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ASSESSMENT OF POTENTIAL EXPOSURE TO FRIABLE INSULATION MATERIALS CONTAINING ASBESTOS

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SUMMARY

Asbestos has been widely used for fireproofing, thermal insulation, sound deadening, and aesthetic purposes. The construction industry, in particular, uses spray-applied asbestos in buildings for insulation. The asbestos fibers can be easily released from friable material and can contaminate the environment. Inhalation of asbestos may result in diseases such as asbestosis, lung cancer, and mesothelioma. To assess the potential exposure, a bulk sample of the suspected material is tested for the presence of asbestos, and the air is monitored, if necessary. Based on field inspections and laboratory analyses, the health hazard is evaluated, and abatement measures are taken if a potential hazard exists. Throughout the assessment and abatement program, all applicable regulations are administered as specified by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA).

INTRODUCTION

Recently, there has been much public concern over the hazards of exposure to asbestos. Lack of information and improper planning have caused some misunderstanding, as in the case of a township in New Jersey (ref. 1). A parent who worked at the State Department of Environmental Protection had a ceiling sample from a school building tested for the presence of asbestos. Then, at a meeting of the School Board, the parent declared the ceiling material to be a health hazard to the school children.

Motivated by fear of carcinogens, the parents and the State Department of Education pressured the School Board to remove the ceiling material from the school buildings. The pressure was intensified when, at the beginning of the 1976-77 school year, a schoolchild developed severely swollen glands (the cause was later diagnosed as mononucleosis). Finally, in the middle of the 1976-77 school year, six elementary schools were closed for 4 weeks for removal of the ceilings, at a cost of $180,000. Later, the "asbestos" turned out to be cellulose.

This case was mishandled, as evidenced by the panic of the people involved, the incorrect initial identification of the material as asbestos, and the consequent unnecessary removal of the material from the school buildings. However, it called attention to the presence of asbestos materials in schools throughout the country (refs. 2 and 3). Lately, government-owned and privately-owned buildings are being evaluated for the presence of asbestos, particularly in the friable insulation materials.

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USES OF ASBESTOS

Asbestos is a generic term used for a group of mineral silicates occurring naturally as masses of fibers. These fibers can separate into a dust of tiny particles that can float in the air, stick to clothes, and be inhaled or ingested. The following is a list of the six types of asbestos and their chemical compositions (refs. 4 and 5):

Asbestos type	Composition	Approximate formula
Chrysotile	$Mg_3Si_2O_5(OH)_4$	$3MgO$-$2SiO_2$-$2H_2O$
Amosite	$(Fe^{2+}, Mg)_7Si_8O_{22}(OH)_2$	$5.5FeO$-$1.5MgO$-$8SiO_2$-H_2O
Crocidolite	$Na_2(Fe^{2+}, Mg)_3Fe_2^{3+}Si_8O_{22}(OH)_2$	Na_2O-Fe_2O_3-$3FeO$-$8SiO_2$-H_2O
Anthophyllite	$(Mg, Fe)_7Si_8O_{22}(OH)_2$	$7MgO$-$8SiO_2$-H_2O
Tremolite	$Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$	$2CaO$-$5MgO$-$8SiO_2$-H_2O
Actinolite	$Ca_2Mg_4FeSi_8O_{22}(OH)_2$	$2CaO$-$4MgO$-FeO-$8SiO_2$-H_2O

Asbestos fibers are incombustible, have good thermal and electrical properties, and are nearly indestructible. Chrysotile is used in about 95 percent of all asbestos products. From 1970 to 1975, about 800,000 tons of asbestos were mined and processed yearly to make over 3,000 different products in the United States. Two-thirds of the asbestos produced was used in the construction industry for insulation and fireproofing (ref. 6). The following are some of the past and current uses of asbestos: Coverings for pipes and surfaces; insulation in construction, power-houses and chemical plants, and for engines, hulls and decks of ships; coatings for cables and electric wires; putties, caulks, and paints; floor and ceiling tiles, sealants, and patching tape; friction products such as clutch facings and brake linings for automobiles, railroad cars, and airplanes; filtration materials; theater curtains; a wide variety of asbestos cement materials and wallboards; artificial ashes in false fireplaces; and drywall patching compounds.

PREVALENCE OF ASBESTOS

Large numbers of persons worked with or around asbestos in shipyards during and since World War II. During 1940 to 1944, about 4.5 million persons worked in shipyards. In the last 15 years, the number of shipyard workers has stabilized to an annual workforce of about 200,000. The Department of Health, Education and Welfare estimated that the total number of workers exposed to asbestos since the beginning of World War II, including shipyard workers, is between 8 and 11 million (ref. 6).

Since World War II, the general public has come in contact with asbestos in offices, stores, churches, schools -- nearly every building constructed between 1940 and 1973. One in six schools nationwide is believed to contain asbestos that was sprayed-on (ref. 7).

Along with the Food and Drug Administration's research on asbestos in drugs and food, the Consumer Product Safety Commission (CPSC) has been investigating products for asbestos. Through an interagency agreement with CPSC, NIOSH tested and evaluated various hair dryers for the release of asbestos fibers (ref. 8). Through another interagency agreement, CPSC and NIOSH plan to test other consumer products, such as toasters, for asbestos. Currently, EPA is considering regulation of asbestos under the Toxic Substances Control Act, and the Office of Drinking Water under EPA is considering what to do about asbestos fibers in drinking water (refs. 9 and 10).

HEALTH HAZARDS FROM ASBESTOS

Health hazards from asbestos have been recognized among workers who have been heavily exposed in the shipbuilding trades, asbestos mines, asbestos manufacturing, and in insulation work in building trades. Every year, since World War II, nearly 67,000 people in the United States die of asbestos-related cancers. The following are the principal diseases that can result from exposure to asbestos.

Asbestosis

Asbestosis is a chronic lung disease whose signs and symptons result from permanent changes in lung tissue due to asbestos. The earliest signs of abestosis appear at least a decade after first exposure. The most characteristic sign is the dry, crackling sound in the lungs during inhalation. In the later stages of the disease, clubbing of the fingers may appear, as well as a bluish discoloration of the skin and the lining of the mouth and of the tongue.

Lung Cancer

Asbestosis does not necessarily lead to lung cancer, but it indicates considerable asbestos exposure and greater risk of developing lung cancer. In most lung cancer patients, a cough or a change in cough habit is found. A persistent chest pain unrelated to coughing is the second most common symptom. Sometimes, blood-streaked sputum is coughed up from the lungs in the initial stages of the disease.

Mesothelioma

Mesothelioma is a cancer that commonly appears in workers and rarely in the general population. Affected parts are the linings of the chest cavity and of the abdominal cavity. The common symptons are shortness of breath, pain in the walls of the chest, and abdominal pain. Sometimes, pain is accompanied by a need to urinate or defecate.

Other Cancers

Increased exposure to asbestos increases the occurrence of cancers in the esophagus, stomach, colon, and rectum. How asbestos causes disease and how much asbestos exposure is hazardous are not known. Inhaled asbestos can be trapped within the lungs indefinitely. The disease appears 15 to 35 or more years after first exposure. The ubiquitous nature of asbestos in the general population was emphasized in a report by the Mt. Sinai School of Medicine, which had studied 3000 consecutive autopsies at three New York City hospitals. The report (ref. 11), which was based specifically on the 302 asbestos cases from the 3000 autopsies, stated that asbestos fibers in lung parenchyma were found in 100 percent of asbestos workers, 85 percent of shipyard workers, 75 percent of construction workers, and 60 percent of maintenance workers. The occupations appeared to be associated with asbestos concentrations in that the frequency of asbestos decreased as the percentage of exposure decreased.

RELATIVE HAZARDOUSNESS OF VARIOUS TYPES OF ASBESTOS-CONTAINING MATERIALS

The relative hazardousness of asbestos-containing materials depends on such factors as the percentage of asbestos contained in the material; the type, condition, and location of the material; and the handling or treatment to which the material is subjected.

