of the mine

   b. Mine entrance

   c. Exits

   d. Major travelways and haulage ways

   e. Maintenance and storage shops

2. Who should take charge in an emergency?

3. What is the mine's emergency alarm system, and how will you know when it has been activated?

4. What is your first responsibility when an emergency occurs?

5. An undetonated explosive is not hazardous, as it can be easily removed. (true, false)

SELF-CHECK #2: FIRE FIGHTING AND BARRICADING

1. What three things do fires need in order to burn?

   _______, _______ and _______.

2. What are the four types of fires?

   a. Class A -

   b. Class B -

   c. Class C -

   d. Class D -

   Why is it important to understand the differences in the types?

3. Most portable fire extinguisher will last about how long?

4. Name locations of fire extinguishers in your mine.

5. What is crucial in fighting any fire?

6. Under what circumstances would barricading be the best possible means of surviving an emergency at the mine?

FIRE PREVENTION CHECK LIST

ELECTRICAL EQUIPMENT

- ☐ No makeshift wiring
- ☐ Extension cords serviceable
- ☐ Motors and tools free of dirt and grease
- ☐ Lights clear of combustible materials
- ☐ Safest cleaning solvents used
- ☐ Fuse and control boxes clean and closed
- ☐ Circuits properly fused
- ☐ Equipment approved for use in hazardous areas (if required)
- ☐ Ground connections clean and tight

FRICTION

- ☐ Machinery properly lubricated
- ☐ Machinery properly adjusted and/or aligned

SPECIAL FIRE-HAZARD MATERIALS

- ☐ Storage of special flammables isolated
- ☐ Nonmetal stock free of tramp metal

WELDING AND CUTTING

- ☐ Area surveyed for fire safety
- ☐ Combustibles removed or covered
- ☐ Permit issued

OPEN FLAMES

- ☐ Kept away from spray rooms and booths
- ☐ Portable torches clear of flammable surfaces
- ☐ No gas leaks

PORTABLE HEATERS

- ☐ Set up with ample horizontal and overhead clearances
- ☐ Secured against tipping or upset
- ☐ Combustibles removed or covered
- ☐ Safely mounted on noncombustible surface
- ☐ Not used as rubbish burners

HOT SURFACES

- ☐ Hot pipes clear of combustible materials
- ☐ Ample clearance around boilers and furnaces
- ☐ Soldering irons kept off combustible surfaces
- ☐ Ashes in metal containers

SMOKING AND MATCHES

- ☐ "No smoking" and "smoking" areas clearly indicated
- ☐ Butt containers available and serviceable
- ☐ No discarded smoking materials in prohibited areas

SPONTANEOUS IGNITION

- ☐ Flammable waste materials in closed, metal containers
- ☐ Flammable waste material containers emptied frequently
- ☐ Piled material cool, dry, and well ventilated
- ☐ Trash receptacles emptied daily

STATIC ELECTRICITY

- ☐ Flammable liquid dispensing vessels grounded or bonded
- ☐ Moving machinery grounded
- ☐ Proper humidity maintained

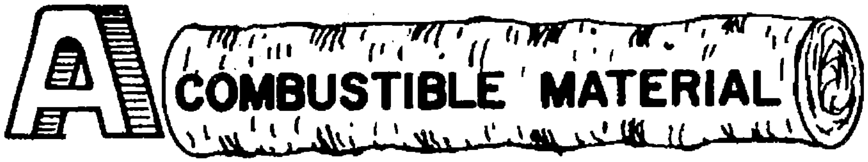
HOUSEKEEPING

- ☐ No accumulation of rubbish
- ☐ Safe storage of flammables
- ☐ Pasageways clear of obstacles
- ☐ Premises free of unnecessary combustible materials
- ☐ No leaks or drippings of flammables and floor free of spills
- ☐ Fire doors unblocked and operating freely with fusible links intact

EXTINGUISHING EQUIPMENT

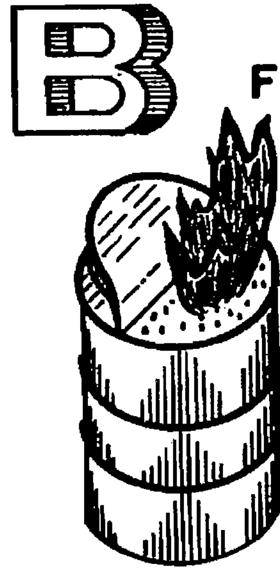
- ☐ Proper type
- ☐ In proper location
- ☐ Unobstructed
- ☐ Clearly marked.
- ☐ In working order
- ☐ Service date current
- ☐ Personnel trained in use of equipment

THE FOUR TYPES OF FIRES



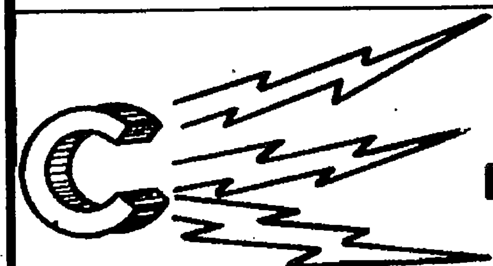
COMBUSTIBLE MATERIAL

Timber
Smoldering Trash
Card Board Boxes
Wooden Pallets
Dry Rags
Tires



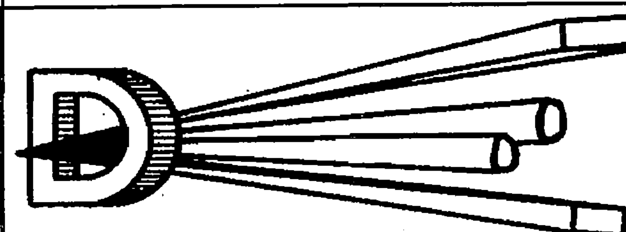
FLAMMABLE LIQUID

Lubricating Oils
Greases
Fuel Oils
Gasoline



ELECTRICAL

Electrical Motor
Battery Equipment
Battery Charging Station
Junction Box
Transformer
Circuit Breaker



COMBUSTIBLE METAL

Sodium
Titanium
Zirconium
Magnesium

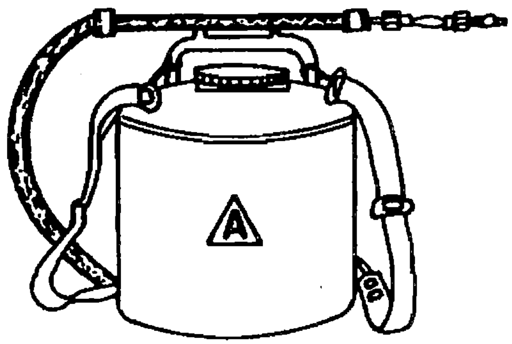
VISUAL 41

PORTABLE FIRE EXTINGUISHER CHARACTERISTICS

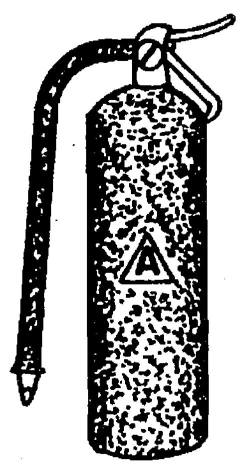
Fire Class	Extinguishing Agent	Available Sizes	Horizontal Range, Ft.	Discharge Time, Sec.
A	Water	1½-5 gal	30-40	45-180
A,B	Foam	1½-2½ gal	35	35-60
A, B, C	Ammonium phosphate	2-3 lb.	5-20	8-25
B, C	Carbon dioxide	2½-20 lb	2-4	15-30
B, C	Potassium bicarbonate	2-30 lb	5-20	8-25
B, C	Potassium chloride	2-30 lb	5-20	8-25
B, C	Potassium bicarbonate/urea	17-19 lb	15-30	26-30
B, C	Halon 1211	2½ lb	4-6	8-10
B, C	Halon 1301	2-4 lb	8-12	8-12

COMMON TYPES OF FIRE EXTINGUISHERS

WATER CARRIERS
For Class A Fires Only



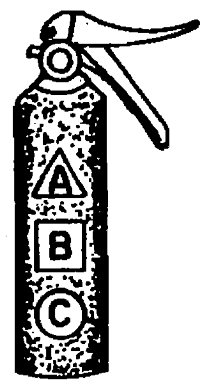
PUMP TANK



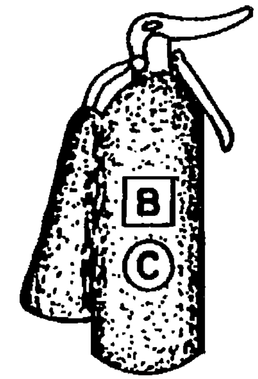
PRESSURIZED WATER

Do Not Use Water on Class B and C Fires

MULTI-PURPOSE
For All Types of Fires
EXCEPT Metal Fires



CARBON DIOXIDE
For Class B or
Class C Fires



Class	A	Ordinary Combustibles
Class	B	Grease and Other Flammable Liquids
Class	C	Electrical Fires

TIPS ON USE:

Stand close to the fire and aim at the base of the fire using a side-to-side sweeping motion to smother the fire. Stand by in case of reflash.

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

GROUND CONTROL AND VENTILATION PLANS

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: GROUND CONTROL AND VENTILATION PLANS

I. GOAL: The goal of this module is to insure that the new miner can understand the necessity of and how to maintain a safe and healthful workplace with respect to ground control and ventilation.

II. BACKGROUND: There are a variety of hazards that are found only in underground mines, and statistics show that accidents do result from these hazards. In 1979 there were 589 accidents in underground metal/nonmetal mines related to falling, rolling or sliding material, as well as roof falls. Training in recognizing these hazards is critical to the development of safe work habits in the workforce.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe the purposes of ground control and a listing of the many causes of failure of the back and sides.

2. Discuss the methods used to provide temporary and permanent support for the back and the sides.

3. Describe responsibilities for ground control by management and miners.

4. Discuss mine ventilation plans, including the pattern of air flow through the mine. Describe of hazards associated with ventilation.

B. Trainees will do the following:

1. Describe the ground control plan and support method used at particular facility.
2. Discuss procedures for testing ground and removal of hazardous materials. Identify possible hazards. Display of appropriate technique for removal, e.g., scaling.
3. Describe reasons for ventilation at facility.
4. Discuss general overall air flow pattern at the facility.

5. Identify devices used to produce and direct air flow. When appropriate, the miner shall display ability to direct air flow in a particular fashion in the mine.
6. Describe techniques for determining adequacy and quality of air flow. Describe procedures to follow when hazardous condition exists. Where use of respirator is appropriate, miner should demonstrate its proper use.

III. ACTIVITIES

A. On site - in conjunction with introduction to work environment

1. Testing back and barring down rock
2. Test of recognition of intake and return air
3. Examination of auxillary air flow devices

IV. MATERIALS

A. Visual aids contained in the Lesson Guide and Materials

B. Company ground control and ventilation plans

V. EVALUATION

A. Describe, discuss or demonstrate:

1. Ground control plan and procedures
2. Ventilation techniques
3. Demonstrate knowledge of intake and return air
4. Demonstrate capability for testing roof and barring down rock

B. Self-checks

1. Any time hands on evaluation such as operating equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessry to fit your local mine situation.

VI. RESOURCES

A. Training and Enforcement Standards

1. CFR 30 Part 48.6-6
2. CFR 30 Part 57.5-3 Ground Control
3. CRF 30 Part 57.5 Air Quality, Ventilation, Radiation and Physical Agents

B. Company ground control and ventilation plans

C. Films

1. MSHA Film No. 807 - "Rock Bolting Safety."
2. DuPont - "The Right Way."

D. Applicable MSHA fatalgrams.

TOPICS COVERED

I. PURPOSE OF GROUND CONTROL

A. Minimum protection from ground failure

B. Time line for support of back

1. temporary support
2. permanent support

C. Causes of ground failure

1. loose rock
2. large boulders
3. roof arches
4. type of rock
5. sag of back
6. seeping water
7. rock bursts
8. adjacent blasting
9. adjacent caving
10. load redistribution on back
11. rock fractures or faulting
12. rock vibrations from adjacent work
13. failure of back support devices
14. gouging of back by mining equipment

II. METHODS OF GROUND CONTROL

A. Testing back and rib for loose rock

1. sounding of back and rib
2. barring or scaling back or ribs
3. safe work habits while barring down

B. Temporary supports

1. wooden posts
2. screw - type jacks
3. hydraulic jacks
4. spilling
5. forepoling
6. stulls
7. use of bearing surface
8. planned placements of roof supports
9. other temporary supports

C. Permanent supports

1. rock bolting
2. split set
3. resin bolts
4. concrete
5. shortcrete
6. timbering
7. lagging
8. cribbing
9. yieldable arches
10. advantages of rock bolting compared to timbering
11. advantages of timbering compared to rock bolting

III. RESPONSIBILITIES FOR GROUND CONTROL

A. Responsibility of management and supervision

1. routine inspections of back and ribs
2. testing torque of rock bolts

B. Responsibility of miners

1. identifying and reporting hazardous back
2. safe work habits

IV. MINE VENTILATION PLANS

A. Purpose of ventilation

1. supply oxygen
2. remove harmful contaminants

B. Producing and directing air flow

1. fans pushing or pulling air
2. directing from bulkheads, mine doors, and man doors

C. Air flow pattern in the mine

1. intake and return air
2. location of fan(s) and flow pattern
3. supplemental ventialtion

D. Ventilation hazards

1. Testing amount of oxygen in the air
2. miner reactions to loss of ventilation

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: GROUND CONTROL AND VENTILATION PLANS

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A DISCUSSION WHICH COVERS ALL MAJOR POINTS WITHIN THIS LESSON GUIDE. ONE VERY IMPORTANT ASPECT TO REMEMBER IN NEW EXPERIENCED MINER TRAINING IS THAT CONDITIONS, EQUIPMENT AND PROCEDURES WILL VARY FROM ONE MINE TO THE NEXT.

I. PURPOSES AND POLICIES REGARDING GROUND CONTROL

A. Provide protection from ground failure.

B. Company policy for ground control at the mine.

INSTRUCTOR NOTE: PROVIDE A DESCRIPTION OF COMPANY POLICY FOR ROOF CONTROL METHODS AND PROCEDURES AT THE MINE.

II. Causes of ground failure

1. Loose rock
2. Large boulders
3. Roof arches
4. Type of rock
5. Roof sag
6. Seeping water
7. Rock bursts
8. Adjacent blasting
9. Adjacent caving
10. Roof load redistribution
11. Rock fractures or faulting
12. Rock vibrations from adjacent work
13. Failure of roof support devices
14. Gouging of roof by mining equipment

INSTRUCTOR NOTE: IF ANY OF THE ABOVE CAUSES ARE PROMINENT PROBLEMS AT THE MINE, DISCUSS THAT PROBLEM IN MORE DETAIL.

III. METHODS IN GROUND CONTROL

A. Testing roof or back and rib for loose rock

1. Loose rock gives off a hollow or dull sound when hit with a hammer or scaling bar, compared to a solid ring of sound roof. Loose rock is also detected by visual inspection of protruding rock, cracks, and deteriorating pillars. Skill in identifying loose rock requires practice.

INSTRUCTOR NOTE: DEMONSTRATE SOUNDING FOR THE STUDENTS DURING THE MINE TOUR.

2. The method of removing loose rock from the back, or rib is called barring down or scaling down. A metal pry bar called a scaling bar is used.

3. Safe work habits while barring down.

   a. Stand under a safe area, preferably one already tested for loose rocks.
   b. Do not stand directly beneath the loose rock which you are barring down. Pry away from you rather than toward you.
   c. Assure yourself a safe route of retreat. Do not put your back up against the rib because you may become trapped.
   d. Often more roof will come down than you might expect.

VISUALS NOTE: SHOW VISUAL 21 ILLUSTRATING SAFE AND UNSAFE METHODS OF BARRING DOWN. POINT OUT THE UNSAFE CONDITIONS IN THAT DRAWING.

B. Time line for support of roof or back

1. Temporary support provides immediate support in an active working area for a relatively short period of time.
2. Permanent support provides support over a longer period of time. It is used in areas of high foot and/or equipment traffic or in long-life haulageways, shops, power distribution centers, storage areas, lunch rooms, and pump rooms.

C. Temporary supports

INSTRUCTOR NOTE: PICTURES OF THE TYPES OF SUPPORT USED IN YOUR MINE WILL BE HELPFUL HERE.

1. Wooden posts with cap blocks and wedges.
2. Screw-type jacks that extend as the handle is turned, along with cap blocks.
3. Hydraulic jacks that extend as the handle is pumped.
4. Spilling involves inserting rods into the ribs and roof at several points along a drift.
5. Forepoling involves insertion of poles into the face of a drift or stope. The poles are either all wood or half wood and half metal. The wood section would eventually be mined out, leaving the metal section in the rock for support.
6. Stulls are thick wood posts used to support protruding rock. Wedges are used to secure the post against the rock.
7. A bearing surface (another wood post or square piece of wood) may be placed between the roof and the post or jack. This prevents the support from poking through the roof by distributing the force over a larger area.
8. Temporary supports are installed a planned distance apart so that the weight of the roof is more evenly distributed. Supports are usually no more than five feet apart.
9. Other temporary supports.

INSTRUCTOR NOTE: DISCUSS OTHER TYPES OF TEMPORARY ROOF SUPPORT USED AT THE MINE.

D. Permanent supports

1. Roof (or rock) bolts are metal rods at least four feet long which are installed in drilled holes in the roof or rib. The point anchor roof bolt consists of a long threaded bolt and an expansion shell that expands when the bolt is tightened to anchor the bolt in the rock. A bearing plate fits between the bolt head and the roof to disbribute the weight of the roof. Bolts are tightened to a predetermined torque which is periodically checked. Roof bolts provide several methods of support:

    a. The beam method draws together several layers of rock, making a strong beam of supporting rock. Fully grouted resin bolts are used to make the beams.
    b. The suspension method passes roof bolts through weak layers of rock and tightens into a higher main rock layer with a point anchor expansion type bolt.
    c. Wire matting is held up by several roof bolts and is used to catch smaller pieces of rock that might fall between bolts.
    d. Trusses are metal plates or strips held up by several roof bolts. Trusses are bent to conform to the shape of the roof.

2. Resin type bolts employ resin and hardening agent packed in sausage-like tubes. These tubes are placed in the drill hole. When the bolts are inserted and spun, the resin tubes break and the hardener is mixed with the resin. The bolt is then held tightly against the rib or back until the resin sets enough to prevent the bolt from slipping out, usually about 30 seconds.

INSTRUCTOR NOTE: IF YOUR MINE USES RESIN BOLTS BE SURE YOU DESCRIBE THE MANUFACTURER'S RECOMMENDED TIMES FOR SPINNING AND HOLDING OF THE BOLTS.

3. The split set is similar to the roof bolt except that the bar is hollow with a one inch gap along its length. The bar is squeezed and inserted into the drill hole. As the bar attempts to spring back open its own force keeps it wedged in the hole. Split sets may be used with wire matting or trusses.

4. Concrete is used for roof, rib, and floor support in drifts, draw points, and ore passes. Forms are set and concrete laid to provide as much support as necessary.

5. Shotcrete (or gunite) is similar to concrete. It keeps moisture from the rock and helps prevent sloughing off, but does not have the same strength as concrete.

6. Timbering is also known as the conventional method of roof control. Timbers or posts are placed between the roof and floor, usually against the ribs. Crossbars span the posts along the roof, forming a three-piece set. This supports a wide area, such as a haulageway. Wedges are used to tighten the fit between the post and roof or floor.

7. With a three-piece set of timber, lagging may be used to join posts on the same side of the rib to prevent loose rock from falling into the haulageway.

8. With a three-piece set of timber, cribbing involves placing smaller three-piece sets above one another to fill unsupported space. Timber then contacts the entire width of the roof, and can support a very heavy load.

9. Yieldable arches use four steel braces, two against the ribs and two curved to fit the arch of the roof. The roof-rib braces are joined by a friction clamp. Increased roof pressure is compensated for by slippage through these clamps. In addition, the distance between the floor and connections between the two roof braces indicates roof sag.

INSTRUCTOR NOTE: SUPPLEMENT THIS DISCUSSION WITH DRAWINGS AND SLIDES FROM THE MINE SHOWING RELEVANT METHODS OF ROOF CONTROL. EMPHASIZE METHODS OF GROUND CONTROL USED AT THE MINE. A BRIEF INTRODUCTION TO THE OTHER METHODS WILL HELP MAKE THE MINER AWARE OF THEM FOR POSSIBLE FUTURE NEEDS.

10. Advantages of rock bolting relative to timbering

    a. More suitable for uneven backs and high cave areas.
    b. Do not get in the way of mine equipment
    c. No restriction to ventilation
    d. Quicker to install and last longer.
    e. Less of a fire hazard
    f. Less likely to be knocked out accidently
    g. Use less space for storage, requires less manpower to install, and simpler skills are required for roof bolters.

11. Advantages of timbering compared to rock bolting

    a. Does not require special machinery for installation.
    b. Early indication of roof problems by visual deformation and snaps you can hear.
    c. Provides greater support of the roof.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER ONE. STUDENTS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN PURPOSES AND METHODS OF ROOF CONTROl.

IV. RESPONSIBILITIES FOR ROOF AND GROUND CONTROL

A. Responsibility of management and supervision

1. Routine inspections of roof to identify hazards.

2. Routine testing of torque on roof bolts.

B. Responsibility of miners.

1. Identifying hazardous roof conditions and reporting these to supervision.

2. Follow safe work habits and follow proper installation and inspection procedures when roof bolting.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER TWO. STUDENTS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR

FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN GROUND CONTROL AND RESPONSIBILITIES FOR ROOF AND GROUND CONTROL.

V. OVERVIEW OF MINE VENTILATION PLANS

A. Purpose of ventilation

B. Procedures of ventilation

C. Ventilation hazards

VI. PURPOSE OF VENTILATION

A. Ventilation has a direct effect on the health and safety of miners. Good clean air is essential for physical comfort and a safe work area. People work best in areas where oxygen represents at least 20% of the air they breathe.

B. Ventilation is necessary for diluting, rendering harmless, and carrying away all hazardous and harmful contaminants, including:

1. Gases from explosives
2. Equipment exhaust fumes
3. Dust
4. Smoke and carbon monoxide
5. Gases produced in the mine

VII. PRODUCING AND DIRECTING AIR FLOW

A. Ventilation is produced by fans located on the surface. Fans either push or blow air into the mine, or pull air through it by exhaust suction.

1. Temperature and humidity effect ventilation. On a very hot, humid day, outside air will lose its moisture when it meets the cooler surfaces of the mine. This moisture will condense on equipment and rock surfaces, causing rust and decay.

2. The speed of air through the mine is slowed as it drags across rough roof, ribs or floor. This is known as mine resistance.

B. The direction of ventilation is controlled by several methods. These methods channel fresh air to all work areas and close off non-production areas.

1. Mine door is a large hinged door closing off a mine passageway
2. Bulkhead is an airtight wall built across an older non-production area.

3. Man door built into a bulkhead permits miners to go from one area to another. As with the mine door, man doors should always be closed to maintain correct ventilation.

VISUALS NOTE: SHOW VISUAL 22 ILLUSTRATING A MINE DOOR, BULKHEAD, AND MAN DOOR. POINT OUT THESE FEATURES DURING THE MINE TOUR.

C. Air flow pattern in the mine.

1. Fresh air brought into the mine is called intake. Air that has passed through the mine and contains contaminants is called return air.

2. Locations of fans and flow patterns permit fresh air to all areas in the mine.

VISUALS NOTE: SHOW ON THE MINE MAP THE VENTILATION PATTERN IN THE MINE, AS WELL AS THE LOCATIONS OF FANS.

3. Maintaining an adequate flow of fresh air to each work area may require booster fans to supply supplemental ventilation.

VIII. VENTILATION HAZARDS

A. Federal regulation part 57.5-15 requires mine air to contain at least 19.5% oxygen. Oxygen tests are routinely made accordingly.

B. Any major change in ventilation that you discover should be reported to your supervisor who will investigate for possible open doors or other ventilation obstructions.

EVALUATION NOTE: DISTRIBUTE SELF-CHECK NUMBER THREE. STUDENTS MAY ANSWER INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE MINE VENTILATION PLAN.

SELF CHECK #1: SOLUTIONS

1. Possible answers: loose rock, large boulders, roof arches, type of rock, roof sag, seeping water, rock bursts, adjacent blasting, adjacent caving, roof load redistribution, rock fracture, rock vibrations from adjacent work, failure of roof support devices, and gouging of roof by mining equipment.

2. hollow or dull sound (compared to a solid ring of sound roof.)

3. a. Stand under a safe area
   b. Pry away from you - don't stand directly beneath loose rock you're barring down.

   c. Assure yourself a safe route of retreat.

4. a. t
   b. t
   c. p
   d. t
   e. p
   f. t
   g. p
   h. t
   i. p
   j. p

5. a. III
   b. V
   c. IV
   d. II
   e. I

SELF CHECK #2: SOLUTIONS

1. S
2. M
3. M
4. S

SELF CHECK #3: SOLUTIONS

1. true
2. false
3. false
4. true
5. true
6. true

Self Check: Ground Control and Ventilation Plans

Self Check: #1: Purposes and Methods of Roof Control

1. Name at least 8 causes of ground failure

   a.
   b.
   c.
   d.
   e.
   f.
   g.
   h.

2. Describe the sound loose rock gives off when hit with a hammer.

3. Three safe work habits while barring down are:

   a.
   b.
   c.

4. Place the proper letter in front of the following types of supports to indicate: T: temporary supports, and P: permanent supports.

_____a.	screw type jacks	_____f.	stulls
_____b.	hydraulic jacks	_____g.	suspension method
_____c.	beam method	_____h.	forepoling
_____d.	spilling	_____i.	trusses
_____e.	wire matting	_____j.	concrete

5. Match column A with the correct column B response.

_____a.	split set	I. keeps moisture from the rock
_____b.	yieldable arches	II. place smaller 3-piece sets of timber above one another
_____c.	lagging	III. a hollow bar with 1 inch gap is squeezed into drill hole
_____d.	cribbing	IV. 2 steel braces against the ribs and 2 curved to fit arch of roof
_____e.	shortcrete	V. used to join posts on same side of the rib.

Self Check #2: Responsibilities for Ground and Roof Control

Place the proper letter in front of the following tasks to indicate: S responsibility of supervision and management, or M responsibility of miner.

_____1. Routine inspections of roof to identify hazards

_____2. Identifying hazardous roof conditions and reporting these to supervision.

_____3. Follow proper installation procedures when roof bolting.

_____4. Routine testing of torque on roof bolts.

Self Check #3: Mine Ventilation

1. Ventilation dilutes, renders harmless, and carries away gasses, dust, exhaust fumes, and smoke and carbon monoxide. (true, false)

2. Mine resistance refers to the reluctance of miners to return to work after lunch. (true, false)

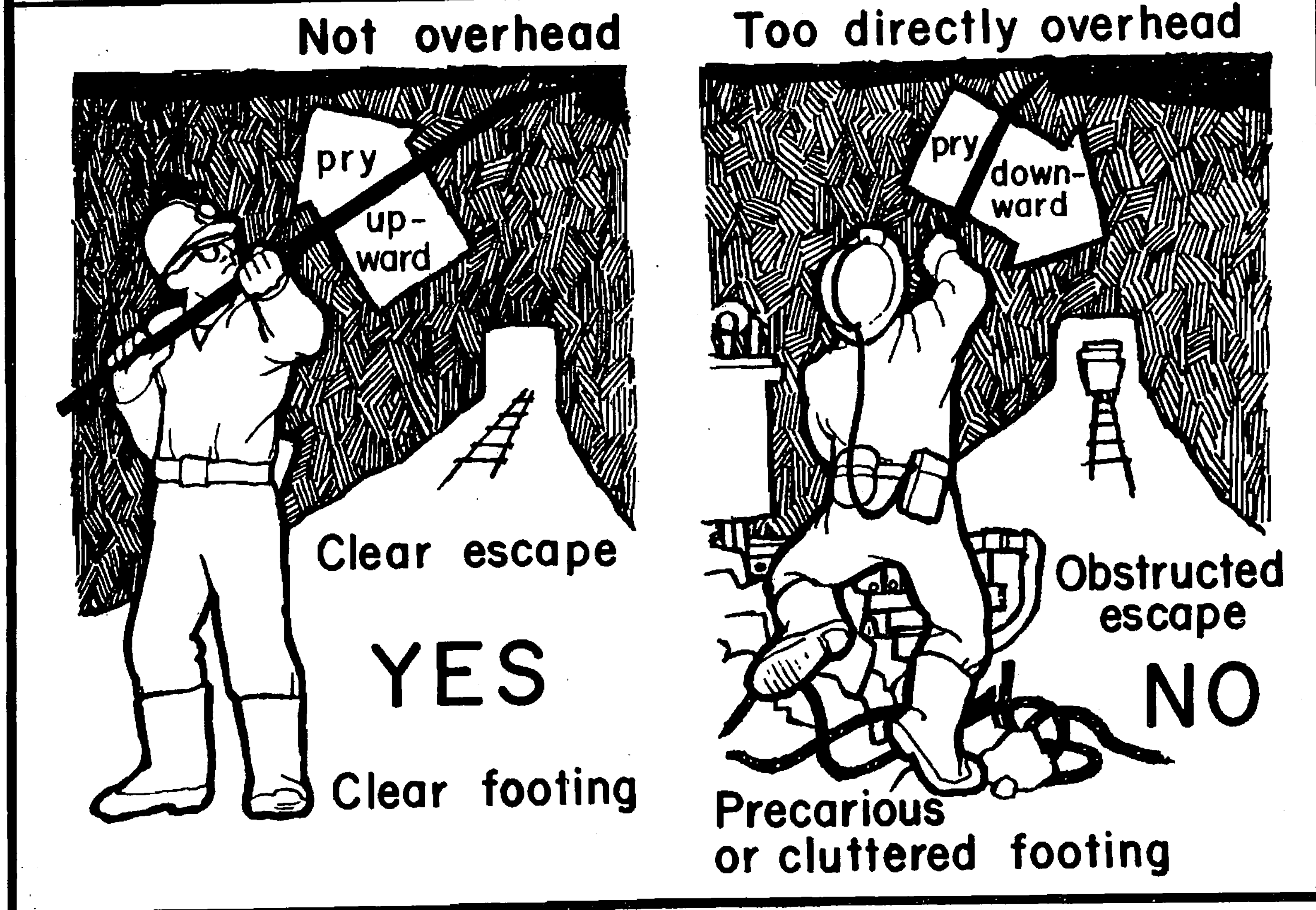
3. Man doors remain open while mine doors are kept closed. (true, false)

4. Intake refers to fresh air brought into the mine. (true, false)

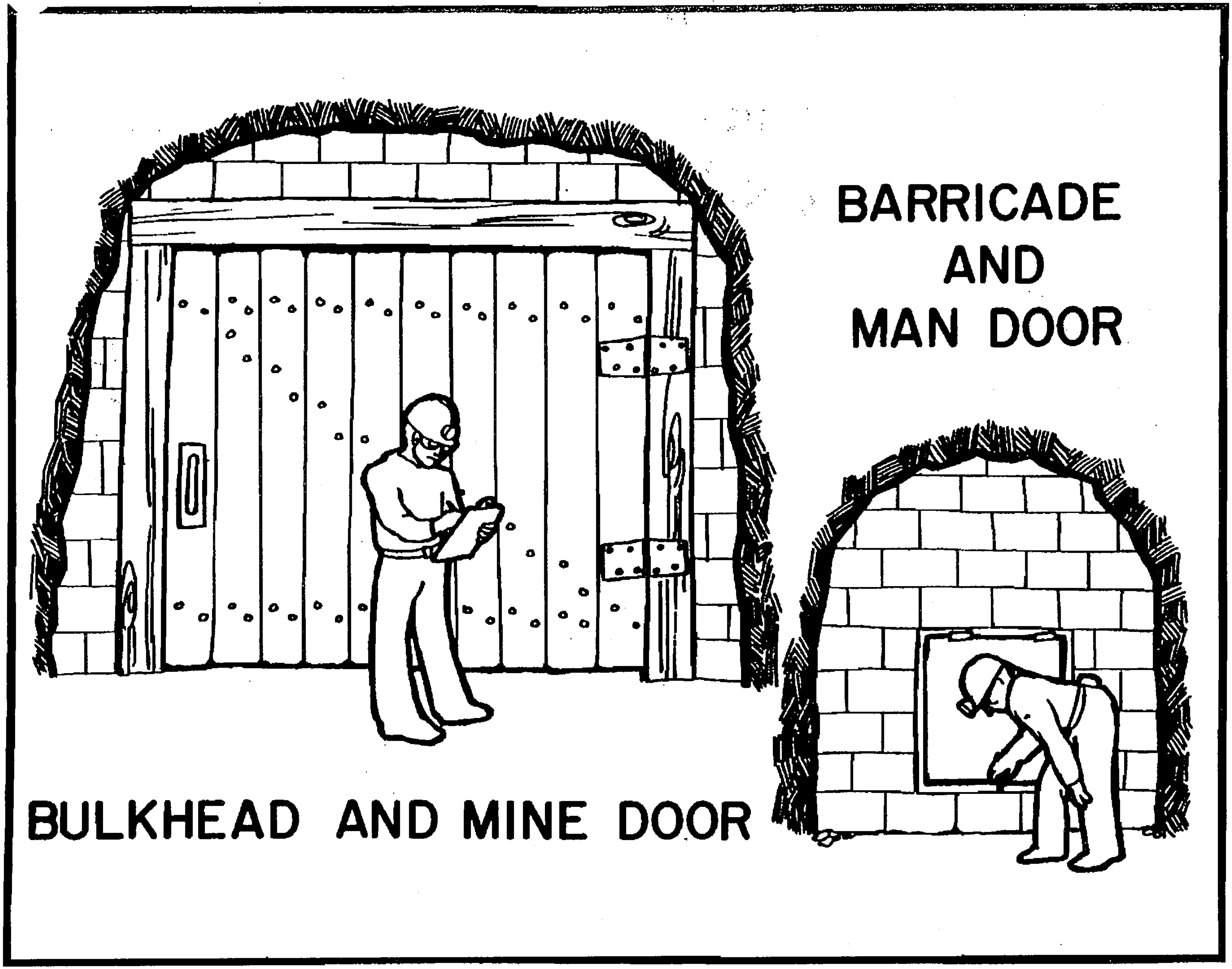
5. Booster fans may be required to supply supplemental ventilation to each work area. (true, false)

6. Major changes in ventilation may be caused by open doors or obstructions, and should be reported to your supervisor. (true, false)

BARRING DOWN CORRECTLY



VISUAL 21



VISUAL 22

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

HAZARD RECOGNITION

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: HAZARD RECOGNITION

I. GOAL: The goal of this module is to assure that miners will recognize hazards in the mine and know the appropriate steps to take for the elimination of hazards and reduction of accidents.

II. BACKGROUND: One of the primary concerns of the Federal Mine Safety and Health Act of 1977 was the prevention of mining accidents. Training in hazard recognition is important even for experienced miners because it shows miners what the hazards are in the mine and how to recognize and avoid them before they turn into an accident.

III. OBJECTIVES

A. Trainer will do the following:

1. Present a descriptive analysis of accidents and contributing factors, including unsafe acts and conditions.
2. Describe the most common types of accidents in metal and nonmental mines.
3. Discuss the most common accidents at your operation.

B. Trainees will be able to do the following:

1. Describe accidents and factors contributing to their occurrence.
2. Name and describe the most common types of accidents occurring in underground metal/nonmetal mines.
3. Recognize hazards on the mine tour and describe ways to avoid accidents relating to those hazards.

IV. ACTIVITIES

A. On Site - in conjunction with introduction to work environment

1. Recognizing ground hazards
2. Barring down rock

B. In classroom - correct identification in slides or drawings of contributing hazardous factors resulting in accidents.

V. MATERIALS

A. Visual Aids

1. Illustrations contained in the Lesson Guide and Materials.
2. Illustrations of accidents shown in MSHA Fatalgrams.

B. Company accident records, first aid records, and results of MSHA inspections at the mine.

C. List of hazards relevant to your mine.

VI. EVALUATION

A. Demonstrate, describe or identify:

1. An accident and common accidents in metal/nonmetal mines.
2. Procedures for correcting unsafe conditions and unsafe acts, and proper procedures to follow when hazards exist.
3. Hazards in slides and illustrations of accidents, and identify procedures that might have prevented these accidents from occurring.

B. Self-checks contained in the Lesson Guide and Materials.

1. Any time hands-on evaluation such as operating equipment is possible it should be used.
2. Eliminate the use of self-check if inappropriate for your class.
3. Change written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. Training Standards CFR 30 Part 48.6-7

B. Health and Safety Standards contained in CFR 30 Part 57.7-53, 57.13-19, 20, 21.

C. Textual Materials

1. MESA Safety Manual No. 4 - Accident Prevention.
2. National Safety Council - Accident Prevention Manual for Industrial Operations
3. MSHA Programmed Instruction Workbook - Accident Prevention.
4. National Safety Council, Supervisors Safety Manual. 444 North Michigan Ave., Chicago, IL, 60611

D. Films

1. National Audio-Visual Center - "Prevention of Heat Casualties." "It Can't Happen to Me - Anatomy of an Accident".
2. Salenger Educational Media - "Good Housekeeping Prevents Accidents".
3. National Film Board of Canada - "Eyes." "Feet." "Hands." "Slips and Falls." "Striking against Objects."
4. Bureau of National Affairs - "The Big Lift."
5. Mine Safety Appliance - "Dust You Can't See."
6. National Coal Board - "A Sense of Responsibility." "Tidy Why."
7. MSHA Film Number 836 - "Conveyor Belts - Be Careful".
8. MSHA Film Number 860 - "In Search of the Facts: Accident Investigations in Metal and Nonmetal Mining Operations".

E. Applicable Fatalgrams

TOPICS COVERED

I. ANALYSIS OF ACCIDENTS AND CONTRIBUTING FACTORS

A. Definition of an accident

B. Causes of accidents

1. Basic causes

a. Management safety policy and decisions
b. Environmental factors
c. Personal factors

2. Indirect causes

a. Unsafe acts

i. Operating equipment at excessive speeds
ii. Operating equipment without authorization or training
iii. Using equipment or tools improperly
iv. Using defective equipment
v. Removing or damaging safety devices on equipment
vi. Not using personal protective equipment when appropriate
vii. Not warning others of hazardous conditions
viii. Failure to secure equipment and block tires
ix. Improper lifting, loading, or placement of equipment, tools, or supplies
x. Servicing equipment in motion
xi. Horseplay

xii. Use of alcohol or drugs (review company policy)
xiii. Working in confined spaces

b. Unsafe conditions.

i. Sliding or falling material at bins, hoppers, and dump points
ii. Pressure lines and vessels
iii. Inadequate supports or guards
iv. Poor housekeeping
v. Poor illumination
vi. Fire and explosion hazards
vii. Defective tools, equipment, or supplies
viii. Congestion of work place
ix. Inadequate warning systems
x. Possible inundation from cutting into old workings that are flooded
xi. Excessive noise
xii. Slippery or rough haulage and walkways

3. Direct causes: Unplanned release of energy.

C. Distinction between health and safety concerns in the mine

D. Miner's responsibility

II. MOST COMMON TYPES OF ACCIDENTS IN METAL/NONMETAL MINES

A. Materials handling

1. Frequency of occurrence in mines
2. Accident characteristics
3. Prevention of materials handling accidents

B. Powered haulage

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of powered haulage accidents

C. Machinery

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of machinery accidents

D. Slips and falls

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of machinery accidents

E. Hand tools

1. Frequency of occurrence
2. Accident characteristics
3. Prevention of accidents with hand tools

F. Hazards specific to your mine.

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HAZARD RECOGNITION

INSTRUCTOR NOTE: THE LISTING OF HAZARDS AND ACCIDENTS INCLUDED IN THIS MODULE ARE THOSE MOST COMMONLY FOUND IN METAL/NONMETAL MINES BASED ON 1979 ACCIDENT RECORDS. IF OTHER HAZARDS NOT INCLUDED IN THIS LIST ARE RELEVANT TO YOUR MINE THEY SHOULD BE ADDED AND DISCUSSED IN THE TRAINING SESSION.

I. ANALYSIS OF ACCIDENTS AND CONTRIBUTING FACTORS

A. Definition of an accident.

1. Any unplanned and unanticipated event that results in personal injury and/or in property damage.
2. An analysis of accidents must consider a number of contributing factors, which must at least include the accident type (falls, being struck by object), energy source (electricity, machinery), unsafe acts or conditions, nature of the injury, and the affected part or parts of the body.

B. Causes of accidents

VISUAL NOTE: DURING THE FOLLOWING DISCUSSION YOU MAY WANT TO PASS OUT THE DIAGRAM, VISUAL 7 ILLUSTRATING RELATIONSHIPS BETWEEN CAUSES IN THE ACCIDENT SEQUENCE.

1. Basic causes of accidents may be one or more elements in the following lists.

a. Management safety policy and decisions

i. Production and safety goals
ii. Communications
iii. Inspection procedures
iv. Maintenance
v. Housekeeping

b. Environmental factors

i. Weather
ii. Dusts, gases and vapors

iii. Noise
iv. Illumination

c. Personal factors

i. Safety motivation and awareness
ii. Knowledge and training
iii. Physical and mental state
iv. Reaction time

2. Indirect causes

a. Unsafe acts

i. Operating equipment at excessive speeds
ii. Operating equipment without authorization or training
iii. Using equipment or tools improperly
iv. Using defective equipment
v. Removing or damaging safety devices on equipment
vi. Not using personal protective equipment when appropriate
vii. Not warning others of hazardous conditions
viii. Failure to secure equipment and block tires
ix. Improper lifting, loading, or placement of equipment, tools, or supplies
x. Servicing equipment in motion
xi. Horseplay
xii. Use of alcohol or drugs (review company policies)

b. Unsafe conditions.

i. Sliding or falling material at bins, hoppers, and dump points
ii. Pressure lines and vessels
iii. Inadequate supports or guards
iv. Poor housekeeping
v. Poor illumination
vi. Hazardous highwalls, spoil banks, and water pools
vii. Fire and explosion hazards
viii. Defective tools, equipment, or supplies
ix. Congestion of work place
x. Inadequate warning systems
xi. Excessive noise
xii. Slippery or rough haulage or walkways

3. Direct causes: Unplanned release of energy and/or hazardous material such as falls of rock or materials, failing brakes, or removal of air hose without first bleeding the line.

