INSTRUCTOR'S TEACHING GUIDE C-4

AIRBORNE CONTAMINANTS IN ABOVE GROUND METAL AND NONMETAL MINING AND PROCESSING WORK AREAS

(For Metal and Nonmetal Mine Employees)

Prepared for

UNITED STATES DEPARTMENT OF INTERIOR
Bureau of Mines

Contract No. JO 25501

CORPORATION

Prepared by
LFE CORPORATION
LFE ENVIRONMENTAL ANALYSIS LABORATORIES DIVISION
2030 Wright Avenue
Richmond, California 94804

April 26, 1977

DISCLAIMER NOTICE

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or of the U. S. Government.

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FOREWORD

This report was prepared by LFE Corporation, Environmental Analysis Laboratories, Richmond, California 94804, under USBM Contract Number JO 255001. The contract was initiated under the Metal and Nonmetal Health and Safety Program. It was administered under the Technical direction of the Pittsburg Mining and Safety Research Center with Dr. R.W. Freedman acting as the Technical Project Officer. Mr. B.G. Horton was the contract administrator for the Bureau of Mines.

This document was completed as part of this contract during the period December 23, 1974 to May 18, 1977. It was submitted by the authors on May 18, 1977.

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16. Abstract

This document is one of a series of instruction guides developed to help instructors present health and safety training courses to workers in the metal and nonmetal mining industry. This course is intended to provide above ground metal and nonmetal mining employees with training which will assist them in performing their work safely and healthfully. A document entitled, "Airborne Contaminants in Above Ground Metal and Nonmetal Mining and Processing Work Areas," is used as a manual for the students during the course. The unique features of the teaching guide are thumb rules for recognizing hazardous situations, candidate contaminants for each work area and descriptions of control devices and work procedures.

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PREFACE

This is one of a series of instruction guides developed to help instructors in the presentation of health and safety training courses to the people of the metal and nonmetal mining industry. The course is intended to train above ground workers to perform their duties healthfully. Normally it will be the mine safety officers who perform these surveys. This training will be invaluable to the workers when working in above ground metal and nonmetal mining and processing work areas for inhalation hazards. The guide contains three sections: Suggestions to the instructor, an introduction to the course stating its objective and recommended class time, and the text of the course. Standard 8 x 10 transparencies have been prepared for use by the instructor. Other training aids required for the course consist of sampling equipment which is used in the demonstrations.

SUGGESTIONS FOR THE INSTRUCTOR

This course is designed as mutual endeavor between trainees and instructor. In a sense, it is a course which provides additional information on general subjects that the trainees already have some fundamental knowledge about. It can only be successful if a sense of mutual cooperation is established immediately at the start of the training period. Too often resentment about extra study reacts negatively on the ability to learn.

To this end, the course is not designed as a series of lectures to be read or recited to the trainees. Such a procedure could only be destructive. Rather, the course is set up to provide the instructor with the basic materials he is to present, but the actual technique of presentation is left up to the instructor; he alone can tell from the start what type of class he is facing, what their attitudes may be, and what their reactions prove to be.

Frequent emphasis is made on the need for class discussion. Any question dealing with the subject is legitimate food for consideration. THE MOST EFFECTIVE WAY OF LEARNING IS TO SHARE EXPERIENCE. The instructor is urged to solicit experience/ response and to use it as much as possible in his presentation of the material.

Frequent reference is made in the course to the manual which is entitled "Airborne Contaminants in Above Ground Metal and Nonmetal Mining and Processing Work Areas".

The trainees should be directed to follow the progress of the course with their manual and become familiar with it. Knowing how and when to use the manual is as essential as learning the contents of this course.

GENERAL INFORMATION

Introduction

The inhalation hazards which have been found in the above ground metal and nonmetal mining and processing work areas include dusts, mists, vapors and gases. During this course the students will learn how to sample for harmful concentrations of these inhalation hazards. Most of the students have some familiarity with the proper use of the sampling systems which will be described. These include the personal sampler system, detector tubes and hand pumps.

Purpose

A manual, entitled "Employees Training Course Manual: Airborne Contaminants in Above Ground Metal and Nonmetal Mine Work Areas", is intended to be used with the instructors guide to assist company safety officers (and their representatives) in presenting this course. Considerable detail has been included in the manual in order that it may be referred to later to remind the employees how to work safely and healthfully in their work areas. The purpose of this course is to provide above ground metal and nonmetal mining employees with information which will assist them in performing their work safely and healthfully.

Goals and Methods

The goals of this course are to assist employees in:

1. Learning how to use the course manual in performing their duties healthfully.
2. Learning how to wear sampling equipment and perform their duties while wearing the samplers in order for representative samples to be collected.
3. Learning how to use control devices properly and follow prescribed work practices.

The training methods employed will include lecture-discussion and demonstration techniques reinforced with the use of audio-visual materials. Class participation should be encouraged for the motivation of interest and the further development of concepts.

Objectives

The objectives of this course are to enable employees to:

Develop the capability for working without receiving harmful exposures to airborne contaminants in their work areas.

Time

The instruction time required to cover the materials in this course will vary according to the instructor's needs. However, the recommended time is a minimum of six hours.

Tools and Supplies Required

Items	Number Required
Metal and Nonmetal Mine Inspector Inhalation Contaminants Handbook	One for each student
Handouts 1 through 6	"
Instruction Sheets for Experiments (See Appendix)	"
Personal Sampling Pump, MSA Type G	1
3' Sampling Hose with Clamp, Bendix Catalogue No. 3900-908	1
Personal Sampling Pump, Bendix Catalogue No. 3900	1
Cassette with Weighted Membrane Filter, MSA Catalogue No. 457193	1
Cyclone, MSA Catalogue No. 456228	1
Charcoal Tube, MSA Catalogue No. 459004	1
Charcoal Tube Holder, MSA Catalogue No. 459054	1
Gas Sampler, 12 cc, Bistable, Chemical Projects Ltd., Toronto, Canada	1