Generally, the amount of asbestos in materials used for decorative or aesthetic purposes ranges from 30 to 65 percent. In fireproofing and insulation materials, the asbestos content is from 10 to 80 percent. Any given building material may have an asbestos content of 5 to 100 percent. The minimum asbestos concentration that is subject to Environmental Protection Agency (EPA) regulations is 1 percent.

Hard materials, such as vinyl floor tile, generally do not cause exposure problems. Asbestos fibers may be released only by sanding, grinding, or cutting. Therefore, hard materials are not considered hazardous unless they are machined. Ceiling tiles, also, are not considered hazardous.

Friable materials are loosely bound and can be easily crumbled or pulverized, even by slight hand pressure. Thus, asbestos fibers are easily released from these materials. However, such things as pipe covering and boiler lagging are not hazardous unless the friable insulation material is damaged, exposed, or disturbed in some way.

AERODYNAMICS OF ASBESTOS FIBERS RELEASED FROM FRIABLE INSULATION MATERIALS

Any damage, deterioration, or disturbance of asbestos-containing friable insulation material can release asbestos fibers into the air. Once the fibers are in the air, their downward settling is determined by their mass, form, and axis attitude. Fibers between 0.1 and 20 micrometers (μm) long are aerodynamically mobile and respirable, and can remain suspended in the air for many hours. The settling velocity is more dependent on the diameter than on the length of the fiber. For a fiber 10 μm long and 0.05 μm in diameter, the settling velocity is nearly 10^{-4} cm/sec; while a fiber of the same length but with a diameter of 0.5 μm, the settling velocity is about 10^{-2} cm/sec (ref. 12).

Any turbulence in the air prolongs the settling of fibers. Airborne fibers can move laterally with the air current and can contaminate an environment distant from the point of release. Any disturbance can easily cause settled fibers to reenter the environment and to recontaminate the atmosphere.

The aerodynamic mobility and the respirability of asbestos fibers has alarmed many health and public-school officials. For this reason, many public buildings and school buildings are being closely monitored for potential exposure to asbestos fibers released from friable insulation materials.

NASA SURVEY OF FRIABLE INSULATION MATERIALS

To address the asbestos problem throughout its facilities, NASA has issued a directive (ref. 13) for an Agency-wide survey of all buildings to locate, sample, and analyze asbestos-containing friable insulation materials. The specific survey procedures contained in the NASA directive are based on documents published by the Environmental Protection Agency (refs. 12 and 14) and on instructions issued by the U.S. Navy for a similar asbestos survey. The first phase of the NASA survey will concentrate on those buildings that are most frequently occupied or used by personnel. The second phase will concentrate on the remaining buildings. The results of this survey will be used to determine the need for follow-up air monitoring, to assess the extent and degree of the health hazard, and to develop any necessary abatement procedures.

LOCATING FRIABLE INSULATION MATERIALS FOR SAMPLING AND ANALYSIS

The presence of asbestos in a material cannot be determined positively by visual inspection alone. Laboratory analyses are essential for positive identification. Incorrect identification of a material could result in either continued exposure of people to asbestos, or needless and expensive renovations. Therefore, it is important to have bulk samples of all friable insulation materials analyzed by approved identification methods.

Locating the various friable insulation materials in a building is essentially a matter of knowing what to look for and where to look for it. However, the task is complicated by the variety of such materials, any of which may contain asbestos, the wide range of asbestos content in these materials, and the many uses for these materials. Often, the architectural specifications and records identify the asbestos-containing materials and may include the type and amount of asbestos contained in the materials. But reliance on building records alone is not recommended.

Description of Materials

The surface appearance of friable insulation materials varies from a loose, fluffy, or sponge-like composition to a dense, nearly solid consistency. Uncoated materials may be slightly gray, brown, or blue, depending on the type and amount of asbestos contained in them. However, the presence or absence of asbestos cannot be positively determined by the texture, color, or general appearance of the material. Since they are not subject to any rigorous specifications, friable insulation materials of nearly identical appearance may contain from 5 to 100 percent asbestos or various nonasbestos substances, such as vermiculite, rock wool, cellulose, slag wool, fiber glass, or mineral wool. Most friable insulation materials are between 0.25 and 5 centimeters (between 1/8 and 2 in.) thick, and they can be grouped into the following three general categories.

Fibrous insulation. - Figures 1 to 3 illustrate typical fibrous friable insulation materials which may contain asbestos fibers. The rough surfaces were painted years ago. Figure 2 shows the deterioration and damage of the material. Figure 3 illustrates a pipe covering with damaged and exposed surface. Where the friable insulation is located in view, the surface is normally tamp-finished. Untamped material is found in areas of limited access such as boiler rooms and basements.

Granular or cementitious insulation. - This type of friable insulation material has a coarse appearance and has been used for sound insulation as well as for decorative purposes. The material may be easily removed from the surface with very little mechanical disturbance, even by simply wiping with the hand.

Insulating or fireproofing concrete. - This kind of friable insulation has a foamy appearance with a strong possibility of containing vermiculite or mica. Insulating concrete may be soft and spongy to hand pressure, or it may require the use of a mechanical device to penetrate the material's surface. Insulating concrete is traditionally applied to steel members of high-rise structures. This material is normally hidden from view, but it may still be responsible for asbestos fiber release to the work environment.

Locations of Materials

As discussed earlier, friable insulation material exists in various forms and has been used for many purposes. Consequently, such material may be located in various parts of a building. It may be in open view on ceilings or walls throughout the entire building, or in one particular room; in corridors and staircases; in restricted areas, as in heaters or boiler rooms and attics; or in enclosed areas, such as plenum spaces between structural members and above dropped ceilings.

Although spray-applied asbestos was used mainly between 1940 and 1970, no building should be excluded from the survey solely on the basis of the year of construction. Buildings constructed prior to 1940 may have undergone several renovations, for which friable insulation may have been used. Post-1970 buildings may have "direct-to-steel" friable insulation which may contain asbestos fibers. Friable insulation material can potentially be found in any type of building without exception. Therefore, it is essential to survey each structure individually.

Once friable insulation material has been identified in a building, the entire building should be inspected for identical appearing material. If other forms of friable insulation are found which appear different in texture, fiber type, or color (other than color due only to paint), they should be regarded as separate types of material to be sampled for analysis.

OBTAINING BULK SAMPLES OF MATERIALS FOR ANALYSIS

Sampling Precautions

All friable insulation material should be considered a potential source of hazard because of the similarities in the appearances of asbestos and nonasbestos material. All applicable safety precautions specified in reference 15 should be closely followed throughout the survey. Disturbance of the material, other than that sampled, should be kept to a minimum. Properly fitted respirators approved for protection against exposure to asbestos should be used when obtaining the samples. Industrial hygiene personnel can recommend or provide an approved respirator. When taking overhead samples, protective eyewear should also be used.