C. Distinction between health and safety concerns in the mine

1. Health refers to proper functioning of the body

   a. Health is affected by substances which interfere with normal functioning.
   b. Health problems while slow in occuring may be permanently disabling.

2. Safety refers to avoiding accidents by following safe work procedures and recognizing and correcting unsafe conditions.

D. Miner's responsibility

1. Reporting hazards
2. Tagging unsafe equipment
3. Eliminating known hazards
4. Warning others
5. Avoiding areas of hazards

II. MOST COMMON TYPES OF ACCIDENTS IN METAL/NONMETAL UNDERGROUND MINES

INSTRUCTOR NOTE: DISCUSS BRIEFLY ALL COMMON TYPES OF ACCIDENTS, BUT FOCUS ON THOSE MOST FREQUENT IN YOUR LOCAL MINE.

VISUAL NOTE: SHOW THE PIE CHART OF COMMON TYPES OF ACCIDENTS AND THEIR PERCENTAGES.

A. Handling materials is a common activity related to accidents (lifting, pulling, pushing or shoveling packaged or loose material).

1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 31% occurred during handling of materials.

2. Accident characteristics

   Of all accidents in underground mines involving materials handling, 62% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 12 to 164 days.

3. These accidents may often be avoided by using correct procedures for handling materials.

   a. Use proper lifting, lifting with the legs rather than the back.
   b. Wear gloves.

c. Do not allow your vision to be obscured by the load and be careful when passing through entrances.
d. Do not attempt to carry a load which is too heavy, and coordinate your moves with those assisting you.
e. Be careful of sharp edges or protruding sides of the materials you are carrying.
f. When setting materials down, make sure you have sufficient clearance from your toes.

VISUAL NOTE: PASS OUT ILLUSTRATIONS, VISUALS 1, 2 and 8 OF LIFTING AND CARRYING. THESE MATERIALS WILL BE HELPFUL TO SHOW THE PROPER TECHNIQUES.

CLASSROOM ACTIVITY: DEMONSTRATE LIFTING TECHNIQUES WITH LIGHT LOADS, THEN HEAVY MATERIALS. INVOLVE STUDENTS IN LIFTING INDIVIDUALLY AND IN PAIRS.

B. Powered haulage activities are another source of accidents (conveyors, front-end loaders, haulage trucks, locomotives and railroad cars, and personnel conveyances).

1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 8% occurred around powered haulage.

2. Accident characteristics

a. Of all accidents in underground mines involving powered haulage, 74% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 30-210 days.

b. Some of the sorts of haulage accidents which occur are as follows:

i. Collisions with other vehicles or stationary objects
ii. Being struck, run over by or squeezed between vehicles
iii. Striking arms, legs, or other body parts against protruding objects while riding in mine transportation
iv. Slipping or falling while mounting vehicle

INSTRUCTOR NOTE: A QUESTION ABOUT PROCEDURES FOR PREVENTING ACCIDENTS MAY PRODUCE SOME OF THE FOLLOWING RESPONSES.

3. Haulage accidents may be reduced by using the rules as follows:

   a. Never exceed the vehicle's capabilities for speed, stopping, and turning.
   b. When on foot watch out for all vehicles and let operators know you are near.
   c. Never get on or off of moving vehicles of any kind.
   d. Keep limbs and head within the riding area.
   e. Make frequent inspections of vehicle's brakes, lights, steering, and other devices related to safety.
   f. Don't work on moving conveyor belts or attempt to cross or mount them.
   g. Don't wear loose clothing or long hair around moving conveyor belts or machinery which has exposed moving parts.
   h. When shoveling onto a moving belt, always shovel in the direction the belt is moving.

C. Another major source of accidents is the use of machinery (drills, slushers, power shovels, and compressors).

1. Frequency of occurrence - Of all accidents reported in 1979 for underground mines, 17% occurred around machinery.

2. Accident characteristics

   a. Of all accidents in underground mines involving machinery, 64% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 18 to 194 days.

   b. The sorts of accidents which occur are as follows:

      i. Being caught between a machine and the highwall during a slide.
      ii. Being struck by a moving boom or bucket or blade
      iii. Being struck or crushed by falling or overturning equipment.
      iv. Being struck by flying objects.

VISUALS NOTE: ILLUSTRATIONS OF TYPES OF ACCIDENTS AND DANGEROUS CONDITIONS WITH PROCEDURES OF AVOIDING THEM WILL BE HELPFUL HERE. CHOOSE THOSE MOST SUITED FOR YOUR MINE.

3. Many accidents of this nature can be avoided by following safe work procedures.

   a. When working near equipment in operation, be sure operator knows you are there.

b. Avoid the area included in the circle of movement of booms and loaders. Never walk under raised equipment.
c. Never leave equipment unattended in raised position.
d. Be sure equipment is securely blocked before attempting any repair or maintenance with it in raised position.
e. Never attempt to defeat or override the safety devices built into equipment.

D. Another source of accidents is slips and falls (while getting on or off machinery and haulage equipment which is not moving, and while servicing or repairing equipment or machinery).

1. Frequency of occurrence - Of all accidents in 1979 for underground mines, 13% resulted from slips and falls.

2. Accident characteristics

   Of all accidents in underground mines resulting from slips and falls, 73% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 21 to 210 days.

3. Some rules which will prevent slips and falls are as follows:

   a. Wear proper footwear.
   b. Always watch where you are going. Don't allow material being carried to block your visibility.
   c. Use both hands when climbing up or down a ladder. Never jump from rung to rung or try to slide down the ladder.
   d. Clean up any spills that might cause someone to slip.
   e. Never lean over equipment without stable footing.
   f. Use a safety belt to catch any fall from a high place, or when working in a hole or trench.

E. An additional major source of accidents is the use of hand tools (nonpower assisted tools)

1. Frequency of occurrence - Of all accidents in 1979 for underground mines, 11% resulted from use of hand tools.

2. Accident characteristics

   Of all accidents in underground mines resulting from use of hand tools, 45% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 11 to 125 days.

3. The following are procedures which will help in avoiding these accidents.

a. Use the right tool for the job.
b. Keep tools in their place when they are not being used. Don't leave them around as hazards to safety.
c. Be sure you have clearance from other workers and machinery when using hammers and sledges.
d. Always wear safety glasses to protect your eyes from flying material.
e. Follow recommended safety procedures in the use of special tools and equipment.

VISUAL NOTE: PASS OUT THE ILLUSTRATION, VISUAL 48, OF PROPER AND IMPROPER USE OF TOOLS.

VISUAL NOTE: YOU MAY WISH TO CREATE TRANSPARENCIES FROM VISUALS 19, 20 and 47 FOR USE WHILE YOU DISCUSS TOOLS.

F. The final major source of accidents is falls of the back or sides. This includes falls while barring down or placing props, as well as pressure bumps and bursts. This does not include accidents due to equipment gouging the rock.

1. Frequency of occurrence of all accidents in 1979 for underground mines, 10% resulted from falls of the back or sides.

2. Accident characteristics

   Of all accidents in underground mines resulting from falls of the back or sides, 65% resulted in lost work days for non-fatally injured miners. The average severity of these accidents was lost time ranging from 12 to 600 days.

3. These accidents may often be avoided by observing some of the following safety rules.

   a. While barring down always follow safe procedures and keep a path for escape open. When scaling, always wear safety glasses and work under supported roof.
   b. If you suspect weak rock, report it to supervision.
   c. You may want to test the rock periodically with a hammer to assess its soundness.
   d. Avoid going around the mine's roof control plan, such as working in areas that have not yet been bolted.
   e. Look for stress cracks or rocks protruding from the back or sides.
   f. Look for formerly dry areas that suddenly become wet.
   g. Look for the falling of small chips that might signal larger falls.
   h. Look for rock bolts showing signs of stress.
   i. Never assume someone else has made tests in the area.

III. SOURCES OF HEALTH HAZARDS

A. Toxic fumes and gases

1. Toxic gases produce specific ill effects.

2. Asphyxiating gases cause suffocation by reducing the quantity of oxygen available.

B. Respirable dust is more hazardous than nonrespirable dusts as the latter are filtered out before reaching the lungs.

C. Exposure to noise can cause discomfort and loss of hearing, especially at high noise levels.

D. The above hazards are the most common, but are not all the possible hazards. Each miner is responsible for watching for and reporting hazards specific to their work area.

EVALUATION NOTE: HAVE MINERS ANSWER SELF CHECK NUMBER ONE, INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE ANALYSIS OF ACCIDENTS AND THEIR CAUSES, AS WELL AS THE MOST COMMON TYPES OF ACCIDENTS IN UNDERGROUND MINES.

SELF CHECK #1: SOLUTIONS

1. handling materials, haulage activities, use of machinery, slips and falls, and use of hand tools.

2. a, b, & d.

3. True

4. a. turning with one hand or while eating
   b. safety motivation and awareness
   c. Hal should not drive with the bucket raised

5. fingers

6. Always leave your vision clear when carrying materials. Store tools when not in use.

7. a. Use wrench only with square-shanked screwdriver.
   b. Use tools with handles in good condition
   c. Carry tools in a shoulder bag when climbing
   d. get a longer wrench
   e. hold nail near the head
   f. use the right tool for the right job.

Self Check: Hazard Recognition

Self Check #1: Analysis and Causes of Accidents, and Common Types of Accidents in Underground Mines.

1. List the 5 main types of accidents.

   a.

   b.

   c.

   d.

   e.

2. (circle each correct answer,) An accident is:

   a. any unplanned event that may result in property damage

   b. an unanticipated event that sometimes results in personal injury

   c. always management's fault

   d. sometimes the result of unsafe acts

3. Indirect causes of accidents are unsafe acts and unsafe conditions. (true, false).

4. Hal is new to mining. One day he drives his front end loader down the drift with the bucket of ore raised. Because he's eating a sandwich he steers wide on the curve and runs the bucket into a rib. He breaks the bucket and hits his head on the canopy.

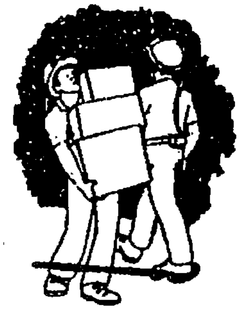
   a. What is the indirect cause of this accident?

   b. What is the basic cause?

   c. How could this powered haulage type of accident be prevented?

5. Which body parts are most frequently injured in mining accidents?

6. What rules are not being followed here?



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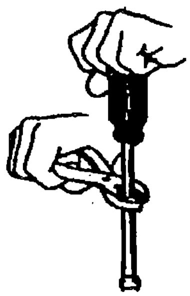
7. On each line below tell what hand tool rule is not being followed.

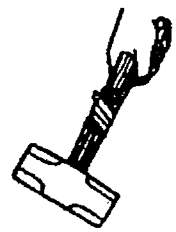


a. ______________________________

____

____

____

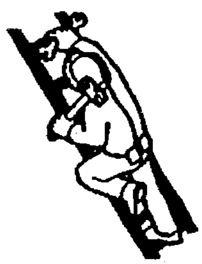


b. ______________________________

____

____

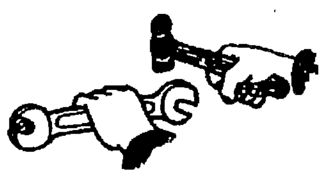
____



c. ______________________________

____

____



d. ______________________________

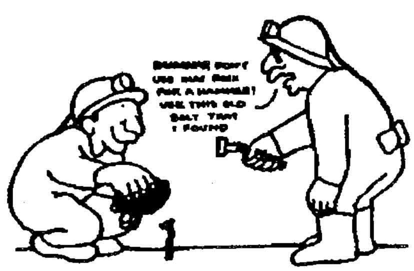
____

____

e. ______________________________

____

____

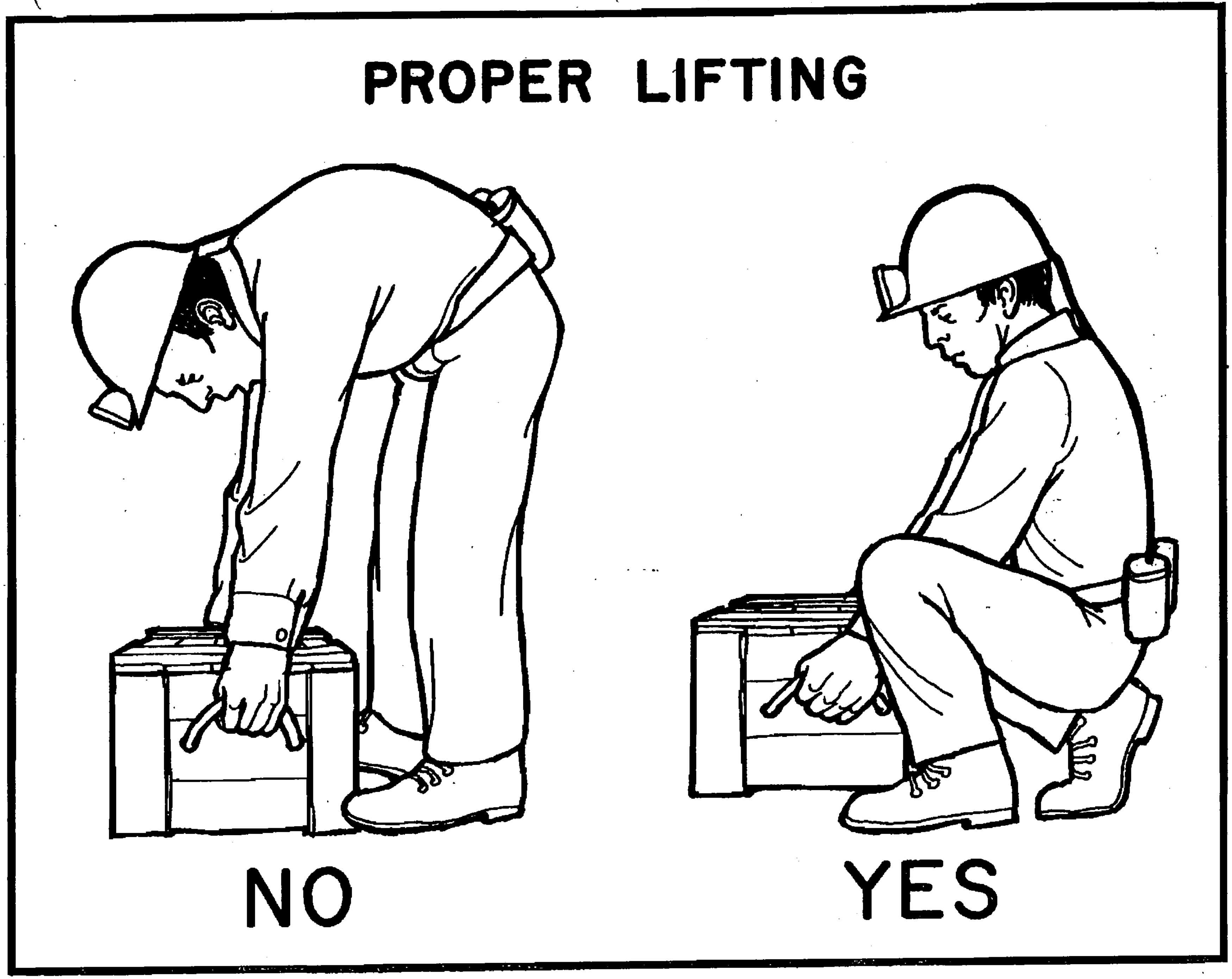


f. ______________________________

____

____

____



VISUAL I

IF THE LOAD IS TOO HEAVY:

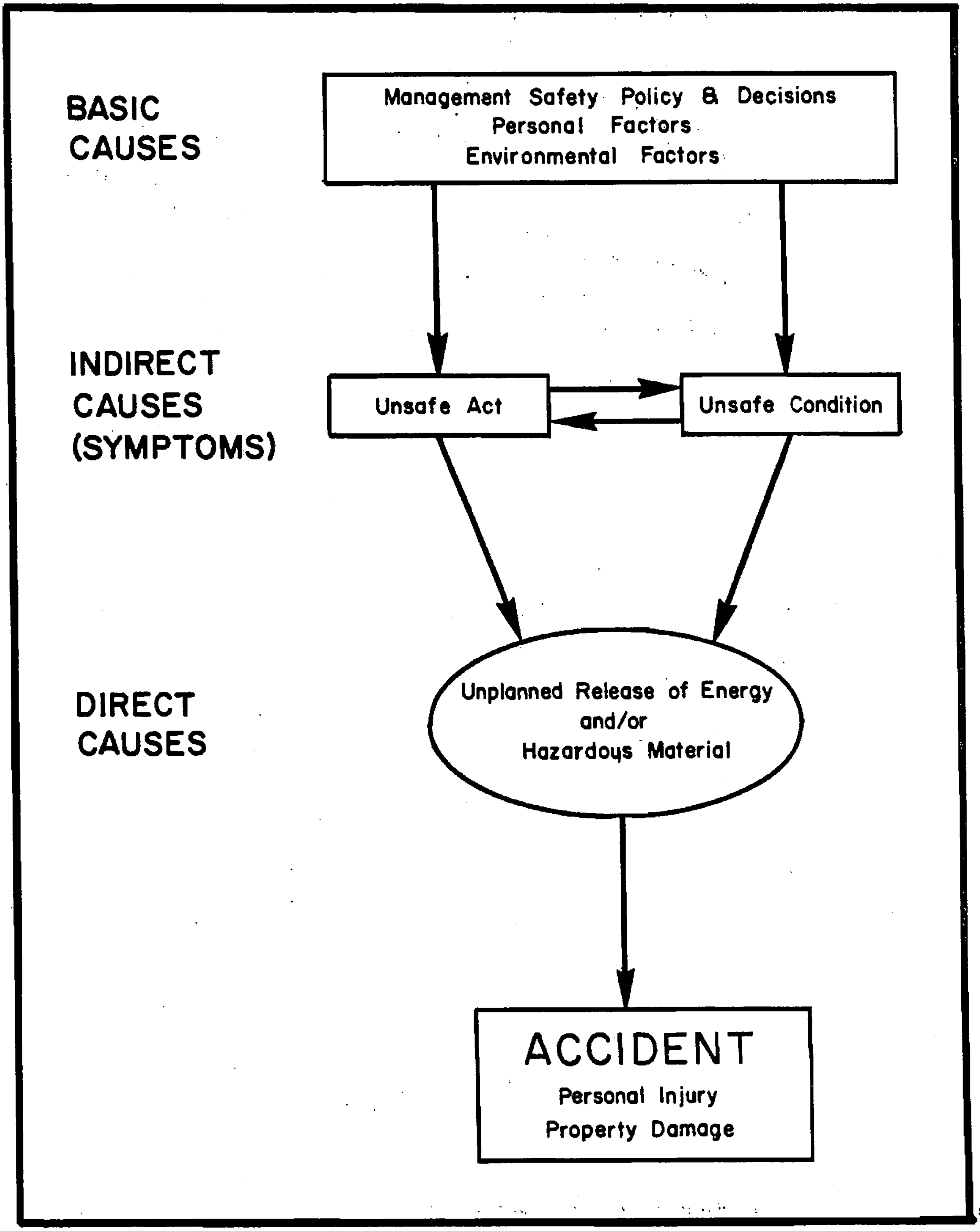
GET HELP! Both face in direction of travel.

LIFTING IN CONFINED AREAS

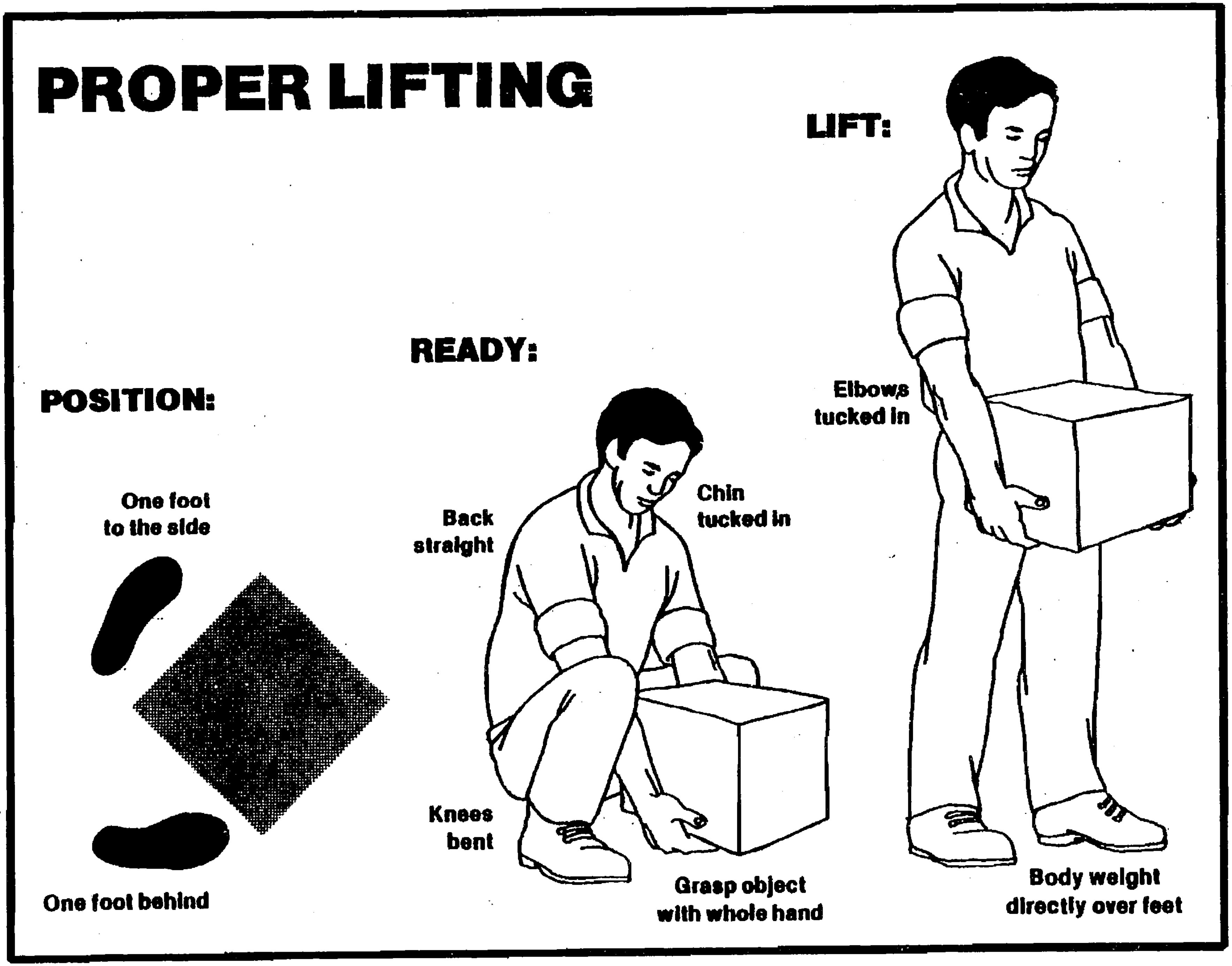
ON HANDS AND KNEES:

Lift object with one hand, balance with the other.

VISUAL 2

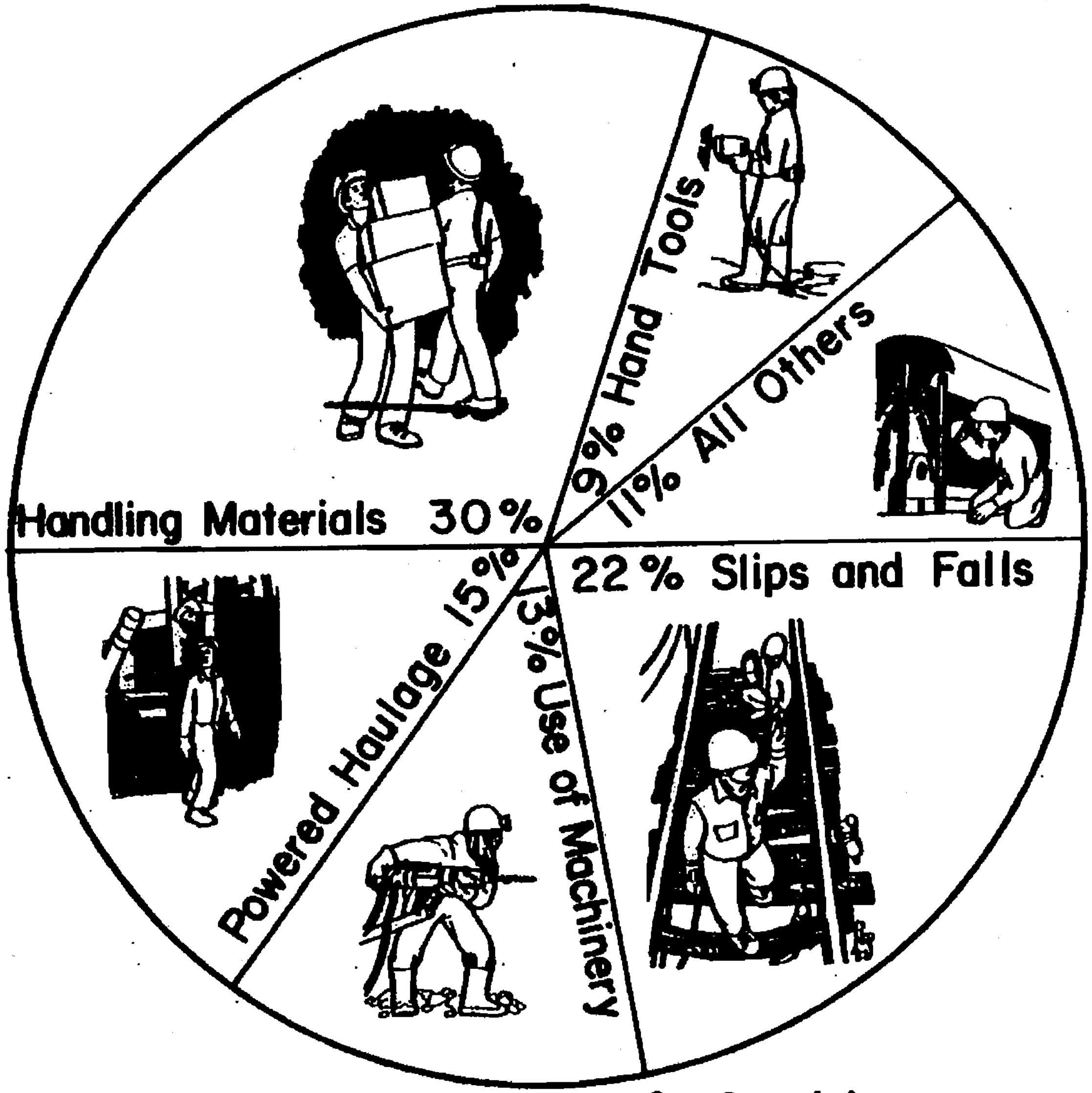

BASIC
CAUSES
Management Safety Policy & Decisions
Personal Factors
Environmental Factors
INDIRECT
CAUSES
(SYMPTOMS)
Unsafe Act
Unsafe Condition
DIRECT
CAUSES
Unplanned Release of Energy
and/or
Hazardous Material
ACCIDENT
Personal Injury
Property Damage

VISUAL 7


PROPER LIFTING
POSITION:
One foot to the side
One foot behind
READY:
Back straight
Chin tucked in
Knees bent
Grasp object with whole hand
LIFT:
Elbows tucked in
Body weight directly over feet

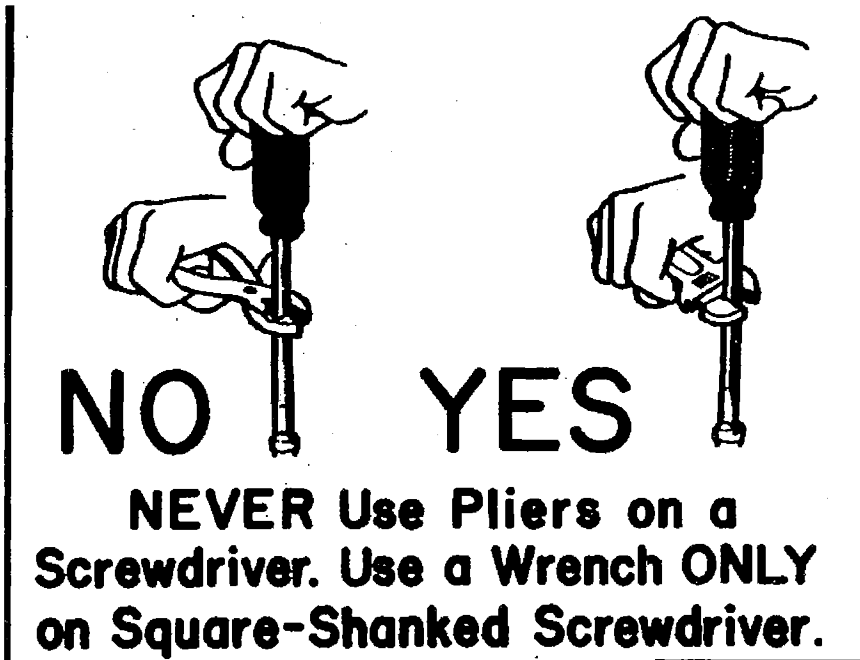
VISUAL 8

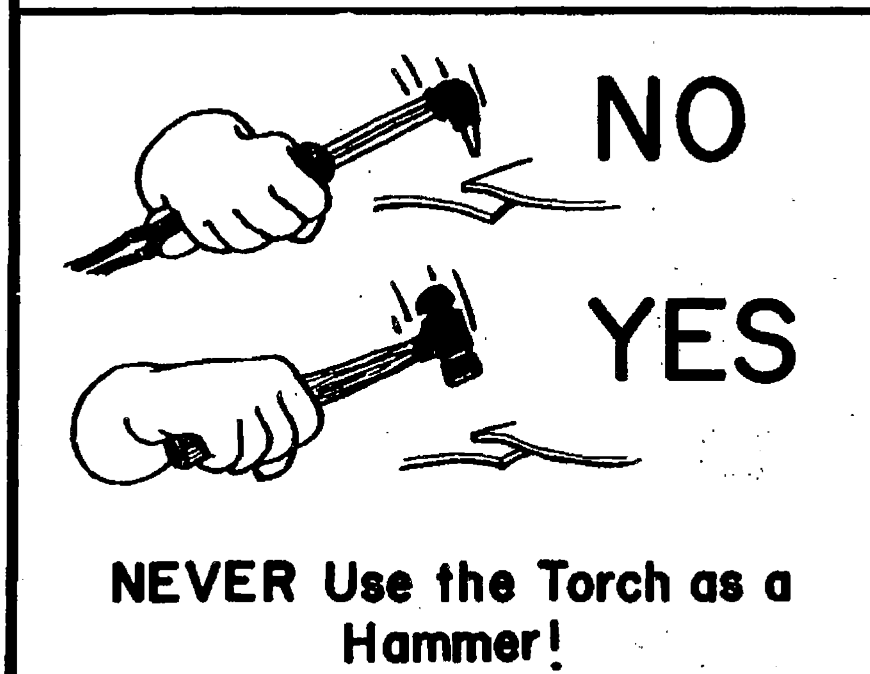
HAZARD RECOGNITION

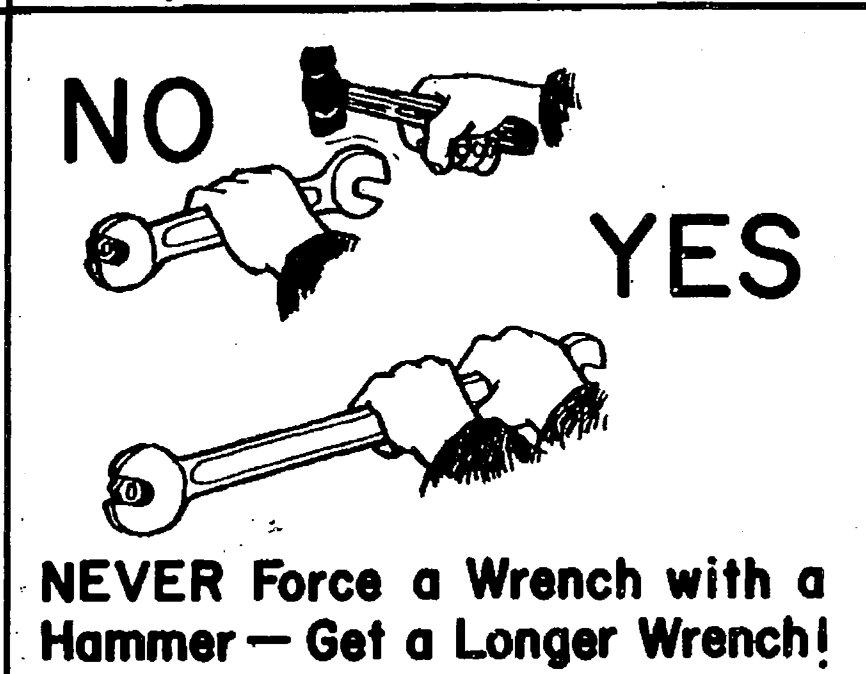


Common Types of Accidents
and Their Percentages

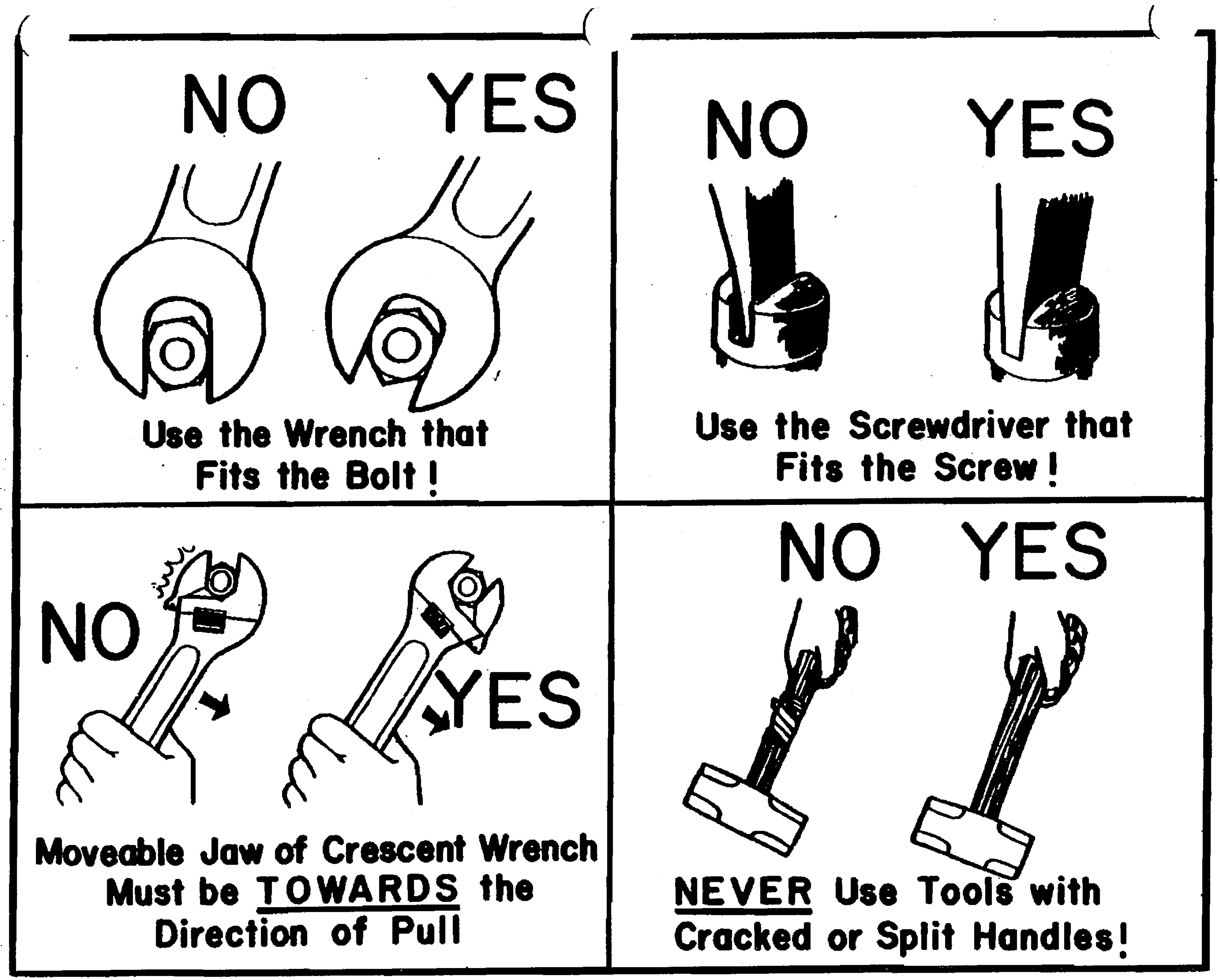

NO
YES
Hold the Nail Near the Head, Not Near the Point


NO
YES
NEVER Use Pliers on a Screwdriver. Use a Wrench ONLY on Square-Shanked Screwdriver.

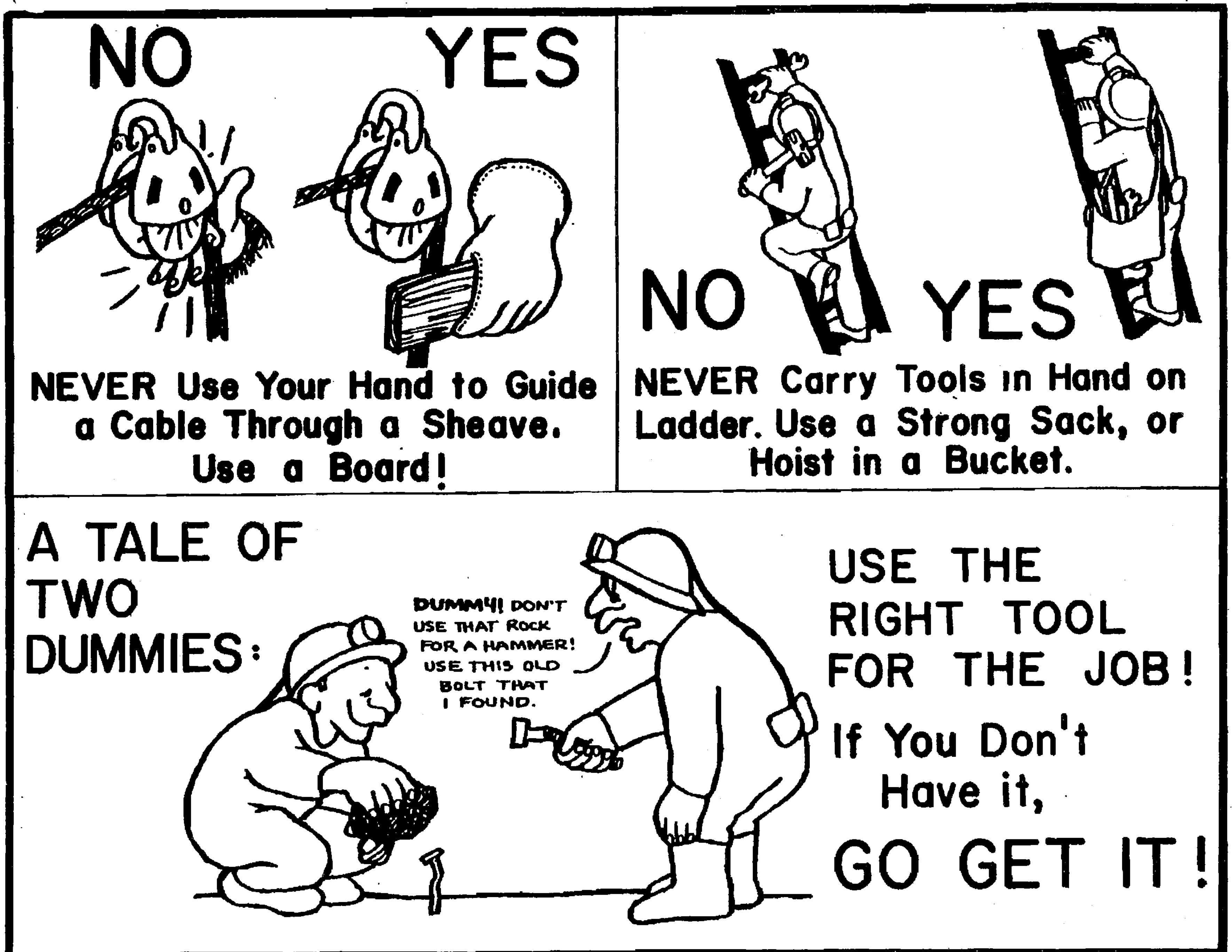

NO
YES
NEVER Use the Torch as a Hammer!


NO
YES
NEVER Force a Wrench with a Hammer — Get a Longer Wrench!

