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ABSTRACT

The Environmental Protection Agency (EPA) has worked with the states to develop a program for accurate information and guidance to deal with the problem of school buildings constructed with asbestos-containing materials. This is the first of two guidance manuals that are a major part of this program and are being mailed to all public school districts. They were prepared to inform administrators of the health hazards associated with asbestos and outline the steps that can be taken to identify asbestos-containing materials and to protect students and school personnel from exposure. Chapters constructed in a question and answer format discuss the concern about asbestos, its uses, steps involved in conducting an asbestos control program, and corrective action. Specifications and requirements for contractors are listed, as are sources of assistance from federal and state agencies. The appendices contain the asbestos regulations from three federal agencies, addresses of agencies involved in asbestos control, and a brief report, "Mineral Characterization of Asbestos-Containing Spray Finishes." (Author/MLF)

United States
Environmental Protection
Agency

Office of
Toxic Substances
Washington, D.C. 20460

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Toxic Substances

EPA

Asbestos-Containing Materials in School Buildings:

Part 1

A Guidance Document

March 16, 1979

Dear School Officials:

Until recently exposure to asbestos was generally considered an occupational health hazard for asbestos workers. However, now we have learned of an equally serious exposure problem that can occur in all types of buildings in which certain asbestos-containing materials have been used for fireproofing, insulation, and decoration. Asbestos can be released from these materials and contaminate the building environment. Individuals who are then exposed to the asbestos could develop lung cancer or cancers of other parts of the body. Unfortunately, detection of asbestos-related diseases is difficult since the latency period between exposure and appearance of the disease is sometimes as many as 20 to 40 years.

Since these materials are found in school buildings, we at EPA are particularly concerned with the exposure of school children. EPA has worked with the States to develop a program that responds to the need for accurate information and guidance to deal with this difficult problem. The enclosed manuals are a major part of this program and are being mailed to all public school districts. They were prepared to inform you of the health hazards associated with asbestos and outline the steps you and the schools in your district can take to identify asbestos-containing materials and to protect students and school personnel from exposure.

Also participating in this EPA program are the Department of Health, Education, and Welfare, the Occupational Safety and Health Administration, and the Consumer Product Safety Commission. Through the Regional Offices located in major cities across the country, EPA and these Agencies will provide assistance for the difficulties that you may encounter in undertaking a control program in your schools. We are operating several toll-free numbers that you can call to ask for information and assistance. A videotape that was prepared to supplement this manual will also be available for your use.

A survey form is included in this manual. The form asks questions on the results of the control programs you conduct in your schools. Your participation in this part of the EPA program would be appreciated. By completing the form you will assist us in assessing the extent of the asbestos-containing material problem in the United States.

I encourage you and your staff to review the enclosed manuals and inform the schools in your district of the EPA program. A successful nationwide school asbestos program depends on your efforts and those of school officials across the country. We look forward to working with you in the important weeks and months ahead.

Sincerely,

Steven D. Jellinek
Assistant Administrator
for Toxic Substances

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Acknowledgements

We gratefully acknowledge the assistance of the many individuals who contributed their time and efforts to the preparation of this manual.

This manual embodies the comments and input of State and local government officials, environmental and special interest groups, industry, and interested private citizens as well as staff in EPA Headquarters and Regional Offices. The assistance of the Department of Health, Education, and Welfare (DHEW), the Occupational Safety and Health Administration, the Consumer Product Safety Commission, and the Department of Interior is also gratefully acknowledged.

We are particularly grateful for the assistance and cooperation of DHEW's National Institute of Environmental Health Sciences (NIEHS) and the National Institute for Occupational Safety and Health. We appreciate the review and comments from the members of NIEHS's Subcommittee to Coordinate Asbestos Research of the Committee to Coordinate Toxicology and Related Programs.

We are indebted to Dr. Robert N. Sawyer of the Yale University School of Medicine. In his capacity as the principal technical consultant to the project, Dr. Sawyer provided his invaluable assistance to the development of the manual. Dr. Sawyer was also responsible for generating interest and comments from individuals who have had experience in dealing with the asbestos-containing material problem.

Preface

Recently there has been an increasing awareness of the significance of environmental factors in causing illness. The fibrous minerals known as asbestos, used in many different kinds of products and applications, have entered the environment in both occupational and non-occupational settings. The lung disease, asbestosis, and some cancers of the lung, abdomen, and other parts of the body have been clearly related to asbestos exposure.

The Environmental Protection Agency (EPA) is concerned with the disease-causing potential of intermittent, low-level exposures that can occur in some school buildings from certain asbestos-containing materials. EPA has established a guidance program to inform States and local school officials of the possible health hazards associated with asbestos. EPA will provide guidance to schools which undertake programs to identify and control exposure to these asbestos-containing materials. Although the EPA program is specifically directed to schools, information and assistance will also be available to contractors, workers, and any individuals who are concerned about exposure to asbestos in buildings.

EPA's guidance package contains two parts. This manual, which is Part 1 of the package, is written for school officials. Part 1 outlines steps that schools can take to conduct an asbestos control program. Part 2 contains more detailed information on asbestos identification and control methods. Part 2 will be particularly useful to school personnel, contractors, and others involved in actual asbestos inspection and control activities.

As the lead Agency for the school asbestos program, EPA will provide additional information and assistance to the States and school districts through the Agency's ten Regional Offices located throughout the country. Each Regional Office will have a Regional Asbestos Coordinator who will work with the States to assist in undertaking asbestos control programs.

Other Federal Agencies concerned with the asbestos problem will also participate in the program. The Occupational Safety and Health Administration (OSHA) and the Department of Health, Education, and Welfare through the National Institute for Occupational Safety and Health (NIOSH) and the Public Health Service will provide assistance particularly in the areas of occupational safety and health. This assistance will be made available through these Agencies' Regional Offices.

Questions about the information in these manuals or about the EPA school asbestos program should be referred to the EPA Regional Asbestos Coordinators listed on page 33.

Close-up of a Type of Asbestos-Containing Material That Can Be Found in School Buildings

Chapter 1: Introduction: The Concern

Exposure to asbestos was initially associated with a chronic and debilitating lung disease called asbestosis. More recently exposure to asbestos has been associated with lung cancer, a rare cancer of the chest and abdominal lining called mesothelioma, and cancers of the esophagus, stomach, colon, and other organs. Asbestos also acts as a potent cancer-causing agent in combination with cigarette smoking. In all asbestos-related diseases there is a latency or induction period of many years between initial exposure and appearance of the disease.

In most cases asbestosis has followed long exposure to high levels of asbestos fibers. Therefore, asbestosis is not as significant a concern in schools as cancer risk. The potential for increasing cancer risk may exist at much lower and shorter exposures than those for asbestosis.

Under certain conditions, exposure to fibers released from asbestos-containing materials in buildings can reach levels considered potentially hazardous. Some asbestos levels measured in school buildings have even been shown to briefly exceed the current Federal workplace exposure level standards.

Why is there so much concern now?

EPA is concerned in view of the increasing knowledge of the potential of asbestos as a cancer-inducing agent at low-level exposures and the asbestos contamination that has been found in some schools. Another very important concern is that cigarette smoking can enhance the disease potential of asbestos exposure.

Is there a safe level of exposure?

EPA and the scientific community believe that any exposure to asbestos involves some health risk. No safe level of exposure (or threshold exposure level) has been established. Further, it is impossible at this time to confidently estimate the exact degree of risk associated with low-level exposures.

What is considered the best or safest approach to asbestos exposure?

Where possible all exposure to asbestos should be eliminated or controlled.

Are there special concerns about asbestos in schools?

The school children population differs from other non-occupational populations in age, population density, and behavior.

The exposure of children and adolescents to asbestos in the school building occurs early in their life span. Their remaining life expectancy provides a long development period for asbestos-related diseases.

A large number of students can be exposed at one time to asbestos that is released from asbestos-containing materials present in the school building. The duration of exposure is of concern since school children attend school daily for most of the year.

The school population is very active. Certain asbestos-containing materials can be damaged during school activities and as a result of the capricious behavior of students. When the material is damaged, asbestos fibers are released and exposure can occur. Many cases of badly damaged asbestos-containing materials have been found in schools.

Are there any Federal laws or regulations that protect school children from asbestos exposure in school buildings?

There are currently no Federal laws or regulations that protect children in school buildings where asbestos-containing materials are already present.

Is a medical examination necessary for persons exposed to asbestos in school buildings?

Medical examinations are not recommended in school exposure situations. It is difficult to detect asbestos-related diseases in children due to the long induction period before the disease appears. Individuals who have been exposed to asbestos should avoid smoking; and, of course, medical advice should be obtained for any specific concerns or symptoms.

Chapter 2: Asbestos and Its Uses

What is asbestos?

Asbestos is a term for a group of naturally occurring minerals that separate into fibers. The mineral rock is mined and then milled for commercial use. Asbestos fibers are incombustible and have good thermal and electrical insulating properties. There are six asbestos minerals that are used commercially:

Chrysotile
Amosite (Cummingtonite-grunerite asbestos)
Crocidolite
Anthophyllite asbestos
Tremolite asbestos
Actinolite asbestos

Chrysotile and amosite are the most frequently found asbestos minerals in the asbestos-containing materials used in school buildings.

Why is asbestos a unique environmental contaminant?

The durability of asbestos fibers and their small size and fibrous shape make asbestos an unusual environmental contaminant.

Asbestos fibers cannot be easily destroyed or degraded. The size and shape of these fibers permit them to remain airborne for long periods of time. Asbestos fibers that are released from asbestos-containing materials enter the air and contaminate the building environment.

When the fibers have entered the air, individuals in the building can be exposed and inhale the fibers. Although most fibers will not remain in the lungs, those that are retained will stay indefinitely.

What are some uses of asbestos in school buildings?

Most asbestos products are used in building construction and many products containing asbestos are found in buildings. Asbestos has been used in cement products, plaster, fireproof textiles, vinyl floor tiles, thermal and acoustical insulation, and sprayed materials.

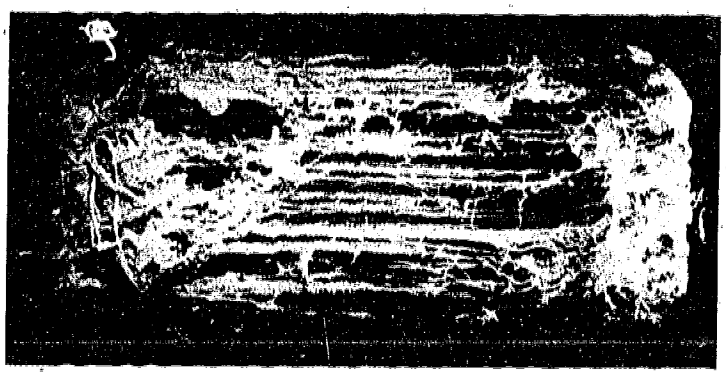
Asbestos also is used in automotive brake linings. In schools that have shops for automotive training, asbestos contamination can occur as a result of automotive brake servicing.

For more information on the uses of asbestos, see pages I–1–1 and I–1–3 of Part 2.

What asbestos-containing materials in school buildings can create an exposure problem?

Only certain kinds of asbestos-containing materials in school buildings are considered hazardous. The potential for release, contamination, and exposure depends on the condition of the asbestos-containing material (such as deterioration from age) and the probability that the material will be damaged.

Hard asbestos-containing materials such as vinyl floor tile do not generally create exposure problems. Asbestos fibers are firmly bound or encased in the material. Sanding, grinding, or cutting will cause



Raw Chrysotile Showing Fiber Structure

Sample of Friable Material

asbestos fibers to be released. Therefore, these hard materials should not be considered hazardous unless they are machined.

Soft or loosely bound (i.e., friable) asbestos-containing materials can release asbestos fibers following only minor disturbance to the material. It is these soft asbestos-containing materials that can cause contamination and exposure problems.

What is friable material?

Friable material is material that can be crumbled, pulverized, or reduced to powder in the hand. Friable material may be an asbestos-containing material or it may be a material that contains other fibers such as cellulose and glass fibers.

This manual is primarily concerned with identifying friable asbestos-containing materials in school buildings and recommending steps to reduce the exposure that they may cause.

What are friable asbestos-containing materials?

Friable asbestos-containing materials are materials that were used for fireproofing, thermal and acoustical insulation, or decoration in building construction and renovation. The asbestos content of these materials is usually found in the range of 5% to 50%. These materials were usually applied by spraying but have also been applied by troweling. They are friable in varying degrees depending on the components of the material, the amount of cement added, and the method of application. Sprayed material is usually soft. Cementitious material varies from soft to relatively hard.

Throughout this manual, both cementitious and sprayed asbestos-containing materials will be called asbestos materials.

What is sprayed asbestos material?

Sprayed asbestos material is a mixture of asbestos fibers, other fibers (cellulose, non-asbestos mineral fibers) and a binder which has been applied to ceilings, beams, and other surfaces by spraying. It has been widely used for fireproofing, thermal and acoustical insulation, and decoration. Most friable material in schools is sprayed material.

In 1973 EPA prohibited the spraying of asbestos material for fireproofing and insulation. EPA prohibited the application of sprayed asbestos material for nearly all purposes in 1978.

Where are friable asbestos materials located?

Friable asbestos materials are usually found on overhead surfaces, steel beams, ceilings, and occasionally on walls and pipes.

Does all friable material contain asbestos?

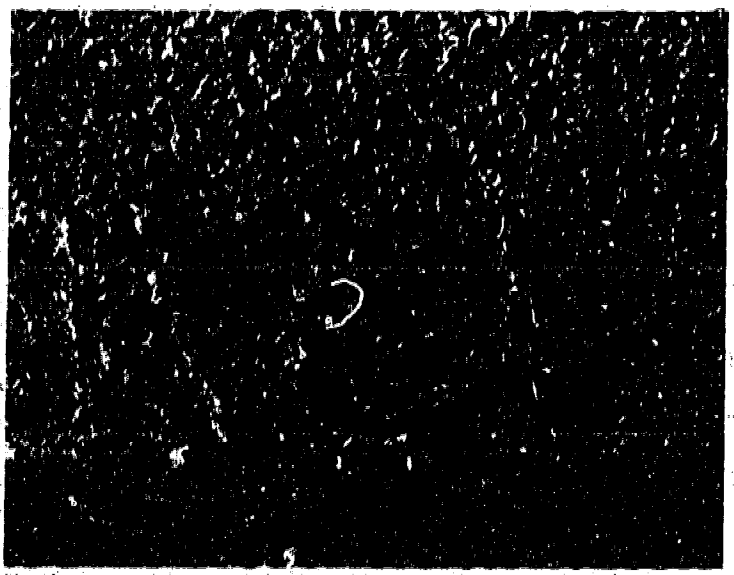
Many materials that look like friable asbestos material do not necessarily contain asbestos. Some friable material contains glass fibers, cellulose, or other non-asbestos fibers.

How are asbestos fibers released from friable asbestos material?

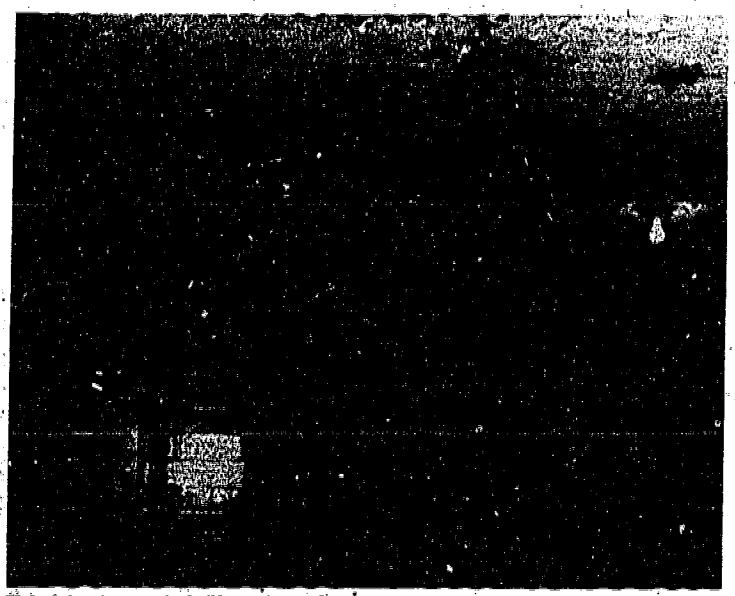
Fibers are released from friable material as a result of a breakdown in the integrity of the material due to deterioration or direct contact and damage.

As friable asbestos material ages, it can lose its cohesive strength and release fibers. Fallout of fibers from deteriorated material is usually low-level but continuous.

Fiber release by contact and damage depends on the accessibility of the material and the degree of disturbance. Contamination can be very high for brief periods of time during a disturbance and then gradually decrease as the fibers settle. Fiber release can occur



ble Material That Has Been Scraped



Friable Material Showing Water Damage

after only minor contact with friable material.

Direct contact or damage to asbestos materials can occur in a number of ways:

- ***School Activities***—A ball hitting friable material on a gymnasium ceiling or wall. Hanging pictures or attaching displays to friable material will cause fiber release.
- ***Maintenance Activities***—Any maintenance activity involving intentional or accidental contact with friable material.
- ***Vandalism***—Material may be scraped, gouged, or hit.
- ***Water Damage***—Water from roof or plumbing leaks will cause material deterioration and in some cases delamination (i.e., breaking away of layers of material from the underlying surface).
- ***Vibration***—Building vibration from sources within or outside the building. For example, vibration from activities on the floor above or vibration from machinery can cause movement of the friable material and release fibers.

Fibers that have been released can remain suspended in the air for many hours. After the fibers settle, they can be resuspended in the air by disturbances created by student activities or custodial work such as dusting or sweeping. Resuspension of asbestos fibers in the air is called reentrainment. Reentrainment may cause repeated exposures after the fibers are released from the friable asbestos material.

For more information on asbestos contamination, see pages I-2-3 to I-2-11 of Part 2.

Is asbestos contamination permanent once it occurs?

Asbestos fibers tend to remain in the building that they contaminate but can be removed by cleaning. Wet mopping is recommended since water inhibits fiber movement, thus preventing reentrainment during the cleaning process. Dry dusting and sweeping will cause reentrainment and should be avoided. If wet cleaning is not feasible, a High Efficiency Particulate Absolute (HEPA) filtered vacuum should be used. Conventional vacuum cleaning equipment normally used in the school is not equipped with a filter size small enough to collect asbestos fibers and should not be used to clean in areas of asbestos contamination. If conventional vacuum cleaning equipment is used, fibers can be reentrained.

For more information on HEPA filtered vacuums, see page II-4-2 of Part 2.

When should school officials be concerned about asbestos material?

If friable asbestos material is present in the school building, an exposure problem may exist. Chapter 3 outlines the recommended steps to identify friable asbestos material and to undertake a control program to reduce exposure.

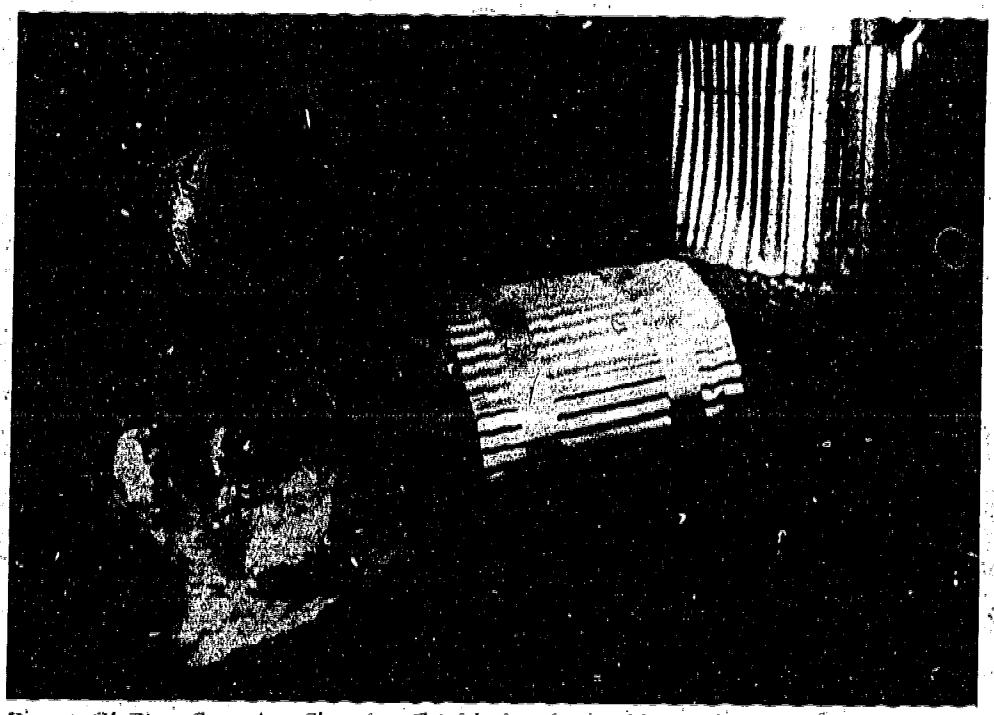
Is pipe covering and boiler lagging of concern?

Friable asbestos material was used for many years in pipe covering and boiler lagging until EPA prohibited its application in 1975. Pipe covering and boiler lagging do not create an exposure hazard unless the friable insulation material is exposed and damaged.

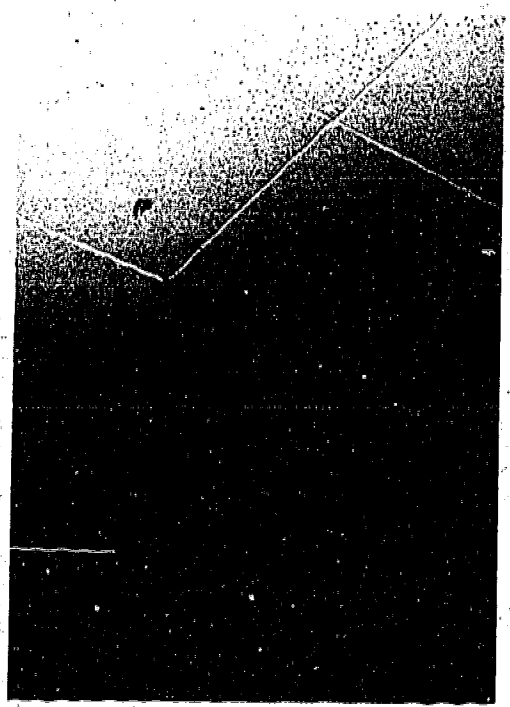
Pipe covering and boiler lagging should be routinely inspected. If the insulation material is exposed, retaping or covering the damaged area will prevent asbestos fiber release.

Is ceiling tile of concern?

Ceiling tiles are not friable and should be of no concern.



