A MANAGEMENT GUIDE TO ASBESTOS: MEDICO-LEGAL, REGULATORY, AND HAZARD ABATEMENT CONSIDERATIONS

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This study was done to develop an authoritative and comprehensive guide to asbestos which would provide management with the knowledge necessary to identify and control asbestos hazards within institutions under their control. Key topics covered by the guide include description and uses of asbestos; health hazards associated with asbestos and related liability issues; a history of government involvement in the asbestos issue; facility inspection and asbestos hazard assessment; methodology for initiating an asbestos abatement project; asbestos abatement alternatives; current government regulations affecting asbestos abatement projects; and monitoring the performance of asbestos abatement contractors.

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CHAPTER I.

INTRODUCTION

> There are a lot of fly-by-night contractors removing asbestos. Some don't even know the Occupational Safety and Health Administration and Environmental Protection Agency (EPA) standards on asbestos removal, much less try to follow them. There's more asbestos in the air after their work than before. And the hospital administrator might think they did a good job.[1]
>
> --William Wagner,
> Industrial Hygenist
> Industrial Health, Inc.

It has been suspected for decades that asbestos posed a serious health threat to persons exposed to the mineral. In 1967, Dr Irving J. Selikoff of the Mount Sinai School of Medicine in New York provided concrete medical evidence that individuals exposed to asbestos experienced mortality rates for lung cancer and mesothelioma far in excess of unexposed individuals.[2] As one authority has pointed out, by the time the federal government began to take steps to control the use of asbestos in this country in the early 1970s, the country was virtually saturated with asbestos fibers. Surveys conducted by the Environmental Protection Agency (EPA) estimate that asbestos-containing materials (ACM) can be found in some 31,000 schools and 733,000 other public buildings in this country.3

Selikoff has noted that the first phase of asbestos exposure was associated with product manufacture. During the last 40 years we've experienced disease associated with product use. We are now entering a third phase--in which asbestos exposure will be associated with environmental exposure, during repair, renovation, removal, and the maintenance of the asbestos put in place during phase two.[4]

Federal regulations for controlling asbestos use, establishment of asbestos exposure limits, and guidance on proper methods for abating asbestos hazards have been slowly evolving. Ultimate responsibility for compliance falls on organizational executives and managers. Yet, as has been indicated, such individuals frequently lack the knowledge necessary to conduct asbestos hazard abatement projects, or to evaluate the performance of contractors.

The Department of the Air Force (as well as the other branches of the Department of Defense) faces a considerable asbestos problem, as many of its facilities were built at a time when asbestos-containing materials were used extensively for insulation and other purposes. The Secretary of the Air Force announced in 1985 an asbestos policy that establishes a multiyear asbestos control program. The program calls for development of asbestos control expertise by personnel employed at the base level.5

Statement of the Problem

This graduate research project was to develop an authoritative and comprehensive guide to asbestos which would provide management with the knowledge necessary to identify and control asbestos hazards within institutions under their control. Key topics covered by the guide include description and uses of asbestos; health hazards associated with asbestos and related liability issues; a history of government involvement in the asbestos issue; facility inspection and asbestos hazard assessment; methodology for initiating an asbestos abatement project; asbestos abatement alternatives; current government regulations affecting asbestos abatement projects; and monitoring the performance of asbestos abatement contractors.

Limitations

Individuals employed in the mining of asbestos, or in the manufacturing of asbestos products, have been and will continue to suffer the effects in terms of premature disability and/or death. Government, however, has taken significant action to reduce occupational exposure to asbestos fibers. Current concern centers on non-occupational exposure to asbestos. This project is limited to the asbestos hazard in health care facilities and other institutions, where employees, maintenance workers, and visitors face exposure to asbestos incorporated into building structures. Asbestos hazards faced by individuals employed in the production or manufacture of asbestos or asbestos-related products, or asbestos hazards found in private buildings, are excluded.

Additionally, this management guide has been written to a level of detail sufficient to make executives and managers aware of all major actions associated with an asbestos abatement project. It is obviously beyond the scope of this project to attempt to cover all the possible contingencies that may arise at individual facilities.

Literature Review

This introductory chapter will not contain a specific literature review. This entire research project is, in fact, a literature review. The writer's specific purpose was to survey as much as possible the literature available on asbestos, and consolidate it in a digestible and relevant manner for institutional executives and managers. When information presented in this guide is directly attributable to a specific writer(s), such information is clearly identified. Government publications have been used extensively in developing this guide, and specific authors are frequently unknown.

Organization of the Guide

This management guide to the asbestos problem is presented in what is believed to be a logical and methodical manner. It is important first to know what asbestos is, how it has been used, and in what quantities. If this mineral posed no health hazards, this guide would be of absolutely no value. Therefore, the health consequences of exposure to asbestos are discussed next, along with current and future estimates of asbestos-related disease and death.

The morbidity and mortality associated with exposure to asbestos have created massive legal and economic problems for asbestos manufacturers, insurance companies, the judicial system, and the victims of asbestos. Managers of buildings containings asbestos face possible lawsuits from employees, maintenance and construction personnel, and visitors. These issues are discussed in chapter IV of this guide.

In taking steps to abate asbestos hazards, management must ensure compliance with all applicable governmental regulations. Discussion of the evolution of these regulations is the next logical step, and is presented in chapter V. With this firm background established, management should be prepared to survey their institutions for asbestos hazards, evaluate abatement alternatives, secure the necessary outside assistance (contractors), and monitor abatement activities for appropriateness and effectiveness. The concluding chapters of this guide provide the necessary information.

Footnotes

[1]Wagner, William, "Hiring asbestos contractors: caveat emptor!" Hospitals, January 5, 1986, p. 100.

[2]Selikoff, Irving J., Churg, Jacob, and Hammond, E. Cuyler, "Asbestos Exposure and Neoplasia," Journal of the American Medical Association Vol. 188, No. 1 (April 6, 1964), pp. 22-6.

[3]United States Environmental Protection Agency, Office of Toxic Substances, Asbestos in Buildings: A National Survey of Asbestos-Containing Friable Materials, Washington, D.C.: U.S. Environmental Protection Agency, 1984, p. 2-7.

[4]Selikoff, Irving J., "Twenty Lessons from Asbestos: A Bitter Harvest of Scientific Information," EPA Journal, May 1984, p. 22.

[5]Headquarters United States Air Force letter, "Air Force Policy on Building Materials Containing Asbestos," Washington, D.C.: Directorate of Engineering and Services, November 4, 1985.

CHAPTER II.

BACKGROUND ON ASBESTOS

History of Asbestos

Asbestos has been used by man for literally thousands of years. In Finland, pottery dating from 2500 B.C. has been found to incorporate asbestos. The word asbestos comes from the Greek word for "unquenchable," alluding to the fact that asbestos wicks used in ancient oil lamps lasted almost indefinitely. References to asbestos, its uses, and properties are scattered throughout human history, yet its production was never widespread. It was not until the middle of the 19th century that asbestos reached a breakthrough period. The rediscovery and development of very large deposits of asbestos in Canada and South Africa around 1880 provided the basis for an industry that continues to this day.[1]

Description of Asbestos

Asbestos is a generic term given to a group of naturally occuring, fibrous mineral silicates.[2] The three main types of asbestos that have seen wide commercial use are chrysotile, amosite, and crocidolite. The form of asbestos most commonly used is chrysotile, or white asbestos. Other types of asbestos of lesser importance are anthophyllite, tremolite, and actinolite.[3] Chrysotile has yellowish or greenish white fibers which are usually silky in nature. Crocidolite is blue and less silky, and amosite has white, grey, pale yellow, or pale brown fibers which are more brittle than those of the other varieties.[4]

Long, thin and flexible enough to be woven, asbestos fibers are heat-resistant and chemically inert. A virtually indestructible insulating material, asbestos has been widely used in the United States since the 1800s. The presence of asbestos is pervasive throughout the country. As DiGregorio points out, "virtually every community in the United States (and other industrialized countries) is saturated with asbestos fibers."[5] Surveys conducted by the Environmental Protection Agency (EPA) estimate that asbestos containing materials can be found in approximately 31,000 schools and 733,000 other public buildings in this country.[6] The problem apparently exists in private dwellings as well. For example, scientists funded by the Department of Health and Human Services discovered up to 200,000 California homes that contain air-distribution ducts made of corrugated asbestos paper.[7]

Production of Asbestos

Estimates of the production of asbestos vary, though it is clear that Canada, South Africa and the Soviet Union lead the world in asbestos mining. The first major boon to the production of asbestos was the industrial revolution. Machines for the production and use of power furnished an immediate stimulus to the asbestos industry through the need for packing and insulation.[8] World War II provided a tremendous boost in the demand for asbestos when government contractors and private industry utilized huge quantities of materials containing asbestos for use in the manufacture of ships, clothing, building materials, brake linings, and insulation.

Production of asbestos has increased dramatically since World War II and has doubled since 1960. In the past 20 years, about 70 million tons of asbestos have been mined, distributed, and used in various applications throughout the world. It is estimated that almost 32 million tons of asbestos had been used in over 3,000 products in this country by 1978.[9] For the future, the U.S. Bureau of Mines estimates that known reserves of asbestos are 87 million tons, and that total resources may be in the order of 135 million tons.[10] Despite problems to be extensively described later in this paper, the Manville Corporation plans to produce more than 700,000 tons of asbestos fiber per year through at least 1990 from proven reserves.[11]

Uses of Asbestos

The EPA has grouped asbestos-containing materials (ACM) into three categories: (1) sprayed- or trowelled-on materials on ceilings, walls, and other surfaces; (2) insulation on pipes, boilers, tanks, ducts, and other equipment; and (3) other miscellaneous products. Asbestos in the first two categories can be "friable," that is, it can be crumbled, pulverized, or reduced to powder by hand pressure.12

In 1947 the trade journal "Asbestos" listed the scope of asbestos uses as providing protection against weather, corrosion, fire, heat, cold, acid, alkalies, electricity, noise, energy losses, vibration, accident, frost, dust and vermin.[13] The 1953 edition of the Asbestos Fact Book listed 40 uses for raw asbestos, 16 for asbestos yarn, 29 for asbestos cloth, 17 for asbestos paper, 14 for asbestos mill board, 11 for asbestos-cement flat sheets, and 10 for asbestos composition material.[14] Appendix A shows various uses of asbestos in building products over the last several decades.

In focusing on uses of asbestos in buildings, the EPA found that prior to 1960, most of the asbestos-containing friable materials found were boiler and pipe insulation materials. After 1960 most of the asbestos-containing friable materials were sprayed or trowelled onto ceilings and steel beams. This continued until 1973, when the EPA banned the use of sprayed-on asbestos-containing friable materials for all but decorative use. These materials were banned totally in 1978.[15]

Footnotes

[1]Lee, Douglas H.K., and Selikoff, Irving J., "Historical Background to the Asbestos Problem," Environmental Research 18 (1979): 300-1.