Hand Pump, MSA Catalogue No. 83499 with Instruction Sheet	1
Detector Tubes, MSA CO_2, Catalogue No. 85976	1 box
Detector Tubes, MSA CO, Catalogue No. 919229	1 box
Detector Tubes, MSA Chlorinated Hydrocarbons, Catalogue No. 88536	1 box
Pyrolyzer, MSA Catalogue No. 87505 with Instruction Sheet	1
Freon, 10 ml	1 bottle
Toluene, 10 ml	1 bottle
Pipette with Rubber Bulb	1
Beaker, 2 liter or coffee can, 2 lb	
Hand Pump, Drager Model No. 31 with Instruction Sheet	1
Detector Tubes	
Drager (5/a) Toluene, Catalogue No. CH23001	1 box
Drager (5/c) Carbon Monoxide Catalogue No. CH 20601	1 box
Rubber Hose, 1/4" ID, 4" length	1
Charcoal Tube Plastic Cap with both ends open	1
Marking Pen	1
Clipboard	1

Note this course must be taught by a qualified Industrial Hygienist or safety officer. He should thoroughly review this course material before presenting it. It is particularly important that he verify that all the training aids (transparancies and sampling equipment) are available. The instructor should perform the demonstrations before class time. He may rearrange the material in order to present it in a manner most suited to his desires.

INSTRUCTOR'S TEACHING

GUIDE

(For Metal and Nonmetal Mine Employees)

AIRBORNE CONTAMINANTS IN ABOVE GROUND METAL AND NONMETAL MINING AND PROCESSING WORK AREAS

Purpose

The purpose of this handbook is to teach metal and nonmetal mine employees how to work in above ground metal and nonmetal mining and processing work areas without receiving harmful exposures to airborne chemical contaminants present in the work areas. This will be accomplished by presenting the thumb rules for recognizing hazardous situations, the candidate contaminants for each work area and the proper use of control devices and work procedures for the duties being performed.

Recognition

In order for an employee to recognize hazardous situations, he should familiarize himself with the four items listed on page 1 of the manual. These are repeated below:

1. The thumb rules for recognizing potentially hazardous situations.
2. The candidate contaminants for his work operations and symptoms and effects of harmful exposures to them.
3. The proper work practices for performing the work safely, healthfully and efficiently.
4. The proper use of engineering controls such as natural and mechanical ventilation and personal protective devices such as respirators.

Thumb Rules

To assist the worker recognize hazardous situations, we have provided the following basic rules which are listed below and found on page 2 of the manual:

1. A visible dust or fume cloud is present in the working environment. In addition, there may be visible quantities of settled dust in the work area.
2. A strong odor or eye irritation is noticed by the inspector upon entering the work area.
3. There is evidence of corrosion of ventilation systems or other equipment in the work areas.
4. Visible clouds are observed coming from poorly maintained ventilation systems such as holes in ducts.
5. The local ventilation system is not capturing all of the contaminants which are produced by an operation.
6. Chemicals are mishandled as evidenced by chemical spills and careless handling of highly toxic materials.
7. Substances which are hazardous under normal conditions of control and handling such as carcinogens are located at the worksite.
8. Worker's comments and symptoms indicate exposure to at least one contaminant. See Appendix I of manual.
9. Recognized hazardous situations are present such as operations of internal combustion equipment, unvented combustion heaters or spray equipment in confined areas. Another hazard would be the vapors in explosive storage areas.
10. In cases of doubt concerning the use of the above rules or in suspect situations not covered, tests should be made.

The instructor should illustrate these rules with specific examples from his experience. The students will not likely be familiar with many of the physical forms and physiological effects of most of the contaminants listed in Appendix I of the manual. Referring the students to this appendix, present the physical forms and physiological effects for carbon monoxide, carbon disulfide, hydrogen cyanide, stoddard solvent, welding fumes and welding gases.

It is helpful to the inspector to remember that the following contaminants have been found in metal and nonmetal mining and processing surface work areas in concentrations exceeding their standards. These are listed on page 3 of the manual and are presented below:

1. Welding fumes.
2. Fumes from metal cutting with torches.
3. Solvent vapors from degreasing operations.
4. Concentrations of airborne asbestos dust exceeding the standard have been found by others in automotive and truck brake and clutch maintenance operations.

For practice the instructor should show the basic rules or effects which each of these contaminants would exhibit if their concentrations exceeded their standards. For instance the production of welding fumes and fumes from metal cutting torches illustrates Rule No. 1. Solvent vapors from degreasing operations illustrates Rule No. 2.

The special work procedures prepared by NIOSH and presented as Appendix II in the manual should be discussed in detail to the trainees.

Candidate Contaminants

In order for an employee to recognize hazardous situations involving inhalation contaminants, he should be thoroughly familiar with all the activities associated with metal and nonmetal mining and processing work areas. Obviously, he must also be familiar with the candidate contaminants for each type of work area. Table 1 on page 4 of the manual was prepared as a checklist to assist the employee in remembering the candidate contaminants for each work operation.

The work areas listed in Table 1 cover those in open pit mining as well as in the above ground work areas for the underground metal and nonmetal mines and the processing facilities. To familiarize the students with the checklist, discuss the contaminants which are listed for the following work functions:

Explosive Storage
Field Maintenance
Heavy Equipment Operation
Machinery Repair
Painting

Emphasize that this checklist indicates the possible contaminants in each work area.

Typical Sampling Systems and Direct Measurement Devices

General - In this section we shall discuss the sampling and field measurement techniques which are used to determine the atmospheric concentrations of the candidate contaminants.

Sampling Devices - These consist of two types: Sample collection systems whose samples must be analyzed in a laboratory and direct reading devices. Examples of the first type are cassettes with membrane filters and charcoal tubes. Detector tubes and direct reading instruments are of the other type (direct reading instruments). When collecting respirable samples, the inspector should attach a cyclone upstream of the membrane filter to remove particles larger than 10 micrometers (μm). Only particles whose diameters are less than 10 μm are retained by the lungs.

Personal Pumps - Only Bureau of Mines approved pumps should be used with the above sampling systems. Show the students a personal sampler system which consists of a cyclone, cassette with preweighed 5μm PVC filter and a personal pump. This is the same system which inspectors routinely use for dust sampling. In order for a cyclone to function properly, the pump should operate at a flow rate of 2.0 liters per minute. The sampling period for respirable dust samples is generally a complete shift. Using Slide No. 1, describe the components of the cyclone and its operation. Caution the inspectors against dumping the large particles onto the filters by inverting the cyclones.