Damaged Pipe Covering Showing Friable Insulation Material



Ceiling Tile

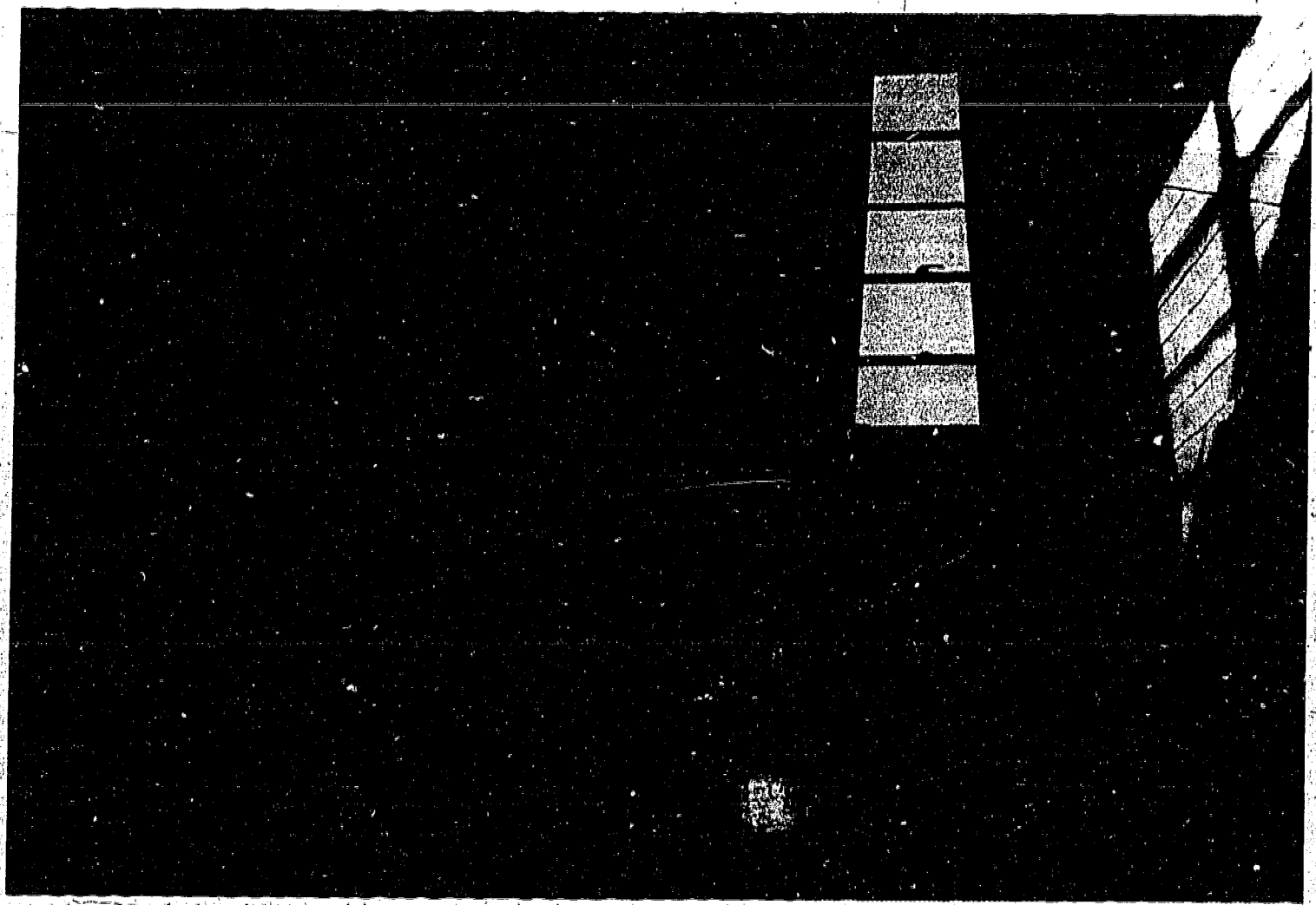
Chapter 3: How To Conduct an Asbestos Control Program

An asbestos control program begins with locating friable material and determining whether the material contains asbestos. If contamination of the building by asbestos fibers is occurring or will likely occur, corrective action should be taken to protect school children and other users of the building from exposure.

A recommended approach for conducting an asbestos control program is outlined in the following table.

Conducting an Asbestos Control Program

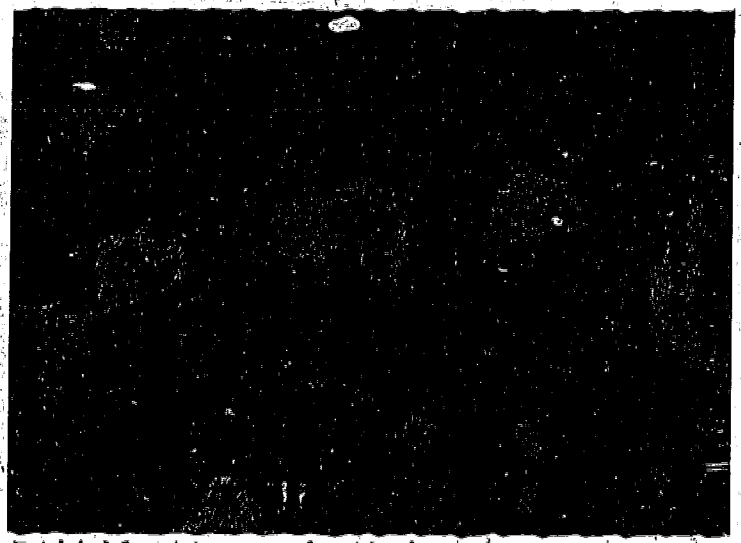
Steps	*Action*	*Chapter*
Inspection:	Locate friable material in the school building.	4
Sampling:	If friable material is found, take a bulk sample of the material.	5
Analysis:	Send the bulk sample to a laboratory for analysis to determine if asbestos is present.	6
Exposure Assessment:	If the friable material contains asbestos, assess the exposure potential.	7
Corrective Action:	If an exposure problem exists, take a corrective action.	8



Friable Material in Machinery Area

Overhead Surface and Steel Beams Covered With Friable Material

Cafeteria With Friable Material Ceiling Surface



Friable Material on Overhead Surface of Gymnasium

Chapter 4: Inspecting for Friable Material

All areas including student, administrative, maintenance, and custodial areas in the building should be visually inspected for friable asbestos material. If friable material is located, it must be sampled and analyzed for asbestos content. The fact that material is friable does not establish that asbestos is present.

Which schools should be inspected?

Schools built or renovated during the period following World War II to 1978 should be inspected. Although the spray application of asbestos materials for fireproofing and insulation was prohibited in 1973 by EPA, spray application for nearly all uses of these materials was not prohibited until 1978.

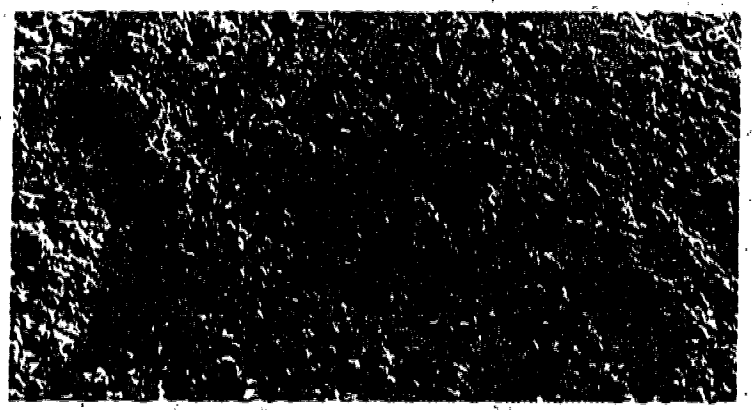
Where will friable material be found?

Friable material is commonly found on steel support beams and columns and on ceilings and walls of classrooms, corridors, auditoriums, cafeterias, machinery rooms, and storage rooms. It also may be found on overhead surfaces of indoor pools and gymnasiums.

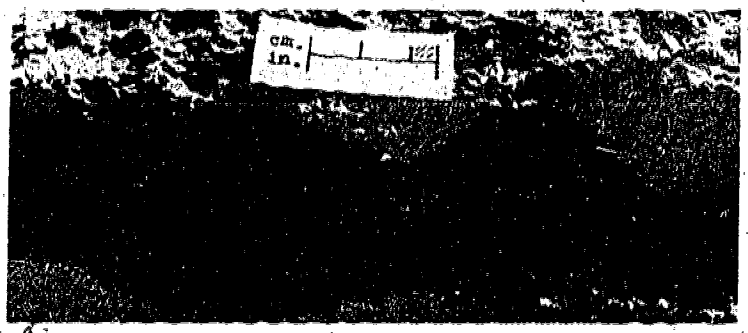
What will friable material look like?

Friable material can have the following characteristics:

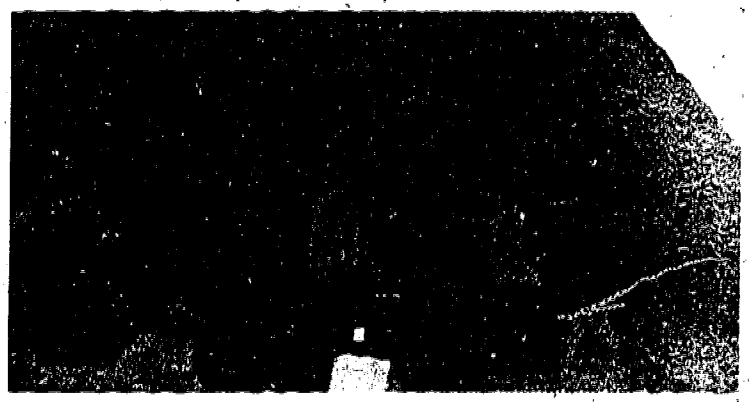
- Fluffy or spongy appearance (always applied by spraying)



- Irregular, soft surface (usually applied by spraying)



- Textured, dense, fairly firm surface (usually applied by troweling)



If friable material has been damaged or is deteriorating, the material may be flaking or pieces may be hanging from the surface of the material.

Should inspections be made above suspended ceilings?

Inspections should be made above suspended ceilings. Asbestos material may have been applied to the original ceiling, steel beams, and other surfaces above the suspended ceiling.

If the overhead space between the suspended ceiling and original ceiling is part of the building's air circulation system, fibers which have been released from deteriorating or damaged material could travel throughout the ventilation system to other areas in the building.

Settled asbestos fibers or fallen ceiling material may cover the upper surface of the suspended ceiling panels. In this case moving or removing the panel will cause fiber release.

When inspecting above suspended ceilings, the following precautions should be taken:

- The ceiling should be inspected when the area is not in use.
- If the overhead space is part of the air circulation system (air plenum), the system should be shut down during inspection.
- Only persons necessary to assist in the inspection should be present.
- The National Institute for Occupational Safety and Health (NIOSH) recommends that the person inspecting wear an approved respirator. Contact the NIOSH Regional Offices listed in Appendix E for information on approved respirators.

Should building records be checked?

Building construction records can be checked as a supplementary measure to determine if asbestos materials were listed in the building specifications. However, since building records may be unreliable, checking records should not take the place of visually inspecting school buildings.

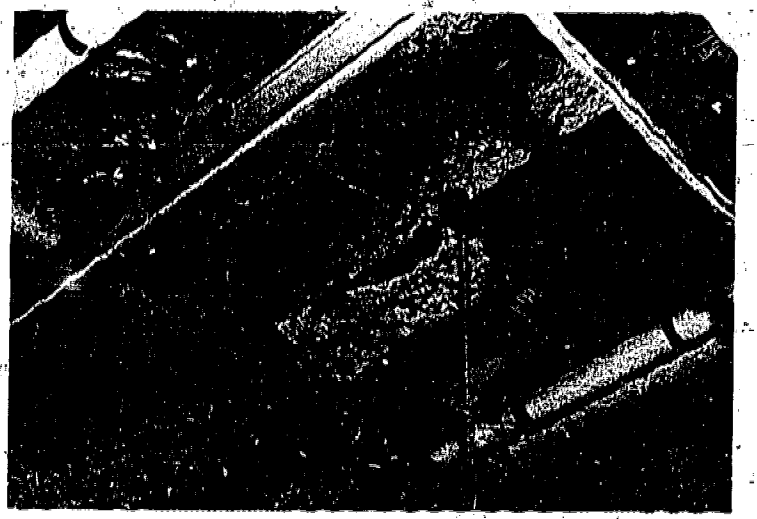
What is the next step if friable material is located?

If friable material is located during inspection, a sample of the material itself should be taken for laboratory analysis. Chapters 5 and 6 have instructions for sampling and information on recommended analytical techniques to identify asbestos fibers in friable material samples.

What if no friable material is located?

If no friable material is located during visual inspection, a dated report stating that no material has been located in the school building should be prepared. The report should identify which areas of the building were visually inspected and if the building records were also checked. A copy of this report should be kept in a school asbestos program file.

Removing Suspended Ceiling Panel For Inspection



Area Above Suspended Ceiling With Friable Material

Chapter 5: Sampling Friable Material

The sampling and analysis of friable material are extremely important. The decision to take corrective action will depend, in large part, on the results of the laboratory analysis. It is critical, therefore, that sampling in schools is carried out properly and that laboratory analyses are performed accurately.

The sampling procedures outlined in this chapter should be followed closely. Improper sampling will result in unreliable analyses and lead to either unnecessary corrective action or to no action for potentially hazardous material.

The choice of the analytical technique and an analytical laboratory are also important. Chapter 6 contains information on analytical techniques and laboratory selection.

Is sampling and analysis of friable material necessary?

Friable material should always be sampled and analyzed for asbestos. Neither visual inspection nor checking building records establish the presence of asbestos in friable material. Suspect material could contain glass fibers, cellulose, or other non-asbestos mineral fibers.

How to take a sample

If friable material is found, a representative sample should be taken from within the material itself by penetrating the depth of the material with a sample container. It is important to penetrate the material because it may have been applied in more than one layer or covered with paint or a protective coating. This kind of sample is called a *bulk sample*.

a Bulk Sample

One sample should be taken for approximately every 5,000 square feet of material having the same color and texture (i.e., it is homogeneous in appearance). Material of a different appearance should be sampled separately.

Small classrooms, offices, or closets with less than 5,000 square feet of friable material should also be sampled separately if different material is found.

Sampling is not difficult and can be performed by school personnel if these procedures are followed:

(1) Use a small container such as a plastic 35 mm film canister or a *small*, wide-mouthed glass jar with a screw-on lid. The container should be dry and clean.

(2) *Gently* twist the open end of the container into the material. A core of the material should fall into the container. A sample can also be taken by using a knife to cut out or scrape off a small piece of material and then placing it into the container.

Be sure to penetrate any paint or protective coating and all the layers of the material. If the sample container cannot penetrate the material, consider whether the material is really friable or not.

(3) Tightly close the sample container; wipe the exterior of the container with a damp cloth to remove any material which may have adhered to it during sampling.

(4) Tape the container lid to prevent the accidental opening of the container during shipment or handling.

(5) Label the sample container. This label should identify the school and date the sample was taken, and bear a unique identification (ID) number.

(6) Make a record of each sample by noting the date the sample was taken, location of material sampled, the area or room sampled, and the sample ID number.

(7) Send the sample to an analytical laboratory for analysis (see Chapter 6).

What precautions should be taken during sampling?

To avoid causing unnecessary exposure to asbestos fibers, the following precautions should be taken during sampling.

- The material should be sampled when the area is not in use.
- Only those persons needed for the sampling should be present.
- The sample container should be held away from the face during actual sampling.
- Do not disturb the material any more than necessary.
- The material can be sprayed with a light mist of water to prevent fiber release during sampling.
- If a large number of samples are taken, NIOSH recommends that the sampler wear an approved respirator. Contact the NIOSH Regional Offices listed in Appendix E for information on approved respirators.
- If pieces of material break off during sampling, wet mop the floors and areas where they have fallen.

Should the air be sampled?

Air sampling is the counting of fibers suspended in the air. A known volume of air is pumped through a filter where all suspended particles are collected. A standardized air sampling method with specific equipment and particle counting techniques is used by the Occupational Safety and Health Administration (OSHA) and industrial hygienists for evaluation of airborne asbestos contamination. Unfortunately air sampling by this standard method cannot show whether the friable material actually contains asbestos fibers. The method counts any particle of a certain size and fibrous shape. The fibers that are counted may or may not be asbestos.

Bulk sampling and analysis of the friable material itself is the only method to determine whether or not asbestos is present in the material.

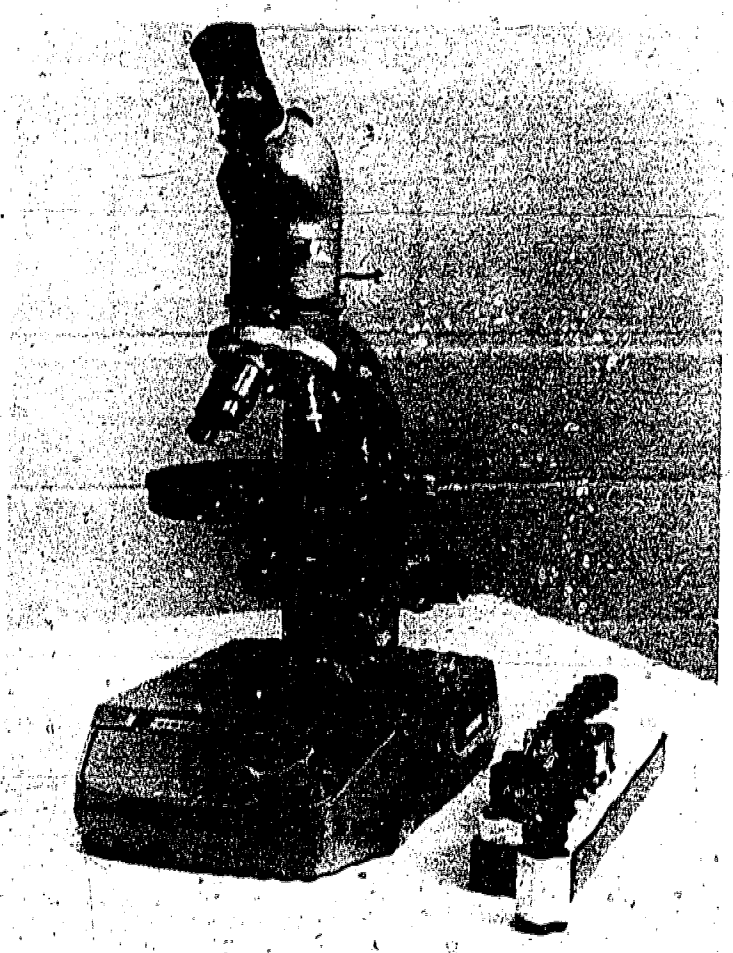
Chapter 6: Analysis of Bulk Samples

It is important that analyses of bulk samples are performed by the recommended technique. In choosing a laboratory, assistance from the State Asbestos Program contact or the EPA Regional Asbestos Coordinators is recommended.

What kind of analysis should be requested?

Analysis of friable material bulk samples by the following techniques should be requested:

1) Polarized Light Microscopy (PLM)
2) X-Ray Diffraction (XRD) as necessary to supplement the PLM method.



Polarized Light Microscope

Why are PLM and XRD recommended for bulk sample analysis?

Polarized Light Microscopy (PLM) is a technique used to identify asbestos fibers by their shape and unique optical properties. It is a relatively inexpensive and quick method for identifying asbestos in bulk samples. PLM is particularly suitable for examination of the complex mixes of friable construction materials.

X-Ray Diffraction (XRD) is recommended where a second, independent analytical technique is necessary to confirm an analysis by PLM. It is a more expensive analytical method than PLM.

For more information on these analytical techniques, see pages I–4–2 to I–4–3 of Part 2.

Is Electron Microscopy recommended for bulk sample analysis?

Electron Microscopy (EM) is not a recommended analytical technique for bulk sample asbestos analysis. EM is costly, time-consuming, and limited in availability.

For more information on Electron Microscopy, see pages I–4–3 of Part 2.

Is Phase Contrast Microscopy recommended?

Phase Contrast Microscopy is a technique used to count fibers present in air samples. It is unacceptable for identification of asbestos in bulk samples. Do not accept analysis of bulk samples by Phase Contrast Microscopy.

For more information on Phase Contrast Microscopy, see pages I–4–5 to I–4–6 of Part 2.

Is there a standard analytical protocol for bulk sample asbestos analysis?

A standard protocol for bulk sample analysis is not currently available. However, guidelines have been prepared for bulk sample asbestos analysis using PLM and XRD. These guidelines are included as Appendix H to this manual and should be made available to the laboratories which perform the analyses of bulk samples.

Are any laboratories certified for bulk sample asbestos analysis with PLM?

No laboratories have been certified for performing bulk sample analysis with PLM or XRD.

Laboratories which participate in the National Institute for Occupational Safety and Health (NIOSH) proficiency analytical testing program (PAT) for certification by the American Industrial Hygiene Association may or may not be qualified to perform bulk sample asbestos analysis with Polarized Light Microscopy. Typically these laboratories use Phase Contrast Microscopy, which is inappropriate for the differentiation of asbestos from other fibrous material such as cellulose, hair, and glass fibers. Laboratories proficient in air sample counting using Phase Contrast Microscopy may lack both the equipment and expertise to perform PLM identification of asbestos in bulk samples.

What laboratories perform bulk sample asbestos analysis?

It is important to select a laboratory competent in bulk sample asbestos analysis. Since there currently is no list of certified laboratories, locating a laboratory could be difficult. The State Asbestos Program Agency or the EPA Regional Asbestos Coordinator should be contacted for their assistance and advice in laboratory selection. The names and addresses of the State Asbestos Program contacts are available from the EPA Regional Asbestos Coordinators and on the EPA toll-free information number (800-424-9065 or 554-1404 in the Washington, D.C. area). The EPA Regional Asbestos Coordinators are listed in Chapter 11.

Is guidance available to schools which plan to monitor laboratory performance?

EPA will provide guidance to schools and school districts which plan to undertake a program to ensure good laboratory performance. Information can be obtained by calling the EPA toll-free technical assistance number (800-334-8571, extension 6892).

What should the laboratory report?

It is important that a complete written and signed report of the analytical results be obtained from the laboratory. The laboratory should report the following information for each sample submitted:

(1) The sample ID number.

The laboratory results should be reported by referencing each sample by its ID number.

(2) The analytical method used to analyze the sample.

The report should name the analytical equipment and the technique used to perform the analysis.

(3)a. A description of the sample appearance.

Good laboratory procedure requires that the analyst note whether or not the bulk sample is a uniform mixture.

(3)b. Whether the sample was homogenized before analysis.

Asbestos materials were not always uniformly mixed before application. If a sample is not homogenized prior to analysis, some materials present in the sample may not be detected.

(4) Percent of each type of asbestos present.

The analyst should report the types of asbestos present and the estimated percent present. The estimated precision associated with the percentage of asbestos reported for each sample should be specified.

(5) Type and amount of the other fibrous materials present in the sample.

The analyst should report what non-asbestos fibrous materials are present in the sample and the percent present, and provide the basis for that judgment. Identification of the other fibers present will minimize the reporting of false results.

(6) Comments on any other materials present.

(7) A description of the laboratory's quality control program.

Laboratories should indicate the quality control procedures followed in their PLM analysis.

Should samples be retained for analysis?

School officials may wish to request that the laboratory retain the samples for up to six months or return them to the schools so that they will be available if reanalysis is necessary.

Chapter 7: Exposure Assessment

If bulk material analysis establishes that asbestos is present in the sampled friable material, the potential exposure of students and other users of the building should be evaluated.

What should be considered in an exposure assessment? Material condition, building structure characteristics, and human activity are factors that will have significance in any potential exposure situation involving friable asbestos materials. These factors may act singly or in combination to cause environmental contamination and exposure of building users. Experience has shown that eight factors generally influence exposure potential.

1. ***Condition of Material:*** Material condition indicates the extent of contamination and the likelihood of future contamination. This factor is a combination of quality of installation, adhesion of the friable material to the underlying surface, material deterioration, and damage. Delamination or deterioration of the material depends on the characteristics of the material itself (whether it shows signs of aging or loss of cohesive strength). Damage is incurred by either accidental or intentional contact. Evidence of debris can be a good clue to the condition of material, which may vary from minor deterioration and damage to widespread and severe material disintegration.

2. ***Water Damage:*** Water can dislodge, delaminate, and disturb asbestos materials that are otherwise in excellent condition. Water can carry fibers in the slurry to other areas in the building where evaporation will leave a collection of fibers that can become resuspended in the air. Water damage will have a significant effect on selection of a corrective method, essentially eliminating certain types of sealants.

3. ***Exposed Surface Area:*** The exposed surface area of friable material has an effect on potential fiber fallout levels and the possibility for contact and damage. A useful criterion to apply for this factor is whether the friable material is visible.

Asbestos material above suspended ceilings is not considered as exposed. However, if the ceiling panels are removed for routine maintenance activities above the suspended ceiling or are damaged due to vandalism, the asbestos material should be considered as exposed in that area. Areas with louvers, grids, or other open ceiling systems should be considered as exposed. However, exposed does not mean accessible, which is a separate factor.

4. ***Accessibility:*** If the material can be reached, it is accessible and subject to accidental or intentional contact and damage. Accessibility is a good indicator of possible future exposure caused by contact and damage. This factor should also include some consideration of the proximity of friable material to heating, ventilation, lighting, and plumbing systems requiring maintenance or repair.

The behavior characteristics of the student population should be considered in evaluating accessibility. For example, students involved in sports activities may accidentially cause damage to asbestos materials on the walls and ceilings of gymnasiums. Material that is easily accessible is also subject to damage by vandalism.

5. ***Activity and Movement:*** This factor combines the effects of general causes that may result in contact and damage of friable material. These causes include air movement, building vibration from machinery or any other source, and activity levels of students or building workers. This factor is also an indicator of future exposure potential. Its value will be low in school libraries, offices, and most classrooms; moderate in some classrooms and in school corridors; and can be exceedingly high in gymnasiums and cafeterias.

6. ***Air Plenum or Direct Air Stream:*** Friable asbestos material contained within an air plenum or in an air stream, if undisturbed, has very low potential for contaminating the building environment. However, it must be considered since contact and damage may occur during maintenance, repairs, and renovation. In dealing with asbestos material located in air plenums, special attention should be given to the management system described in Chapter 8.

7. ***Friability:*** The asbestos materials can vary in degree of friability. The more friable the material, the greater potential for asbestos fiber release and contamination. Sprayed asbestos material is generally more friable than most troweled materials.