Sampling Equipment

The following items are recommended for safely obtaining and handling the samples of friable insulation materials:

(1) Respirator approved for protection against inhalation of asbestos
(2) Protective eyewear for obtaining overhead samples
(3) Plastic spray bottle containing water and a surfactant (a 5-percent soap solution is suitable) for wetting the area from which the sample is to be obtained
(4) Tweezers or wooden sticks for obtaining samples of fibrous material
(5) Plastic containers with which the samples can be obtained and in which the samples can be sealed and sent to the laboratory
(6) Labels for the sample containers for complete and accurate identification of the samples
(7) Paper towels or other disposable wipers to be dampened and used for wiping friable-insulation dust or debris from sampling equipment, from the floor, or from any other surface, after the sample has been obtained
(8) Tape for sealing the sample containers after they have been capped and wiped clean
(9) Sealable container for disposal of all discards from the sampling operation
(10) Disposable gloves
(11) Disposable drop cloth

Sampling Procedure

To reduce fiber release during sampling, a plastic spray bottle containing a soapy water solution should be used to thoroughly wet the material in the area from which the sample is to be taken. One sample should be taken at every 5,000 square feet. From each location, a full-thickness core sample should be obtained by penetrating the surface with a firm, twisting motion with the container. If the friable material is in the form of a thin, dense layer, obtain a sample by scraping with the edge of the container. When the friable insulation is predominantely a fibrous material that cannot be easily penetrated, the sample should be removed with tweezers or wooden sticks. The surface should be disturbed as little as possible. Any material dropped on the floor or other surfaces while sampling should be cleaned up immediately with a wet disposable wiper. The sample container must be capped, wiped with a damp disposable wiper, and sealed with tape when dry. The sample container should then be accurately labeled, with sample number, location, and date. The sample, with its corresponding survey record sheet (fig. 4), should be packed in a protective shipping envelope and sent immediately to the laboratory for analysis.

Disposal of Sampling Equipment

If tweezers were used, wipe them off with a wet disposable wiper. If wooden sticks were used, discard them in a designated sealable container. If a single-use respirator and disposable gloves were used, they are also discarded in the container. If a disposable drop cloth was used, carefully fold it onto itself and discard it in the container. All material broken off and fallen onto the floor should be cleaned up immediately with wet disposable wipers. The sealed container with discarded material should be disposed of by the approved procedure specified in reference 15.

BULK-SAMPLE ANALYSIS

Many friable insulation materials contain mixtures of asbestos and other components such as fiber glass, rock wool, slag wool, and cellulose fibers. Qualitative analytical techniques can be used to determine the presence, type, and relative amount of asbestos in a bulk sample of the material. These analytical techniques are relatively straightforward and give accurate results in most cases.

Polarized-Light Microscopy

A transmitted polarized-light microscope with dispersion staining is usually sufficient for the identification of asbestos fibers (refs. 16 and 17). This technique is well established in the geological and chemical sciences for identification of the particular mineral species present. Commercial laboratories with polarized-light microscopy capabilities for bulk sample analysis are listed in appendix A. Approximate cost per analysis is \$25.00 to \$100.00.

X-Ray Diffraction

In this technique, diffracted X-rays produce a specific characteristic pattern that is unique to any given crystalline material (refs. 18 to 21). A significant investment in equipment is required, along with references, standards, and technical expertise. In routine analysis, X-ray diffraction may fail to detect small concentrations of asbestos, and other silicates or crystalline phases may significantly interfere with correct identification. The usual detection limit is about 5 percent asbestos in a bulk sample (EPA regulations apply to concentrations of 1 percent). Therefore, X-ray diffraction is usually used as a confirmation of polarized-light microscopy results. Approximate cost per analysis is \$75.00 to \$225.00.

Electron Microscopy

The electron microscope can be used in conjunction with electron diffraction or energy-dispersive X-ray analysis to accurately identify specific fibers (ref. 22). However, the extrapolation of the electron-microscopy data to significant bulk-sample information is inefficient and costly. Therefore, electron microscopy is usually used to resolve conflicting results between polarized-light microscopy and X-ray diffraction. Approximate cost per analysis is \$200.00 to \$600.00.

Chemical Screening Test

An inexpensive and simple test is available for screening asbestos in building materials (refs. 23 and 24). With certain chemicals, the magnesium or iron in asbestos is released, and a blue or red colored complex is produced with indicators. Lack of color change indicates the absence of asbestos. For the negative samples, the probability of finding any asbestos by further testing is extremely low and does not warrant laboratory analysis. Thus, the screening test can be useful for bulk testing, especially if a large number of samples must be tested during a survey with time constraint.

AIR MONITORING

Asbestos fibers 0.3 to 30.0 micrometers in length are most likely to be permanently retained in the lungs. Smaller sizes generally remain suspended in the respired air and are exhaled. Larger sizes are trapped and removed before entering the lungs, but they can enter the lungs by sedimentation or impaction.

Based on the EPA and OSHA definitions of asbestos fibers, the following requirements must be met for air monitoring:

(1) A bulk sample must be identified as containing asbestos.

(2) Length of fibers must be greater than 5 micrometers, with the diameter less than 3 micrometers.

(3) The length-to-width ratio must be at least 3 to 1.

(4) Fibers must be visible by the phase contrast microscope at a magnification of 450.

Air Sampling

A pump is used to draw a volume of air through a membrane filter at a known flow rate. A high-volume air sample is taken at a flow rate of 10 liters per minute to monitor the general environment. The personal samples are taken at flow rates of 0.5 to 2.0 liters per minute. Depending on the anticipated fiber concentrations, the sampling times are 30 minutes to 1 hour or more.

Air samples should be obtained under the following conditions:

(1) Without normal work activity, for sample of undisturbed air

(2) With normal work activity, for sample of disturbed air

(3) Outside building, for sample of background air

For asbestos monitoring, the National Institute for Occupational Safety and Health (NIOSH) recommends a mixed cellulose ester filter with a pore size of 0.8 micrometers (ref. 25). Collected asbestos fibers adhere to the filter surface by the electrostatic charge. After the sampling, filters are transported to a laboratory for fiber counting.

Analysis of Air Sample

Phase contrast microscopy is routinely performed for determination of airborne asbestos in an occupational setting. This is the optical technique specified by OSHA regulations. The filter membrane is chemically rendered transparent, and the fibers are counted at a magnification of 400 to 500.

Both scanning and transmission electron microscopes can be used for detailed identification of asbestos fibers of all sizes. The fiber counting is usually carried out at 15,000 to 20,000 magnification. While electron microscopy is the definitive method for identification, counting, and exposure estimation, the time and cost of the analysis make this technique impractical for routine examination of air samples.

Although the filter technique is the valid procedure, direct-reading, dust-monitoring instruments have recently been applied to asbestos counting. These techniques utilize light-scattering and beta-impaction. The accuracy, precision, and sensitivity of these methods have not been validated.

Commercial laboratories and consultants are listed in appendix B. The approximate costs for analyses of air samples are \$35.00 to \$50.00 for phase-contrast microscopy and \$300.00 to \$500.00 for electron microscopy.

HAZARD EVALUATION

If bulk-sample analysis established that asbestos is present in a friable insulating material, a potential exposure exists. The significant factors to be considered are condition of material, structure characteristics and human activity levels. The EPA lists eight factors that generally influence exposure potential (ref. 12):

(1) Condition of material

(2) Water damage

(3) Exposed surface area

(4) Accessibility

(5) Activity and movement

(6) Air plenum or direct air stream

(7) Friability

(8) Asbestos content

These factors and the air-sampling data must be carefully considered in the evaluation of the hazard of potential exposure to asbestos. If it is determined that no potential exposure exists, corrective action can be deferred. However, a continuing inspection program should be implemented to ensure that, if the situation changes, the necessary steps will be taken to control exposure.

It should be noted that air-sampling data from a building can be misleading if compared to the OSHA standards. The Federal limits for asbestos concentrations in workplace air were established by OSHA specifically for workplace environments for asbestos workers. These standards do not apply to general workplace buildings.

ASBESTOS ABATEMENT METHODS

If exposure is occurring or likely to occur, an efficient long-term solution should be adopted based on the material condition, location, use, user activity and cost. In the interim, between identification and resolution, exposure can be significantly reduced by controlling maintenance, custodial, and repair activities.

The three main approaches to controlling exposure are enclosure, encapsulation, and removal (refs. 12 and 14). Enclosure and encapsulation are containment methods; removal is a permanent solution, since the source of exposure is completely eliminated. Containment methods are temporary measures, and if the building is to be renovated or demolished, contained asbestos material must be removed according to the EPA and OSHA regulations.