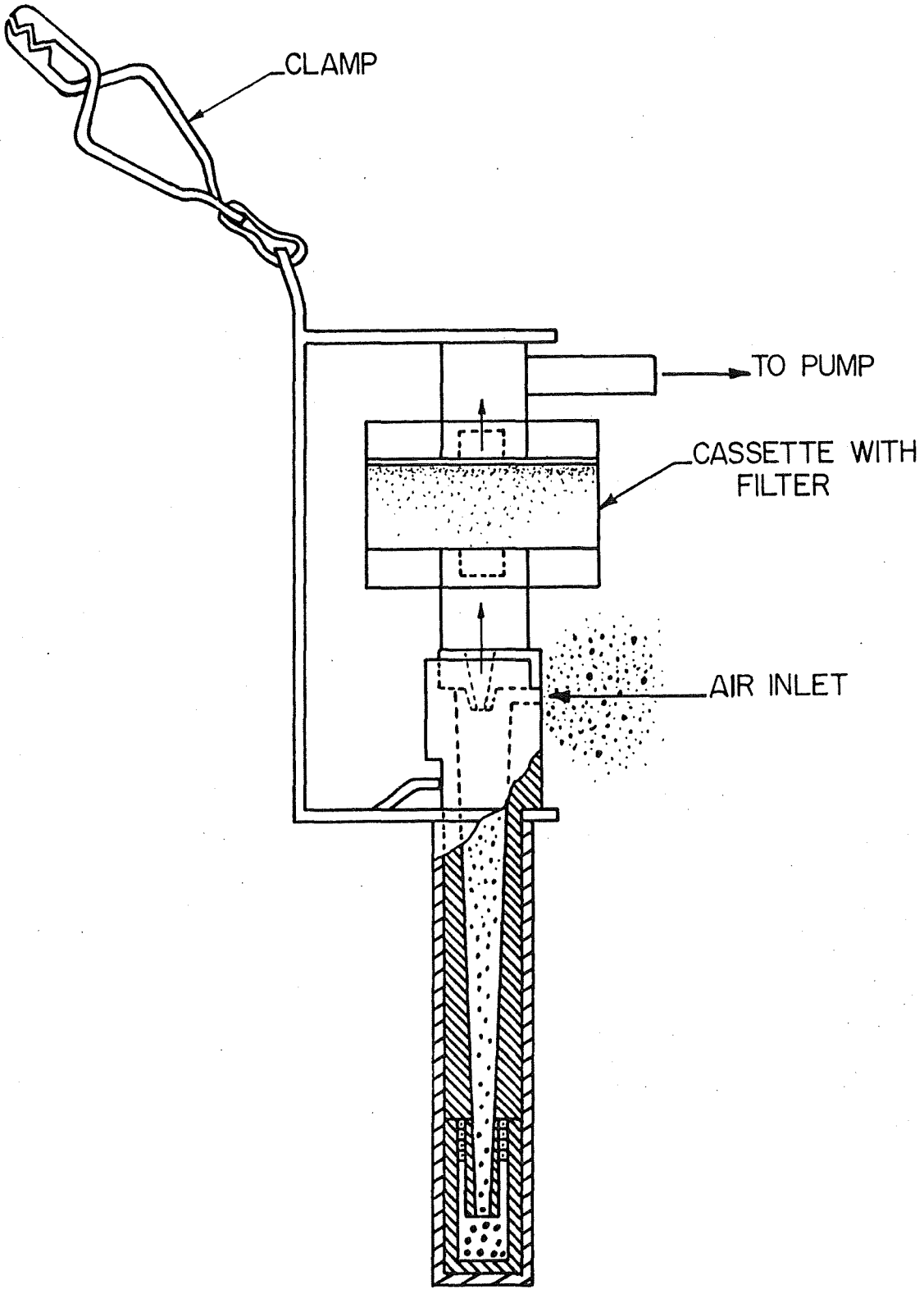
List the operating characteristics of the personal pump:

Flow Rate - 1/2 - 2 liters per minute
Typical Operating Period - eight hours before recharging is required
Recharging period - sixteen or sixty-four hours
Portability - It can be worn by an employee performing his usual duties.

Generally the sample collectors are placed in the worker's breathing zone (within 36" of his mouth). While the sampler systems are being operated, the inspectors should check them at frequent intervals to verify that;

the pumps are operating
the filters have not been plugged by high dust concentrations and
the workers appear to be performing their duties as anticipated

The flow rate during the sampling period is an average of that at the beginning and end of this period.