8. *Asbestos Content:* The percentage for all the types of asbestos present should be added for the total asbestos content. With a high percentage of asbestos, there are more fibers that can be released and contaminate the building environment.

Is an exposure assessment straightforward?

Assessing exposure can be difficult. The eight factors can vary from school to school; from room to room; and sometimes from one area to another in the same room. These factors should adequately describe most situations. They are presented here to provide general guidance, and exceptions can occur. Unique building structure characteristics, unusual material condition, or other considerations can influence the evaluation of exposure.

How is an exposure assessment carried out?

The following steps are recommended for an exposure assessment.

(1) Determine whether each factor is applicable in the area where the asbestos material is present.

(2) If a factor or factors are applicable, note the actual effects or situation associated with each factor. For example, if the Accessibility factor is applicable, consider whether (a) the material is subject to damage during maintenance or repair work or; (b) the material is accessible to students who may damage it during sports activities or who will scrape, gouge, or hit the material.

(3) Evaluate the exposure potential. Simply, if asbestos fibers are being released and causing contamination of the building environment, exposure of students and other building users is occurring or is likely to occur.

In carrying out the exposure assessment, it is important that the factors are uniform throughout the area being evaluated. If factors differ in one room or in one area of a room, they are not uniform. In this case, a separate evaluation should be made. For example, an auditorium with both an inaccessible ceiling surface in the stage area and a very accessible and damaged surface in the audience area constitutes two different areas.

The above discussion has described the factors relating to exposure. Is there any system that ties these subjective factors in a more precise way to aid the school official in the decisionmaking for an exposure assessment?

EPA has developed a scoring system using a mathematical formula which can be used as an aid in assessing exposure and in deciding what kind of corrective action to take. EPA is currently evaluating the accuracy of the scoring system through field tests and statistical analysis. It is EPA's intention to make this scoring system and instructions for its use available to school districts through the State Asbestos Program contacts and through the Regional Asbestos Coordinators.

Is air sampling necessary to evaluate the exposure potential?

Air sampling is inappropriate to estimate asbestos contamination and exposure. In the school environment, it is virtually impossible to establish exposure potential using standard air sampling techniques. Air sample results from monitoring in school buildings can be misleading if they are compared to the Federal workplace air concentration levels established by OSHA.

The standard optical microscopy method (Phase Contrast Microscopy) used to analyze air samples has technical restrictions. Only particles of a certain size and fibrous shape are counted in an air sample. The fibers that are counted may or may not be asbestos. More importantly, the low air levels of asbestos that have been found in school buildings are at the lower limits of effectiveness for the optical microscopy technique. Therefore, the results can be misleading.

The Federal workplace air concentration levels do not apply to children. They were established for asbestos workers in workplace environments. Comparing air levels found in school buildings to the Federal occupational standards is a totally ineffective method of determining whether an exposure problem exists.

What is the next step if exposure is occurring?

If exposure is found to be occurring or is likely to occur, a corrective action may be warranted. This decision will involve a judgment of the degree of the exposure problem and what corrective method is appropriate.

Chapter 8 discusses each of the corrective actions. The charts on pages 18 and 19 of Chapter 8 should be consulted for the advantages and disadvantages of each corrective method and the conditions where each method is appropriate or inappropriate.

Is corrective action required if there is no exposure problem?

If it is determined that the exposure is negligible or that there is no exposure potential, action can be deferred. However, a continuing inspection program and management system as described in Chapter 8 should be implemented to ensure that if the situation changes, the necessary steps will be taken to control exposure.

Chapter 8: Corrective Action

If friable asbestos material is present and exposure is occurring or will likely occur, corrective action should be considered. The selection of the method or methods of action should reach the most efficient long-term solution after consideration of material condition, location, function, and cost.

There are four approaches to controlling exposure:

(1) Removal: Asbestos material is removed and disposed of by burial.

(2) Encapsulation: Asbestos material is coated with a bonding agent called a sealant.

(3) Enclosure: Asbestos material is separated from the building environment by barriers such as suspended ceilings.

(4) Deferred action: No action is taken. The area is inspected periodically for changes in exposure potential.

Removal, encapsulation, and enclosure are corrective methods and can be used separately or in combination. Removal completely eliminates the source of exposure to asbestos and is, therefore, a permanent solution. Both enclosure and encapsulation are containment methods.

Since the asbestos material remains within the building, enclosure and encapsulation should be considered as temporary control measures. The length of time before building renovation or demolition is planned will be a factor in deciding whether to use either of these methods. If the building is later renovated or demolished, encapsulated and enclosed asbestos material must be removed and disposed of according to the EPA regulations discussed in Chapter 9.

Removal, encapsulation, enclosure, and deferred action are discussed in the following sections. The chart on pages 18 and 19 at the end of this chapter outlines each corrective action, lists advantages and disadvantages, and notes the conditions under which each method is appropriate.

Schools that do undertake a corrective action should refer to Chapter 9 for information on the applicable Federal regulations and proper work practices that are required to protect workers and the building from contamination during removal, encapsulation, or enclosure.

Removal

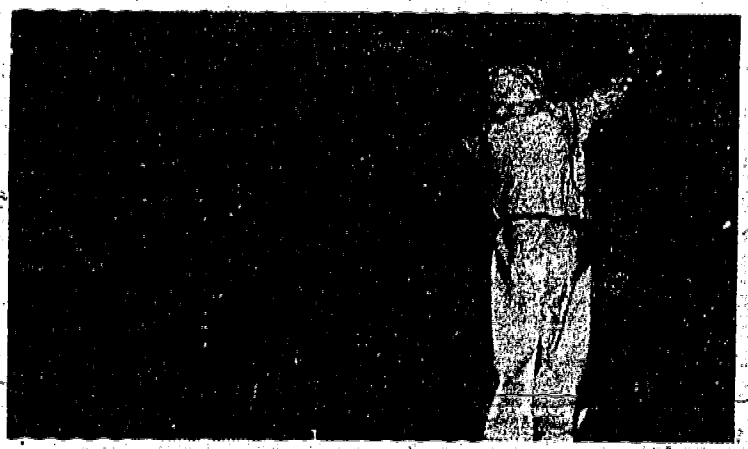
For removal, all the asbestos material is taken off the underlying surface, collected, and placed in containers for burial in an approved waste disposal site. Removal may require interruption of building activities. Vacation periods in schools often provide a convenient time to carry out the removal operation.

EPA has regulations that cover the removal of asbestos material. The regulations require wetting of the material prior to removal. Thoroughly wetting asbestos material greatly reduces the release of fibers. As the wet material is removed, only a small number of fibers will be released and those that are will settle rapidly to the floor rather than remain suspended in the air.

Using water that has been amended with a wetting agent (surfactant) is strongly recommended for all removal operations. Amended water ensures greater penetration of the material and reduces the amount of water needed for the operation.

For more information on wet removal techniques, see pages II–4–2 to II–4–3 and E–1 to E–5 of Part 2.

With Amended Water



Removal of Wet Asbestos Material From Overhead Surfaces

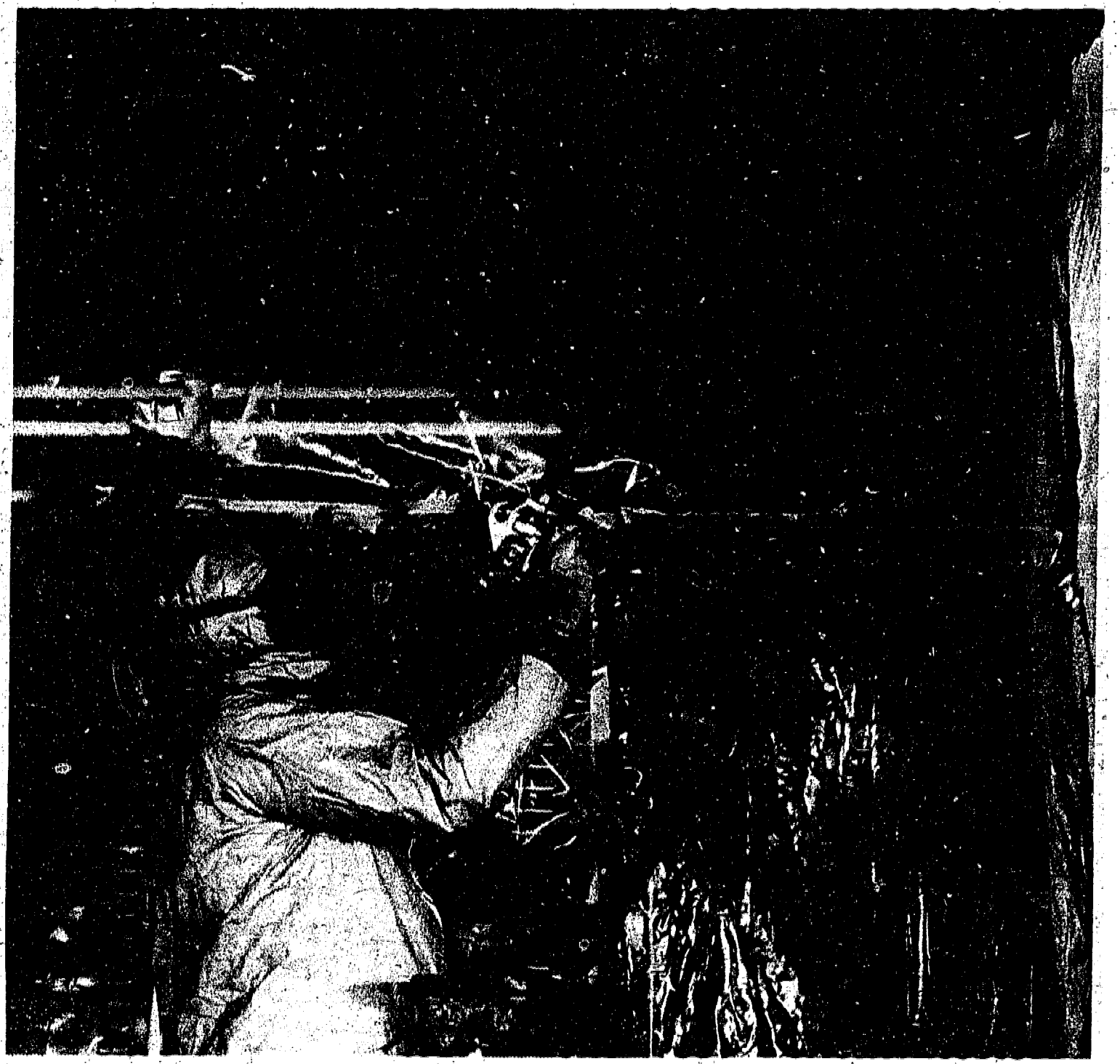
Should consideration be given to the original purpose of the material?

The original purpose of the material should be considered when a corrective method is chosen. Removed fireproofing material should be replaced to maintain compliance with fire and building codes. If the asbestos material served either an insulating or acoustical function, a replacement material should have similar characteristics.

Encapsulation

For encapsulation, the asbestos material is coated with a bonding agent called a sealant. Sealants penetrate and harden the asbestos material (penetrants) or cover the surface of the material with a protective coating (bridging sealants). The sealant prevents fiber release from the asbestos material.

Sealants are applied over the surface of the material



Encapsulation of a Ceiling Surface

using airless spray equipment at a low pressure setting. Airless equipment reduces the pressure of the sealant spray and the impact upon the friable asbestos material surface, thus reducing fiber release during application.

Encapsulation should be limited to areas where contact damage will not occur, a factor which may preclude encapsulation in many areas of school buildings because of high activity levels. Encapsulation should also be limited to asbestos material that still retains its bonding integrity since the material must support the additional weight of the sealant. Encapsulated material should be routinely inspected for deterioration or damage.

For more information on the encapsulation method, see pages II–3–2 to II–3–5 of Part 2.

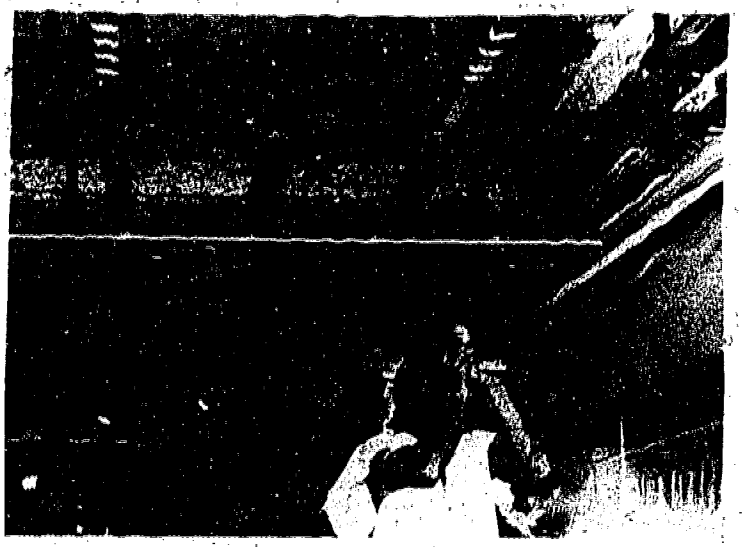
What sealants are recommended for encapsulation?

An EPA contractor is evaluating sealants for asbestos material to determine if they meet designated specifications for flammability, smoke generation, toxicity, and impact resistance. Until a report of the sealant study (expected in May 1979) is published, State Asbestos Program agencies and the EPA Regional Asbestos Coordinators should be contacted for information.

Enclosure

For enclosure, a barrier such as a suspended ceiling is constructed between the asbestos material and the building environment. Since the asbestos material remains, fiber release and fallout can continue behind the barrier, and accumulation of fibers will usually occur. When the enclosure is damaged or entered for maintenance, fibers collected behind the enclosure can be released into the building environment.

For more information on the enclosure method, see page II–3–1 of Part 2.



Constructing a Suspended Ceiling Barrier

Deferred Action

If the exposure potential is considered negligible, action can be deferred. A continuing inspection program should be implemented as part of deferred action. The asbestos material should be routinely checked for deterioration or damage. If the condition of the material changes so that fibers are being released and contaminating the building environment, the exposure potential should be reevaluated according to the guidelines set out in Chapter 7.

Asbestos Material Management Program

Encapsulation, enclosure, and deferred action leave the asbestos material within the building. Assuming that the exposure assessment is accurate and that an appropriate corrective action has been taken, exposure of building users will not occur.

The asbestos, however, remains and conditions can change. For example, asbestos material can be damaged by inadvertent or uninformed maintenance, repair, or renovation activities.

Therefore, a management system should be implemented to control maintenance, renovation, or repair work by either school personnel or contractors. These individuals should be informed that asbestos material is present and trained in proper work procedures to prevent damage to the material or to the containment system. Work order procedures and school building sign-in or entry systems are usually good methods for alerting workers and school administrative personnel that work in an area having asbestos material is planned.

When should a school be closed for corrective action?

Generally, it is not necessary to close a school in order to take a corrective action. However, a severe exposure problem may require that the problem areas or rooms be closed off until a corrective action is taken. Usually this situation arises when there is a potential for high contamination levels of asbestos caused by continuing contact and damage of highly friable material.

Are there Federal regulations that must be followed when taking a corrective action?

EPA and OSHA have regulations covering removal, encapsulation, and enclosure of asbestos materials. Chapter 9 contains a brief summary of these regulations.

Some States and local governments may also have regulations covering asbestos removal, encapsulation, and enclosure. The State Asbestos Program Agency should be contacted for information on State and local government regulations.

Selection of a Corrective Action Method

Method	*Advantages of Method*	*Disadvantages of Method*	*When Method Is Appropriate*	*When Method Is Inappropriate*
° Removal	° Eliminates asbestos source ° Ends exposure	° Usually most costly and complicated method ° Usually most time consuming method ° Replacement with substitute material may be necessary ° Higher potential for worker exposure	° High exposure ° Material is deteriorating or damaged ° Material is accessible ° Flat, open material surface	° Removal is not feasible because of cost, location of material, and kind of surface to which material has been applied (e.g., removal of material from complex surfaces such as pipes, lines, and ducts)
° Encapsulation	° Controls exposure ° Usually most rapid and economical method	° Asbestos source remains ° If material is damaged or deteriorating, additional weight of the sealant may cause delamination[1] ° Management system required. Precautions necessary to prevent damage during maintenance or renovation ° Continuing inspection required to check for damage to encapsulated surface ° Maintenance on damaged or deteriorating encapsulated surface required ° Encapsulated material is difficult to remove	° Removal not feasible ° Material still retains bonding integrity ° Damage to material not probable ° Limited accessibility of material ° Complex surfaces to be covered ° Economic or time advantage	° Removal feasible ° Material does not adhere well to substrate.[2] Weight of sealant may cause delamination ° Material is deteriorating or damaged ° Damage to material is probable ° Water damage ° Continuing inspection and maintenance of encapsulated material doubtful

[1] Delamination is the breaking away of layers of material from the underlying surface.
[2] Substrate is the surface to which the asbestos material was applied (e.g., ceilings, steel beams, pipes).

Method	*Advantages of Method*	*Disadvantages of Method*	*When Method Is Appropriate*	*When Method Is Inappropriate*
° Enclosure	° Controls exposure ° May be most rapid, economical, uncomplicated method	° Asbestos source remains ° Fiber fallout continues behind enclosure ° May be costly if enclosure disturbs functions of other systems (e.g., enclosure may require lighting changes) ° Management system required. Precautions necessary for entry into enclosure for maintenance or renovation ° Continuing inspection required to check for damage to enclosure system ° Maintenance on damaged enclosure system required	° Removal not feasible ° Disturbance or entry into enclosed area not likely ° Economic advantage	° Removal feasible ° Damaged or deteriorating material causing high levels of fiber fallout ° Water damage ° Damage to enclosure likely ° Entry into enclosure probable for repairs and maintenance ° Continuing inspection and maintenance of enclosure doubtful
° Deferred Action	° No direct cost	° Potential for exposure may increase ° Management system required. Precautions necessary to prevent damage during maintenance or renovation ° Continuing inspection and reevaluation necessary	° Negligible exposure potential	° Definite or questionable exposure potential ° Continuing inspection doubtful

Chapter 9: Specifications and Requirements for Contractors

Removal, encapsulation, and enclosure operations must be performed carefully. Poorly performed work can cause a greater exposure problem than it eliminates. Workers who do not remove asbestos material wet or who damage the material during encapsulation or enclosure cause uncontrolled release of asbestos fibers. If fiber release is not properly contained in the work area, workers will be exposed and widespread contamination of the building will occur.

EPA and OSHA have issued regulations which cover the removal, encapsulation, and enclosure of asbestos material. Contractors are required to comply with both regulations. EPA regulations require that removed asbestos material be properly contained and disposed of without release of asbestos fibers into the environment. OSHA regulations require worker protection to prevent exposure to hazardous levels of asbestos fibers.

It should not be assumed that all contractors will comply with these regulations. Some contractors may not know that compliance is required; others may ignore the regulations in order to save time or money.

The EPA and OSHA regulations do not require worker decontamination before leaving the job site and clean-up of the contaminated work area after the job has been completed. Therefore, school officials should not only require contractors to comply with the EPA and OSHA regulations but also require them to take additional measures to ensure proper work practices and protection of the building environment. Past experience has shown that in many cases without adequate supervision and instruction from supervisors or management, workers will remove asbestos dry instead of wet, work without respirators, eat or drink in the work area, and leave the job site in their contaminated worksuits and clothing.

For these reasons, there are a number of precautions that should be taken:

(1) Become familiar with the EPA and OSHA regulations and any State and local government regulations that apply to asbestos material removal, encapsulation, and enclosure.

(2) Require contractors submitting bids to explain in their bids how they intend to comply with the applicable regulations.

(3) Include specifications for asbestos fiber containment, worker protection, and decontamination of the work area in contracts and enforce the requirements of the contract.

(4) NIOSH recommends that contractors who submit bids provide evidence that they and their workers have attended training courses dealing with occupational safety and the health hazards associated with asbestos material removal, encapsulation, and enclosure. Information on contractor training materials is available from the OSHA and NIOSH Regional Offices listed in Appendices D and E.

(5) For any corrective action, notify the nearest OSHA office listed in Appendix D when work will begin and let the contractor know that OSHA will be notified.

(6) For removal, notify the appropriate EPA NESHAPS Coordinator listed in Appendix B before the removal operation is begun.

(7) Recommend that the contractor contact the EPA Regional Asbestos Coordinator for technical assistance.

The task of finding a qualified contractor may be complicated by various political and economic pressures. There may be pressure by people who are unaware of the hazards of poorly performed work to take action as soon as possible and as cheaply as possible. Strict compliance with the EPA and OSHA regulations and the recommended specifications takes time and money. Contractors offering the lowest bid may not be knowledgeable or capable of complying with these regulations.

Short summaries of the EPA and OSHA asbestos regulations follow. The full texts of these regulations are printed in Appendices A and C. Recommended specifications for removal, encapsulation, and enclosure contracts are also included in this chapter. These specifications can be used to guide school officials in negotiating contracts which will ensure proper work practices and a protected building environment.

EPA Regulations

EPA regulates the removal and disposal of asbestos materials from ceilings, walls, pipes, and other surfaces in buildings. The regulations were issued under the EPA National Emissions Standards for Hazardous Air Pollutants (NESHAPS). Written notification to the NESHAPS Coordinator is required before asbestos material can be removed.

The regulations require wetting of the asbestos material before, during, and after stripping to prevent dust emissions. The regulations use "stripping" to refer

to taking asbestos off the ceilings, walls, pipes, etc.; and "removal" to refer to taking stripped asbestos material out of the building for disposal. If material cannot be removed wet because of freezing temperatures or damage to equipment by water, the EPA NESHAPS Coordinator should be notified. In some cases dry removal of asbestos material requires written permission from EPA.

Stripped asbestos material must be placed in leak-tight containers while still wet before removal from the building. Containers of asbestos material may not be dropped out of windows or down from one floor to the next. Asbestos material must be transported within the building in containers or dust-tight chutes.

Containers must be marked with a warning label (use the OSHA label on page and be buried in a waste disposal site meeting the requirements of Section 61.25 of the EPA regulations. In most cases a State-approved sanitary landfill will be an acceptable disposal site.

Before contractors begin any asbestos removal operation, they must send a written notification to the EPA NESHAPS Coordinator before starting the removal operation. The notification must contain the following information:

(1) Name and address of the contractor.

(2) Address and description of the building, including size, age, and prior use of the building and amount of friable asbestos material present (square feet).

(3) Scheduled starting and completion dates for removal.

(4) Procedures that will be employed to comply with the regulation.

(5) The name and address of the waste disposal site where the asbestos waste will be deposited.

When contractors send in notification of an asbestos removal operation to EPA, the EPA NESHAPS Coordinator will notify the OSHA office for that area that a removal operation is planned.

See Appendix A for the full text of the EPA asbestos regulations. Questions about the regulations and compliance problems can be answered by the NESHAPS Coordinator listed in Appendix B.

OSHA Regulations

OSHA regulates workplace practices and the airborne concentration levels to which asbestos workers can be exposed. The OSHA regulations apply to removal, encapsulation, and enclosure operations involving asbestos materials.

OSHA has established limits on the amount of airborne asbestos to which a worker may be exposed on a daily basis. Over an 8-hour period the average airborne asbestos concentration level (also known as the time weighted average (twa)) to which a worker may be exposed may not exceed two fibers longer than five micrometers per cubic centimeter of air (2f/cc). At no time during the 8-hour period may the airborne concentration exceed 10 fibers longer than 5 micrometers per cubic centimeter of air (10f/cc). The 10f/cc concentration is called the ceiling concentration. NIOSH has recommended lowering the 8-hour twa to 0.1 fibers per cubic centimeter (0.1f/cc).

Contractors must use air monitoring to determine whether the airborne concentration of asbestos exceeds these exposure limits. The regulations prescribe the method to be used for air monitoring and where and how often air samples must be taken.

If the airborne concentration does exceed the specified exposure limits (either the 8-hour twa or the ceiling concentration), then the contractor performing removal, encapsulation, or enclosure must:

(1) Provide employees with approved respirators. The OSHA regulations require different types of respirators under different conditions. The OSHA Regional Offices listed in Appendix D can provide information on respirator requirements. The NIOSH Regional Offices listed in Appendix E can provide information on approved respirators.

(2) Provide change rooms and two separate lockers or storage containers so that employees can keep street clothes and work clothes separate.

In addition, if the ceiling concentration is exceeded, the contractor must provide his employees with protective clothing.

The regulations require contractors to place caution signs inside and immediately outside of the work area. The signs must advise people entering the area of the hazards of exposure to asbestos.