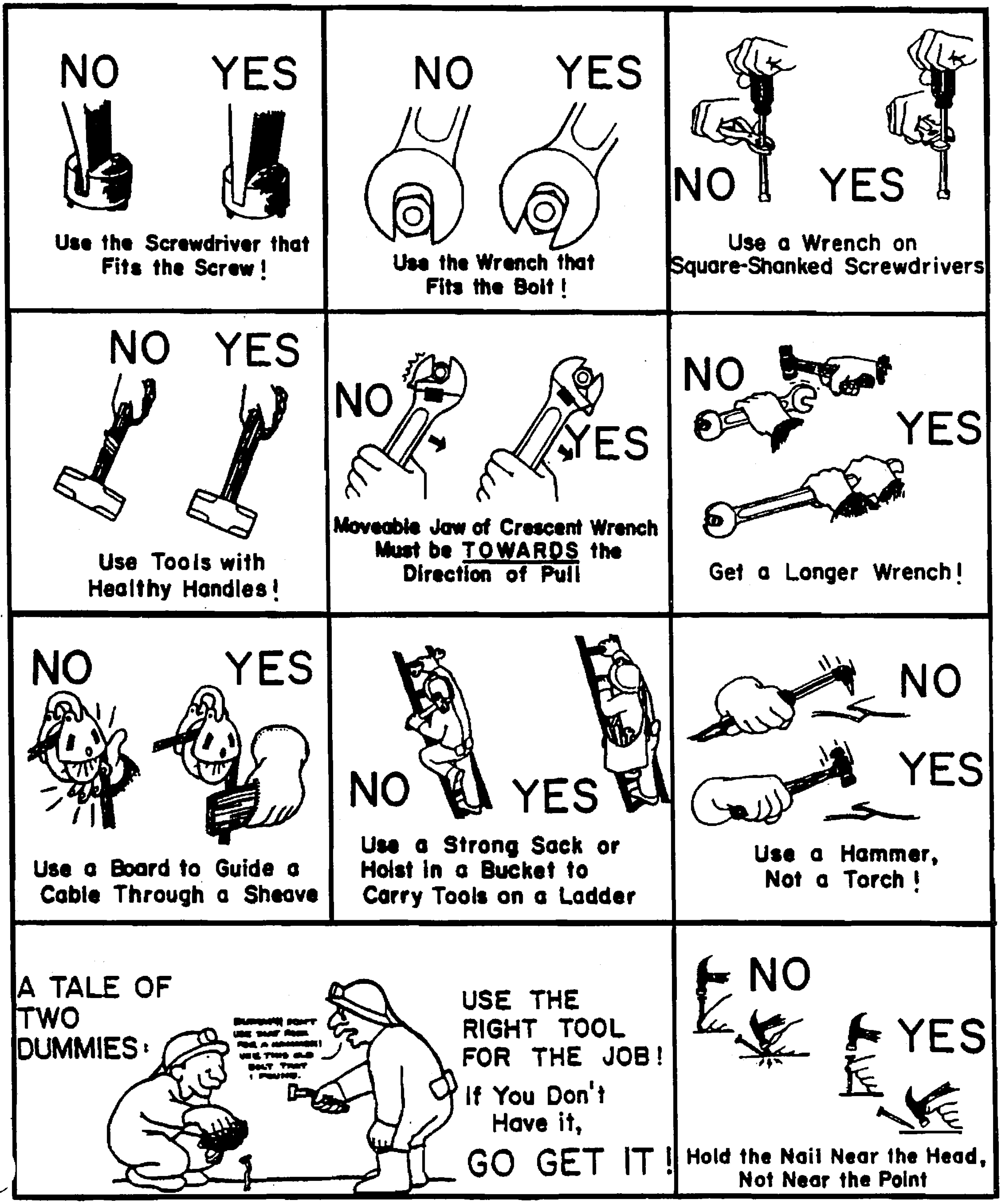
VISUAL 19


NO YES
Use the Wrench that
Fits the Bolt!
NO YES
Use the Screwdriver that
Fits the Screw!
NO YES
Moveable Jaw of Crescent Wrench
Must be TOWARDS the
Direction of Pull
NO YES
NEVER Use Tools with
Cracked or Split Handles!

VISUAL 20


NO
YES
NEVER Use Your Hand to Guide a Cable Through a Sheave. Use a Board!
NO
YES
NEVER Carry Tools in Hand on Ladder. Use a Strong Sack, or Hoist in a Bucket.
A TALE OF TWO DUMMIES:
DUMMY! DON'T USE THAT ROCK FOR A HAMMER! USE THIS OLD BOLT THAT I FOUND.
USE THE RIGHT TOOL FOR THE JOB!
If You Don't Have it,
GO GET IT!

VISUAL 47


NO YES
Use the Screwdriver that Fits the Screw!
NO YES
Use the Wrench that Fits the Bolt!
NO YES
Use a Wrench on Square-Shanked Screwdrivers
NO YES
Use Tools with Healthy Handles!
NO YES
Moveable Jaw of Crescent Wrench Must be TOWARDS the Direction of Pull
NO YES
Get a Longer Wrench!
NO YES
Use a Board to Guide a Cable Through a Sheave
NO YES
Use a Strong Sack or Hoist in a Bucket to Carry Tools on a Ladder
NO YES
Use a Hammer, Not a Torch!
A TALE OF TWO DUMMIES:
USE THE RIGHT TOOL FOR THE JOB!
If You Don't Have it,
GO GET IT!
NO YES
Hold the Nail Near the Head, Not Near the Point

VISUAL 48

NEWLY-EMPLOYED EXPERIENCED MINERS

DEEP METAL/NONMETAL

EXPLOSIVES

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

COURSE PLAN: EXPLOSIVES

I. GOAL: The goal of this module is to have the miner identify explosives and blasting accessories, recognize the hazards associated with blasting, and procedures to follow to make a safe work environment.

II. BACKGROUND: The use of explosives in underground metal and nonmetal mines presents a tremendous hazard to everyone. Although only specially trained experienced personnel are permitted to use explosives, the results from accidental misuse or misfiring of explosives are a serious problem for everyone. For this reason all employees shall be trained on the materials and hazards of explosives.

III. OBJECTIVES

A. Trainer will do the following:

1. Present those explosives and blasting accessories used at the mine (dummys available from the Institute of Makers of Explosives)
2. Describe hazards associated with explosives, such as transportation hazards and toxic fumes
3. List safe procedures to follow when working near the blasting area, or when finding an explosive.

B. Trainees will be able to do the following:

1. Identify fired and misfired non-electric blasting caps using dummys.
2. Identify by naming the types of explosives and blasting accessories used at your mine.
3. Name safe procedures to follow when guarding near blasting areas or when finding an explosive.
4. Move to a safe place in the mine as would be done during blasting while on the mine tour.

IV. ACTIVITIES

A. In the classroom identify the different types of blasting equipment used in the mine.

B. On site during the mine tour

1. Determine the locations of magazines.
2. Lead the miners through the procedures to be followed during blasting operations

V. MATERIALS

A. Visual aids contained in the Lesson Guide and Materials

B. Blasting Cap (dummy) Display available from the Institute of Makers of Explosives.

VI. EVALUATION

A. Demonstrate, describe, or identify:

1. Explosives and blasting accessories
2. Hazards with explosives
3. Safety procedures to follow

B. Review of performance

1. Identifying the responsibilities for guarding the blast area.
2. Finding the locations of magazines.
3. Following correct procedures when finding an undetonated explosive or cap.

C. Self-Check

1. Anytime hands on evaluation such as identifying different types of explosives or locating underground magazines is possible it should be used.
2. Eliminate the use of self-checks if it is too difficult for your class.
3. Changes written self-check items where necessary to fit your local mine situation.

VII. RESOURCES

A. This unit is not required by law but may be useful in your training program.

B. Applicable Federal regulations CFR 30 Part 57.6.

C. Reading materials

1. Manufacturer's explosives manual
2. "Explosives and Blasting". West Virginia University Mining Extension Service, Study Guide Series, Number 5. Available at MSHA Informational Resource Library, Catalog Number 200-408.
3. Safety library publications from the Institute of Makers of Explosives

a. Number 1 Typical Storage Magazines
b. Number 2 American Table of Distances
c. Number 3 Suggested Code of Regulations
d. Number 4 Do's and Don't
e. Number 6 Recommended Industry Safety Standards
f. Number 12 Glossary of Industry Terms
g. Number 17 Safety in the Transportation, Storage, Handling and Use of Explosives
h. Number 20 Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Electric Blasting Caps.
i. Number 22 IME Standard for the Safe Transportation of Class C Detonators (Blasting Caps) in a Vehicle With Certain Other Explosives

4. "Primacord Detonating Cord - What it is and how to use it". Published by the Ensign Bickford Company, Simsbury, Conn., Ninth Printing.
5. "New non-electric explosive initiation systems". By Richard Dick of the U.S. Bureau of Mines. Appeared in Pit and Quarry, March, 1976, pages 104-106.

D. Films

1. ENT/Gates Films, Inc. - "Developing a Safe Rock Slope."
2. National Coal Board - "How Not to Keep a Head While Shot-Firing."

TOPICS COVERED

I. EXPLOSIVES AND BLASTING ACCESSORIES USED AT THE MINE

II. HAZARDS ASSOCIATED WITH EXPLOSIVES

A. Transportation hazards

B. Magazine hazards

C. Detonator hazards

D. Blasting hazards

III. SAFE WORK PROCEDURES WITH EXPLOSIVES

A. Task training
B. Clearing and guarding the blast area
C. Re-entering blasting area
D. Reporting finding an undetonated or misfired explosive

NEW EXPERIENCED MINER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: EXPLOSIVES

I. EXPLOSIVES AND BLASTING ACCESSORIES USED AT THE MINE

INSTRUCTOR'S NOTE: AT THIS TIME PRESENT THOSE EXPLOSIVES AND BLASTING ACCESSORIES USED IN YOUR MINE. THIS WILL ALLOW THE MINERS TO BECOME MORE FAMILIAR WITH THEM SO THAT WHEN ANY ARE SEEN IN THE MINE THEY WILL BE MORE QUICKLY RECOGNIZED. THE FOLLOWING VISUAL NOTES MAY BE HELPFUL.

VISUALS NOTE: SHOW VISUAL NUMBER 27 DISPLAYING THE CONTENTS OF AN ELECTRIC BLASTING CAP.

VISUALS NOTE: SHOW VISUAL NUMBER 55 ILLUSTRATING A NON-ELECTRIC BLASTING CAP

II. HAZARDS IN USE OF EXPLOSIVES

A. Transportation hazards

1. The vehicle used to transport explosives should be in good operating condition. If the vehicle were to get a flat tire or lose its brakes it would lead to a serious hazard for everyone. The cargo space in which the explosives are stored should be of non-sparking material. If the vehicle got into an accident with damage to the cargo area, you would want to minimize any sparks that could set off the explosives.
2. Detonators and explosives should be kept apart by at least four inches of hardwood, or transported separately. If a detonator were to accidently fire this would prevent it from setting off any explosives.
3. Explosives should be transported at times when the fewest number of people will be endangered. During shift change or before or after personnel are transported into or out of the mine is usually a good time to bring explosives into the mine.
4. Explosives should not be stacked higher than the sideboards of the vehicle. If the vehicle were to hit a bump some boxes could fall off the side.
5. No smoking is permitted on or near the vehicle. Hot ashes or flames pose a danger when mixed with powder.
6. If ANFO or any other powder is spilled it should be immediately cleaned up.
7. Do not ride on the cage when it is being used to transport explosive material.

8. Vehicles should be driven carefully and excessive speeds should be avoided. Do not drive over unbridged power cables.
9. Vehicles loaded with explosives should not drive into any maintenance area where sparks from welding or stray electric currents could set off explosives.

B. Detonator Hazards

1. Do not let leg wires and detonators come into contact with electrical equipment, wires or rails. These may carry enough of a current to set off the charge.
2. Caps can deteriorate and become more sensitive because of age. Caps may also become useless from such damage as being kinked, exposed to extreme heat, or contaminated with water. They should be properly disposed but only by experienced powdermen.

C. Magazine hazards

1. Magazines must be built in dry, isolated areas of the mine so as to be well ventilated, bullet-proof, locked, and have non-sparking material on the inside wall. It must be marked with a sign located in such a place that if a bullet were to be fired into it the bullet would not pass into the stored powder.
2. Flammable materials such as fuel or oil should not be stored near a magazine.
3. Smoking in and around a magazine is prohibited.
4. Detonators and explosives should not be stored together in the same magazine. Separate magazines for them should be at least 25 feet apart.
5. The magazine must be kept clean of trash, empty boxes, and paper at all times. They are both a fire hazard and a cause of slips and falls.
6. No electric wiring or open lights should be taken into a magazine.
7. Surplus or loose explosives should not be left in unsecured areas such as cuts, passes, or by the outside walls of the magazine.

VISUALS NOTE: PRESENT VISUAL NUMBER 29 SHOWING A LOST DETONATOR ON A HAULAGE TRACK. COMMENT ON SUCH HAZARDS AS THEY MAY EXIST IN YOUR MINE.

D. Blasting hazards

1. A misfire is a loaded hole that fails to fire. The procedure following firing a round is that the blaster or supervisor will inspect the muck pile for misfires. No one else is permitted to enter the area until the all-clear signal is given.

a. If the blaster finds a misfire he will attempt to re-wire and detonate it or flush it out of the drill hole with water and then dispose of it.
b. In the event the misfire is completely covered by rock, the blaster may not see it. This results in a very dangerous situation. Do not attempt to move it yourself. If you discover a misfire in the rock, work should stop immediately, the area should be cleared and guarded, and the supervisor should be contacted.
c. Toxic fumes may be found after detonation. You can avoid these fumes by remaining out of the blast area until ventilation dilutes the gases and carries them out of the mine.
   i. Carbon monoxide can be detected by observing one of the first symptoms of such poisoning - headache pain.
   ii. Explosives containing nitroglycerine or other nitro compounds may burn rather than detonate. One gas resulting from this is nitrogen dioxide which is extremely dangerous to your lungs in small amounts. It has a burned powder odor.
   iii. Wet ANFO will generate nitrous oxide fumes.

VISUALS NOTE: PRESENT VISUAL NUMBER 28 SHOWING A MINER FINDING A DETONATOR. COMMENT ON THE PROCEDURES HE SHOULD NOW FOLLOW.

2. Overshooting results from either an excessive use of explosives, an improperly sized drill hole, or holes that are not properly placed according to the delay pattern. Undershooting is just the opposite. Overshooting weakens the remaining rock making it susceptible to falls and may require use of supports. Undershooting results in an uneven back and creates haulage problems by having to move larger sized rocks.
3. Fly rock consists of pieces of rock blown from the shot area by the explosive force. This rock can be lethal because of its weight and velocity of travel. Flyrock is also caused by a blowout. When a blast hole is not drilled deep enough into the rock, the explosive force blows the rock out into the drift or work area.
4. Electrical hazards are present if the mine uses electric blasting caps.
   a. Natural sources like static electricity or lighting storms.
   b. Man-made sources like stray electricity and underground radio transmitters.
   c. Only special galvanometers should be used to test continuity. Regular galvanometers may set off the charge.

If you find a cap in the muck pile do not attempt to test the leg wires - only experienced powdermen are equipped to do such work.

d. Any power equipment with leaking current presents a hazard.

e. Static charge built up from pneumatic loading equipment.

5. Never drill into a bootleg - it could contain powder that might detonate when struck by the drill steel. Prior checks of the hole may have accidentally not detected the powder, so do not take any shortcuts.

III. SAFE WORK PROCEDURES WITH EXPLOSIVES

A. Task training is given to the powdercrew to increase their technical skills in the use of explosives. Only experienced people trained in use of explosives or working under close supervision should work with explosives. All other miners should stay out of the way while the powdercrew works unless assigned to the area.

B. Clearing the blast area is very important. Unless the area is secured, other people may unknowingly walk into a life threatening situation from either the blast itself or the toxic fumes that follow the blast.

1. The blasting crew will clear the area of all personnel, and then give a warning signal before setting off the round. Guards should be posted at all entrances to the area with specific instructions to keep everyone out. Guards should not leave their post even for a moment because someone could walk past without being seen. Guards must remain at their posts until specifically told to return to their regular work.
2. Equipment should be moved clear of the blast area to prevent damage.
3. Miners should stand clear of the blast area, such as behind equipment, to protect themselves from being hit by flyrock. Always give yourself enough room to stay clear.

C. Re-entering blasting area. Before resumption of work, a supervisor or blaster will inspect the blast area for misfires and fumes. No one should enter this area past the guards until the all-clear signal is given by this person.

D. Reporting undetonated or misfired explosives. Any miner who discovers an undetonated explosive near a magazine or along a haulageway, or a misfired explosive near their work area shall halt work, clear everyone out of the area and guard it, and notify a supervisor about the hazardous situation. Never attempt to move the explosive yourself because it may be very unstable and could go off in your hand.

EVALUATION NOTES: HAVE TRAINEES ANSWER THE SELF-CHECK QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN EXPLOSIVES AND BLASTING ACCESSORIES, HAZARDS IN USE OF EXPLOSIVES, AND SAFE WORK PROCEDURES.

SELF CHECK #1: SOLUTIONS

1. Answers will vary according to mine situation.
2. false
3. false
4. electric blasting cap
5. false
6. false
7. a. Vehicle should be in good condition, with cargo space of non-sparking material.
   b. Detonators and explosives should be separated by at least four inches of hardwood or transported separately.
   c. Transportation should take place when fewest people would be endangered.
8. true
9. false
10. Sample answer: Magazine must be built in dry, isolated areas of the mine in order to be well ventilated, electrically grounded, bullet-proof, locked, and built with non-sparking material inside.
11. false
12. Instructor must check answers individually.

Self Check: Explosives

Self Check #1: Permissible Explosives and Firing Devices, Hazards in Use of Explosives, and Safe Work Procedures with Explosives

1. Name the kind of explosives used at your mine, and tell how they can be identified.

2. Using more explosives than necessary is one way of making sure the job is done right. (true, false).

3. Guards are allowed to move from their post once they hear the charge go off. (true, false).

4. An ______________________________ consists of a metal shell loaded with several explosive charges and an electrical ignition element attached to a pair of insulated wires.

5. Any miner can help an experienced blaster set a charge as long as the blaster observes his work. (true, false).

6. Miners may safely smoke around magazines as long as there is adequate ventilation. (true, false)

7. List 3 hazards in transporting explosives.

   a.

   b.

   c.

8. Miners should always take cover during blasting, even at long distances, because hard hats are not sufficient protection from fly rock. (true, false)

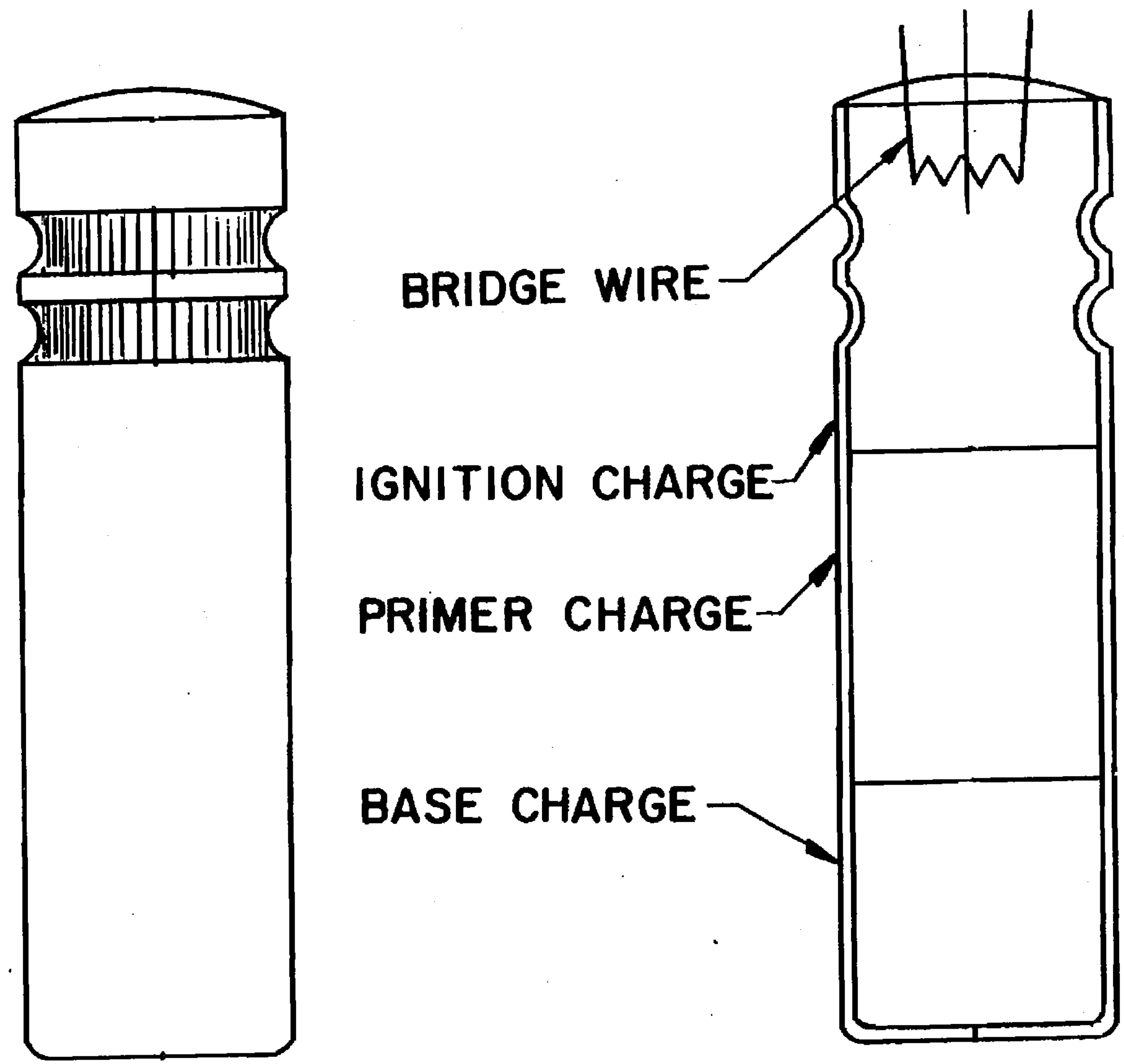
9. Electric blasting caps can safely be exposed to static electric charges. (true, false).

10. Describe a properly built explosives magazine.

11. A miner, having taken this course is qualified to return to a blast area and check for misfires. (true, false).

12. Name the person you would contact if you found an electric blasting cap in your drift _____________.

ELECTRIC BLASTING CAP

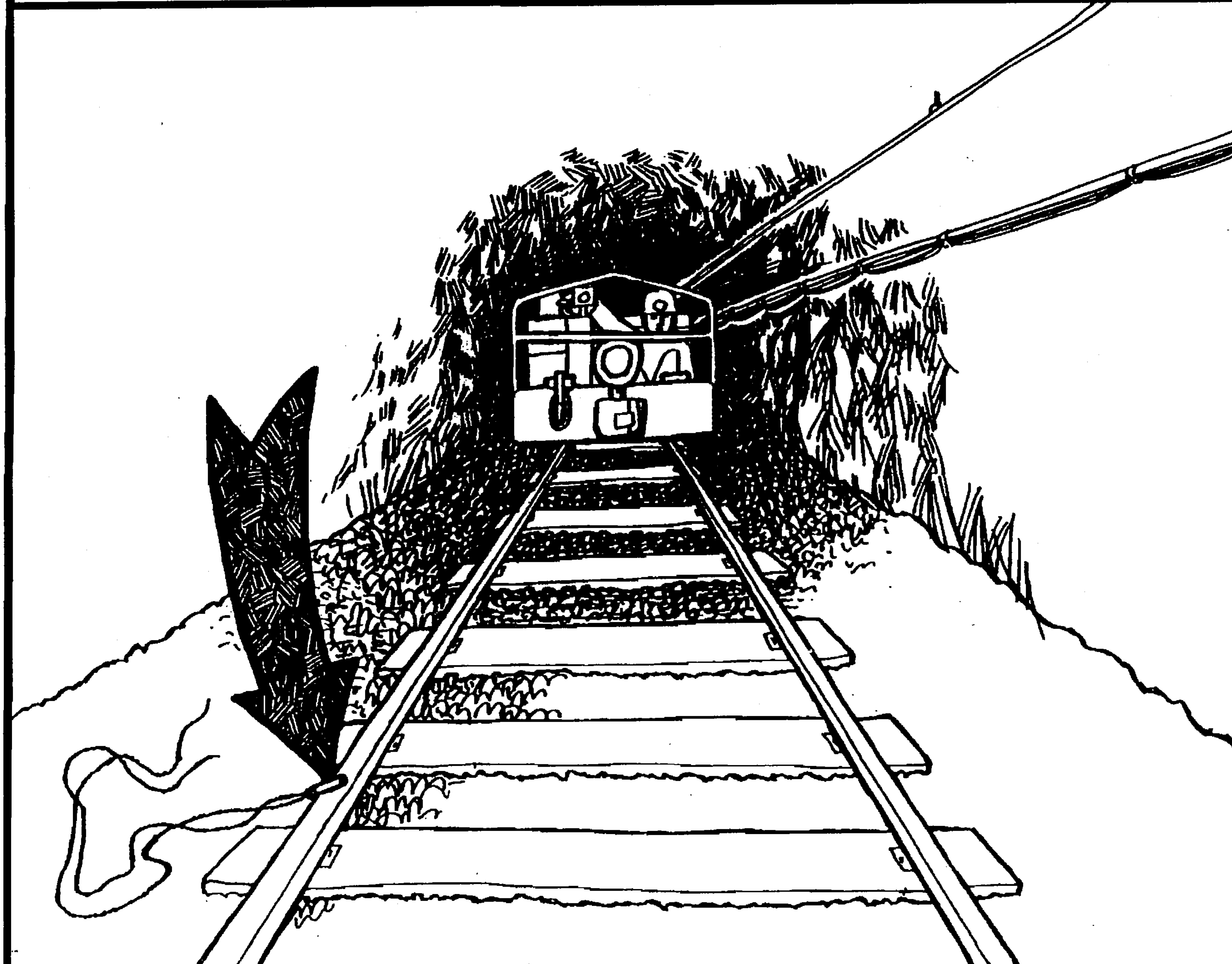


VISUAL 27

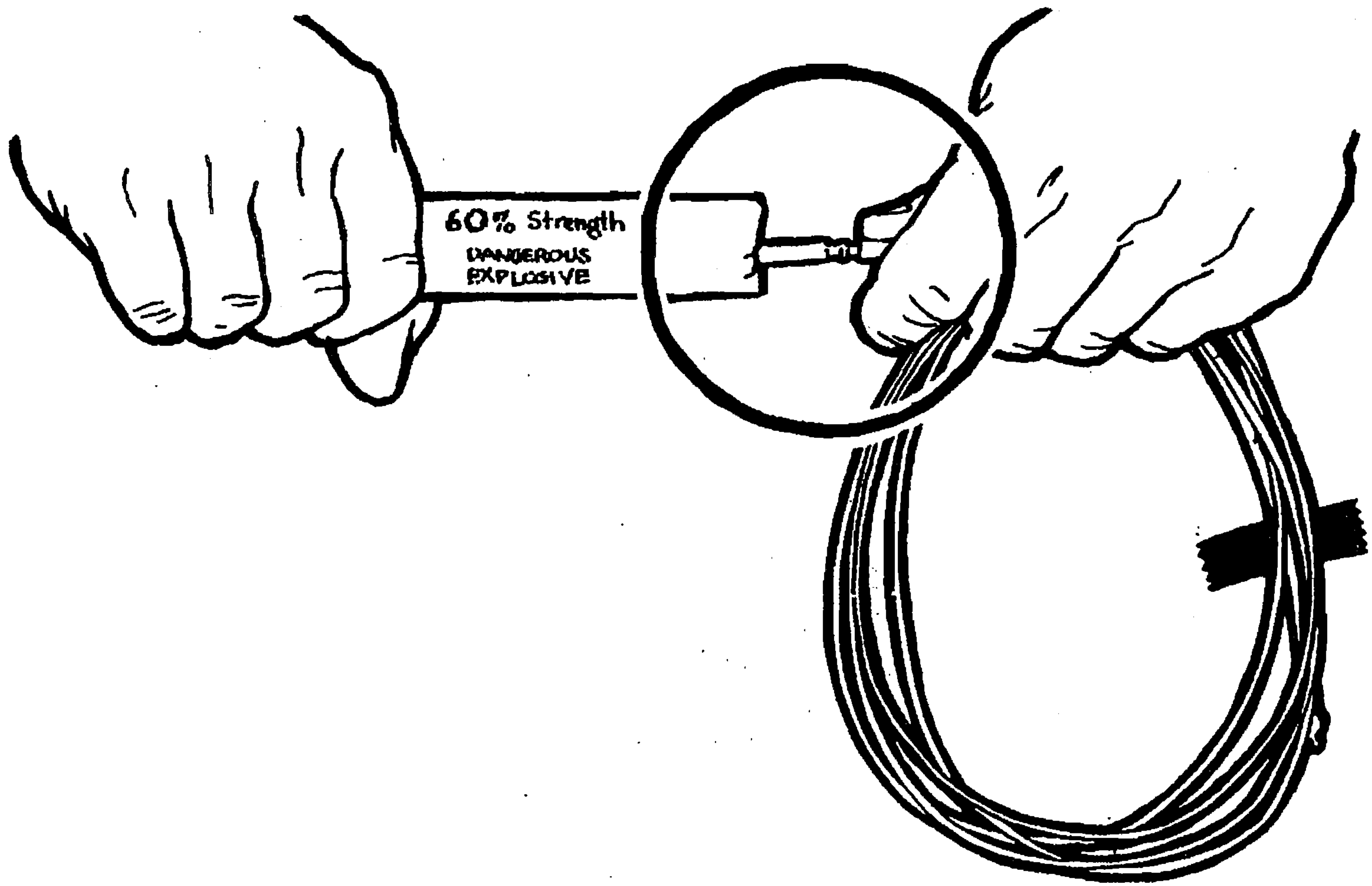
MISFIRES ARE DANGEROUS. AVOID MOVING THEM AND REPORT THEM IMMEDIATELY

VISUAL 28

LOOK OUT FOR LOST EXPLOSIVES



NON-ELECTRIC BLASTING CAP



VISUAL 55

DEEP METAL / NONMETAL

ANNUAL REFRESHER

PREPARED FOR THE U.S. BUREAU OF MINES

PITTSBURGH RESEARCH CENTER

UNDER CONTRACT #J0308011

WILLIAM WIEHAGEN, GROUP SUPERVISOR
JAMES TAVOULARIS, TECHNICAL PROJECT OFFICER

And Coordinated Through

JAMES USRY, EDUCATION SPECIALIST
MINE SAFETY AND HEALTH ADMINISTRATION

Principal Researchers:

JOHN ADKINS
PAUL KROES
MARY HINTON
JOHN NUSSBAUMER
DAVID LEONARD

BENDIX CORPORATION
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ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: HEALTH AND SAFETY ASPECTS OF TASKS TO WHICH ASSIGNED

I. GOAL: The goal of this module is to refresh the miner's understanding of specific health and safety hazards in the job and appropriate precautions when performing that job.

II. BACKGROUND: To the experienced miner the health and safety aspects of the assigned task may become a low priority item due to the constant exposure to the same environment each day. The miner may become accustomed to those hazards involved in his job. Refresher training will give the miner the knowledge and skills needed to avoid hazards and follow regulations dealing with them.

III. OBJECTIVES

A. Trainer will do the following:

1. Present health and safety hazards specific to tasks

2. Discuss specific mandatory health and safety standards that apply to tasks assigned

3. Discuss company policy that applies to the mandatory health and safety standards

B. Trainees will be able to do the following:

1. Describe health and safety hazards specific to tasks to be performed.

2. Identify applicable mandatory health and safety standards and discuss company policy as it relates to them

IV. MATERIALS AND RESOURCES

A. Visual Aids

B. Training Standards: CFR 30 Part 48.8-1

C. Applicable company policy

V. EVALUATION

A. Identify, describe or discuss:

   1. Health and safety hazards

   2. Mandatory standards and company policy

B. Self Check

   1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
   2. Eliminate the use of self checks if too difficult for your class.
   3. Change written self check items where necessary to fit your local mine situation.

TOPICS COVERED

I. Hazards involved in tasks assigned

   A. Potential accidents

      1. struck by falling rock
      2. burns from electrical equipment, fire, or hot metal
      3. falls caused by uncleaned spills or debris
      4. pinched or caught by machinery
      5. premature explosion or flying debris

   B. Potential health problems

      1. respirable dust
      2. toxic gases
      3. radon daughters

II. Techniques for avoiding hazards

   A. Precautionary measures with equipment
   B. Precautions used in blasting
   C. Personal protective equipment to be worn

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HEALTH AND SAFETY ASPECT OF TASKS TO WHICH ASSIGNED

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

I. DUTIES OF ASSIGNED TASKS

   A. Work station

      1. Location
      2. Transportation

   B. Tasks to be performed

      1. Skills training with equipment.
      2. Safe work procedures.

   C. Tasks which must be performed by others.

      1. Qualified, certified, or competent persons.
      2. Electrical repairs.
      3. Equipment maintenance.
      4. Use of explosives.

INSTRUCTOR'S NOTE: THE FOLLOWING POINTS ARE INTENDED TO GUIDE YOUR DISCUSSION OF HEALTH AND SAFETY ISSUES. YOU SHOULD EXPAND UPON THOSE ISSUES OF MOST RELEVANCE TO YOUR MINE.

II. HAZARDS INVOLVED IN ASSIGNED TASKS

   A. Potential accidents

      1. Struck by falling back or rib.
      2. Electrical shock.

3. Burns from electrical equipment, fire, or hot metal
4. Slips and falls from uncleaned spills, debris, or equipment.
5. Fingers or arms pinched or caught by machinery.
6. Premature explosion or flying debris.
7. Lifting techniques.

B. Potential health problems

1. Respirable dust

a. Nuisance dust has little permanent effect on lungs.
b. Fibrogenic dust such as asbestos (silica dioxide), quartz, and feldspar cause pneumoconiosis which can be fatal.

INSTRUCTOR'S NOTE: SEE THE MODULE ON HEALTH FOR SUPPLEMENTAL INFORMATION ON RESPIRABLE DUST

2. Toxic gases

a. Carbon monoxide from fires, explosions, and diesel engines.
b. Nitric oxide and nitrogen dioxide from diesel engines, electrical discharges, and explosives.
c. Sulfur dioxide from fires or explosions.

INSTRUCTOR'S NOTE: SEE THE MODULE ON MINE GASES FOR SUPPLEMENTAL INFORMATION ON TOXIC GASES.

3. Radon daughters

INSTRUCTOR'S NOTE: SEE THE MODULE ON HEALTH FOR SUPPLEMENTAL INFORMATION ON RADON DAUGHTERS.

C. Techniques for avoiding hazards.

1. Precautionary measures with equipment

INSTRUCTOR'S NOTE: REVIEW SAFETY HAZARDS ASSOCIATED WITH THE OPERATION OF PARTICULAR MINING EQUIPMENT.

2. Precautions used in blasting.

INSTRUCTOR'S NOTE: REVIEW SAFE WORK PROCEDURES ASSOCIATED WITH THE USE OF EXPLOSIVES.

3. Personal protective equipment

   a. hard hat
   b. respirators
   c. rubber gloves and boots for electrical repairs
   d. safety glasses
   e. ear plugs or muffs

III. MANDATORY HEALTH AND SAFETY STANDARDS FOR METAL AND NONMETALLIC UNDERGROUND MINES - Part 57

Sections of Part 55

Section	Title
57.1	Purpose and Scope
57.2	Definitions
57.3	Ground control
57.4	Fire prevention and control
57.5	Air quality and physical agents
57.6	Explosives
57.7	Drilling
57.8	Rotary jet piercing
57.9	Loading, hauling, dumping
57.10	Aerial tramways
57.11	Travelways
57.12	Electricity
57.13	Compressed air and boilers
57.14	Use of equipment
57.15	Personal protection
57.16	Materials storage and handling
57.17	Illumination
57.18	Safety programs
57.19	Man hoisting
57.20	Miscellaneous

INSTRUCTOR'S NOTE: HAVE MINERS LIST ALL THE POTENTIAL HAZARDS THAT MAY OCCUR WITHIN THEIR WORK AREA. DISCUSS WITH THE MINERS HOW THOSE HAZARDS MAY BE ELIMINATED. ASK THE QUESTION - WHICH OF THESE HAZARDS ARE REGULATION VIOLATIONS?

INSTRUCTOR'S NOTE: ASK THE MINERS TO ASSESS THE POTENTIAL SERIOUSNESS OF EACH HAZARD AS IT RELATES TO HEALTH AND SAFETY - BOTH SHORT TERM AND LONG TERM EFFECTS. STRESS THE IMPORTANCE OF REPORTING EACH HAZARD TO THE PROPER PERSON.

INSTRUCTOR'S NOTE: IN ORDER TO FAMILIARIZE MINERS WITH PART 57, YOU MAY WANT TO DISTRIBUTE COPIES OF PART 57 AND LEAD THEM THROUGH IT. AS AN AID, THERE ARE EXERCISES WITH THIS GUIDE DESCRIBING PROBLEM SITUATIONS FOR WHICH MINERS CAN LOCATE THE REGULATION THAT GOVERNS THE PROBLEM. YOU MAY WANT TO DEVELOP YOUR OWN EXERCISES BASED ON PARTICULAR SITUATIONS IN THE MINE.

EVALUATION NOTE: HAVE MINERS ANSWER SELF-CHECK NUMBER ONE AND/OR TWO. MINERS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE SELF CHECKS ON ALTERNATE YEARS. REVIEW ANSWERS AND CLARIFY INCORRECT RESPONSES. QUESTIONS CONCERN HEALTH AND SAFETY ASPECTS OF ASSIGNED TASKS.

SELF CHECK #1: SOLUTIONS

1. a, c, d

2. Answers may include hard hat, respirator, rubber gloves and boots for electrical repairs, safety glasses, ear plugs and muffs, etc.

3. answers will vary

4. answers will vary

SELF CHECK #2: SOLUTIONS

1. A. Accumulation of debris at belt. Hitching an unauthorized ride on a materials converyor. Not wearing protective equipment. Not notifying others. Not turning in an alarm.

   B. Answers may vary

   C. Yes

   D. Answers may vary.

2. A. No backup warning device on loader.

B. Steve should have checked around the loader before starting to work again. Rich should have notified Steve that he was working near the loader.

3. A. Carrying materials in such a manner as to obstruct view.

   B. Yes, trash pile left in hallway.

   C. Mike should have made two trips while carrying the boxes. Terry could have assisted Mike with the boxes or have observed and corrected Mike's performance.

4. A. Answers will vary

   B. Management must provide proper hearing protection equipment.

   C. Vince should have told his foreman that the protection provided was not comfortable and ask for an alternative protective device.

   D. If the noise level cannot be lowered by engineering efforts, management and employees should agree on hearing protection equipment that is comfortable and functional.

   E. Answers may vary.

5. A. Cleaned up the spill.

   B. Answers will vary.

6. A. Not wearing safety hat.

   B. Answers will vary.

7. See handout on proper lifting.

Exercise Number 1

A burnt out fuse needs to be quickly replaced but the switch box is 100 yards away. The current may be weak, and the fuse could be replaced by hand without de-energizing the circuit. What should be done? (Answer: Part 57.12-36).

Exercise Number 2

An electrician must climb a twenty-foot ladder on a light pole to replace a bulb. The bulb is larger but can be handled with one hand. Should he carry it by hand or use some sort of bag? (Answer: Part 57.11-11)

Exercise Number 3

A new mechanics helper shows up for work wearing athletic shoes. Should he be permitted to work? (Answer: Part 57.15-3)

Exercise Number 4

You need to get off the man trip at an undesignated discharge point. The only way you can get off is to jump while the man trip is moving. What should you do? (Answer: Part 57.9-114).

Self Check #1: Health and Safety Aspects of Assigned Tasks

1. Circle all of the situations below where you would call in a trained or certified person to repair something at your mine.

   a. You accidentally run over an electric cable with your forklift, cutting it almost in half.

   b. You trip over a can of motor oil while checking a dipstick.

   c. While warming up the engine you notice the temperature gauge is broken on your Euclid 100.

   d. You find a blasting cap near the powder magazine.

2. List all items of personal protective equipment used at your mine.

3. Circle each of the following that is a potential hazard at your mine.

   a. electrical shock

   b. injury from falling highwall

   c. burns from electrical equipment, fire, or hot metals

   d. premature explosion or flying debris

   e. slips and falls from uncleaned spills and debris

4. Discuss ways of avoiding hazards at your mine.

Self Check #2

1. Karl was working at the conveyor when he noticed smoke rising from the belt approximately 100 yards away from his position. Not wanting to walk to the site to investigate or turn in an alarm, Karl decided to hitch a ride on the conveyor. Throwing down his shovel and gloves, Karl jumped on the conveyor with the moving ore. As he neared the site of the smoke, Karl realized that he could not safely get off until he reached the smoldering portion of the belt line. As he approached the area, Karl grabbed the edge of the belt to jump off and got his hand caught between the belt and roller bearing which was extremely hot. Not only did he receive a crushing injury, but compounded it with a severe burn. An investigation of the accident and fire revealed the fact that an accumulation of debris coupled with friction caused the fire.

   A. What violations of CFR 30 can you find in this accident?

   B. How should Karl have handled this situation?

   C. Was this a preventable hazard and accident?

   D. Is it possible for this type of accident to happen at our mine?

2. Steve was operating a loader when he noticed a hand shovel lying in the area. Stopping the loader, Steve got out and moved the shovel when he returned to his loader and backed it up, Steve pinned Rich between the loader and the rib. Rich has been cleaning up debris with the hand shovel, but stopped to take a break and was returning to work when crushed.

   A. Was there a possible safety violation here?

   B. What could Steve and/or Rich have done to avoid this mishap?

3. Terry had to transport several boxes of supplies to the face area. He had just been appointed acting foreman and decided to practice his new role. Terry told Mike to carry the boxes to a scoop. Mike, a new miner, was eager to impress his foreman and decided to carry two boxes at the same time? By stacking the boxes, Mike obstructed his view directly in front of his direction of travel. He tripped over a pile of trash in the aisle, fell and sprained an ankle and hurt his back.

   A. What safety aspect had either not been stressed enough in new miner training or had been ignored by Mike?

   B. Were there any safety violations involved?

   C. What could the acting foreman and the new miner have done to prevent this accident?

4. Vince was assigned to work near the conveyor hopper. The noise level was intense. At the end of each shift Vince's ears were ringing and he complained to his wife about a temporary hearing loss. Vince had been instructed by his foreman to wear ear plugs but he found them uncomfortable.