Enclosure

Enclosure of asbestos-containing material by a physical barrier is the most rapid corrective method. But, the abestos source remains, and fiber fallout continues behind the barrier. Possible changes in piping and lighting systems can be costly. Enclosure is considered when removal is not feasible and when the enclosed area is not likely to be disturbed or entered. The approximate cost of enclosure is \$3.00 to \$7.00 per square foot.

Encapsulation

In this method, the asbestos material is coated and sealed with a bonding agent. The Environmental Protection Agency has published a list of commercial sealants that have been tested and found to be effective for encapsulation (ref. 26). Since the asbestos source remains, any damage to the material or any deterioration of the sealant can result in the recurrence of asbestos exposure. Also, if the sealant is applied over damaged or deteriorated material, the added weight of the sealant may cause the material to delaminate. Appendix C contains additional information about the sealants. The approximate cost of encapsulation is \$3.00 to \$7.00 per square foot.

Removal

Removal completely eliminates the source of asbestos exposure. This method is recommended if the asbestos material is deteriorated or damaged, is easily accessible, or is on an exposed surface. Dry removal is not recommended, but may be necessary if damage to the structure or equipment is likely by the wet removal procedure. In the wet removal procedure, water containing a wetting agent is recommended to prevent release of fibers into the air. Also, wetted fibers settle quickly due to the added weight. The approximate cost of removal is \$4.00 to \$7.00 per square foot.

Other Methods

At present, the National Cancer Institute, the National Institute of Environmental Health Sciences and NIOSH are jointly seeking demonstration programs for asbestos abatement methods (ref. 27). The purpose and scope of the programs are (1) to develop and evaluate the effectiveness of new and innovative procedures for safe removal or containment; and (2) to effectively disseminate information on accepted procedures for safe removal or containment to State Health Departments, State Education Departments, school boards, and especially to contractors and maintenance personnel.

REGULATIONS

Friable insulation material has a potential not only for worker exposure, but also for contamination of the structure, the community, and workers' homes. Of the abatement methods for asbestos, removal is the permanent solution to prevent further contamination and exposure. Persons engaged in the abatement work must comply with all applicable Federal, State, and local regulations.

Generally, the OSHA regulations are applicable to routine occupational exposure situations, and the EPA regulations apply to emissions into the outside environment and disposal of material from job sites. The Federal regulations specify workplace exposure limits for asbestos workers. Air monitoring is required to determine if the concentrations exceed acceptable limits in an occupational setting. The testing laboratory to count air samples should be approved by the Government and should participate in the NIOSH Proficiency Analytical Testing (PAT) program. The accredited laboratories are listed in appendix D.

Occupational Safety and Health Administration (OSHA) Regulations

The OSHA regulations pertaining to asbestos in the workplace environments of asbestos workers are contained in Title 29, Code of Federal Regulations, Part 1910. The following is a summary of some of those regulations:

Section 1910.1001 - Contains regulations specific to removal, or stripping, of asbestos materials.

- (a) - Defines asbestos and asbestos fibers. Specifies 5 micrometers (μm) as minimum length of fibers subject to the regulations.
- (b) - Sets limits for airborn asbestos-fiber concentrations to which personnel may be exposed. The 8-hour time-weighted average (TWA) concentration limit is 2 fibers per cubic centimeter of air. The peak concentration limit for any 15-minute period is 10 fibers per cubic centimeter of air.

(c) - Recommends methods for meeting, or complying with, the exposure limits.

(1) - Engineering methods: Isolation, enclosure, ventilation, and dust collection.

(2) - Worker protection methods: Wet methods are to be used, insofar as practicable, to prevent the release of fibers.

(iii) - Lists specific requirements for respiratory protection and special protective clothing for asbestos-removal workers.

(d) - Specifies personal protective equipment required whenever the exposure limits are expected to be exceeded. Lists the protective equipment that is approved by OSHA. Also specifies that when use of protective clothing is required, laundering service or means of disposal should be provided.

(2) - Designates the type of respiratory protective equipment required for various levels of asbestos concentration in excess of the permissible exposure limits.

(i) - For asbestos concentrations up to 10 times the allowable limits (i.e., up to a TWA concentration of 20 fibers/cm^3 or a peak con-concentration of 100 fibers/cm^3), use of an air-purifying respirator is required.

(ii) - For asbestos concentrations up to 100 times the allowable limits (i.e., up to a TWA concentration of 200 fibers/cm^3 or a peak concentration of 1000 fibers/cm^3), use of a powered air-purifying respriator is required.

(iii) - For asbestos concentrations greater than 100 times the allowable limits, use of a type-C, supplied-air, continuous-flow or pressure-demand respirator is required.

(3) - If the allowable asbestos limits are to be exceeded, special protective clothing such as coveralls, head coverings, and foot coverings are to be provided.

(e) - States that determinations of airborne concentrations of asbestos fibers shall be made by the membrane-filter collection method with phase-contrast microscopy.

(f) - Discusses personnel monitoring, environmental monitoring, and frequency of monitoring.

(g) - Outlines specifications and use of caution signs. Describes the posting of work sites and the use of caution labels on asbestos material.

(h) - Discusses housekeeping and waste-disposal methods to reduce exposure. Recommends that all accumulated asbestos debris be cleaned up and sealed in impermeable containers.

(i) - Specifies record-keeping requirements, including employer records on personnel exposure, time requirements, and disposition of records. Requires that records of monitoring be retained for 3 years.

(j) - Lists medical examination requirements, including applicability, specific requirements, and frequency of medical evaluations. Also lists requirements for annual and termination examinations.

A notice of proposed rule-making for occupational exposure to asbestos (29 CFR Part 1910) is found in the Federal Register, Thursday, October 9, 1975. The major issues relevant to removal and stripping operations contained in this proposal are the following:

(1) Lowering the exposure limits to a TWA concentration of 0.5 fiber/cm^3 and a peak concentration of 5 fibers/cm^3

(2) Applying the standards to transient work forces in work places of a non-fixed nature, such as in demolition and removal operations

(3) Requiring respiratory protection commensurate with the anticipated concentrations of asbestos in removal or stripping activities

(4) Introducing the regulated area concept as any work area where a person may be exposed to airborne concentrations of asbestos fibers in excess of the limits imposed

(5) Requiring decontamination by showering

(6) Requiring an employee information and training program

Environmental Protection Agency (EPA) Regulations

The U.S. EPA regulations pertaining to asbestos removal operations are contained in Title 40, Code of Federal Regulations, Part 61, as amended.

Subpart A - general provisions. - This subpart contains definitions (Sect. 61.02), regional EPA office addresses (Sect. 61.04), waiver information (Sect. 61.11), and other pertinent information.

Subpart B - national emission standard for asbestos. -

Section 61.21 - Terms relating to asbestos material; visible emissions; demolition; friable asbestos material; renovation; wetting; removal; stripping; and waste-material are defined in this section.

Section 61.22 - Contains information on application of standards; notification requirements; stripping of friable asbestos material; wetting; exhaust ventilation systems; restriction of spraying of asbestos-containing material; waste-material handling and labelling; and disposal regulations, including site requirements. Specifies the applicability of standard to stripping or removal of asbestos materials of more than 80 meters (260 ft) of pipe covering, or 15 square meters (160 ft^2) of friable asbestos materials used to cover a structural member.

Written notification to Regional EPA Administrator is required 120 days prior to beginning of renovation (information to be provided is listed).

Procedures to prevent emissions are described: Adequate wetting, local exhaust ventilation systems, proper movement and handling, and exceptions to wetting requirements.

Spraying of over 1-percent-asbestos material on structural members is prohibited.

Waste-disposal methods in renovation shall not produce visible emissions: Waste material will be placed in lock-tight container while wet, and disposed of in sites in accordance with provisions of Section 61.25.

Section 61.25 - This section contains regulations on emissions access restrictions, sign posting, and operating methods for asbestos waste-disposal sites.