Containers of waste asbestos material must be marked with a warning label which states:

CAUTION
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
BREATHING ASBESTOS DUST MAY CAUSE
SERIOUS BODILY HARM

See Appendix C for the full text of the OSHA asbestos regulations. Questions about the regulations and compliance problems can be answered by the OSHA Regional Offices listed in Appendix D. Information on contractor training and occupational safety is also available from these OSHA offices and the NIOSH Regional Offices listed in Appendix E.

Contract Specifications

The following general specifications are recommended for removal and encapsulation contracts. Some of these specifications are also appropriate for enclosure contracts. If these recommended specifications are incorporated into contracts and strictly enforced, the building environment will be protected against contamination.

Contractors should be encouraged to receive training and to train their workers in safe work practices and in proper removal, encapsulation, and enclosure methods. Contractor and worker training can be required in the contract.

1. Regulations

Contractors shall comply with the requirements of the EPA regulations, National Emission Standards for Asbestos, and the OSHA regulations on asbestos, Section 1910.1001 [and any applicable State and local government regulations] which are incorporated by reference.

2. Scope of Work

A. The Contractor shall furnish all labor, materials, services, insurance, and equipment necessary to carry out the [removal operation, encapsulation operation] in accordance with the EPA and OSHA regulations [and any applicable State and local government regulations].

B. The Contractor shall be responsible for obtaining approval for a waste disposal site in compliance with Section 61.25 of the EPA regulations.

C. Contractors shall post the EPA and OSHA regulations [and any applicable State and local government regulations] at the job site.

3. Worker Protection

A. The Contractor shall provide workers with approved respirators. The Contractor shall provide a sufficient quantity of filters approved for asbestos so that workers can change filters during the work day. Filters shall not be used any longer than one (1) work day. The respirator filters shall be stored at the job site in the change room and shall be totally protected from exposure to asbestos prior to their use.

B. Workers shall always wear a respirator properly fitted on the face in the work area.

C. Contractors shall instruct and train workers in proper respirator use.

D. Workers shall wear disposable, full-body coveralls and disposable head covers and footwear in the work area. Footwear may be disposable. Non-disposable footwear shall be left in the work area at all times until disposal at job completion.

E. The Contractor shall set up a change room and a shower outside of the work area.

F. All workers without exception shall:

(1) Remove street clothes in the change room and put on the disposable coveralls and head covers, and respirator before entering the work area.

(2) Remove the disposable coveralls, head covers, and footwear in the work area before leaving the work area. Still wearing their respirators, proceed to the showers and remove their respirators while showering with soap and water.

(3) Shower at the end of each day's work before entering the change room to change into street clothes.

G. Workers shall not eat, drink, smoke, chew gum, or chew tobacco in the work area. To eat, drink, or smoke, workers shall remove the disposable work clothes and footwear in the work area before leaving the work area. Still wearing their respirators, workers shall proceed to the showers and remove their respirators while showering with soap and water. Workmen shall then dress into a new, clean disposable coverall to eat, smoke, or drink. The new coverall can be worn to reenter the work area.

H. The Contractor shall provide a respirator and disposable coveralls, headcover, and footwear to any official representative of the school who inspects the job site.

I. All persons entering the work area shall wear an approved respirator and disposable coveralls, head cover, and footwear.

Worker Dressed in Protective Clothing

4. Work Area Preparation

A. The Contractor shall set up a decontamination facility outside of the work area which will consist of a change room, shower area, and equipment area. The decontamination facility shall be subject to the approval of the official representative of the school.

B. The Contractor shall isolate the work area for the duration of the work by completely sealing off all openings and fixtures in the work area including, but not limited to, heating and ventilation ducts, doorways, corridors, windows, skylights, and lighting with plastic sheeting taped securely in place.

C. The Contractor shall build double barriers of plastic sheeting at all entrances and exits to the work area so that the work area is always closed off by one barrier when workers enter or exit.

D. All floor and wall surfaces in the work area shall be covered with plastic sheeting taped securely in place to protect from water damage [or damage by sealants].

E. Before the work is begun, the Contractor shall wet clean all removable items and equipment not located on the asbestos material, remove them from the work area, and then return these items and equipment to the work area after the job has been completed and the area has been decontaminated.

F. The Contractor shall cover all non-removable items and equipment in the work area with plastic sheeting taped securely in place.

G. After work area isolation, the Contractor shall take out all detachable electrical, heating, ventilation equipment, and other items located on the asbestos material, clean them before covering with plastic sheeting taped securely in place, and return them to their proper place after the job has been completed and the work area has been decontaminated.

H. The Contractor shall remove all heating, ventilation, and air conditioning system filters, pack them in sealable plastic bags (6-mil minimum) for burial in the approved waste disposal site and replace them with new filters.

I. The contractor shall establish emergency and fire exits from the work area. Emergency procedures shall have priority.

5. Method of Removal

A. The asbestos material shall be sprayed with water containing a wetting agent to enhance penetration. The wetting agent shall be 50% polyoxyethylene ester and 50% polyoxyethylene ether (Aqua-GRO*), or the equivalent, in a concentration of one (1) ounce in five (5) gallons of water. A fine spray of the amended water shall be applied to reduce fiber release preceding the removal of the asbestos material. The material shall be sufficiently saturated to prevent emission of airborne fibers in excess of the exposure limits prescribed in the OSHA regulations referenced in these specifications.

B. The asbestos material shall be removed in small sections by two-man teams on staging platforms. Before beginning the next section, the material shall be packed while still wet into sealable plastic bags (6-mil minimum) and placed into fiber or metal drums or skips for transport. Bags, drums, and skips shall be marked with the OSHA label prescribed by the OSHA regulations referenced in these specifications. The outside of all containers shall be clean before leaving the work area.

C. All plastic sheeting, tape, cleaning material, clothing, and all other disposable material or items used in the work area shall be packed into sealable plastic bags (6-mil minimum) and placed into metal or fiber drums or skips for transport. The drums and skips shall be marked with the OSHA label prescribed by the OSHA regulations referenced in these specifications.

D. The Contractor shall transport the sealed drums or skips to the approved waste disposal site. The sealed plastic bags may be dumped from the drums into the burial site unless the bags have been broken or damaged. The damaged bags shall be left in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled.

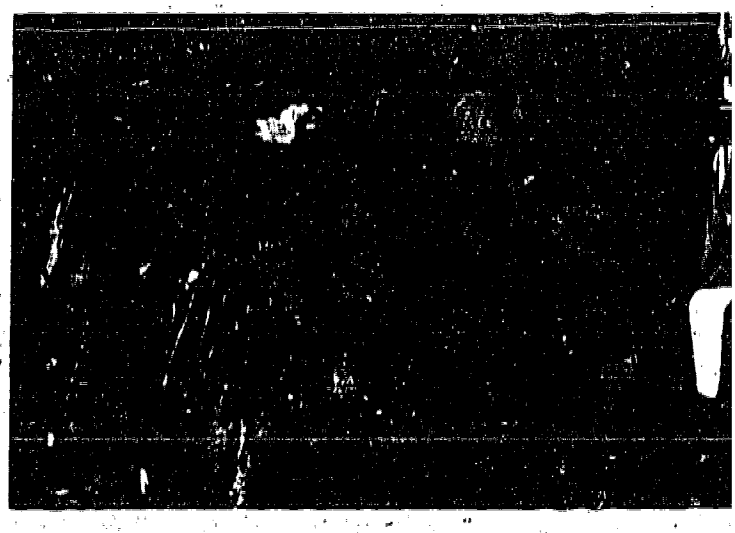
6. Decontamination of Work Area

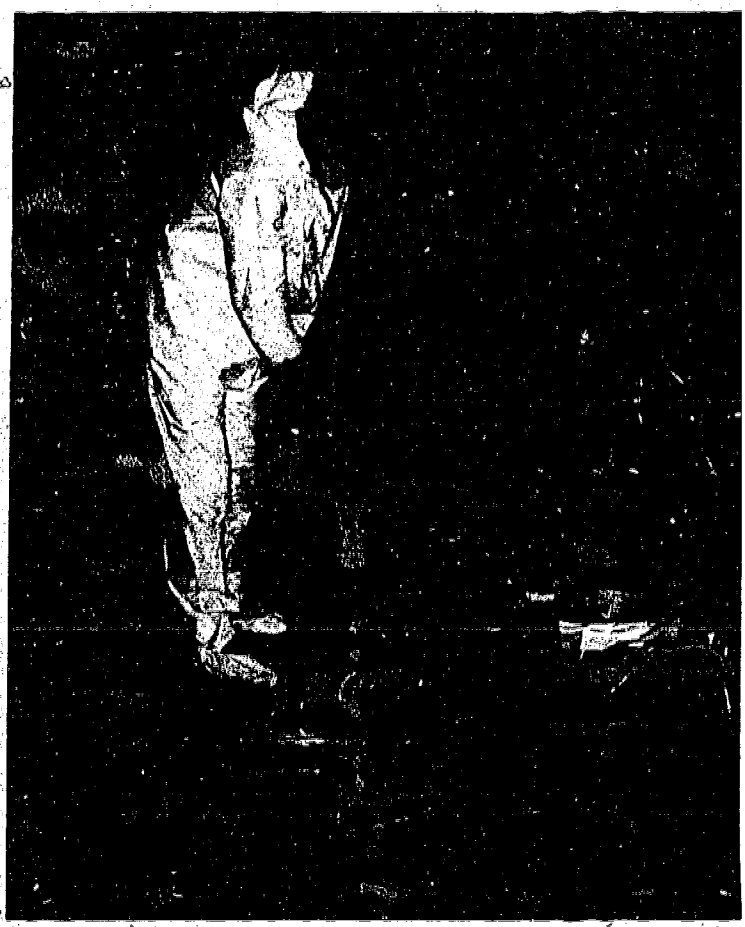
A. The Contractor shall clean all surfaces in the work area with water and/or with a High Efficiency Particulate Absolute (HEPA) filtered vacuum. (A HEPA vacuum will fail if used on wet material.) After cleaning the work area, the Contractor shall wait 24 hours to allow for settlement of dust, and then wet-clean all surfaces in the work area again. After completion of the second cleaning operation, the Contractor shall perform a complete visual inspection of the work area to ensure that the work area is dust free. The Contractor shall take two air samples within 48 hours after completion of all cleaning work. (Minimum volume of air sample is 240 L).

B. If the official representative of the school finds that the work area has not been decontaminated, the Contractor shall repeat the cleaning and air monitoring until the work area is in compliance.

C. After the work area is found to be in compliance, all entrances and exits are unsealed and the plastic sheeting, tape, and any other trash and debris is disposed of in sealable plastic bags (6-mil minimum) and buried in the approved waste disposal site.

* Mention of trade names or specific products does not constitute endorsement by EPA.





7. Air Monitoring

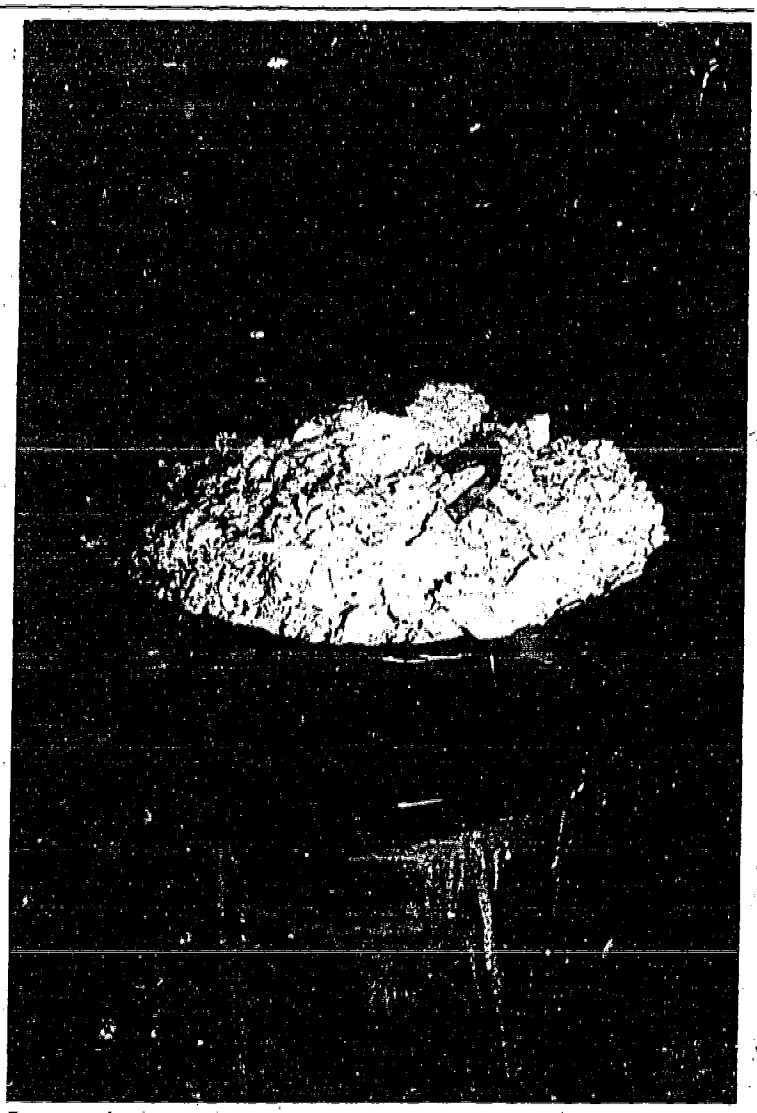
A. Throughout the entire [removal, encapsulation] and cleaning operations, air monitoring shall be conducted to ensure that the Contractor is complying with the EPA and OSHA regulations [and any applicable State and local government regulations]. The school shall provide an air monitoring technician to take air samples at the job site at no cost to the Contractor.

B. Air monitoring will be conducted according to the method prescribed by Section 1910.1001(f) of the OSHA regulations.

C. Air monitoring shall be performed to provide the following samples during the period of asbestos [removal, encapsulation]:

Areas to be Sampled	*Minimum Number of Samples for Each Work Day*	*Each Sample Minimum Volume Litres*
Work Area	2	120 L
Outside Work Area	1	120 L
Outside Building	1	240 L

D. Samples should only be taken after actual [removal, encapsulation] work has proceeded.



Removed Material in Drum With Plastic Liner

Chapter 10: EPA School Survey

EPA plans to assess the extent of the asbestos material problem in schools and to determine the need for further Federal action to control exposure to asbestos in school buildings. To aid in this evaluation, EPA encourages school districts to complete the survey form at the end of this chapter.

What information does the form request?

The form asks questions about the results of (1) inspection for friable materials and (2) sampling and laboratory analysis of friable materials for asbestos. It also asks what kind of corrective action (removal, encapsulation, enclosure, or deferred action) has been or will be taken to control exposure to friable asbestos material.

Where to send the form

School districts (or individual schools, if the school district does not plan to file a report) should send a copy of the completed survey form to their EPA Regional Asbestos Coordinator. The Coordinators are listed on the back of the survey form. In States which have an Asbestos Program Agency, the school district should contact the agency to determine whether the reporting form should also be sent to the State. The names and addresses of these State contacts are available from the EPA Regional Asbestos Coordinator and by calling the EPA toll-free information number listed below:

800-424-9065
(in the Washington, D.C. area: 554-1404)

A copy of the reporting form should be kept by school districts in an asbestos control program file.

When to complete the form

The survey form should be completed as soon as information is available from schools. Since asbestos control programs in schools may begin at different times, school districts may want to file more than one form.

If possible, officials should mail completed survey forms *before* September 1, 1979.

Additional Reporting Forms

Additional reporting forms can be obtained by calling the EPA toll-free information number (800-424-9065 or 554-1404 in the Washington, D.C. area).

Will reports on the survey results be available?

Depending on the data received, EPA will compile monthly reports for the Regional Asbestos Coordinators. EPA will also publish an interim status report in September 1979 and a final report in February 1980. These reports will summarize the data received and will contain nationwide projections on the extent of the asbestos problem in schools and efforts to control it. These reports will be available to the States and local school officials upon request from the Regional Asbestos Coordinators.

DETACH HERE

U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA ASBESTOS SURVEY REPORT

(Survey of Activities to Control Asbestos-Containing Materials in School Buildings)

Form Approved OMB No. 158-R-0165

GENERAL

This information is collected under the authority of the Toxic Substances Control Act, Sections 6 and 8. EPA is compiling information on the progress of State and local programs to control exposure to asbestos-containing materials in schools. This form should be used to periodically report information concerning the asbestos control activities in your school district. To obtain more forms, call this toll-free number: 800-424-9065 or in the Washington, D.C. area, call 554-1404. Data collected in this survey will be subject to the provisions of the Freedom of Information Act (5 U.S.C. 552).

MAILING INSTRUCTIONS

MAIL ONE COPY TO: The EPA Regional Asbestos Coordinator for your Region. *(For names and addresses see reverse side.)*

ALSO, please mail a copy to your official State asbestos program contact *(for name and address, call this toll-free number: 800-424-9065 or if in the Washington, D.C. area, call 554-1404).*

IDENTIFICATION

1 SCHOOL DISTRICT INFORMATION

NAME OF SCHOOL DISTRICT

CITY OR COUNTY

STATE | ZIP CODE

2. PERSON TO CONTACT REGARDING THIS REPORT

NAME *(last, first, & middle initial)*

OFFICIAL JOB TITLE

TELEPHONE NO. *(area code & number)* | DATE *(mo., day, & year)*

SPECIFIC QUESTIONS

3. Has the school district submitted an EPA Asbestos Survey Report before?

☐ YES ☐ NO ☐ UNKNOWN

4. How many schools in the district were built or renovated between 1945 and 1978?

NUMBER OF SCHOOLS

5. As of_____*(mo./yr.)*, how many schools in the district have been inspected for the presence of friable asbestos-containing materials?

NUMBER OF SCHOOLS

6. How many schools had bulk samples analyzed for asbestos with the EPA recommended technique of Polarized Light Microscopy?

NUMBER OF SCHOOLS

7. As of_____*(mo./yr. of analysis)* for how many schools in the district was friable material analyzed as containing asbestos?

NUMBER OF SCHOOLS

8. (a) In how many schools was friable asbestos-containing material determined to present an exposure problem?
(b) Approximately how many square feet of this material were found?
(c) Estimate the number of children per school year exposed to this material. *(Multiply the percent of children exposed by the total number of enrolled students. e.g., An exposure problem in five classrooms may involve 15% of the total population of 700 students; 15% x 700 equals 105 students exposed.)*
(d) Have the names of the children been recorded and retained for future reference?

a. NO. OF SCHOOLS | b. SQUARE FEET | c. NO. OF CHILDREN | d. NAMES RECORDED ☐ YES ☐ NO

Questions 9 through 11 refer to the friable asbestos-containing material that presents an exposure problem in Question 8.

9. (a) Approximately how many square feet of this material have been or will be removed?
(b) What is the estimated total cost of removal?

a. SQUARE FEET | b. COST: $

10. (a) Approximately how many square feet of this material have been or will be encapsulated?
(b) What is the estimated total cost of encapsulation?

a. SQUARE FEET | b. COST: $

11. (a) Approximately how many square feet of this material have been or will be enclosed?
(b) What is the estimated total cost of enclosure?

a. SQUARE FEET | b. COST: $

12. (a) For approximately how many square feet of asbestos-containing material was action deferred?
(b) Will this material be inspected periodically to determine if an exposure problem exists?

a. SQUARE FEET | b. PERIODIC INSPECTION ☐ YES ☐ NO

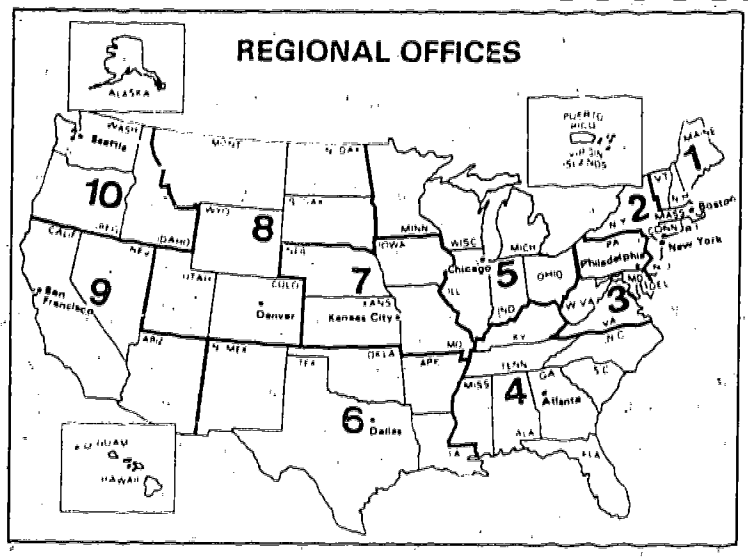
13. What is the source of funding for the asbestos control activities in your district?

FUNDING SOURCE

14. When did *(or will)* the asbestos control activities in the district begin and end?

BEGINNING YEAR | ENDING YEAR

COMMENTS



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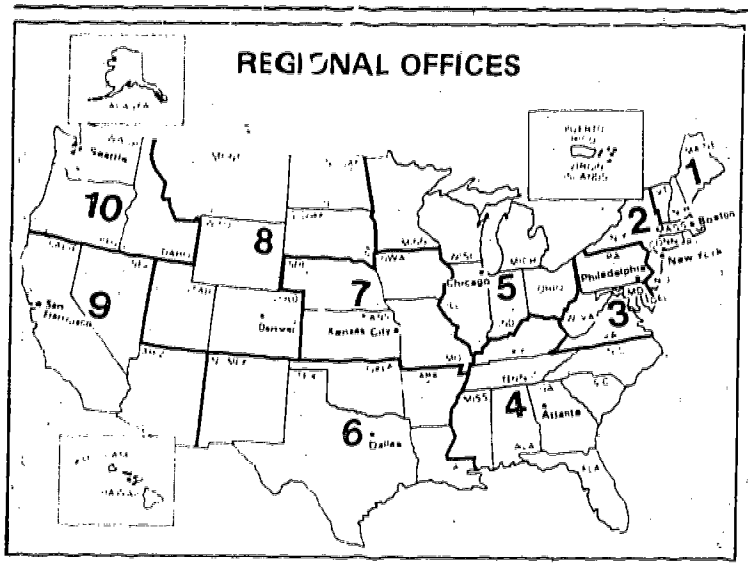

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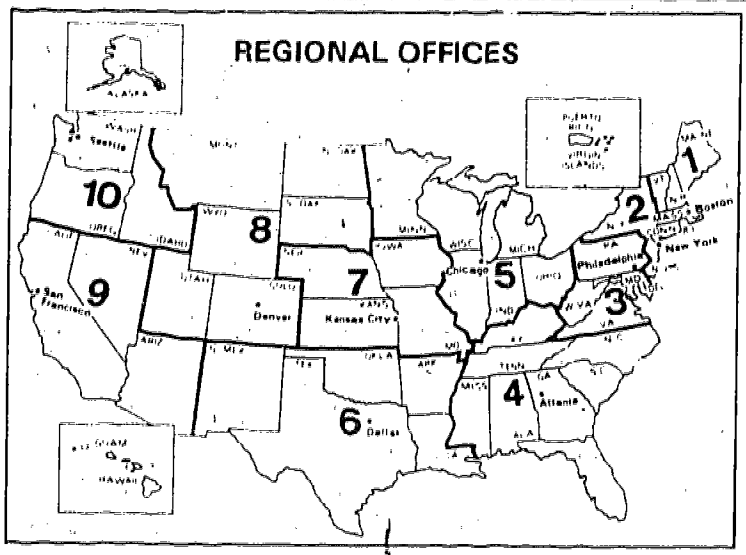

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Chapter 11: Assistance From Federal and State Agencies

The EPA Regional Asbestos Coordinators will coordinate the EPA school asbestos program with the States in their Regions. The other Federal agencies participating in the program will provide assistance to the States on matters of worker protection, contractor training, and safety and health. Several toll-free numbers will be operated by EPA and the Consumer Product Safety Commission. The numbers are listed in this chapter and in Appendix G.

