TRAINING PROGRAM AND MANUAL

TABLE OF CONTENTS

SECTION I : INTRODUCTION TO ASBESTOS . . . . . PAGE 3

. What Is Asbestos? 4
. History of Asbestos Use 5
. Recognition of Asbestos 7

SECTION II : HEALTH EFFECTS ASSOCIATED WITH ASBESTOS EXPOSURE 9

. The Respiratory System 10
. Health Effects Associated with Asbestos 11

SECTION III : OSHA STANDARD ON "OCCUPATIONAL EXPOSURE TO ASBESTOS" 13

. Federal Register 29 CFR 1926.58 14
. Appendices 22

SECTION IV : MEDICAL SURVEILLANCE PROGRAM 23

. Salisbury Medical Surveillance Program 24
. Reasons for Specific Tests 26
. The Asbestos Exposure Log 27

SECTION V : PROTECTING THE WORKER 29

. Protective Clothing 30
. Respiratory Protection 31
. Respiratory Protection Program 33
. Video-Tape: "Proper Care and Use of the COMFO II Particulate Filter Respirator"

SECTION VI : ASBESTOS REMOVAL WORK PRACTICES 39

. Negative Pressure Work Areas 40
. Wet Removal Techniques 46
. Insulation Removal from Pipes & Vessels 47
. Glovebag Techniques 48
. Cleanup and Waste Disposal 50

SECTION I

INTRODUCTION TO ASBESTOS

REFERENCES:

(1) Course Manual for EPA "Asbestos Abatement Training". Drexel University, Philadelphia, Pa., January, 1987.

(2) Environmental and Occupational Medicine, William N. Rom, ed., 1983.

(3) Fundamentals of Industrial Hygiene, 2nd edition, National Safety Council, 1979.

051442

WHAT IS ASBESTOS ?

The public is often confused about the source of asbestos. It is a mineral rock mined from the earth in much the same ways as other minerals, such as iron, lead, and copper. However, instead of crushing up into dust particles, it divides into millions of fine fibers. Asbestos is mined primarily from open pits in the following countries: the Soviet Union, Canada, South Africa, Rhodesia, People's Republic of China, Australia, Cyprus, and the United States (primarily California, Vermont, and Arizona).

These fibers come in three common varieties:

(1) CHRYSOTILE (White Asbestos) - fibrous form of mineral serpentine, most common variety (90% of commercial use), widely distributed geographically, with the largest deposits being in Canada, Russia, and Rhodesia.

(2) AMOSITE - fibrous form of mineral grunerite, mined only in South Africa, brownish-yellow to almost white color.

(3) CROCIDOLITE (Blue Asbestos) - fibrous form of mineral riebeckite, fine, resilient fibers of a characteristic blue color.

All three varieties exhibit substantial resistance to heat and chemicals, and thus have been used for a variety of commercial and industrial purposes. In fact, asbestos has been used in more than 3,000 products. Some of the key uses (and potential exposures to be aware of when developing an occupational history) include:

- asbestos-cement pipe
- brake linings
- clutch facings
- filters, gaskets, friction materials
- gas mask filters
- sprayed acoustical asbestos
- textiles (yarn, thread, belt, rope, cloth)
- steam and fire hoses
- wall, floor, roofing tile
- electrical insulation
- paints and fillers

HISTORY OF ASBESTOS USE

The asbestos industry started during the 1870's when the first commercial chrysotile mine opened in Quebec. Canada. The crocidolite variety was first mined in South Africa during the 1890's. Amosite also comes from Africa. but its mining did not begin until 1916.

Asbestos was used some as insulation during the period 1870-1900, but its use became more common on steam pipes and boilers of ships after 1900. Until the early 1940's, most asbestos-containing insulations in the United States contained chrysotile from Canada. The 1940's marked significant changes in the American use of asbestos. Amosite became widely used in American ships and ship yards during WWII.

The use of asbestos then started expanding to include acoustical and decorative purposes, especially in buildings. After WWII ended and military demand for asbestos declined, sprayed asbestos fireproofing materials were used extensively in buildings. Estimates indicate that more than half of the large multi-story buildings constructed during the 1950-1970 period contain some form of sprayed asbestos-containing materials. Asbestos use in the United States did not start to decline until the 1973-1978 EPA bans on spray-applied materials, and the building recession which happened during that same period.

The construction industry was the major consumer of asbestos in the United States. Listed by end use, the percentages of distribution are:

25 % Asbestos-cement pipe

21 % Flooring

14 % Friction products

10 % Roofing

5 % Asbestos-cement sheets

5 % Coatings and compounds

5 % Paper

4 % Packings and gaskets

2.5% Thermal insulation

1 % Plastics and textiles

0.5% Electrical insulation

7 % Other materials

Diseases and deaths associated with exposure to asbestos fibers are the principle factors behind the "Asbestos Problem." The three major respiratory diseases associated with asbestos are asbestosis, lung cancer, and mesothelioma. Their medical nature are discussed in much greater detail in section II, "Health Effects Associated with Asbestos Exposure."

During the early 1970's, the federal government attempted to respond to these health and legal problems by issuing regulations and guidelines to provide some controls for industrial exposures to asbestos fibers. Then during the late 70's and early 80's, they added guidelines and requirements to cover building occupants, especially schools. These actions, combined with the health and legal issues, prompted the need for asbestos abatement policies.

RECOGNITION OF ASBESTOS

Recognition of asbestos by sight is unreliable and, even for trained personnel, extremely difficult. This method should not be relied upon for identification. The following methods are acceptable and are listed in order of accuracy:

I. ANALYTICAL METHODS [outside labs]

A. Analysis of airborne fibers collected on filters

. Phase Contrast Microscopy (PCM)

. Scanning Electron Microscopy (SEM)

. Transmission Electron Microscopy (TEM)

B. Analysis of bulk samples

. Polarized Light Microscopy (PLM)

. X-Ray Diffraction (XAD)

. Infrared Spectroscopy (IR)

. Electron Microscopy

II. TEST KITS
(For example: Asbestest^{R}, E & C Apparatus Corp., St. Petersburg, Fla.)

This procedure is a colormetric qualitative test for the detection of magnesium and iron from asbestos in bulk samples. The kit is intended to be used for wet chemical analysis of silicon bound magnesium and/or iron which is found in asbestos and asbestos-containing materials. In certain forms of asbestos (chrysotile) only magnesium is present and in other forms (crocidolite) only iron is present, while in several forms (amosite) both are present. The sample is first treated to wash away unwanted and interfering substances and then the magnesium and/or iron is released from the sample by chemical treatment and an appropriate color reagent is added which turns a specific color.

The test will not give a false negative, but will give false positives. In other words, if a sample tests negative, it can be considered non-asbestos. However, if it tests positive, the sample may still not be asbestos. For purposes of use at the Salisbury Plant, a positive test will be assumed to indicate the presence of asbestos.

The kit contains toxic and corrosive materials and should be used only in a controlled (lab) area.

III. LABELS

In October-November, 1986, a survey was conducted by the Safety/Health/Environmental Department to determine primary areas of asbestos-containing insulation in the Salisbury Plant. Although this survey did not provide complete coverage, it did identify the insulation material in the most likely areas of removal work. Based on this survey, insulation will be labeled as follows if it contains asbestos:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

IV. EXPERIENCE

Any equipment and piping installed, modified, or upgraded since 1976-78, should not carry asbestos-containing insulation. Other lines and vessels which undergo routine turn-arounds or which are commonly worked on (i.e.: HP end caps, reboiler relief valves) also will not have asbestos-containing insulation. This experience and knowledge base is a key element in asbestos recognition.

SECTION II

HEALTH EFFECTS ASSOCIATED WITH ASBESTOS EXPOSURE

REFERENCES:

Course Manual for EPA "Asbestos Abatement Training", Drexel University, Philadelphia, Pa., January, 1987.

THE RESPIRATORY SYSTEM

The primary diseases associated with asbestos are due to inhalation of asbestos fibers. A brief discussion of the respiratory system will help in understanding these effects. As air is breathed into the body, it passes through the mouth and nose into the windpipe or trachea. The trachea splits into two smaller airways called bronchi. Each bronchus divides into smaller and smaller tubes which terminate into air sacs called alveoli. In these air sacs, oxygen is absorbed into small blood vessels and waste gases such as carbon dioxide pass out of the blood.