APPENDIX A

COMMERCIAL LABORATORIES WITH POLARIZED-LIGHT MICROSCOPY CAPABILITIES FOR BULK ASBESTOS IDENTIFICATION

The following listing is not an endorsement of the laboratories, nor is it a comprehensive list of all such laboratories. Also, initial and periodic quality-assurance checks should be conducted to monitor or verify the test results of any laboratory whose services are being used.

American Can Company
Safety & Industrial Hygiene Laboratory
U.S. Highway 22
Union, New Jersey 07083

James McVeigh
(201) 686-4500

American Interplex Corporation
3400 Asher Avenue
Little Rock, Arkansas 72204

Richard T. Plant
(501) 664-5060

Analytical Center, Inc.
6001 Clinton Drive
Houston, Texas 77020

W. S. Sease, President
(713) 676-0141

Brandt Associates Inc.
P.O. Box 81
Martins Creek, Pennsylvania 18063

Marlene O. Frey
(215) 258-2911

Brewer Analytical Laboratories
311 Pacific Street
Honolulu, Hawaii 96810

Roy Ishikawa
(808) 533-4411, Ext. 47

The Carborundum Company
P.O. Box 1054
Niagara Falls, New York 14302

Bernard McCabe
(716) 278-6347

Casalina Associates, Inc.
47-345 Mahakea Road
Kaneohe, Hawaii 96744

Sam Casalina
(808) 239-6514

Certified Testing Laboratories, Inc.
2905 East Century Boulevard
South Gate, California 90280

Stuart Salot
(213) 564-2641

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

Jaswant Singh
(313) 424-8860

Colorado School of Mines
Mineralogy Projects Exploration &
Mining Div.
P.O. Box 112
Golden, Colorado 80401

Jerome Krause
(303) 279-2581

Continental Insurance Companies
1810 Commerce Street
Dallas, Texas 75201

Virgil Doty
(214) 748-7351

Dunn Geoscience Corporation
5 Northway Lane North
Latham, New York 12110

William E. Cutcliffe
(518) 783-8102

Eastern Analytical Laboratories
One "A" Street
Burlington, Massachusetts 01803

Robert L. MacDonald
(617) 272-5212

Employers Insurance of Wausau
Wausau, Wisconsin

Thomas Stavros
(715) 845-5211

EMS Laboratories
12517 Crenshaw Boulevard
Hawthorne, California 90250

B. M. Tooper
(213) 973-6694

EMV Associates, Inc.
Microanalysis Laboratory
15825 Shady Grove Road
Rockville, Maryland 20850

John Wehrung
(301) 948-7400

Enviro-Med Laboratories, Inc.
414 W. California
Ruston, Louisiana 71270

Fred Morales
(318) 255-0060

Environmental Consulting and Testing
Services
P.O. Box 3521
Cherry Hill, New Jersey 08034

Nathan R. Frenkel
(609) 779-1195

Erie Testing Laboratories
2401 W. 26th Street
Erie, Pennsylvania 16506

Mark R. Banister
(814) 833-4790

Erlin, Hime Associates
811 Skokie Boulevard
Northbrook, Illinois 60062

Bernard Erlin
(312) 272-7730

GCA Corporation
Technology Division
Burlington Road
Bedford, Massachusetts 01730

Charles Spooner
(617) 275-9000

Geoscience Consultants, Inc.
P.O. Box 341366
Coral Cables, Florida 33134

Jose Honnorez
(305) 446-5801

Hager Laboratories
12000 E. 47th Avenue
Denver, Colorado 80239

Robert Hager, Jr.
(303) 371-1441

Hauser Laboratories
5680 Central Avenue
P.O. Box G
Boulder, Colorado 80306

Dean P. Stull
(303) 443-4662

Health Science Associates
19041 Bloomfield Street, Suite B/C
Los Alamitos, California 90720

Howard Spielman
(213) 430-1031

Herron Testing Laboratories
5405 Schaaf Road
Cleveland, Ohio 44131

Douglas Allenson
(216) 524-1450

IIT Research Institute
10 West 35th Street
Chicago, Illinois 60616

Mr. Gaynor
(312) 567-4303

Industrial Hygienics, Inc.
755 New York Avenue
Huntington, New York 11743

James Schirripa
(516) 427-0950

Industrial Medical Clinic
1523 Kalakaua Avenue, Suite 101
Honolulu, Hawaii 96826

Fred Hertlein III
(808) 949-6191

Institute for Research, Inc.
8330 Westglen Drive
Houston, Texas 77063

Benjamin Mosier
(713) 783-8400

Interscience Research
2614 Wyoming Avenue
Norfolk, Virginia 23513

Joseph H. Ruth
(804) 853-8813

R. J. Kuryvial
Petrography Consultant
31720 Hilltop Road
Golden, Colorado 80401

(303) 642-7559

Law Engineering Testing Company
P.O. Box 18288
3301 Winton Road
Raleigh, North Carolina 27619

Richard Hatfield
Gary Laue
(919) 876-0416

LFE Corporation
Environmental Analysis Lab Division
2030 Wright Avenue
Richmond, California 94804

Robert Reinhart
(415) 235-2633

Maryland Mineral Analysis Laboratory
P.O. Box V
College Park, Maryland 20740

Ann Wylie
Henry Siegrist
(301) 454-3548

Michigan State University
Department of Geology
East Lansing, Michigan 48824

Thomas Vogel
(517) 355-1855

Northrop Services, Inc.
P.O. Box 12313
Research Triangle Park, NC 27709

Robert G. Wilder
(919) 549-0611

Occupational Health Safety Services
940 Kiowa
Burkburnett, Texas 76354

John Breeding
(817) 569-0456

Pedco Environmental Specialists
11499 Chester Road
Cincinnati, Ohio 45246

Craig Caldwell
(513) 782-4700

Rockwell International
P.O. Box 51308
Tulsa, Oklahoma 74151

Clyde G. Ford
(918) 835-3111, Ext. 2314

Ryckman's Emergency Action &
Consulting Team
2208 Welsch Industrial Court
St. Louis, Missouri 63141

Mark Ryckman
(314) 569-0991

Southern Illinois University
School of Science and Technology
Edwardsville, Illinois 62026

Stephen K. Hall
(618) 692-3634

Southwestern Laboratories
P.O. Box 10687
Dallas, Texas 75207

Gary Cude
(214) 688-0088

Southwestern Laboratories
P.O. Box 8768
Houston, Texas 77009

Bob Laws
(713) 692-9151

Southwestern Laboratories, Inc.
P.O. Box 2150
Midland, Texas 79702

Jack Barton
(915) 683-3349

Spectric Corporation
7408 Fannin
Houston, Texas 77054

Donald Flory
(713) 790-1800

State University of New York
Department of Geological Sciences
College at New Paltz
New Paltz, New York 12562

Martin Rutstein
(914) 257-2166

St. Paul Fire & Insurance Company
Environmental Services Analytical
Laboratory
494 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Ken Bergstrom
(612) 221-7043

Sunbelt Associates, Inc.
6961 Mayo Road
New Orleans, Louisiana 70126

Gary C. Allen
(504) 242-5026

Truesdail Laboratories, Inc.
4101 N. Figueroa Street
Los Angeles, California 90065

Karl Schiller
(213) 225-1564

United States Testing Company, Inc.
1415 Park Avenue
Hoboken, New Jersey 07030

Ray Robinson
(201) 792-2400

Utah Biomedical Test Laboratory
520 Wakara Way
Salt Lake City, Utah 84108

Jim Snarr
(801) 581-5277

Walter McCrone Associates, Inc.
Electron Optics Group
2820 S. Michigan Avenue
Chicago, Illinois 60616

Ian M. Stewart
(312) 842-7100

APPENDIX B

ASBESTOS DUST MONITORING LABORATORIES AND CONSULTANTS

The following listing is not an endorsement of the laboratories, nor is it is comprehensive list of all such laboratories. Many insurance companies have technical service departments capable of asbestos-fiber monitoring. Also, initial and periodic quality-assurance checks should be conducted to monitor or verify the test results of any laboratory whose services are being used.