Assistance From EPA

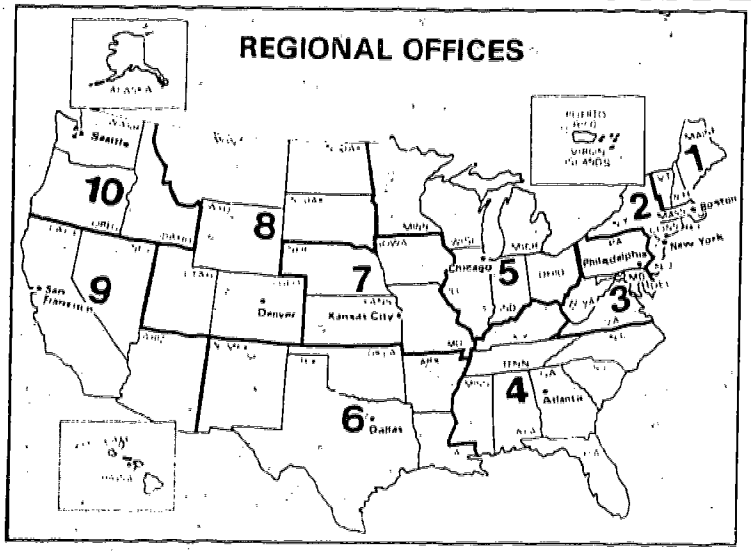
The EPA Regional Asbestos Coordinators can provide information and assistance to the States. The Coordinators are listed in this chapter. They will be available to meet with State and local officials to discuss the asbestos material problem and to answer questions about the EPA school asbestos program.

A videotape supplementing the information contained in this manual will be available to schools from the EPA Regional Offices. The videotape will show how to inspect schools and how to sample friable material, and will also show removal, encapsulation, and enclosure operations. The EPA Regional Asbestos Coordinators should be contacted for copies of the videotape.

As part of the school asbestos program EPA will conduct training sessions in the Regional Offices for State and local officials and other interested individuals and provide technical assistance to schools and their contractors who undertake corrective actions. The Regional Asbestos Coordinators should be contacted for information on scheduling of training sessions and the technical assistance program.

EPA Regional Asbestos Coordinators

The following persons are the Regional Asbestos Coordinators in each of the ten EPA Regional Offices. The map on this page shows which States are in each of the ten Regions.



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Toll-Free Action Line
(Leave name and number ask to have your call returned)
Missouri: 800-892-3837
Iowa, Nebraska, Kansas:
800-821-3714

Region 8	Region 9	Region 10
Mr. Ralph Larsen Asbestos Coordinator EPA Region VIII 1860 Lincoln Street Denver, CO 80295 (303) 837-3926	Mr. John Yim Asbestos Coordinator EPA Region IX 215 Fremont Street San Francisco, CA 94105 (415) 556-3352	Ms. Margo Partridge Asbestos Coordinator EPA Region X 1200 Sixth Avenue Seattle, WA 98101 (206) 442-5560

EPA Toll-Free Numbers

Copies of the guidance package, additional-survey forms, or other information on the EPA school asbestos program is available by calling:

800-424-9065
(in the Washington, D.C. area: 554-1404)

Information on sampling and analysis is available by calling:

800-334-8571, extension 6892

Assistance From State Asbestos Program Contacts

Many States have programs or are developing programs to control asbestos materials in schools and other buildings. The names of persons who have been designated by the Governors as the Asbestos Program contact for each State are available on the EPA toll-free information number. The Regional Asbestos Coordinators can also be contacted for the names of the State Asbestos Program Agencies.

School officials should check with their State Agency before beginning a school asbestos control program. Some States may already have an asbestos program and will want schools to follow certain procedures for inspecting, sampling and analysis, and taking corrective actions.

Assistance From Other Federal Agencies

Other Federal agencies can provide assistance to schools which have questions about consumer products containing asbestos and matters of occupational safety and health.

(1) Consumer Product Safety Commission

The U.S. Consumer Product Safety Commission (CPSC) operates a toll-free information number. School districts with questions about consumer products that contain asbestos can call:

800-638-8326
(in Alaska, Hawaii, Puerto Rico, Virgin Islands: 800-638-8333)
(in Maryland: 800-492-8363)

(2) Occupational Safety and Health Administration

The Occupational Safety and Health Administration (OSHA) has regulations covering safe workplace practices that must be followed during removal, encapsulation, and enclosure of asbestos materials. These regulations are summarized in Chapter 9 and are printed in Appendix C.

Some States have assumed responsibility for development and enforcement of their own occupational safety and health standards following approval from OSHA. A complete list of the approved State Program Offices and Federal OSHA field locations is included as Appendix D. Questions about proper worker protection and respirator requirements should be referred to the appropriate State Program Office or Federal OSHA Offices listed in Appendix D.

To assist small business employers in meeting the requirements of the Occupational Safety and Health Act of 1970 Congress has authorized a joint federal OSHA-State on-site consultation program. For information on this free consulting service, employers should contact the nearest State or Federal OSHA Office listed in Appendix D.

(3) Department of Health, Education and Welfare (DHEW)

A. ***National Institute for Occupational Safety and Health***

The National Institute for Occupational Safety and Health (NIOSH) can provide assistance on selection of approved respirators and answer questions on occupational safety and health. The NIOSH Regional Consultants are listed in Appendix E.

B. ***Regional Health Administration***

The Regional Health Administrators listed in Appendix F can provide information on the health problems associated with asbestos exposure.

Appendix A: U.S. Environmental Protection Agency Regulations for Asbestos

(Code of Federal Regulations Title 40, Part 61, Subparts A and B)

PART 61—NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Subpart A—General Provisions

Subpart B—National Emission Standard for Asbestos

AUTHORITY: Section 112 of the Clean Air Act as added by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1685 (42 U.S.C. 1857c-7); section 114 of the Clean Air Act, as added by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1687, and amended by Pub. L. 93-319, sec. 6(a)(4), 88 Stat. 259 (42 U.S.C. 1857c-9); section 301(a) of the Clean Air Act, as amended by sec. 15(c)(2) of Pub. L. 91-604, 84 Stat. 1713 (42 U.S.C. 1857g(a)).

SOURCE: 38 FR 8826, Apr. 6, 1973, unless otherwise noted.

Subpart A—General Provisions

§ 61.01 Applicability.

The provisions of this part apply to the owner or operator of any stationary source for which a standard is prescribed under this part.

§ 61.02 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the act:

(a) "Act" means the Clean Air Act (42 U.S.C. 1857 et seq.).

(b) "Administrator" means the Administrator of the Environmental Protection Agency or his authorized representative.

(c) "Alternative method" means any method of sampling and analyzing for an air pollutant which is not a reference method or an equivalent method but which has been demonstrated to the Administrator's satisfaction to produce, in specific cases, results adequate for his determination of compliance.

(d) "Commenced" means that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

(e) "Compliance schedule" means the date or dates by which a source or category of sources is required to comply with the standards of this part and with any steps toward such compliance which are set forth in a waiver of compliance under § 61.11.

(f) "Construction" means fabrication, erection, or installation of a stationary source.

(g) "Effective date" is the date of promulgation in the FEDERAL REGISTER of an applicable standard or other regulation under this part.

(h) "Equivalent method" means any method of sampling and analyzing for an air pollutant which has been demonstrated to the Administrator's satisfaction to have a consistent and quantitatively known relationship to the reference method, under specified conditions.

(i) "Existing source" means any stationary source which is not a new source.

(j) "Modification" means any physical change in, or change in the method of operation of, a stationary source which increases the amount of any hazardous air pollutant emitted by such source or which results in the emission of any hazardous air pollutant not previously emitted, except that:

(1) Routine maintenance, repair, and replacement shall not be considered physical changes, and

(2) The following shall not be considered a change in the method of operation:

(i) An increase in the production rate, if such increase does not exceed the operating design capacity of the stationary source;

(ii) An increase in hours of operation.

(k) "New source" means any stationary source, the construction or modification of which is commenced after the publication in the FEDERAL REGISTER of proposed national emission standards for hazardous air pollutants which will be applicable to such source.

(l) "Owner or operator" means any person who owns, leases, operates, controls, or supervises a stationary source.

(m) "Reference method" means any method of sampling and analyzing for an air pollutant, as described in Appendix B to this part.

(n) "Startup" means the setting in operation of a stationary source for any purpose.

(o) "Standard" means a national emission standard for a hazardous air pollutant proposed or promulgated under this part.

(p) "Stationary source" means any building, structure, facility, or installation which emits or may emit any air pollutant which has been designated as hazardous by the Administrator.

[38 FR 8826, Apr. 6, 1973, as amended at 39 FR 15398, May 3, 1974]

§ 61.03 Abbreviations.

The abbreviations used in this part have the following meanings:

°C—Degrees Centigrade.
cfm—Cubic feet per minute.
ft²—Square feet.
ft³—Cubic feet.
°F—Degrees Fahrenheit.

in—Inch.
l—Liter.
ml—Milliliter.
M—Molar.
m³—Cubic meter.
nm—Nanometer.
oz—Ounces.
v/v—Volume per volume.
yd²—Square yards.
w.g.—Water gage.
inHg—Inches of mercury.
inH₂O—Inches of water.
g—Grams.
mg—Milligrams.
N—Normal.
°R—Degree Rankine.
min—Minute
sec—Second.
avg.—Average.
I.D.—Inside diameter.
O.D.—Outside diameter.
μg—Micrograms (10^{-6} gram).
%—Percent.
Hg—Mercury.
Be—Beryllium.

§ 61.04 Address.

(a) All requests, reports, applications, submittals, and other communications to the Administrator pursuant to this part shall be submitted in duplicate and addressed to the appropriate Regional Office of the Environmental Protection Agency, to the attention of the Director, Enforcement Division. The regional offices are as follows:

Region I (Connecticut, Maine, New Hampshire, Massachusetts, Rhode Island, Vermont), John F. Kennedy Federal Building, Boston, Massachusetts 02203.

Region II (New York, New Jersey, Puerto Rico, Virgin Islands), Federal Office Building, 26 Federal Plaza (Foley Square), New York, N.Y. 10007.

Region III (Delaware, District of Columbia, Pennsylvania, Maryland, Virginia, West Virginia), Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

Region IV (Alabama, Florida, Georgia, Mississippi, Kentucky, North Carolina, South Carolina, Tennessee), Suite 300, 1421 Peachtree Street, Atlanta, Georgia 30309.

Region V (Illinois, Indiana, Minnesota, Michigan, Ohio, Wisconsin), 230 South Dearborn Street, Chicago, Illinois 60604.

Region VI (Arkansas, Louisiana, New Mexico, Oklahoma, Texas), 1600 Patterson Street, Dallas, Texas 75201.

Region VII (Iowa, Kansas, Missouri, Nebraska), 1735 Baltimore Street, Kansas City, Missouri 63108.

Region VIII (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming), 196 Lincoln Towers, 1860 Lincoln Street, Denver, Colorado 80203.

Region IX (Arizona, California, Hawaii, Nevada, Guam, American Samoa), 100 California Street, San Francisco, California 94111.

Region X (Washington, Oregon, Idaho, Alaska), 1200 Sixth Avenue, Seattle, Washington 98101.

(b) Section 112(d) directs the Administrator to delegate to each State, when appropriate, the authority to implement and enforce the national emission standards for hazardous air pollutants for stationary sources located in such State. All information required to be submitted to EPA under paragraph (a) of this section, must also be submitted to the appropriate State Agency of any State to which this authority has been delegated (provided, that each specific delegation may exempt sources from a certain federal or State reporting requirement). The appropriate mailing address for those States whose delegation request has been approved is as follows:

(A) [Reserved]

(B) State of Alabama, Air Pollution Control Division, Air Pollution Control Commission, 645 S. McDonough Street, Montgomery, Alabama 36104.

(C) [Reserved]

(D) Arizona:

Pima County Air Pollution Control District, 151 West Congress Street, Tucson AZ 85701.

(E) [Reserved]

(F) California:

Bay Area Air Pollution Control District, 939 Ellis Street, San Francisco, CA 94109.

Del Norte County Air Pollution Control District, Courthouse, Crescent City, CA 95531.

Fresno County Air Pollution Control District, 515 S. Cedar Avenue, Fresno, CA 93702.

Humboldt County Air Pollution Control District, 5600 S. Broadway, Eureka, CA 95501.

Kern County Air Pollution Control District, 1700 Flower Street (P.O. Box 997) Bakersfield, CA 93302.

Madera County Air Pollution Control District, 135 W. Yosemite Avenue, Madera, CA 93637.

Mendocino County Air Pollution Control District, County Courthouse, Ukiah, CA 95482.

Monterey Bay Unified Air Pollution Control District, 420 Church Street (P.O. Box 487), Salinas, CA 93901.

Northern Sonoma County Air Pollution Control District, 3313 Chanate Road, Santa Rosa, CA 95404.

Sacramento County Air Pollution Control District, 3701 Branch Center Road, Sacramento, CA 95827.

San Diego County Air Pollution Control District, 9150 Chesapeake Drive, San Diego, CA 92123.

San Joaquin County Air Pollution Control District, 1601 E. Hazelton Street (P.O. Box 2009), Stockton, CA 95201.

Santa Barbara Air Pollution Control District, 4440 Calle Real, Santa Barbara, CA 93110.

Stanislaus County Air Pollution Control District, 820 Scenic Drive, Modesto, CA 95350.

Trinity County Air Pollution Control District, Box AJ, Weaverville, CA 96093.

Ventura County Air Pollution Control District, 625 E. Santa Clara Street, Ventura, CA 93001.

(G) State of Colorado, Colorado Air Pollution Control Division, 4210 East 11th Avenue, Denver, Colorado 80220.

(H) State of Connecticut, Department of Environmental Protection, State Office Building, Hartford, Connecticut 06115.

(I)-(K) [Reserved]

(L) State of Georgia, Environmental Protection Division, Department of Natural Resources, 270 Washington Street, S.W., Atlanta, Georgia 30334.

(M)-(O) [Reserved]

(P) State of Indiana, Indiana Air Pollution Control Board, 1330 West Michigan Street, Indianapolis, Indiana 46206.

(Q)-(T) [Reserved]

(U) State of Maine, Department of Environmental Protection, State House, Augusta, Maine 04330.

(V) [Reserved]

(W) Massachusetts Department of Environmental Quality Engineering, Division of Air Quality Control, 600 Washington Street, Boston, Massachusetts 02111.

(X) State of Michigan, Air Pollution Control Division, Michigan Department of Natural Resources, Stevens T. Mason Building, 8th Floor, Lansing, Michigan 48926.

(Y)-(Z) [Reserved]

(AA)-(DD) [Reserved]

(EE) New Hampshire Air Pollution Control Agency, Department of Health and Welfare, State Laboratory Building, Hazen Drive, Concord, New Hampshire 03301.

(FF)-(GG) [Reserved]

(HH) New York: New York State Department of Environmental Conservation, 50 Wolf Road, Albany, New York 12233, attention: Division of Air Resources.

(II) North Carolina Environmental Management Commission, Department of Natural and Economic Resources, Division of Environmental Management, P.O. Box 27687, Raleigh, North Carolina 27611. Attention: Air Quality Section.

(JJ) State of North Dakota, State Department of Health, State Capitol, Bismarck, North Dakota 58501.

(KK)-(LL) [Reserved]

(MM) State of Oregon, Department of Environmental Quality, 1234 SW Morrison Street, Portland, Oregon 97205.

(NN) (a) Commonwealth of Pennsylvania (except for City of Philadelphia and Allegheny County) Pennsylvania Department of Environmental Resources, Bureau of Air Quality and Noise Control, Post Office Box 2063, Harrisburg, Pennsylvania 17120.

(b) City of Philadelphia, Philadelphia Department of Public Health Air Management Services, 801 Arch Street, Philadelphia, Pennsylvania 19107.

(OO) [Reserved]

(PP) State of South Carolina, Office of Environmental Quality Control, Department of Health and Environmental Control, 2600 Bull Street, Columbia, South Carolina 29201.

(QQ)-(TT) [Reserved]

(UU) State of Vermont, Agency of Environmental Protection, Box 489, Montpelier, Vermont 05602.

(VV) Commonwealth of Virginia, Virginia State Air Pollution Control Board, Room 1106, Ninth Street Office Building, Richmond, Virginia 23219.

(WW) (i) Washington: State of Washington, Department of Ecology, Olympia, Washington 98504.

(ii) Northwest Air Pollution Authority, 207 Pioneer Building, Second and Pine Streets, Mount Vernon, Washington 98273.

(iii) Puget Sound Air Pollution Control Agency, 410 West Harrison Street, Seattle, Washington 98119.

(iv) Spokane County Air Pollution Control Authority, North 811 Jefferson, Spokane, Washington 99201.

(v) Yakima County Clean Air Authority, County Courthouse, Yakima, Washington 98901.

(vi) Olympic Air Pollution Control Authority, 120 East State Avenue, Olympia, Washington 98501.

(vii) Southwest Air Pollution Control Authority, Suite 7601 H, NE Hazel Dell Avenue, Vancouver, Washington 98665.

(XX) [Reserved]

(YY) Wisconsin—Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, Wisconsin 53707.

(ZZ) [Reserved]

(AAA)–(BBB) [Reserved]

(CCC) U.S. Virgin Islands: U.S. Virgin Islands Department of Conservation and Cultural Affairs, P.O. Box 578, Charlotte Amalie, St. Thomas, U.S. Virgin Islands 00801.

(Secs. 101, 110, 111, 112 and 301 of the Clean Air Act, as amended, 42 U.S.C. 1857, 1857c-5, 6, 7 and 1857g.)

NOTE: For amendments to § 61.04 see the List of CFR Sections Affected in back of this volume.

§ 61.05 Prohibited activities.

(a) After the effective date of any standard prescribed under this part, no owner or operator shall construct or modify any stationary source subject to such standard without first obtaining written approval of the Administrator in accordance with this subpart, except under an exemption granted by the President under section 112(c)(2) of the act. Sources, the construction or modification of which commenced after the publication date of the standards proposed to be applicable to such source, are subject to this prohibition.

(b) After the effective date of any standard prescribed under this part, no owner or operator shall operate any new source in violation of such standard except under an exemption granted by the President under section 112(c)(2) of the act.

(c) Ninety days after the effective date of any standard prescribed under this part, no owner or operator shall operate any existing stationary source in violation of such standard, except under a waiver granted by the Administrator in accordance with this subpart or under an exemption granted by the President under section 112(c)(2) of the act.

(d) No owner or operator subject to the provisions of this part shall fail to report, revise reports, or report source test results as required under this part.

§ 61.06 Determination of construction or modification.

Upon written application by an owner or operator, the Administrator will make a determination of whether actions taken or intended to be taken by such owner or operator constitute construction or modification or the commencement thereof within the meaning of this part. The Administrator will within 30 days of receipt of sufficient information to evaluate an application, notify the owner or operator of his determination.

§ 61.07 Application for approval of construction or modification.

(a) The owner or operator of any new source to which a standard prescribed under this part is applicable shall, prior to the date on which construction or modification is planned to commence, or within 30 days after the effective date in the case of a new source that already has commenced construction or modification and has not begun operation, submit to the Administrator an application for approval of such construction or modification. A separate application shall be submitted for each stationary source.

(b) Each application shall include:

(1) The name and address of the applicant.

(2) The location or proposed location of the source.

(3) Technical information describing the proposed nature, size, design, operating design capacity, and method of operation of the source, including a description of any equipment to be used for control of emissions. Such technical information shall include calculations of emission estimates in sufficient detail to permit assessment of the validity of such calculations.

§ 61.08 Approval by Administrator.

(a) The Administrator will, within 60 days of receipt of sufficient information to evaluate an application under § 61.07, notify the owner or operator of approval or intention to deny approval of construction or modification.

(b) If the Administrator determines that a stationary source for which an application pursuant to § 61.07 was submitted will, if properly operated, not cause emissions in violation of a standard, he will approve the construction or modification of such source.

(c) Prior to denying any application for approval of construction or modification pursuant to this section, the Administrator will notify the owner or operator making such application of the Administrator's intention to issue such denial, together with:

(1) Notice of the information and findings on which such intended denial is based, and

(2) Notice of opportunity for such owner or operator to present, within such time limit as the Administrator shall specify, additional information or arguments to the Administrator prior to final action on such application.

(d) A final determination to deny any application for approval will be in writing and will set forth the specific grounds on which such denial is based. Such final determination will be made within 60 days of presentation of additional information or arguments, or 60 days after the final date specified for presentation, if no presentation is made.

(e) Neither the submission of an application for approval nor the Administrator's granting of approval to construct or modify shall:

(1) Relieve an owner or operator of legal responsibility for compliance with any applicable provision of this part or of any other applicable Federal, State, or local requirement, or

(2) Prevent the Administrator from implementing or enforcing this part or taking any other action under the act.

§ 61.09 Notification of startup.

(a) Any owner or operator of a source which has an initial startup after the effective date of a standard prescribed under this part shall furnish the Administrator written notification as follows:

(1) A notification of the anticipated date of initial startup of the source not more than 60 days nor less than 30 days prior to such date.

(2) A notification of the actual date of initial startup of the source within 15 days after such date.

§ 61.10 Source reporting and waiver request.

(a) The owner or operator of any existing source, or any new source to which a standard prescribed under this part is applicable which had an initial startup which preceded the effective date of a standard prescribed under this part shall, within 90 days after the effective date, provide the following information in writing to the Administrator:

(1) Name and address of the owner or operator.

(2) The location of the source.

(3) The type of hazardous pollutants emitted by the stationary source.

(4) A brief description of the nature, size, design, and method of operation of the stationary source including the operating design capacity of such source. Identify each point of emission for each hazardous pollutant.

(5) The average weight per month of the hazardous materials being processed by the source, over the last 12 months preceding the date of the report.

(6) A description of the existing control equipment for each emission point.

(i) Primary control device(s) for each hazardous pollutant.

(ii) Secondary control device(s) for each hazardous pollutant.

(iii) Estimated control efficiency (percent) for each control device.

(7) A statement by the owner or operator of the source as to whether he can comply with the standards prescribed in this part within 90 days of the effective date.

(b) The owner or operator of an existing source unable to operate in compliance with any standard prescribed under this part may request a waiver of compliance with such standard for a period not exceeding 2 years from the effective date. Any request shall be in writing and shall include the following information:

(1) A description of the controls to be installed to comply with the standard.

(2) A compliance schedule, including the date each step toward compliance will be reached. Such list shall include as a minimum the following dates:

(i) Date by which contracts for emission control systems or process modifications will be awarded, or date by which orders will be issued for the purchase of component parts to accomplish emission control or process modification;

(ii) Date of initiation of onsite con-

struction or installation of emission control equipment or process change;

(iii) Date by which onsite construction or installation of emission control equipment or process modification is to be completed; and

(iv) Date by which final compliance is to be achieved.

(3) A description of interim emission control steps which will be taken during the waiver period.

(c) Changes in the information provided under paragraph (a) of this section shall be provided to the Administrator within 30 days after such change, except that if changes will result from modification of the source, as defined in § 61.02 (j), the provisions of § 61.07 and § 61.08 are applicable.

(d) The format for reporting under this section is included as Appendix A of this part. Advice on reporting the status of compliance may be obtained from the Administrator.

§ 61.11 Waiver of compliance.

(a) Based on the information provided in any request under § 61.10, or other information, the Administrator may grant a waiver of compliance with a standard for a period not exceeding 2 years from the effective date of such standard.

(b) Such waiver will be in writing and will:

(1) Identify the stationary source covered.

(2) Specify the termination date of the waiver. The waiver may be terminated at an earlier date if the conditions specified under paragraph (b) (3) of this section are not met.

(3) Specify dates by which steps toward compliance are to be taken; and impose such additional conditions as the Administrator determines to be necessary to assure installation of the necessary controls within the waiver period, and to assure protection of the health of persons during the waiver period.

(c) Prior to denying any request for a waiver pursuant to this section, the Administrator will notify the owner or operator making such request of the Administrator's intention to issue such denial, together with:

(1) Notice of the information and findings on which such intended denial is based, and

(2) Notice of opportunity for such owner or operator to present, within such time limit as the Administrator specifies, additional information or arguments to the Administrator prior to final action on such request.

(d) A final determination to deny any request for a waiver will be in writing and will set forth the specific grounds on which such denial is based. Such final determination will be made within 60 days after presentation of additional information or arguments, or 60 days after the final date specified for such presentation, if no presentation is made.

(e) The granting of a waiver under this section shall not abrogate the Administrator's authority under section 114 of the act.

§ 61.12 Emission tests and monitoring.

(a) Emission tests and monitoring shall be conducted and reported as set forth in this part and Appendix B to this part.

(b) The owner or operator of a new source subject to this part, and at the request of the Administrator, the owner or operator of an existing source subject to this part, shall provide or cause to be provided, emission testing facilities as follows:

(1) Sampling ports adequate for test methods applicable to such source.

(2) Safe sampling platform(s).

(3) Safe access to sampling platform(s).

(4) Utilities for sampling and testing equipment.

§ 61.13 Waiver of emission tests.

(a) Emission tests may be waived upon written application to the Administrator if, in his judgment, the source is meeting the standard, or if the source is operating under a waiver of compliance or has requested a waiver of compliance.