   A. If you had a similar problem, what would you do?

   B. What was managements responsibility?

   C. What was Vince's responsibility?

   D. How could a compromise in noise level exposure and/or hearing protection devices be reached?

   E. Where in our operation is this a potential health hazard?

5. Jack had to add hydraulic fluid in the equipment he was operating. In the process of pouring the fluid in the machine, Jack spilled approximately a quart on the floor. Sam, who was walking by about thirty minutes later with a heavy tool box in hand slipped on the fluid and fell breaking his wrist.

   A. What should Jack have done?

   B. List some similar hazards that you have noted in the mine.

6. John was repairing the continuous miner near the face area. His safety hat seemed to get in the way so he removed it. During the course of the repair job, several rocks fell and one of them struck John on the head rendering him unconscious.

   A. What was the safety violation?

   B. List those times when you removed your safety hat for any length of time.

7. List the steps you would follow in lifting a heavy object.

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

TRANSPORTATION CONTROLS AND COMMUNICATION SYSTEMS

1981

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ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: TRANSPORTATION AND COMMUNICATIONS

I. GOAL: The goal of this module is to insure that the miner can use the mine's transportation and communications systems safely and effectively.

II. BACKGROUND: Accidents related to motion of powered haulage transportation equipment including conveyors, rail cars, scoop/tractor and personnel conveyances occur often, resulting in fatalities periodically and days lost from work frequently. Annual refresher training is one strategy for preventing transportation accidents and for reviewing procedures for using the communications system safely and effectively.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe hazards involved in transportation systems and appropriate safety measures to be taken.
2. Demonstrate communication signals and signs used in the mine.

B. Trainees will be able to do the following:

1. Describe each hazard involved in transportation and appropriate safety measures to be taken.

2. Respond to correct meaning when presented with signs and signals used in mine.

IV. MATERIALS AND RESOURCES

A. Visual aids

1. Mine conveyances.
2. Outline of signaling system.
3. Outline of warning signals.

B. Resources

1. Training standards: CFR 30 Part 48.8-2

2. Company policies regarding transportation and communication.

V. EVALUATION

A. Discuss, describe or demonstrate:

1. Communications system
2. Procedure for using transportation system, hazards, and appropriate safety measures

B. Self Check

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self checks if too difficult for your class.
3. Change written self check items where necessary to fit your local mine situation.

TOPICS COVERED

I. Hazards involved in transportation system

A. objects protruding from ribs and roof

B. falling out of or off moving equipment

C. injury to body parts hanging out of trip and hitting rib or other object

D. flying objects when equipment stops suddenly, derails, or is involved in a collision

E. body parts touching electrical power sources

F. collison due to excessive speed

G. collision due to not seeing other vehicle or people walking

H. injury to eyes or lungs from dust

II. Communcation system signals

A. Equipment signals

1. backing-up signal
2. bells on motors
3. equipment status signals

B. Mine emergency warning signals

1. warning signals: stench canisters and alarms
2. Escapeway marking signs.

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: TRANSPORTATION; COMMUNICATION

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO SKIP THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

I. MINE TRANSPORTATION SYSTEM HAZARDS

A. Objects protruding from the ribs or roof, such as rock, timber, or pipes.

B. Falling out of or off moving equipment due to recklessness, bumps, quick stops or horseplay.

C. Injury to head, arms, hand or legs, that are hanging out of the trip and hit a rib or other object.

VISUALS NOTE: SHOW VISUAL 4 ILLUSTRATING WITH THE MINER'S HEAD CAUGHT BETWEEN A LOCOMOTIVE AND AN ORE PASS, AND/OR VISUALS ILLUSTRATING THE MINER'S ARM CAUGHT BETWEEN MAN CAR AND RIB TIMBER.

D. Equipment and tools sticking out of car or cage during transport.

VISUALS NOTE: SHOW VISUAL 51 ENTITLED "SECURE LOOSE MATERIAL".

E. Flying objects, such as lunch pails, tools, or rock, when the trip stops suddenly, derails, or is involved in a collision.

F. Body parts hanging out of trip and making contact with an electrical power source.

G. Collision of trip due to excessive speed and subsequent loss of control or brake failure.

H. Collision of trip with other vehicle or striking person due to poor visibility or inattention.

I. Injury to eyes or lungs from dust or small particles.

INSTRUCTOR'S NOTE: MENTION TO THE STUDENTS THE AVAILBILITY OF RESPIRATOR FILTERS FOR PROTECTION FROM DUST. USE OF FILTERS IS MORE THOROUGHLY DISCUSSED IN THE TRAINING MATERIALS ON SELF-RESCUE AND RESPIRATORY DEVICES.

EVALUATION NOTE: HAVE MINERS ANSWER SELF-CHECK NUMBER ONE AND/OR THREE. MINERS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE THE SELF CHECKS ON ALTERNATE YEARS. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN THE MINE TRANSPORTATION SYSTEM.

II. MINE COMMUNICATION SYSTEM.

A. Mine communications are important for routine messages. Requests for supplies or assistance with operational problems save time when done over an efficient communications system. In the case of accident or other emergency, people in the mine must be able to tell people on the surface what happened so that proper measures can be taken quickly.

INSTRUCTOR'S NOTE: REMIND MINERS THAT ACCURATE SIGNALING IS NECESSARY FOR SAFE AND EFFICIENT COMMUNICATION .

B. Equipment signals are signals mounted on equipment to warn the operator or others of some particular condition of the vehicle.

1. Backing-up signals warn others that the vehicle is in reverse gear and that they should immediately move out of its way.

2. A bell may sound when a motor starts up.

3. Equipment status signals inform the operator of critical status levels of various components of the equipment, such as low oil or hydraulic pressure.

C. Mine emergency warning signals alert miners to immediately initiate mine evacuation procedures.

1. Warning signals inform miners of the emergency, and can be of two types.

a. Stench canisters containing a smell of rotten eggs.
b. Alarms located throughout the mine.

2. Another important emergency signal is the escapeway marking signs located throughout the mine. Their directional information guides miners through the escapeways system.

EVALUATION NOTE: HAVE MINERS ANSWER SELF CHECK NUMBER TWO AND/OR FOUR. MINERS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE THE SELF CHECKS ON ALTERNATE YERAS. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN THE MINE COMMUNICATION SYSTEM.

ANSWERS TO SELF CHECK #1

1. false
2. false
3. true
4. true
5. false
6. false
7. true
8. false
9. true

ASNWERS TO SELF CHECK #2

1. false
2. false
3. true
4. false
5. false
6. false
7. true
8. true

ANSWERS TO SELF CHECK #3

1. a. He should not have taken tools on the man-trip with him.

   b. Answers will vary according to form of transportation.

2. a. Personnel transportation vehicles must not be overcrowded. Never hang arms, head, etc. out of transportation vehicle.

3. Answers will vary.

4. true

5. false

ANSWERS TO SELF CHECK #4

1. a. Answers will vary
2. a. Answers will vary
3. a. Answers will vary
4. a. Yes

SURFACE

SELF CHECK: TRANSPORATION CONTROLS AND COMMUNICATION SYSTEMS

SELF CHECK #1: TRANSPORTATION SYSTEM AND ITS HAZARDS (true or false)

_____ 1. It is alright to ride on top of loaded haulage equipment.

_____ 2. Personnel may ride a bucket conveyor that is specifically designed for carrying ore.

_____ 3. When an operator is present, men must notify him before getting on or off equipment.

_____ 4. Crowding personnel on a vehicle used to transport men to and from work areas may save time and money by requiring fewer trips but is a hazard and must be avoided.

_____ 5. Costing a piece of heavy mobile equipment is safe as long as the clutch is pushed in.

_____ 6. Personnel may cross over moving conveyors at any point so long as they cross cautiously and safely.

_____ 7. Guards should be placed over tail and takeup pulleys on conveyor belts even if they make cleanup of fallen material difficult.

_____ 8. As long as ore cars are stationary you may cross between them.

_____ 9. Transporting explosives requires special preparations such as lining the vehicle's storage space with wood or rubber floor matting.

SELF CHECK #2: MINE COMMUNICATION SYSTEM (true or false)

______ 1. The main reason the mine provides 2-way communication at various places in the mine is to speed requests for supplies and maintenance.

______ 2. Radio communciations are the quickest and safest means of relaying information because they never present hazardous conditions.

______ 3. A miner should never work in a hazardous area when he cannot be seen by others or is unable to communicate with others.

______ 4. Back-up signals are used to inform the driver that his vehicle is in reverse gear.

______ 5. When an equipment alarm, gauge or light indicates low brake pressure, the driver should alert his supervisor and continue operating the vehicle until maintenance arrives.

______ 6. As long as there is no immediate hazard, a malfunctioning fire alarm on a conveyor belt can be locked out.

______ 7. The blasting alarm is always sounded before the blast to warn others to stand clear.

______ 8. When a mine evacuation signal is sounded in the mine, personnel should stop all work and proceed to leave the mine but only after making sure others in their area also heard the alarm.

SELF CHECK #3

1. Irvin was riding in a closed man-trip (trolley) and decided to carry a new scaling bar with him. When Irvin reached to his work area and the trolley stopped, he got out on the tight side and his scaling bar touched the wire - electrocuting him?

   a. What rules did Irvin violate?

   b. List the rules for entering and leaving your mine transportation system.

2. Cal and two of his friends were the last three miners to leave the portal for their assigned work areas. They crawled into an already over crowded man-trip. Cal had to hang his arms out the side to be able to sit down. As the vehicle made its way down in the mine, Cal's arm was crushed between a rib and the vehicle.

   List the violations found here.

3. List the equipment traveling the same route as your man-trip that you cannot legally ride as a passenger.

4. Track haulage equipment must be operated under power control at all times. (true, false)

5. Backpoling of trolley is strictly illegal. (true, false)

SELF CHECK #4

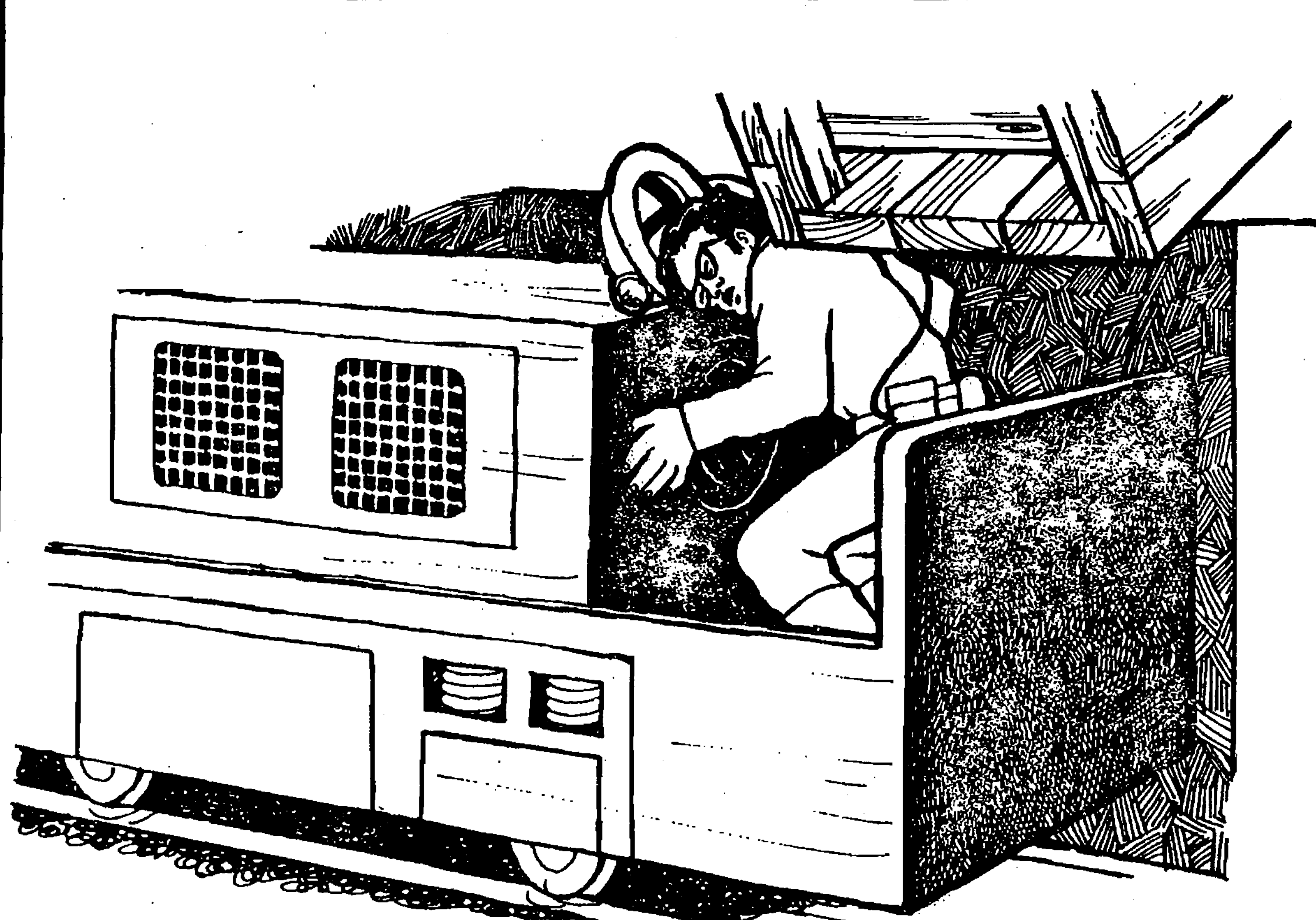
1. You are near the face area when the blasting warning signal is sounded. According to your company policy, what should you do?

2. The evacuation alarm is sounded in the mine. List the steps (in order) and route to be taken according to the company plan.

3. List the location of phones nearest your work area.

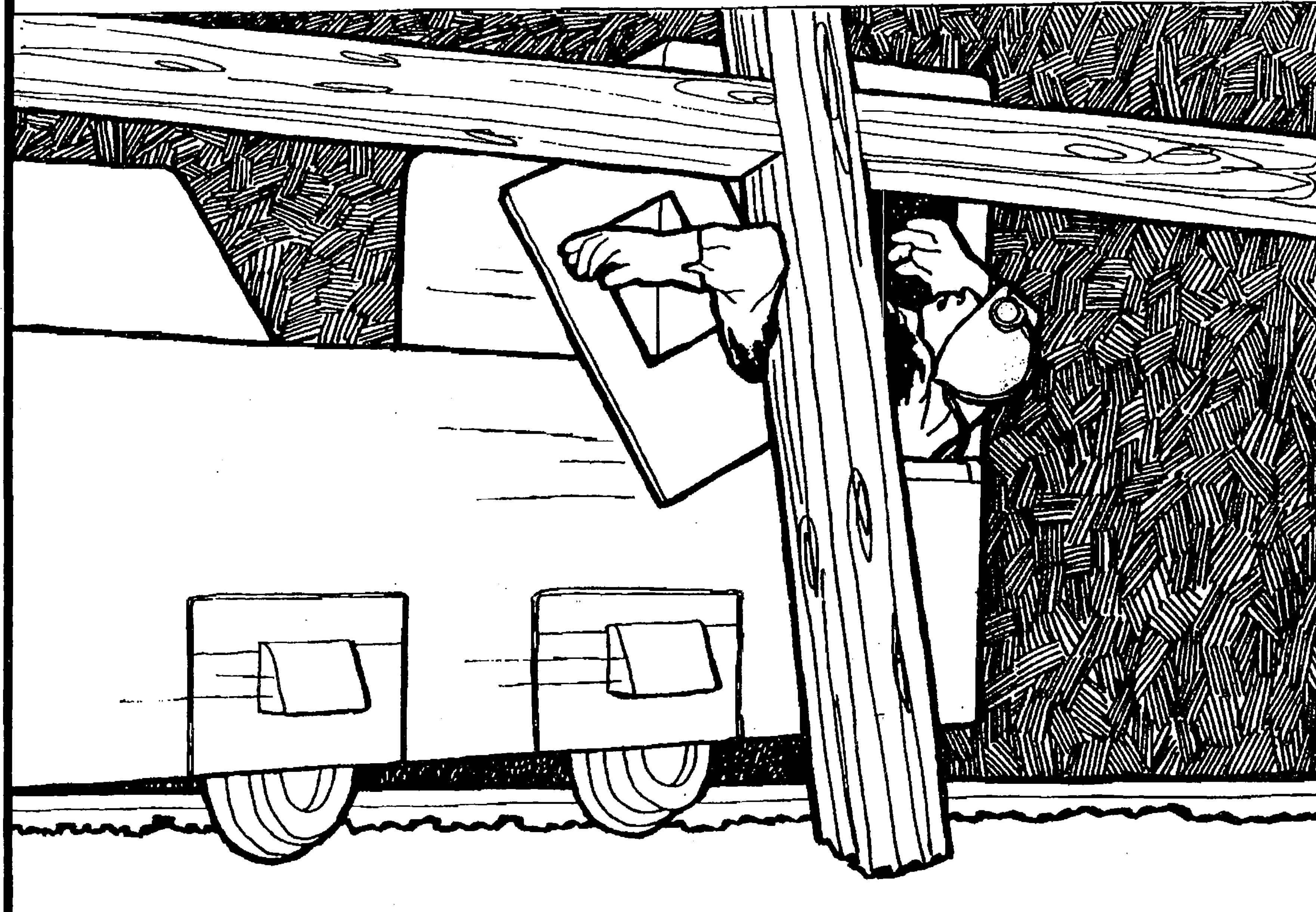
4. Is each type of powered transportation vehicle required to have a warning device for start up?

FACE IN DIRECTION OF TRAVEL



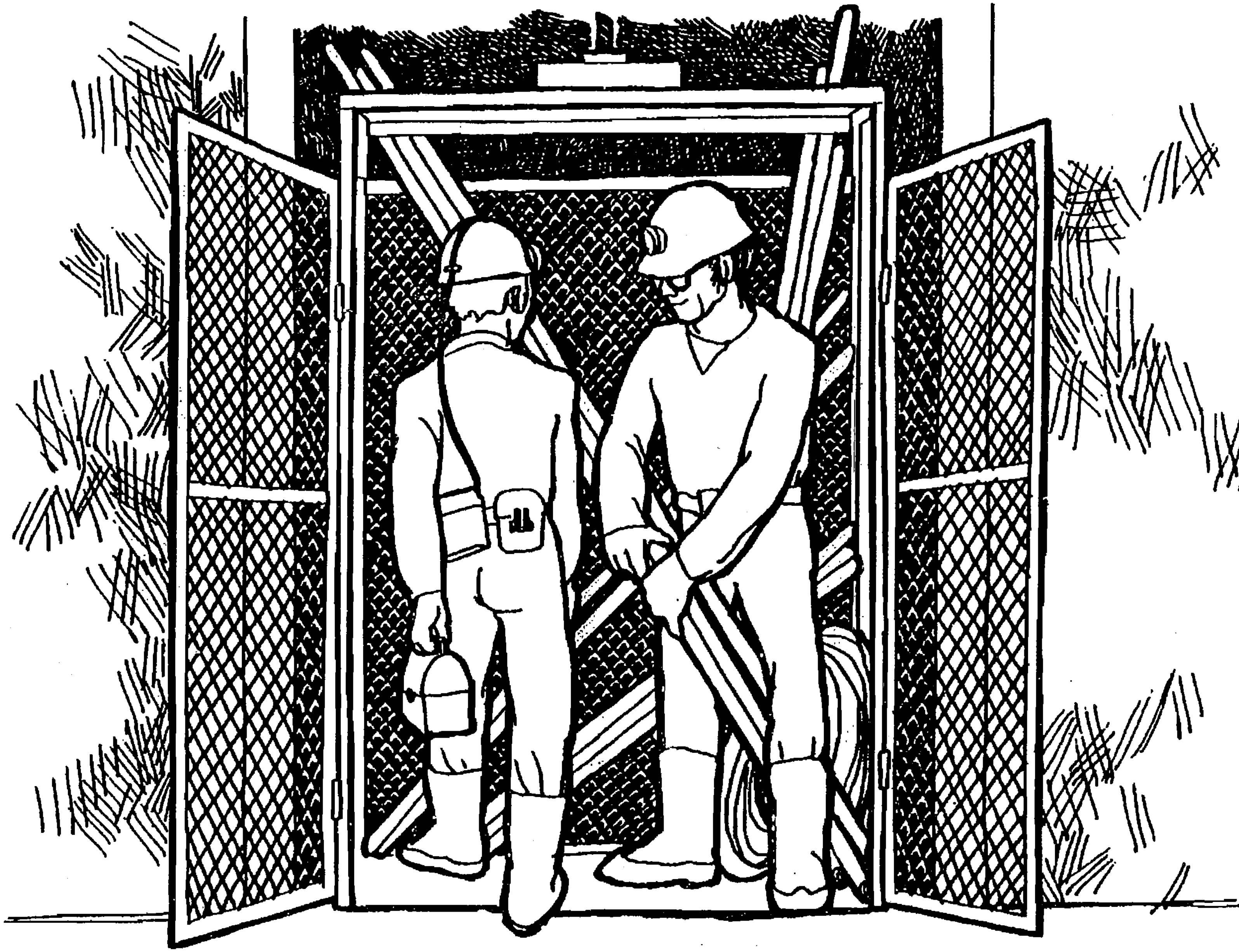
VISUAL 4

KEEP ARMS AND HEAD INSIDE



VISUAL 5

SECURE LOOSE MATERIALS



ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

BARRICADING

1981

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ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: BARRICADING

I. GOAL: The goal of this module is to refresh the miner's understanding of how and when to barricade.

II. BACKGROUND: In certain mines barricading may be feasible while in other deep metal mines barricading may not be a viable alternative. Depending on your mine situation, you may want to spend time refreshing the miners in other methods of survival such as evacuation. The fact that disasters are infrequent in underground metal/nonmetal mines does not negate the need for escape training.

III. OBJECTIVES

A. Trainer will do the following:

1. Discuss when to barricade.

2. Describe procedures to follow in barricading.

B. The trainees will be able to do the following:

1. Identify circumstances when barricading is appropriate.

2. Locate on the mine map or during mine tour good places to barricade.

3. Choose from a box of many assorted mining items those most useful during the barricading process.

IV. MATERIALS AND RESOURCES

A. Visual aids

B. Company map and emergency evacuation plan

C. Training standards

1. CFR 30 Part 48.8-b3
2. CFR 30 Part 57.11-50, 53

V. EVALUATION

A. Demonstrate, describe or identify:

B. Self Checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self check items where necessary to fit your local mine situation.

TOPICS COVERED

A. When to barricade

B. How to barricade

1. choosing a site
2. materials for barricading
3. sealing airways
4. waiting inside barricade.

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: BARRICADING

I. COURSE OVERVIEW

A. When to barricade

B. How to barricade.

II. WHEN TO BARRICADE

INSTRUCTOR NOTE: THE TRAINER SHOULD WEIGH THE EMPHASIS ON BARRICADES WITH THE COMPANY EMERGENCY EVACUATION POLICY AND THE PRACTICALITY OF BARRICADING AT HIS MINE. IN ANY GIVEN MINE BARRICADING MAY NOT BE A POSSIBLE OR EVEN DESIRABLE RESPONSE TO AN EMERGENCY. THE SAFETY AND TRAINING STAFF SHOULD EXPLORE THE UTILITY OF BARRICADING WITH OTHER COMPANY PERSONNEL AND WITH STATE AND FEDERAL MINE INSPECTORS TO FORMULATE AN APPROPRIATE EMERGENCY RESPONSE FOR THE MINE.

A. Under most circumstances when an evacuation of the mine is called for, all underground miners should be about to escape. However, if an explosion or fire is serious enough, all escapeways may become blocked. When you are certain that all possible escapeways are closed off to you, you have no other choice but to build a barricade to prevent noxious or poisonous gases from reaching you.

B. Barricading means building airtight bulkheads or stoppings to enclose a large quantity of relatively fresh air and to keep any poisonous gases out while you wait for rescue.

C. Some underground mines have refuge centers that double as lunch rooms. By closing off the center completely, you can seal the smoke out. Air and water valves may be available in the refuge center. Some mines have two air doors located close together. Located between these doors may be a red fire seal box containing burlap, nails, hammer, candles, matches, pipe wrench and an ax, all of which can be used to seal out smoke.

III. HOW TO BARRICADE

A. The purpose of a barricade is to form an airtight refuge chamber that keeps fresher air in and smoke and gases out. The following is a list of factors to be considered in building a barricade.

1. Keep the air in your chamber as free of contaminates as possible. Choose an area in which you can short-circuit the ventilation as soon as possible to keep noxious gases from entering the area. It may be necessary to open doors, destroy doors, or stoppings, etc.
2. The size of the enclosed space determines the number of men the barricade will shelter and the length of time they can remain there safely. As much area as possible containing fresh air should be sealed off. In general, barricade as large a space as possible with the fewest barricades necessary. Often there may be only time to erect one permanent barricade which may take from 30 minutes to 2 hours to build, depending on conditions.
3. Try to barricade at any available borehole. A good barricade at a borehole helps assure a safe refuge because air, food, and communications can pass through the borehole to the trapped miners.
4. Back-filled ground should not be used because gases are likely to pass right through it. Remember, for your chamber to be effective, all openings into it must be sealed.
5. Remember, in many instances there may be a general power failure. Water pumps and ventilating fans won't work, so don't barricade in areas where water might accumulate or where certain gases might settle.
6. It would be good if the area you choose to barricade also has air or water lines.
7. Do not build your barricade in an area connected or next to mined out or caved-in areas.

B. You should write on the outside of both the temporary and permanent barricades the date, time, and number of men inside the chamber. This will tell the rescue team what materials they will need when they break through the barricade.

C. Waiting inside the barricade.

1. The leader should space the miners throughout the refuge area. You should rest to conserve oxygen. (You can use up more than ten times as much oxygen when you are active.) Cooperation with the leader is of the upmost importance.

2. Air in an enclosed space doesn't circulate and can get stale. Someone should periodically stir the atmosphere. This person should check the condition of each miner. Also, the barricade should be checked regularly for leaks.

3. You don't know how long you will have to wait to be rescued so the leader should collect all lunch pails and then ration the food and water.

4. Leader should be ready with a list of names and any injuries to report when rescue party appears.

5. Remember, only the mine rescue party should open a barricade. The immediate concern of mine rescue is to find miners not protected by adequate barricades. They'll return soon to free your barricaded group.

INSTRUCTOR NOTE: PRESENT TO EACH MINER A MINE MAP WITH NUMBERED LOCATIONS SUCH AS ESCAPE ROUTES, ELECTRICAL STATIONS, BATTERY CHARGING STATIONS, EXPLOSIVE MAGAZINES, ETC. YOU ALONE WILL HAVE THE DESCRIPTIONS OF EACH LOCATION AND ITS PART IN THE SCENARIO. CONDUCT AN ESCAPE EXERCISE OF A REALISTIC DISASTER. AS THE MINERS MOVE TOWARD ESCAPE THROW IN A ROAD BLOCK SUCH AS AN EXPLOSION AT THE CHARGING STATION, ETC. CONTINUE THIS UNTIL THERE IS ONLY ONE AVAILABLE ESCAPE ROUTE. IF BARRICADING CAN BE USED IN YOUR MINE BLOCK ALL POSSIBLE ESCAPEWAYS AND HAVE THE MINERS VERBALLY CONSTRUCT A BARRICADE, OR CONSTRUCT AN ACTUAL BARRICADE IN OLD WORKINGS.

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

GROUND CONTROL AND VENTILATION PLANS

1981

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ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: GROUND CONTROL AND VENTILATION PLANS

I. GOAL: The goal of this module is to refresh the experienced miner with the importance and methods of maintaining a safe and healthful workplace with respect to ground control and ventilation.

II. BACKGROUND: Ground control and ventilation hazards are widespread in underground mines. A large percent of the accidents involving ground control and ventilation result in fatalities or lost time from work. Refresher training in these hazards is critical in that the entire work force of a particular mine can be exposed to these hazards and thus need to be reminded to take appropriate safety precautions.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe the purpose of ground control and causes of ground failure.

2. Identify responsibilities for ground control by management and miners.

3. Discuss mine ventilation plans and ventilation hazards.

B. Trainees will be able to do the following:

1. Describe the purpose of ground control and causes of ground failure.

2. Identify responsibilities for ground control by management and miners.

3. Discuss mine ventilation plans and describe ventilation hazards.

IV. MATERIALS AND RESOURCES

A. Training and Enforcement Standards

1. CFR 30 Part 48.8-4
2. CFR 30 Part 57.5-1 through 6, 15, 16

B. Films

1. MSHA Film N. 807 - "Rock Bolting Safety"
2. DuPont - "The Right Way"

V. EVALUATION

A. Discuss, describe or identify ground control and ventilation plans and hazards.

B. Self Check.

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self checks if too difficult for your class.
3. Change written self check items where necessary to fit your local mine situation.

TOPICS COVERED

I. Purpose of ground control

A. Minimum protection from ground failure

B. Causes of ground failure

1. loose rock
2. large boulders
3. roof arches
4. type of rock
5. sag of back
6. seeping water
7. rock bursts
8. adjacent blasting
9. adjacent caving
10. load redistribution on back
11. rock fractures or faulting
12. rock vibrations from adjacent work
13. failure of back support devices
14. gouging of back by mining equipment

C. Testing back and rib for loose rock

1. sounding of back and rib
2. barring or scaling back or ribs
3. safe work habits while barring down

II. Responsibilities for ground control

A. Responsibility of management and supervision

1. routine inspections of back and ribs
2. testing torque of rock bolts

B. Responsibility of miners

1. identifying and reporting hazardous back
2. safe work habits

III. Mine ventilation plans

A. Purpose of ventilation

1. supply oxygen
2. remove harmful contaminants

B. Ventilation hazards

1. Testing amount of oxygen in the air
2. miner reactions to loss of ventilation

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: GROUND CONTROL AND VENTILATION PLANS

I. PURPOSES AND POLICIES REGARDING GROUND CONTROL

A. Provide protection from ground failure.

B. Company policy for ground control at the mine.

INSTRUCTOR NOTE: PROVIDE A DESCRIPTION OF COMPANY POLICY FOR ROOF CONTROL METHODS AND PROCEDURES AT THE MINE. IF THE MINE HAS INTRODUCED A NEW METHOD OF ROOF CONTROL YOU MAY WANT TO COVER IT IN DETAIL.

II. Causes of ground failure

1. Loose rock
2. Large boulders
3. Roof arches
4. Type of rock
5. Roof sag
6. Seeping water
7. Rock bursts
8. Adjacent blasting
9. Adjacent caving
10. Roof load redistribution
11. Rock fractures or faulting
12. Rock vibrations from adjacent work
13. Failure of roof support devices
14. Gouging of roof by mining equipment

INSTRUCTOR NOTE: IF ANY OF THE ABOVE CAUSES ARE PROMINENT PROBLEMS AT THE MINE, DISCUSS THAT PROBLEM IN MORE DETAIL. REVIEW ANY ACCIDENTS AT YOUR MINE THAT OCCURRED WITHIN THE LAST YEAR AND HOW THE GROUND WAS CORRECTED.

III. METHODS IN GROUND CONTROL

A. Testing roof or back and rib for loose rock

1. Loose rock gives off a hollow or dull sound when hit with a hammer or scaling bar, compared to a solid ring of sound roof. Loose rock is also detected by visual inspection of protruding rock, cracks, and deteriorating pillars. Skill in identifying loose rock requires practice.

2. The method of removing loose rock from the back, or rib is called barring down or scaling down. A metal pry bar called a scaling bar is used.

VISUALS NOTE: SHOW THE DRAWING OF A MINER SAFELY BARRING DOWN LOOSE ROCK FROM THE ROOF.

3. Safe work habits while barring down.

   a. Stand under a safe area, preferably one already tested for loose rocks.
   b. Do not stand directly beneath the loose rock which you are barring down. Pry away from you rather than toward you.
   c. Assure yourself a safe route of retreat. Do not put your back up against the rib because you may become trapped.
   d. Often more roof will come down than you might expect.

VISUALS NOTE: SHOW THE DRAWINGS OF SAFE AND UNSAFE METHODS OF BARRING DOWN. ASK THE MINERS TO POINT OUT THE UNSAFE CONDITIONS IN THAT DRAWING.

IV. RESPONSIBILITIES FOR ROOF AND GROUND CONTROL

A. Responsibilitiy of management and supervision

1. Routine inspections of roof to identify hazards.

2. Routine testing of torque on roof bolts.

B. Responsibility of miners.

1. Identifying hazardous roof conditions and reporting these to supervision.

2. Follow safe work habits and follow proper installation and inspection procedures when roof bolting.

V. OVERVIEW OF MINE VENTILATION PLANS

A. Purpose of ventilation

B. Ventilation hazards

VI. PURPOSE OF VENTILATION

A. Ventilation has a direct effect on the health and safety of miners. Good clean air is essential for physical comfort and a safe work area. People work best in areas where oxygen represents at least 20% of the air they breathe.

B. Ventilation is necessary for diluting, rendering harmless, and carrying away all hazardous and harmful contaminants, including:

1. Gases from explosives
2. Equipment exhaust fumes
3. Dust
4. Smoke and carbon monoxide
5. Gases produced in the mine

VII. VENTILATION HAZARDS

A. Federal regulation part 57.5-15 requires mine air to contain at least 19.5% oxygen. Oxygen tests are routinely made accordingly.

B. Any major change in ventilation that you discover should be reported to your supervisor who will investigate for possible open doors or other ventilation obstructions.

EVALUATION NOTE: HAVE TRAINEES ANSWER TWO OF THE REFRESHER SELF-CHECKS. SELF-CHECKS ONE, TWO AND THREE CONCERN GROUND CONTROL, AND FOUR AND FIVE CONCERN VENTILATION. TRAINEES MAY ANSWER INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE SELF CHECKS ON ALTERNATE YEARS. REVIEW ANSWERS AND CLARIFY INCORRECT RESPONSES.

SELF CHECK #1: SOLUTIONS

1. Possible answers: loose rock, large boulders, roof arches, type of rock, roof sag, seeping water, rock bursts, adjacent blasting, adjacent caving, roof load redistribution, rock fracture, rock vibrations from adjacent work, failure of roof support devices, and gouging of roof by mining equipment.

2. hollow or dull sound (compared to a solid ring of sound roof.)

3. a. Stand under a safe area
   b. Pry away from you - don't stand directly beneath loose rock you're barring down.
   c. Assure yourself a safe route of retreat.

4. a. t
   b. t
   c. p
   d. t
   e. p
   f. t
   g. p
   h. t
   i. p
   j. p

5. a. III
   b. V
   c. IV
   d. II
   e. I

SELF CHECK #2: SOLUTIONS

1. S
2. M
3. M
4. S

SELFCHECK #3: SOLUTIONS

1. a. Answers may include - Protect eyes make good visual inspection and then make examination under supported roof. Never turn your back on the face or ribs. Examine roof frequently while working. Turn off machinery during testing. Use a long testing tool or sturdy bench for testing high places. Never assume someone else has made the tests. If unsafe, immediately notify your supervisor.
2. True
3. True

SELF CHECK #4: SOLUTIONS

1. True
2. False
3. False
4. True
5. True
6. True

SELF CHECK #5: SOLUTIONS

1. **True**
2. **True**
3. **True**
4. **True**
5. **False**

Self Check: Ground Control and Ventilation Plans

Self Check: #1: Purposes and Methods of Roof Control

1. Name at least 8 causes of ground failure

   a. e.

   b. f.

   c. g.

   d. h.

2. Describe the sound loose rock gives off when hit with a hammer.

3. Three safe work habits while barring down are:

   a.

   b.

   c.

4. Place the proper letter in front of the following types of supports to indicate: T: temporary supports, and P: permanent supports.

_____a.	screw type jacks	_____f.	stulls
_____b.	hydraulic jacks	_____g.	suspension method
_____c.	beam method	_____h.	forepoling
_____d.	spilling	_____i.	trusses
_____e.	wire matting	_____j.	concrete

5. Match column A with the correct column B response.

_____a.	split set	I. keeps moisture from the rock
_____b.	yieldable arches	II. place smaller 3-piece sets of timber above one another
_____c.	lagging	III. a hollow bar with 1 inch gap is squeezed into drill hole
_____d.	cribbing	IV. 2 steel braces against the ribs and 2 curved to fit arch of roof
_____e.	shortcrete	V. used to join posts on same side of the rib.

Self Check #2: Responsibilities for Ground and Roof Control

Place the proper letter in front of the following tasks to indicate: S responsibility of supervision and management, or M responsibility of miner.

_____1. Routine inspections of roof to identify hazards

_____2. Identifying hazardous roof conditions and reporting these to supervision.

_____3. Follow proper installation procedures when roof bolting.

_____4. Routine testing of torque on roof bolts.

Self Check #3: Ground Control

1. List five safety points to remember when roof testing.

2. It is often better to scale loose material rather than support it. (True, False)

3. Roof supports can be either temporary or permanent (True, False)

Self Check #4: Mine Ventilation

1. Ventilation dilutes, renders harmless, and carries away gasses, dust, exhaust fumes, and smoke and carbon monoxide. (true, false)

2. Mine resistance refers to the reluctance of miners to return to work after lunch. (true, false)

3. Man doors remain open while mine doors are kept closed. (true, false)

4. Intake refers to fresh air brought into the mine. (true, false)

5. Booster fans may be required to supply supplemental ventilation to each work area. (true, false)

6. Major changes in ventilation may be caused by open doors or obstructions, and should be reported to your supervisor. (true, false)

Self Check #5: Mine Ventilation

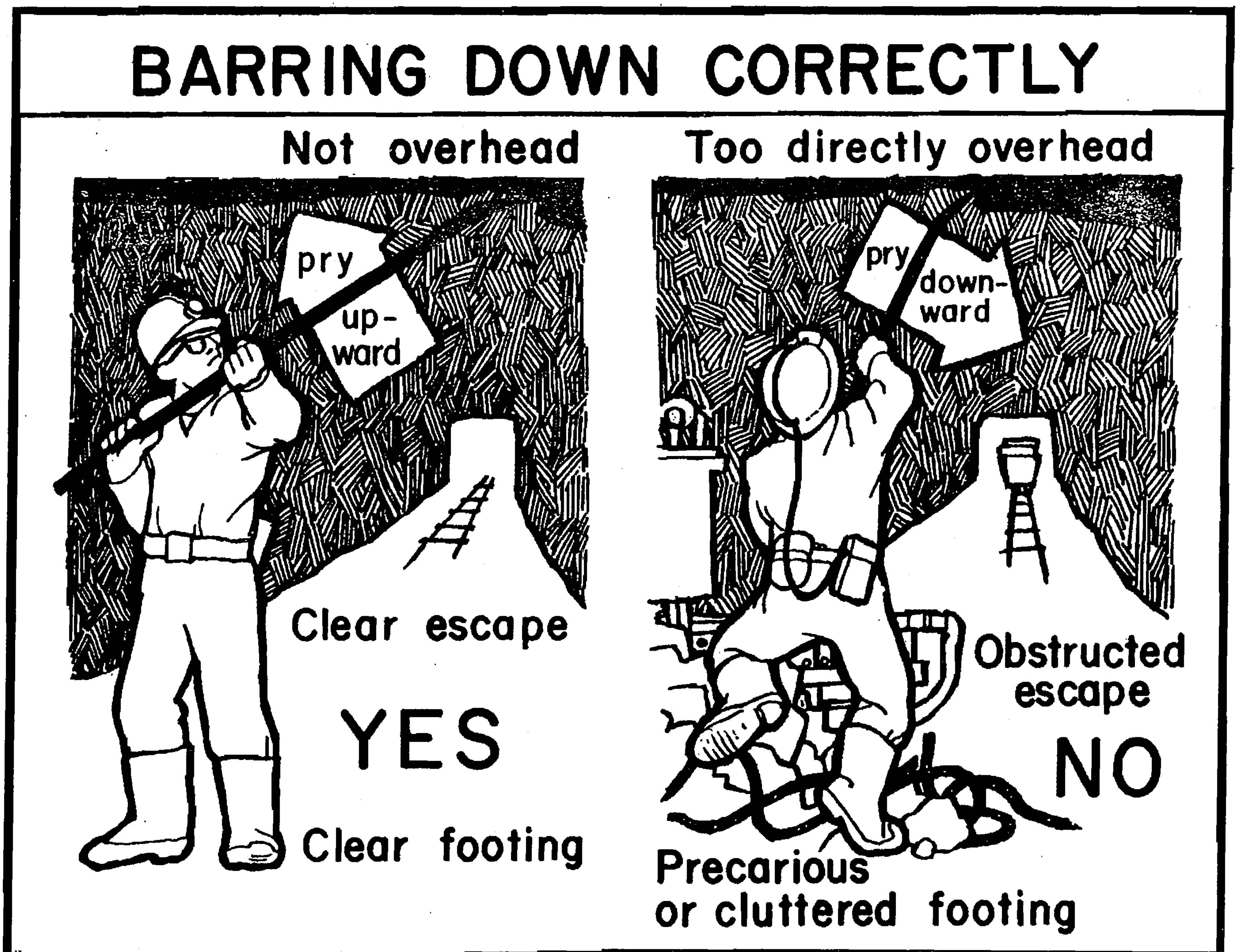
1. Fans are used to ventilate a mine in two ways (True, False)

2. Mine ventilation fans are located on the surface. (True, False)

3. Each working section of the mine must have its own separate supply or split of air (True, False)

4. In ventilation terms, a short circuit refers to air following the path of least resistance of leaking through a partially sealed check curtain.

5. If caught in a gassey or hazardous atmosphere situation in a mine, it is better to be located in the return air passage. (True, False).


BARRING DOWN CORRECTLY
Not overhead
pry
up-
ward
Clear escape
YES
Clear footing
Too directly overhead
pry
down-
ward
Obstructed
escape
NO
Precarious
or cluttered footing

VISUAL 21

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

ELECTRICAL HAZARDS

1981

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ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: ELECTRICAL HAZARDS

I. GOAL: The goal of this module is to refresh the miner on how to identify electrical hazards and follow appropriate procedures to avoid them.