CYCLONE USED FOR RESPIRABLE SAMPLING

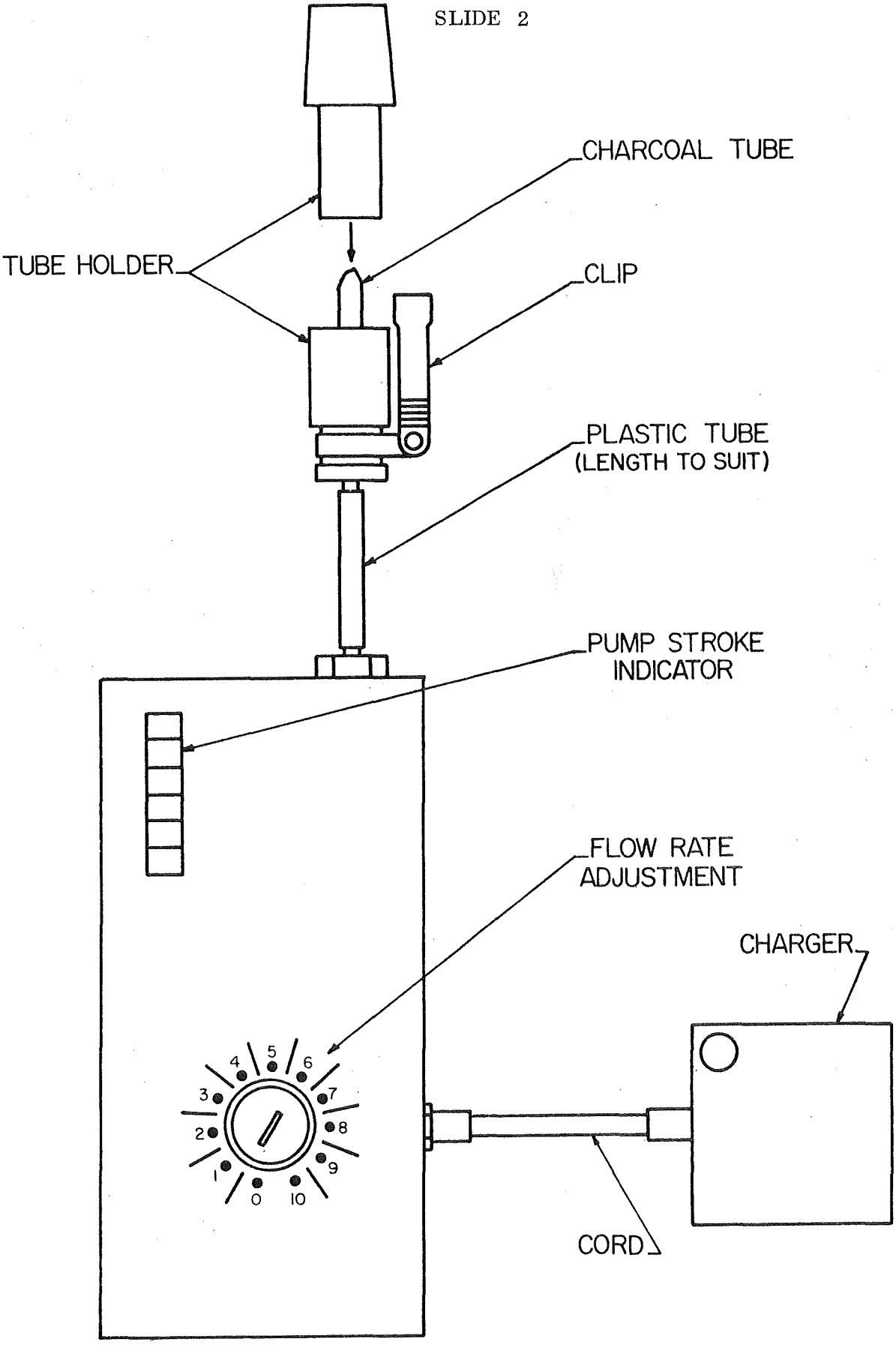
The Sipin low-flow rate personal pumps Models SP-1 and SP-2 are excellent for sampling organic vapors.

Show a Sipin pump with charcoal tube and holder. Use Slide No. 2 showing the Sipin pump, charcoal tube holder, and recharger being sure to point out the air volume indicator (stroke counter), flow rate adjustment, charging jack, and off-on switch. The primary advantage of low-flow rate pumps is that they extend the time for collecting a 10 liter sample on a charcoal tube from 10 minutes (for MSA or Bendix personal pumps) to 200 minutes. The longer sampling time allows one to evaluate the worker's eight hour exposure with fewer samples. The Sipin pumps are portable, battery operated and rechargeable. Mention that the stroke counter allows one to calculate the volume sampled.

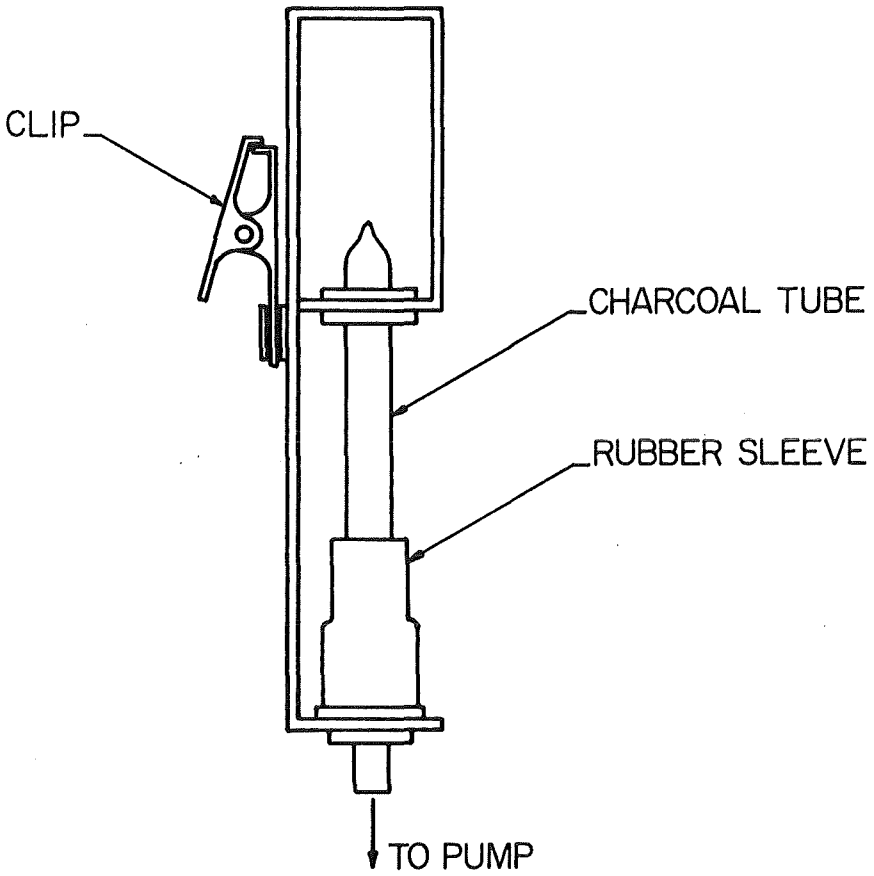
Membrane Filters - As mentioned earlier the personal sampler system consists of a cyclone, a cassette with a preweighed 5 μm PVC membrane filter and a personal pump which is recommended for sampling fumes, mists and airborne dusts except for asbestos. Generally full shift collections at 2 liters per minute are made with these sampling systems. Figure 1 on page 7 of the manual illustrates the collection system used for airborne asbestos fibers. Note that this system consists of a three piece plastic cassette and a Millipore filter with 0.8μm pores. When this system is used, the top cap of the filter cassette is removed and sample is collected with the cassette pointing downward. Asbestos is sampled at 2 liters per minute for fifteen minutes to four hours depending on the airborne asbestos and background dust concentrations. The samples are analyzed manually by phase contrast microscopy at 450X.