The lung itself is divided into two halves and sits in the pleural cavity. This cavity and the outside of the lung itself have a Saran-wrap type lining. The pleural cavity and lung linings are in contact with each other and are very moist. Just like two panes of glass with a drop of water between them, these linings slide easily across each other, but are very difficult to pull apart. Accordingly, as the chest cavity expands, the lungs expand and air rushes in. If these linings (mesothelia) were to become damaged, inhalation could not occur properly.

The body has several mechanisms by which it "filters the air it breathes. First, very large particles are removed in the nose and mouth. Many smaller particles impact on the mucous-coated walls of the airways and are caught. These airways have a hair-like lining (ciliated cells) which constantly beats upward. Accordingly, particles caught in the mucous are swept up into the back of the mouth. From here they are swallowed or expelled by coughing. Cigarette smoking temporarily paralyzes these ciliated cells, inhibiting one of the body's natural defenses against unwanted dust. As the smoker sleeps, the hair-like cells start working again and carry large amounts of mucous into the back of the mouth. This causes the so-called "smoker's hack" in the morning. After the first cigarette or two, the cleansing mechanism is paralyzed again and the coughing stops. It should now be evident why cigarette smokers who are exposed to asbestos appear to be at greater risk. Other reasons will also be discussed later in this section.

Even with the above-mentioned natural defenses of the body, some dust particles inevitably reach the tiny air sacs. When this occurs, large cells (called macrophages) attempt to engulf the particle and "digest" it. For this reason, they are sometimes called the lung's garbage collectors. However, because asbestos is a mineral fiber, the macrophages are often not successful. If the cells cannot digest the fibers, they call in a secondary defense mechanism. They deposit a coating on the fibers causing scar tissue to be formed, and a condition develops known as asbestosis.

HEALTH EFFECTS ASSOCIATED WITH ASBESTOS

The adverse health effects associated with asbestos exposure have been extensively studied for many years. Results of these studies and epidemiologic investigations have demonstrated that inhalation of asbestos fibers may lead to increased risk of developing one or more diseases. Exactly why some people develop these diseases and others do not remains unclear. In this discussion, each of the major diseases associated with asbestos will be examined, along with the risk and how that risk can be minimized.

It is important to recognize that the majority of people who have developed a disease as a result of asbestos exposure were asbestos workers. These workers were frequently exposed to high concentrations of asbestos fibers each working day with little or no protection. The asbestos abatement worker of today follows specific work practices and wears appropriate protection, including respirators, to minimize the risk of exposure. This training session is designed to help prevent future disease as a result of exposure to asbestos fibers during plant removal/disposal operations.

Specific diseases are discussed as follows:

I. ASBESTOSIS

Asbestosis is a disease characterized by fibrotic scarring of the lung. It is a restrictive lung disease which reduces the capacity of the lung. The common symptom is shortness of breath. Asbestosis is prevalent among workers who have been exposed to large doses of asbestos fibers over a long period of time. Accordingly, there is a clear dose-response relationship between asbestos exposure and development of this disease. This means that the greater the asbestos exposure, the more likely asbestosis will develop. All forms of asbestos have demonstrated the ability to cause asbestosis. Like all diseases associated with asbestos exposure, it may take many years for the disease to develop. The typical latency period for asbestosis is 15-30 years. An asbestos abatement worker using work practices and protective equipment described in this manual will have a much smaller liklihood of developing asbestosis as a result of his or her work.

II. LUNG CANCER [BRONCHOGENIC CARCINOMA]

There are many causes of lung cancer, of which asbestos is only one. While employees exposed to industrial concentrations of asbestos in years past have a five times greater risk of getting lung cancer, the risk is not as great as the cigarette smoker who has a ten times greater risk. Even more important, these two factors operate together to produce the greatest risk of all. A cigarette smoker who also works with asbestos is more than 50 times more likely to contract lung cancer than a non-smoking non-asbestos worker.

Like asbestosis, there exists a long lag time between initial exposure and the occurrence of lung cancer, typically 20-30 years. There appears to be some relationship between asbestos exposure and lung cancer, although no "safe level" has yet been determined. Again, these figures relate to past industrial situations where workers wore little or no protective equipment. Proper protection and work practices will substantially lessen the risk of abatement workers getting lung cancer due to asbestos.

III. MESOTHELIOMA

The asbestos-associated disease of greatest concern in asbestos abatement is probably mesothelioma. Fortunately, it is also the rarest. Mesothelioma is a cancer of the chest cavity lining (mesothelium) and can also occur in the lining of the abdominal cavity. Although exposure to asbestos has been strongly associated with most cases of mesothelioma, some cases may occur without asbestos exposure. If mesothelioma occurs in the chest cavity, it is called pleural mesothelioma. In the abdominal cavity, it is known as peritoneal mesothelioma. This type of cancer spreads very rapidly and is always fatal. The exact cause remains unknown. There does not appear to be any increased risk of mesothelioma for smokers and there does not appear to be a dose-related relationship between the amount of asbestos exposure and mesothelioma. Cases have been recorded where the person's asbestos exposure had been extremely limited. Like the other diseases of asbestos, mesothelioma develops 30-40 years after initial exposure, if it occurs.

IV. OTHER DISEASES

Several other diseases are found more often among persons exposed to asbestos than the normal population. These include cancer of the esophagus, stomach, colon, and pancreas, pleural plaques, pleural thickening, and pleural effusion. The incidence of these health effects is much less than lung cancer. Again, the importance of using the proper work practices and protective equipment cannot be overemphasized to minimize the occurrence of these diseases due to unnecessary asbestos exposure.

SECTION III

O S H A STANDARD

ON

"OCCUPATIONAL EXPOSURE TO ASBESTOS"

FEDERAL REGISTER 29 CFR 1926.58

A. SCOPE AND APPLICATION

This section applies to all construction work, including the following:

- Demolition or salvage of structures where asbestos is present.
- Removal or encapsulation of materials containing asbestos.
- Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos.
- Installation of products containing asbestos.
- Asbestos spill/emergency cleanup.
- Transportation, disposal, storage, or containment of asbestos or products containing asbestos.

B. DEFINITIONS [partial listing]

- ACTION LEVEL - an airborne concentration of asbestos of 0.1 fiber per cubic centimeter (f/cc) of air calculated as an eight (8)-hour time-weighted average.
- ASBESTOS - includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.
- CLEAN ROOM - an uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.
- DECONTAMINATION AREA - an enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment contaminated with asbestos.
- EMPLOYEE EXPOSURE - that exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.

. EQUIPMENT ROOM [change room] - a contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated clothing and equipment.

. FIBER - a particulate form of asbestos 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

. HIGH-EFFICIENCY PARTICULATE AIR (HEPA) FILTER - a filter capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 micrometers in diameter or larger.

. REGULATED AREA - an area established by the employer to demarcate areas where airborne concentrations of asbestos exceed or can reasonably be expected to exceed the permissible exposure limit.

C. PERMISSIBLE EXPOSURE LIMIT (PEL)

0.2 fibers/cc eight (8)-hour time-weighted average (TWA)

NOTE: This is a reduction in the existing PEL by a factor of 10.

D. COMMUNICATION AMONG EMPLOYERS

On multi-employer worksites, an employer performing asbestos work requiring the establishment of a regulated area shall inform other employers on the site of the nature of the work and of the existence of and requirements pertaining to regulated areas.

E. REGULATED AREAS

The employer shall establish a regulated area in work areas where airborne concentrations of asbestos exceed or can reasonably be expected to exceed the permissible exposure limit.

Demarcation

Limited Access

Respirators

051450

Prohibited Activities: Employees may not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated area.

Requirements:

(1) Negative pressure enclosure

(2) Competent person to perform the following:

- . Set-up enclosure.
- . Control the entry and exit from the enclosure.
- . Supervise employee exposure monitoring.
- . Ensure proper use of protective clothing/equipment and hygiene facilities.
- . Ensure employees are properly trained.

(3) Exception: For small-scale, short-duration operations, such as pipe repair, valve replacement, installing electrical conduits, installing or removing drywall, roofing, and other general building maintenance or renovation, the employer is not required to comply with these requirements. Other engineering controls and work practices are applicable (i.e.: glove bags).