Actus Environmental Services
7370 Industrial Road
Florence, KY 41042

Charles Nenadic
(606) 371-4010

The Almega Corporation
607 C Country Club Drive
Bensenville, IL 60106

Hank Taylor
(312) 595-0175

Bernville Biological Laboratory
Rd. #1 - Route 183
Bernville, PA 19506

Spencer Watts
(215) 488-6258

William Burgess
Environmental Health Engineer
38 Fox Hill Street
Westwood, MA 02090

(617) 326-0814

Clayton Environmental Assoc.
25711 Southfield Road
Southfield, MI 48075

Robert Soule
(313) 424-8860

Environmental Health Laboratory
1021 Georgia Avenue
Macon, GA 31201

John Savidge
(912) 745-4702

ECO Science Laboratory
490 West Main Street
Norwich, CT 06360

Richard Benoit
(203) 889-8104

Industrial Health Foundation
Mellon Institute, CMU
4400 Fifth Avenue
Pittsburgh, PA 15213

Dennis Balya
(412) 621-1100

Kettering Laboratory - Analytical Section
University of Cincinnati
Eden & Bethesda Avenue
Cincinnati, OH 45267

David Yeager
(513) 872-5739

LFE Corporation
Environmental Analysis Labs
2030 Wright Avenue
Richmond, CA 94804

Walter Holland
(415) 235-2633

Walter C. McCrone Associates
2820 South Michigan Avenue
Chicago, IL 60616

Ian Steward
(312) 842-7100

Medlins Microscopy Service
1905 Andrew Johnson Road
Kinston, NC 28501

G. Dan Medlin
(919) 527-0637

Particle Data Laboratories
115 Hahn Street
Elmhurst, IL 60126

(312) 832-5658

Swanson Environmental, Inc.
P.O. Box 735
Sheboygan, WI 53081

James Yanko

Swanson Environmental, Inc.
24680 Swanson Road
Southfield, MI 48076

Joe Swanson
(313) 352-0960

Tulane University School of Medicine
Pulmonary Diseases Section
1700 Perdido Street
New Orleans, LA 70112

V. Dharmarajan
(504) 866-0212

U.S. Testing Company
1415 Park Avenue
Hoboken, NJ 07087

David Hansen
(201) 792-2400

Environmental Health Sciences
805 Goethal Drive
Richland, WA 99352

Don G. Quilici

APPENDIX C

ASBESTOS SEALANT INFORMATION

The use of a sealant coating may be expedient when the in-place asbestos-containing material is needed for thermal insulation, sound attenuation, or fire retardant properties, is in sound condition, adheres well to the building surface, and is not subject to frequent contact by maintenance workers or other building occupants, or is in an area where removal is too difficult or costly to be practical.

Probably any paint sprayed on friable asbestos-containing material would reduce the release of asbestos fibers from the surface. However, the idea of using a sealant is to completely stop asbestos fiber release and to tie the fibers into a tough mat which can take some abuse without releasing any fibers. Not many sealant candidates tested to date showed this property. The sealant should also be water based for use in unventilated areas and have a Class-A fire rating or flame-spread index.

Keep in mind that each area requiring treatment must be carefully evaluated to decide whether removal, enclosure, or sealing is the best course of action. If it is decided that sealing is indicated, a number of other factors must be considered. If the area is subject to moisture accumulation behind or in the asbestos-containing material, a membrane or water-tight barrier type of sealant may not be the best idea because moisture accumulation could cause obvious problems possibly resulting in the failure of a portion or all of the sealed area. Penetrating type liquid sealants or other systems which allow "breathing" of the sealed area may be best for these problem areas.

If moisture is not a problem, there are available several systems which can be used over the asbestos to seal off the fibers from the building airspace. These include plastic artificial stucco type materials, such as Pleko-Glo, which can be applied over a "chicken-wire" reinforcement in about a quarter-inch thickness, fiberglass cloth installed over the asbestos and sprayed with epoxy to form a reinforced shield, and other fiber-glass or "chicken-wire" reinforced systems of various cement or plastic coverings. Cellulose sprayed systems, such as National Cellulose K-13, seal asbestos, add thermal insulation, acoustic damping, and light reflectancy at relatively low cost and allow "breathing" of the sealed area.

The EPA has attempted to evaluate candidate sealants and is continuing to do so. This does not mean that all of the materials useful as sealants have been evaluated by EPA or that better materials for this purpose than any we have evaluated are not now available or under development. Our investigation shows that application procedures may be as important as the sealant material applied. Again, prudence and common sense must be used in selecting a material and the contractor to perform the sealing work. Ask for samples, test data, references, and inspect other jobs where the contractor has applied the material he is recommending. Get close to the surface and feel it to see if it has the strength and toughness to do the long-term job of preventing asbestos fiber release. Write a tight contract specifying proper work-area isolation, worker protection, and clean up.

The following listed materials have been tested by EPA and found to do a satisfactory job of sealing friable asbestos fibers in place in applications we performed or witnessed. Names and phone numbers of people who can provide information about the products are also included. The listing of these product names and associated people does not constitute an endorsement or recommendation by EPA and is presented for information only. Omission of products from this list does not mean or imply that EPA disapproves of the product.

Decadex Fire-Chek
(an elastomeric-membrane "bridging" sealant)

Pentagon Plastics Ltd.
7659C Fullerton Road
Springfield, Virginia 22153

William F. Russek, National Sales Manager
(703) 569-5277

554-21-1 Water Based Coating
(a "penetrating" sealant)

H. B. Fuller Co.
Foster Products Division
P.O. Box 6255
Springhouse, Pennsylvania 19477

Gene Secor
(215) 628-2600 or toll free 800-523-6017

EX-64-2 Asbestos Binding Compound
(a "bridging" sealant)

Lehman Brothers Corp.
22 Holladay Street
Jersey City, New Jersey 07304

Carmine Spatola
(201) 434-1882

K-13 Cellulose System

National Cellulose Corp.
12315 Robin Boulevard
Houston, Texas 77045

Dan Kelly, Marketing Manager
(713) 433-6701

Pleko-Glo
(a synthetic-resin, combination wall covering - artificial stucco)

Makus Development Corp.
P.O. Box 31
Mercer Island, Washington 98040

Dan S. Makus
(206) 641-7373

Cafco-Bond-Seal

U.S. Mineral Products Co.
Stanhope, New Jersey 07874

Frank Meuwirth
(201) 347-1200

APPENDIX D

ACCREDITED LABORATORIES FOR ASBESTOS ANALYSIS

The following laboratories have been accredited under the Laboratory Accreditation Program of the American Industrial Hygiene Association. Proficiency testing is an integral part of the American Industrial Hygiene Association's laboratory accreditation program and is fulfilled by the laboratory's participation in the NIOSH Proficiency Analytical Testing Program (PAT). This program presently includes bimonthly samples for lead, cadmium, zinc, asbestos, silica and organic solvents. (The following solvents are provided on a rotating basis: carbon tetrachloride, benzene, trichloroethylene, p-dioxane, toluene and chloroform.) Accredited laboratories are required to analyze all materials in the PAT Program which they analyze as a part of their routine laboratory operations.