Charcoal Tubes - Specially manufactured charcoal tubes are used with personal sampling pumps for collecting samples with gases and vapors. The MSA Company and SKC, Inc., are two of the manufacturers of these tubes. These tubes which are illustrated in Figure 2 of the manual are about three inches long by 1/4" in diameter. As shown in Figure 2, they are provided with plastic end caps to seal the tubes after the ends are broken off to permit air to be drawn through. The instructor should now demonstrate how these tubes are properly used by using the hole in key or in one of the plastic cassettes to break off the sealed ends. He should insert the tube into the special holder (Slide No. 3) making sure that the air will flow through the tube in the proper direction as indicated by the arrow. The instructor should point out that there are two layers of charcoal an initial and backup layer is used to indicate when the front section was over-loaded. The hose

SLIDE 2



SIPIN PUMP, CHARCOAL TUBE HOLDER AND CHARGER



SPECIAL HOLDER FOR CHARCOAL TUBE

on the special holder should be attached to a sampling pump and the holder with the charcoal tube should be attached to instructor's collar so that it hangs a few inches from his mouth. The pump should now be attached behind the instructor on his belt with the hose running up over his left shoulder. The pump should now be turned on for a short period of time to simulate the sampling period. The system should now be removed from the instructor. He should disconnect the charcoal tube and seal it immediately with the plastic end caps. It should be sealed and labeled with the sample designation. Collection times are usually limited to ten minutes at 1 liter/min using the standard sampling pumps. Thus the volume sampled will be 10 liters. As described previously, the Sipin low-flow rate pumps are frequently used to increase the sampling time without increasing the volume sampled. At 50 cc/min they can increase the time to 200 min for collecting a 10 liter sample.

Gas Collectors - Gas collector systems are 250 ml evacuated glass sampling bottles, 10 ml syringes, and 10 ml vacutainers. In addition, there is the Bistable gas sampler, produced by Chemical Projects Limited, Toronto, Canada, in which a vacuum is produced by bending this flexible metal container which is informally called the "cricket". (One of these units should be passed around the class.) These samples which are called grab samples are collected by quickly opening the containers in the atmosphere to be sampled.

Detector Tube Systems - On Figure 3, page 9 of the manual, the gas detector tube systems are illustrated. These systems consist of hand operated suction pumps which draw fixed volumes of air through sealed glass tubes containing chemically impregnanted packing which indicates the concentration of a contaminant in the air or the length of chemically produced color change in the packing. The manufacturers of detector tube sampling systems include Bacharach, Bendix/Gastec, Matheson-Kitagawa, MSA, and National Mine Service Company/Dräger.

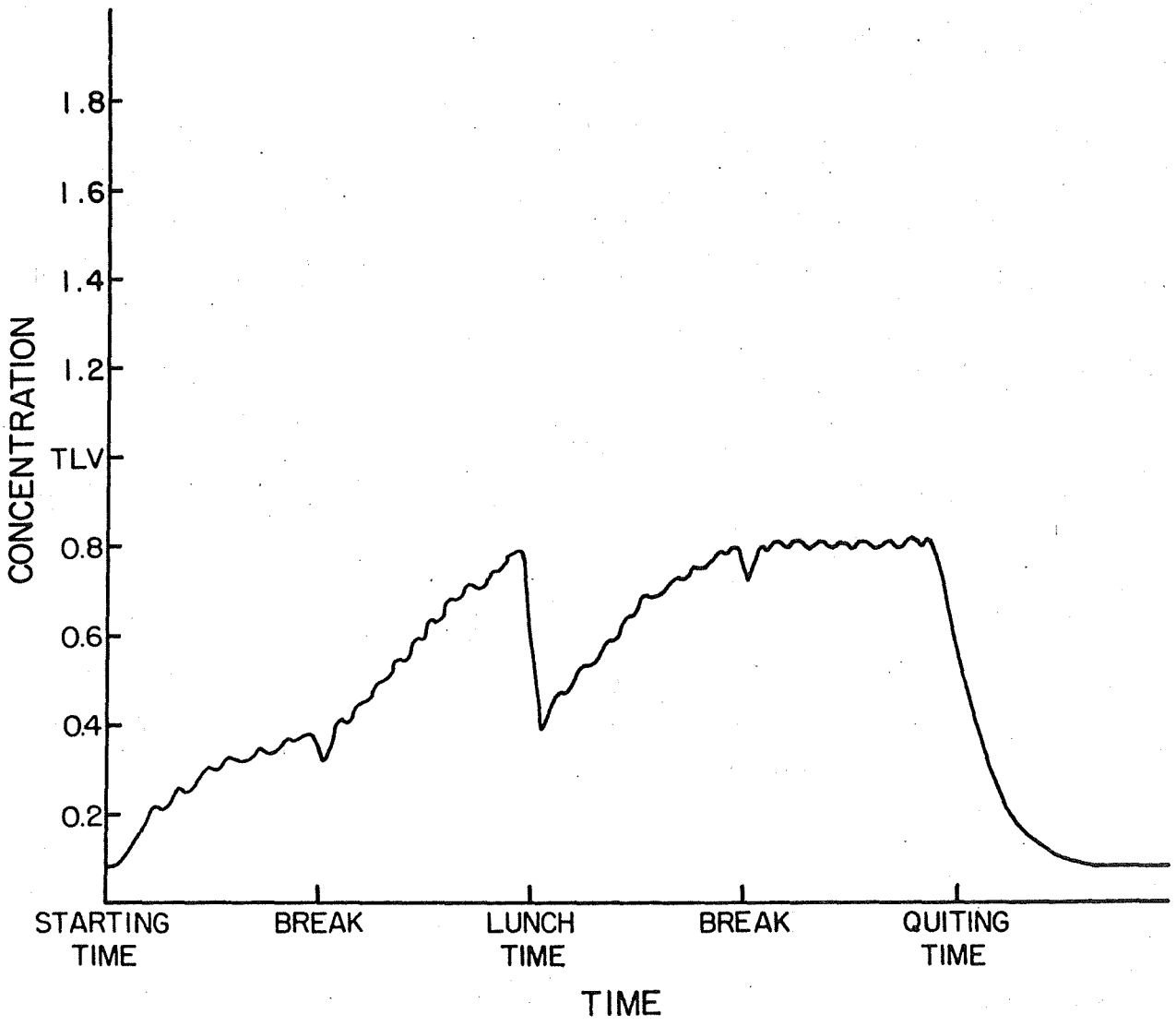
The instructor should now illustrate the use of the MSA system to show that the background concentration of carbon dioxide is approximately 0.03%. Be sure to follow the instructions for the pump and tubes being used. Pumps should be used only with tubes made by the same manufacturer. The following steps should be taken:

1. Select proper orifice if required.
2. Break off the tips of the tube and insert it in the pump.
3. Position the pump in the zone being sampled.
4. Wait the required periods during strokes in order for the required air volume to pass through the tubes.
5. Insure that the stain has the proper color and none of the interferences listed on the instruction sheet are present.
6. Read the contaminant concentration directly before comparing the stain length to the markings on the tube or the scale on the instruction sheet. When determining the stain length, the observer should have his eye directly above the tube.

Direct Reading Instruments - As illustrated in Figure 4 of the manual, direct reading instruments are those which employ a sensitizing cell which produces a signal electronically that indicates the concentration of a contaminant on a dial or recorder. The employees are likely familiar with such instruments for measuring noise and methane. Others are available for determining ozone, total oxides of nitrogen, nitrogen oxide, carbon monoxide, carbon dioxide and oxygen and organic halides. Because of their limited availability, these instruments were not often used by company safety officers or MESA inspectors. Also they must have MESA approval if used underground in or by the last open cross-cut or in the return.

The instructor should mention that one should follow the operating instructions and particularly look for compounds which interfere with the readings.

Some direct reading instruments are attached to recorders which plot concentration against time (Slide 4) and integrators which show the average concentration during the period sampled.



TYPICAL RESULTS FROM RECORDER ATTACHED TO A DIRECT READING INSTRUMENT

HOW TO BE A GOOD SAMPLEE

There are four ways that the employee being sampled can assist the one collecting the sample in obtaining an accurate value.

1. Perform his work in a typical fashion during the sampling period.
2. Wear the sampling equipment properly.
3. Inform the one collecting the sample of situations which would greatly increase exposure.
4. Use his control devices properly during the period he is being sampled.

Each of these will now be discussed in detail.

Perform Work In A Typical Fashion - This is necessary in order for the analyzed sample to reveal the typical or average exposure which the worker receives to a contaminant. Therefore, the worker must wear the sampling system properly and perform his normal duties during the time that he is sampled.

Wear Sampling Equipment Properly - The personal sampling system should be worn with the collector in the workers breathing zone and the pump attached to the workers belt. The sampling system should be worn through the entire sampling period. This includes wearing the system during breaks and lunch periods. The one responsible for collecting the samples should be the one who places the sample on the worker and removes it after the sampling period has been completed. Should the sampler be accidentally contaminated during the sampling period, the worker should inform his supervisor or the one collecting the sample as soon as practicable.

Inform Sampler Of Special Situations Which Might Produce Harmful Exposure - If the employee knows of any special situations which might cause high concentrations of any contaminants, he should inform the one collecting the sample. These special situations would include those covered in the thumb rules, which are presented on page 2 of the manual.

Use Personal Protective Equipment And Control Devices Properly - It is of course important that the worker always use his personal protective equipment and control devices properly. Personal protective equipment consists of respirators and protective clothing. Respirators or face masks which contain filters and/or chemical cartridges which remove particles, dust, mists, and gases. Control devices are mainly ventilating systems which are provided to remove or dilute the contaminants to safe levels.

STANDARDS

Standards are defined by concentrations of airborne contaminants which most workers can be exposed to indefinitely without any harmful effects. These exposure periods are generally considered to be ten hours per day, forty hours per week. The effects may be immediate ones such as headaches, eye, nose and throat irritation, fatigue, nausea and dizziness. In high concentrations some severely affect vital organs to produce death. Examples such as ammonia, carbon monoxide, hydrogen cyanide and nitrogen dioxide should be selected from Appendix I in the manual and presented to the class. Other contaminants produce no significant immediate effects but do produce harmful long term effects such as severe lung, liver and kidney damage as well as cancer. These effects may be delayed as long as thirty years after the exposure began. Several of these contaminants can also produce significant physical impairment or death after excessive exposures. Examples of these contaminants from Appendix I in the manual are asbestos, cutting fumes, silica dust and welding fumes. In a few instances the standards are based only on good housekeeping practices.

Each standard is selected on studies of the following types:

1. Repeated exposures of experimental animals to known concentrations of the contaminant.
2. Examination of health records of large numbers of exposed workers.
3. Studies of effects on a few exposed workers.
4. Short exposures of volunteers to determine odor and irritation.
5. Comparison to other well-investigated contaminants which are similar to the one of interest.

Also there are significant safety factors which are used in the selection of the standards. These standards, which are established by federal regulations will be revised as additional information indicates such is appropriate.

CONTROLS

Introduction - The Code of Federal Regulations, Title 30, Chapter I, Sub-Chapter I, Part 55, Section 55.5-5 and Part 57, Section 57.5-4 requires that each metal and nonmetal mine operator provide proper control devices or procedures after monitoring results indicate that the standards are exceeded.

It is important for employees to have some understanding of control methods in order to perform their work without receiving excessive exposures. Control methods are divided into three types of devices. These are work practices, engineering controls, and personal protective equipment.

Work Practices - It should be pointed out that often workers normally develop good work habits which will greatly reduce their exposures to contaminants. For instance they can position their work so it will be downstream from the direction of air movement, thus reducing their exposures. They also often work with the item at almost an arms length from them and they may have their heads to the side of the work rather than directly over it, in order to reduce their exposures. Thus, they may frequently adjust their position relative to their work to be in a more advantageous position. Notice that the above mentioned work practices are essentially common sense which one should use to reduce his exposures. Likewise, it would be important that good housekeeping be performed to reduce dust exposures such as clean up accumulations of dust. Solvent spills must be wiped up promptly. Ventilation equipment should be checked frequently to make sure it is operating properly. Frequently the substitution of products is possible. In fact, one can often use this means as an inexpensive one for controlling exposure to contaminants.