II. BACKGROUND: Accidents involving electricity are extremely serious due to the high voltage involved in most mining operations. Experienced miners can become immune to electrical hazards all too easily, and it therefore becomes necessary to remind them that recognizing and reporting problems to supervisors may save lives, their own or other miners. Annual refresher is designed to fill this need.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe effects of electricity on humans.
2. Discuss common electrical accidents in general, and specific electical accidents at the mine in particular.
3. Identify who to notify in the event of an electrical hazard is discovered.
4. Demonstrate rescue techniques for an electrocuted miner.
5. Describe safe procedures when working with batteries and battery chargers.

B. Trainees will be able to do the following:

1. Answer questions concerning effects on human body from contact with electricity.
2. Identify factors contributing to electrical accidents.
3. Describe procedures for reporting electrical hazards.
4. Demonstrate rescue procedures for an electrocuted miner.
5. Describe safe procedures when working with batteries and battery chargers.

IV. MATERIALS AND RESOURCES

A. Visual aids

1. Lesson guide visuals
2. Locally produced visuals

B. Electrical devices

C. Training standards: CFR 30 Part 48.8-6

D. Textual Materials

1. NMHSA-CE-005 Electrical Hazards Workbook.
2. MESA Safety Manual No. 9 - Electrical Hazards

E. Films

1. MSHA Training Film No. 864 - "Electrical Lock-Out Procedures"
2. International Film Bureau - "Contact"

F. Applicable MSHA fatalgrams.

V. EVALUATION

A. Demonstrate, describe or identify:

1. Effects of electricity on humans and rescue procedures
2. Safety procedures to follow

B. Self Checks

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self checks if too difficult for your class.
3. Change written self check items where necessary to fit your local mine situation.
4. Applicable MSHA fatalgrams.

TOPICS COVERED

I. Effects of electricity on humans

A. Human as electrical conductor
   1. Conduction to ground
   2. Need for insulation
B. Water as conductor of electricity
C. Effects of electricity on health
   1. Shock
   2. Burns
   3. Eye injury
   4. Death
D. Rescue techniques for person in contact with electrical wire
   1. Shut off current

2. Use insulation in removal from wire
3. First aid procedures

II. Factors contributing to electrical accidents

A. Unsafe conditions
   1. Faulty insulation
   2. Faulty connections and splices
   3. Faulty grounding
B. Importance of reporting unsafe conditions, company policy
C. Unsafe acts
   1. Working on energized conductor
   2. Operating equipment or working near energized lines
   3. Use of improperly maintained equipment
   4. Unauthorized work on electrical equipment
D. Special factors related to batteries
   1. Explosive nature
   2. Gases from charging

III. Miners responsibility for reporting malfunctions

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: ELECTRICAL HAZARDS

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

I. EFFECTS OF ELECTRICITY ON HUMANS

A. Human as an electrical conductor

1. Electric shock occurs when the human becomes part of the electric circuit.

VISUAL NOTE: SHOW VISUAL 52 ILLUSTRATING A MINER AS PART OF AN ELECTRIC CIRCUIT. POINT OUT THE MINER IS DOING ELECTRICAL WORK ON AN ENERGIZED CONDUCTOR, OR IS WORKING TOO NEAR AN ENERGIZED CONDUCTOR, DEPENDING ON WHICH DRAWING YOU USE.

2. Whenever working with electrical equipment you should wear protective clothing. Rubber boots and rubber gloves should be in good condition with no holes or tears. Additional protection is provided by insulated platforms, rubber mats and belts, timbers, and other wooden poles and slats.

B. Water as a conductor of electricity.

1. Any pool of water through which an exposed electrical conductor passes is just as hazardous as the wire or cable itself.

C. Effects of electricity on health

1. Current is the factor in electricity that shocks and kills people. Current is measured in amperes.

VISUALS NOTE: SHOW VISUAL 32 LISTING THE EFFECTS OF INCREASED CURRENT ON HEALTH

a. currents of 1 mA or less are safe.
b. 1 mA to 8 mA produces a shock but it isn't very painful. 5 mA is considered the maximum harmless current intensity.
c. 8 mA to 15 mA are dangerous currents.
d. 15 mA to 20 mA produces a painful shock.
e. 20 mA to 50 mA results in a very painful shock. Muscles would contract severely. Your respiratory system could be paralyzed and breathing would be very difficult.
f. 100 mA to 200 mA causes the heart to stop its beat and it twitches or contracts without control.
g. 200 mA and over leads to severe burns. Muscular contractions become so bad that chest muscles clamp down on the heart and stop it from beating for however long the shock lasts. Death often results.

2. Electric burns - electric burns can be caused by touching an overheated conductor, just as you would touch an overheated stove. As electricity travels through the conductor it generates heat.
3. Electric flash - even though the miner may not come into physical contact with an electric arc, the bright flash of light from the arc can cause eye injury due to inflammation of the retina.
4. Electrical currents should always be treated with respect. Low voltage electricity, as low as 27 volts, is still powerful enough to be lethal with low resistance or high current.

D. Rescue techniques for person in contact with an electrical wire.

1. If the current is sufficiently strong, the miner may not be able to break away from the wire or cable. The victim is held in the circuit because the current causes the muscles to contract and remain rigid.
2. Your goal in rescuing the miner is to remove him from the circuit as quickly as possible. Do not touch the person or you too will become part of the circuit. There are two ways to do this.

   a. Disconnect the power to the circuit by turning off the switch or pulling the plug.
   b. Use an insulator (wood, rope, jacket) to remove the person from the wire or cable. Protect yourself from the circuit while doing this.

VISUALS NOTE: SHOW VISUAL 34 ILLUSTRATING TWO RESCUE TECHNIQUES. AGAIN EMPHASIZE THAT THE TRAINEE SHOULD NOT DIRECTLY TOUCH THE MINER IN THE CIRCUIT.

3. Following rescue, appropriate first aid measures, especially CPR, will probably be required to restore heart beat or breathing. Protect wounds.

INSTRUCTOR NOTE: THIS WOULD BE A GOOD POINT TO REVIEW CPR METHODS AND FIRST AID TREATMENT FOR BURNS.

INSTRUCTOR NOTE: YOU MAY WANT TO PRESENT THE FOLLOWING MATERIALS AS A LIST OF SAFE WORK HABITS TO FOLLOW WHEN DOING ELECTRICAL WORK OR WORKING NEAR ELECTRICAL EQUIPMENT.

II. FACTORS CONTRIBUTING TO ELECTRICAL ACCIDENTS

A. Unsafe conditions

1. Rubber boots or gloves with holes or tears through which your skin could contact the wire or cable.
2. Loose connections to power distribution centers and electrical equipment. Incomplete connections on splices.
3. Incomplete ground.

B. Report to your supervisor any unsafe condition you find that could result in an electrical accident.

C. Unsafe acts

1. Working on an energized conductor is an unsafe act. Always shut the power off before beginning work on electrical lines and equipment.
2. Forgetting location of energized lines relative to your location.
3. Using faulty equipment. Make sure that lights and brakes are in good operating condition.
4. Working on equipment when not authorized to.

D. Special problems associated with batteries.

1. Batteries are used in mines to power electric motors, to start diesel engines, and to power lights. Physical size is the only basic difference between an automobile battery and the large mining batteries. Automobile batteries have a voltage output of 12 volts, but in the mines, many cells are connected in series. A common tray voltage output is 300 volts.

VISUALS NOTE: SHOW VISUAL 53 ILLUSTRATING A MINE BATTERY TRAY.

2. The acid in battery cells consists of a water-sulfuric acid mixture. This mixture will cause severe skin burns and eye damage if allowed to remain in contact. Plenty of clean water dilutes the acid, or a baking soda-water solution will neutralize the acid.
3. The energy used from a battery has to be restored frequently. Mining batteries are recharged by battery chargers. During the recharging cycle and use cycle, the chemical reaction produces hydrogen gas which can be very explosive.
4. To minimize fire hazards, the tops of batteries must be kept clean of grease and dirt.

III. All miners are responsible for reporting to their supervisors any malfunctioning electrical equipment. Report any unsafe work condition to your supervisor. Discuss any unsafe act with the miner to reduce hazardous behavior.

IV. LOCK-OUT AND TAG-OUT PROCEDURES.

1. Whenever work is done on electrical components or equipment, the power to these units must be disconnected or turned off. The disconnects may be blade switches or plug-receptacle combinations.
2. In addition to the lock-out, a tag-out will permit quick visual observation by others that someone is working on a particular unit.

VISUALS NOTE: SHOW VISUALS 54 AND 31 ILLUSTRATING LOCK-OUT AND TAG-OUT PROCEDURES FOR BLADE SWITCHES AND PLUG-RECEPTACLE COMBINATIONS.

EVALUATION NOTE: HAVE MINERS ANSWER SELF-CHECK NUMBER ONE, TWO AND/OR THREE INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY ANY INCORRECT ANSWERS. YOU MAY WANT TO ALTERNATE SELF CHECKS ON ALTERNATE YEARS. THESE QUESTIONS CONCERN PRINCIPLES OF ELECTRICITY, FACTORS CONTRIBUTING TO ELECTRICAL ACCIDENTS, RESCUE TECHNIQUES, PERFORMANCE OF ELECTRICAL WORK, LOCK-OUT AND TAG-OUT. PROCEDURES, AND BATTERIES AND BATTERY CHARGERS.

SELF CHECK #1: SOLUTIONS

1. e
2. f
3. a

4. c
5. b
6. d
7. c
8. d
9. c - best answer
10. b

SELF CHECK #2: SOLUTIONS

1. rubber
2. connections
3. complete
4. unsafe
5. operating
6. authorized
7. a. board
   b. jacket
   c. rope
   d. wooden-handled shovel
8. Answers will vary according to mine.
9. a. breaker or fuse box
   b. circuit breaker
   c. fuse
10. c

SELF CHECK #3: SOLUTIONS

1. a. notify his supervisor
2. a. connection must be tight.
   b. machine must have all power switches and circuit breakers turned off.
   c. machine controls should be in a neutral position.
   d. power center distribution circuit breaker should be off.
   e. stand on rubber mat or dry wooden platform.
3. a. turn machine off.
   b. make sure that it is the proper switch.
   c. stand on rubber mat or dry wooden platform.
   d. turn switch off before pulling plug.
4. a. shut off power.
   b. immediately notify your foreman or a qualified electrician. Only qualified electricians are permitted to work on electrical equipment.
5. If you are not certified to do this job, don't do it. You may disconnect the wrong cable.
6. false
7. false
8. b

Self Check: Electrical Hazards

Self Check #1: Principals of Electricity and Effects on Health

Match Column A to correct responses in Column B

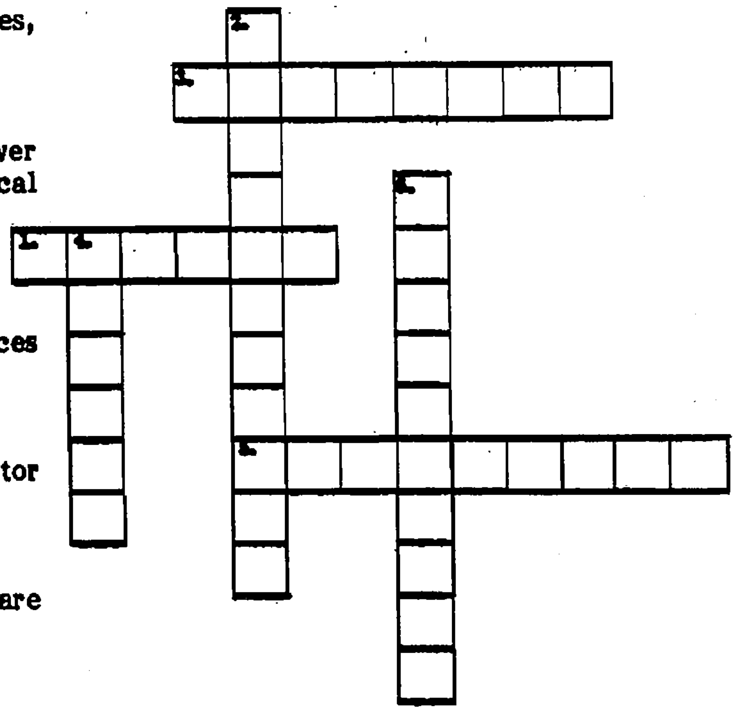
COLUMN A	COLUMN B
_____1. insulators	a. a conductor connecting the power source to the electrical equipment and another conductor returning the electrons to the power source or serving as a ground.
_____2. use electricity in the mine	b. connecting the circuit with the earth
_____3. complete circuit	c. the volume of flow of electricity passing a particular point each second, measured as amperes.
_____4. current	d. material which allows electricity to flow easily
_____5. grounding	e. wood, rubber, plastic, and glass do not allow electricity to flow along them and are good ________ when they are not wet.
_____6. conductor	f. lights, ventilation fans, water pumps, cap lamps, shop equipment

Choose the best answer to the following questions where appropriate

7. The best way you can avoid shocks when working with electricity is to:
   a. stand in water
   b. work on damp earth
   c. wear rubber gloves with no holes
   d. stand on a metal grate
   e. c and d
8. If electrocuted you would not be able to release the wire or cable because.
   a. the skin on your hand might have melted to the wire.
   b. once you let go the damage to your body begins.
   c. all you attention would be focused on trying to breath.
   d. electricity causes your muscles to contract and you no longer have control.
9. Your heart would stop beating if you become part of a:
   a. 1 mA current
   b. 300 mA current
   c. 150 mA current
   d. 20 mA current
10. Your first action after removing an electrocuted miner would be to:
   a. run out of the mine for help
   b. begin CPR to restore heart beat
   c. find the nearest miner
   d. turn the electricity on again

Self Check #2: Electrical Accident Factors, Rescue Techniques Performance of Electrical Work, Lock-Out and Tag-Out Procedures, and Batteries and Battery Chargers.

Fill in the blanks in the sentences below. The crossword grid below is for your assistance.



1. When using ____________ gloves, check for holes or tears.

2. Make sure ____________ to power distribution centers and electrical equipment are tight.

3. Electrical grounds must be ____________ to minimize chances for electrocution.

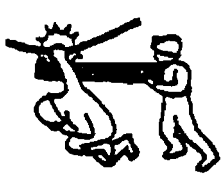
4. Working on an energized conductor is an ____________ act.

5. Make sure that lights and brakes are in good ____________ condition.

6. Only ____________ personnel are permitted to work on electrical equipment.

Complete the following questions.

7. Name the insulated materials used to remove the electrocuted miner.



a. ____________

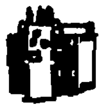
b. ____________

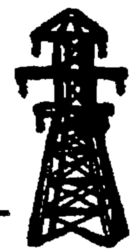
c. ____________

d. ____________

8. Describe the lock-out and tag-out procedure to be used in your mine.

9. Name the following pieces of electrical equipment.

a. ____________ 

b. ____________________ 

c. ____________ 

10. While handling a battery you get battery acid on your hand. You should:

   a. blow on it to ventilate the skin area
   b. rub a first aid lotion
   c. wash with plenty of clean water and put baking soda on it.
   d. place a band-aid on it

Self Check #3

1. It was near the end of his shift when Rodney noticed a frayed trailing cable leading to the machine he was operating. He removed the power to the machine and posted a warning sign before leaving for home. What very important step did Rodney forget?

2. You have to connect your machine to a power distribution box. What important steps must you follow?

   a.
   b.
   c.
   d.

3. When disconnecting your machine from a power distribution box, what steps are to be followed?

   a.
   b.
   c.
   d.
   e.

4. You are having electrical problems with your electrically powered machine. You have watched the company electrician correct the problem before and know exactly what to do. You have the necessary tools with you to do the job. What is the first step you should take? The second step?

   a.
   b.

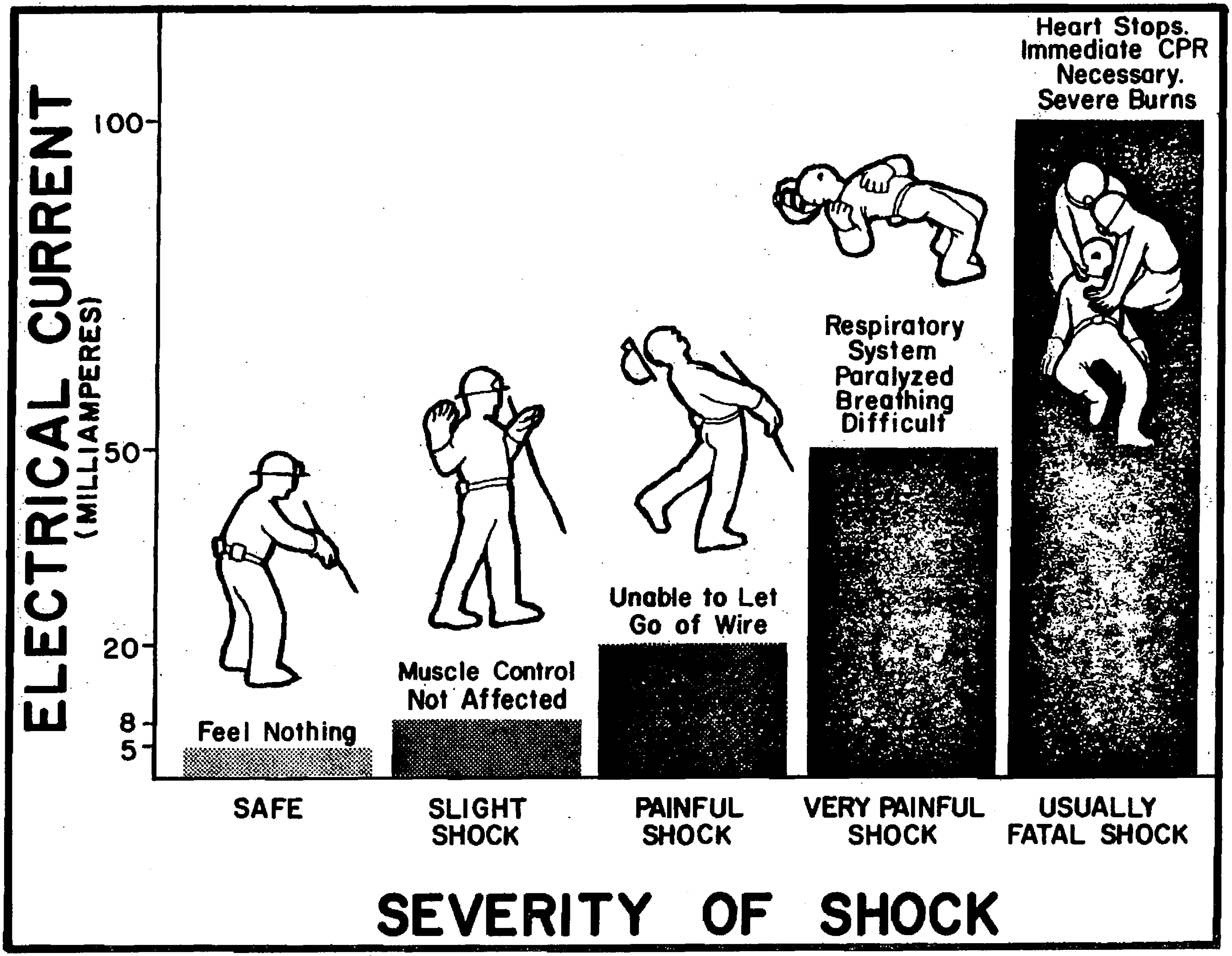
5. The electrician has arrived to repair your malfunctioning machine. He wants you to disconnect the cable at the distribution box. What should you do?

6. Splices taped with friction tape are good splices. (true, false)

7. If you notice that a plug has been tagged out, you must plug it back into the distribution box. (true, false)

8. The reason for not smoking near a battery changing station is

   a. battery acid and cigarette smoke combined can cause cancer.
   b. the charging process produces an explosive gas.


ELECTRICAL CURRENT
(MILLIAMPERES)
100
50
20
8
5
Feel Nothing
Muscle Control Not Affected
Unable to Let Go of Wire
Respiratory System Paralyzed Breathing Difficult
Heart Stops. Immediate CPR Necessary. Severe Burns
SAFE
SLIGHT SHOCK
PAINFUL SHOCK
VERY PAINFUL SHOCK
USUALLY FATAL SHOCK
SEVERITY OF SHOCK

VISUAL 32

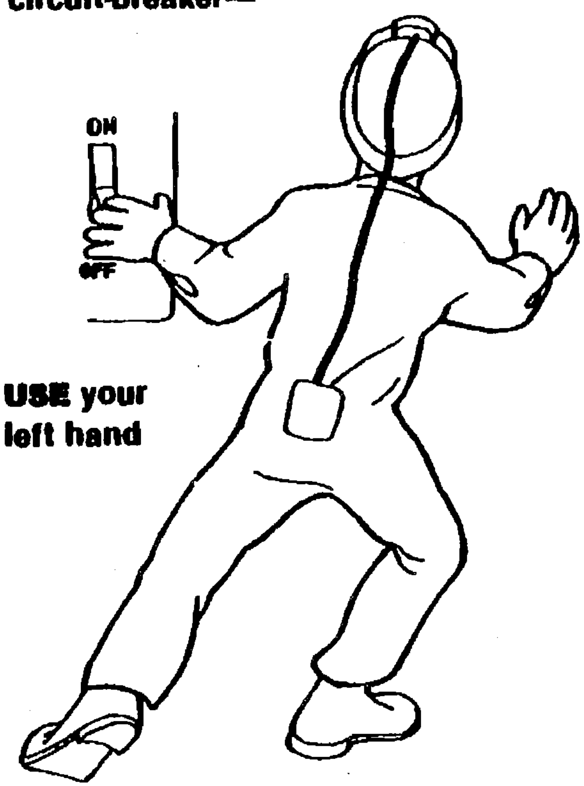
ELECTROCUTION RESCUE

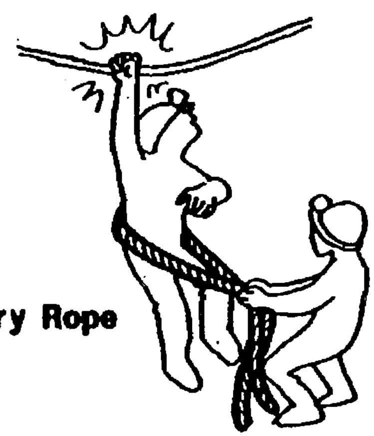
SHUT OFF CURRENT AND/OR GET PERSON OFF CIRCUIT FAST.

DON'T TOUCH PERSON DIRECTLY. USE:

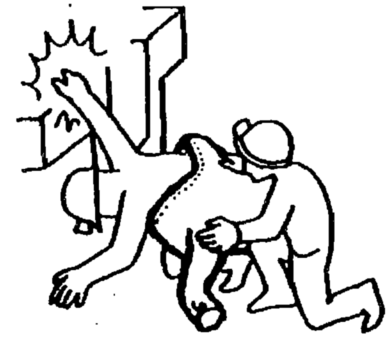
DON'T place your body directly in front of circuit-breaker—

USE your left hand

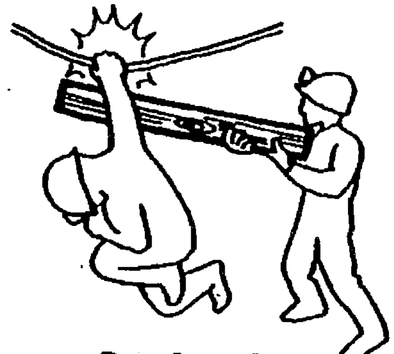




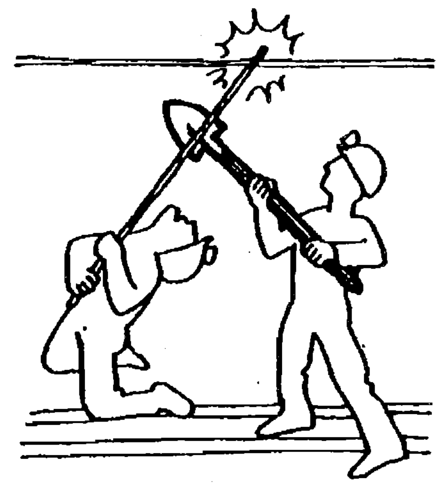
Dry Rope



Dry Jacket



Dry Board

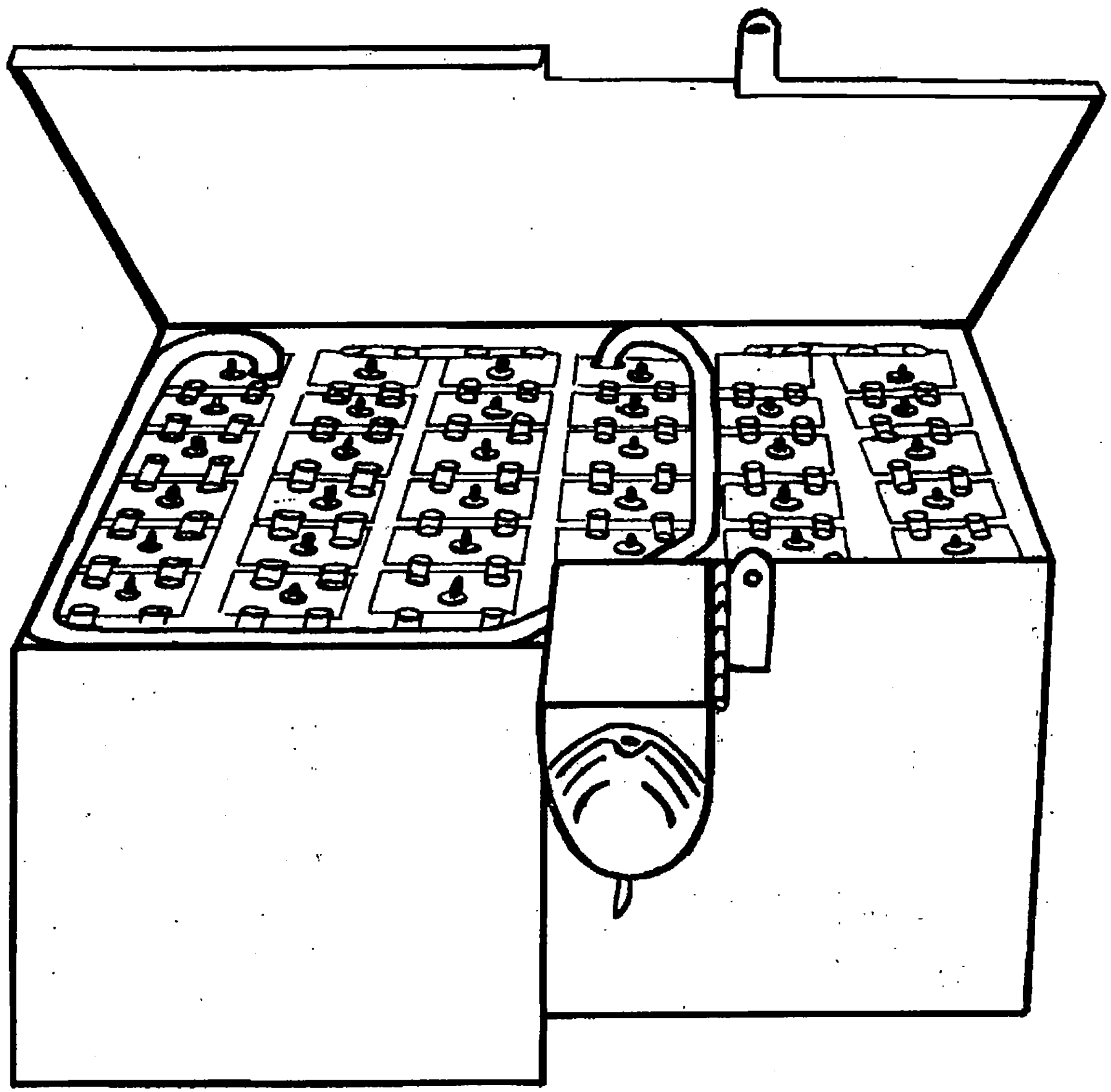


Dry Wooden-handled tool

BE QUICK.

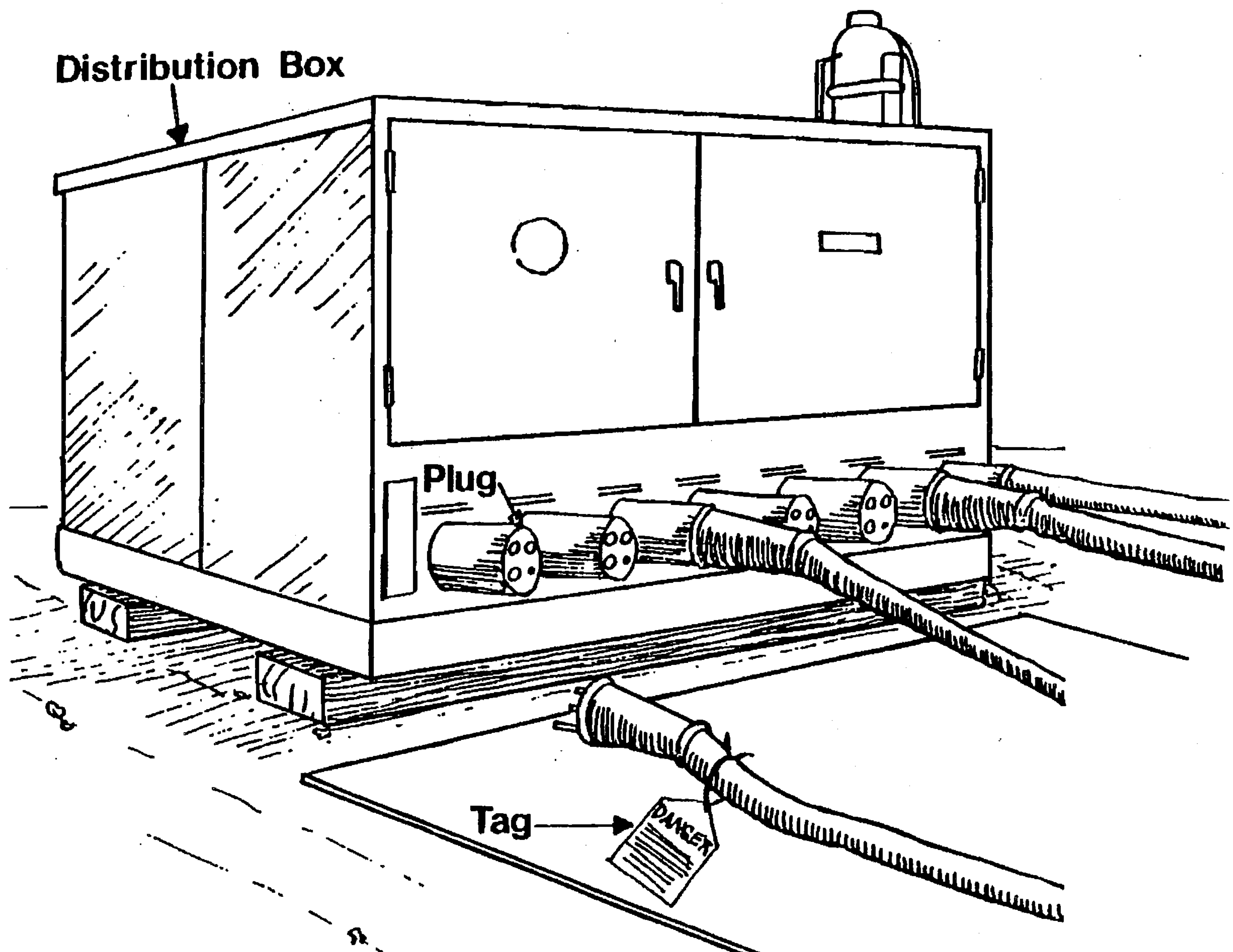
VISUAL 34

MINE BATTERY TRAY

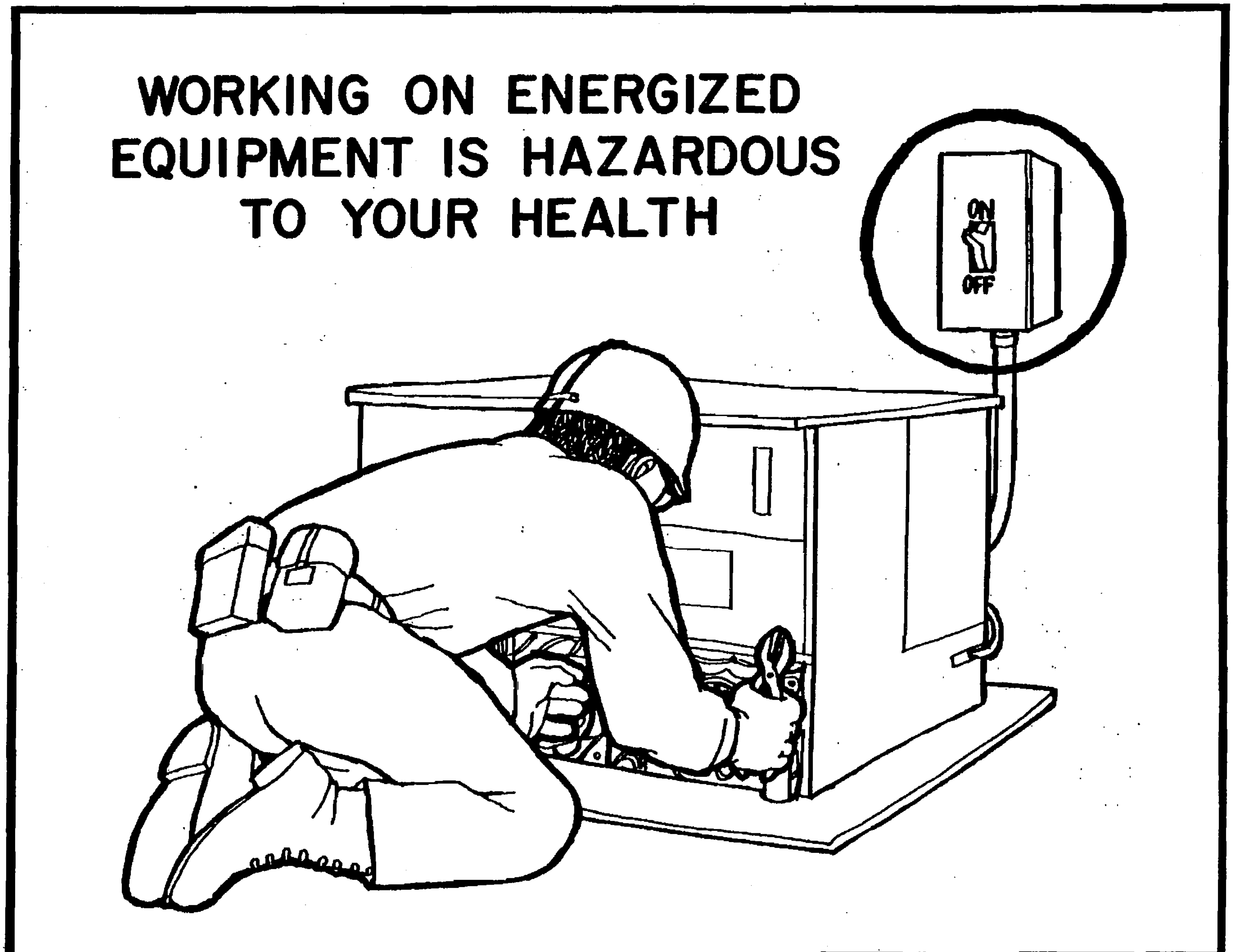


VISUAL 53

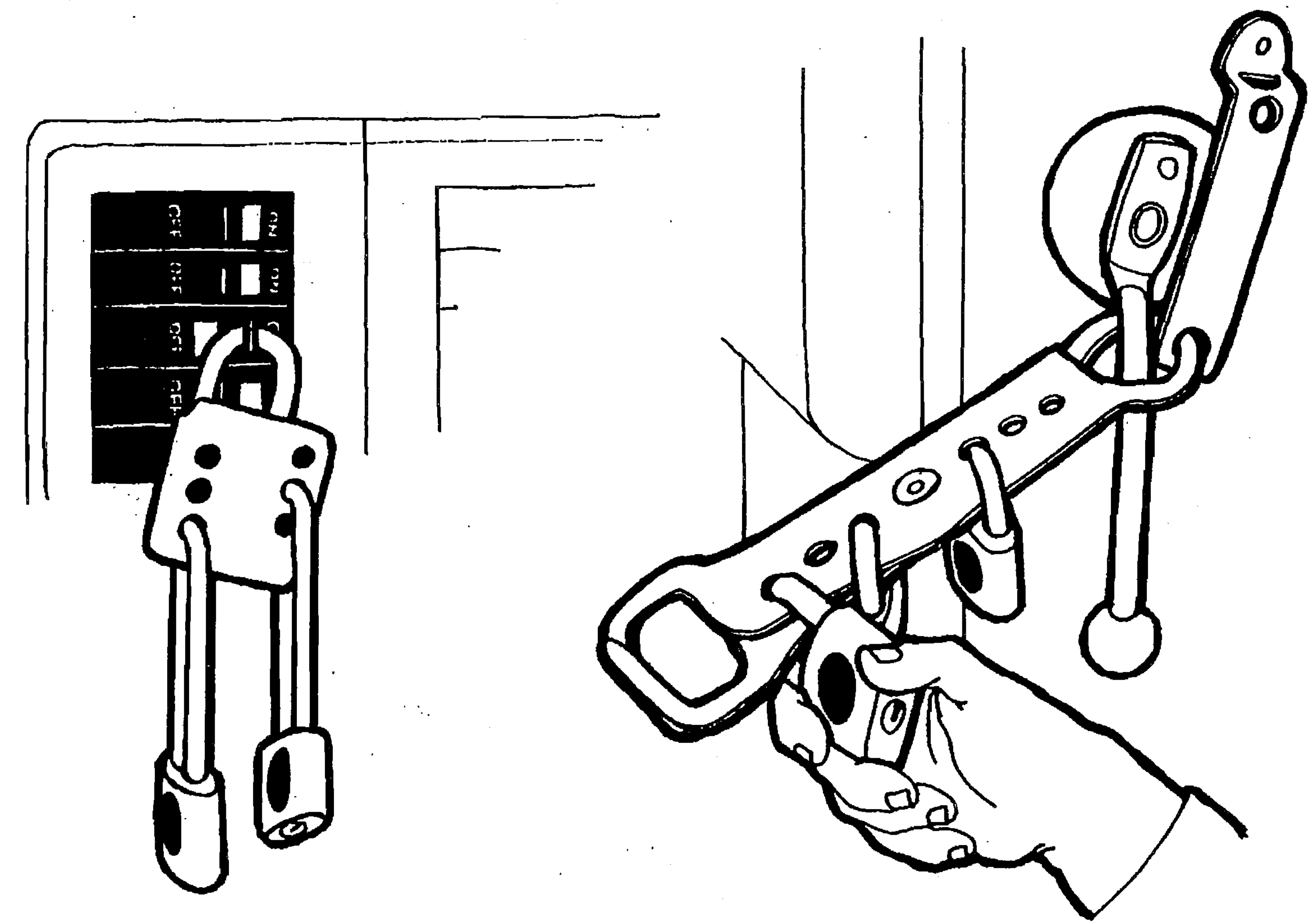
TAGGING OUT PROCEDURES



VISUAL 31


WORKING ON ENERGIZED
EQUIPMENT IS HAZARDOUS
TO YOUR HEALTH
ON
OFF

LOCKING OUT PROCEDURES



VISUAL 54

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

PREVENTION OF ACCIDENTS

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: PREVENTION OF ACCIDENTS

I. GOAL: The goal of this module is to refresh the miners understanding of basic accident prevention principles and have them apply those principles to their work environment.

II. BACKGROUND: Mining is one of the most hazardous occupations. Refresher training in accident prevention is extremely important to the miner who becomes accustomed to those hazards in his or her work environment. Awareness of potential accidents through recognition of hazards is imperative.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe the most frequent kinds of injuries and accidents occuring at the mine.
2. Discuss how to recognize unsafe conditions which may occur in the mine.
3. Describe common unsafe acts and discuss how to avoid them.
4. Discuss incident versus accident.

B. Trainee will be able to do the following:

1. Identify major accident categories and their causes.
2. Describe common accident prevention measures at the mine.
3. Identify type of hazards they should correct themselves and those they should report to qualified person.
4. Identify near miss incidents

IV. MATERIALS AND RESOURCES

A. Visual Aids

B. Company accident records

C. List of hazards relevant to particular operation

D. Training standards

1. CRF 30 Part 48.8-7
2. CFR 30 Part 55.7-53, 55.13-19, 20, 21

E. Textual Materials

1. MESA Safety Manual No. 4 - <u>Accident Prevention.</u>

2. National Safety Council - <u>Accident Prevention Manual for Industrial Operations.</u>

3. NMHSA Programmed Instruction Workbook - <u>Accident Prevention.</u>

F. Films

1. Salenger Educational Media - "Good Housekeeping Prevents Accidents"

2. National Film Board of Canada - "Eyes." "Feet." "Hands." "Slips and Falls." "Striking against Objects."

3. Bureau of National Affairs - "The Big Lift."

4. National Coal Board - "A Sense of Responsibility." "Tidy Why".

5. National Safety Council - "Your Body Is Only Human", "Accidents Made Easy".

G. Applicable MSHA Fatalgrams

V. EVALUATION

A. Identify, describe or discuss accident prevention.

B. Self check

1. Any time hands-on appraisal such as operating equipment or physically responding to instruction is possible, it should be used.