[2]DiGregorio, G. John, "Toxicology of Asbestos," American Family Physician 32:5 November 1985, p. 201.

[3]Michaels, L., and Chissick, S.S., Asbestos: Properties, Applications, and Hazards, (New York: John Wiley and Sons, 1979): 46-7.

[4]Ibid.

[5]DiGregorio, p. 201.

[6]United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, Washington, D.C.: U.S. Environmental Protection Agency, 1985, p. S-1.

[7]Mereson, Amy, "Asbestos: The Problem Grows," Science Digest, January 1985, p. 32.

[8]Lee and Selikoff, p. 301.

[9]Zelen, Melissa, "Products Liability Issues in School Asbestos Litigation," American Journal of Law and Medicine 10:4 Winter 1985, p. 469.

[10]Lee and Selikoff, p. 302.

[11]Scheibla, Shirley Hobbs, "Heat on Asbestos: Legislative, Legal Challenges to Producers Mount," Barron's, February 11, 1985, p. 4.

[12]United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, Washington, D.C.: U.S. Environmental Protection Agency, 1985, p. S-1.

[13]As cited in Lee, Douglas H.K., and Selikoff, Irving J., "Historical Background to the Asbestos Problem," Environmental Research 18 (1979): 301.

[14]Ibid.

[15]United States Environmental Protection Agency, Office of Toxic Substances, Asbestos in Buildings: A National Survey of Asbestos-Containing Friable Materials, Washington, D.C.: U.S. Environmental Protection Agency, 1984, p. 2-7.

CHAPTER III.

ASBESTOS-RELATED HEALTH HAZARDS

Asbestos poses no hazard to humans when it is contained. It is only when it becomes friable (i.e., easily crumbled by hand pressure) that it becomes a health problem. Friable asbestos can release fibers into the air when it is disturbed or by gradual deterioration over time.

Asbestos fibers vary in width from 0.06 to 0.25u, and in length from 0.2 to 2.0u (u = one micrometer or one 1,000,000th of a meter). These fibers enter the body primarily through inhalation and are deposited in the respiratory tract. Table 1 demonstrates how fiber length impacts on disposition of fibers in the body. Larger fibers may remain in the lungs, while shorter fibers can be transported to the bloodstream through lymphatic channels. Between 10 and 30 percent of asbestos fibers retained by the lungs become coated with bodily substances which leave them biologically inactive. The other 70 to 90 percent remain free in the lungs. Asbestos fibers may also be ingested via contaminated food and liquids. Once in the bloodstream,

Table 1.--Asbestos Fibers Less Than 3.3 Microns are Deposited in Lungs

Length, in micrometers	Disposition
Over 10	Fibers deposited in mucous layer of bronchi (upper respiratory tract)
5 - 10	Fibers are removed in the bronchi
3 - 5	Fibers may pass deep into lungs, but not is any appreciable quantity
0.8 - 3	Most fibers deposited at the alveoli (air sacks). Fibers cannot be seen by unaided eye, but cause significant injury to lungs
0.4 - 0.5	Few fibers deposited; 80% exhaled
Under 0.2	Electrostatic forces cause these extremely fine particles to combine; deposited in alveoli

Source: Ryckman, Mark D. et al "Asbestos Control Program for Institutional Facilities," Journal of Environmental Engineering 109 (April 1983): 279.

asbestos fibers are distributed throughout the body: they have been found in the tonsils, lymph nodes, pleura, liver, spleen, pancreas and kidneys.1

Diseases Associated With Asbestos

Three major diseases have been linked to asbestos exposure: (1) adenocarcinoma of the lungs; (2) pleural and peritoneal mesothelioma; and (3) asbestosis.

Adenocarcinoma is the most common type of lung cancer found in asbestos-exposed patients, occuring with a frequency of 30 to 40 percent. Research has shown that lung carcinoma related to asbestos is more dependent on exposure than to type of asbestos fiber. The more intense the exposure, the greater the chance of developing lung cancer. The intensity of exposure also appears to impact on the latency period between the first exposure to asbestos and death from lung cancer. Studies show that there seems to be a 15-year minimum latency for individuals who are heavily exposed and a 25- to 35-year latency period among those with less intense exposure.2

Additionally, there appears to be a strong correlation between the occurrence of cancer and the age of the individual when initially exposed. Men first exposed at older ages have a higher incidence of cancer. Cigarette smoking also appears to work synergistically with asbestos in causing lung cancer. Individuals who smoke and have been exposed to asbestos have a higher incidence of lung cancer than either those who only smoke or those who have been exposed to lung cancer but do not smoke.[3]

Mesothelioma, or cancer of the mesothelial tissue which lines the pleural, pericardial and peritoneal spaces, has also been found in asbestos-exposed persons. The thick, yellowish-gray tumor gradually encases part or all of the lung. The tumor can metastasize to the chestwall and to organs in the peritoneal cavity, compressing the organs with minimum invasion of their walls.[4] Mesotheliomas are uniformly fatal. Neither radical surgery, radiation, nor chemotherapy prolongs survival.[5] This form of cancer is rare, however, affecting only two or three people per million per year. In over 80 percent of the cases, however, significant exposure to asbestos has been documented.

Asbestosis is a progressive form of lung fibrosis which causes irreversible respiratory disability. Modern knowledge of asbestosis dates from the year 1900, when Dr. H. Montague Murray, a physician in London's Charity Cross Hospital, performed a post-mortem examination of a 33 year old man who had worked for fourteen years in an asbestos-textile factory. When Dr. Murray found specules of asbestos in the lung tissues at autopsy he was able to establish a presumptive connection between the man's occupation and the disease that killed him.[6] The underlying mechanism in asbestosis is fibrogenesis, or the production of collagen in the lungs. The collagen interferes with the transfer of oxygen between the lungs and hemoglobin in the blood.[7]

While the exact toll that asbestos takes on the health of the nation cannot be determined, Selikoff estimates that at least one person dies from asbestos exposure-related illness every 58 minutes.[8] This statistic does not include the effects of asbestosis, which can be extremely debilitating but rarely fatal.

Estimates of Asbestos-associated Disease and Death

It has been estimated that more than 27 million Americans have been exposed to asbestos.[9] This figure covers individuals with only casual exposure, to asbestos industry employees who worked in clouds of asbestos dust for years. Selikoff points out that we are now in the midst of widespread asbestos disease resulting from exposures during the past 60 years. One scientist has calculated that there have been more than 100,000 deaths of asbestos-related disease, and that there will be up to 350,000 additional deaths before the effects of past exposures run their course.[10] It is important to note that these are deaths related to occupational exposure. These figures do not include deaths from non-occupational exposure to asbestos. More importantly, they do not include far greater numbers of individuals with asbestosis of greater or lesser severity, which may be disabling but insufficient to cause death.

There are a number of the major difficulties in estimating asbestos-related death and disease. One key factor is the matter of latency. In the majority of cases, diseases related to asbestos exposure present themselves 20 or more years after initial exposure to asbestos. Another factor is the so-called "dose-disease" response. It has generally been proven that the less exposure to asbestos, the less disease; the more exposure, the more disease.[11] Studies have shown that brief exposure, if fairly intense, produces disease. Long-term exposure at relatively low levels also produces disease. Due to the latency factor associated with asbestos-related disease, it is often difficult for workers now experiencing illness to recall intensity or duration of asbestos exposure. Lacking such data, it is difficult to construct predictive models to estimate future disease.

There also appears to be multiple factor interaction when examining asbestos-related diseases. Selikoff demonstrated this with an extensive cohort study. In the study, 17,800 asbestos insulation workers were registered on January 1, 1967 and followed to December 31, 1976. Using some 73,000 similar men as a control, Selikoff found that the rate of lung cancer for men who neither smoked cigarettes nor worked with asbestos was 11 per 100,000 per year. For non-smokers who worked with asbestos, it was 58. Among those who smoked, but were not asbestos-exposed, the risk was 112 per 100,000 per year, and for those who had both exposure, asbestos and cigarette smoking, the figure was 601.[12]

Walker et al have attempted to arrive at estimates of the number of cases of mesothelioma, lung cancer, and asbestosis which will arise in the United States between the years 1980 and 2009. Their focus is on individuals with nontrivial exposure to asbestos. The results of their study are shown at tables 2, 3, and 4.

Table 2 - Projected Numbers of New Lung Cancer Cases 1980-2009 in U.S. Men Plausibly Exposed to Asbestos

Year	No. of New Cases
1980-1984	17,800
1985-1989	13,600
1990-1994	10,200
1995-1999	7,000
2000-2004	4,300
2005-2009	2,200
Total	55,100

Table 3 - Projected Numbers of New Mesothelioma Cases 1980-2009 in Men With Plausible Asbestos Exposure Using Two Models of Incidence

	No Latency Period (Peto)	Latency Period (Breslow)
1980-1984	3,200	3,400
1985-1989	3,500	3,900
1990-1994	3,600	4,200
1995-1999	3,400	4,000
2000-2004	2,900	3,500
2005-2009	2,100	2,500
Total 1980-2009	18,700	21,500

Table 4 - Projections of the Number of Prevalent Cases of Asbestosis in U.S. Males 1980-2009

Years	No. of Men Alive with Asbestosis
1980-1984	64,000
1985-1989	45,300
1990-1994	31,000
1995-1999	19,700
2000-2004	11,400
2005-2009	5,700

Source: Walker, Alexander M. et al "Projections of Asbestos-Related Disease 1980-2009," Journal of Occupational Medicine Vol. 25, No. 5 (May 1983).

Costs Associated with Asbestos Disease

In one of the first studies of its kind, Johnson and Heler attempted to measure the financial losses incurred by workers or their survivors as a result of death and disability from exposure to asbestos. In the vast majority of cases, it was found that workers' compensation laws with limitations on coverages and restrictions on the time period in which a claim could be filed, severely limited compensation to asbestos victims.[13] Workers' compensation laws also barred workers from suing their employers, resulting in thousands of workers filing product liability suits against asbestos manufacturers.

Johnson and Heler focused their study on the widows of men followed in the Selikoff study mentioned previously. Wage rate estimates were taken from the labor agreements of these asbestos workers. Allowing for loss of household production, taxes and consumption, and discounting for future earnings, the researchers arrived at an average gross loss of about $250,000 for each asbestos-related death.