F. EXPOSURE MONITORING

Each employer shall perform monitoring to determine accurately the airborne concentrations of asbestos to which employees are exposed. All samples should be personal samples made from the breathing zone and representative of the 8-hour time-weighted average of each employee.

Initially, all asbestos handling jobs must be monitored.

The employer shall notify (in writing either individually or by posting at a centrally located place) affected employees of the monitoring results that represent that employee's exposure as soon as possible following receipt of results.

G. METHODS OF COMPLIANCE -

The following control methods may be used individually or in any combination to achieve compliance with the permissible exposure limit:

- Local exhaust ventilation with HEPA filter dust collection system.
- General ventilation.
- Vacuum cleaners equipped with HEPA filters.
- Enclosure or isolation.
- Use of wet methods, wetting agents, or removal encapsulation.
- Prompt disposal in leak-tight containers.
- Work practices.

Respirators must be used with these methods in accordance with section H of this standard.

The following practices/equipment are prohibited:

- High-speed abrasive disc saws for removal.
- Compressed air for removal operations unless used in conjunction with an enclosed ventilation system designed to capture the dust cloud.
- Spraying of asbestos-containing materials.
- Employee rotation as a means of compliance with the exposure limit.

H. RESPIRATORY PROTECTION

EXPOSURE LIMIT	REQUIRED RESPIRATOR
Not in excess of 2.0 fiber/cc (10 X PEL)	Half mask, air purifying with HEPA filter.
Not in excess of 10 fiber/cc (50 X PEL)	Full facepiece, air purifying with HEPA filter.

EXPOSURE LIMIT	REQUIRED RESPIRATOR
Not in excess of 20 fiber/cc (100 X PEL)	Supplied air respirator operated in continuous flow mode.
Not in excess of 200 fiber/cc (1000 X PEL)	Full facepiece supplied air respirator operated in pressure demand mode.
Above 200 fiber/cc	Full facepiece supplied air respirator operated in pressure demand mode and equipped with auxiliary positive pressure SCBA.

No employee shall be assigned to tasks requiring the use of respirators if, based on his or her most recent examination, it is determined that the employee will be unable to function normally wearing a respirator, or that the safety and health of the employee will be impaired by the use of a respirator.

Fit-testing (qualitative) is required for testing the fit of half-mask negative-pressure respirators. Facial hair (i.e.: beard) is not permitted with the use of negative-pressure respirators. Persons with facial hair which would come in contact with the sealing surface of the mask, would be required to wear a full-facepiece air-supplied (positive pressure) unit.

Fit-testing is required every 6 months following the initial fitting.

I. PROTECTIVE CLOTHING

Coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings are required. Disposable-type clothing is preferable to eliminate additional laundering requirements.

J. HYGIENE FACILITIES AND PRACTICES

The employer may permit employees engaged in small-scale, short-duration operations to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the area.

On jobs requiring total enclosure and isolation (i.e.: negative-pressure enclosures), hygiene facilities must be located adjacent and connected to the regulated area. Hygiene facilities must include:

. Decontamination area

. Clean room

. Shower area

. Equipment room (including disposal bags)

. Decontamination area entry/exit procedures

K. COMMUNICATION OF HAZARDS TO EMPLOYEES

Warning signs at regulated areas and at approaches to regulated areas:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

Labels for products and waste containers containing asbestos:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

Employee training shall be provided prior to or at the time of initial assignment, unless the employee has received equivalent training within the previous 12 months, and at least annually thereafter. The program must include the following:

- Methods of recognizing asbestos.
- The health effects associated with asbestos exposure.
- The relationship between smoking and asbestos in producing lung cancer.
- The nature of operations that could result in exposure to asbestos; the importance of necessary protective controls to minimize exposure; any necessary instruction in the use of these controls and procedures.
- The purpose, proper use, fitting instructions, and limitations of respirators.
- The appropriate work practices for performing the asbestos job.
- Medical surveillance program requirements.
- A review of this standard, including appendices.

L. HOUSEKEEPING

Vacuuming: HEPA filtered vacuuming equipment.

Waste Disposal: sealed, labeled, impermeable bags or other closed, labeled, impermeable containers.

M. MEDICAL SURVEILLANCE

The employer shall institute a medical surveillance program for all employees engaged in work involving levels of asbestos at or above the action level for 30 or more days per year, or who are required by this section to wear negative pressure respirators.

Details of the program are covered in section IV of this handbook.

N. RECORDKEEPING

Objective data for exempted operations.

Exposure measurements [30 years].

Medical surveillance [duration of employment plus 30 years].

Training records [1 year beyond last day of employment].

Availability.

Transfer of records.

O. DATES

EFFECTIVE DATE: JANUARY 16, 1987

051453

APPENDICES

APPENDIX A : [mandatory]	OSHA Reference Method (Procedure for Analyzing Air Samples for Asbestos)
APPENDIX B : [non-mandatory]	Detailed Procedure for Asbestos, Tremolite, Anthophyllite, and Actinolite Sampling and Analysis
APPENDIX C : [mandatory]	Methods for Respirator Fit Testing
APPENDIX D : [mandatory]	Medical Questionnaire
APPENDIX E : [mandatory]	Information for X-Ray Interpretations
APPENDIX F : [non-mandatory]	Work Practices and Engineering Controls for Major Asbestos Removal, Renovation, and Demolition Operations
APPENDIX G : [non-mandatory]	Work Practices and Engineering Controls for Small-Scale Short-Duration Asbestos Renovation and Maintenance Activities
APPENDIX H : [non-mandatory]	Substance Technical Information for Asbestos
APPENDIX I : [non-mandatory]	Medical Surveillance Guidelines for Asbestos

SECTION IV

MEDICAL SURVEILLANCE PROGRAM

REFERENCES:

(1) Course Manual for EPA "Asbestos Abatement Training", Drexel University, Philadelphia, Pa., January, 1987.

(2) Salisbury Plant Safety/Health/ Environmental Department

SALISBURY MEDICAL SURVEILLANCE PROGRAM

It is important for any employer who has workers who will have potential asbestos exposure to establish an ongoing medical surveillance program. The two most obvious reasons and the two areas of greatest concern are:

(1) The safety and health of all employees.

(2) Regulatory requirements.

Through implementation of a sound medical surveillance program, an employer will be able to verify every employee's medical status at a particular time and comply with OSHA standards on medical surveillance of workers exposed to asbestos.

According to the OSHA asbestos standard, 29 CFR 1926.58, subpart M, the employer must provide at his/her own expense, medical examinations relative to their employees' exposure to asbestos. More specifically, the employer must institute a medical surveillance program for all employees engaged in work involving levels of asbestos at or above the action level for 30 or more days per year, or who are required by this section to wear negative pressure respirators. An acceptable program must include pre-placement, annual, and termination examinations provided there is sufficient evidence that demonstrates that an employee has not been examined in accordance with the standard within the past one year period. This standard also outlines the requirements for maintaining medical records on each employee.

The three parts of the medical surveillance program are discussed as follows:

I. PRE-PLACEMENT EXAMS

According to the OSHA standard, pre-placement examinations must take place within 30 calendar days following the worker's first employment. A comprehensive medical evaluation must be performed. This includes, as a minimum, a chest X-ray, pulmonary function tests, a ColoScreen, and a medical history to determine the presence of any possible respiratory diseases. The pulmonary function tests include forced vital capacity (FVC) (the maximum amount of air that can be expired from the lung after full inhalation) and forced expiratory volume after one second (FEV1.0) (the amount of air forcibly expired in one second after full inhalation).

The results of this examination will be used as the employee's baseline health status, and also to determine whether or not they are capable of wearing respirators. A physician's report will then be furnished to the employer for their files. A statement should be provided indicating whether or not an employee is capable of wearing a respirator, and also outlining any limitations associated with its use. This form must also indicate any other limitations (i.e.: heat, cold, etc.). If an employee requests to see the report, the employer is required to supply them with a copy.

II. ANNUAL EXAMINATIONS

According to OSHA, every employer must provide, or make available, comprehensive medical evaluations to each of their employees engaged in jobs which cause exposure to airborne asbestos fibers (i.e.: maintenance personnel). Again, the annual examination is for all employees engaged in work involving levels of asbestos at or above the action level for 30 or more days per year, or who are required by this section to wear negative pressure respirators. Such annual examinations must include, as a minimum, a chest X-ray, a study to determine the presence of any respiratory diseases, a pulmonary function test (including FVC and FEV1.0), and a ColoScreen (a test for occult blood in the stool). This exam is basically the same as the pre-placement evaluation, and is used as an ongoing surveillance mechanism.