2. Eliminate the use of self check items where necessary to fit your local mine situation.

<u>TOPICS COVERED</u>

I. Distinction between health and safety problems

A. Health refers to body functions
B. Accidents involve trauma from external source
C. Definition of an accident

II. Kinds of accidents at the mine

   A. Contribution to accidents from unsafe acts
   B. Methods for prevention of these accidents (Job Safety Analysis)

III. Recognition of unsafe conditions

   A. Sliding or falling material at bins, hoppers, and dump points
   B. Pressure lines and vessels
   C. Inadequate supports or guards
   D. Poor housekeeping
   E. Poor illumination
   F. Explosives

IV. Sources of health hazards at the mine

   A. Toxic substances.
   B. Dust
   C. Noise
   D. Heat stress

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: PREVENTION OF ACCIDENTS

INSTRUCTOR NOTE: THE LIST OF HAZARDS AND ACCIDENTS INCLUDED IN THIS MODULE MAY INVOLVE HAZARDS WHICH ARE NOT RELEVANT TO YOUR MINE AND THESE MAY BE DELETED. IF OTHERS WHICH ARE NOT INCLUDED HERE ARE RELEVANT THEY SHOULD BE ADDED. ASSESS THE MINERS' KNOWLEDGE OF ACCIDENT PREVENTION BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF CHECKS AS A PRETEST. IF NEEDED, REVIEW THE MATERIAL IN THIS MODULE. FACILITATE DISCUSSION OF ACCIDENTS AT YOUR MINE USING THOSE RELEVANT FATAL GRAMS OR ACCIDENT REPORTS. IF TIME PERMITS DISCUSS NEAR MISS INCIDENTS FOCUSING ON ACCIDENT PREVENTION.

II. DISTINCTION BETWEEN HEALTH AND SAFETY PROBLEMS

A. Health refers to proper functioning of the body

B. Safety refers to keeping the body free from the impact of foreign objects - avoiding accidents.

VISUALS NOTE: DURING THE FOLLOWING DISCUSSION YOU MAY WANT TO PASS OUT VISUAL 7 ILLUSTRATING RELATIONSHIPS BETWEEN CAUSES IN THE ACCIDENT SEQUENCE.

C. Definition of an accident and causes of accidents.

1. Unplanned release of energy.
2. Energy released causes injury or damage to property.
3. Basic causes
    a. Management safety policy and decisions.
    b. Environmental factors
    c. Personal factors
4. Indirect causes.
    a. Unsafe conditions
    b. Unsafe acts

5. Direct causes: Unplanned energy release.

III. MOST COMMON TYPES OF ACCIDENTS

INSTRUCTOR NOTE: YOUR DISCUSSION OF TYPES OF ACCIDENTS SHOULD CONSIDER THE ACCIDENT AND INJURY HISTORY OF YOUR MINE. DRAW ON YOUR MINERS EXPERIENCES WITH EFFORTS AT ACCIDENT PREVENTION.

A. Handling materials is a common activity related to accidents.

1. These accidents may often be avoided by using appropriate handling techniques, some of which are as follows:

   a. Use proper lifting techniques, using the legs rather than the back.
   b. Wear gloves and be careful of sharp edges.
   c. Do not allow your vision to be obscured by the load and be careful when passing through entrances.
   d. Do not attempt to carry a load which is too heavy, and coordinate your moves with those assisting you.

VISUALS NOTE: SHOW VISUAL 8 ILLUSTRATING LIFTING AND CARRYING MATERIALS.

B. Haulage activities are a major source of accidents.

INSTRUCTOR NOTE: A QUESTION ABOUT PROCEDURES FOR PREVENTING ACCIDENTS MAY PRODUCE SOME OF THE FOLLOWING RESPONSES.

1. Haulage accidents may be reduced by using the rules as follows:

   a. Never exceed the vehicle's capabilities.
   b. When on foot watch out for all vehicles and let operators know you are near.
   c. Never get on or off of moving haulage of any kind.
   d. Keep limbs and head within mantrip.
   e. Make frequent checks of vehicle's brakes, lights, steering, and other devices related to safety.

C. Another major source of accidents is the use of machinery.

VISUALS NOTE: SHOW VISUALS 10 THROUGH 18 ILLUSTRATING TYPES OF ACCIDENTS AND DANGEROUS CONDITIONS.

1. Many accidents of this nature can be avoided by obeying the rules as follows:

   a. When working near equipment in operation, be sure operator knows you are there.
   b. Avoid the area included in the circle of movement of booms, loaders and dozers. Never walk under raised equipment.
   c. Never leave equipment unattended in raised position.
   d. Be sure equipment is securely blocked before attempting any repair or maintenance with it in raised position.
   e. Don't work on moving conveyor belts or attempt to cross or mount them.
   f. Never ride on a conveyor belt which is loaded with ore.
   g. Don't wear loose clothing or long hair around moving conveyor belts or machinery which has exposed moving parts.
   h. Never attempt to defeat or override the safety devices built into equipment or hand tools.
   i. Never put your hands between a drill and the roof or rib.

D. A major source of accidents which may occur anywhere in the mine is slips and falls. These accidents often happen when simply walking.

1. Some rules which will help prevent slips and falls are as follows:

   a. Wear proper footwear.
   b. Always walk carefully and watch where you are going. Don't allow material being carried to block your visibility.
   c. Use a ladder when you must work above your comfortable reach. Don't rely on stacked materials to be stable.
   d. Clean up any spills.

VISUALS NOTE: SHOW VISUAL 45 ENTITLED "CLEAN UP ALL SPILLS."

   e. Always use guard rails, etc.
   f. Use a safety belt to catch any fall from a high space, or when working in a hole.

E. The final major source of accidents is the use of hand tools

1. Some rules which will help in avoiding these accidents are as follows:

   a. Don't use the wrong tool for the job.

b. Keep tools in their place when they are not being used. Don't leave them around as hazards to be avoided.
c. When shoveling onto a moving belt always shovel in the direction the belt is moving.
d. Be sure you have clearance from other workers and machinery when using hammers and sledges.
e. Always wear safety glasses to protect your eyes from flying chips.

INSTRUCTOR NOTE: AT THIS POINT YOU MAY WANT TO DISCUSS THE PROPER (SAFE) METHOD FOR USE OF TOOLS ESPECIALLY THOSE TOOLS WHICH PRESENT A CONSTANT HAZARD.

INSTRUCTOR NOTE: IF THERE IS A PARTICULAR JOB OR TASK WITHIN YOUR SYSTEM WHICH EXHIBITS AN EXTREMELY HIGH ACCIDENT RATE, YOU MAY WANT TO PERFORM A JOB SAFETY ANALYSIS ON THE AREA. THE FOUR STEPS ARE:

A. SELECT THE JOB TO BE ANALYZED
B. BREAK THE JOB DOWN INTO SUCCESSIVE STEPS.
C. IDENTIFY THE HAZARDS AND POTENTIAL ACCIDENTS
D. DEVELOP WAYS TO ELIMINATE THE HAZARDS AND PREVENT THE POTENTIAL ACCIDENTS

VISUALS NOTE: SHOW VISUALS 19, 20 and 47 ILLUSTRATING OF PROPER AND IMPROPER USE OF TOOLS.

F. Another source of serious accidents in some mines is contact with electrical wiring.

1. Reduction of the likelihood of electrical accidents will be aided by the following:

a. Avoid areas where bare wires such as trolley wires are located.
b. Report any worn or broken insulation immediately.
c. Watch out for power lines when carrying or operating equipment.
d. When connecting power lines make sure the current is off.

IV. OTHER HAZARDOUS CONDITIONS

A. Sliding or falling material

1. Safety belts must be worn when working in bins and hoppers.

B. Pressure lines and vessels

1. Never disconnect lines under pressure.

2. Before lines are pressurized personnel should be clear of the possible movement.

C. Inadequate supports or guards

1. Any inadequate supports or guards should be reported immediately.

D. Poor housekeeping

1. The job is not finished until all tools, equipment, and materials have been returned to their proper places and any scrap or debris has been cleaned up.

E. Poor illumination

1. Make sure that illumination is adequate for the task at hand.

F. Explosives

1. Make sure each shot is properly guarded.

2. Extreme care should be used in examining for misfires.

VISUALS NOTE: SHOW AND DISCUSS VISUAL 28 ENTITLED "MISFIRES ARE DANGEROUS."

3. All miners in the area must be warned of an impending shot and cleared from the area.

V. NEAR-MISS INCIDENTS

A. Distinction between accident and incident

1. An accident is an undesired event that results in physical harm to a person or damage to property.

2. An incident is an undesired event that could result in loss.

B. Relationship of incidents to accidents.

1. For every serious or disabling injury there are approximately 10 minor injuries.

2. For each serious or disabling injury there are 30 property damage accidents.

3. For every accident involving a serious or disabling injury, there are 400 to 600 incidents (near-miss accidents)

INSTRUCTOR NOTE: HAVE THE MINERS LIST ALL THE NEAR-MISS ACCIDENTS THAT THEY HAVE WITNESSED OR HEARD ABOUT AND DISCUSS THE POTENTIAL SERIOUSNESS OF THOSE INCIDENTS.

EVALUATION NOTE: HAVE MINERS ANSWER SELF CHECK NUMBER ONE, AND/OR NUMBER TWO INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO USE ALTERNATE SELF CHECKS ON ALTERNATE YEARS. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN THE ANALYSIS OF ACCIDENTS AND THEIR CAUSES, AS WELL AS THE MOST COMMON TYPES OF ACCIDENTS IN UNDERGROUND MINES.

SELF CHECK #1: SOLUTIONS

1. handling materials, haulage activities, use of machinery, slips and falls, and use of hand tools.

2. a, b, & d.

3. True

4. a. turning with one hand or while eating
   b. safety motivation and awareness
   c. Hal should not drive with the bucket raised

5. fingers

6. Always leave your vision clear when carrying materials. Store tools when not in use.

7. a. Use wrench only with square-shanked screwdriver.
   b. Use tools with handles in good condition
   c. Carry tools in a shoulder bag when climbing
   d. get a longer wrench
   e. hold nail near the head
   f. use the right tool for the right job.

SLEF CHECK #2: SOLUTIONS

1. a. made several trips and by doing so not stacked the boxes so as to block his vision.

2. a. He should not have been smoking in an area where flammable was used and/or stored. He could have carried boxes in such a way as to not block his vision.

b. Yes, someone left the open can of solvent in the pathway.

c. Answers will vary.

3. a. Answers will very
   b. Horseplay

4. a. Answers will vary
   b. 4

5. a. Answers will vary
   b. No

6. a. Both
   b. Answers will vary

7. a. Never work between the face and equipment
   b. Yes

Self Check: PREVENTION OF ACCIDENTS

Self Check #1: Analysis and Causes of Accidents, and Common Types of Accidents in Underground Mines.

1. List the 5 main types of accidents.

   a.

   b.

   c.

   d.

   e.

2. (circle each correct answer,) An accident is:

   a. any unplanned event that may result in property damage

   b. an unanticipated event that sometimes results in personal injury

   c. always management's fault

   d. sometimes the result of unsafe acts

3. Indirect causes of accidents are unsafe acts and unsafe conditions. (true, false).

4. Hal is new to mining. One day he drives his front end loader down the drift with the bucket of ore raised. Because he's eating a sandwich he steers wide on the curve and runs the bucket into a rib. He breaks the bucket and hits his head on the canopy.

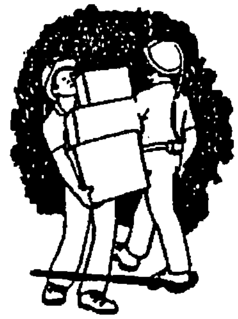
   a. What is the indirect cause of this accident?

   b. What is the basic cause?

   c. How could this powered haulage type of accident be prevented?

5. Which body parts are most frequently injured in mining accidents?

What rules are not being followed here?



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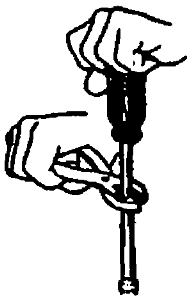
7. On each line below tell what hand tool rule is not being followed.

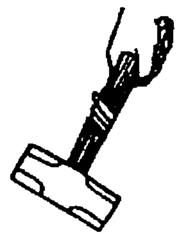


a. ______________________________

____

____

____



b. ______________________________

____

____

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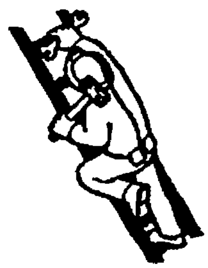
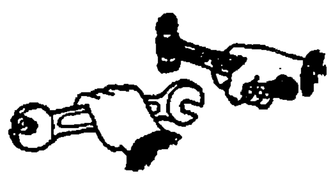


c. ______________________________

____

____



d. ______________________________

____

____

e. ______________________________

____

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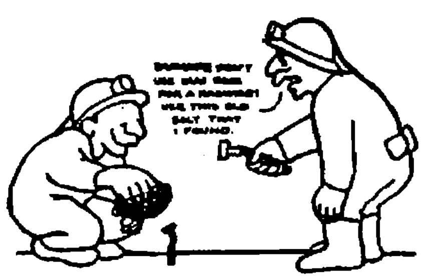


f. ______________________________

____

____

____

Self Check: Accident Prevention

Self Check #2: Materials Handling

1. Sam was carrying supplies from a shuttle car to the face area. Rather than making several trips, Sam stacked the boxes high and proceeded to the face. Halfway to his destination, Sam tripped over a trailing cable, fell and sustained a broken arm.

    a. What could Sam have done to prevent this accident?

2. Pete had worked for XYZ mine for twelve years. He was recovering from surgery so his foreman assigned him to work in the repair shop which also doubled as a supply storage area. Today Pete was carrying boxes from the storeroom to a supply shuttle car. While smoking a cigarette, Pete picked up several boxes and proceeded through the shop to the car. Half way through the shop Pete tripped over an open can of cleaning solvent. He fell and his cigarette ignited the solvent. Pete sustained second degree burns on his face, arms and hands. It was back to the hospital for Pete.

    a. What could Pete have done to prevent this accident?

    b. Did someone other than Pete also contribute to this accident? If so, what did they contribute?

    c. List any combustible or flammable materials used in your job.

HAULAGE ACTIVITIES

3. Tod and Greg were two of several miners riding in an open man-trip. They had been warned before about their constant horse-play. Today, Tod had grabbed Jack's lunch pail and was tossing it to Greg. The pail hit someone's safety hat and bounced out of the man-trip. Jack quickly reached out to try and retrieve the pail. His body became wedged between the man-trip and a rib.

    a. List your company's rules for riding in a man-trip.

    b. What unsafe act initated this accident?

4. Tom was walking along the "tight side of the haulageway in order to get a better look at Mary, the new miner. He was so intent at watching Mary that he didn't see the run-a-way track haulage car loaded with ore. The car hit a piece of equipment and derailed, crushing Tom who had no place to go.

    a. List the rules for traveling along a haulageway.

    b. What is required every 105 feet of a haulageway for the miner's protection (circle one)

1. stop light
2. warning sign
3. brakes
4. shelter hole

5. Gary and three other miners were riding in a scoop to the face. He had his feet dangling over the edge. Gary's foot became wedged between the scoop and the mine floor causing him to be thrown out and run over.

   b. List the proper precedures for riding a scoop.

   b. Was the direction of travel of the scoop proper?

MACHINERY

6. Betsy did not like to tie her hair back when she worked in the mine. She operated a drill at the face area drilling explosive holes. In the process of drilling, Betsy's hair got caught in the drill and beside loosing most of her hair, she suffered multiple scalp lacerations.

   a. Was this an unsafe act or condition?

   b. What other possible incidents such as this could happen?

7. Bill was working on the continuous miner drum. He was replacing broken teeth and had placed himself between the drum and the face. There was no roof support above the area where Bill was working. Suddenly there was a sluffing of material from the roof and adjacent face. Bill had no way to escape and was crushed beneath the material.

   a. What safety rule did Bill violate?

   b. Was there a violation in regards to roof support?

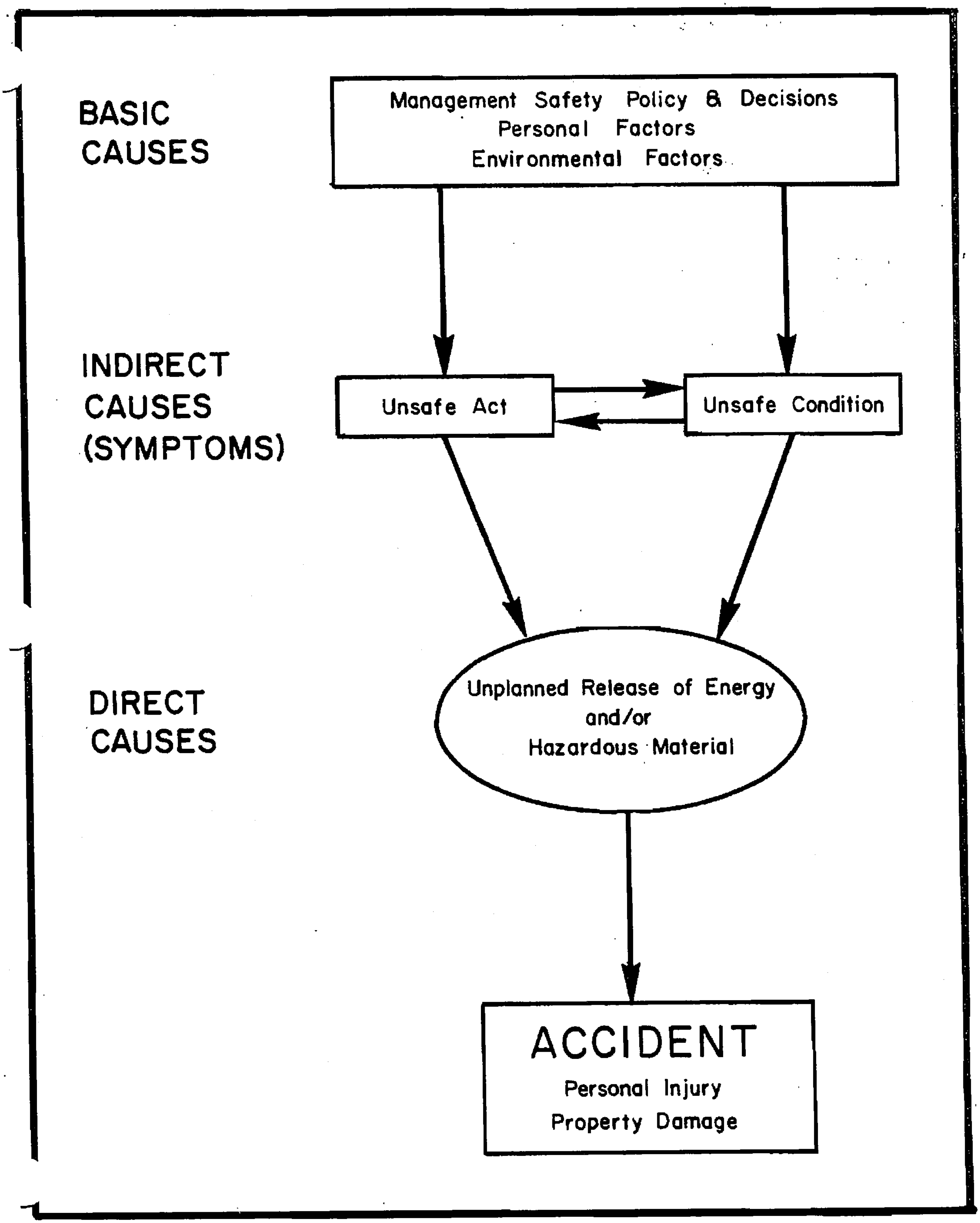
SLIPS AND FALLS

8. List all the areas at your job site that are potential areas for slips and falls.

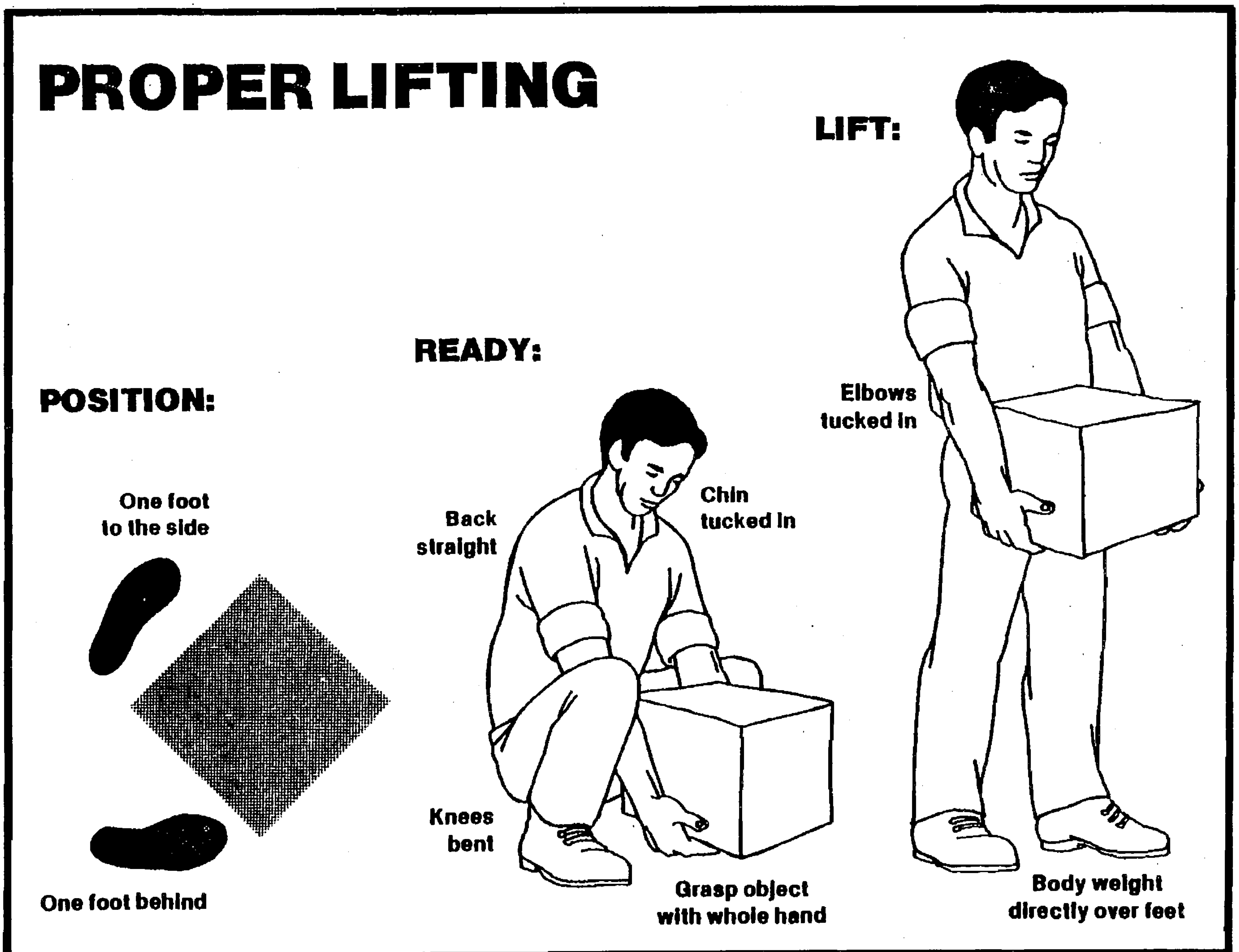
9. List all preventative measures that one should take to avoid slips and falls.

HAND TOOLS
(Manpower assisted tools)

10. List the hand tools you may use in your particular job.

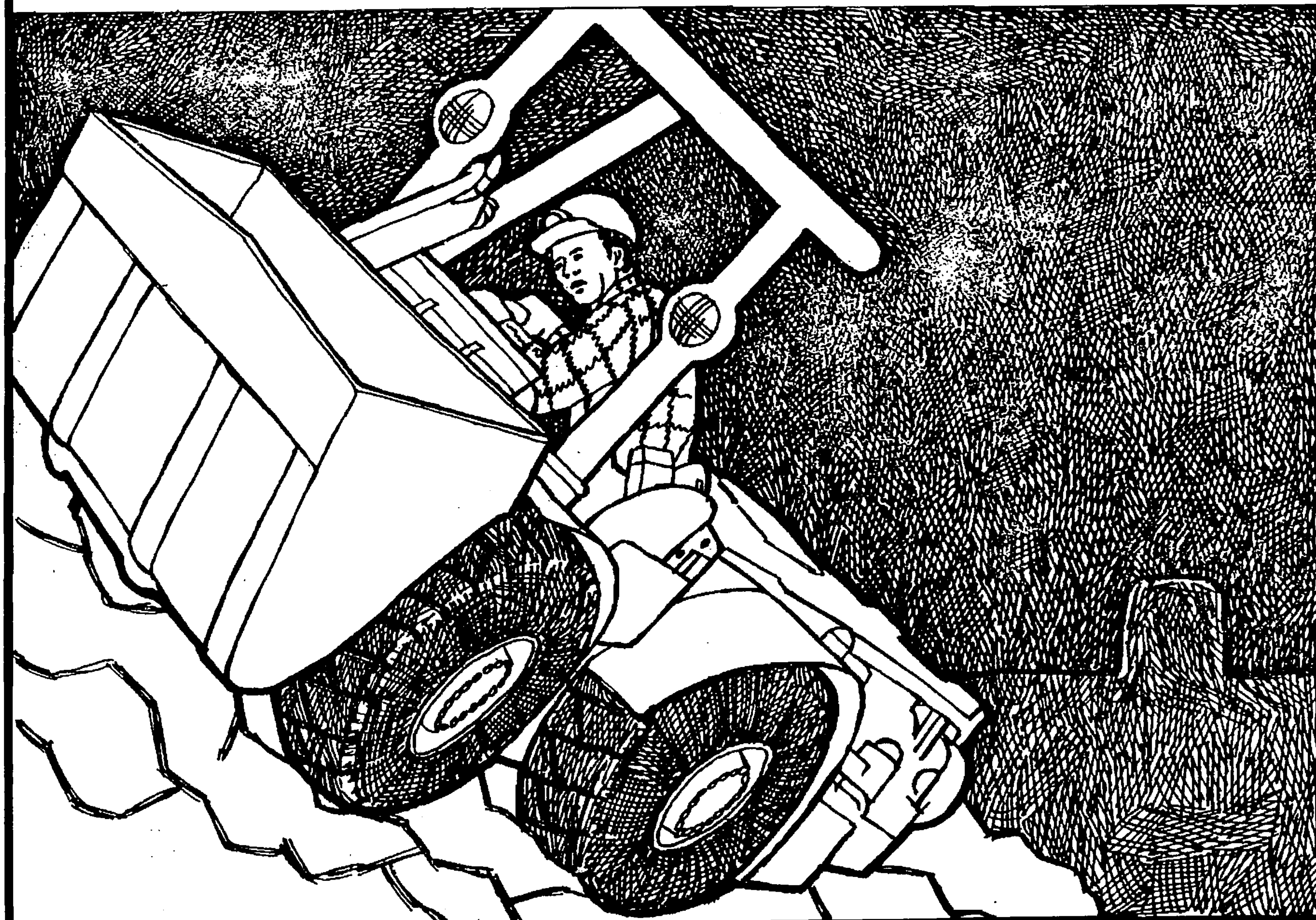

BASIC CAUSES
Management Safety Policy & Decisions
Personal Factors
Environmental Factors
INDIRECT CAUSES (SYMPTOMS)
Unsafe Act
Unsafe Condition
DIRECT CAUSES
Unplanned Release of Energy
and/or
Hazardous Material
ACCIDENT
Personal Injury
Property Damage

VISUAL 7

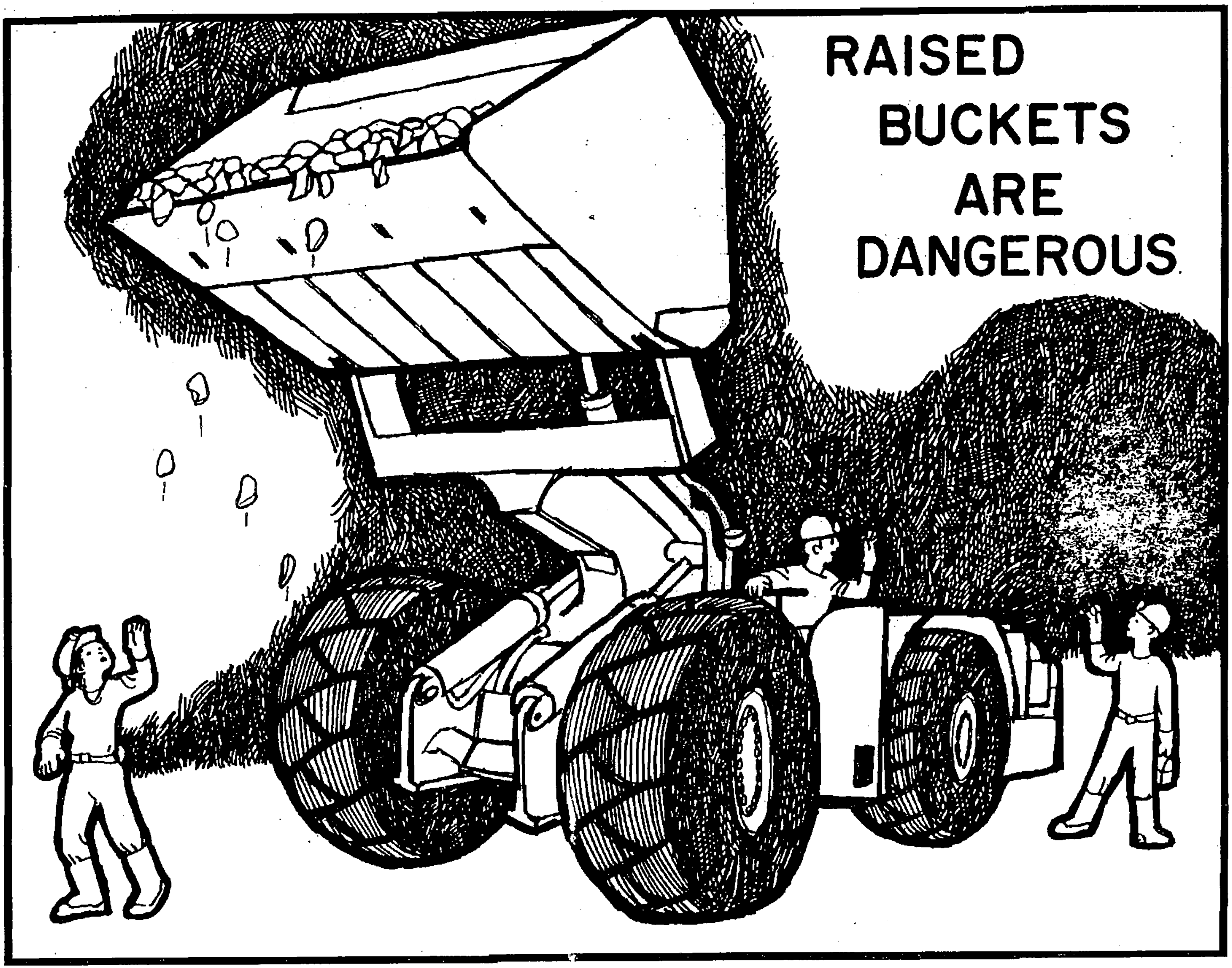

PROPER LIFTING
POSITION:
One foot
to the side
One foot behind
READY:
Back
straight
Chin
tucked in
Knees
bent
Grasp object
with whole hand
LIFT:
Elbows
tucked in
Body weight
directly over feet

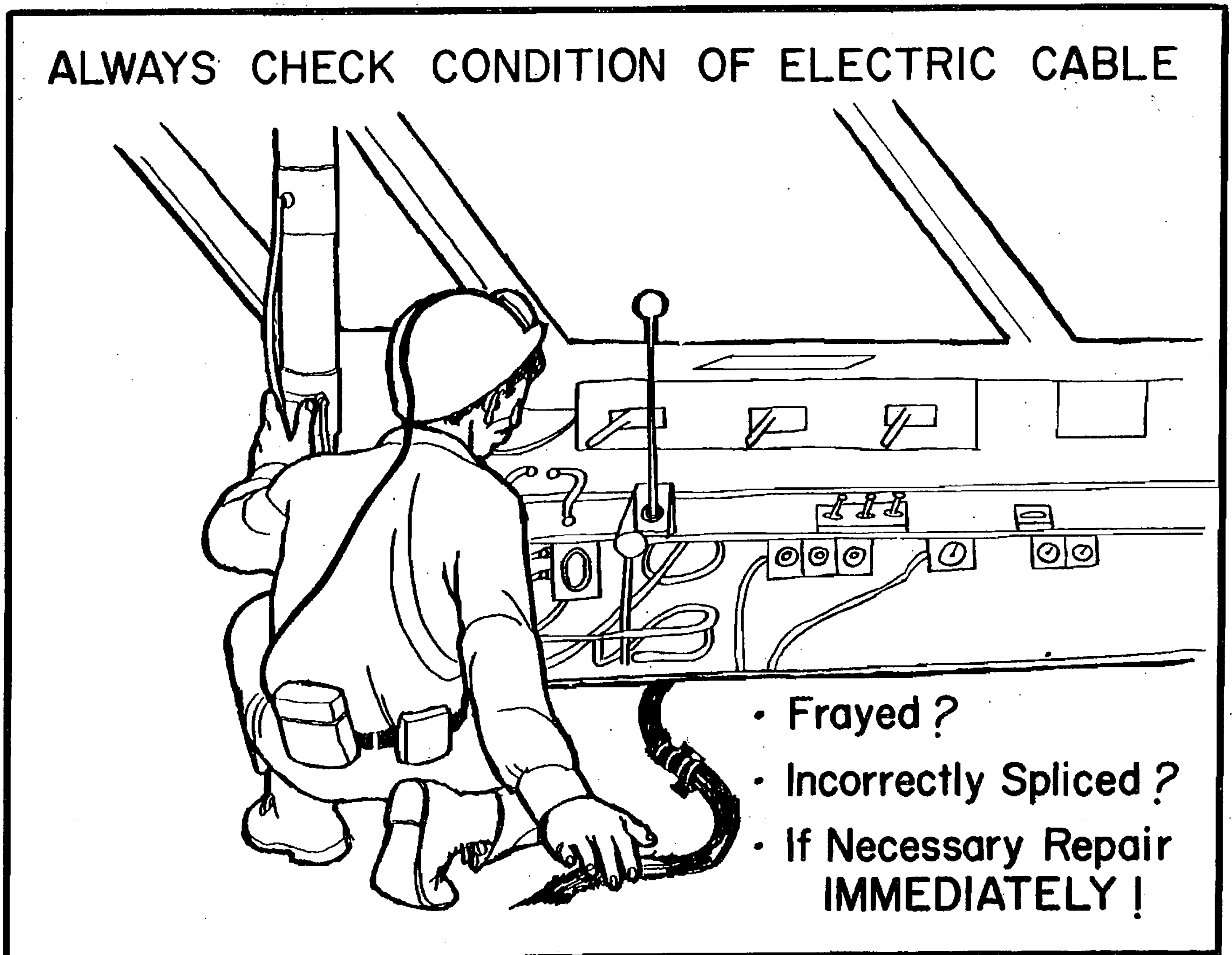
VISUAL 8

AVOID SIDEHILLS



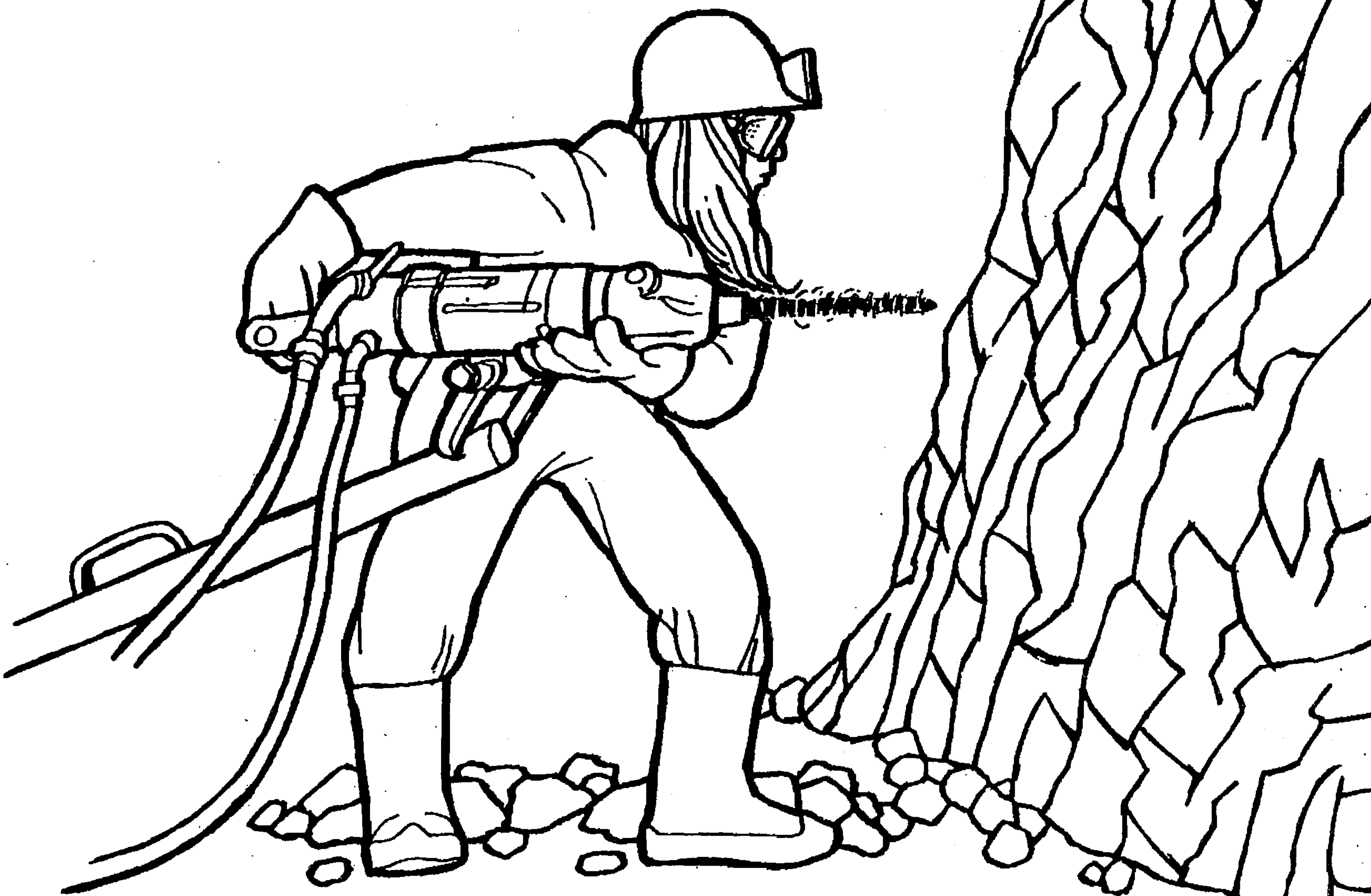
VISUAL 10


RAISED
BUCKETS
ARE
DANGEROUS


ALWAYS CHECK CONDITION OF ELECTRIC CABLE
• Frayed ?
• Incorrectly Spliced ?
• If Necessary Repair IMMEDIATELY !