Compensation for these losses was determined to be only a fraction of what was needed. Sources of compensation that can be attributed to the worker's death included: tort suit awards, Social Security survivor's benefits, veteran's (widow's) benefits, workers' compensation benefits, survivor's benefits from private pensions, and public assistance. To measure benefit adequacy, the authors developed a "replacement ratio," defined as the ratio of total (death-related) benefits to the net loss to the household. The median replacement ratio for widows studied in 1979 was 34.3 percent, indicating that they bore approximately 66 percent of the annual loss due to their husbands' deaths.14

Johnson and Heler made further calulations of cost using figures provided by Nicholson, who predicts that 353,300 workers will die from 1978 through 2027 as a result of asbestos exposures from 1940 to 1979. Using their estimates of gross loss per death, the researchers estimate that deaths that occur between the years 1978 through 2027 will cost some $310 billion dollars. This figure could be raised even higher by an amount equal to the costs of medical care, litigation costs, and the administrative costs incurred by social agencies who deal with the problems of workers' survivors.15

Footnotes

[1]DiGregorio, G. John, and Kotyuk, Bernard L., "Toxicology of Asbestos," American Family Physician, 32 (November 1985): 201.

[2]Ibid.

[3]Ibid, p. 202.

[4]DiGregorio, p. 201.

[5]Michaels, L., and Chissick, S.S. ed. Asbestos: Properties, Applications, and Hazards, (New York: John Wiley and Sons, 1979): 509.

[6]Brodeur, Paul, "The Asbestos Industry on Trial. Part I - A Failure to Warn," New Yorker, June 10, 1985, p. 58.

[7]DiGregorio, "Toxicology of Asbestos," p. 203.

[8]Mereson, Amy, "Asbestos: The Problem Grows," Science Digest, January 1985, p. 32.

[9]Jubak, Jim, "They are the first: Asbestos workers are at the beginning of a wave of occupational diseases," Environmental Action, February 1983, p. 9.

[10]Selikoff, Irving J., "Twenty Lessons from Asbestos: A Bitter Harvest of Scientific Information," EPA Journal, May 1984, p. 21.

[11]Ibid, p. 22.

[12]Selikoff, Irving J., "Asbestos-Related Disease - An Overview, 1982," presented to the World Symposium on Asbestos, Montreal, Canada, Session I - Asbestos: The Medical Data, May 25, 1982, p. 6.

[13]Johnson, William G., and Heler, Edward, "The Costs of Asbestos-associated Disease and Death," Milbank Memorial Fund Quarterly 61 (Spring 1983): 177.

[14]Ibid, p. 189.

[15]Ibid, p. 192.

CHAPTER IV.

LEGAL ISSUES ASSOCIATED WITH THE ASBESTOS PROBLEM

As noted previously, millions of Americans have been exposed to asbestos, and those with significant exposure face disability or early death from asbestosis, mesothelioma, and lung cancers. A myriad of legal issues has arisen which involve workers, manufacturers, insurance companies, and government. Most of these issues center on the question of responsibility for compensating the victims of asbestos exposure.

It is tragic to note that much of the suffering attributable to asbestos might have been avoided if government and industry had heeded warnings regarding asbestos as early as the 1930s.[1] Health experts contend that despite widespread recognition at that time of the hazards of asbestos exposure, manufacturers uniformly failed to adequately warn workers of the danger.[2]

Lawsuits

As victims of asbestos exposure began to experience disability or death, they or their families began to seek compensation. The outlook for victims improved dramatically in 1973, when the U.S. 5th Circuit Court of Appeals upheld a Texas federal jury award of $79,000 to Clarence Borel, an insulation worker who died of mesothelioma that same year. The appellate court ruled that the defendant, Fibreboard Paper Products Corporation, had had a duty to warn anyone likely to come in contact with its products that asbestos posed a serious health hazard, one that had been known.[3]

Up to this point, victims had to rely on workers compensation laws, which precluded employees from suing their employers for occupational injuries. Unfortunately, it has been noted in Senate testimony that only five percent of workers severely disabled by an occupational disease ever receive workers compensation benefits.[4] Additionally, one study has shown that a worker who is totally disabled by an occupational disease and is able to prove that the disease is work-related recovers an average of only $9700 in total benefits compared to his $77,000 of expected future earnings.[5] This lack of adequate compensation, the precedent set by the Borel case, and a dramatic increase in the asbestos-related disease rate, has resulted in what one author describes as an avalanche of litigation.[6]

Basis for the Lawsuits

Damages may be sought by plaintiffs on the basis of property damage, economic loss, or personal injury or death. The defendants, primarily asbestos manufacturers, may be held accountable under strict products liability standards.[7]

Strict liability is the primary theory of recovery in products liability law. The theory is based on the belief that defendants who benefit from the use or sale of a dangerous product should pay for the harm it causes. Imposition of strict liability is justified in three ways: it reduces the plaintiffs' burden of proof; it promotes increased product safety; and it presumes that the defendants are in a superior position to insure against the harms their products cause and to spread the cost of liability throughout the market.[8]

Legal Obstacles to Plantiffs

Even under the best of circumstances, plaintiffs face several barriers to a successful judgement. The first barrier is the sheer numbers of lawsuits being filed against asbestos manufacturers. These numbers continue to swell as the result of considerable publicity on television, radio and in newspapers. In the past, the government has even included warnings on asbestos hazards along with Social Security checks.[9]

Another major obstacle to claims by persons injured by asbestos exposure is the application of the statute of limitations.[10] As previously noted, it takes a long time--anywhere from about 10 to 40 years--before enough scar tissue builds up than an individual notices the shortness of breath associated with asbestosis. The cancers caused by asbestos have a latency period just as long, usually 15 to 30 years.[11]

Another impediment is proof of causation, or the multiple defendants problem. Persons suffering from asbestos-related disease may have been exposed to several different products containing asbestos. More than one manufacturer may have been the cause of the asbestos injury. Experts maintain that in this case, the best solution is to shift the burden of proof from the plaintiff to the defendant.[12]

Plaintiffs have repeatedly had to prove that manufacturers had prior knowledge of the medical hazards of asbestos exposure. Essentially, plaintiffs suffer from a failure of the courts to apply the doctrine of collateral estoppel. This doctrine precludes a party from relitigating an issue that has already been litigated.[13]

Additionally, when Manville Corporation has been named as a litigant, important documents could be introduced demonstrating prior knowledge of medical hazards. Such documents include correspondence from 1935 between Sumner Simpson, then president of Raybestos-Manhattan, and Vandiver Brown, then general counsel of Johns-Manville, discussing how they should respond to new British studies on the hazards of asbestos:

> In one letter Sumner wrote: "I think the less said about asbestos, the better off we are." Brown replied: "I quite agree with you that our

> interests are best served by having asbestosis receive the minimum of publicity.[14]

These letters have been introduced as evidence in courtrooms nationwide, and in some cases, juries have awarded punitive damages that ran into seven figures.[15] However, when Manville filed for Chapter 11 bankruptcy in 1982 (see discussion below), they could not be named in new lawsuits, and the documents were frequently held to be inadmissible in court.

Industry Reaction of the Litigation Deluge

It is estimated that there are currently more than twenty-four thousand personal injury cases and thousands of property damage suits pending against the asbestos industry. The vast majority of these cases involve factory and industrial use of asbestos. In the area of personal injury, as more and more people are debilitated or die from asbestos, the number of damage suits is skyrocketing.

The nation's largest asbestos producer, the Denver-based Manville Corporation (formerly Johns-Manville), chose a unique way to shield itself from liability to workers who contracted asbestos-related disease as a result of exposure to Manville products. On August 26, 1982 attorneys for the company filed for Manville's reorganization under Chapter 11 of the Federal Bankruptcy Act. Far from being insolvent, at the time of the filing the company had an estimated net worth of $1.1 billion.

Inundated with legal claims, Manville sought refuge in the fact that under federal bankruptcy laws, no lawsuit can be commenced or continued against a Chapter 11 company while it is in reorganization.[16]

The implications of Manville's action for victims of asbestos-related disease are numerous and varied. If Manville, a corporation with considerable assets, can shield itself from liability, there seems to be no reason why other asbestos manufacturers won't do the same thing.[17] There are significant concerns that any industry or firm with substantial projected liability may shield itself by filing for bankruptcy, regardless of its financial situation. As a counter-point, the asbestos industry contends that future claims against them will force them to liquidate, leaving all those injured by their products without any recourse. Company attorneys argue that such claims must be ascertained and provided for in a fund that will pay out a formulated amount for those injured over a set period of time, perhaps the next 20 years or so.[18]

Some observers predicted that Manville's bankruptcy filing might again spur the Congress into action. Previous legislative efforts to aid victims of asbestos-related disease failed. In 1977, Rep. Edward R. Beard (D., R.I.) sponsored a bill to aid disabled asbestos workers. The bill would have established a special uniform workers compensation benefit, to be financed partly by taxes on asbestos and cigarettes.[19] As expected, however, the powerful asbestos and tobacco industries rose up and easily squelched the bill.

Compensation for victims of asbestos-related disease may depend on the insurance industry. Asbestos manufacturers have, at various times and with various companies, taken out major insurance policies to protect themselves against afflicted workers' claims. The long period of time between exposure to asbestos and manifestation of disease, however, raises a difficult question. Which insurer should be responsible for paying a given worker's claim: the company that provided coverage when the worker was exposed to asbestos, the company that provided coverage when the disease became manifest, or the company that provided coverage at anytime in between?[20]

In 1947, Johns-Manville signed the first of a series of policies it would hold with Travelers Insurance Corporation for the next thirty years. Aggregate coverage under the policies is $16 million, with a $5,000 deductible for each claim. In addition, the company took out $348 million in back-up coverage with other insurers that could be called on if the primary coverage is exhausted.[21]

How long the insurance coverage will last is certainly open to speculation. Many thousands of personal injury suits totaling billions of dollars have been filed by workers suffering from asbestos-related diseases.