The physician will be able to compare the annual examinations with the pre-placement evaluations to determine if there are any changes in an employee's health status. If there are noticeable changes, the employer and the employee should both be notified since the situation may require immediate action.

III. TERMINATION OF EMPLOYMENT EXAMINATION

Within 30 calendar days before or after the termination of an employee, OSHA requires that each employee exposed to asbestos receive a medical examination. This exam must entail the same items as the pre-placement and annual exams. Records of these examinations must be retained by the employer for a minimum period of 30 years to provide documentation of the health status of the employee. The reason for this 30 year period is because the latency period associated with asbestos-related diseases often ranges between 15-30 years.

REASONS FOR SPECIFIC TESTS

All of the tests that are required to be performed during pre-placement, annual, and termination medical examinations are required in order to properly evaluate the human body systems that are most likely to be affected by exposure to elevated levels of airborne asbestos fibers. Some specific reasons for each test are discussed as follows:

I. CHEST X-RAY

These are performed primarily to detect irregularities in the lungs or the heart, including any fibrosis or pleural plaques induced by exposure to asbestos. Chest X-rays may also be used as a baseline for comparing future X-rays.

II. PULMONARY FUNCTION

These tests are conducted to determine if a person's lungs are expanding normally, and if there is adequate air movement in and out of the lungs. The FVC and FEV1.0 are conducted through the use of a spirometer. If the FEV1.0 is reduced, this may signify a possible obstruction or problem in the lungs. If the FVC or the ratio of FEV1.0 to FVC is reduced, this may signify restrictive changes in the lungs.

III. COLOSCREEN

This is a test to determine the presence of occult blood in the stool. If the test is positive it indicates a potential problem which should be investigated further.

IV. PULMONARY HISTORY

This part of the examination is simply a questionnaire that is completed by the employee. It is used to identify the potential for respiratory diseases. Several questions relate to chronic lung diseases, while others address the employee's personal habits such as smoking. There is often particular concern for the health of a person who smokes and is also exposed to asbestos. Recent studies indicate that an asbestos worker who smokes is more likely to develop lung cancer than non-smokers who do not work with asbestos.

THE ASBESTOS EXPOSURE LOG

As stated previously in this section, the requirements regarding the annual physical examination are based in part on the number of days of actual exposure to levels of asbestos dust above the action level. The Salisbury Plant has taken the conservative approach that any job involving asbestos removal will present potential exposures at or above the action level. Therefore, anyone who engages in a job requiring asbestos removal would be considered as having exposure on that particular day.

To provide an accurate record of daily asbestos exposure, a log sheet will be posted in all maintenance shops. A copy of this log sheet is shown on the next page.

The following guidelines must be followed for proper use of this sheet:

(1) Each shop should list all employees who are likely to have asbestos exposure during the month and who also qualify as follows:

- Have received formal asbestos removal training.
- Have been properly fit-tested for a respirator.

(2) The log sheet for each shop should be posted in a convenient and visible location.

(3) If an employee is involved in a job requiring handling of asbestos (i.e.: insulation removal), an "X" should be placed on the log sheet corresponding to that day's date. <u>It is each employee's responsibility to maintain the accuracy of this log.</u>

(4) At the end of each month, the completed log should be returned to the Safety/Health/Environmental Department and a new sheet started.

NOTE: **MAINTENANCE PERSONNEL WHO HAVE NOT BEEN PROPERLY TRAINED AND FIT-TESTED FOR A RESPIRATOR SHOULD NOT BE INVOLVED IN ASBESTOS HANDLING, EVEN ON A SMALL SCALE.**

051457

CELANESE - SALISBURY PLANT

ASBESTOS EXPOSURE LOG

MONTH _____, 19 ____ SHOP/AREA: _____ SUPERVISOR: _____

EMPLOYEE NAME	PAYROLL NUMBER	DAYS* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

* Enter an "X" on date that employee works directly with asbestos or in an area where asbestos is being worked with.

RETURN LOG SHEET TO INDUSTRIAL HYGIENE ENGINEER (S/H/E DEPARTMENT) AT END OF EACH MONTH.

SECTION V

PROTECTING THE WORKER

REFERENCES:

Course Manual for EPA "Asbestos Abatement Training", Drexel University, Philadelphia, Pa., January, 1987.

PROTECTIVE CLOTHING

It is important to understand why protective clothing is worn during asbestos abatement work. The primary reason is to keep gross amounts of asbestos-containing debris off the body, hair, etc. The use of protective clothing and showers will minimize the chance of bringing asbestos out of the work area and into the home. Protective clothing will also minimize the chance of rashes and discomfort caused by the material being removed. In addition to the asbestos, frequently the material being removed contains mineral wool, fiberglass, and binders such as cement. Each of these may be irritating to the skin. Continued direct contact with asbestos has also been shown to cause "asbestos warts." These warts often take months to heal and occur more frequently if asbestos is trapped beneath a watchband, or in other ways kept in close contact with the skin.

Protective clothing for asbestos abatement projects usually consists of disposable coveralls, foot covering and head covering. The foot and head covering should be attached to the coveralls. This eliminates the need to tape openings between garments, etc. Gloves should be worn when inside the work area unless using a glovebag.

Other protective clothing/items such as hard hats and safety shoes/boots should remain in the work area for the duration of the project. Upon project completion, these items can be cleaned, placed in a plastic bag, labeled as containing asbestos, and taken to the next job.

After completing small-scale, short-duration type jobs disposable coveralls and other disposable protective clothing should be completely cleaned using a vacuum with HEPA filter and then disposed along with the asbestos waste. Clothing worn underneath the coveralls must also be vacuumed before leaving the work area.

To summarize, listed below is a list of items normally worn by asbestos abatement employees:

- Disposable coveralls, disposable foot covering, disposable head covering
- Shoes with non-skid rubber soles
- Hard hat (as required)
- Gloves (cotton is practical)
- Eye protection (not needed if full facepiece respirators are used)

RESPIRATORY PROTECTION

As required by the OSHA respirator standard (29 CFR 1910.134), only approved respirators should be considered during the selection process. And, the respirators must be approved for protection against the specific hazard - asbestos, for example. The National Institute for Occupational Safety and Health (NIOSH) is the testing agency to see if a respirator model can receive approval. If the entire respirator assembly, including cartridges / filters / hoses, passes their test, then they and the Mine Safety and Health Administration (MSHA) issue a joint NIOSH/MSHA approval number for that specific respirator assembly.

There are three major classes/categories of respirators, plus subcategories for each category. The major types are:

(1) Air-Purifying

(2) Air-Supplied

(3) Self-Contained

Each type will be discussed in more detail as follows:

I. AIR-PURIFYING RESPIRATOR

Air purifying respirators remove limited concentrations of air contaminants from the breathing air, but do nothing to improve (or change) the oxygen content. Thus, they can only be used in atmospheres where there is enough oxygen, and where air contaminants do not exceed the specified range of the respirator and cartridge.

These respirators generally consist of a soft, rubber facepiece and some kind of replaceable filter or cartridge. Two major subcategories of air purifying respirators are the mechanical filter type and the chemical cartridge type. The mechanical filter variety is designed to protect against particulate matter such as dust and asbestos fibers. The chemical cartridge variety is used to protect against light concentrations of chemicals, such as solvent vapors. There are even combination models approved for both types of protection. Respirator facepieces (including those for the air-purifying category) are used to further describe specific subcategories, based on the construction and face coverage. The major subcategories are:

Single-Use (disposable): Commonly referred to as a "dust mask," this type of respirator is no longer acceptable for use in the Salisbury Plant for asbestos removal jobs.

Half Mask : It is called half-mask because it covers half of the face - from under the chin to the bridge of the nose. Most, but not all, half-mask respirators are NIOSH/MSHA approved. It is still necessary to chose the correct approved model for the identified air contaminant.