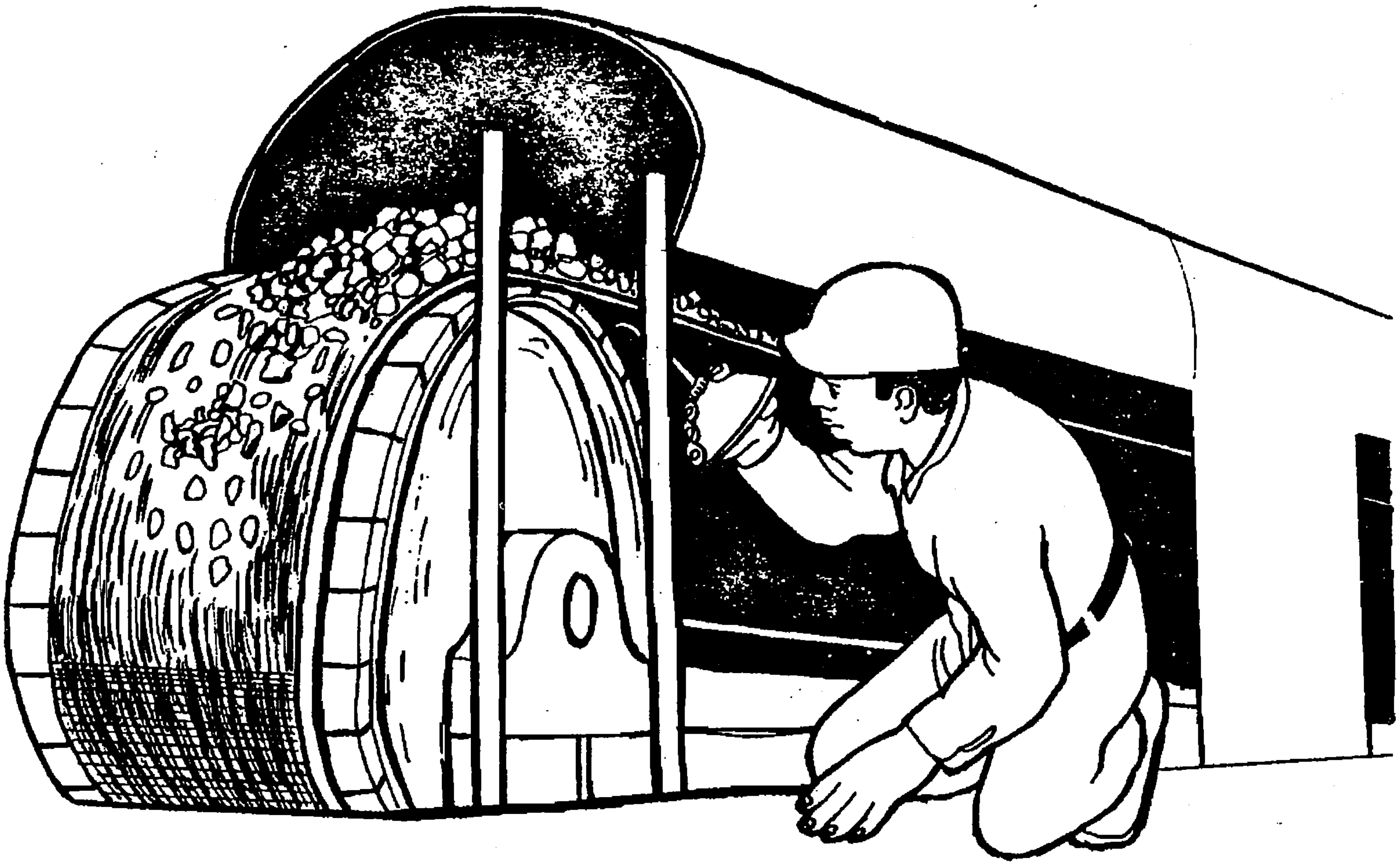
VISUAL 12

KEEP HAIR AND LOOSE CLOTHING
AWAY FROM MACHINERY



VISUAL 13

BEWARE WHILE SERVICING MOVING MACHINERY

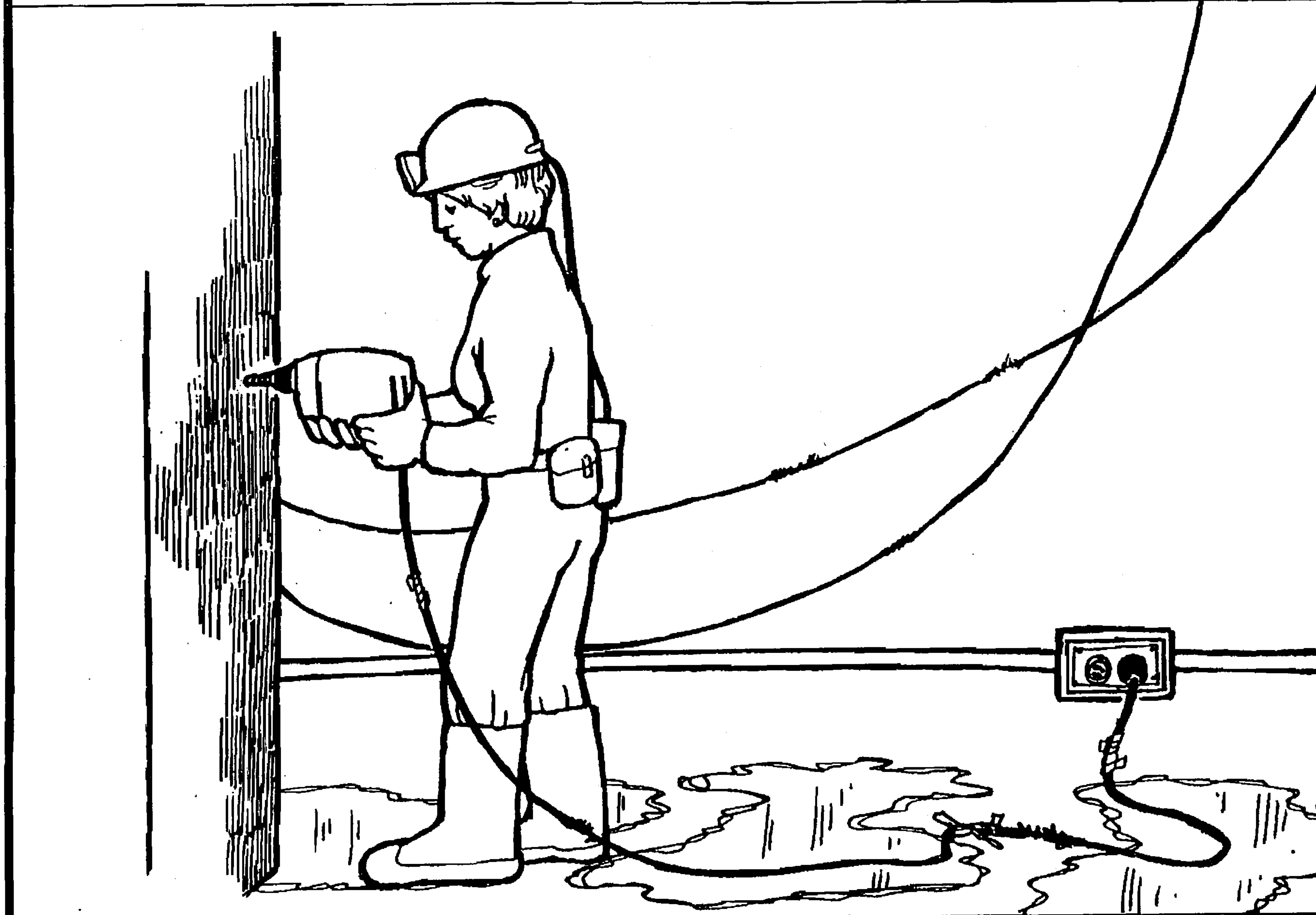


VISUAL 14

AVOID SLIPS AND FALLS

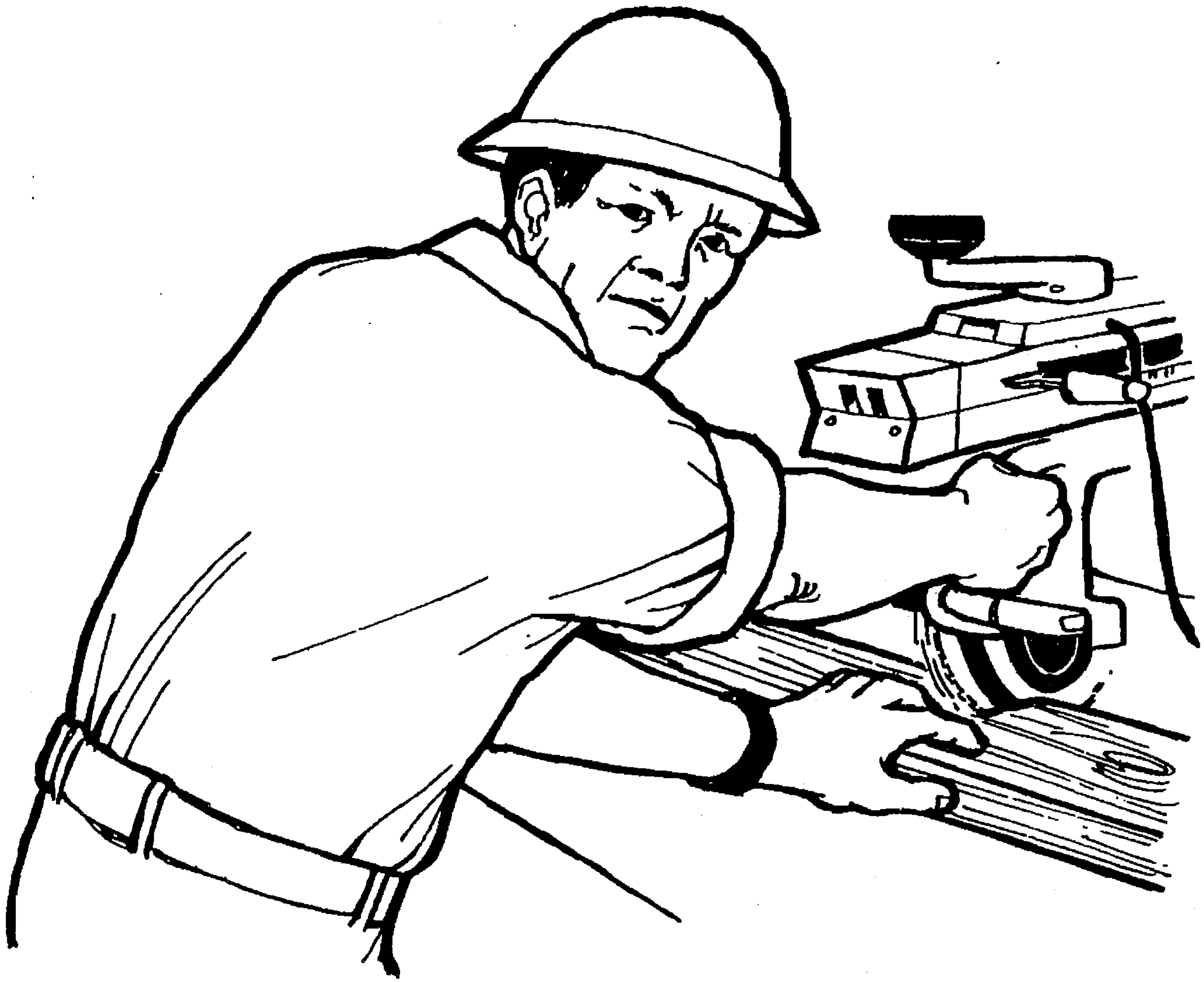
VISUAL 15

INSPECT HAND TOOLS BEFORE USE



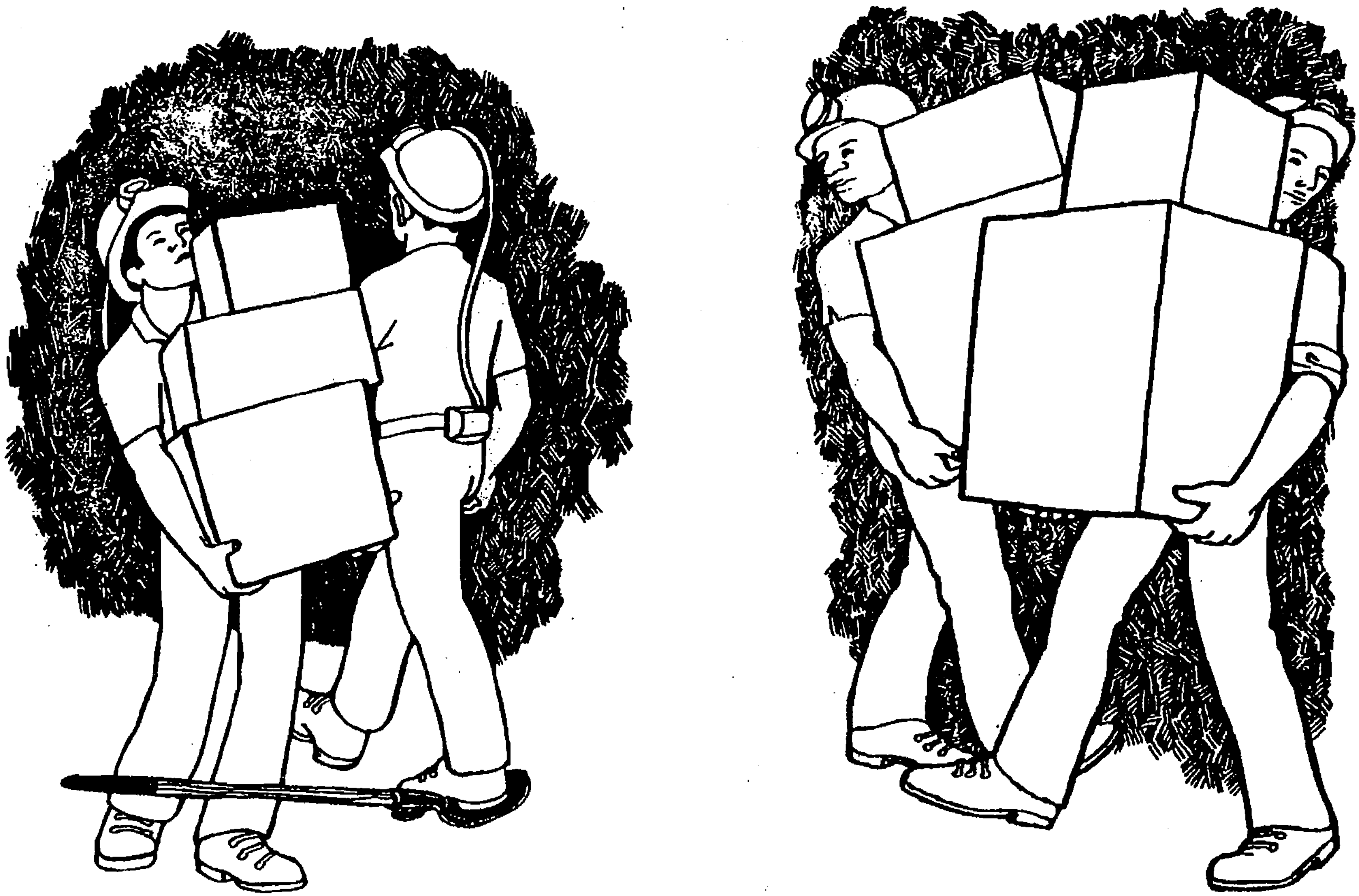
VISUAL 16

USE EQUIPMENT PROPERLY

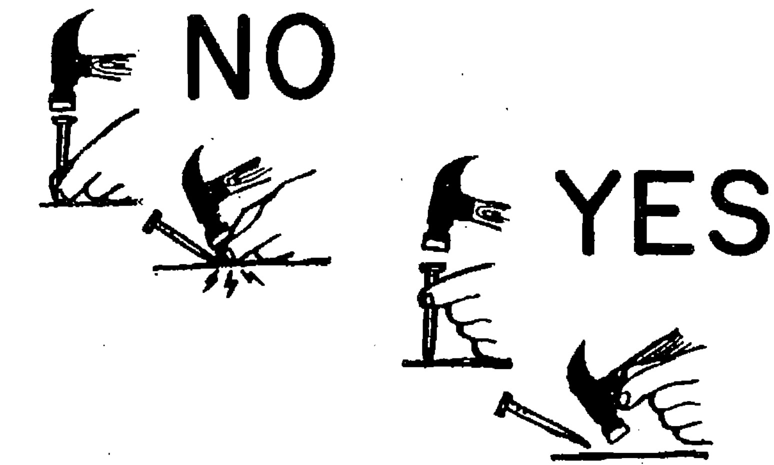


VISUAL 17

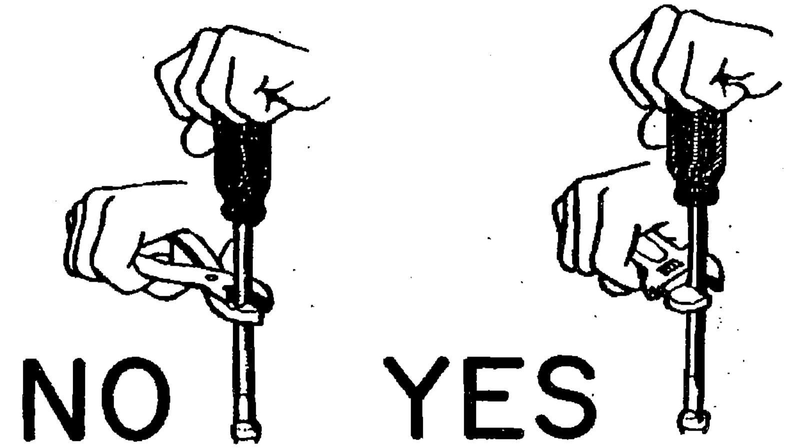
HANDLING MATERIALS



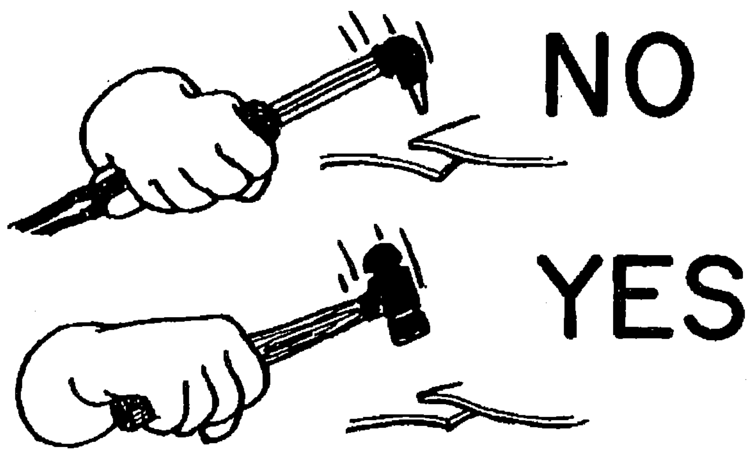
VISUAL 18



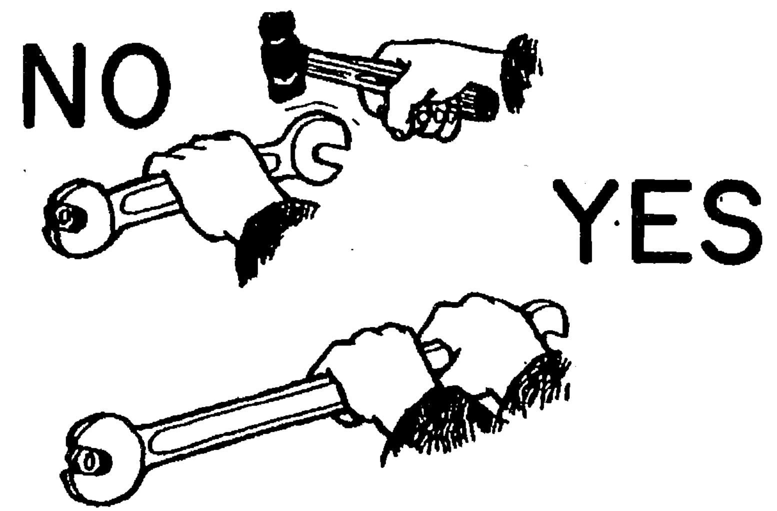
Hold the Nail Near the Head, Not Near the Point



NEVER Use Pliers on a Screwdriver. Use a Wrench ONLY on Square-Shanked Screwdriver.

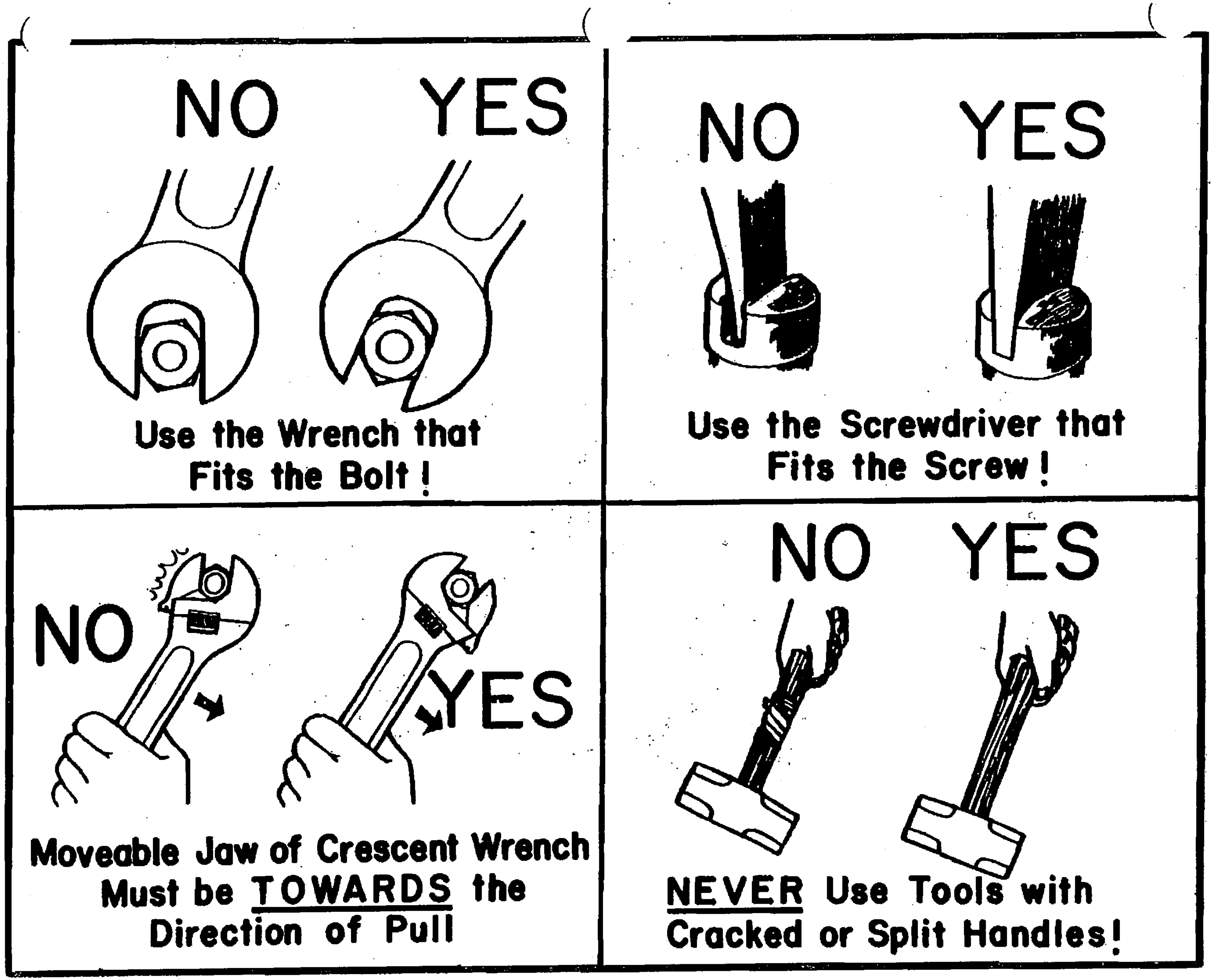


NEVER Use the Torch as a Hammer!



NEVER Force a Wrench with a Hammer — Get a Longer Wrench!

VISUAL 19

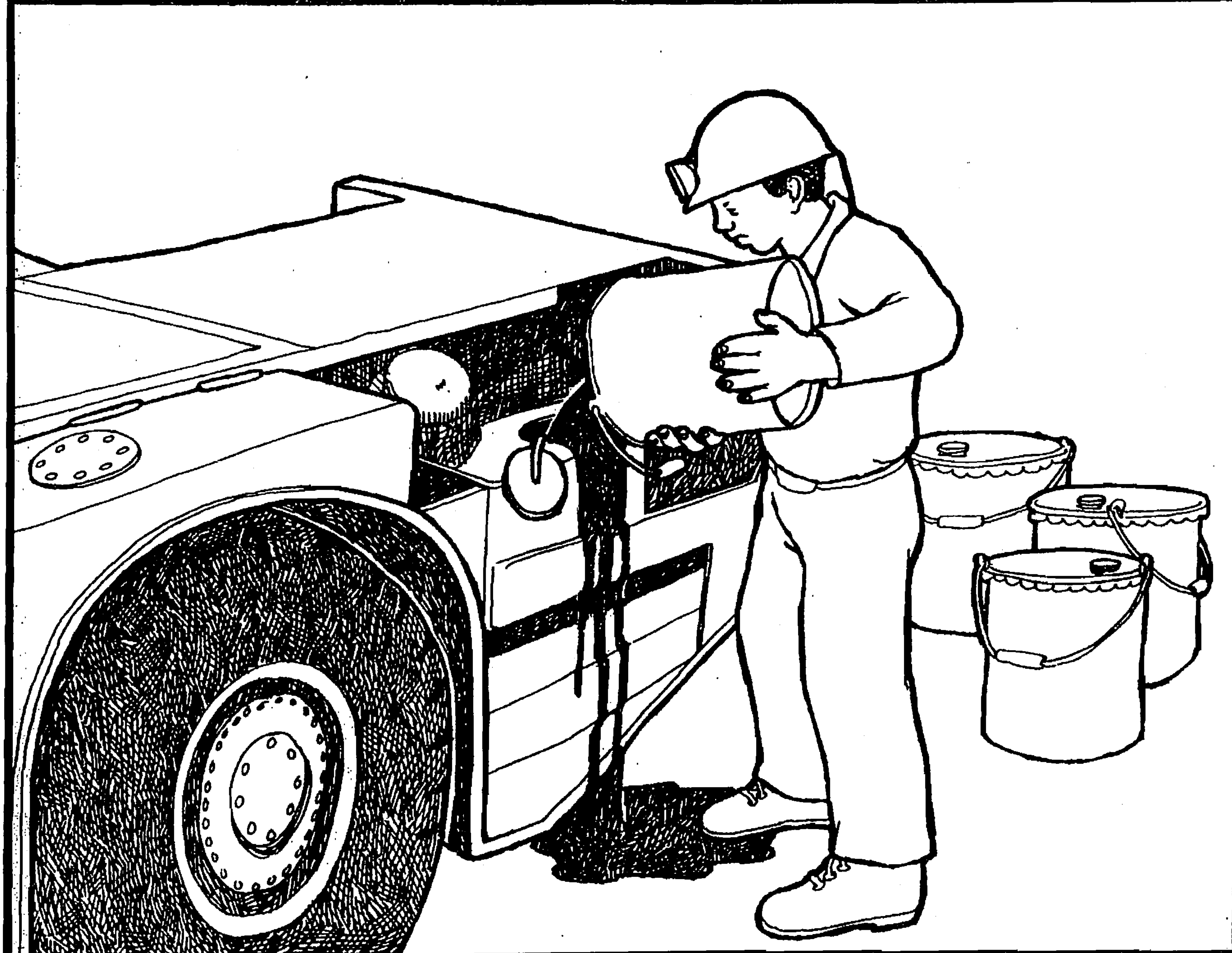

NO
YES
Use the Wrench that
Fits the Bolt !
NO
YES
Use the Screwdriver that
Fits the Screw !
NO
YES
Moveable Jaw of Crescent Wrench
Must be TOWARDS the
Direction of Pull
NO
YES
NEVER Use Tools with
Cracked or Split Handles!

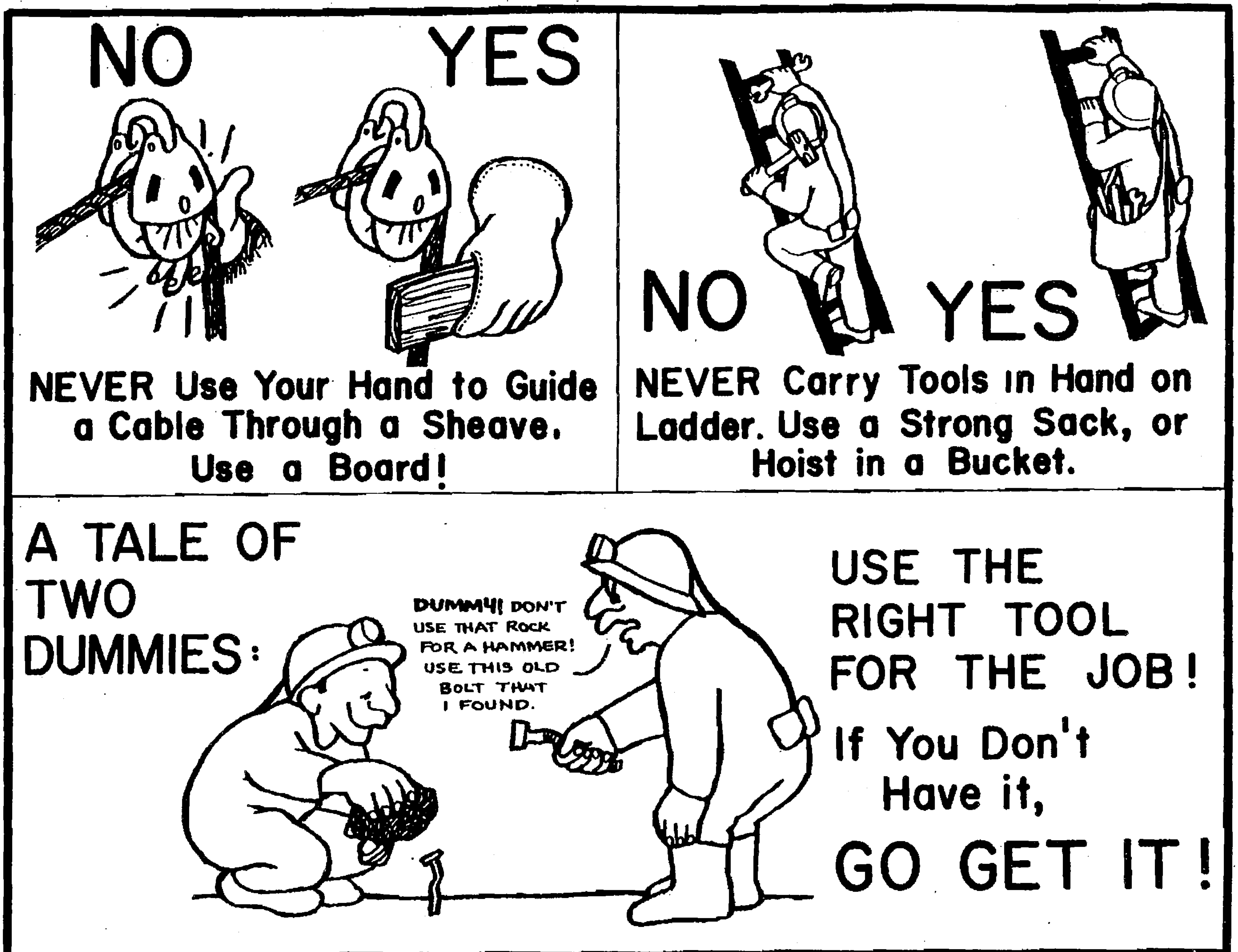
VISUAL 20

MISFIRES ARE DANGEROUS. AVOID MOVING THEM AND REPORT THEM IMMEDIATELY

VISUAL 28

CLEAN UP ALL SPILLS




NO
YES
NEVER Use Your Hand to Guide a Cable Through a Sheave. Use a Board!
NO
YES
NEVER Carry Tools in Hand on Ladder. Use a Strong Sack, or Hoist in a Bucket.
A TALE OF TWO DUMMIES:
DUMMY!! DON'T USE THAT ROCK FOR A HAMMER! USE THIS OLD BOLT THAT I FOUND.
USE THE RIGHT TOOL FOR THE JOB!
If You Don't Have it,
GO GET IT!

VISUAL 47

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

EXPLOSIVES

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: EXPLOSIVES

I. GOAL: The goal of this module is to refresh the miner in how to identify explosives and recognize both the procedures and hazards associated with their use in blasting.

II. BACKGROUND: One of the mining industry's most hazardous situations is the use of explosives. In underground metal and nonmetal mines, explosives accidents present a tremendous hazard to experienced as well as new miners. All miners need to review safe work habits around explosives. This annual refresher training unit is designed to increase miner's awareness of and an alertness toward the hazards involved in the use of explosives.

III. OBJECTIVES

A. Trainer will do the following:

1. Show any new explosives or blasting accessories used at the mine.
2. Discuss hazards associated with explosives, such as transportation hazards and toxic fumes.
3. Describe safe procedures to follow when working rear areas where explosives are used.

B. Trainees will be able to do the following:

1. Answer questions dealing with identifying new explosives or blasting accessories now used in the mine.
2. Identify hazards related to the use of explosives.
3. Describe safe procedures to follow when working with explosives.

IV. MATERIALS

A. Dummy explosives

B. Visual aids contained in the Lesson Guide.

V. RESOURCES

A. Training and Standards

1. CFR 30 Part 48.8-9.
2. CFR 30 Part 57.6-90.

B. Textual materials

1. Manufacturer's explosives manual
2. "Explosives and Blasting". West Virginia University Mining Extension Service, Study Guide Series, Number 5. Available at MSHA Informational Resource Library, Catalog Number 200-408.

C. Films as available.

1. ENT/Gates Films, Inc. - "Developing a Safe Rock Slope."
2. National Coal Board - "How Not to Keep a Head While Shot-Firing."

D. Applicable MSHA Fatalgrams

VI. EVALUATION

A. Demonstrate, describe or identify:

1. Explosives and blasting accessories
2. Hazards with explosives
3. Safety procedures to follow

B. Self Check

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
2. Eliminate the use of self-checks if too difficult for your class.
3. Change written self-check items where necessary to fit your local mine situation.

TOPICS COVERED

I. Hazards in use of explosives

A. Transportation hazards

B. Magazine hazards

C. Blasting hazards

II. Safe work procedures with explosives

A. Task training

B. Clearing the area before firing the shot

C. Re-entering blasting area

D. Reporting the finding of undetonated explosives

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: EXPLOSIVES

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF-CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

I. HAZARDS IN USE OF EXPLOSIVES

A. Transportation hazards

1. The vehicle used to transport explosives should be in good operating condition. If the vehicle were to get a flat tire or lose its brakes it would lead to a serious hazard for everyone. The cargo space in which the explosives are stored should be of non-sparking material. If the vehicle got into an accident with damage to the cargo area, you would want to minimize any sparks that could set off the explosives.
2. Detonators and explosives should be kept apart by at least four inches of hardwood, or transported separately. If a detonator were to accidently fire this would prevent it from setting off any explosives.
3. Explosives should be transported at times when the fewest number of people will be endangered. During shift change or before or after personnel are transported into or out of the mine is usually a good time to bring explosives into the mine.
4. Explosives should not be stacked higher than the sideboards of the vehicle. If the vehicle were to hit a bump some boxes could fall off the side.
5. No smoking is permitted on or near the vehicle. Hot ashes or flames pose a danger when mixed with powder.
6. If ANFO or any other powder is spilled it should be immediately cleaned up.
7. Do not ride on the cage when it is being used to transport explosive material.
8. Vehicles should be driven carefully and excessive speeds should be avoided. Do not drive over unbridged power cables.
9. Vehicles loaded with explosives should not drive into any maintenance area where sparks from welding or stray electric currents could set off explosives.

B. Detonator Hazards

1. Do not let leg wires and detonators come into contact with electrical equipment, wires or rails. These may carry enough of a current to set off the charge.
2. Caps can deteriorate and become more sensitive because of age. Caps may also become useless from such damage as being kinked, exposed to extreme heat, or contaminated with water. They should be properly disposed but only by experienced powdermen.

C. Magazine hazards

1. Magazines must be built in dry, isolated areas of the mine so as to be well ventilated, bullet-proof, locked, and have non-sparking material on the inside wall. It must be marked with a sign located in such a place that if a bullet were to be fired into it the bullet would not pass into the stored powder.
2. Flammable materials such as fuel or oil should not be stored near a magazine.
3. Smoking in and around a magazine is prohibited.
4. Detonators and explosives should not be stored together in the same magazine. Separate magazines for them should be at least 25 feet apart.
5. The magazine must be kept clean of trash, empty boxes, and paper at all times. They are both a fire hazard and a cause of slips and falls.
6. No electric wiring or open lights should be taken into a magazine.
7. Surplus or loose explosives should not be left in unsecured areas such as cuts, passes, or by the outside walls of the magazine.

VISUALS NOTE: PRESENT VISUAL NUMBER 29 SHOWING A LOST DETONATOR ON A HAULAGE TRACK. COMMENT ON SUCH HAZARDS AS THEY MAY EXIST IN YOUR MINE.

D. Blasting hazards

1. A misfire is a loaded hole that fails to fire. The procedure following firing a round is that the blaster or supervisor will inspect the muck pile for misfires. No one else is permitted to enter the area until the all-clear signal is given.
   a. If the blaster finds a misfire he will attempt to re-wire and detonate it or flush it out of the drill hole with water and then dispose of it.

b. In the event the misfire is completely covered by rock, the blaster may not see it. This results in a very dangerous situation. Do not attempt to move it yourself. If you discover a misfire in the rock, work should stop immediately, the area should be cleared and guarded, and the supervisor should be contacted.

c. Toxic fumes may be found after detonation. You can avoid these fumes by remaining out of the blast area until ventilation dilutes the gases and carries them out of the mine.

   i. Carbon monoxide can be detected by observing one of the first symptoms of such poisoning - headache pain.

   ii. Explosives containing nitroglycerine or other nitro compounds may burn rather than detonate. One gas resulting from this is nitrogen dioxide which is extremely dangerous to your lungs in small amounts. It has a burned powder odor.

   iii. Wet ANFO will generate nitrous oxide fumes.

VISUALS NOTE: PRESENT VISUAL NUMBER 28 SHOWING A MINER FINDING A DETONATOR. COMMENT ON THE PROCEDURES HE SHOULD NOW FOLLOW.

2. Overshooting results from either an excessive use of explosives, an improperly sized drill hole, or holes that are not properly placed according to the delay pattern. Undershooting is just the opposite. Overshooting weakens the remaining rock making it susceptible to falls and may require use of supports. Undershooting results in an uneven back and creates haulage problems by having to move larger sized rocks.

3. Fly rock consists of pieces of rock blown from the shot area by the explosive force. This rock can be lethal because of its weight and velocity of travel. Flyrock is also caused by a blowout. When a blast hole is not drilled deep enough into the rock, the explosive force blows the rock out into the drift or work area.

4. Electrical hazards are present if the mine uses electric blasting caps.

   a. Natural sources like static electricity or lighting storms.

   b. Man-made sources like stray electricity and radio transmitters.

   c. Only special galvanometers should be used to test continuity. Regular galvanometers may set off the charge. If you find a cap in the muck pile do not attempt to test the leg wires - only experienced powdermen are equipped to do such work.

   d. Any power equipment with leaking current presents a hazard.
   e. Static charge built up from pneumatic loading equipment.
5. Never drill into a bootleg - it could contain a charge of powder that might detonate when struck by the drill steel. Prior checks of the hole may have accidentally not detected the powder, so do not take any shortcuts.

II. SAFE WORK PROCEDURES WITH EXPLOSIVES

A. Task training is given to the powdercrew to increase their technical skills in the use of explosives. Only experienced people trained in use of explosives or working under close supervision should work with explosives. All other miners should stay out of the way while the powdercrew works unless assigned to the area.

B. Clearing the blast area is very important. Unless the area is secured, other people may unknowingly walk into a life threatening situation from either the blast itself or the toxic fumes that follow the blast.

   1. The blasting crew will clear the area of all personnel, and then give a warning signal before setting off the round. Guards should be posted at all entrances to the area with specific instructions to keep everyone out. Guards should not leave their post even for a moment because someone could walk past without being seen. Guards must remain at their posts until specifically told to return to their regular work.
   2. Equipment should be moved clear of the blast area to prevent damage.
   3. Miners should stand clear of the blast area, such as behind equipment, to protect themselves from being hit by flyrock. Always give yourself enough room to stay clear.

C. Re-entering blasting area. Before resumption of work, a supervisor or blaster will inspect the blast area for misfires and fumes. No one should enter this area past the guards until the all-clear signal is given by this person.

D. Reporting undetonated or misfired explosives. Any miner who discovers an undetonated explosive near a magazine or along a haulageway, or a misfired explosive near their work area shall halt work, clear everyone out of the area and guard it, and notify a supervisor about the hazardous situation. Never attempt to move the explosive yourself because it may be very unstable and could go off in your hand.

EVALUATION NOTES: HAVE TRAINEES ANSWER SELF-CHECK ONE OR TWO. MINERS MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN EXPLOSIVES AND BLASTING ACCESSORIES, HAZARDS IN USE OF EXPLOSIVES, AND SAFE WORK PROCEDURES.

SELF CHECK #1: SOLUTIONS

1. Answers will vary according to mine situation.
2. false
3. false
4. electric blasting cap
5. false
6. false
7. a. Vehicle should be in good condition, with cargo space of non-sparking material.
   b. Detonators and explosives should be separated by at least four inches of hardwood or transported separately.
   c. Transportation should take place when fewest people would be endangered.
8. true
9. false
10. Sample answer: Magazine must be built in dry, isolated areas of the mine in order to be well ventilated, electrically grounded, bullet-proof, locked, and built with non-sparking material inside.
11. false
12. Instructor must check answers individually.

SELF CHECK #2: SOLUTIONS

1. A. 57.6-53, 57.6-48, 57.6-2

2. True

3. True

4. Intake air

5. moisture in the explosive
   charges loosley spaced
   cartridges damaged or torn open

6. Force explosion evenly in all directions and prevent blow out.

Self Check: Explosives

Self Check #1: Permissible Explosives and Firing Devices, Hazards in Use of Explosives, and Safe Work Procedures with Explosives

1. Name the kind of explosives used at your mine, and tell how they can be identified.

2. Using more explosives than necessary is one way of making sure the job is done right. (true, false).

3. Guards are allowed to move from their post once they hear the charge go off. (true, false).

4. An ______________________________ consists of a metal shell loaded with several explosive charges and an electrical ignition element attached to a pair of insulated wires.

5. Any miner can help an experienced blaster set a charge as long as the blaster observes his work. (true, false).

6. Miners may safely smoke around magazines as long as there is adequate ventilation. (true, false)

7. List 3 hazards in transporting explosives.

   a.

   b.

   c.

8. Miners should always take cover during blasting, even at long distances, because hard hats are not sufficient protection from fly rock. (true, false)

9. Electric blasting caps can safely be exposed to static electric charges. (true, false).

10. Describe a properly built explosives magazine.

11. A miner, having taken this course is qualified to return to a blast area and check for misfires. (true, false).

12. Name the person you would contact if you found an electric blasting cap in your drift _____________.

Self Check #2

1. It was the end of his shift and Ray was transporting unused detonators back from the face to the storage magazine. He offerred his fellow miners a ride back to the entrance. When Ray and his friends arrived at the storage area he found that he did not have the key to unlock the detonator magazine but could unlock the explosive magazine. Ray and his fellow miners stacked the detonators in the explosive magazine and forgot to lock the magazine door.