Researchers at the Mt. Sinai School of Medicine in New York have estimated that the total cost of compensating workers exposed to the mineral could run well beyond $40 billion.[22]

Equally staggering is the number of property damage claims filed against asbestos manufacturers. As examples, New York City, which has a very aggressive asbestos abatement program, is seeking $250 million in compensatory damages from 64 companies who were connected in some fashion with asbestos. Los Angeles has sued more than 90 companies for compensatory damages in excess of $135 million, and punitive damages of more than $50 million.[23] Manville officials recently estimated the total number and price of property damage claims filed against the corporation at 9,500 and $69 billion, respectively.[24]

These property damage suits serve two purposes. First, they help organizations and institutions avoid negligence lawsuits against themselves by their own employees. Second, institutions can speed the removal of asbestos by making more money available to pay for asbestos abatement programs.[25]

<u>Consolidated Claims Facility</u>

It appears that the two major parties in asbestos litigation, manufacturers and victims, are both extremely dissatisfied with the American tort system. Indeed, Manville Corporation filed for its Chapter 11 bankruptcy to dramatize the problems that proliferating asbestos litigation is causing manufacturers, their insurers, the courts, and the injured workers.[26]

The true beneficiaries of the asbestos legal tangle seem to be attorneys. The complex nature of these cases present dozens, if not hundreds, of technicalities and fine points of law. The result has been lawyers who are paid fees that often exceed by far the compensation received by victims fortunate enough to have had their cases heard.[27]

A study made by the Rand Corporation in 1984 found that asbestos victims to date had received $236 million in compensation, their lawyers have earned $164 million, and defense lawyers for asbestos and insurance industries have earned more than $600 million--including $395 million to fight claims from victims who got nothing.[28] A typical asbestos case involves 20 asbestos companies as defendants, several insurance carriers, and teams of lawyers. The average case costs $95,000 to resolve--$35,000 for awards to the worker, and almost $60,000 for legal fees.[29]

A proposed solution to these excesses is a consolidated claims facility. All the manufacturers and insurers involved would pool their resources to set up a facility that handles and tries to settle claims.[30] When Johns-Manville filed for Chapter 11 bankruptcy, it included in its reorganization plan a proposal to contribute earnings to a trust fund set up to pay victims of asbestos-related diseases. Under their initial plan, claims would be evaluated by medical experts, who would adjust awards up or down from standard payments of $50,000 for mesothelioma, $45,000 for lung cancer, $40,000 for asbestosis, and $1,000 for thickening of the lung membrane.[31]

The Manville Corporation very recently overcame two major obstacles to its proposed reorganization under Chapter 11 bankruptcy laws. It has created a plan acceptable to its creditors, and has announced a new management team.[32] The plan also established two trusts to pay bodily injury and property damage claims. Present and future claimants would receive compensation from an asbestos-health trust fund established by an initial funding of about $1 billion in cash, receivables and Manville stock as well as additional cash payments of $75 million per year. Also, as much as 20 percent of Manville's operating profits can be used to fund the trust if additional funding is needed. Total payments are expected to exceed $2.5 billion over a period of 20 to 25 years. The property damage trust would receive initial funding of $125 million, and could receive additional money from unused asbestos-health trust funds.[33]

The future of the consolidated claims center looks encouraging. The Manville corporation recently signed up as a conditional participant in the Asbestos Claims Facility, which is being developed with the help of Harry Wellington, dean of the Yale Law School.[34] The Asbestos Claims Facility will represent 23 asbestos manufacturers and 17 insurers.

It is hoped that all pending personal injury claims will be funneled through the claims center, and proponents of the system say the average award to asbestos victims will be about what they could expect to win from juries. Legal fees will be slashed dramatically, victims will receive much swifter payment, and claimants who think that settlement offers are too low may still take the asbestos manufacturers to court.[35]

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[9]Ibid, p. 77.

[10]Jubak, "They are the first," p. 10.

[11]O'Hare, p. 85.

[12]Ibid, p. 85-6.

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[32]Bulman, Philip, "Manville clears 2 reorganization hurdles," The Denver Post, May 11, 1986, p. F1.

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[34]Cifelli, "Asbestos Defendants Try a New Approach," p. 165.

[35] Ibid.

CHAPTER V.

HISTORY OF GOVERNMENT INVOLVEMENT IN THE ASBESTOS PROBLEM

> The history of efforts to control human exposure to asbestos has not been an auspicious one. There has been little for which to congratulate ourselves.[1]
>
> -- Dr. William J. Nicholson

The health implications of asbestos have been known for many decades. In 1924, W.E. Cooke published an article in the British Medical Journal reporting on a young woman who had worked with asbestos and who had died with extensively scarred lungs. In a second article in 1930, he gave the disease the name it still bears, pulmonary asbestosis.[2] Major surveys conducted in 1928 and 1929 by the British Factory Inspectorate of asbestos textile mills showed that of those workers exposed for more than 20 years, 80 percent had abnormal x-rays.[3] As a result of these studies, the British government established the Asbestos Industry Regulations 1931. These regulations required certain precautions aimed at reducing the exposure of workers to asbestos dust.[4]

It has only been within the last decade, however, that the U.S. government has begun to take effective action to reduce exposure to this harmful substance. As has been noted, the approach of the American government has been to lay down the maximum allowable exposure of workers to asbestos, above which protection is deemed to be necessary.[5]

Evolution of Asbestos Exposure Standards

In 1938, on the basis of a study conducted on North Carolina asbestos workers, a tentative asbestos standard of 5 million particles per cubic foot (mppcf) was proposed as guidance for industry. It had no force of law.[6] In 1946, the American Conference of Governmental Industrial Hygienists (ACGIH), a private organization, adopted the 5 mppcf standard for their list of Maximum Acceptable Concentration Values. It was not until 1960 that the 5 mppcf standard obtained legal status under the Walsh-Healey Act for employers conducting more than $10,000 of business with the United States government.[7] Leading the way again, the ACGIH proposed an exposure standard of 2 mppcf or 12 fibers per milliliter of air (12 f/ml) in 1968, and this became law under amendments to the Walsh-Healey Act on May 20, 1969.

In the late 1960s, nation-wide concern for the condition of the environment reached a peak. In 1970, President Nixon proposed the formation of an Environmental Protection Agency (EPA), and secured widespread support from the Congress. The EPA was established to coordinate the national effort to clean up the environment, consolidating the federal agencies assigned to deal with air and water pollution, regulation of pesticides and atomic radiation, and solid-waste disposal.[8] The same year, Congress passed Public Law 91-596, the Occupational Safety and Health Act of 1970. Congress cited concern over personal injuries and illnesses arising out of work situations that resulted in lost production, wage loss, medical expenses, and disability compensation payments. The law created the Occupational Health and Safety Administration (OSHA), and enpowered it to develop standards which prescribed suitable protective equipment and control on technological procedures to be used in connection with workplace hazards (such as asbestos), and to monitor and measure employee exposure to such hazards.

On May 29, 1971 OSHA established a national emission standard for asbestos of 2 mppcf or 12 f/ml. Just seven months later, an emergency standard of 5 f/ml was promulgated in the Federal Register. It must be noted that, although the carcinogenic nature of asbestos had been established by this time, the new standard was intended to prevent only asbestosis.[9]

Change 12 to OSHA Standard 1910.1001--Asbestos, established a permanent exposure standard of 5 fibers per cubic centimeter (f/cc) of air effective July 7, 1972. It also provided for the 8-hour time-weighted exposure standard to drop to 2f/cc effective July 1, 1976. The ceiling concentration for short term exposure was not to exceed 10 f/cc for longer than 15 minutes. In 1973, under the Clean Air Act, OSHA banned all visible emissions of asbestos, to include sprayed-on asbestos insulation. In 1975, based on renewed concern over the carcenogenic effects of asbestos, OSHA proposed a standard of 0.5 f/cc, while the National Institute for Occupational Safety and Health (NIOSH) recommended a 0.1 fiber standard. To date, the 2f/cc standard remains in effect.

Asbestos in Schools

In the late 1970s, the topic of asbestos in schools became an area of national concern. The EPA had estimated that as many as 14,000 schools in this country might contain dangerous friable asbestos, with more than 3 million students and 250,000 staff members at risk.10 On June 14, 1980, Congress passed Public Law 96-270, the Asbestos School Hazard Detection and Control Act of 1980. Congress cited the following concerns as the basis for its action:

a. Exposure to asbestos significantly increases the incidence of cancer and other severe or fatal diseases.

b. Medical evidence has suggested that children are particularly vulnerable to asbestos-induced cancers (because of the latency nature of asbestos exposure).

c. Substantial amounts of asbestos had been used in school buildings, particularly during the period 1946 through 1972.

d. No Federal health standard regulating the concentration of asbestos fibers in noncommercial workplace environments had been established.[11]

This law, along with the Toxic Substances Control Act, required schools to inspect their facilities for possible friable asbestos, sample the materials and have them analyzed, post warnings if asbestos was present, and then send written notice to staff members and the parent-teacher organization (PTO) of the school.[12] Neither law required the schools to remove, enclose, or encapsulate the asbestos material if found. Individual school systems were given the perrogative to deal with the situation an they saw fit. Compliance with these laws was to have been completed by June 1983. However, an EPA staff memorandum in August 1983 indicated that 80 percent of a sample of 167 schools were in violation of the EPA inspection rules.[13] In reaction, on November 16, 1983, the Service Employees International Union (SEIU), AFL-CIO, petitioned the EPA under section 21 of the Toxic Substances Control Act to initiate rulemaking proceedings concerning the abatement of friable asbestos-containing materials in public and private elementary and secondary schools and the inspection and abatement of these materials in other public and commerical buildings.[14]

In response to the petition, the EPA pointed out that it had established the Technical Assistance Program (TAP) in March 1979 to encourage states and schools to establish voluntary programs to detect and correct hazards posed by asbestos materials. A truly significant contribution was the development and distribution of the EPA document entitled, "Asbestos-Containing Materials in School Buildings: A Guidance Document," in 1979. The EPA also noted that it had appointed a Regional Asbestos Coordinator (RAC) at each EPA regional office, and had employed technical advisors (usually retired architects and engineers) to provide expertise to the RACs, and to offer guidance on developing and managing asbestos control programs.[15] However, the effectiveness of EPA methods is in substantial doubt. According to EPA documents released on November 16, 1985, EPA inspectors general leveled an indictment of EPA's asbestos program by documenting a pattern of lax inspection and enforcement procedures and failures to distribute EPA guidance.[16]

Congress took additional action in 1984 by passing the Asbestos School Hazard Abatement Act. The law authorized the EPA to oversee a program of inspecting the nation's schools for asbestos, and to allocate up to six hundred million dollars in loans and grants over six years for the purpose of removing asbestos found in schools.[17] Despite substantial Congressional authorizations, the EPA provided only $45 million in grants and loans to 341 schools in 1985.[18] These schools were located in 189 of 1,107 school districts that applied for funds. Prospects for 1986 don't look substantially better. A recent memorandum from the EPA's Asbestos Action Program Director to public and private school administrators pointed out that funds for 1986 will only go to school districts with serious asbestos hazards and severe financial needs.[19] The future situation looks bleaker. The memorandum notes that "future Federal funding for the program is not a high priority and the Administration is not seeking funds for this program in 1987."[20]

Current EPA Initiatives

Despite its failure to provide loans and grants to schools to inspect for and abate asbestos materials, the EPA has begun to step up enforcement of its school inspection requirements. Inspection of schools has become one of the EPA's Top Ten priority items, and the agency has recently doubled its monitoring staff.[21]

Additionally, on January 16, 1986 the Environmental Protection Agency and the U.S. Department of Justice filed lawsuits in 10 cities, citing that buildings had been demolished or renovated in ways that released deadly asbestos fibers into the air.[22] Named in the lawsuits were the states of Florida, Washington, and Idaho, as well as Boise State University, the board of education in Franklin, N.J., and the Consolidated Rail Corporation.

Finally, in a move that faces considerable opposition, the EPA earlier this year proposed tough rules that would ban all asbestos processing and use within 10 years.[23] The rules would immediately ban asbestos in products for which substitute materials are readily available, and phase out other uses over a 10-year period. The rules face lengthy public hearings, and stiff resistance from the asbestos industry. The EPA bases its proposed rules on the opinion that no level of exposure to asbestos is without risk.