Full Face : It is called a full-face type because it covers from under the chin up to the forehead. This broader coverage provides a better face fit, higher degree of protection, and gives some eye protection. Many full-face respirators have four or more straps. Regardless of the number of straps, the respirator should be put on by placing the chin into the chin cup, then tightening the straps going from the bottom to the top.

A relatively new (last 5-10 years) and special subcategory of air-purifying respirator is the Powered Air Purifying (PAPR) type. The previously described air-purifying respirators depend on breathing energy to draw the air in through the respirator cartridge or filter (negative pressure). However, these PAPR units use a battery-powered blower that passes the contaminated air through the cartridge or filter where the air is cleaned and forced through a hose to the facepiece. The face covering can be a half-mask, full-face mask, helmet (hat), or hood.

An advantage of using a powered air-purifying respirator is that it supplies air at a positive pressure within the facepiece, helmet, or hood, so that any leak is hopefully outward. Therefore, they provide a higher degree of protection than do half-mask and full-face air-purifying respirators.

II. AIR-SUPPLIED RESPIRATOR

Air-supplied respirators deliver breathing air through a supply hose connected to the worker's facepiece (half mask or full face). This category of respirator is becoming the most important type on large asbestos abatement jobs. They provide a very high degree of protection. They are often required by the contract specifications on larger projects.

III. SELF-CONTAINED RESPIRATOR

Self-contained respirators provide protection for various periods of time depending upon the amount of breathing air (air pressure and tank size) and the breathing demands of the wearer. The worker is independent of his/her surrounding atmosphere when using these devices; therefore, they can be used in environments immediately harmful to life. They have several disadvantages, and are seldom used on asbestos jobs. They are heavy and awkward to wear. The air supply usually lasts only 30 to 60 minutes.

RESPIRATORY PROTECTION PROGRAM

Any employer who requires or permits employees to wear a respirator must have a written respiratory protection program. This is required by OSHA in the asbestos standard and in respiratory protection regulations (29 CFR 1910.134). The written respirator program establishes standard operating procedures concerning the use and maintenance of respiratory equipment. The program must be enforced and updated as necessary.

Below, some items of this program have been highlighted and discussed, with special emphasis on application to asbestos removal work.

SELECTION AND USE OF RESPIRATORY PROTECTION EQUIPMENT

Respirators used shall be selected from those approved by the Mine Safety and Health Administration (MSHA) or the National Institute for Occupational Safety and Health (NIOSH) for use in atmospheres containing asbestos. Use of a single-use disposable dust mask is no longer an acceptable type of respirator for use during asbestos removal operations.

As a rule of thumb, air-purifying respirators (half-mask, negative pressure) will be used for small-scale, short-duration type asbestos handling jobs at the Salisbury Plant. It is important to note, however, that facial hair (i.e.: beard) is not permitted with the use of negative-pressure respirators. Persons with facial hair that would come in contact with the sealing surface of the mask, will be required to wear a full-facepiece air-supplied (positive pressure) unit, provided an appropriate fit can be obtained. This will be discussed in more detail during the fit-testing exercise.

MEDICAL SURVEILLANCE

Only those individuals who are medically able to wear respiratory protective equipment shall be issued a respirator. Before being issued a respirator, an employee will receive pertinent tests for medical and physical conditions. Medical tests to be considered by a physician include: pulmonary function tests (FVC and FEV), chest X-ray, and any others deemed appropriate by the examining physician. Medical factors to be considered, and which should appear on the pulmonary history questionnaire, include: emphysema, asthma, chronic bronchitis, heart disease, anemia, hemophilia, poor eyesight, poor hearing, epileptic seizures, and other factors which might inhibit the ability of an employee to wear respiratory equipment.

FIT-TESTING

Any employee who is assigned a respirator must be given the opportunity to wear the respirator and be qualitatively fit-tested. The qualitative fit-test is used to determine the fit of the respirator to the face of the individual. Qualitative (pass/fail) tests are fast, require no complicated, expensive equipment, and are easily performed. However, they depend on the wearer's response, and thus are not entirely reliable. A more detailed quantitative fit-test may be conducted instead.

The fit of respirators must be determined when the respirators are issued. Each employee should check the fit each time they put the respirator on. These are valid requirements since the weakest point of protection for a respirator is leakage around the face seal/fit.

During any type of fit-testing, the respirator straps must be properly located and as comfortable as possible. Over tightening the straps will sometimes reduce facepiece leakage, but the wearer may be unable to tolerate the respirator during the work period. The facepiece should not press into the face and shut off blood circulation or cause major discomfort. At the time of issuance, a visual inspection of the fit should always be made by a second person. That person should check to see that there are not visible openings/leaks and that the respirator appears properly adjusted and comfortable.

There are several methods of testing within both categories of fit-tests. Those considered most applicable to the qualitative fit-testing done at the Salisbury Plant are discussed as follows:

- Negative Pressure Test: For this test, the user closes off the inlet of the cartridges or filters by covering with the palms or squeezing the breathing tube so it does not allow air to pass; inhales gently so the facepiece collapses slightly; and holds his/her breath for about 10 seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator probably fits tightly enough.

- Positive Pressure Test: This test is very similar in principle to the negative pressure test. It is conducted by closing off/covering the exhalation valve and exhaling gently into the facepiece. The respirator fit is considered okay if slight pressure can be built up inside the facepiece without any evidence of outward leakage around the facepiece.

- Isoamyl Acetate (banana oil) Test
- Saccharin Solution Aerosol Test
- Irritant Fume (smoke) Test

All three of these tests rely on the wearer's odor threshold or taste response to an externally applied material. The banana oil and the irritant smoke tests are the two most often used at the Salisbury Plant. Details of the test will not be given in this discussion as this method is administered by the Safety/Health/Environmental Department and will be explained at the time of the actual fit test.

RESPIRATOR ASSIGNMENT AND MAINTENANCE

Where possible, respirators will be assigned to individual workers for their exclusive use. A system of recordkeeping should be established to document all employees who have respiratory protection equipment, and the periodic cleaning and maintenance of equipment.

Respirators should be regularly cleaned and disinfected. Those issued for the exclusive use of one person should be cleaned after each day's use, or more often, if necessary. Those used by more than one worker shall be thouroughly cleaned and disinfected after each use. This procedure is described as follows:

(1) Before leaving the work area, each user must clean his respirator of surface dust by using a vacuum cleaner with HEPA filter. On large-scale jobs requiring a negative-pressure regulated area, the user must shower with the respirator on to remove any asbestos-containing material which may have settled on the equipment.

(2) Respiratory equipment should be washed with detergent in warm water using a brush. If possible, detergents containing a bactericide should be used. Organic solvents should not be used, as they deteriorate the rubber facepiece.

If bactericide detergent is not available, the detergent wash should be followed with a disinfecting rinse. Two types of disinfectants may be made from readily available household solutions. A hypochlorite solution (50 ppm) can be made by adding two tablespoons of chlorine bleach to one gallon of water. An aqueous solution of iodine (50 ppm) can be made by adding one teaspoon tincture of iodine to one gallon of water. A two minute immersion of the respirator (without the filter pad) into either solution would be sufficient for disinfection.

(3) Respiratory equipment should be thoroughly rinsed in warm clean water (120°F maximum) to remove all traces of detergent, cleaner and sanitizer, and disinfectant.

(4) Respiratory equipment should be allowed to air dry on a clean surface.

(5) When not in use, respiratory equipment should be sealed in plastic bags and stored with the facepiece and exhalation valve in a non-distorted position.

Repair or replacement of component parts must be done by qualified individuals. Substitution of parts from a different brand or type of respirator will invalidate the approval of the respirator.