   A. Can you find any regulation violations in this incident?

2. When explosives are detonated they produce toxic gases. (True, False)

3. If detonation fails and the explosive powder burns, toxic gases are produced in larger amount than if the powder had exploded (True, False)

4. In order to avoid toxic gases after an explosion, you must remain in the ____________________ current.

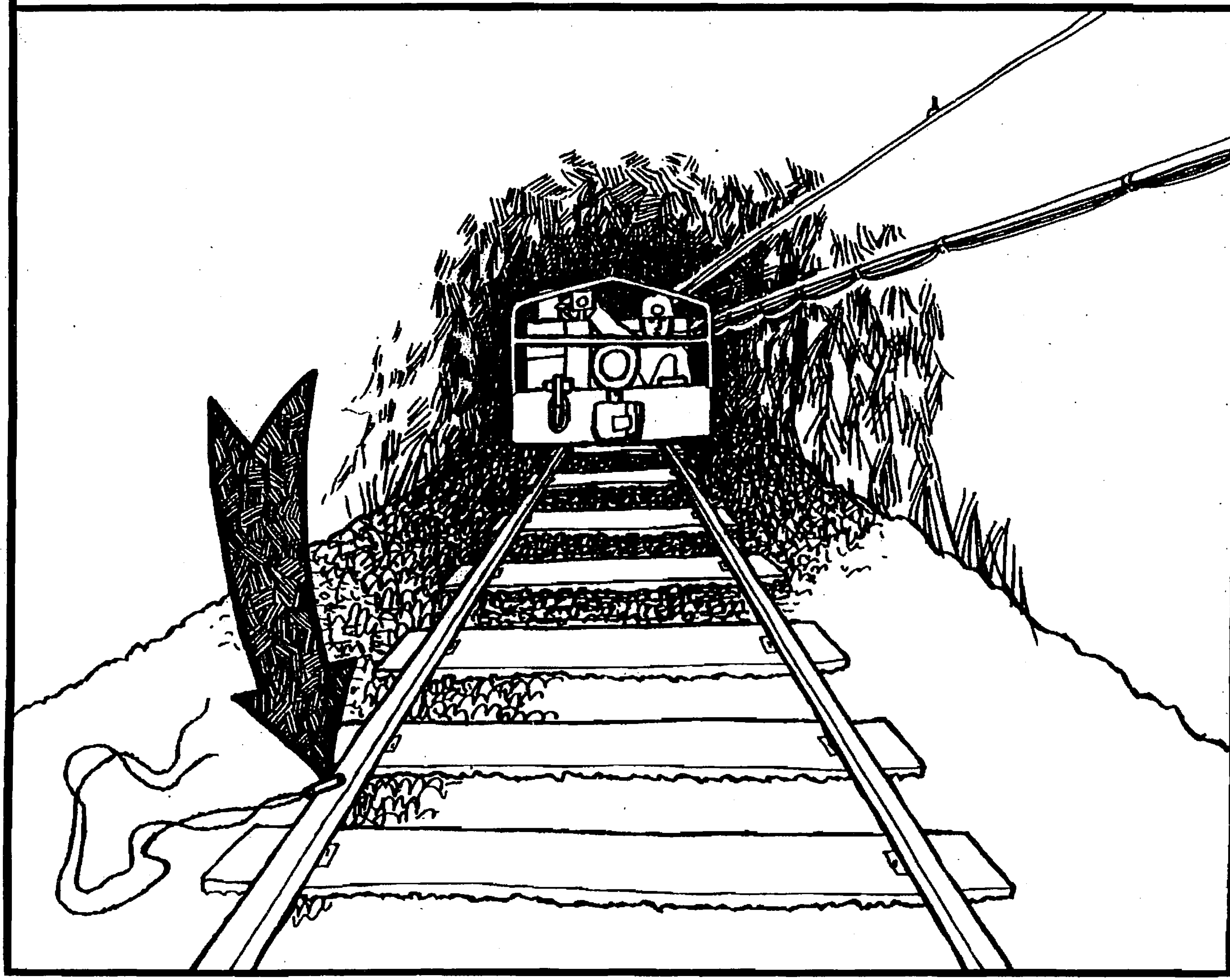
5. List two conditions that may cause power to burn rather than detonate.

6. Stemming is done for two reasons. What are the reasons?

MISFIRES ARE DANGEROUS. AVOID MOVING THEM AND REPORT THEM IMMEDIATELY

VISUAL 28

LOOK OUT FOR LOST EXPLOSIVES



VISUAL 29

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

MINE GASES

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: MINE GASES AND TOXIC MATERIALS

I. GOAL: The goal of this module is to refresh the miner on how to recognize and respond to hazardous mine gas or toxic materials.

II. BACKGROUND: The severity of explosives accidents due to mine gases has been a problem both in fatalities and days lost from work. The fact that a build up of gas concentration can occur undetected by the miner makes it extremely important to refresh the miners awareness of this hazard.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe properties of gases
2. Demonstrate methods of testing for gases
3. Disucss control of mine gas hazards
4. Identify toxic substances used in mine and discuss procedures for handling them

B. Trainees will be able to do the following:

1. Describe techniques for recognizing gases.
2. Discuss properties of various gases.
3. Describe procedures to follow in presence of the gases.
4. Identify toxic substances used in the mine and procedures for handling.

IV. MATERIAL AND RESOURCES

A. Permissible gas detectors and measuring devices

B. Training and Enforcement Standards

1. CFR 30 Part 48.8-10
2. CFR 30 Part 57.5-1 through 6, Part 57.5-10, Part 57.5-15, 16
3. CFR 30 Part 57.5-34, 37, 41, 44-47 (Uranium)

C. Textual Materials

1. MESA Safety Manual No. 2 - Mine Gases
2. NMHSA-CE-002 Mine Gases
3. Mine Gases, Mining Extension Service, West Virginia Unviersity, Study Guide Series, No. 13.

D. Applicable MSHA Fatalgrams

V. EVALUATION- Self Check

A. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.
B. Eliminate the use of self checks if too difficult for your class.
C. Change written self check items where necessary to fit your local mine situation.

TOPICS COVERED

I. Properties of mine gases and dusts (source, properties, and effects on health)

A. Nitrogen

B. Carbon dioxide

C. Carbon monoxide

D. Oxides of nitrogen

1. Nitric oxide
2. Nitrogen dioxide

E. Sulfur dioxide

F. Hydrogen sulfide

G. Hydrogen

H. Acetylene

I. Gas mixtures

J. Smoke

K. Silica dust

L. Asbestos dust

M. Radon and thoron daughters

II. Methods of testing for gases

A. Company policy regarding air quality

B. Testing for amount of oxygen

C. Testing for amount of carbon monoxide

D. Testing for amounts of other gases

III. Control of mine gas hazards

A. Adequate ventilation

B. Emergency response to hazardous gas conditions

IV. Toxic materials in the mine

A. Types of toxic materials used in the mine

B. Procedures for handling toxic materials

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: MINE GASES AND TOXIC MATERIALS

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

I. PROPERTIES AND EFFECTS OF MINE GASES AND DUSTS

A. Nitrogen

1. Released from the detonation of explosives and gas blowers
2. It is colorless, odorless and tasteless
3. Excessive amounts of nitrogen produce an asphyxiating atmosphere that will not support life.

B. Carbon dioxide

1. Produced by people, fires, and explosions
2. Carbon dioxide is colorless, odorless and tasteless
3. Carbon dioxide is not poisonous at smaller concerntrations, but at 3% breathing is faster, and at 12% people lose consciousness.

C. Carbon monoxide

1. Produced by fires, explosions, and diesel engines. Gases remaining after an explosion or fire always contain carbon monoxide.
2. Carbon monoxide is colorless, odorless and tasteless
3. Symptoms of increased carbon monoxide poisoning are:

   a. Slight tightening across forehead
   b. Throbbing, temples and headache
   c. Severe headache and dizziness
   d. Rapid pulse and flushed color
   e. Unconsciousness and death

INSTRUCTOR'S NOTE: YOU MAY WANT TO REVIEW ALL OF THE FOLLOWING GASES, OR SELECT THOSE WITH WHICH YOUR MINE HAS THE MOST EXPERIENCE. IF THE MINE HAS HAD AN ACCIDENT RELATED TO HAZARDOUS GASES, YOU MAY WANT TO REVIEW THE CIRCUMSTANCES SURROUNDING THE ACCIDENT.

VISUALS NOTE: SHOW VISUAL 26 ILLUSTRATING EFFECTS OF INCREASED PERCENTAGES OF CARBON MONOXIDE IN THE AIR ON HEALTH AND WORK ACTIVITY.

D. Oxides of nitrogen are nitric oxide and nitrogen dioxide

1. Produced by diesel engines, electrical discharges, and detonation of explosives
2. Both have an irritating odor. Nitrogen dioxide has a brick red color at higher concentrations.
3. They are extremely toxic in small amounts

E. Sulfur dioxide

1. Formed in fires or detonation of explosions in mines containing iron pyrite.
2. Detected by its irritating sulfur smell

F. Hydrogen sulfide

1. Produced when blasting for sulfide ores and occurs in some natural gas, oil, and coal fields.
2. Colorless but has an odor of rotten eggs
3. Very toxic

    a. Irritation of eyes and nose at lower concentrations
    b. Eye inflammation and intense pain at higher concentrations.

G. Hydrogen

1. Not normally found in mine air, but is produced during the charging of batteries
2. Colorless, odorless and tasteless
3. Flammable at concentrations of 4% and greater

H. Acetylene

1. Used for lighting purposes in non-gassy mines as well as welding
2. Smells like geraniums
3. Not poisonous, but combustible in small amounts

I. Most of the above gases occur in mixtures. One such mixture is rock gas, which consists of nitrogen and carbon dioxide. Rock gas creates a hazardous oxygen deficient atmosphere. Rock gas enters the mine from adjacent rock strata.

J. Smoke consists of small particles of soot and tars. These particles irritate the nose and throat, but are not poisonous unless mixed with carbon monoxide.

K. Silica dust

1. Is part of ore being mined
2. Results in lung disease known as silicosis, contraction of which depends on the length of exposure and the free silica content in the ore
3. Suppressed by dust control measures and ventilation

L. Asbestos dust

1. Is part of the ore being mined
2. Contributes to the development of lung cancer
3. Suppressed by dust control measures and ventilation.

M. Radon and thoron daughters

1. Released from radon and thoron gases in uranium ore.
2. Excessive exposure results in lung cancer, especially among tobacco smokers.
3. Suppressed by ventilation and monitoring of miner exposure.

INSTRUCTOR NOTE: A MORE DETAILED DISCUSSION OF SILICA AND ASBESTOS DUSTS, AS WELL AS RADON AND THORON DAUGHTERS, IS CONTAINED IN THE MODULE ON HEALTH.

INSTRUCTOR NOTE: THE FOLLOWING SECTION CONCERNS COMPANY POLICY FOR AIR QUALITY. THIS SECTION STARTS WITH A REVIEW OF THAT POLICY, INCLUDING THE SCHEDULE FOR AIR TESTING WHICH YOU SHOULD PRESENT NOW.

II. METHODS OF TESTING FOR GASES

A. Company policy regarding air quality: Permissible levels of contaminants.

B. The level of oxygen is tested with various liquid absorption devices, fuel cells, or the flame safety lamp.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE OXYGEN TEST DEVICE AND HOW IT WORKS.

C. The level of carbon monoxide is tested with a detector tube. The tube contains a chemical which changes color in relation to the amount of carbon monoxide in the air.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE CARBON MONOXIDE TEST DEVICE AND HOW IT WORKS.

D. The levels of sulfur dioxide, hydrogen sulfide, and oxides of nitrogen are measured with indicator tubes. The tube contains a chemical which changes color in relation to the amount of gas in the air.

DEMONSTRATION NOTE: SHOW THE TRAINEES THE INDICATOR TUBE TEST DEVICE AND HOW IT WORKS.

III. CONTROL OF MINE GAS HAZARDS

A. The best defense against accumulation of toxic gases is adequate ventilation to dilute and carry away the gases.

B. Hazardous gas conditions call for emergency responses, such as

1. Warning other miners of the danger
2. Use your self-rescuer and keep it on.
3. Move to fresh intake air because the ventilation system will move the poisonous gases toward the return air.

IV. TOXIC MATERIALS IN THE MINE

A. Types of toxic materials used in the mine

1. Caustic materials
2. Other materials

INSTRUCTOR NOTE: PREPARE A LIST OF ANY TOXIC MATERIALS USED IN THE MINE, SUCH AS SOLVENTS OR GLUES. IN THE FOLLOWING SECTION DISCUSS PROCEDURES FOR HANDLING THESE SUBSTANCES.

B. Review procedures for handling toxic materials

C. Review procedures for emergencies involving toxic or caustic materials

EVALUATION NOTE: HAVE TRAINEES ANSWER SELF-CHECKS. TRAINEES MAY ANSWER QUESTIONS INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE THE SELF CHECKS ON ALTERNATE YEARS. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. THESE QUESTIONS CONCERN METHODS FOR TESTING GASES AND CONTROL OF MINE GAS HAZARDS.

SELF CHECK #1: SOLUTIONS

1.	false	6.	false
2.	true	7.	true
3.	false	8.	true
4.	false	9.	false
5.	true	10.	false

SELF CHECK #2: SOLUTIONS

1. Answers will vary depending on your mine situation
2. a. warn other miners.

   b. use your self rescuer if you suspect carbon monoxide is in the air.

   c. move to fresh intake air.
3. Carbon monoxide and afterdamp should be checked.

SELF CHECK #3: SOLUTIONS

1. Answers will vary
2. Answers will vary according to cases
3. Answers will vary
4. false
5. false
6. false
7. false
8. a. shut off anything that could ignite an explosion, warn others in the area and immediately notify your supervisor.

   b. Yes, hydrogen gas is given off during the charging process. It is an explosive gas.
9. false
10. true

SELF CHECK: MINE GASES AND TOXIC MATERIALS

SELF CHECK #1: NEED FOR OXYGEN, EFFECTS OF GASES, AND PROPERTIES OF MINE GASES

Answer true of false

_______ 1. A miner consumes the same amount of oxygen regardless of how hard he is working.

_______ 2. Oxygen-deficient air can be caused by the presence of increasing amount of non-toxic gases.

_______ 3. Oxygen-deficient air is solely caused by inadequate ventilation through the mine.

_______ 4. Although the law requires at least 19.5% oxygen in mine air, miners have no difficulty in working in areas with much smaller amount of oxygen.

_______ 5. One reason gases such as nitrogen, carbon dioxide, carbon monoxide, are hazardous is because they decrease the oxygen content in the air.

_______ 6. A slight tightening across the forehead, dizziness, and a severe headache are symptoms of increased poisoning from methane.

_______ 7. Hydrogen, hydrogen sulfide, acetylene, and methane are all dangerous combustible gases that may be found in mine air.

_______ 8. Dust control measures & ventilation are effective measures in suppressing silica dust and asbestos dust, and radon and thoron daughters.

_______ 9. Rock gas consists of nitrogen and carbon dioxide and is hazardous because it is combustible in small amounts.

_______ 10. The sources of most hazardous mine gases are limited to electrical discharges, the ore itself, and diesel engines.

SELF CHECK #2: METHODS FOR TESTING GASES, CONTROL OF MINE GAS HAZARDS & TOXIC MATERIALS IN THE MINE

1. Name the device used to test for the levels of the following gases:

    a. Oxygen

    b. Carbon monoxide

    c. Sulfur dioxide

    d. Hydrogen sulfide

    e. Oxides of nitrogen

    f. Methane

2. Name 3 emergency actions you should take under hazardous gas conditions.

    a.

    b.

    c.

3. Place a check beside those gases from which your self-rescuer protects you.

    a. Methane ______

    b. Rock gas ______

    c. Carbon monoxide ______

    d. Afterdamp ______

    e. Oxides of nitrogen ______

SELF CHECK #3:

1. List those gases that have been or potentially could be found in your mine.

2. Name the hazards associated with each gas listed in number one.

3. Who on your shift is responsible for the testing for mine gases and how often is this test conducted?

4. Methane in higher concentrations can be seen and has a strong odor. (true, false)

5. The main danger of methane is its toxic qualities. (true, false)

6. Carbon monoxide is dangerous because of its explosive qualities. (true, false)

7. The concentration of gases produced by an explosion are never high enough to be harmful to a miner. (true, false)

8. You are near the battery charging station and you notice that the ventilation system is not working. a. What should you do? b. Is there a hazard involved? If so, what is it?

9. If you are exposed to a high concentration of any of the mine gases, you will always have time to reach safety. (true, false)

10. Diesel engines do produce carbon monoxide and oxides of nitrogen. (true, false)

Fatalgram

U.S Department of Labor
Mine Safety and Health Administration
Metal and Nonmetal Mine Safety and Health Activity

date February 25, 1981

A 27-YEAR-OLD MINER WITH 6 1/2 YEARS OF MINING EXPERIENCE, 7 MONTHS IN HIS CURRENT JOB, DIED OF CARBON MONOXIDE POISONING IN AN UNVENTILATED MINE HEADING.

THE VICTIM AND HIS PARTNER HAD THE TASK OF MUCKING OUT THE HEADING, WHICH HAD BEEN SHOT AT THE END OF THE EVENING SHIFT THE PREVIOUS DAY. THE AIR APPEARED CLEAR, SO THEY STARTED TO WORK, BUT BOTH FELT UNWELL AFTER A FEW MINUTES AND LEFT. THEY BARELY REACHED THE SHAFT STATION ONLY 50 FEET AWAY AND WERE UNABLE TO SIGNAL TO BE HOISTED. THEY WERE FOUND A LITTLE LATER IN THE MUCK BUCKET AND THEN HOISTED, BUT THIS WAS IN TIME FOR ONLY ONE TO RECOVER.

THE OPERATION WAS A LEAD-COPPER-SILVER-GOLD VEIN MINE, AND THIS ACCIDENT OCCURRED ON THE BOTTOM DRIFT OF FOUR. IT WAS CUSTOMARY TO LEAVE AIR TURNED ON WHEN FIRING AT THE END OF A SHIFT, BUT IT WAS FORGOTTEN THIS TIME, AND THE MORNING CREW FAILED TO RECOGNIZE THIS.

RECOMMENDATIONS:

1. The supervisor or a competent person designated by him shall examine working area for unsafe conditions at the beginning of each shift. Any unsafe condition encountered shall be corrected immediately.

57.3-8 (Mandatory)

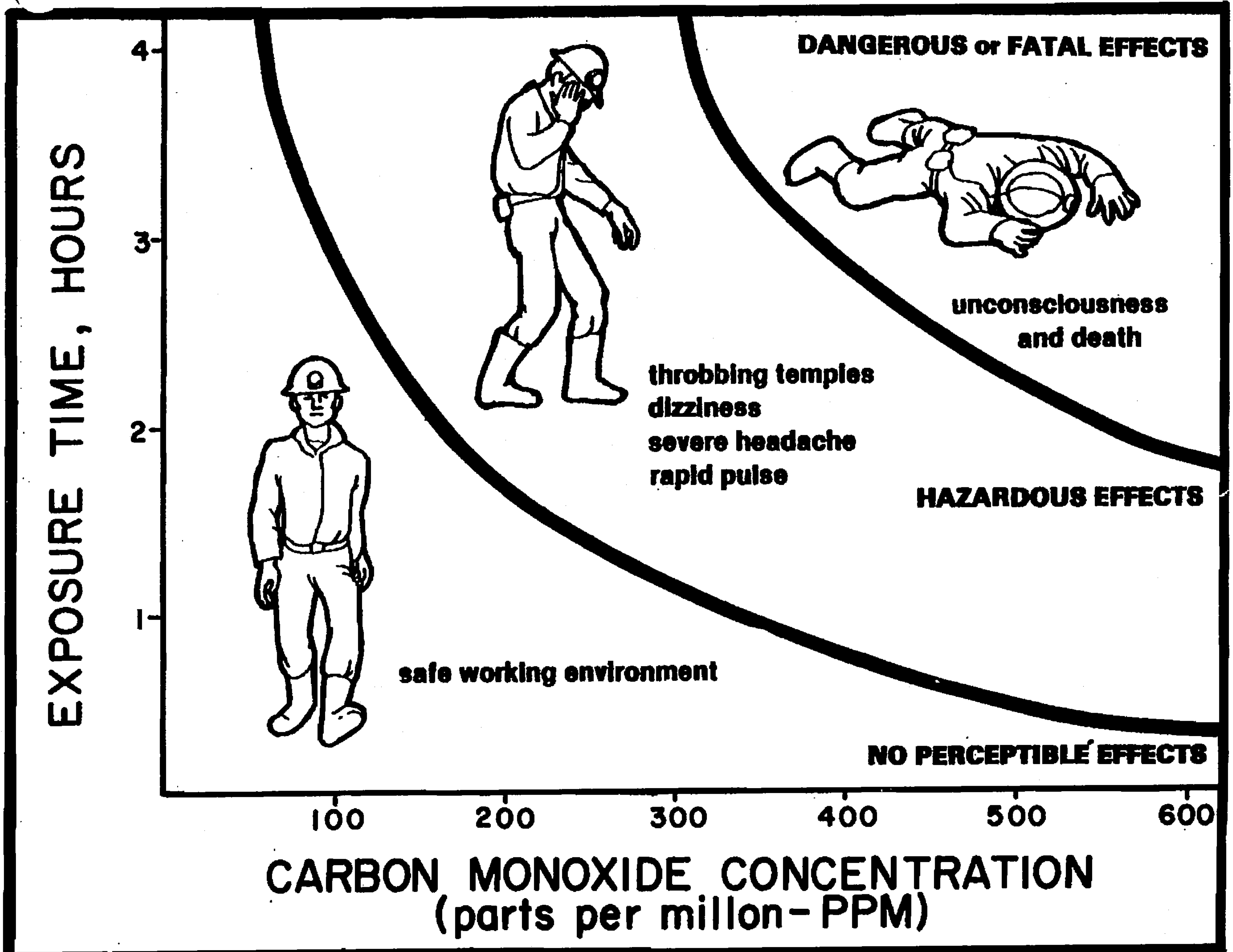
81-013

DEATH TOLL Period covered: January through November

Year	Underground	Surface	Mills	Total
1979	26	59	26	111
1980	18	48	27	[illegible]

DO YOUR PART TO KEEP THE TOLL DOWN!
SAFETY IS EVERYBODY'S BUSINESS

☆U.S. Government Printing Office: 1980—777-064/26


EXPOSURE TIME, HOURS
4
3
2
1
DANGEROUS or FATAL EFFECTS
unconsciousness
and death
throbbing temples
dizziness
severe headache
rapid pulse
HAZARDOUS EFFECTS
safe working environment
NO PERCEPTIBLE EFFECTS
100
200
300
400
500
600
CARBON MONOXIDE CONCENTRATION
(parts per millon-PPM)

VISUAL 26

ANNUAL REFRESHER TRAINING

DEEP METAL/NONMETAL

HEALTH

1981

THE BENDIX CORPORATION
ENERGY, ENVIRONMENT AND TECHNOLOGY OFFICE
2582 South Tejon Street
ENGLEWOOD, COLORADO 80110
303-922-6394

ANNUAL REFRESHER

DEEP METAL/NONMETAL

COURSE PLAN: HEALTH

I. GOAL: The goal of this module is to have miners review health hazards which may exist in their working environment and discuss appropriate precautions in order to avoid being affected by these hazards.

II. BACKGROUND: It is generally recognized that mining is one of the most hazardous occupations in America. May hazards to health are brought about by underground operations, including loud noises from equipment and machinery, toxic materials used in the work area, and danger to lungs from airborne particles. Annual refresher training reminds miners that lack of awareness of hazardous conditions through daily contact is an almost certain invitation to personal injury or death.

III. OBJECTIVES

A. Trainer will do the following:

1. Describe types of airborne particles in mine air and their effects on health.
2. Discuss methods for controlling and measuring airborne particles, including their tolerance limits.
3. Identify sources of noise in the mine and discuss the effects of noise on health.
4. Demonstrate measurement instruments and protective equipment for noise control.
5. Identify toxic materials used in the mine and their effects on health.

B. Trainees will be able to do the following:

1. Describe airborne particles and their effects on health.
2. Discuss controls and measurement of airborne particles.
3. Describe noise and its effects on health.
4. Describe noise control, and demonstrate measurement instruments and protective equipment.
5. Identify toxic materials used in the mine.

IV. MATERIALS AND RESOURCES

A. Visual aids

B. Training and enforcement standards

1. CFR 30 Part 48.8-11
2. CFR 30 or Part 57.5
3. CFR 30 or Part 57.5
4. CFR 30 Part 57.5-34, 57.5-37 through 47.

C. Textual materials

1. Hearing and Noise in Industry by William Burns
2. Gravimetric Mass Respirable Dust Sampling - Metal and Nonmetal Mining Industry. MESA Instruction Guide Number 33. Available from MSHA Technical Support Group.
3. Heat Stress in Hot U.S. Mines and Criteria for Standards for Mining in Hot Environments. MESA Informational Report 1048.

D. Films

1. MSHA Film No. 845 - Breath and Live: Ventilation in Metal and Nonmetal Mines

E. Applicable MSHA fatalgrams

V. EVALUATION

A. Demonstrate, describe or identify:

1. Types of airborne particles occurring in the mine and their effects
2. Health hazards from noise, and toxic materials,

B. Self Check

1. Any time hands on appraisal such as operating equipment or walking prescribed routes is possible it should be used.

2. Eliminate the use of self-checks if too difficult for your class.

3. Change written self-check items where necessary to fit your local mine situation.

TOPICS COVERED

I. TYPES OF AIRBORNE PARTICLES AND EFFECTS ON HEALTH

A. Nuisance respirable dust

B. Fibrogenic respirable dust

1. Effects on lungs
2. major, minor, and benign pneumoconiosis

C. Factors that determine harmfulness of dust

1. Composition
2. Concentration
3. Particle size
4. Exposure time

II. CONTROL MEASURES FOR AIRBORNE PARTICLES

A. Ventilation
B. Respiratory devices
C. Water sprays

III. NOISE

A. Hearing loss

1. Temporary loss
2. Nerve deafness
3. Conductive loss

B. Noise control

1. Measurement instruments
2. Personal protection equipment

ANNUAL REFRESHER

DEEP METAL/NONMETAL

LESSON GUIDE AND MATERIALS: HEALTH

INSTRUCTOR NOTE: AS A PRETEST, ASSESS THE MINERS' KNOWLEDGE OF THE MATERIAL COVERED IN THIS MODULE BY POSING QUESTIONS AND/OR ADMINISTERING THE SELF CHECKS. IF YOU FEEL THAT MOST OF THE MINERS HAVE ADEQUATE KNOWLEDGE OF THIS MATERIAL, YOU MAY WANT TO FORGO THE LECTURE AND FACILITATE A CLASS DISCUSSION WHICH COVERS ALL MAJOR POINTS IN THIS LESSON GUIDE.

INSTRUCTOR'S NOTE: THIS MODULE COVERS SEVERAL HEALTH-RELATED TOPICS. YOU MAY WANT TO DISCUSS EACH TOPIC THOROUGHLY OR FOCUS ON TOPICS OF MOST RELEVANCE TO YOUR MINE. FOR SOME TOPICS HAVE THE MINERS DISCUSS THEIR OWN PERSONAL EXPERIENCE.

I. TYPES OF AIRBORNE PARTICLES AND THEIR EFFECTS ON HEALTH.

A. Respirable and nonrespirable dust.

1. Nonrespirable dust is less dangerous; larger particles are filtered out by the nose and throat.
2. Respirable dust is more dangerous; particles are invisible to the eye.

B. Nuisance respirable dust.

1. Little effect on lungs.
2. Any reaction is potentially reversible.

C. Fibrogenic respirable dust (e.g., asbestos, quartz)

1. Small particles enter lower lungs. Accumulations of particles cause scar tissue to be formed. Scar tissue interferes with transfer of oxygen and carbon dioxide through the lungs.
2. Silicosis is lung fibrosis caused by prolonged inhalation of silica dust.
3. Pneumoconiosis is a generic term describing several types of respiratory ailments, one of which is coal workers' pneumoconiosis.

a. Major pneumoconiosis - lung disorder developed over a prolonged time causing disabling symptoms, is irreversible, and shortens life expectancy. Includes silica dioxide dusts, such as asbestos, quartz, and coal.

b. Minor pneumoconiosis - dust causes little or no inflammation and no major fibrosis, but can cause mechanical irritation of the lungs. Includes micas, clays, feldspars, and anthracite.

c. Benign penumoconiosis - similar to minor pneumoconiosis. Includes calcium from limestone, marble, or cement; graphite; titanium dioxide; stannic dioxide; ferric oxide; and barium sulfate or oxide.

II. CONTROL MEASURES FOR AIRBORNE PARTICLES

A. Ventilation dilutes the concentration of dust and carries it out of the mine.
B. Respirators that filter dust.
C. Water sprays

VISUALS NOTE: SHOW VISUALS 37 and 38 ILLUSTRATING NOISE LEVELS AND PERMISSIBLE NOISE EXPOSURE LEVELS.

III. NOISE

A. Hearing loss

1. Temporary loss at certain sound frequencies but hearing recovers after a period of time.
2. Permanent loss.
   a. Nerve deafness concerns the nerve cells of the inner ear and results from exposure to high noise levels and can rarely be corrected.
   b. Conductive loss comes from infection, wax, or a perforated eardrum. Hearing is still possible, especially with the use of hearing aids.

B. Noise Control

A. Measurement instruments.

1. Sound level meters
2. Time schedule for sampling

DEMONSTRATION NOTE: YOU MAY WANT TO SHOW HOW A SOUND LEVEL METER FUNCTIONS TO YOUR TRAINEES.

2. Personal protection equipment.

   a. Ear plugs
   b. Ear muffs

IV. HAZARDS FROM TOXIC, ALL OR NOXIOUS MATERIALS

A. Types of toxic, costic or noxious substances used in the mine.

B. Procedures for handling toxic, costic or noxious substances.

INSTRUCTOR'S NOTE: YOUR DISCUSSION OF TOXIC MATERIALS SHOULD COVER HEALTH AND SAFETY PROBLEMS WITH TOXIC, ALL OR NOXIOUS MATERIALS USED IN YOUR MINE OR MILL. MAKE A LIST OF SUCH ITEMS e.g., SOLVENTS, SPRAY PAINT, CLEANERS, ACIDS, RESINS, RAT POISONS, ETC. AND REVIEW MANUFACTURE'S HANDLING AND ANTIDOTE PROCEDURES.

EVALUATION NOTE: HAVE MINERS ANSWER SELF-CHECKS. MINERS MAY ANSWER INDIVIDUALLY OR IN GROUPS OF THREE OR FOUR. YOU MAY WANT TO ALTERNATE USING SELF CHECKS ON ALTERNATE YEARS. REVIEW RESPONSES AND CLARIFY INCORRECT ANSWERS. QUESTIONS CONCERN NOISE AND ITS CONTROL, TOXIC MATERIALS, AIRBORNE POLLUTION AND THE HEALTH PROVISIONS CONTAINED IN THE ACT OF 1977.

SELF CHECK #1: SOLUTIONS

1. b and c
2. true
3. Answers will vary
4. a, c, and d
5. open air, respirators to filter dust, and water sprays
6. true

SELF CHECK #2: SOLUTIONS

1. ear plugs
2. 50 dB
3. ear plugs
4. nerve deafness
5. ear muffs and ear plugs
6. nerve deaness
7. 90 dB
8. 130 dB
9. Answers will vary according to individual mines
10. life, health and safety, accidents

SELF CHECK #3: SOLUTIONS

1. a and c
2. a. breathing zone
   b. for the entire shift
3. a. lungs
   b. liver
   c. stomach
   d. kidneys
4. true
5. true
6. 15 years

SELF CHECK #4: SOLUTIONS

1. f (all of the above)
2. every six months
3. answers will vary
4. answers will vary

SELF CHECKS: HEALTH

Self Check # 1: Airborne Particles and their Control and Management

Circle each correct answer below.

1. Nonrespirable dust is less dangerous because:

   a. dust particles are so small they are invisible
   b. the body's natural defenses eliminate it
   c. short, hairlike structures in the air passageways move dust up and out of the respiratory system

2. Breathing respirable dust may cause pneumoconiosis, which can shorten life expectancy. (true, false).

3. Name any respirable dust present in your mine.

4. Circle each correct answer below.

   Major pneumoconiosis is a lung disorder which:

   a. may make it impossible for you to work.
   b. will not change your life.
   c. shortens life expectancy.
   d. is irreversible.
   e. causes little or no inflammation of the lungs.

5. Name three ways of controlling dust.

6. The longer you work in harmful dust, the greater the danger to your health. (true, false)

Self Check #2: Noise and Its Control, Toxic Materials, and the Health Provisions Contained in the Act of 1977.

Use the following words to fill in the blanks below. Words may be used more than once. Some words may not be used at all.

ear plugs	cotton	50 dB
permanent	conductive loss	nerve deafness
130 dB	90 dB	temporary
ear muffs		

1. ______________ reduce noise by 25 to 30 dB in the higher and more harmful frequencies.

2. Due to the conduction of sound through the skull close to the ear you won't be able to reduce noise more than ___________.

3. ______________ does not/don't hinder conversation in noisy surrounding.

4. ______________________ involves damage to the nerve cells of the inner ear.

5. To gain an additional 3-5 dB more protection, you might wear a combination of _____________ and ___________.

6. ________________ is damage to the ear that can rarely be corrected.

7. Long exposure to noises over ____________ may eventually harm hearing.

8. Noises over ______________ may begin to cause pain.

9. List any of the toxic materials or substances used in your mine and possible hazards to your health.

10. Regulations in the MSHA Act of 1977 are designed to protect ________, promote ___________, and prevent ________________.

Self Check #3

1. Doug worked in a dusty area of the mine. He complained to his wife of having irritated eyes, nose and throat. Doug could not sleep and lost his appetite. The dust problem had intensified two days ago when the water spray truck broke down. What should Doug do?

   a. Report the problem to his foreman
   b. Go to the doctor and ask for medication
   c. wear respiratory equipment
   d. refuse to work

2. Larry complained to his foreman that he could no longer stand the dust pollution in his work area. Sam, Larry's foreman who also doubled as the company's safety officer clipped a dust sampling device on Larry at the beginning of his next shift.

   a. The air samples should be taken from what area of Larry's body?
   b. How long should Larry keep the sampling device on?

3. Breathing respirable dust can cause damage to the following organs.

   a.
   b.
   c.
   d.

4. If you smoke in addition to working in a dusty atmosphere, you may increase the risk of contracting lung cancer. (true, false)

5. Lung cancer is one of the harder forms of cancer to medically control. (true, false)

6. It usually takes up to how many years for pneumoconiosis to progress to a stage where it can be detected by x-ray.

   a. 5
   b. 10
   c. 15
   d. 20

Self Check #4

1. Of the following, which can be caused by excessive noise exposure over a period of years?

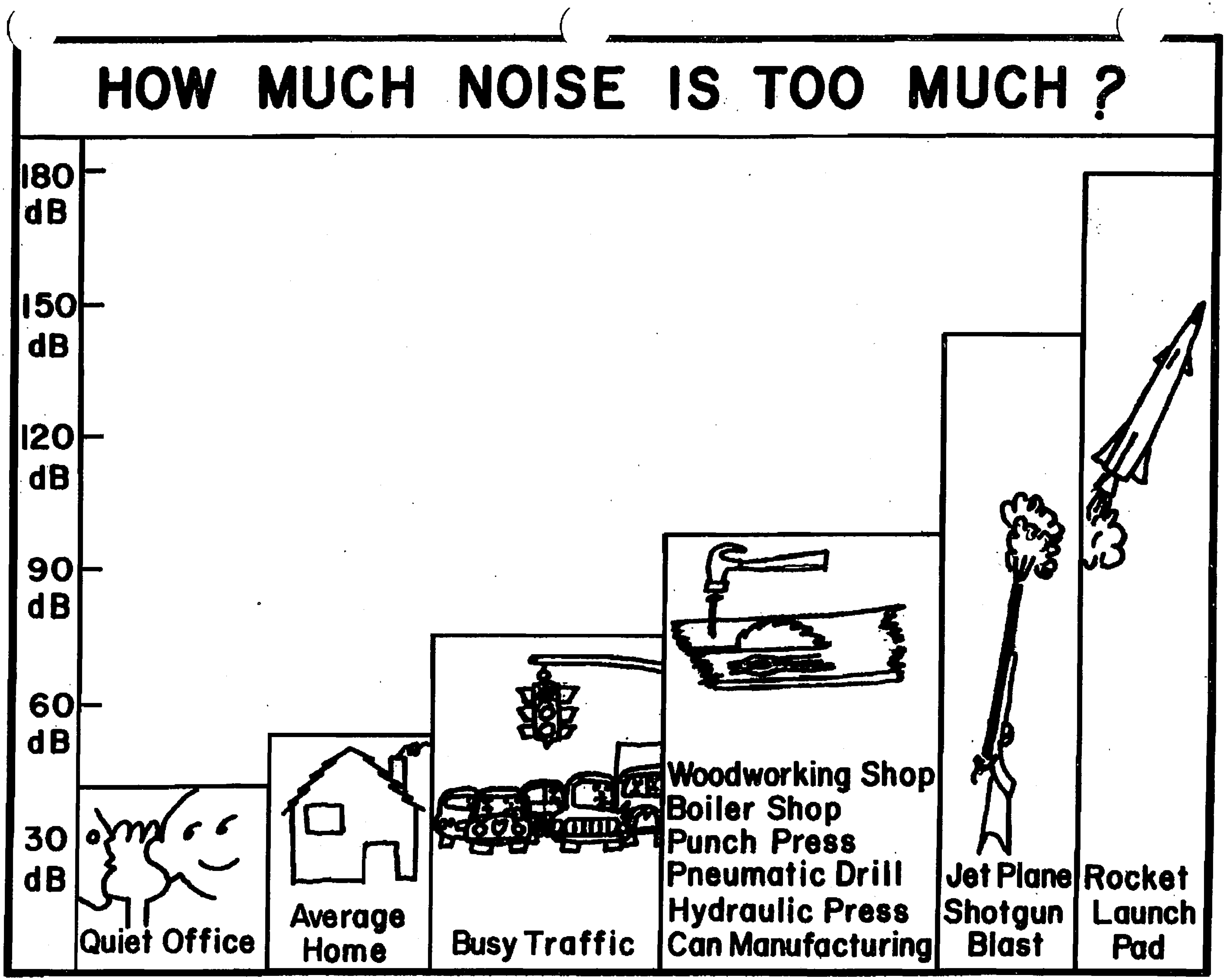
   a. nerve deafness
   b. temporary hearing loss
   c. constriction of the arteries
   d. conductive loss
   e. increased heart rate
   f. All of the above

2. How often should noise level measurements be taken?

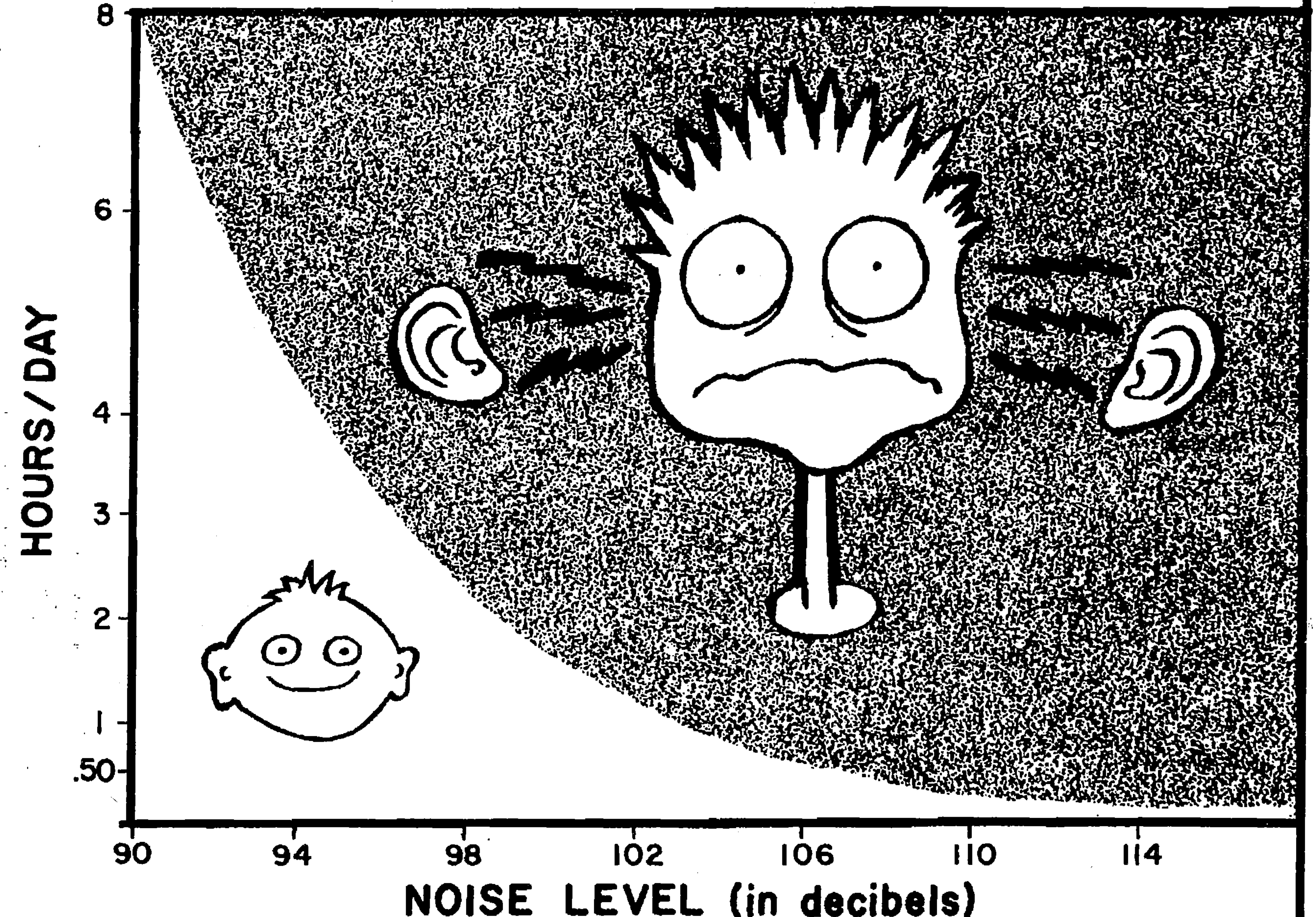
3. List the machinery or equipment within your work environment that produces excessive noise.

4. For each of the toxic or hazardous materials used by you or used in your work area:

   a. list the hazard this material presents to you
   b. Is this a long term hazard or short term or both?
   c. Is there an antidote? If so what is it?


HOW MUCH NOISE IS TOO MUCH?
180 dB
150 dB
120 dB
90 dB
60 dB
30 dB
Quiet Office
Average Home
Busy Traffic
Woodworking Shop
Boiler Shop
Punch Press
Pneumatic Drill
Hydraulic Press
Can Manufacturing
Jet Plane
Shotgun Blast
Rocket Launch Pad

PERMISSIBLE NOISE EXPOSURE LEVELS



VISUAL 38

• U.S. GOVERNMENT PRINTING OFFICE: 1983-0-381-608/3896