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CHAPTER VI.

ASBESTOS ABATEMENT

Scope of the Problem

In the early 1980's, the United States Environmental Protection Agency (USEPA) conducted an extensive study of various structures in ten major U.S. cities. The survey's primary objective was to determine the extent of the use of friable asbestos-containing materials in buildings and the amounts of asbestos in them. These estimates were made for three types of buildings: federal government (owned or operated by a civilian agency); residential (with 10 or more rental units); and private, nonresidential (largely commercial--office, retail and other).

The major study findings are summarized below. Managers can compare these characteristics to gain yet another indication if buildings under their control may contain asbestos.

a. About 20 percent of all buildings have some type of asbestos-containing friable material. This represents some 733,000 buildings nationwide.

b. Five percent of buildings have asbestos-containing sprayed- or trowelled-on friable material.

c. Sixteen percent of buildings, or 563,000 buildings have asbestos-containing pipe and boiler insulation. This material is generally limited to closed, restricted-access areas rather than offices or other highly-used space.

d. The amount of sprayed- or trowelled-on asbestos-containing material is estimated at 1,184 million square feet.

e. The average percent of asbestos content in asbestos-containing sprayed- or trowelled-on friable material was 14 percent. For asbestos-containing pipe and boiler insulation material, the average percent asbestos content was 70 percent.

f. Federal government buildings had a higher incidence of asbestos-containing friable materials than private, nonresidential buildings.

g. Buildings constructed in the sixties are more likely to have asbestos-containing sprayed- or trowelled-on friable material (15% of such buildings do), than other buildings. Older buildings are more likely than newer ones to have asbestos-containing pipe and boiler insulation.[1]

Appendix B provides a visual example of three types of spray-applied asbestos-containing materials.

Building Inspections

If a manager suspects that a building has asbestos-containing materials, the next step is to conduct a survey of the building. The EPA suggests four major components for an accurate survey:

1. Review building records for references to asbestos used in construction or repairs;

2. Inspect materials throughout the building to identify those that may contain asbestos;

3. Sample suspect materials for laboratory confirmation that asbestos is present; and

4. Map the locations of all confirmed or suspected asbestos-containing materials (ACM).2

Appendix C provides a decision diagram covering the building inspection process. A properly conducted survey will provide accurate information that is completely documented.

Organization executives should appoint an over-all asbestos program manager. This individual should possess the skills to direct the survey team, develop an asbestos control program, initiate special operations and maintenance (O and M) programs, communicate with employees and the public, and monitor abatement projects or contract for special skills required.

Conducting the Survey

Although building records may be helpful, visual inspection is essential to a thorough and accurate survey. To ensure completeness, yet minimize costs, the following procedures, as recommended by the EPA, should be followed:

1. Identify all friable surfacing materials and group them into homogeneous Sampling Areas. Generally, homogeneous surfaces will be similar in texture and appearance, and were installed at approximately the same time.

2. Prepare diagrams of each Sampling Area. Basic floorplans can be used for this purpose. Each diagram should include:

a. An identification number;

b. A brief description of the Sampling Area; and

c. Area dimensions and scale.

A cover document should be placed over the compiled diagrams listing the name and address of the building; name and telephone number of the asbestos program manager, name of inspector, and date of inspection.

3. Determine number of samples to be taken. Recommendation on the number of samples to take vary considerably. Ryckman et al suggest a minimum of one bulk sample per 5,000 sq ft of surface, or three bulk samples per

sample area. EPA recommendations are more stringent, as demonstrated in table 5.

Table 5. The Number of Samples to be Collected from each Sampling Area.

Size of the Sampling Area	Recommended No. of Samples to be Collected	Minimum No. of Samples to be Collected
< 1,000 sq ft	9	3
1,000 - 5,000 sq ft	9	5
> 5,000 sq ft	9	7

Source: United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials, Washington, D.C.: U.S. Environmental Protection Agency, October 1985, p. 5.

4. Select and identify sample locations. The asbestos program manager should decide on the number of samples to be taken from each sampling area. The area should then be divided into a similar number of subsections. The bulk sample should be taken as close to the center of the subarea as possible. Both the bulk sample and the specific location on the diagram should be assigned a non-systematic but unique sample I.D. number. A non-systematic numbering system is used to prevent bias on the part of laboratory analysts.

5. Collect samples. During sampling, asbestos-containing material can be damaged and significant amounts of fibers released. The following steps should be taken to alleviate these conditions:

a. Minimize the number of personnel in the sampling area.

b. Ensure that the individual taking the samples wears at least a half-face respirator with disposable filters.

c. Wet the surface to be sampled with water from a spray bottle, or place a plastic bag around the sampler.

d. Choose either reusable (such as a cork borer), or a single-use sampler such as glass vials. With a twisting motion, slowly push the sampler into the material. Seal the sample container, wet-wipe the exterior, and label it with the sample number.

e. Cover the sample area with latex paint or other appropriate sealant.

f. Send the samples to a qualified laboratory. The EPA runs a bulk asbestos sample quality assurance program. An updated list of participating laboratories can be obtained within a few working days by calling the EPA's Asbestos Technical Information Service at (800) 334-8571.

It should be noted that the sampling procedures listed above are intended for sprayed- or trowelled-on materials. Pipe and boiler insulation that is in good condition should not be disturbed. If necessary, such insulation should be sampled from damaged areas or exposed ends using procedures listed above.

Bulk Testing Results

Appendix D gives an example of how the selected laboratory may report bulk sampling test results. The EPA recommends that if one or more bulk samples from a Sampling Area has more than 1 percent asbestos, then the entire Sampling Area should be treated as if it contains asbestos. Once asbestos is found, the EPA recommends instituting a special operations and maintenance program immediately. The purpose of any such program is to:

1. Clean up asbestos fibers previously released.

2. Prevent future release by minimizing ACM disturbance or damage.

3. Monitor the condition of ACM.

Once areas in the building containing asbestos have been identified, the ACM should be more closely examined. It must be remembered that the mere presence of asbestos-containing materials does not constitute a health hazard. It is only when the ACM is releasing fibers in potentially harmful quantities that specific action is required.

Standards for Exposure for Airborne Asbestos

The current industrial standard as established by OSHA is that no one will be exposed to air containing more than 2 fibers per cubic centimeter (cm3) for more than 8 hours at a time. Put another way, one cubic meter (slightly larger than a cubic yard) would contain approximately 2,000,000 fibers. At the time this research paper was being finalized, OSHA announced that a revised, and signficantly lower standard for exposure, was imminent. What that precise standard will be is unknown at this time. Appendix E provides graphic illustrations of how asbestos fibers are measured.

It must be remembered that OSHA standards apply only to occupational environments, i.e., where asbestos is mined or asbestos-containing products are manufactured or worked. Considering the carcenogenic effects of asbestos fibers, any exposure to the substance is harmful, and friable asbestos materials should be removed as soon as possible. Measuring for airborne asbestos fibers merely provides management with information on the urgency of the situation.

There are three ways to measure for the presence of airborne asbestos fibers:

1. Phase contrast microscopy (PCM).
2. Scanning electron microscopy (SEM).
3. Transmission electron microscopy (TEM).

The EPA has evaluated each of these methods based on testing standards, cost, availability, time requirements for preparation and analysis, sensitivity (thinnest fibers visible), and specificity. Phase contrast microscopy is the least sensitive, and does not specify if fibers collected are asbestos. However, PCM standard methods have been established by NIOSH, the cost is only $25-50 per sample, it is the most available testing procedure, and results can be reported in a matter of hours if necessary. Consequently, PCM is the testing method of most interest to managers.

The laboratory selected to test for airborne asbestos should be most familiar with USEPA and NIOSH procedures. A brief description of air sampling techniques is provided for management personnel.

a. Standard equipment for testing air includes a pump mounted in a canister, and a filter mounted in a casette. (For PCM testing, a cellulose ester filter is used).

b. At least 3,000 liters of air is drawn through each filter at a rate of 2 to 12 liters per minute.

c. At least five samples are taken per worksite, or one per room, whichever is greater.

Dyer Asbestos Hazard Index

James Dyer has proposed an asbestos hazard index for managing friable asbestos insulating material.3 The index provides the manager yet another tool for evaluating the need to take asbestos abatement action. Such an index is valuable in situations where management does not have the immediate resources to conduct an asbestos abatement project, yet needs an indication of the urgency of the situation.

The index takes into consideration the "dose" factor previously mentioned, i.e., concentration of asbestos fibers, period of exposure, and number of people exposed. The index relies less on air sampling techniques as described above, and more on characteristics of the building and its operations. The objective is to score a situation on several factors that describe the condition of the asbestos-containing material and the nature of the activities carried on in the facility. The score is then used to determine the appropriate level of the exposure factor.

The major factors included in the asbestos hazard index include:

Number of persons exposed

Level of exposure

Time duration of exposure

Amount of friable asbestos

- fiber content (percentage)
- location/accessibility

Condition of asbestos

- friability

- deterioration and adhesion

Disturbances

- air movement
- noise
- vibrations
- physical activity

Appendix F shows the index established by Dyer based on the factors listed above. Management attention is called to the hazard index values shown in the final 3 columns of the chart. The manager should locate the single line of elements that best describes the level of exposure elements found in the building concerned. Using information on the asbestos content of materials obtained by bulk sampling and testing, the appropriate hazard index value is located. This value is applied to the scale shown at table 6.

Table 6

Hazard Management Guide

Hazard Index Value	Recommended Action
Less than 100	Long-term corrective action can usually be deferred. Survey building each year for evidence of change in conditions or occupancy level. Initiate interim control measures to include employee education, posting of hazard signs, and special maintenance procedures.
100 - 1,000	Review projected remaining life of structure, projected renovation and utilization; conduct air sampling studies. Defer actions unless hazard exists.
Over 1,000	Asbestos abatement program should be initiated for long-term control.

SOURCE: Dyer, James S., "An Asbestos Hazard Index for Managing Friable Asbestos Insulating Material," Policy Studies Review, Vol. 1, No. 4 (May 1982): 663.

The EPA offers a more simplified table for assessing the need to take asbestos abatement actions.

Table 7. Assessment Table for Surfacing Materials

	Current Condition of ACM		
Potential for Future Damage, Disturbance or Erosion	Good	Minor Damage or Deterioration	Poor
Low	No action. Monitor.		
High	Remove, Enclose, Encapsulate during scheduled activities.	Selective or complete Removal as Soon as Possible	

Source: United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, Washington, D.C.: U.S. Environmental Protection Agency, June 1985, p. 4-7.

Asbestos Management Actions

If management decides that the asbestos-containing material poses a health hazard, and abatement action must be taken, three basic alternatives are available:

1. Removal of the asbestos.
2. Enclosure of the asbestos.
3. Encapsulation of the asbestos.

Before describing the specific positive and negative aspects of each alternative, it is important to note the common features of each asbestos abatement alternative.