Inspection for defects in respiratory equipment must be done before and after each use and during cleaning. The primary defects to look for in the inspection of component parts of the respirator and corrective actions where appropriate are itemized below:

I. Air Purifying Respirators (half-mask and full facepiece)

A. Rubber facepiece - check for:
- Excessive dirt (clean all dirt from facepiece)
- Cracks, tears, or holes (obtain new facepiece)
- Distortion (allow facepiece to "sit" free from any constraints and see if distortion disappears; if not, obtain new facepiece)
- Cracked, scratched, or loose-fitting lenses (contact respirator manufacturer to see if replacement is possible; otherwise, obtain new facepiece)

B. Headstraps - check for:
- Breaks or tears (replace headstraps)
- Loss of elasticity (replace headstraps)
- Broken or malfunctioning buckles or attachments (obtain new buckles)
- Allow the facepiece to slip (replace headstrap)

C. Inhalation valve, exhalation valve - check for:
- Detergent residue, dust particles, or dirt on valve or valve seat (clean residue with soap and water)
- Cracks, tears, or distortion in the valve material or valve seat (contact manufacturer for instructions)
- Missing or defective valve cover (obtain valve cover from manufacturer)

D. Filter element(s) - check for:
   . Proper filter for the hazard
   . Approval designation
   . Missing or worn gaskets (contact manufacturer for replacement)
   . Worn threads - both filter threads and facepiece threads (replace filter or facepiece, whichever is applicable)
   . Cracks or dents in filter housing (replace filter)
   . Missing or loose hose clamps (obtain new clamps)

II. Atmosphere-Supplying Respirators

A. Check facepiece, headstraps, valves, and breathing tube, as for air-purifying respirators.

B. Hood, helmet, blouse, or full suit, if applicable - check for:
   . Headgear suspension (adjust properly)
   . Cracks or breaks in faceshield (replace faceshield)
   . Protective screen to see that it is intact and fits correctly over the faceshield, abrasive blasting hoods, and blouses (obtain new screen)

C. Air supply system - check for:
   . Breathing air quality
   . Breaks or kinks in air supply hoses and end fitting attachments (replace hose and/or fitting)
   . Tightness of connections
   . Proper setting of regulators and valves (consult manufacturer's recommendations)
   . Correct operation of air-purifying elements and carbon monoxide or high-temperature alarms

EMPLOYEE TRAINING PROGRAM

Each employee designated to wear a respirator must receive adequate training. The training session (initial and periodic retraining) should be conducted by a qualified individual to ensure that employees understand the limitations, use, and maintenance of respiratory equipment.

Respirator fit-testing must be conducted every six (6) months for all employees required to wear negative-pressure type respirators.

RESPIRATOR PROGRAM EVALUATION AND RECORDKEEPING

The respirator program shall be evaluated at least annually with program adjustments, as appropriate, made to reflect the evaluation results.

Attention should be given to proper recordkeeping. Records which should be kept include: employees who are trained in respirator use, documentation of the care and maintenance of respirators, medical reports of each respirator user, airborne concentrations of asbestos fibers during work, and any problems encountered during asbestos handling projects with regards to respiratory equipment.

SECTION VI

ASBESTOS REMOVAL WORK PRACTICES

REFERENCES:

(1) Course Manual for EPA "Asbestos Abatement Training", Drexel University, Philadelphia, Pa., January, 1987.

(2) Celanese - Salisbury "Hourly Industrial Relations Guide Manual", HIRG 10:13, August 20, 1984.

NEGATIVE PRESSURE WORK AREAS

This section provides guidelines for the use of negative pressure systems in removing asbestos-containing materials from work areas. The manufacturer's instructions for equipment use should be followed for negative air filtration units, as well as any other equipment needed. A negative pressure system is one in which the static pressure in an enclosed work area is lower than that of the environment outside the containment barriers.

The pressure gradient is maintained by moving air from the work area to the environment outside the area via powered exhaust equipment at a rate that will support the desired air flow and pressure differential. Thus, the air moves into the work area through designated access spaces and any other barrier openings. Exhaust air is filtered by a high-efficiency particulate air (HEPA) filter to remove asbestos fibers.

The use of negative pressure during asbestos removal helps protect against the large-scale release of fibers to the surrounding area in case of a breach in the containment barrier. A negative pressure system also can reduce the concentration of airborne asbestos in the work area by increasing the dilution ventilation rate (i.e.: diluting contaminated air in the work area with uncontaminated air from outside) and exhausting contaminated air through HEPA filters. The circulation of fresh air through the work area reportedly also improves worker comfort by increasing the cooling effect, which may aid the removal process by increasing job productivity.

This type of system would be set up for large-scale long-duration jobs and would not likely be executed by plant maintenance. An outside contractor would be the likely choice due to the complexity of set up. However, if such a system is required, the Safety/Health/Environmental Department would be responsible for ensuring proper procedures are followed. The required equipment has been bought by the Salisbury Plant and is available for maintenance use.

PREPARING THE WORK AREA

Airborne fibers which are generated by disturbance of asbestos-containing material may remain suspended in the air for long periods of time because of their small size and aerodynamic properties. These airborne asbestos fibers can migrate via air currents to other parts of the building.

Each job has unique requirements for effective preparation. For instance, the sequence of steps would probably be different for preparing a boiler room than preparing an area with asbestos material above a suspended ceiling. The following are general guidelines which can be modified to address specific problems encountered on different jobs:

STEP 1 - Conduct walkthrough survey of the work area.

STEP 2 - Post warning signs.

STEP 3 - Shut down the heating, ventilating, and air conditioning system (HVAC).

STEP 4 - Clean and remove furniture and non-stationary items from the work area.

STEP 5 - Seal stationary items with polyethylene.

STEP 6 - Tape and seal windows with polyethylene.

STEP 7 - Cover the floor with polyethylene.

STEP 8 - Cover the walls with polyethylene.

STEP 9 - Locate and secure the electrical system to prevent shock hazards.

STEP 10 - Remove or cover light fixtures.

STEP 11 - Secure the work area.

ESTABLISHING A DECONTAMINATION UNIT

The decontamination station is designed to allow passage to and from the work area during removal operations with minimal leakage of asbestos-containing dust to the outside. A typical unit consists of a clean room, a shower room, and an equipment (change) room separated by airlocks. The airlocks are formed by overlapping two sheets of polyethylene at the exit of one room, and two sheets at the entrance to the next room with three feet of space between the barriers.

PORTABLE, HEPA-FILTERED, POWERED EXHAUST UNIT

The exhaust unit establishes lower pressure inside than outside the enclosed work area during asbestos removal. Basically, a unit consists of a cabinet with an opening at each end, one for air intake and one for exhaust. A fan and a series of filters (HEPA) are arranged inside the cabinet between the openings. The fan draws contaminated air through the intake and filters and discharges clean air through the exhaust.

MATERIALS AND EQUIPMENT LIST FOR PREPARATION OF THE WORK AREA AND ESTABLISHING THE DECONTAMINATION STATION

Polyethylene Sheeting Material

Used to:

Seal off work areas and items within work areas; protect surfaces in the work area other than those being altered; construct decontamination and enclosure systems.

Types:

4 mil thickness	12' x 100' rolls	20 lbs
6 mil thickness	20' x 100' rolls	60 lbs

Duct Tape

Used to: Seam polyethylene sheets together; form airtight seal between polyethylene and wall; provide some support for vertical sheets.

Adhesive Spray

Used to: Seal seams; provide additional support to vertical sheets.

Furring Strips (cut into blocks)

Used to: Support vertical sheets of polyethylene.

Nails

Used to: Attach furring strips to top edge of polyethylene and then to the wall; construct the frame of the decontamination unit.

Staples & Staple Gun

Used to: Attach polyethylene to wood frame.

Retractable Razor Knives

Used to: Slice polyethylene and tape.

Warning Signs

Used to: Post entrances to building and decontamination unit.