(b) If application for waiver of the emission test is made, such application shall accompany the information required by § 61.10. The appropriate form is contained in Appendix A to this part.

(c) Approval of any waiver granted pursuant to this section shall not abrogate the Administrator's authority under the act or in any way prohibit the Administrator from later canceling such waiver. Such cancellation will be made only after notice is given to the owner or operator of the source.

§ 61.14 Source test and analytical methods.

(a) Methods 101, 102, and 104 in Appendix B to this part shall be used for all source tests required under this part, unless an equivalent method or an alternative method has been approved by the Administrator.

(b) Method 103 in Appendix B to this part is hereby approved by the Administrator as an alternative method for sources subject to § 61.32(a) and § 61.42 (b).

(c) The Administrator may, after notice to the owner or operator, withdraw approval of an alternative method granted under paragraphs (a), (b) or (d) of this section. Where the test results using an alternative method do not adequately indicate whether a source is in compliance with a standard, the Administrator may require the use of the reference method or its equivalent.

(d) Method 105 in Appendix B to this part is hereby approved by the Administrator as an alternative method for sources subject to § 61.52(b).

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48299, Oct. 14, 1975]

§ 61.15 Availability of information.

The availability to the public of information provided to, or otherwise obtained by, the Administrator under this part shall be governed by Part 2 of this chapter.

[41 FR 36918, Sept. 1, 1976]

§ 61.16 State authority.

(a) The provisions of this part shall not be construed in any manner to preclude any State or political subdivision thereof from:

(1) Adopting and enforcing any emission limiting regulation applicable to a stationary source, provided that such emission limiting regulation is not less stringent than the standards prescribed under this part.

(2) Requiring the owner or operator of a stationary source, other than a stationary source owned or operated by the United States, to obtain permits, licenses, or approvals prior to initiating construction, modification, or operation of such source.

§ 61.17 Circumvention.

No owner or operator subject to the provisions of this part shall build, erect, install, or use any article machine, equipment, process, or method, the use of which conceals an emission which would otherwise constitute a violation of an applicable standard. Such concealment includes, but is not limited to, the use of gaseous dilutants to achieve compliance with a visible emissions standard, and the piecemeal carrying out of an operation to avoid coverage by a standard that applies only to operations larger than a specified size.

[40 FR 48299, Oct. 14, 1975]

Subpart B—National Emission Standard for Asbestos

§ 61.20 Applicability.

The provisions of this subpart are applicable to those sources specified in § 61.22.

§ 61.21 Definitions.

Terms used in this subpart are defined in the act, in Subpart A of this part, or in this section as follows:

(a) "Asbestos" means actinolite, amosite, anthophyllite, chrysotile, crocidolite, tremolite.

(b) "Asbestos material" means asbestos or any material containing asbestos.

(c) "Particulate asbestos material" means finely divided particles of asbestos material.

(d) "Asbestos tailings" means any solid waste product of asbestos mining or milling operations which contains asbestos.

(e) "Outside air" means the air outside buildings and structures.

(f) "Visible emissions" means any emissions which are visually detectable without the aid of instruments and which contain particulate asbestos material.

(g) "Asbestos mill" means any facility engaged in the conversion or any intermediate step in the conversion of asbestos ore into commercial asbestos. Outside storage of asbestos materials is not considered a part of such facility.

(h) "Commercial asbestos" means any variety of asbestos which is produced by extracting asbestos from asbestos ore.

(i) "Manufacturing" means the combining of commercial asbestos, or in the case of woven friction products the combining of textiles containing commercial asbestos, with any other material(s), including commercial asbestos, and the processing of this combination into a product as specified in § 61.22(c).

(j) "Demolition" means the wrecking or taking out of any load-supporting structural member and any related removing or stripping of friable asbestos materials.

(k) "Friable asbestos material" means any material that contains more than 1 percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.

(l) "Control device asbestos waste" means any asbestos-containing waste material that is collected in a pollution control device.

(m) "Renovation" means the removing or stripping of friable asbestos materials used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member. Operations in which load-supporting structural members are wrecked or taken out are excluded.

(n) "Planned renovation" means a renovation operation, or a number of such operations, in which the amount of friable asbestos material that will be removed or stripped within a given period of time can be predicted. Operations that are individually non-scheduled are included, provided a number of such operations can be predicted to occur during a given period of time based on operating experience.

(o) "Emergency renovation" means a renovation operation that results from a sudden, unexpected event, and is not a planned renovation. Operations necessitated by non-routine failures of equipment are included.

(p) "Adequately wetted" means sufficiently mixed or coated with water or an aqueous solution to prevent dust emissions.

(q) "Removing" means taking out friable asbestos materials used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member from any building, structure, facility, or installation.

(r) "Stripping" means taking off friable asbestos materials from any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member.

(s) "Fabricating" means any processing of a manufactured product containing commercial asbestos, with the exception of processing at temporary sites for the construction or restoration of buildings, structures, facilities or installations.

(t) "Inactive waste disposal site" means any disposal site or portion thereof where additional asbestos-containing waste material will not be deposited and where the surface is not disturbed by vehicular traffic.

(u) "Active waste disposal site" means any disposal site other than an inactive site.

(v) "Roadways" means surfaces on which motor vehicles travel including, but not limited to, highways, roads, streets, parking areas, and driveways.

(w) "Asbestos-containing waste material" means any waste which contains commercial asbestos and is generated by a source subject to the provisions of this subpart, including asbestos mill tailings, control device asbestos waste, friable asbestos waste material, and bags or containers that previously contained commercial asbestos.

(x) "Structural member" means any load-supporting member, such as beams and load-supporting walls; or any non-load-supporting member, such as ceilings and non-load-supporting walls.

[38 FR 8826, Apr. 6, 1973, as amended at 39 FR 15398, May 3, 1974; 40 FR 48299, Oct. 14, 1975; 42 FR 12127, Mar. 2, 1977]

§ 61.22 Emission standard.

(a) Asbestos mills: There shall be no visible emissions to the outside air from any asbestos mill except as provided in paragraph (f) of this section.

(b) Roadways: The surfacing of roadways with asbestos tailings or with asbestos-containing waste that is generated by any source subject to paragraphs (c), (d), (e) or (h) of this section is prohibited, except for temporary roadways on an area of asbestos ore deposits. The deposition of asbestos tailings or asbestos-containing waste on roadways covered with snow or ice is considered surfacing."

(c) Manufacturing: There shall be no visible emissions to the outside air, except as provided in paragraph (f) of this section, from any of the following operations if they use commercial asbestos or from any building or structure in which such operations are conducted.

(1) The manufacture of cloth, cord, wicks, tubing, tape, twine, rope, thread, yarn, roving, lap, or other textile materials.

(2) The manufacture of cement products.

(3) The manufacture of fireproofing and insulating materials.

(4) The manufacture of friction products.

(5) The manufacture of paper, millboard, and felt.

(6) The manufacture of floor tile.

(7) The manufacture of paints, coatings, caulks, adhesives, sealants.

(8) The manufacture of plastics and rubber materials.

(9) The manufacture of chlorine.

(10) The manufacture of shotgun shells.

(11) The manufacture of asphalt concrete.

(d) *Demolition and renovation.* The requirements of this paragraph shall apply to any owner or operator of a demolition or renovation operation who intends to demolish any institutional, commercial, or industrial building (including apartment buildings having more than four dwelling units), structure, facility, installation, or portion thereof which contains any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member that is covered or coated with friable asbestos materials, except as provided in paragraph (d)(1) of this section; or who intends to renovate any institutional, commercial, or industrial building, structure, facility, installation, or portion thereof where more than 80 meters (ca. 260 feet) of pipe covered or coated with friable asbestos materials are stripped or removed, or more than 15 square meters, (ca. 160 square feet) of friable asbestos materials used to cover or coat any duct, boiler, tank, reactor, turbine, furnace, or structural member are stripped or removed.

(1) (i) The owner or operator of a demolition operation is exempted from the requirements of this paragraph: *Provided,* (A) The amount of friable asbestos materials in the building or portion thereof to be demolished is less than 80 meters (ca. 260 feet) used on pipes, and less than 15 square meters (ca. 160 square feet) used on any duct, boiler, tank, reactor, turbine, furnace, or structural member, and (B) the notification requirements of paragraph (d)(1)(ii) are met.

(ii) Written notification shall be postmarked or delivered to the Administrator at least 20 days prior to commencement of demolition and shall include the information required by paragraph (d)(2) of this section, with the exception of the information re-

quired by paragraphs (d)(2) (iii), (vi), (vii), (viii), and (ix) of this section, and shall state the measured or estimated amount of friable asbestos materials which is present. Techniques of estimation shall be explained.

(2) Written notice of intention to demolish or renovate shall be provided to the Administrator by the owner or operator of the demolition or renovation operation. Such notice shall be postmarked or delivered to the Administrator at least 10 days prior to commencement of demolition, or as early as possible prior to commencement of emergency demolition subject to paragraph (d)(6) of this section, and as early as possible prior to commencement of renovation. Such notice shall include the following information:

(i) Name of owner or operator.

(ii) Address of owner or operator.

(iii) Description of the building, structure, facility, or installation to be demolished or renovated, including the size, age, and prior use of the structure, and the approximate amount of friable asbestos materials present.

(iv) Address or location of the building, structure, facility, or installation.

(v) Scheduled starting and completion dates of demolition or renovation.

(vi) Nature of planned demolition or renovation and method(s) to be employed.

(vii) Procedures to be employed to meet the requirements of this paragraph and paragraph (j) of this section.

(viii) The name and address or location of the waste disposal site where the friable asbestos waste will be deposited.

(ix) Name, title, and authority of the State or local governmental representative who has ordered a demolition which is subject to paragraph (d)(6) of this section.

(3)(i) For purposes of determining whether a planned renovating operation constitutes a renovation within the meaning of this paragraph, the amount of friable asbestos material to be removed or stripped shall be:

(A) For planned renovating operations involving individually non-scheduled operations, the additive amount of friable asbestos material that can be predicted will be removed or stripped at a source over the maximum period of time for which a prediction can be made. The period shall be not less than 0 days and not longer than one year.

(B) For each planned renovating operation not covered by paragraph (d)(3)(i)(A), the total amount of friable asbestos material that can be predicted will be removed or stripped at a source.

(ii) For purposes of determining whether an emergency renovating operation constitutes a renovation within the meaning of this paragraph, the amount of friable asbestos material to be removed or stripped shall be the total amount of friable asbestos material that will be removed or stripped as a result of the sudden, unexpected event that necessitated the renovation.

(4) The following procedures shall be used to prevent emissions of particulate asbestos material to outside air:

(i) Friable asbestos materials, used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member, shall be removed from any building, structure, facility or installation subject to this paragraph. Such removal shall occur before wrecking or dismantling of any portion of such building, structure, facility, or installation that would break up the friable asbestos materials and before wrecking or dismantling of any other portion of such building, structure, facility, or installation, that would preclude access to such materials for subsequent removal. Removal of friable asbestos materials used on any pipe, duct, or structural member which are encased in concrete or other similar structural material is not required prior to demolition, but such materials shall be adequately wetted whenever exposed during demolition.

(ii) Friable asbestos materials used on pipes, ducts, boilers, tanks, reactors, turbines, furnaces, or structural members shall be adequately wetted during stripping, except as provided in paragraphs (d)(4)(iv), (d)(4)(vi), or (d)(vii) of this section.

(iii) Pipes, ducts, boilers, tanks, reactors, turbines, furnaces, or structural members that are covered or coated with friable asbestos materials may be taken out of any building, structure, facility, or installation subject to this paragraph as units or in sections provided the friable asbestos materials exposed during cutting or disjoining are adequately wetted during the cutting or disjoining operation. Such units shall not be dropped or thrown to the ground, but shall be carefully lowered to ground level.

(iv) The stripping of friable asbestos materials used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member that has been removed as a unit or in sections as provided in paragraph (d)(4)(iii) of this section shall be performed in accordance with paragraph (d)(4)(ii) of this section. Rather than comply with the wetting requirement, a local exhaust ventilation and collection system may be used to prevent emissions to the outside air. Such local exhaust ventilation systems shall be designed and operated to capture the asbestos particulate matter produced by the stripping of friable asbestos materials. There shall be no visible emissions to the outside air from such local exhaust ventilation and collection systems except as provided in paragraph (f) of this section.

(v) All friable asbestos materials that have been removed or stripped shall be adequately wetted to ensure that such materials remain wet during all remaining stages of demolition or renovation and related handling operations. Such materials shall not be dropped or thrown to the ground or a lower floor. Such materials that have been removed or stripped more than 50 feet above ground level, except those materials removed as units or in sections, shall be transported to the ground via dust-tight chutes or containers.

(vi) Except as specified below, the wetting requirements of this paragraph are suspended when the temperature at the point of wetting is below 0°C (32°F). When friable asbestos materials are not wetted due to freezing temperatures, such materials on pipes, ducts, boilers, tanks, reactors, turbines, furnaces, or structural members shall, to the maximum extent possible, be removed as units or in sections prior to wrecking. In no case shall the requirements of paragraphs (d)(4)(iv) or (d)(4)(v) be suspended due to freezing temperatures.

(vii) For renovation operations, local exhaust ventilation and collection systems may be used, instead of wetting as specified in paragraph (d)(4)(ii), to prevent emissions of particulate asbestos material to outside air when damage to equipment resulting from the wetting would be unavoidable. Upon request and supply of adequate information, the Administrator will determine whether damage to equipment resulting from wetting to comply with the provisions of this paragraph would be unavoidable. Such local exhaust ventilation systems shall be designed and operated to capture the asbestos particulate matter produced by the stripping and removal of friable asbestos material. There shall be no visible emissions to the outside air from such local exhaust ventilation and collection systems, except as provided in paragraph (f) of this section.

(5) Sources subject to this paragraph are exempt from the requirements of §§ 61.05(a), 61.07, and 61.09.

(6) The demolition of a building, structure, facility, or installation, pursuant to an order of an authorized representative of a State or local governmental agency, issued because that building is structurally unsound and in danger of imminent collapse is exempt from all but the following requirements of paragraph (d) of this section:

(i) The notification requirements specified by paragraph (d)(2) of this section;

(ii) The requirements on stripping of friable asbestos materials from previously removed units or sections as specified in paragraph (d)(4)(iv) of this section;

(iii) The wetting, as specified by paragraph (d)(4)(v) of this section, of fri-

able asbestos materials that have been removed or stripped;

(iv) The portion of the structure being demolished that contains friable asbestos materials shall be adequately wetted during the wrecking operation.

(e) *Spraying.* There shall be no visible emissions to the outside air from the spray-on application of materials containing more than 1 percent asbestos, on a dry weight basis, used on equipment and machinery, except as provided in paragraph (f) of this section. Materials sprayed on buildings, structures, structural members, pipes, and conduits shall contain less than 1 percent asbestos on a dry weight basis.

(1) Sources subject to this paragraph are exempt from the requirements of § 61.05(a), § 61.07, and § 61.09.

(2) Any owner or operator who intends to spray asbestos materials which contain more than 1 percent asbestos on a dry weight basis on equipment and machinery shall report such intention to the Administrator at least 20 days prior to the commencement of the spraying operation. Such report shall include the following information:

(i) Name of owner or operator.
(ii) Address of owner or operator.
(iii) Location of spraying operation.
(iv) Procedures to be followed to meet the requirements of this paragraph.

(3) The spray-on application of materials in which the asbestos fibers are encapsulated with a bituminous or resinous binder during spraying and which are not friable after drying is exempted from the requirements of paragraphs (e) and (e)(2) of this section.

(f) Rather than meet the no-visible-emission requirements as specified by paragraphs (a), (c), (d), (e), (h), (j), and (k) of this section, an owner or operator may elect to use the methods specified by § 61.23 to clean emissions containing particulate asbestos material before such emissions escape to, or are vented to, the outside air.

(g) Where the presence of uncombined water is the sole reason for failure to meet the no-visible-emission requirement of paragraphs (a), (c), (d), (e), (h), (j), or (k) of this section, such failure shall not be a violation of such emission requirements.

(h) *Fabricating:* There shall be no visible emissions to the outside air, except as provided in paragraph (f) of this section, from any of the following operations if they use commercial asbestos or from any building or structure in which such operations are conducted.

(1) The fabrication of cement building products.

(2) The fabrication of friction products, except those operations that primarily install asbestos friction materials on motor vehicles.

(3) The fabrication of cement or silicate board for ventilation hoods; ovens; electrical panels; laboratory furniture; bulkheads, partitions and ceilings for marine construction; and flow control devices for the molten metal industry.

(i) *Insulating:* Molded insulating materials which are friable and wet-applied insulating materials which are friable after drying, installed after the effective date of these regulations, shall contain no commercial asbestos. The provisions of this paragraph do not apply to insulating materials which are spray applied; such materials are regulated under § 61.22(e).

(j) *Waste disposal for manufacturing, fabricating, demolition, renovation and spraying operations:* The owner or operator of any source covered under the provisions of paragraphs (c), (d), (e), or (h) of this section shall meet the following standards:

(1) There shall be no visible emissions to the outside air, except as provided in paragraph (j)(3) of this section, during the collection; processing, including incineration; packaging; transporting; or deposition of any asbestos-containing waste material which is generated by such source.

(2) All asbestos-containing waste material shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(3) Rather than meet the requirement of paragraph (j)(1) of this section, an owner or operator may elect to use either of the disposal methods specified under (j)(3)(i) and (ii) of this section, or an alternative disposal method which has received prior approval by the Administrator:

(i) Treatment of asbestos-containing waste material with water:

(A) Control device asbestos waste shall be thoroughly mixed with water into a slurry and other asbestos-containing waste material shall be adequately wetted. There shall be no visible emissions to the outside air from the collection, mixing and wetting operations, except as provided in paragraph (f) of this section.

(B) After wetting, all asbestos-containing waste material shall be sealed into leak-tight containers while wet, and such containers shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(C) The containers specified under paragraph (j)(3)(i)(B) of this section shall be labeled with a warning label that states:

CAUTION

Contains Asbestos
Avoid Opening or Breaking Container
Breathing Asbestos Is Hazardous
to Your Health

Alternatively, warning labels specified by Occupational Safety and Health Standards of the Department of Labor, Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.-93a(g)(2)(ii) may be used.

(ii) Processing of asbestos-containing waste material into non-friable forms:

(A) All asbestos-containing waste material shall be formed into non-friable pellets or other shapes and deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(B) There shall be no visible emissions to the outside air from the collection and processing of asbestos-containing waste material, except as specified in paragraph (f) of this section.

(4) For the purposes of this paragraph (j), the term all asbestos-containing waste material as applied to demolition and renovation operations covered by paragraph (d) of this section includes only friable asbestos waste and control device asbestos waste.

(k) *Waste disposal for asbestos mills:* The owner or operator of any source covered under the provisions of paragraph (a) of this section shall meet the following standard:

(1) There shall be no visible emissions to the outside air, except as provided in paragraph (k)(3) of this section, during the collection, processing, packaging, transporting or deposition of any asbestos-containing waste material which is generated by such source.

(2) All asbestos-containing waste material shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(3) Rather than meet the requirement of paragraph (k)(1) of this section, an owner or operator may elect to meet the following requirements in paragraphs (k)(3)(i) and (ii), or use an alternative disposal method which has received prior approval by the Administrator:

(i) There shall be no visible emissions to the outside air from the transfer of control device asbestos waste to the tailings conveyor, except as provided in paragraph (f) of this section. Such waste shall be subsequently processed either as specified in paragraph (k)(3)(ii) of this section or as specified in paragraph (j)(3) of this section.

(ii) All asbestos-containing waste material shall be adequately mixed, with a wetting agent recommended by the manufacturer of the agent to effectively wet dust and tailings, prior to deposition at a waste disposal site. Such agent shall

be used as recommended for the particular dust by the manufacturer of the agent. There shall be no discharge of visible emissions to the outside air from the wetting operation except as specified in paragraph (f) of this section. Wetting may be suspended when the ambient temperature at the waste disposal site is less than −9.5°C (ca. 15°F). The ambient air temperature shall be determined by an appropriate measurement method with an accuracy of ±1°C (±2°F) and recorded at least at hourly intervals during the period that the operation of the wetting system is suspended. Records of such temperature measurements shall be retained at the source for a minimum of two years and made available for inspection by the Administrator.

(l) The owner of any inactive waste disposal site, which was operated by sources covered under § 61.22 (a), (c) or (h) and where asbestos-containing waste material produced by such sources was deposited, shall meet the following standards:

(1) There shall be no visible emissions to the outside air from an inactive waste disposal site subject to this paragraph, except as provided in paragraph (l) (5) of this section.

(2) Warning signs shall be displayed at all entrances, and along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited, at intervals of 100 m (ca. 330 ft) or less, except as specified in paragraph (l) (4) of this section. Signs shall be posted in such a manner and location that a person may easily read the legend. The warning signs required by this paragraph shall conform to the requirements of 20" x 14" upright format signs specified in 29 CFR 1910.145(d) (4) and this paragraph. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

LEGEND

ASBESTOS WASTE DISPOSAL SITE

Do Not Create Dust

Breathing Asbestos is Hazardous to Your Health

Notation

1" Sans Serif, Gothic or Block

¾" Sans Serif, Gothic or Block

14 Point Gothic

Spacing between lines shall be at least equal to the height of the upper of the two lines.

(3) The perimeter of the site shall be fenced in a manner adequate to deter access by the general public, except as specified in paragraph (l) (4) of this section.

(4) Warning signs and fencing are not required where the requirements of paragraphs (l) (5) (i) or (ii) of this section are met, or where a natural barrier adequately deters access by the general public. Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access to the general public.

(5) Rather than meet the requirement of paragraph (l) (1) of this section, an owner may elect to meet the requirements of this paragraph or may use an alternative control method for emissions from inactive waste disposal sites which has received prior approval by the Administrator.

(i) The asbestos-containing waste material shall be covered with at least 15 centimeters (ca. 6 inches) of compacted non-asbestos-containing material, and a cover of vegetation shall be grown and maintained on the area adequate to prevent exposure of the asbestos-containing waste material; or

(ii) The asbestos-containing waste material shall be covered with at least 60 centimeters (ca. 2 feet) of compacted non-asbestos-containing material and maintained to prevent exposure of the asbestos-containing waste; or

(iii) For inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent which effectively binds dust and controls wind erosion shall be applied. Such agent shall be used as recommended for the particular asbestos tailings by the dust suppression agent manufacturer. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

[38 FR 8826, Apr. 6, 1973, as amended at 39 FR 15398, May 3, 1974; 40 FR 48299, Oct. 14, 1975]

§ 61.23 Air-cleaning.

If air-cleaning is elected, as permitted by §§ 61.22(f) and 61.22(d) (4) (iv), the requirements of this section must be met.

(a) Fabric filter collection devices must be used, except as noted in paragraphs (b) and (c) of this section. Such devices must be operated at a pressure drop of no more than 4 inches water gage, as measured across the filter fabric. The airflow permeability, as determined by ASTM method D737-69, must not exceed 30 $ft^3/min/ft^2$ for woven fabrics or 35 $ft^3/min/ft^2$ for felted fabrics, except that 40 $ft^3/min/ft^2$ for woven and 45 $ft^3/min/ft^2$ for felted fabrics is allowed for filtering air from asbestos ore dryers. Each square yard of felted fabric must weigh at least 14 ounces and be at least one-sixteenth inch thick throughout. Synthetic fabrics must not contain fill yarn other than that which is spun.

(b) If the use of fabric filters creates a fire or explosion hazard, the administrator may authorize the use of wet collectors designed to operate with a unit contacting energy of at least 40 inches water gage pressure.

(c) The administrator may authorize the use of filtering equipment other than that described in paragraphs (a) and (b) of this section if the owner or operator demonstrates to the satisfaction of the administrator that the filtering of particulate asbestos material is equivalent to that of the described equipment.

(d) All air-cleaning equipment authorized by this section must be properly installed, used, operated, and maintained. Bypass devices may be used only during upset or emergency conditions and then only for so long as it takes to shut down the operation generating the particulate asbestos material.

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48302, Oct. 14, 1975]

§ 61.24 Reporting.

The owner or operator of any existing source to which this subpart is applicable shall, within 90 days after the effective date, provide the following information to the administrator:

(a) A description of the emission control equipment used for each process;

(b) If a fabric filter device is used to control emissions, the pressure drop across the fabric filter in inches water gage.

(1) If the fabric filter device utilizes a woven fabric, the airflow permeability in $ft^3/min/ft^2$; and, if the fabric is synthetic, indicate whether the fill yarn is spun or not spun.

(2) If the fabric filter device utilizes a felted fabric, the density in oz/yd^2, the minimum thickness in inches, and the airflow permeability in $ft^3/min/ft^2$.