1. Each alternative requires a more detailed inspection of both the ACM to be treated, and the underlying surface. The following information should be collected on each area with ACM:

a. Size of the area, since this affects the cost of abatement.

b. Type of construction if ceiling is coated with ACM (e.g., suspended lay-in panels, tile, metal, corrugated steel, etc).

c. Ceiling height, as this may determine the practicality of enclosing the material.

d. Type of wall (e.g., smooth or rough concrete), which may indicate whether an encapsulant is needed if material is removed.

e. Average thickness of the ACM, since encapsulants should not be applied to thick material.

2. The second common feature of each alternative is the need for worker protection during abatement activities. This includes proper training, specified work practices, and protective equipment. Details on protective equipment arv provided in Chapter VII.

3. The third common feature is proper work area containment to prevent the escape of asbestos fibers (see chapter VII).

4. The fourth common feature is the need for a rigorous post cleanup. Post-abatement air sampling is also important (see Chapter VII).

Initiating an Asbestos Abatement Project

Developing the plan for an asbestos abatement project will almost certainly require some specialized assistance. Generally, the first step is to hire a competent technical advisor or architectural-engineering (A-E) firm. For Department of Defense (DOD) activities, this generally involves getting project design approval and funding

Managers should require evidence of prospective contractors' experience and/or training in asbestos abatement. Air Force regulations also require that the contracted A-E firm must include qualified experts in health facilities design if a medical facility is involved. Generally, the A-E firm should provide the flowing:

1. A time- or space-phased plan to remove, enclose or encapsulate the asbestos based on management decisions. A number of alternatives may be proposed.

2. Cost estimates for the various alternatives. (NOTE: Management should be sure to include in these estimates the costs of lost business or services due to closure of facilities, etc.)

3. A statement of work for the actual removal contract.

In civilian institutions, initial approvals may be needed from the governing board or executive management. Rohde et al list these as follows:

1. Approval of the project in concept.

2. Approval to award the architectural - engineering contract prior to initiating schematic design.

3. Approval of long-term financing (if needed) prior to signing a financing commitment.

4. Approval to award construction contracts.[4]

Alternatives For Asbestos Abatement

As mentioned, the three primary methods for abatement of the health hazards posed by friable asbestos materials are enclosure, encapsulation, or removal. The various characteristics of each alternative, to include advantages and disadvantages, are discussed below.

Enclosure

Enclosure generally involves construction of airtight walls and ceilings around asbestos-containing materials. Enclosure is usually restricted to situations where ACM can be isolated in small localized areas. The primary enclosure material is gypsum drywall, although metal panels, concrete, masonry, wood, and other suitable materials may be considered by design professionals.[5] The new construction material should be impact-resistant and assembled to be airtight. Gypsum panels taped at the seams, tongue-and-groove boards, and boards with spline joints are all acceptable. Joints between walls and ceilings should be caulked. Suspended ceilings with lay-in panels are not allowable.6

One of the primary advantages of enclosure is the fact that it is generally the least expensive of the three alternatives. Costs may increase significantly, however, if computer lines or other utilities must be relocated. Additionally, the asbestos remains in place, which eliminates the need for a replacement material. The underlying structures must be capable of supporting new walls or ceilings. Installing these walls or ceilings will generally involve drilling, and drills used during installation should be equipped with HEPA (high efficiency particulate absolute)-filtered vacuums (see page 79).

A major disadvantage of enclosure is that the ACM remains in the building, and requires periodic reinspection to check for damage or deterioration. If the enclosure itself is damaged, significant asbestos fiber release may take place. Consequently, this alternative should be considered only when disturbance or entry into the enclosed area is unlikely. Federal regulations also require removal of ACM before building renovation or demolition can take place. Consequently, the long-term costs of enclosure may be higher than initial removal.

Encapsulation

Encapsulation generally involves spraying some type of sealant either to bridge over asbestos-containing materials, or to have the sealant sink into the asbestos insulation and bind the mass up more satisfactorily.[7] A bridging sealant is basically a coating that forms a barrier between the asbestos and the atmosphere. Penetrating sealants are watery polymer solutions which penetrate into and harden the asbestos material.[8] Important properties of acceptable sealants include:

a. The sealants should eliminate asbestos fallout into the atmosphere.

b. The sealants should be able to withstand some impact so that asbestos fibers will not be released with minimal contact.

c. The sealants should be flexible enough to handle movements within buildings caused primarily be temperature fluctuations.

d. The sealants should have good flame resistant properties.

e. The sealants should be easily applied, and not give off noxious odors.[9]

Similar to enclosure, a major disadvantage of encapsulation is that the asbestos remains behind, and must be periodically reinspected for damage or deterioration. Encapsulation should not be considered in locations where the material is highly accessible, or where water damage is likely. Asbestos-containing materials that are fibrous or fluffy are not good candidates for encapsulation. Generally, the material should be cementitious in nature, such as acoustical plaster. If the ACM is not adhering well to the substrate, encapsulation should not be considered as the additional weight may pull down the material.

Encapsulation Procedures

Encapsulation is generally less expensive than removal of ACM. If this method of abatement is chosen, the following procedures should be followed.

a. Airless sprayers are used to apply both bridging and penetrating sealants. Airless sprayers minimize the release of asbestos fibers. However, they do not completely eliminate fiber release, so worker protection, isolation of the work area, and decontamination of the removal site is absolutely necessary.

a. Bridging sealants are similar to latex paint, yet have a very high resin content. The EPA recommends that the sealant be at least 25 percent by weight vehicle resin, although the best bridging sealants may contain up to 60 percent solid, high-built latexes.

b. The coverage rate for bridging sealants is generally specified by the manufacturer. Three gallons per 100 square feet is the general industry standard. This should result in a dry film thickness of roughly 25 mils.

c. Penetrating sealants are more difficult to apply. Penetrating sealants should completely soak into the asbestos-containing materials. Several coats may need to be applied, and this must be done while previous coats are still wet to allow penetration.

d. A coat of penetrating sealant is generally applied until the ceiling glistens but stopped before the solution drips. Such "minicoats" may need to be repeated.

e. Taking core samples is the recommended procedure for determining degree of penetration of sealants. Experience has shown that that maximum penetration of asbestos insulation is generally one inch.[10]

Removal of Asbestos

Complete and proper removal of asbestos-containing material is the only sure method of eliminating potential health hazards within a given facility. Advantages of removal include the fact that once gone, there is obviously no need to continually monitor the ACM as required when encapsulation or enclosure is used. More often than not, removal will be the alternative of choice for controlling friable asbestos materials.

Disadvantages of removal include the probable need to replace the asbestos-containing material with an appropriate substitute. Also, improper removal may result in higher fiber levels than experienced prior to the construction project. This situation need not occur, however, if guidelines presented in this document and elsewhere are carefully adhered to. Depending on the surface to which the ACM was applied, encapsulation of the stripped surface with a sealant may also be necessary to prevent fibers left behind from becoming airborne. Finally, removal of the ACM is the most expensive alternative, but future renovation or demolition projects may be accomplished without delay. The final chapter of this guide extensively covers governmental regulations covering removal of asbestos-containing materials from buildings.

Selecting a Contractor

Hiring a competent contractor to conduct asbestos abatement activities is essential to a successful project. For both financial and liability reasons, managers must protect themselves and their institutions by selecting a contractor qualified to do the job. As an example, one contractor submitted a bid of $5 million to remove asbestos from some government buildings. The sucessful bidder completed the job for $1.8 million.[11]

Potential liability problems are another reason for carefully selecting an asbestos contractor. As noted earlier in this document, there's more asbestos in the air after some contractors complete their work than there was before they started. The federal government is also taking action. After learning of thousands of buildings demolished or renovated in ways that released hazardous asbestos fibers into the air, the EPA and the U.S. Justice Department filed lawsuits in 10 cities in January 1986. The lawsuits seek injunctions against improper activities and fines of $25,000 a day for continued violations. The EPA estimates that work on half of the 40,000 affected buildings torn down or cleaned up each year is done incorrectly.12

Insurance problems are also important considerations for managers. It is estimated that in the past year, insurance has become scarce, and the price has soared to 18 to 25 percent of the gross fee for asbestos abatement.[13] Many contractors are asking clients to sign an exclusion clause promising not to sue the contractor in the future. Experts note, however, that insured contractors are still available, and institutions should never sign away their right to sue.[14] On a more positive note, the Acceleration Corporation, a Dublin, Ohio-based insurance company, plans to address the spiraling demand for liability insurance that covers asbestos removal contractors. The corporation feels that big insurers have stopped selling asbestos liability insurance because they don't understand the business.[15]

The Environmental Protection Agency has compiled of checklist of qualifications for use in selecting a contractor:

a. Contractors should demonstrate reliability in general contracting activities by submission of a list of references for work performed.

b. Contractors should demonstrate ability to perform asbestos abatement activities by submitting evidence of successful completion of training courses covering asbestos abatement. Documentation should also be available showing that employees have had instruction on the dangers of asbestos exposure, use of respiratory equipment, decontamination procedures, and applicable OSHA and EPA guidelines and regulations.

c. Contractors should submit a list of previous abatement projects to include the names, addresses, and phone numbers of building owners for whom the projects were performed.

d. Submission of air monitoring data taken during and after completion of asbestos projects that meets established standards provides excellent evidence of competence in asbestos abatement. Generally, this information should be obtained from the owners of buildings from which the contractor has removed asbestos.

e. Contractors should produce written standard operating procedures and employee protection plans which include specific reference to OSHA medical monitoring and respirator training programs.

f. If required, contractors should possess any required State certifications for the performance of asbestos abatement projects.

g. Contractors must be able to provide a description of any asbestos abatement projects which have been prematurely terminated, including the circumstances surrounding the termination, as well as a list of any contractual penalties which the contractor has paid for breach or noncompliance with contract specifications, such as overruns of completion time or liquidated damages.

h. Contractors must identify any citations levied against them by any Federal, State, or local government agencies for violations related to asbestos abatement, including the name or location of the project, the date(s), and how the allegations were resolved.

i. Contractors must submit a description detailing all legal proceedings, lawsuits or claims which have been filed or levied against the contractor or any of his past or present employees for asbestos-related activities.

j. Contractors must supply a list of equipment that they have available for asbestos work. This should include negative air systems, type "C" supplied air respirator systems, scaffolding, decontamination facilities, disposable clothing, etc. Further information is provided in chapter VII.

Footnotes

[1]United States Environmental Protection Agency, Office of Toxic Substances, Asbestos in Buildings: A National Survey of Asbestos-Containing Friable Materials, Washington, D.C.: U.S. Environmental Protection Agency, 1984, p. 2-6.