Engineering Controls - These consist of ventilation, isolation of operations and rotation of personnel. Ventilation may be either natural or mechanical. Natural ventilation consists of thermal effects which cause contaminants to rise and wind which causes their concentration to be diluted. These natural forms of ventilation usually must be aided by mechanical means because they are not dependable. Thermal effects become less noticeable with the increasing air temperatures and winds vary in velocity and direction. Other factors which are important in specifying the requirements of mechanical ventilation are the rate of generation of the contaminant, the volume of the building, the effectiveness of supply and exhaust air openings, and the

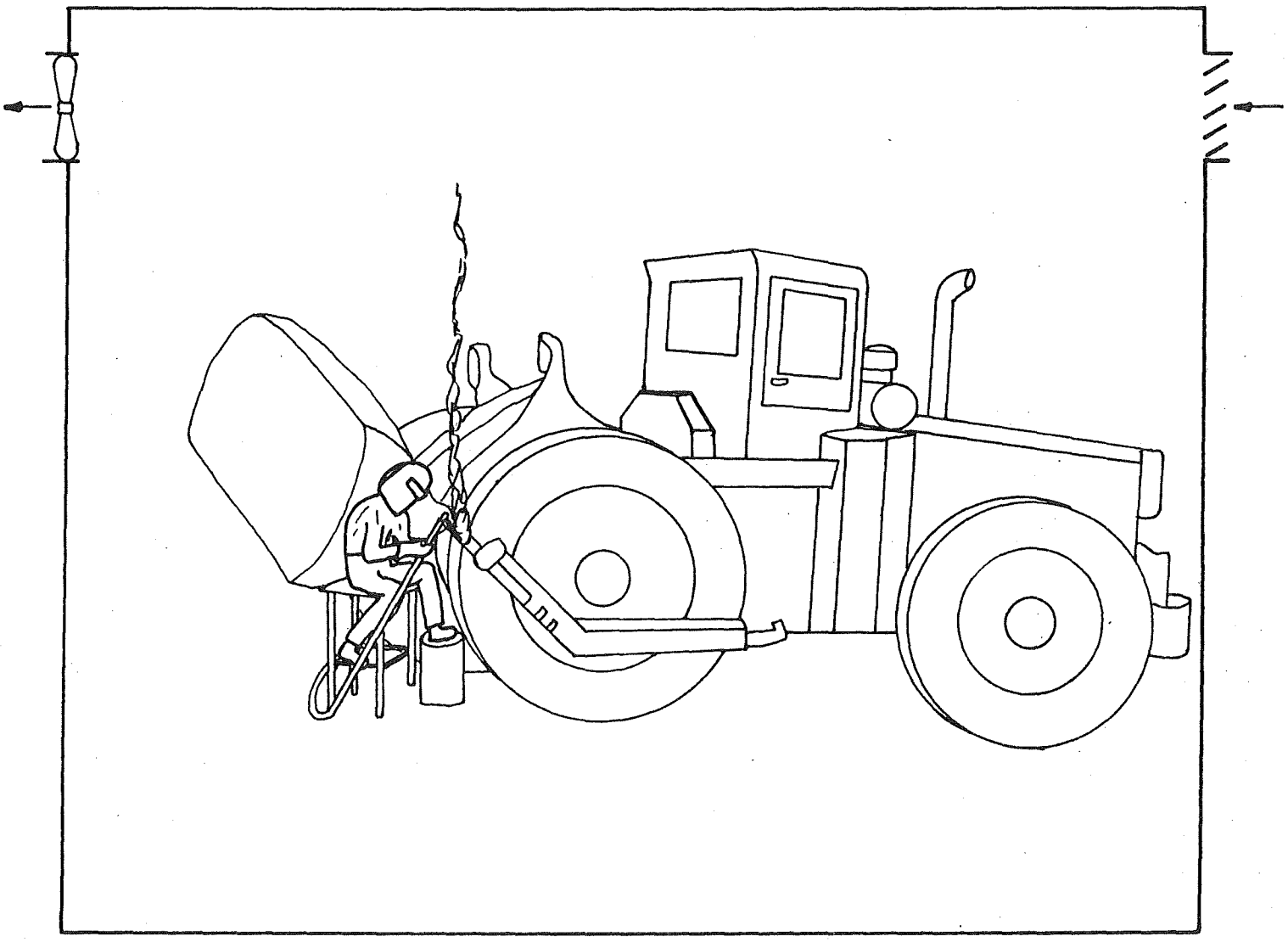
capacity of existing ventilation equipment. The two forms of mechanical ventilation will be described below.

General ventilation involves the use of large quantities of supply and exhaust air to the work area to dilute the concentration of the contaminants. This may be achieved by using a combination of mechanical and natural air supply and exhaust systems. The worker should be located between the air intake and the exhaust to obtain the optimum removal of contaminants (Slide No. 5). In addition, pedestal fans may be used which will be directed at the sources of the contaminants to reduce their concentrations in the breathing zone of nearby workers. Pedestal fans are particularly useful for reducing concentrations of welding fumes for welders working on large or complex vehicles.

A local exhaust system captures a contaminant where it is produced or emitted. A local system consists of a hood or duct opening which leads to an exhaust fan, an air cleaning device, and finally an opening to the outside atmosphere. The local system usually operates on the principle of a high capture velocity for the contaminant but a rather low volume of air used. Thus the advantage of a local over a general exhaust system is that the local requires a much smaller volume of air. Local exhaust systems are excellent where fixed operations such as bench welding are performed. Solvent vapor degreasers when properly operated require no ventilation systems.

Isolation of Operations, Workers and Machinery - This section as well as the ones describing application of water and other wetting agents and other modification processes should be presented essentially as they are in the manual on page 15 and 17.

Rotation of Personnel - As an alternative to the other control measures, the rotation of a personnel may be used to reduce exposures to below the standards. When employee exposures, during specific work operations, exceed a contaminant's eight-hour standard, the jobs can be rotated among several employees so that none receive excessive exposures.