Vacuum Cleaner Equipped with a High Efficiency Particulate Air (HEPA) Filter

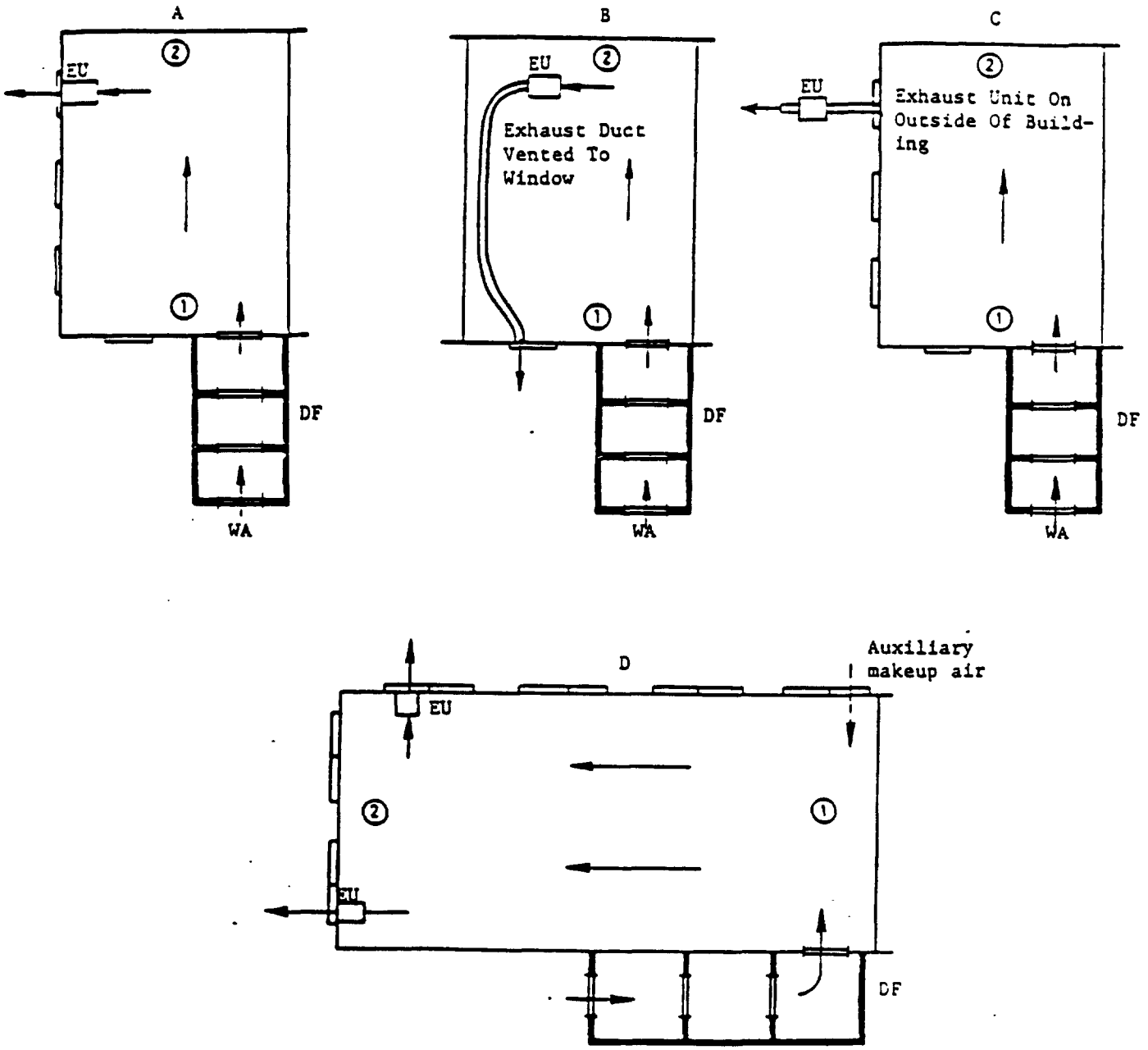
Used to: Clean non-stationary items before removing them from the work area.

Ladders and/or scaffolding

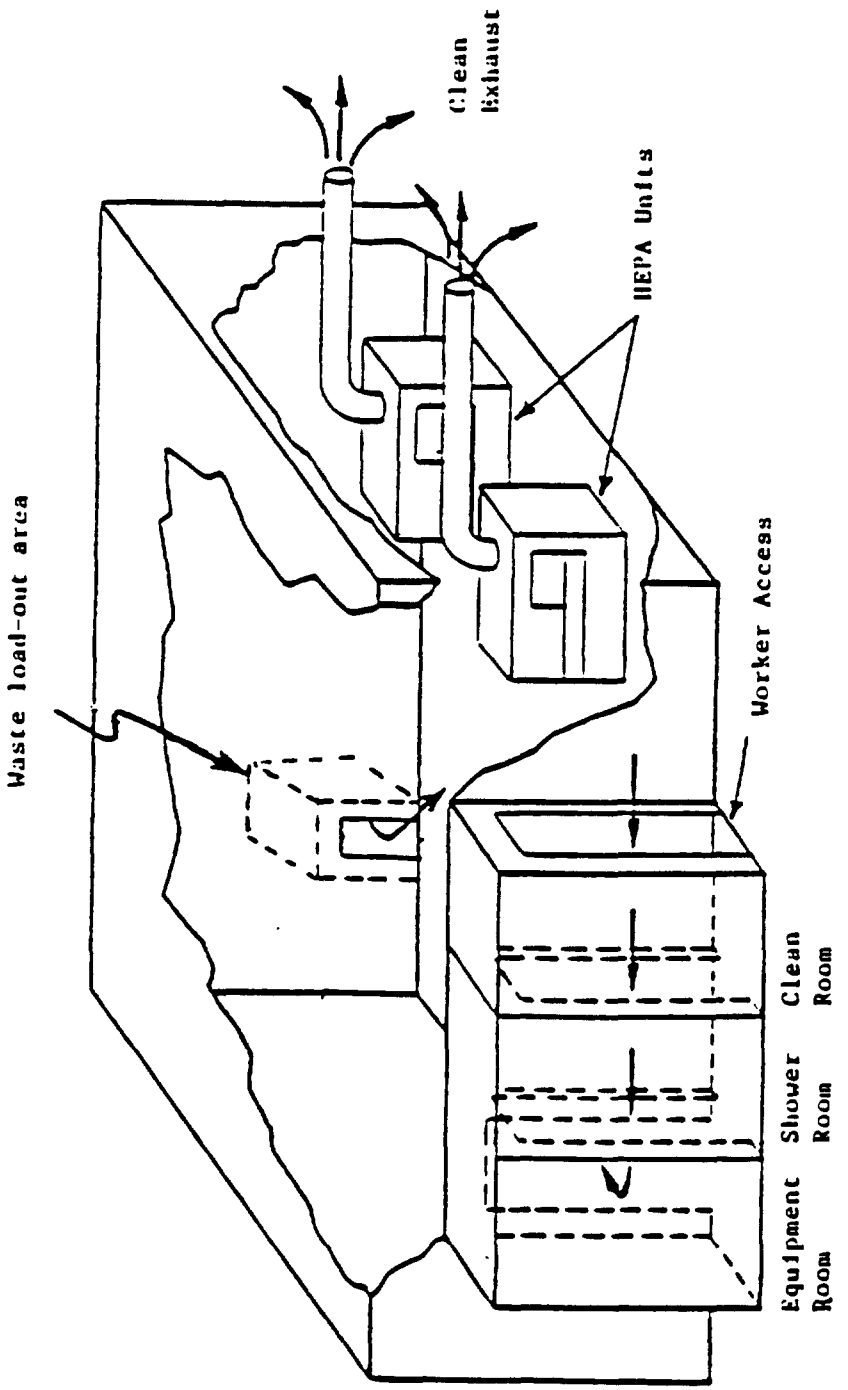
Carpentry tools such as hammers, saws, etc.

Prefab shower stalls or materials for shower construction

051467



Examples of negative pressure systems.
DF, Decontamination Facility; EU, Exhaust Unit; WA, Worker Access; A, Single-room work area with multiple windows; B, Single-room work area with single window near entrance; C, Single-room work area with exhaust unit placed on the outside of the building; D, Large single-room work area with windows and auxiliary makeup air source (dotted arrow). Arrows denote direction of air flow. Circled numbers indicate progression of removal sequence.



Schematic representation of negative air HEPA system in place.

WET REMOVAL TECHNIQUES

EPA regulations which cover the removal of asbestos material require wetting the material before removal begins and keeping it wet as it is removed and while it is being bagged. Dry removal, which requires specific EPA approval, is appropriate for some types of asbestos-containing materials which have been previously encapsulated and will not absorb amended water. Also, there are special conditions which preclude the use of water such as a room containing electrical supply lines which cannot be de-energized during the removal project.

Two advantages to the use of wet methods for removing asbestos materials include a reduction in airborne fiber concentrations which are generated during the removal and a reduction in the effort required to remove the material. Wet removal is based on the ability of water to lower the ability of the asbestos-containing material to release airborne asbestos fibers and increase the settling rate of fibers that are released.

The positive effects of wet removal can be further enhanced by adding a wetting agent to the water. The wetting agent is a combination of chemicals which aids in the penetration of the material and increases the probability of individual fiber wetting. Various wetting agents are available which have been used in the agriculture industry and fire fighting profession for many years. EPA recommends a wetting agent consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether in a ratio of 1 ounce to 5 gallons of water. This wetting agent is not as effective with materials which contain a high percentage of amosite asbestos.