[2]United States Environmental Protection Agency, Office of Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, 1985 ed., Washington, D.C.: U.S. Environmental Protection Agency, 1985, p. 2-1.

[3]Dyer, James S., "An Asbestos Hazard Index for Managing Friable Asbestos Insulating Material," Policy Studies Review Vol. 1, No. 4 (May 1982), p. 660.

[4]Rohde, Deborah J., Prybil, Lawrence D., and Hochkammer, William O., Planning and Managing Major Construction Projects: A Guide for Hospitals, Ann Arbor, Michigan: Health Administration Press Perspectives, 1985, p. 10.

[5]National Institute of Building Science, Model Guide Specifications: Asbestos Abatement in Buildings, Task Force Report, Washington, D.C., March 1, 1986, p. 11.

[6]Guidance for Controlling Asbestos-Containing Materials in Buildings, p. 5-6.

[7]Secor, Eugene J., and Spinazzolo, David, "Putting the Cap on Asbestos," Professional Decorating and Coating Action, May 1982, p. 2.

[8]Ibid.

[9]Ibid.

[10]Ibid.

[11]Wagner, William, "Hiring asbestos contractors: caveat emptor!" Hospitals, January 5, 1986, p. 100.

[12]"Federal Lawsuits: Uncle Sam's new asbestos assault," U.S. News and World Report, January 27, 1986, p. 11.

[13]Wagner, p. 100.

[14]Ibid.

[15] Laderman, Jeffrey M., "An Auto-Loan Insurer Puts a Tiger In Its Tank," Business Week, October 21, 1985, p. 104.

CHAPTER VII.

OVERVIEW OF ENVIRONMENTAL PROTECTION AGENCY (EPA) AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS FOR REMOVAL OF ASBESTOS

The EPA has established extensive controls to govern the abatement of asbestos in buildings. These standards are intended to minimize release of asbestos fibers during and after abatement activities, thereby protecting workers, building occupants, and the general public. The EPA regulations cover such major areas as notifications of asbestos abatement activities, work site preparation, entry and exit from the work site, removal procedures, worker protection, containerization and disposal of ACM, air sampling during removal, decontamination, and final testing.

Notification of Intended Asbestos Removal

The National Emission Standards for Hazardous Pollutants (NESHAPS) Regulations (40 CFR 61, Subpart M) require that the EPA be notified in advance of any intended removal of asbestos-containing materials. In enforcing NESHAPS notification requirements, it has been noted that the EPA has been levying fines against the owner of the building, rather than the abatement contractor. Consequently, it is most important for managers to be aware of proper notification procedures. The following information should be included in the notification to the EPA's regional Asbestos NESHAPS Contact. A listing of regional EPA offices can be found at Appendix G.

a. Name and address of the building owner or operator.

b. Description of the facility being demolished or renovated, including the size, age, and prior use of the facility.

c. Location of the facility being renovated or demolished.

d. An estimate of the approximate amount of friable asbestos material present in the facility in terms of linear feet of pipe or surface area.

e. Scheduled starting and completion dates of demolition or renovation.

f. Planned methods of renovation or demolition.

g. Procedures to be used to comply with the EPA's NESHAPS Asbestos Regulations (40 CFR 61 Subpart M).

h. Name and location of the waste disposal site where the friable asbestos waste material will be deposited.

Work Site Preparation

It is extremely important that the area from which the asbestos-containing material will be removed be completely sealed and isolated from outside areas. Work site prepartion is extensive and time consuming. The Veterans' Admininstration Medical Center in Denver, Colorado found that removal of asbestos from any significant area (i.e., greater than a few hundred square feet) took from 10 days to two weeks to complete. The majority of this time was spent preparing the area for renovation, and cleaning the area after removal.1

Management has responsibility for initial preparation of the work site. This will generally involve vacating offices or other operations to alternate locations. The work site should be stripped to the maximum extent possible of furniture, equipment, materials, etc. In some cases, it may be cost-prohibitive to remove some equipment. For example, when removing asbestos from a hospital, it may be extremely expensive to relocate radiological equipment. In such a case, it may be best to leave the equipment in place and give it adequate protection. Management should give the contractor a list of equipment to remain in place, providing the location of the equipment (room number), nomenclature, dimensions, and particular sensitivities of the equipment. Only broad guidelines should be given to the contractor regarding protection of the equipment. Generally, it is best to build a simple box structure around the equipment, which is then easily sheeted and sealed. The contractor should have clear understanding that they will be responsible for any damage, to be identified by thoroughly testing the equipment after renovation is complete.

Work Site Enclosure

Proper containment of the work area is a must. Generally, this entails constructing barriers with 6 mil polyethylene plastic sheets joined with folded seams. Air vents should be thoroughly sealed with at least two sheets. Lighting fixtures should be removed before abatement work begins whenever possible. It they cannot be removed, lights should be completely sealed with plastic sheeting.

Floors require a minimum of two layers of 6 mil plastic. Generally, plastic sheeting can be attached with heavy tape, though stapling or taping sheets to furring strips fastened to the walls may be required. It is important that contract specifications include restoration of walls damaged by tape or other containment procedures to their original condition by the contractor.

Access into the work area will be through an "air lock" system which also incorporates worker changing and washing facilities. Appendix H gives an example of a basic air lock entry. Workers first enter a personal clothing change room, where they remove street clothing. Lockers should be provided for storage of personal belongings. Next, a shower room is provided. Showers will be used to decontaminate workers after they leave the removal area. All run-off water from the shower must be filtered and disposed of as asbestos waste. The National Institute of Building Sciences' Model Guide Specifications (as noted in chapter VI) provides comprehensive guidance. The next room contains protective gear for the workers--primarily disposable coveralls and respirators (discussed later in this chapter). Following the asbestos clothing change room, a vacuum area is established. The room should be equipped with high efficiency particulate absolute (HEPA)-filtered vacuums to remove excess asbestos fibers from workers and equipment as they leave the removal area and before they enter the showering facilities. HEPA filters are capable of trapping and retaining 99.97 percent of asbestos fibers greater than 0.3 microns in length.

Negative Pressure Systems

A negative pressure system is essential for conducting safe asbestos abatement projects. Negative pressure is air pressure lower than surrounding areas, generally caused by exhausting air from a sealed space (i.e., the work area). Essentially, the use of negative pressure during asbestos removal projects protects against large-scale release of fibers to the surrounding area in case of a breach in the containment barrier. The negative pressure system can also reduce the concentration of airborne asbestos fibers in the work area by increasing the number of air changes and exhausting contaminated air through HEPA filters. It has also been noted that circulation of fresh air through the work area improves worker comfort, which may speed the removal process by increasing job productivity.2

The exhaust units which create negative pressure generally consist of a cabinet with an opening at each end, one for air intake and one for exhaust. A fan and a series of filters are arranged inside the cabinet. The cabinet should be not more than 30 inches to allow passage through standard doorways, and be mounted on casters for easy movement. The final filter in the exhaust unit must be a HEPA filter, and it is recommended that the unit contain a minimum of one, and preferably two prefilters to prevent premature loading of the HEPA filter.

Sufficient exhaust units should be in use to supply a minimum of one air change every 15 minutes. The square footage of the floor in the enclosed abatement area is multiplied by the height of the room to determine total air volume. Dividing the flow rate of the exhaust units into the total air volume provides the number of exhaust units needed. For example:

Volume of abatement area:

20'l x 30'w x 10'h = 6,000 cu ft

Ventilation Required (CFM) =

Volume of work area (cu ft)/15 min =

6,000/15 = 400 cu ft min

Capacity of exhaust unit = 100 cu ft min (example)

Total exhaust units needed = 400/100 = 4 units

One additional unit should be available as a backup in case of equipment failure or machine shutdown for filter changing. It is recommended that the exhaust units be positioned such that the external air comes through the worker access area and traverses as much of the work area as possible.

The contractor should demonstrate effective operation of the negative pressure system. Basically it should be observed that:

1. Plastic barriers and sheeting move slightly in towards the work area.

2. Curtains between rooms in the decontamination unit move slightly in toward work area.

3. Smoke tubes can be used to demonstrate that air moves from in the decontamination unit from the clean room to the shower room, from the shower room to the equipment room, and from the equipment room into the work area.

If possible, a differential pressure meter or nanometer should be used to demonstrate a pressure differnce of at least 0.01 inches of water across every barrier separating the work area from the rest of the building.

Exhaust units should be started before any asbestos-containing material is disturbed, and should be left on coninuously to maintain a constant negative pressure until decontamination of the work area is complete. Filters from the exhaust units should be carefully disposed of as asbestos waste.

Worker Protection

Worker protection is centered around three major areas: proper training, protective equipment, and health examinations.

All workers involved in asbestos abatement projects should be aware of the dangers associated with handling asbestos and breathing asbestos dust. Work supervisors and foremen should have completed formalized training on asbestos abatement, and be able to document it. These individuals, in turn, train the work crews. The following topics should be covered to provide minimally adequate training:

Physical characteristics of asbestos

Health hazards associated with asbestos

Respiratory protection

Use of protective equipment

Negative air systems

Work practices (including hands on or on-job training)

Personal decontamination procedures

Air monitoring, personal and area3

Appendix I shows a suggested form for documenting workers' protective measures.

Protective Equipment

Respirators are no doubt the most important piece of protective equipment that the worker will use. Effective July 1, 1976, OSHA adopted a new standard for exposure to asbestos fibers. 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. 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 this limit (two fibers per cc), then a reusable or single use air purifying respirator will be used to reduce concentrations of airborne asbestos fibers to the established standard. Generally, such respirators may be appropriate when taking initial samples of suspected asbestos-containing materials, as fiber release will be minimal. However, they will generally be inadequate for actual asbestos removal activities.

When the ceiling or the 8-hour time-weighted average concentrations of asbestos fibers are reasonably expected to exceed 10 tiimes, but not 100 times, those limits, then a full facepiece powered air purifying respirator, or a powered air purifying respirator will be used to reduce exposure to acceptable levels. Generally, these are battery-powered respirators that force air through HEPA filters and into the facemask. Filters should be replaced after a maximum of 40 hours of use.

A type "C" continuous flow or pressure-demand, supplied-air respirator shall be used to reduce concentrations of airborne asbestos fibers in the respirator below the prescribed exposure limits when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed 100 times those limits. Such respirators use an external source of air delivered to the face piece by hose. All such systems should include a back-up air supply which allows a 30 minute escape time in the event of compressor failure, and a warning alarm in the event of compressor shut-down or detection of carbon monoxide.

Employers are required to establish a respirator program in accordance with the requirements of the American National Standard Practices for Respiratory Protection, ANSI Z88.2-1969. No employee shall be assigned to tasks requiring the use of a respirator if an examining physician determines that the employee will be unable to function normally wearing a respirator.