Aetna Life and Casualty Company
Engineering Industrial Hygiene Lab.
151 Farmington Avenue
Hartford, Connecticut 06115
John M. Robinson, Director
(203) 273-7289

American Can Company
Safety & Industrial Hygiene Lab.
U.S. Highway 22
Union, New Jersey 07083
J. F. McVeigh, Manager
(201) 686-4500

ASARCO, Incorporated
Department of Environmental Sciences Laboratory
3422 South 700 West
Salt Lake City, Utah 84119
Robert D. Putnam, Ph.D., Co-Director
M. O. Varner, Co-Director
(801) 262-2459

Anaconda Copper Company
Environmental Laboratory
8000 S. Kolb Road
Tucson, Arizona 85726
Rodney J. Anderson, Director
(602) 889-5361

Analytical Research Laboratories, Inc.
160 Taylor Street
Monrovia, California 91016
M. L. Moberg, Director
(213) 357-3247

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075
Jaswant Singh, Ph.D., Director
(313) 424-8860

Continental Insurance Company
Environmental Health Laboratory
1810 Commerce Street
Dallas, Texas 75201

David McNamara, Director
(214) 748-7351, Ext. 403

Employers Insurance of Wausau
Environmental Health Laboratory
2000 Westwood Drive
Wausau, Wisconsin 54401

Tom Stavros, Ph.D., Director
(715) 842-6810

Environmental Health Laboratory
P.O. Box 6195
Macon, Georgia 31208

Alice C. Farrar, Director
(912) 745-4702

Environmental Research Group, Inc.
117 N. First Street
Ann Arbor, Michigan 48104

Ronald H. Peters, Director
(313) 662-3104

Fireman's Fund Insurance
Environmental Laboratory
3333 California Street
San Francisco, California 94119

Jerry Tuma, Ph.D., Director
(415) 929-2053

Free-Col Laboratories
Division of Freeport Brick Company
P.O. Box 557
Meadville, Pennsylvania 16335

J. Richard Wohler, Ph.D., Director
(814) 724-6242

Galson Technical Services
Industrial Hygiene Laboratory
6601 Kirkville Road
E. Syracuse, New York 13057

Allen E. Galson, Director
(315) 437-7181

Gannett-McCreath Laboratories
Environmental Analytical Laboratory
P.O. Box 1963
Harrisburg, Pennsylvania 17105

H. Bruce Gerber, Director
(717) 763-7211, Ext. 334

Hager Laboratory, Incorporated
12000 E. 47th Avenue
Denver, Colorado 80239

Robert N. Hager, Jr., Ph.D., Director
(303) 371-1441

Hanford Environmental Health
Foundation/Northwest Health Services
Environmental Health Sciences Lab.
805 Goethal Drive
Richland, Washington 99352

Maureen K. Hamilton, Director
(509) 943-0802

Industrial Health Foundation, Inc.
Analytical Laboratory
3400 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Daniel C. Braun, M.D., Director
(412) 681-6593

Interlake, Inc.
Interlake Technical Center
Environmental Control Laboratory
150 West 137th Street
Riverdale, Illinois 60627

David Holmberg, Director
(312) 849-2500

Kemron Environmental Services
16550 Highland Road
Baton Rouge, Louisiana 70808

Sham L. Sachdev, Ph.D., Director
(504) 293-8650

Kemron Environmental Services
Borg-Warner Corporation
32740 Northwestern Highway
Farmington Hills, Michigan 48018

Ralph G. Smith, Ph.D., Director
(313) 626-2426

LFE Corporation
Environmental Analysis Lab. Division
2030 Wright Avenue
Richmond, California 94804

Marcel Nathans, Ph.D., Director
(415) 235-2633

Massachusetts Institute of Technology
Industrial Hygiene Laboratory
Room 20B-245
77 Massachusetts Avenue
Cambridge, Massachusetts 02139

Richard I. Chamberlin, Director
(617) 253-2596

Monsanto Research Corporation
Pollution Monitoring
P.O. Box 8, Station B
Dayton, Ohio 45407

William Haynes, Ph.D., Director
(313) 268-3411

National Loss Control Service Corp.
(Lumbermens Mutual Casualty Company)
Environmental Sciences Laboratory
Route 22 & Kemper Center
Long Grove, Illinois 60049

Joan A. Wronski, Director
(312) 540-2488

Pedco Enviromental Inc.
11499 Chester Road
Cincinnati, Ohio 45246

Lawrence A. Elfers, Director
(513) 781-4700

Radiation Detection Company
162 Wolfe Road
P.O. Box 1414
Sunnyvale, California 94088

Joe Lipera, Director
(408) 735-8700

St. Paul Fire & Marine Insurance Co.
Environmental Services Analytical Lab.
494 Metro Square Building
7th & Roberts Streets
St. Paul, Minnesota 55101

Donald J. Larsen, Director
(612) 221-8020

Sentry Insurance
1800 North Point Drive
Stevens Point, Wisconsin 54481

Robert Voborsky, Director
(715) 346-6804

Sherwin Williams Company
10909 S. Cottage Grove Avenue
Chicago, Illinois 60628

Richard W. Scott, Director
(312) 821-3657

Suntech, Incorporated
Industrial Hygiene Laboratory
P.O. Box 1135
Marcus Hook, Pennsylvania 19061

David M. G. Lawrey, Director
(215) 447-1832

Travelers Insurance Company
Chemical & Environmental Lab.
248 C. P. Lab.
Hartford, Connecticut 06115

Harry W. Rapp, Jr., Director
(203) 277-2677

University of Cincinnati
Kettering Laboratory, Analytical Section
3223 Eden Avenue
Cincinnati, Ohio 45267

B. E. Saltzman, Ph.D., Director
(513) 872-5739

University of Iowa
University Hygienic Laboratory
Oakdale Campus
Iowa City, Iowa 52242

W. J. Hausler, Jr., Ph.D., Director
(319) 353-5990

University of Utah Research Institute
UBTL
520 Wakara Way
Salt Lake City, Utah 84108

James H. Nelson, Ph.D., Director
(801) 581-8267

REFERENCES

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2. Jellinek, Steven D.: Asbestos-Containing Materials in School Buildings. Federal Register, vol. 44, no. 58, Mar. 23, 1979, pp. 17790-17791.
3. EPA Advance Notice of Proposed Rulemaking for Asbestos-Containing Materials in School Buildings. Federal Register, vol. 44, no. 184, Sep. 20, 1979, pp. 54676-54680.
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10. Melton, Carl W.; et al.: Development of a Rapid Analytical Method for Determining Asbestos in Water. EPA-600/4-78-066, Environmental Protection Agency, 1978.
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13. Request for an Asbestos Survey of NASA Buildings. Letter from NASA Headquarters to Field Installations, dated Oct. 19, 1979.
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26. Mirick, W.; et al.: Evaluation of Sealants and Removal Methods for Sprayed-on Asbestos-Containing Materials in Buildings. EPA Contract No. 68-03-2552 (T2005), Environmental Protection Agency, Cincinnati, Ohio, July 1979.

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Figure 1. - Spray-applied ceiling insulation.

Figure 2. - Damaged ceiling insulation.