Amended water is not totally effective in controlling fibers emitted from material containing amosite asbestos. Some contractors reportedly use ethylene glycol and/or oils to help reduce amosite emissions. Others have tried an encapsulant which is diluted so that it drys slowly and does not harden before the asbestos material can be removed from the pipes or vessels. No data is available from comparative testing of these wetting methods to determine which is the most effective.

INSULATION REMOVAL FROM PIPES & VESSELS

There is a wide variation in the types of asbestos-containing insulation used on pipes and vessels. Pipes may be insulated with preformed fibrous wrapping, corrugated paper, chalky mixture containing magnesia, fiber felt, and insulating cement. (Note: There are older materials labeled "magnesia" which contain asbestos and new materials also labeled "magnesia" which contain glass fiber rather than asbestos.) Usually a protective jacket, which may also contain asbestos, made of paper, tape, cloth, metal, or cement, covers the insulation materials. Vessels may be insulated with asbestos "blankets" on wire lath, preformed block, or the chalky magnesia mixture which is typically covered with a finishing cement.

Different approaches are required for removing these asbestos-containing materials than sprayed-on or troweled-on ceiling insulation, but the same protective measures are used. Careful handling and packaging is required in many cases because of the metal jackets, bands, or wire associated with the insulation materials.

Glovebags, which can be sealed around sections of pipe to form "mini-containment areas" may be used in some situations for removing pipe insulation. Insulated objects which are not readily accessible or are too large or hot for application of the glovebag technique, require a more conventional approach.

Because insulation on pipes and vessels often contains 70% asbestos and areas where these materials are being removed are often confined, high airborne fiber concentrations may occur. Also, these materials are more difficult to saturate with water and they often contain amosite, which is not controlled as well with water as other types of asbestos.

Removal of insulation from pipes and vessels can be accomplished by two-person teams. Cuts or slits are made in the insulation material, a spray nozzle is inserted, and the material is wetted to the extent feasible. One man cuts away the insulation and bags it while the other continuously sprays the material with amended water. Any metal bands or wire that is removed should be folded or rolled and placed in polyethylene to avoid lacerating personnel.

After the gross material is removed, nylon brushes are used to thoroughly clean the pipes and vessels. Particular care must be taken to clean the fittings and joints where a cement-plaster type material has been removed. After brushing, the surfaces are wet-wiped and the final cleanup phase begins.

Steam and dowtherm distribution systems should be shut down, if at all possible, when insulation is being removed. If these systems must stay on line, special consideration must be given to heat stress by workers and to measures to avoid skin burns. When airline respirators are being used by workers, care must be taken not to let the airlines come into contact with hot pipes which might burn a hole in the rubber line. When airlines are worn by persons working from scaffolds, care must be taken not to wrap the airlines around objects on the ground or the scaffold.

GLOVEBAG TECHNIQUES

The glovebag consists of a 6-12 mil bag fitted with long sleeve gloves, a tool pouch and a two-inch opening used for water application. Although glovebags can be fabricated by the user for each project, most contractors prefer to purchase ready-made bags. The size, quality, style and cost vary depending on the manufacturer. In addition to the glovebag, several other tools and materials are commonly required to perform the project successfully. These materials are listed below:

- Glovebag (one or more depending on project size)
- Pump-up garden sprayer (2-3 gallon size)
- Amended water (surfactant)
- Duct tape (3-inch width)
- Polyethylene disposal bags (6 mil)
- Smoke tubes with aspirator bulb
- HEPA-filtered vacuum cleaner
- Bone saw
- Utility knife with retractable blade
- Wire cutters
- Tin snips (if aluminum jacket is present)
- Polyethylene plastic (roll of 4 or 6 mil)
- Dual cartridge respirators with high efficiency cartridges
- Disposable full-body suits with hood and feet covering
- Small scrub brush
- Stapler
- Several rags
- Wettable cloth
- Asbestos caution signs and labels
- Reinsulation materials as necessary

Two persons are required to perform the glovebag removal project. A third person is often available, however, to assist with supplies, keep unwanted visitors out of the area, and to conduct the air monitoring. Each of these team members should have received training on the use and limitations of glovebag removal projects. They should also be included in the respiratory protection program and medical surveillance program.

Before any work begins, all necessary materials and supplies should be brought into the work area. This work area should be roped off (asbestos barrier tape) and warning signs posted on the perimeter to minimize the chance of visitors entering this area. The HVAC serving the work area should be shut down or isolated, if possible. Employees should be trained in emergency procedures should the glovebag rupture. This usually includes wet cleaning and/or HEPA vacuuming procedures and a shower available at a remote location.

REMEMBER! NEVER PERFORM GLOVEBAG REMOVAL ON HOT PIPES (OVER 150^{o}F). This may cause the bag or gloves to melt over the worker's hands and arms.

CLEANUP AND WASTE DISPOSAL

Although cleanup is a tedious, sometimes lengthy, process, it is one of the most critical tasks of an asbestos removal job. Successful cleanup operations require proper sequencing of tasks on large projects and great attention to detail on any job. For large removal projects where negative pressure regulated work areas are established, cleanup will be directed by a qualified person from the Safety/Health/Environmental Department as per the OSHA standard.

For small-scale, short-duration jobs, a vacuum equipped with HEPA filter is mandatory. The Salisbury Plant has purchased air-powered units which operate off the plant air system and can be used in classified areas. One model can be converted from a dry vacuum to a wet pick-up vacuum. The surrounding areas and any disposable clothing must be cleaned with a HEPA vacuum. NOTE: THE VACUUMS EQUIPPED WITH HEPA FILTERS MUST NEVER BE USED FOR ANYTHING OTHER THAN ASBESTOS REMOVAL OPERATIONS. Use on other jobs could lead to asbestos fiber contamination.

Walls and equipment adjacent to the work area should be wet wiped. For best results, workers should use cotton rags or lint free paper towels which are disposed after one use. Rinsing and reuse of towels may result in smearing asbestos fibers on the surfaces. Also, to avoid smearing of residual fibers, workers should wipe in one direction only.

After the walls are well wiped, the floor is mopped with a clean mop head wetted with amended water. The waste water from the wet wiping and mopping operations is treated as asbestos-containing water and dumped in the shower drain or placed in a barrel for disposal. It is now generally accepted that filtration of asbestos-contaminated water through a five micron filter is the state-of-the-art for asbestos removal from water. Discharge of the filtered water should be to a sanitary sewer system.

Once the asbestos-containing waste material has been removed from the areas of concern, there are certain precautions that must be taken before disposal operations begin. The first, and probably most important, undertaking is to ensure that all of the asbestos-containing waste has been thoroughly treated with water, or "wetted." This may be accomplished by having a water supply available in any area that removal is taking place (i.e.: a hose). As the asbestos-containing material is being removed, the material should be kept as damp as possible via a low pressure water stream. By ensuring this, the chances of airborne asbestos fiber generation are significantly reduced. The waste material will then be suitable for bagging or containerizing.

The safest and most effective way to ensure that the asbestos-containing waste has been properly packaged for transportation to the disposal site is to establish a standard procedure for bagging and handling the waste. The first step in this procedure would be to select the appropriate disposal bags (recommended: 6 mil polyethylene). These will be air-tight and puncture resistent. Also, these bags must be labeled with the OSHA required statement:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

It is important to handle this waste in a careful manner to keep airborne fiber generation minimal. Avoid placing sharp objects in the bag. A bag should be considered "full" when it is half filled (since the material saturated with water will be heavier). Seal completed bags with duct tape after excess air is squeezed out.

Once the asbestos-containing waste is securely enclosed inside the bag, the best recommended practice is to hose the bag down, wet wipe, or HEPA vacuum clean. The bag can then be properly disposed in the dumpsters marked for asbestos material only (one behind H-building and one behind K-building). THIS MATERIAL MUST NEVER BE DISPOSED IN DUMPSTERS USED FOR OTHER TRASH.

Asbestos waste material will be transported to and deposited in the landfill. The landfill operator will ensure that the asbestos-containing material is covered with at least six (6) inches of non-asbestos material each day.