(c) For sources subject to §§ 61.22(j) and 61.22(k):

(1) A brief description of each process that generates asbestos-containing waste material.

(2) The average weight of asbestos-containing waste material disposed of, measured in kg/day.

(3) The emission control methods used in all stages of waste disposal.

(4) The type of disposal site or incineration site used for ultimate disposal, the name of the site operator, and the name and location of the disposal site.

(d) For sources subject to § 61.22(l):

(1) A brief description of the site.

(2) The method or methods used to comply with the standard, or alternative procedures to be used.

(e) Such information shall accompany the information required by § 61.10. The information described in this section shall be reported using the format of Appendix A of this part.

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48302, Oct. 14, 1975]

§ 61.25 Waste disposal sites.

In order to be an acceptable site for disposal of asbestos-containing waste material under § 61.22 (j) and (k), an active waste disposal site shall meet the requirements of this section.

(a) There shall be no visible emissions

to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited, except as provided in paragraph (e) of this section.

(b) Warning signs shall be displayed at all entrances, and along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material is deposited, at intervals of 100 m (ca. 330 ft) or less except as specified in paragraph (d) of this section. Signs shall be posted in such a manner and location that a person may easily read the legend. The warning signs required by this paragraph shall conform to the requirements of 20" x 14" upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

LEGEND

ASBESTOS WASTE DISPOSAL SITE

Do Not Create Dust

Breathing Asbestos
Is Hazardous to Your Health

Notation

1" Sans Serif, Gothic or Block

¾" Sans Serif, Gothic or Block

14 Point Gothic

Spacing between lines shall be at least equal to the height of the upper of the two lines.

(c) The perimeter of the disposal site shall be fenced in order to adequately deter access to the general public except as specified in paragraph (d) of this section.

(d) Warning signs and fencing are not required where the requirements of paragraph (e)(1) of this section are met, or where a natural barrier adequately deters access to the general public. Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access to the general public.

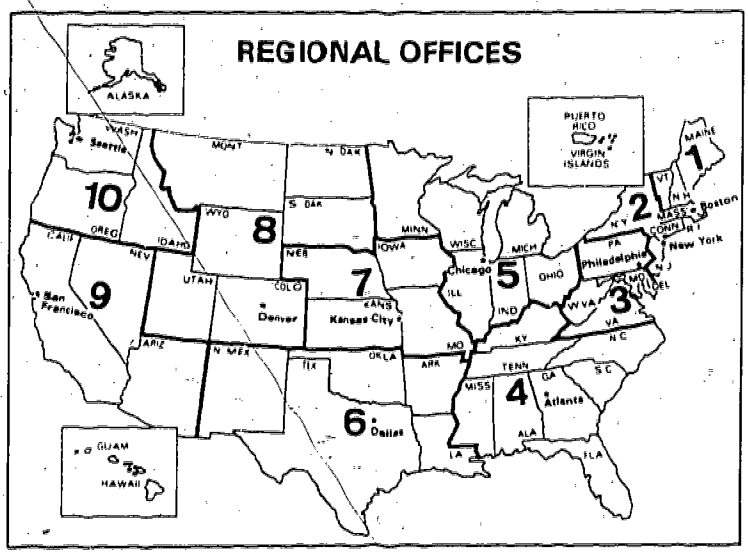
(e) Rather than meet the requirement of paragraph (a) of this section, an owner or operator may elect to meet the requirements of paragraph (e)(1) or (e)(2) of this section, or may use an alternative control method for emissions from active waste disposal sites which has received prior approval by the Administrator.

(1) At the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material which was deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (ca. 6 inches) of compacted non-asbestos-containing material.

(2) At the end of each operating day, or at least once every 24-hour period while the disposal site is in continuous operation, the asbestos-containing waste material which was deposited at the site during the operating day or previous 24-hour period shall be covered with a resinous or petroleum-based dust suppression agent which effectively binds dust and controls wind erosion. Such agent shall be used as recommended for the particular dust by the dust suppression agent manufacturer. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

[40 FR 48302, Oct. 14, 1975]

Appendix B: U.S. Environmental Protection Agency Regional National Emissions Standards for Hazardous Air Pollutants (NESHAPS) Coordinators



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Appendix C: U.S. Department of Labor-Occupational Safety and Health Administration (OSHA) Asbestos Regulations

(Code of Federal Regulations Title 29, Part 1910)

Section 1910.1001

(a) Definitions.

For the purpose of this section.

(1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.

(b) Permissible exposure to airborne concentrations of asbestos fibers.

(1) Standard effective July 7, 1972. The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(2) Standard effective July 1, 1976. The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed two fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(3) Ceiling concentration. No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(c) Methods of compliance.

(1) Engineering methods.

(i) Engineering controls. Engineering controls, such as, but not limited to, isolation, enclosure, exhaust ventilation, and dust collection, shall be used to meet the exposure limits prescribed in paragraph (b) of this section.

(ii) Local exhaust ventilation.

(a) Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2–1971, which is incorporated by reference herein.

(b) See § 1910.6 concerning the availability of ANSI Z9.2–1971, and the maintenance of a historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(iii) Particular tools. All hand-operated and power-operated tools which may produce or release asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems in accordance with subdivision (ii) of this subparagraph.

(2) Work practices.

(i) Wet methods. Insofar as practicable, asbestos shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers in excess of the exposure limits prescribed in paragraph (b) of this section, unless the usefulness of the product would be diminished thereby.

(ii) Particular products and operations. No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne asbestos fibers in excess of the limits prescribed in paragraph (b) of this section.

(iii) Spraying, demolition, or removal. Employees engaged in the spraying of asbestos, the removal, or demolition of pipes, structures, or equipment covered or insulated with asbestos, and in the removal or demolition of asbestos insulation or coverings shall be provided with respiratory equipment in accordance with paragraph (d)(2)(iii) of this section and with special clothing in accordance with paragraph (d)(3) of this section.

(d) Personal protective equipment.

(1) Compliance with the exposure limits prescribed by paragraph (b) of this section may not be achieved by the use of respirators or shift rotation of employees, except:

(i) During the time period necessary to install the engineering controls and to institute the work practices required by paragraph (c) of this section;

(ii) In work situations in which the methods prescribed in paragraph (c) of this section are either technically not feasible or feasible to an extent insufficient to reduce the airborne concentrations of asbestos fibers below the limits prescribed by paragraph (b) of this section; or

(iii) In emergencies.

(iv) Where both respirators and personnel rotation are allowed by subdivisions (i), (ii), or (iii) of this subparagraph, and both are practicable, personnel rotation shall be preferred and used.

(2) Where a respirator is permitted by subparagraph (1) of this paragraph, it shall be selected from among those approved by the Bureau of Mines, Department of the Interior, or the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare, under the provisions of 30 CFR Part 11 (37 F.R. 6244, Mar. 25, 1972), and shall be used in accordance with subdivisions (i), (ii), (iii), and (iv) of this subparagraph.

(i) Air purifying respirators. A reusable or single use air purifying respirator, or a respirator described in subdivision (ii) or (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed no more than 10 times those limits.

(ii) Powered air purifying respirators. A full facepiece powered air purifying respirator, or a powered air purifying respirator, or a respirator described in subdivision (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average concentrations of asbestos fibers are reasonably expected to exceed 10 times, but not 100 times, those limits.

(iii) Type "C" supplied-air respirators, continuous flow or pressure-demand class. A type "C" continuous flow or pressure-demand, supplied-air respirator shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed 100 times those limits.

(iv) Establishment of a respirator program.

(a) The employer shall establish a respirator program in accordance with the requirements of the American National Standard Practices for Respiratory Protection, ANSI Z88.2–1969, which is incorporated by reference herein.

(b) See § 1910.6 concerning the availability of ANSI Z88.2–1969 and the maintenance of an historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(c) No employee shall be assigned to tasks requiring the use of respirators if, based upon his most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or other employees will be impaired by his use of a respirator. Such employee shall be rotated to another job or given the opportunity to transfer to a different position whose duties he is able to perform with the

same employer, in the same geographical area and with the same seniority, status, and rate of pay he had just prior to such transfer, if such a different position is available.

(3) Special clothing: The employer shall provide, and require the use of, special clothing, such as coveralls or similar whole body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos fibers, which exceed the ceiling level prescribed in paragraph (b) of this section.

(4) Change rooms:

(i) At any fixed place of employment exposed to airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, the employer shall provide change rooms for employees working regularly at the place.

(ii) Clothes lockers: The employer shall provide two separate lockers or containers for each employee, so separated or isolated as to prevent contamination of the employee's street-clothes from his work clothes.

(iii) Laundering:

(a) Laundering of asbestos contaminated clothing shall be done so as to prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

(b) Any employer who gives asbestos-contaminated clothing to another person for laundering shall inform such person of the requirement in (a) of this subdivision to effectively prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

(c) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled in accordance with paragraph (g) of this section.

(e) Method of measurement.

All determinations of airborne concentrations of asbestos fibers shall be made by the membrane filter method at 400–450 × (magnification) (4 millimeter objective) with phase contrast illumination.

(f) Monitoring.

(1) **Initial determinations.** Within 6 months of the publication of this section, every employer shall cause every place of employment where asbestos fibers are released to be monitored in such a way as to determine whether every employee's exposure to asbestos fibers is below the limits prescribed in paragraph (b) of this section. If the limits are exceeded, the employer shall immediately undertake a compliance program in accordance with paragraph (c) of this section.

(2) **Personal monitoring.**

(i) Samples shall be collected from within the breathing zone of the employees, on membrane filters of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) **Sampling frequency and patterns.** After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of employees. In no case shall the sampling be done at intervals greater then 6 months for employees whose exposure to asbestos may reasonably be foreseen to exceed the limits prescribed by paragraph (b) of this section.

(3) **Environmental monitoring.**

(i) Samples shall be collected from areas of a work environment which are representative of the airborne concentrations of asbestos fibers which may reach the breathing zone of employees. Samples shall be collected on a membrane filter of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) **Sampling frequency and patterns.** After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than 6 months for employees

whose exposures to asbestos may reasonably be foreseen to exceed the exposure limits prescribed in paragraph (b) of this section.

(4) Employee observation of monitoring. Affected employees, or their representatives, shall be given a reasonable opportunity to observe any monitoring required by this paragraph and shall have access to the records thereof.

(g) Caution signs and labels.

(1) Caution signs.

(i) Posting. Caution signs shall be provided and displayed at each location where airborne concentrations of asbestos fibers may be in excess of the exposure limits prescribed in paragraph (b) of this section. Signs shall be posted at such a distance from such a location so that an employee may read the signs and take necessary protective steps before entering the area marked by the signs. Signs shall be posted at all approaches to areas containing excessive concentrations of airborne asbestos fibers.

(ii) Sign specifications. The warning signs required by subdivision (i) of this subparagraph shall conform to the requirements of 20" x 14" vertical format signs specified in § 1910.145(d)(4), and to this subdivision. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to that specified in this subdivision.

Legend	*Notation*
Asbestos	1" Sans Serif, Gothic or Block.
Dust Hazard	¾" Sans Serif, Gothic or Block.
Avoid Breathing Dust	¼" Gothic.
Wear Assigned Protective Equipment.	¼" Gothic.
Do Not Remain In Area Unless Your Work Requires It.	¼" Gothic.
Breathing Asbestos Dust May Be Hazardous To Your Health.	14 point Gothic.

Spacing between lines shall be at least equal to the height of the upper of any two lines.

(2) Caution labels.

(i) Labeling. Caution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section will be released.

(ii) Label specifications. The caution labels required by subdivision (i) of this subparagraph shall be printed in letters of sufficient size and contrast as to be readily visible and legible. The label shall state:

CAUTION

Contains Asbestos Fibers
Avoid Creating Dust
Breathing Asbestos Dust May Cause
Serious Bodily Harm

(h) Housekeeping.

(1) Cleaning. All external surfaces in any place of employment shall be maintained free of accumulations of asbestos fibers if, with their dispersion, there would be an excessive concentration.

(2) Waste disposal. Asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing, consigned for disposal, which may produce in any reasonably foreseeable use, handling, storage, processing, disposal, or transportation airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(i) Recordkeeping.

(1) Exposure records. Every employer shall maintain records of any personal or environmental monitoring required by this section. Records shall be maintained for a period of at least 20 years and shall be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health, and to authorized representatives of either.

[41 F.R. 11504, March 19, 1976.]

(2) **Employee access.** Every employee and former employee shall have reasonable access to any record required to be maintained by subparagraph (1) of this paragraph which indicates the employee's own exposure to asbestos fibers.

(3) **Employee notification.** Any employee found to have been exposed at any time to airborne concentrations of asbestos fibers in excess of the limits prescribed in paragraph (b) of this section shall be notified in writing of the exposure as soon as practicable but not later than 5 days of the finding. The employee shall also be timely notified of the corrective action being taken.

(j) Medical examinations.

(1) **General.** The employer shall provide or make available at his cost, medical examinations relative to exposure to asbestos required by this paragraph.

(2) **Preplacement.** The employer shall provide or make available to each of his employees, within 30 calendar days following his first employment in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination, which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

(3) **Annual examinations.** On or before January 31, 1973, and at least annually thereafter, every employer shall provide, or make available, comprehensive medical examinations to each of his employees engaged in occupations exposed to airborne concentrations of asbestos fibers. Such annual examination shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

(4) **Termination of employment.** The employer shall provide, or make available, within 30 calendar days before or after the termination of employment of any employee engaged in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

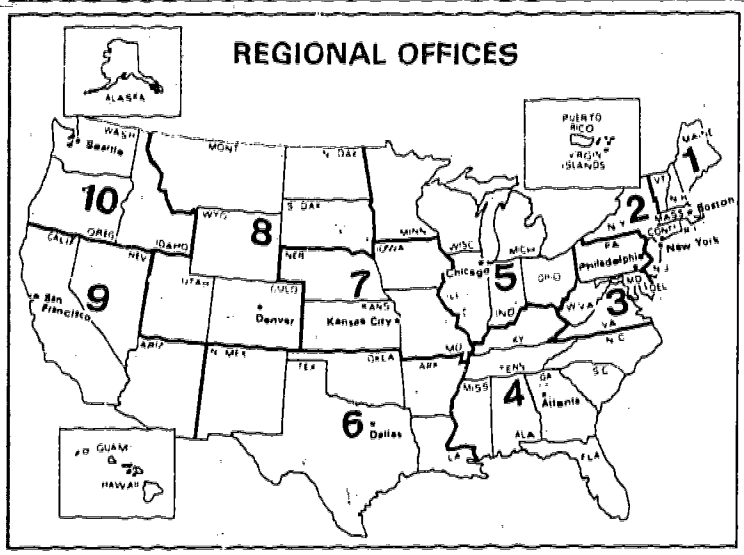
(5) **Recent examinations.** No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with this paragraph within the past 1-year period.

(6) **Medical records.**

(i) **Maintenance.** Employers of employees examined pursuant to this paragraph shall cause to be maintained complete and accurate records of all such medical examinations. Records shall be retained by employers for at least 20 years.

(ii) **Access.** The contents of the records of the medical examinations required by this paragraph shall be made available, for inspection and copying, to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of NIOSH, to authorized physicians and medical consultants of either of them, and, upon the request of an employee or former employee, to his physician. Any physician who conducts a medical examination required by this paragraph shall furnish to the employer of the examined employee all the information specifically required by this paragraph, and any other medical information related to occupational exposure to asbestos fibers.

Appendix D: State Occupational Safety and Health Program Offices and U.S. Department of Labor-Occupational Safety and Health Administration (OSHA) Field Locations



REGION 1

USDOL-OSHA
BOSTON REGIONAL OFFICE

U.S. Department of Labor—OSHA
JFK Federal Building
Room 1804—Government Center
Boston, Massachusetts 02203
(617) 223-6712/3

State Program Offices

Connecticut

Peter A. Riley, Commissioner
Connecticut Department of Labor
200 Folly Brook Boulevard
Wethersfield, Connecticut 06109
(203) 566-5123

Vermont

Joel Cherington, Commissioner
Department of Labor and Industry
Montpelier, Vermont 05602
(802) 832-2286

USDOL-OSHA Area Offices

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Francis R. Amirault, Area Director
USDOL—OSHA—FB/Rm. 334
55 Pleasant Street
Concord, New Hampshire 03301
(603) 224-1995

Harold R. Smith, Area Director
USDOL—OSHA—MDC Bldg.—2nd Floor
555 Main Street
Hartford, Connecticut 06103
(203) 244-2294

Linda Anku, Area Director
USDOL—OSHA/Rm.204
Federal Building and U.S. Post Office
Providence, Rhode Island 02903
(401) 528-4466

Rudolph Bayerle Jr., Area Director
U.S. Department of Labor—OSHA
1200 Main Street—Suite 513
Springfield, Massachusetts 01103
(413) 781-2420 Ext. 522

REGION 2

USDOL-OSHA
NEW YORK REGIONAL OFFICE

Alfred Barden, Regional Administrator
U.S. Department of Labor—OSHA
1515 Broadway (1 Astor Plaza)—Room 3445
New York, New York 10036
(212) 399-5754

State Program Offices

Puerto Rico

Carlos S. Quiros, Secretary of Labor
Commonwealth of Puerto Rico
414 Barbosa Avenue
San Juan, Puerto Rico 00917
(809) 765-3030

Virgin Islands

Richard Upson, Commissioner of Labor
Government of Virgin Islands
Christiansted/Box 890
St. Croix, Virgin Islands 00820

USDOL-OSHA Area Offices

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U.S. Department of Labor—OSHA
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U.S. Department of Labor—OSHA
185 Montague Street—2nd Floor
Brooklyn, New York 11201
(212) 330-7667

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U.S. Department of Labor—OSHA
200 Mamaroneck Avenue—Room 302
White Plains, New York 10601
(914) 946-2510

James Epps, Area Director
U.S. Department of Labor—OSHA
990 Westbury Rd.
Westbury, New York 11590
(516) 334-3344

Howard Edelson, Area Director
U.S. Department of Labor—OSHA
136-21 Roosevelt Avenue—3rd Floor
Flushing, New York 11354
(212) 445-5005

Charles Meister, Area Director
U.S. Department of Labor—OSHA
970 Broad Street—Room 1435C
Newark, New Jersey 07102
(201) 645-5930

James Conlon, Area Director
U.S. Department of Labor—OSHA
Building T3/Belle Mead GSA Depot
Belle Mead, New Jersey 08502
(201) 359-2777

Harry Allendorf, Area Director
U.S. Department of Labor—OSHA
2101 Ferry Avenue—Room 403
Camden, New Jersey 08104
(609) 757-5181

Richard Palmieri, Area Director
U.S. Department of Labor—OSHA
2E Blackwell Street
Dover, New Jersey 07801
(201) 361-4050

Robert Hallock, Area Director
U.S. Department of Labor—OSHA
377 Route 17, Room 206
Hasbrouck Heights, New Jersey 07604
(201) 288-1700

Francisco Encarnacion-Rosa, Area Director
U.S. Department of Labor—OSHA
Carlos Chardon—Room 555
Hato Rey, Puerto Rico 00918
(809) 753-4457/4072

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U.S. Department of Labor—OSHA
100 So. Clinton St.—Room 1267
Syracuse, New York 13202
(315) 423-5188

P. Charles Schwender, Area Director
U.S. Department of Labor—OSHA
Clinton Avenue & North Pearl Street—Room 132
Albany, New York 12207
(518) 472-6085

David Bernard, Area Director
U.S. Department of Labor—OSHA
111 W. Huron Street—Room 1002
Buffalo, New York 14202
(716) 846-4881

Joseph Rufolo, Area Director
U.S. Department of Labor—OSHA
Federal Office Bldg., Room 600
Rochester, New York 14614
(716) 263-6755

REGION 3

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PHILADELPHIA REGIONAL OFFICE

David H. Rhone, Regional Administrator
U.S. Department of Labor—OSHA/Suite 2100
3535 Market Street
Philadelphia, Pennsylvania 19104
(215) 596-1201

State Program Offices

Maryland

Harvey A. Epstein, Commissioner
Department of Licensing and Regulation
203 E. Baltimore Street
Baltimore, Maryland 21202
(301) 383-2251

Virginia

Robert F. Beard, Jr., Commissioner
Department of Labor and Industry
P.O. Box 12064
Richmond, Virginia 23241
(804) 786-2376

Dr. James B. Kenley, Commissioner, State Dept. of Health
ATTN: Dr. Robert Jackson, Deputy Commissioner
James Madison Building/109 Governor Street
Richmond, Virginia 23219
(804) 936-4265

Area Offices, District Offices & Field Stations

Walter E. Wilson, Area Director
U.S. Department of Labor—OSHA
600 Arch Street—Room 4256
Philadelphia, Pennsylvania 19106
(215) 597-4955

Charles A. Straw, Area Director
U.S. Department of Labor—OSHA
400 Penn Center Blvd.—Suite 600
Pittsburgh, Pennsylvania 15235
(412) 644-2905

Maurice Daly, Area Director
U.S. Department of Labor—OSHA
147 W. 18th Street
Erie, Pennsylvania 16501
(814) 453-4351

James W. Stanley, Area Director
U.S. Department of Labor—OSHA
49 N. Progress Avenue/Progress Plaza
Harrisburg, Pennsylvania 17109
(717) 782-3902

Harry Cavuto, Safety Specialist
U.S. Department of Labor—OSHA
802 New Holland Avenue
Lancaster, Pennsylvania 17604
(717) 394-7722

U.S. Department of Labor
OSHA
Armenara Office Center/Suite 470
State College, Pennsylvania 16801
(814) 234-6695

Leo Carey, Area Director
U.S. Department of Labor—OSHA,
20 N. Pennsylvania Ave./Room 3107
Wilkes-Barre, Pennsylvania 18701
(717) 826-6538

Lee O'Brian, Safety Specialist
U.S. Department of Labor—OSHA
940 Hamilton Mall
Allentown, Pennsylvania 18101
(215) 434-0181, Ext. 266

Byron R. Chadwick, Area Director
U.S. Department of Labor—OSHA
31 Hopkins Plaza, Rm. 1110
Baltimore, Maryland 21201
(301) 962-2840

Alonzo L. Griffin, Safety Engineer
U.S. Department of Labor—OSHA
844 King Street, Room 3007
Wilmington, Delaware 19801
(303) 573-6115

Stanley Elliot, Area Director
U.S. Department of Labor—OSHA
700 Virginia Street, Room 1726
Charleston, West Virginia 25301
(304) 343-6181, Ext. 420/429

James Troy, Safety Specialist
U.S. Department of Labor—OSHA
Chapline & 12th Streets/Room 411
Wheeling, West Virginia 26003
(304) 232-8044

U.S. Department of Labor—OSHA
Federal Bldg. & U.S.P.O.—Rm 317
P.O. Box 1427
Elkins, West Virginia 26241
(304) 636-6224

Warren Wright, Area Director
U.S. Department of Labor—OSHA
Federal Building (P.O. Box 10186)
Room 6226
Richmond, Virginia 23240
(804) 782-2864/5

Farris S. Anderson, Safety Specialist
U.S. Department of Labor—OSHA
3661 Virginia Beach Blvd./Room 111
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(804) 441-8381

U.S. Department of Labor—OSHA
Falls Church Office Building, Room 107
900 S. Washington Street
Falls Church, Virginia 22046
(703) 557-1330

U.S. Department of Labor
OSHA
210 Franklin Road, S.W./Box 2828
Roanoke, Virginia 24011
(703) 982-6342

Gilbert L. Esparza, Area Director
U.S. Department of Labor—OSHA
400 First Street, N.W./Room 602
Washington, D.C. 20215
(202) 523-5224/5

REGION 4

USDOL-OSHA
ATLANTA REGIONAL OFFICE

Robert A. Wendell, Regional Administrator
U.S. Department of Labor—OSHA
1375 Peachtree Street, N.E.—Suite 587
Atlanta, Georgia 30309
(404) 881-3573

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James R. Yocum, Commissioner
Kentucky Department of Labor
Capitol Plaza Towers—12th Floor
Frankfort, KY 40601
(502) 564-3070

North Carolina

John C. Brooks, Commissioner
North Carolina Department of Labor
11 West Edenton Street/Box 27407
Raleigh, NC 27611
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Tennessee

James G. Neeley, Commissioner
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505 Union Bldg./Suite A/2nd Floor
Nashville, Tennessee
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South Carolina

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South Carolina Department of Labor
Box 11329/3600 Forest Drive
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Orlando, Florida 32801

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Maurice S. Reizen, M.D., Director
Michigan Department of Public Health
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Lansing, Michigan 48914
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Dept. of Labor & Industry
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North Aurora, Illinois 60542
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REGION 6