EXAMPLE OF GOOD DILUTION VENTILATION

Personal Protective Equipment - This consists of respirators and protective clothing. Respirators are devices placed over the worker's face to filter or absorb contaminants from the air or supply pure air from a tank or air line hose to the worker. These devices should not be used except during periods when engineering controls are being installed, proper work practices are being instigated, engineering control and work practices are not feasible, and in emergency situations. Whenever respirators are used they should be selected from those approved by MESA and the National Institute for Occupational Safety and Health (NIOSH) and used only for the contaminants specified in the approvals.

Instruction sh ould be provided to show the workers how to wear and adjust the respirators for proper fitting. The respirators should be cleaned and inspected regularly. Worn and deteriorated parts should be replaced.

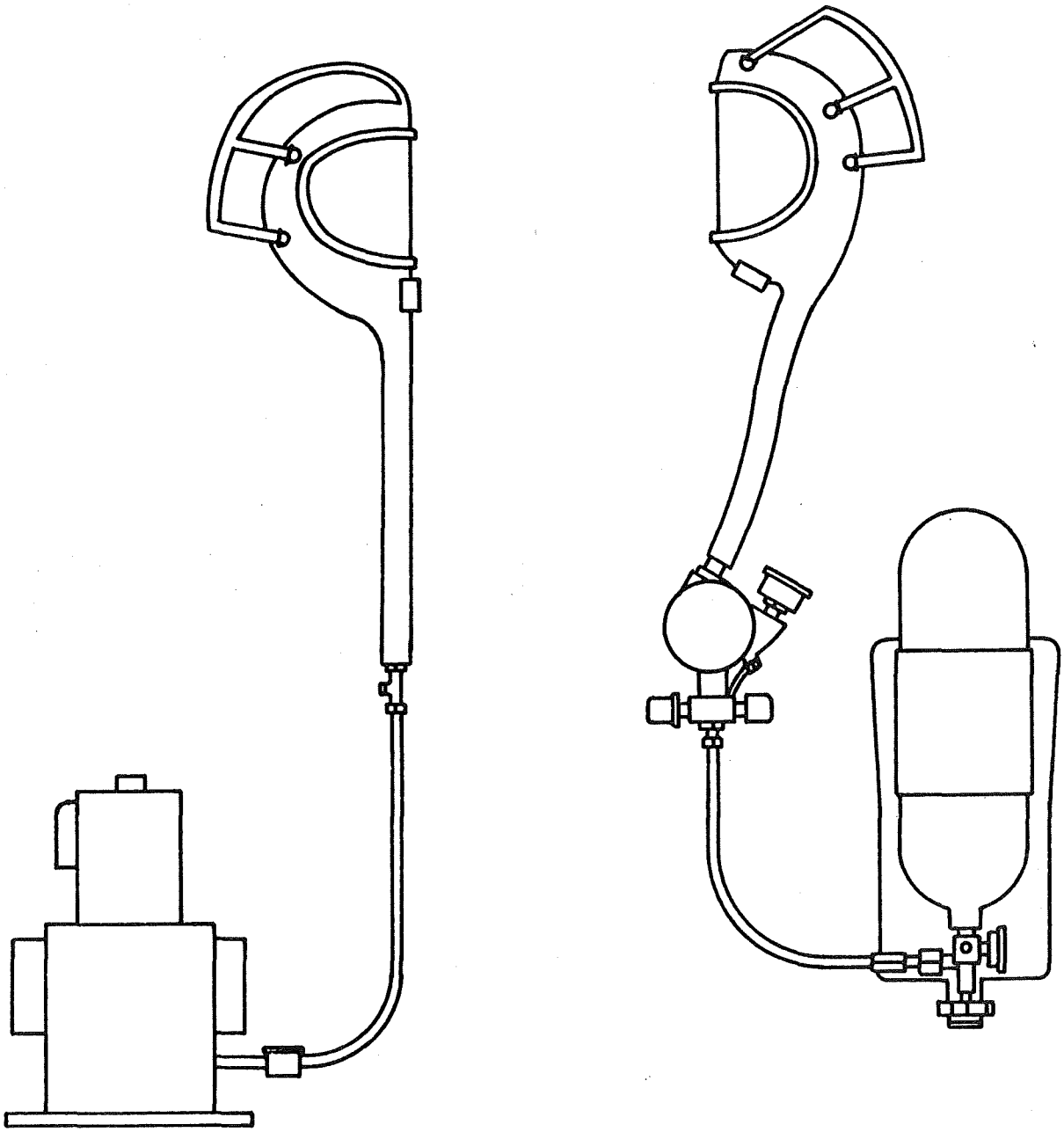
Air Purifying Respirators - Air purifying respirators contain filters or chemical and may or may not be reusable. They remove contaminants from the air being breathed. The contaminants for which they are suitable are listed on canisters or the mask itself. The approval list described above also indicates the contaminants for which each mask may be used.

Even though excessive concentrations of airborne asbestos dust and paint fumes were not found in the initial study of inhalation contaminants in above ground metal and nonmetal mining and processing activities, such concentrations may occasionally be present and it is recommended that appropriate respirators be worn by individuals exposed to visible dust containing asbestos during brake changing operations or from braking cable drums on large shovels and drag lines. Also, employees engaged in paint spraying should wear proper air purifying respirators for protection from paint fumes and mists.

Supplied-Air Respirators - Supplied-Air respirators (Slide No. 6) are two types: continuous flow and pressure demand. Each respirator supplies the worker with an atmosphere which is independent of the ambient air. The continuous flow device supplies the wearer with a selected amount of air fed continuously to it. The demand type has a regulator at the lower end of the breathing tube and a diaphragm valve that opens upon inhalation and closes upon exhalation. In both cases it is required that the compressed air supply for the respirators not contain harmful amounts of carbon monoxide, oil mists or other contaminants.

Protective Clothing - Protective clothing consists of aprons, gloves, special clothing, creams, face shields and safety glasses. These are usually used to prevent skin absorption or skin irritation from the contaminants. Equipment must have MESA and NIOSH approval.

SLIDE 6



SUPPLIED AIR RESPIRATORS