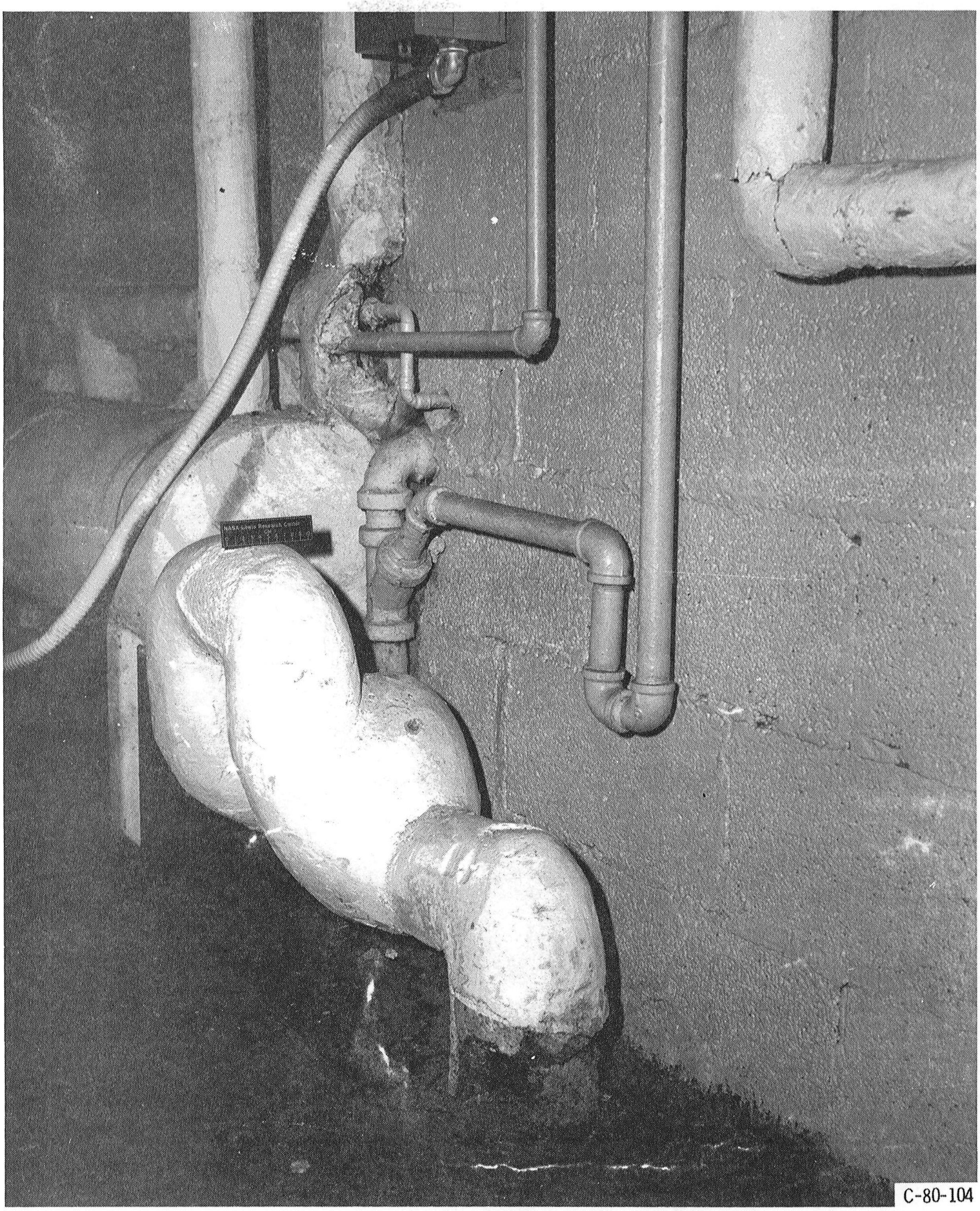

Figure 3. - Damaged pipe insulation.

SURVEY RECORD OF NASA INSTALLATIONS
USE OF SPRAY-APPLIED INSULATION

(THIS TERM INCLUDES SPRAY-APPLIED MATERIAL USED FOR ACOUSTICAL, DECORATIVE AND ARCHITECTURAL PURPOSES)

INSTALLATION__________ BUILDING NUMBER __________ DATE______

USE OF BUILDING__________

AGE OF BUILDING__________

PERSON TO RECEIVE LAB REPORT__________

INSPECTED BY__________

A. SPRAY-APPLIED INSULATION

ON THE BACK OF THIS SHEET ASSIGN A SAMPLE NUMBER FOR EACH SAMPLE TAKEN. EACH SAMPLE SHOULD REPRESENT AN AREA OF DIFFERENTLY APPEARING SPRAY-APPLIED INSULATION (DISREGARDING DIFFERENCES IN ONLY PAINT COLOR). DESCRIBE THE LOCATIONS OF THE SAI MATERIAL IN THIS BUILDING THAT THE SAMPLE REPRESENTS. IT IS POSSIBLE FOR ONE SAMPLE TO REPRESENT MANY DIVERSE AREAS, FLOORS IN A BUILDING, OR EVEN THE ENTIRE BUILDING. ESTIMATE THE TOTAL NUMBER OF PERSONS IN OR USING THE AREA SAMPLED DURING A 24-HOUR DAY. ESTIMATE THE AVERAGE LENGTH OF TIME AN INDIVIDUAL WOULD BE IN THIS AREA.

USE THESE DIVISONS:

FOR OCCUPANCY (Persons)	FOR FREQUENCY OF USE (Hours)
<10 10-100 101-500 >500	<2 2-6 >6

FOLLOW THE FORMAT TO SHOW WHETHER THE SAI IS ON THE WALLS, CEILINGS, PLENUMS, OR A COMBINATION OF THESE, TO GIVE THE AREA OF EACH TYPE OF SURFACE COVERED BY THE SAI, AND TO INCLUDE THE AMOUNT OF SAI MATERIAL THAT SHOWS SAGGING, SEPARATION, DISLOCATION, OPEN EDGES, WEAR, SURFACE DETERIORATION, OR OTHER DAMAGE. INCLUDE OTHER INFORMATION SUCH AS THE RESULTS OF PREVIOUS ANALYSES, CORRECTIVE ACTIONS, SOURCES OF POTENTIAL DAMAGE LIKE VIBRATIONS, OR THE KIND OF DAMAGE ALREADY PRESENT UNDER REMARKS.

IS SAI USED ON STRUCTURAL STEEL IN THIS BUILDING? ___YES ___ NO

B. NON-SAI ASBESTOS

IS PIPE INSULATION OTHER THAN FIBER GLASS AND SAI LISTED ABOVE USED IN THIS BUILDING? ___YES ___NO

WAS ASBESTOS (OR INSULATION OF UNKNOWN TYPE) USED FOR OTHER PURPOSES IN THE CONSTRUCTION OF THIS BUILDING (AS IN BOILER OR FURNACE COVERINGS)? ___YES ___NO
INDICATE USE ______

Check box only if there is NO SAI in this building ☐

(a) Front of sheet.

Figure 4. - Survey record sheet for spray-applied insulation.

SAMPLE NUMBER	LOCATIONS OF AREAS REPRESENTED BY THE SAMPLE	OCCUPANCY OF AREAS DURING 24 HOURS (Persons)				AVERAGE DURATION OF AN INDIVIDUAL'S USE OF THE AREAS PER DAY (Hours)			SURFACE WITH SAI MATERIAL	AREA OF SAI BY SURFACE TYPES (Square Feet)	SAI DAMAGE			REMARKS (RESULTS OF PRIOR SAI SURVEYS, IF APPLICABLE, etc.)	RESULTS BULK SAMPLE ANALYSIS (LEAVE BLANK FOR TEST RESULT REPORTING)
		< 10	10-100	101-500	> 500	< 2	2-8	> 8			NONE	MINOR	SIGNIFICANT		
									CEILINGS						
									WALLS						
									PLENUMS						
									CEILINGS						
									WALLS						
									PLENUMS						
									CEILINGS						
									WALLS						
									PLENUMS						
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									PLENUMS						
									CEILINGS						
									WALLS						
									PLENUMS						

(b) Back of sheet.

Figure 4. - Concluded.

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15. Supplementary Notes

16. Abstract

Asbestos has been widely used for fireproofing, thermal insulation, sound deadening, and aesthetic purposes. The construction industry, in particular, uses spray-applied asbestos in buildings for insulation. The asbestos fibers can be easily released from friable material and can contaminate the environment. Inhalation of asbestos may result in diseases such as asbestosis, lung cancer, and mesothelioma. To assess the potential exposure, a bulk sample of the suspected material is tested for the presence of asbestos, and the air is monitored, if necessary. Based on field inspections and laboratory analyses, the health hazard is evaluated, and abatement measures are taken if a potential hazard exists. Throughout the assessment and abatement program, all applicable regulations are administered as specified by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA).

17. Key Words (Suggested by Author(s)) Asbestos; Friable; Spray applied; Insulation	18. Distribution Statement Unclassified - unlimited; STAR Category 45

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