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Tyler, Texas 75701
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500 Fannin Street
Shreveport, Louisiana 71101
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Houston, Texas 77004
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2900 North Street/Suite 300
Beaumont, Texas 77702
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Cheyenne, Wyoming 82002
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Salt Lake City, Utah 84111
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Russel Bldg./Highway 83 N. Rte 1
Bismarck, North Dakota 58501
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Sioux Falls, South Dakota 57102
(605) 336-2980 Ext. 425

REGION 9

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SAN FRANCISCO REGIONAL OFFICE

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Nevada

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(209) 487-5454

John Williams, Safety Specialist
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SEATTLE REGIONAL OFFICE

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Juneau, Alaska 99801
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Salem, Oregon 97310
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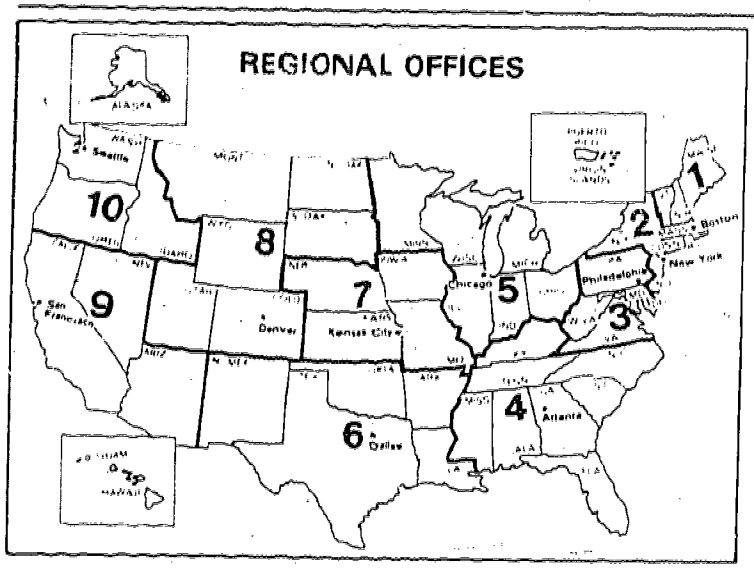
Appendix E: U.S. Department of Health, Education, and Welfare-National Institute for Occupational Safety and Health (NIOSH) Regional Offices



Region 1
Wes Straub
Regional Consultant, NIOSH
DHEW, Region I
Gov't Center (JFK Fed. Bldg.)
Boston, Massachusetts 02203
(617) 223-6668

Region 2
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Regional Consultant, NIOSH
DHEW, Region II—Fed. Bldg.
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New York, New York 10007
(212) 264–2485

Region 3
William E. Shoemaker
Regional Consultant, NIOSH
DHEW, Region III
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Philadelphia, Pennsylvania 19101
(215) 596-6716

Region 4
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Regional Consultant, NIOSH
DHEW, Region IV, Div. of
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Region 6
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Region 7
Ralph Bicknell
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Kansas City, Missouri 64106
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Region 8
Stanley J. Reno
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DHEW/PHS/PREVENTION—Region VIII
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Region 9
Mel Okawa
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DHEW, Region IX
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San Francisco, California 94102
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Region 10
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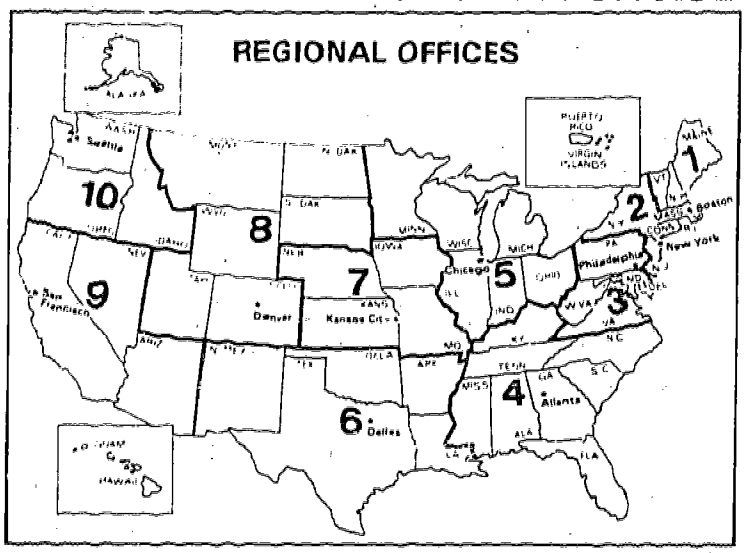
Appendix F: U.S. Department of Health, Education, and Welfare Regional Health Administrators



Region 1
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(Acting)
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Region 3
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DHEW, Region III
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Region 4
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Region 6
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Appendix G: Toll-Free Information Numbers

ENVIRONMENTAL PROTECTION AGENCY

The following numbers are to be used for general information on the EPA school asbestos program and to request additional reporting forms or copies of the guidance manuals:

800—424–9065
(554–1404 in Washington, D.C.)

The following number is to be used for technical assistance in sampling and analysis of asbestos materials:

800—334–8571, extension 6892

CONSUMER PRODUCT SAFETY COMMISSION

The following numbers are to be used for information about asbestos in consumer products:

800—638–8326
800—492–8363 (Maryland)
800—638–8333 (Alaska, Hawaii, Puerto Rico, Virgin Islands)

Appendix H: "Mineral Characterization of Asbestos-Containing Spray Finishes"

by Arthur N. Rohl[1], Arthur M. Langer,[1] and Ann G. Wylie[2]

Composition of Insulation Materials

Asbestos minerals are a common constituent of sprayed-on materials including 1) fire proofing, thermal and acoustical insulation and 2) decorative and textured-spray finishes. In the first category, the asbestos mineral most commonly used is chrysotile and less frequently amosite and crocidolite. The three asbestos minerals may be found singly, or mixed in varying proportions. The formulations used by spray-insulation contractors in the United States have varied considerably depending on cost, availability, purpose and other factors.

Many insulation materials consist of a mixture of asbestos and rock wool fibers, the latter usually being the major constituent. In other formulations non-fibrous binders such as plaster of Paris, vermiculite, perlite and clay are used. Wood pulp and paper fibers are also commonly found.

Decorative and Textured-Spray Finishes or Paints

Decorative and textured-spray finishes or paints are frequently sprayed on walls and ceilings of multiple dwellings, hotels, motels and public buildings. They are commonly white, brown, gray, or blueish, generally stuccoed in appearance with a "textured" surface. It may appear to be fine-grained and compacted, in contrast to untamped thermal and fireproofing insulation. Textured-spray finish may be comprised of mixtures of crystalline filler materials, which may include the following:

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Carbonate minerals, usually *calcite* and/or dolomite;

Talc, often containing various concentrations of tremolite, *anthophyllite* and *serpentine minerals*. This latter mineral group may include *chrysotile* asbestos;

Fine-grained *chrysotile* asbestos ("floats" or "fines"), may also be added to their formulations. Gray or brownish colored finishes may contain amosite and blueish finishes may contain *crocidolite*. Both amphibole asbestos varieties may be found together as well. The total asbestos mineral content may be as high as 50 percent by weight, in these materials;

Mineral-, *rock-*, *slag-wool* or *fibrous glass;*

Various *clay minerals* and *micas*, such as *kaolin*, *vermiculite*, *chlorite*, etc.;

Plaster of Paris, *gypsum*, *quartz*, organic binders and thickeners are added to the above inorganic materials to form a substance which can be trowelled or sprayed on.

The mineralogical characterization of these asbestos-containing spray finishes involves analysis of assemblages which are mixtures of various materials which never occur together naturally. Analysis of these complex mixtures is, therefore, hindered in that the "process of elimination" used to define "difficult minerals" in natural assemblages, is lost to the analyst.

Methods and Problems of Analysis

The inorganic constitutents of asbestos-containing insulation *generally* are of such large particle size, are present in sufficient quantities, possess such unique optical properties, that the use of the petrographic light microscope as an analytical tool is acceptable and justified. Yet, one should say at the outset that the identification of the fibrous minerals in these materials may be difficult because of a number of confounding factors. Small particle sizes, changes in retardation effects (interference colors) in small-sized particles, difficulties in obtaining clear Becke lines (especially for thin fibers), and complexity and range in chemical compositions, often mitigate against the use of the

polarizing microscope. Even in these cases, particles such as carbonates, fibrous glass, perlite, vermiculite, etc., may be quite readily identified on the basis of optical characteristics. Identification of the asbestos minerals may be difficult largely due to the effect of fiber size, or, more specifically fiber diameter. Fibers with diameters of $<0.5\mu m$ will almost certainly limit the usefulness of this technique as a definite identification method. Yet, some optical properties which can be determined on larger fibers, may be used to distinguish between these materials. These are as follows:

I. To properly characterize spray materials by polarized light microscopy, the following instrumentation and accessories are required:

1. A polarizing microscope with a rotating stage and 360° marked scale;

2. The microscope should be equipped for visualization of objects at magnification in the following range: 35X, 100X, 250X, 440X.

3. Standard equipment should include a substage polarizer, and analyzer, and the following accessories: mica plate, gypsum plate, quartz wedge. (One of us [AGW] suggests that the quartz wedge is not really necessary in the study of amphiboles or serpentine minerals. Their intrinsic birefringence is not high enough to require the accurate determination of the order of interference color present. Again, the most important controlling factor in retardation is size of the particle.);

4. A set of immersion oils, with indices of refraction in increments of 0.002, from 1.400 to 1.800;

5. A refractometer, suitable for accurate measurement of indices of refraction, in the range as stipulated above. It is suggested that a spindle stage may be extremely useful in studying fibers which are large enough to isolate approximately $0.5\mu m$ in diameter. The technique has recently been described in detail by Bloss (American Mineralogist, 1978, Vol. 63, page 433).

II. Materials for Which Optical Characteristics Should be Known:

Optical characteristics should be known for the different asbestos varieties (chrysotile, amosite, crocidolite), for acicular cleavage fragments of anthophyllite and tremolite, and for the range of man-made insulating fibers (fibrous glass, rock-wool, mineral-wool, slag-wool). We are stressing the importance of determining the inorganic mineral phases for which biological potential has been established. In addition, the complete analysis of these asbestos-containing materials would require knowledge concerning the optical characteristics of the more common mineral components, clay, talc, mica, kaolin, vermiculite, chlorite, gypsum, bassanite (plaster of Paris), quartz, etc.

III. The Optical Characteristics to be Determined, and Measured with Accuracy, Should Include the Following:

1. FIBROUS GLASS AND ROCK–WOOL

Form:

Normally forms straight rods, with parallel sides. Ends of fibers may be fractured or tapered, especially if fibers are derived from one of the "wool" varieties. Wools of all varieties may form bulbous ends, blebs, and "shot". A range of shapes may exist for glassy components of the wool varieties (see discussion and figures in McCrone's Particle Atlas). Dimensions of length and diameter may range considerably; diameters normally 8–13μm, "shot" up to $100\mu m$. Several varieties of fibrous glass may have diameters down to $< 1\mu m$. Diameters and length may be highly variable, even for a fiber population from the same sample.

Color:

These amorphous fibers may be transparent, so that fibers which lie beneath them are clearly visible. Occasionally they may be "tinted", commonly brownish (common in rock, slag, and mineral wools). Colors may be visible, including yellow, pink, and reddish, reflecting binders and/or resins (commonly observed on fibrous glasses).

Birefringence:

These synthetic insulating fibers possess no birefringent characteristics between crossed nicols. Fibers remain dark in all orientations between crossed polarizer and analyzer, indicating their amorphous character (optical isotropy). Occasionally, a birefringence effect may be observed on the edges of the glass fibers, attesting to "strain birefringence", which may occur when the fiber has been bombarded by particulate debris in the air stream (as in glass fibers in filters).

Extinction:

No extinction characteristics are observable because of the isotropic character of the materials.

Indices of Refraction:

There is only one index of refraction, which is the same for all directions in relation to fiber morphology. Refractive index may range from 1.53 to 1.62, as related to the chemistry of the fiber. Most glass fibers have an index of refraction <1.53, with most slag, mineral, and rock wool >1.53.

General Remarks:

The fiber form, transparency and lack of birefringence, are the most characteristic features which distinguish these man-made inorganic fibers from the asbestos mineral fibers. No internal structure is visible, as contrasted with the asbestos fibers which clearly show the presence of internal fibrils or fiber sub-units.

2. CHRYSOTILE

Form:

Fibers occur as bundles of fibril units. The length: width ratio usually exceeds 10:1, although short bundles may be observed. Fibers may consist of "silky", undulating fibrils which splay at the ends like an "unraveled" rope. Kink bands may be present along the fibers which are easily visualized between crossed nicols. Care should be exercised in labeling blocky serpentine fragments as chrysotile. Antigorite fragments, one of the major constitutents of serpentine, may appear to be composed of fibers due to the peculiar extinction and growth characteristics it displays (herring bone growth). Normally, in spray finishes, only chrysotile fiber is used in a relatively pure form. Therefore we caution against the use of these characteristics for the examination of materials which may come directly from natural sources, e.g., from rock quarry specimens.

Color:

Chrysotile fibers are normally colorless, but may appear brownish in specimens derived from sources in which the fiber was heated (e.g., steam pipes). Although chrysotile displays no pleochroism, slight changes in relief on rotation, especially in heated samples may reflect itself as a "pseudopleochroic" change. This characteristic is true for all of the birefringent asbestos fibers, that is, for amosite, crocidolite, tremolite, and anthophyllite. Occasionally, fibers may be somewhat coated with organic resins, or a cementitious agent, which may alter its characteristic color. Large fiber bundles may contain intergrowths or coatings of opaque iron oxide (magnetite).

Birefringence:

Chrysotile is birefringent, with thicker fibers showing straw-yellow first-order colors. Although birefringence is a crystal-chemical controlled constant, the displayed colors are thickness dependent and are, therefore, variable. One should, therefore, consult a standard retardation color chart, so that one may derive an estimate of mineral thickness based on observed retardation color. Therefore, the observed retardation color is highly variable and related to fiber diameter. For example, first-order yellow-orange colors may be seen on large fibers, as well as purple-blue colors. However, very small fibers may show very slight retardation, displaying a white-gray first-order effect. To properly see these fibers between crossed nicols, conoscopic light should be employed.

Extinction:

Extinction is normally parallel to the fiber length. However, an "undulatory" extinction may occur, especially if the fiber is curved and/or kinked. Use of an accessory plate, when the fiber is turned 45° from its extinction position, indicates the optical sign of elongation is positive (length slow).

Indices of Refraction:

Most of the chrysotile used in fireproofing, thermal or ornamental sprays is from Canada. The index of refraction of light vibrating parallel to the fiber length (Nz) is approximately 1.556, with indices increasing proportionately with iron and nickel content of the mineral. Some indices have been measured as high as 1.560, but these values are rare for chrysotile. The birefringence (defined by Nz-Nx) averages about 0.008 for Canadian fibers. Therefore, on thick fibers, the use of calibrated immersion oils will clearly show differences in the two vibration directions.

General Remarks:

Chrysotile is by far the asbestos mineral most often found in insulation materials. The fibers that are most frequently confused with chrysotile are paper or cotton fibers (cellulose). Fire retardant (borax) treated cellulose is commonly used as fireproofing insulation. In addition, since paper and cotton fibers are commonly found in dust, casual observation may cause difficulty in distinguishing between these fibers and chrysotile. However, internal structure, extinction characteristics, and indices of refraction, when carefully measured, will clearly distinguish between cellulose and chrysotile. In addition, since cellulose is combustible, this can be used to distinguish between the two.

3. AMOSITE (ASBESTIFORM GRUNERITE)

Form:

Amosite fibers, unlike single crystals of grunerite, are composed of microscopic crystals, with the long fiber axis in common alignment. These parallel crystals have often been referred to as "fibrils" or "units" which implies that they represent the smallest particles of amosite. This is clearly fallacious since both amosite and crocidolite form particles with fiber dimensions only 600 angstroms in diameter. By light microscopy one may clearly observe the "polyfilamentous" character of the amphibole asbestos varieties, but the investigator should be cautious in referring to these features as "fibrils". Normally the fibers are straight

and "splintery" with fewer curves and "kinks" than observed for chrysotile. The length:width ratio tends to be greater than chrysotile, with ratios of 10:1 or greater. When fiber ratios increase up to 50:1 or greater, curvature may be pronounced.

Color:

Amosite fibers tend to be brownish in most sections, and may even show suggestions of pleochroism in thicker fibers. Again, as with chrysotile, some suggested change in "color" may be brought about by changes in relief on rotation of the fiber. Opaque inclusions are common, and principally consist of iron oxides commonly associated with the fiber in the banded ironstone ores.

Birefringence:

Amosite is birefringent, with high second-order colors commonly observed. Again, this is primarily due to the thick fibers one commonly encounters in spray materials. Fibers with dimensions approaching the 30μm standard thickness show the more "normal" retardation effects cited in the literature. Occasionally, on very thick fibers, the brown color may mask the interference colors.

Indices of Refraction:

The index of refraction measured parallel to the fiber axis normally ranges from 1.696 to 1.710 (Nz). The index of refraction measured across the fiber diameter varies from the indices anticipated for a single grunerite crystal. X-ray diffraction evidence supports the contention that the crystal units parallel to the fiber axis are disoriented in the *ab* plane. Amosite fibers will therefore not show indices characteristic of the grunerite mineral. One of us [AGW] suggests that the two measured indices (parallel and perpendicular to the fiber axis) be designated Nx_1, Nz_1. This would more correctly indicate that the disorientation of the small crystals, which constitute the fiber bundle, may form a "pseudo-indicatrix". Therefore, the indices measured will be different from those of a "normal" grunerite. The values observed across the fiber axis will tend to range around 1.670 to 1.680. It is important to note that amosite is often contaminated with other amphiboles. Amosite from the Transvaal, South Africa, tends to be contaminated with crocidolite. More commonly, however, actinolite or anthophyllite fibers may be observed. This has been the case in characterizing some standards used in a number of laboratories for biological purpose (seen by AGW and AML).

General Remarks:

Amosite is considered to be the asbestiform variety of grunerite. Optical properties, based on analogues with grunerite indicates that amosite consists of intergrowths of disoriented crystallites with only the c-axis in common alignment. Therefore, the extinction characteristics, range of refractive indices, and sorption characteristics, recorded for grunerite, are not identical for amosite.[1] Normally, the high range of indices of refraction, and the brown coloration, and the presence of sub-unit crystals, indicate a positive identification for amosite.

4. CROCIDOLITE

Form:

Both crocidolite and amosite fibers tend to be more straight and "splintery" than chrysotile asbestos. Fiber composites, making up the fiber bundle, are clearly visible and fibers with great length: width ratio tend to curvilinear.

Color:

Thick fibers tend to be blueish or purple-blue in color. Rotation of the stage shows these colors change in intensity and hue. Standard color absorption characteristics are available in optical mineralogy text books, e.g., Kerr's Optical Mineralogy.[2]

Birefringence:

Although crocidolite is birefringent, the color of the mineral is so intense that the interference color is often obscured. The differences in the velocities of the slowest and fastest rays are such that the birefringence is extraordinarily small so that the color masks most interference color effects.

Extinction:

Extinction is parallel to the fiber length, indicating the average effect of the aggregates of crystal composites. Measurement of sign of elongation indicates that it is *negative*, with the fast ray (indicating the smallest index of refraction) parallel to the fiber length.

Indices of Refraction:

Measurement of the indices of refraction of the crocidolite shows that most fibers have maximum values slightly less than those measured for amosite. The maximum value, measured across the fiber diameter, is close to 1.700.

General Remarks:

The blue color of crocidolite, the highest index of refraction, close to 1.700 and its polyfilamentous character, are diagnostic for this mineral fiber.

Crocidolite is less commonly found in sprayed-on materials than chrysotile and amosite. However, the presence of amosite, should lead the analyst to look further for crocidolite, as they may occur together.

General Characteristics of Other Amphiboles

Although anthophyllite and tremolite are not incorporated in these mixtures as commercial asbestos minerals, they may occur as contaminants in talc. One of the most common constituents of textured-spray finishes is finely pulverized talc. Whereas amosite and crocidolite asbestos possess the optical characteristics of composite fibers, anthophyllite and tremolite appear, on the most part, as single crystals, forming acicular cleavage fragments when comminuted. Acicular cleavage fragments generally possess optical continuity, and do not possess splayed ends or internal sub-unit fibrils. These materials are rectilinear, will tend to show uniform extinction and possess optical properties consistent with single crystals (correct extinction angles will be present, especially true for tremolite acicular cleavage fragments). Single acicular cleavage fragments, will show "normal" amphibole cleavage parallel to (110) or (210). Aspect ratios of such cleavage fragments are generally less than 10:1. Tremolite tends to display characteristics of single crystals (acicular cleavage fragments), whereas anthophyllite appears more often to be composed of composite fibers. This characteristic of anthophyllite may be related to both its intergrowth with talc and its intrinsic asbestiform morphology. The differences in asbestiform characteristics are more evident when examining such minerals by transmission electron microscopy than by optical microscopy.

5. ANTHOPHYLLITE AND TREMOLITE

Form and Color:

Anthophyllite fibers are usually colorless but sometimes light brown. Some appear to be single crystals whereas others, generally large fibers, appear to be fiber composites or bundles. Tremolite is usually colorless or very pale green in color.

Birefringence:

Anthophyllite and tremolite are birefringent with larger fibers displaying moderate (second-order) interference colors. Again, the retardation is enhanced because fiber diameters are commonly in excess of the 30μm reference thickness. Most anthophyllite fibers found as contaminants in "fibrous tales" tend to be long and thin and of such a diameter as to preclude the acquisition of good birefringence characteristics. Tremolite more commonly occurs as short, wide particles, with prismatic terminations.

Extinction:

The extinction for anthophyllite is parallel to the fiber length with a positive elongation (length slow). Tremolite possesses angular extinction, with maximum extinction achieved at an angle of 10–15° with the long cleavage fragment edge. The indices of refraction of anthophyllite fibers tend to range considerably. Their values are consistently less (parallel to the fiber length) than that observed for either amosite or crocidolite.

General Remarks:

If anthophyllite is present with thin fibers of tremolite there may be difficulties in distinguishing between these two mineral phases. Acicular cleavage fragments of tremolite, present as a single crystal rather than composites, may be distinguished from anthophyllite on the basis of their angular extinction (about 10–15° with the fiber edge). If tremolite is composed of polyfilamentous fibers, then x-ray diffraction may be used to distinguish between these phases. It is important to note that the mineral talc may occasionally occur in fibrous habit. Some talc mines contain large proportion of talc fiber. These fibers may be distinguished from the amphibole fibers on the basis of indices of refraction and by birefringence. The general statement may be made that all talc indices of refraction are less than 1.600, whereas the indices of refraction of amphiboles, commonly associated with talc, possess indices greater than 1.600.

X-Ray Diffraction Analysis

X-ray diffraction analysis may be required to differentiate among some of the mineral phases which may be present in these materials. Using an x-ray diffraction unit, equipped with an appropriate x-ray detector, scanning goniometer, suitable x-ray target, an x-ray pulse discrimination device, suitable data output equipment, step-scanning Geneva gears, spray materials may be pulverized by mechanical mills, and prepared for examination by x-ray powder diffractometry. These materials may be also examined in the continuous scan mode of operation at a rate of one degree two theta per minute. This rapid method may be useful for determining the presence of amosite, crocidolite, the serpentine minerals, talc, tremolite, and anthophyllite if these materials are present in amounts of some 3–5% or more by weight. It should be noted that the continuous scan x-ray diffraction method is not specific for chrysotile since reflection for this mineral cannot be distinguished from those of non-fibrous serpentine minerals (antigorite, lizardite) nor from kaolin and some varieties of chlorite and vermiculite. Also, asbestiform varieties of the amphiboles cannot be distinguished from ordinary cleavage fragments of the same minerals.

Studies have shown (e.g., Rohl, *et al.*, 1976)[3] that x-ray diffraction, using a step-scan mode of analysis, can be used to detect tremolite and anthophyllite (when present in a matrix of talc), in amounts as low as 0.1 and 2 percent by weight, respectively. Under most conditions, serpentine minerals (including chrysotile asbestos) can be distinguished from kaolin and chlorite using the same analytical modalities. However, we stress that the presence of sub-microscopic chrysotile fibers must be confirmed by transmission electron microscopy and selected area electron diffraction, since x-ray diffraction techniques cannot.

The use of polarized light microscopy, immersion oils, and standard accessory devices, may be used as a basic tool characterizing the mineral assemblages of asbestos-containing spray finishes. X-ray diffractometry and electron beam techniques may be employed as ancillary methods as well.

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