The contractor must also provide all workers will a sufficient number of disposable full-body coveralls and disposable head covers. Also highly recommended are work boots with non-skid soles, or disposable foot covers. All protective clothing will be maintained in the contaminated clothing room, and disposed of as asbestos-contaminated waste at the end of the abatement project. Other protective equipment that the contractor might provide includes hard hats, goggles to protect from eye injuries, and work gloves.

Medical Examinations

Medical examinations must be provided for all workers who may encounter an airborne fiber level of 2 f/cc or greater for an 8 hour time-weighted average. However, exposure levels will not always be known, so it is prudent to provide medical examinations for all workers who will enter the work area for any reason. OSHA requirements for the medical exam are set forth in 29 CFR 1910, section 1001. The exams are paid for by the employer, and must be provided within 30 calendar days following the worker's first employment in an occupation involving exposure to airborne concentrations to asbestos fibers. This medical examination must include, as a minimum, a chest x-ray (posterior or 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 ($FEV_{1.0}$). It is also advised that they physician evaluate the worker's ability to work in an environment that may produce considerable heat stress. Such an exam should be made available or provided at least annually thereafter, and upon termination of employment. Employers must maintain complete records of these examinations, and retain them for at least 20 years. These records shall be provided upon request to employees, designated representatives (family members, legal counsel), and/or OSHA.

Asbestos Removal Procedures

After the work area has been completely enclosed and the negative pressure system found to be properly working, actual removal of the asbestos-containing material can begin. Of course, workers should be wearing full protective gear.

The first step in removal is to thoroughly wet the ACM. The wetting agent should be applied with an airless or low pressure sprayer which produces a fine spray to reduce dispersal of asbestos fibers into the air. The wetting agent should be 50 percent polyoxethylene either and 50 percent polyoxethylene ester, or the equivalent, mixed one ounce to five gallons of water.4 In some cases, it may be necessary to presaturate the asbestos material the day prior to removal. ACM should be sprayed as often as necessary during the removal process to ensure that is remains continuously saturated.

Asbestos-containing materials should be removed in small sections. Materials can be scraped or tooled from the substrate (surface to which the ACM is attached). The removed ACM should be placed in 6 mil plastic bags (minimum) while still wet. The bag should be twisted closed, with the twisted part folder over and sealed with at least three layers of heavy duct tape. The bags may be sealed in 55 gallon drums if necessary. EPA regulations require that all containers be labeled as follows:

CAUTION

Contains Asbestos
Avoid Opening or Breaking Container
Breathing Asbestos is Hazardous
to your Health

Asbestos-containing materials may be dumped only at approved waste disposal sites. Generally, such a site may have no visible emissions to the outside air, and warning signs at all entrances and along the perimeter of the site. Additionally, at the end of each operating day, or at least once every 24-hour period, any asbestos-containing waste deposited at the site must be covered with at least six inches of compacted non-asbestos-containing material, or a dust suppression agent which effectively binds dust and controls wind erosion. Depositing asbestos-containing waste can be an expensive and inconvenient process. For example, the state of Colorado has only two approved sites, one outside of Denver, and one in Grand Junction. Managers should get written confirmation from the contractor that approved sites are being used in order to reduce liability in the event of improper disposal. A list of approved disposal sites in a given state can be obtained from the EPA's Regional Asbestos Coordinator.

After the asbestos-containing material has been removed from a substrate (surface), it may be necessary to cover that substrate with a sealant to prevent residual asbestos fibers from being released into the air. The nature of the surface of the substrate will be a key determining factor. A smooth surface can usually be well cleaned, and sealant will probably not be necessary. A rough-textured surface, however, may trap residual fibers and therefore require application of a sealant.

Final Decontamination of the Work Area

After all bulk asbestos-containing materials have been removed and substrates have been scrubbed, the extensive process of final decontamination of the work area can begin. Generally, final decontamination involves three separate cleanings conducted in a similar manner. In the first cleaning, all surfaces in the work area (including all barrier sheeting) are cleaned with damp cloths and mops, or HEPA vacuum cleaners, until there is no visible dust, debris or residue on any surface. Dry dusting or sweeping is not permitted. All cleaning materials, including rags and used HEPA filters are sealed in 6 mil bags and disposed of as asbestos waste.

A inspection is then conducted to ensure that all surfaces are free of visible residue. Large floor fans may be used at this point to provide air flow to all parts of the work area. The area is then vacated for 24 hours to allow the HEPA-filtered negative air system to remove airborne asbestos fibers. A second cleaning should then take place, followed by agitation of the air by large fans or powered leaf blowers. Wait an additional 24 hours, and then perform a final wet-wipe or HEPA vacuum cleaning of the work area. If cleaning has been accomplished properly, the work area should be ready at this point for final air sample testing.

Final Air Testing and Contractor Release

For the final sampling, an independent industrial hygienist hired by the building owner should conduct post-removal testing anad provide facility managers with test results from a reputable laboratory. It is highly recommended that the exhaust from some forced air equipment (preferably a leaf blower with at least a one horsepower electric motor) be swept against all walls, ceilings, floors, ledges and other surfaces in the room. This procedures should be continued for five minutes per 10,000 cubic feet of room volume.

At the same time, one 20-inch diameter fan per 10,000 cubic feet of room volume should be mounted in a central location about six feet off the floor, directed towards the ceiling, and operated at low speed for the entire period of sample collection. Fans can be shut off after air sampling pumps have been shut off.

Table 8 lists specifications for final air sampling when phase contrast microscopy will be used. In each homogeneous work area, a minimum of seven (7) samples should be taken.

Table 8 - Final Testing (Phase Contrast Microscopy)

Location Sampled	Number of Samples	Filter Media	Detection Limit (f/cc)	Minimum Volume (Liters)	Rate LPM
Each Work Area	5	Cellulose Ester	0.01	3000	2-12
or					
Each Room	1 (5 min.)	Cellulose Ester	0.01	3000	2-12

Source: National Institute of Building Science, Model Guide Specifications: Asbestos Abatement in Buildings, Task Force Report, Washington, D.C.: National Institute of Building Science, March 1, 1986, p. 01704-2.

It is most important not to confuse current standards for exposure to airborne asbestos particles in the occupational setting with standards for buildings from which asbestos has been removed. While the current OSHA standard for exposure is 8-hour time-weighted average (TWA) of 2 f/cc, as recently as September 1985, OSHA began circulating internally for comment a proposed TWA of 0.2 fibers per cubic centimeter. However, the objective of an asbestos removal project is to get the area absolutely as clean as possible. The detection limit of 0.01 fibers per cc established above is the minimum fiber level concentration which is practical to measure with a phase contrast microscope using NIOSH P and CAM 239 procedures. Getting asbestos fiber concentration levels to the lowest possible point provides maximum protection for occupants, and helps ensure that the area will remain in compliance as new exposure standards are established.

Footnotes

[1]Interview with Peter Ferraro, Jr., and John Reiker, United States Veterans Administration Medical Center, Denver, Colorado, October 29, 1985.

[2]United States Environmental Protection Agency, Office of Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, 1985 ed., Washington, D.C.: U.S. Environmental Protection Agency, 1985, p. J-5.

[3]National Institute of Building Science, Model Guide Specifications: Asbestos Abatement in Buildings, Task Force Report, Washington, D.C., March 1, 1986, p. 01561-7.

[4]Secor, Eugene J., and Spinazzolo, David, "Putting the Cap on Asbestos," Professional Decorating and Coating Action, May 1982, p. 3.

APPENDIX A

ASBESTOS-CONTAINING MATERIALS FOUND IN BUILDINGS

Appendix A.
Asbestos-Containing Materials Found in Buildings

Material	Asbestos (%)	Dates of Use
Surfacing Material sprayed- or trowelled-on	1-95	1935-1970
Preformed thermal insulating products		
85% magnesia	15	1926-1949
Calcium silicate	6-8	1949-1971
Cementitious concrete-like products		
extrusion panels:		
corrugated	20-45	1930-present
flat	40-50	1930-present
flexible	30-50	1930-present
shingles		
siding shingles	12-14	unk-present
roofing shingles	20-32	unk-present
pipe	15-20	1935-present
Roofing felts		
smooth surface	10-15	1910-present
mineral surface	10-15	1910-present
Plaster/stucco	2-10	unk-present
Cement, insulation	2-100	1900-1973
" , finishing	55	1920-1973
" , magnesia	15	1926-1950
Flooring tile and Sheet Goods	21-33	1920-present

Source: United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Guidance for Controlling Asbestos-Containing Materials in Buildings, Washington, D.C.: U.S. Environmental Protection Agency, June 1985, p. A-1,2.

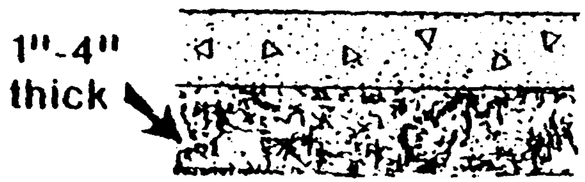
APPENDIX B

DESCRIPTION OF SPRAY-APPLIED ASBESTOS-CONTAINING MATERIAL

Source: United States Environmental Protection Agency, Office of Toxic Substances, Asbestos in Buildings: A National Survey of Asbestos-Containing Friable Materials, 1985 ed., Washinton, D.C.: U.S. Environmental Protection Agency, 1985, p. A-2.

DESCRIPTION OF SPRAY-APPLIED ASBESTOS-CONTAINING MATERIAL

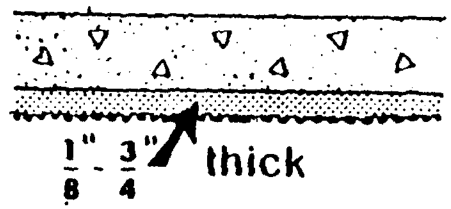
FIBROUS



ASBESTOS IS:

1. Highly Friable
2. Very soft
3. Fluffy & Spongy
4. Loosely bonded together
5. Composed almost entirely of fibers
6. Cotton candy/Spanish Moss appearance
7. Usually contains more than 10% asbestos

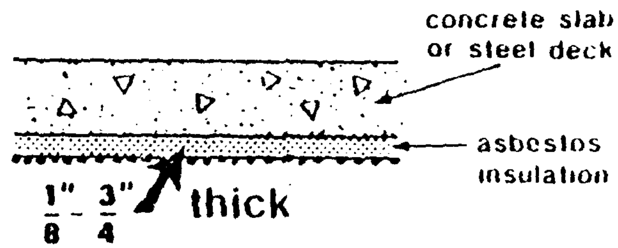
GRANULAR CEMENTITIOUS



ASBESTOS IS:

1. Friable
2. Soft, easily indented by hand pressure
3. Easily rubbed off as powder by hand pressure
4. Non-fibrous mixture of granular material, (only fibrous components are the few asbestos fibers)
5. Densely packed
6. Coarse sand, textured appearance
7. Usually contains less than 10% asbestos
8. Commonly referred to as acoustical plaster

CONCRETE LIKE



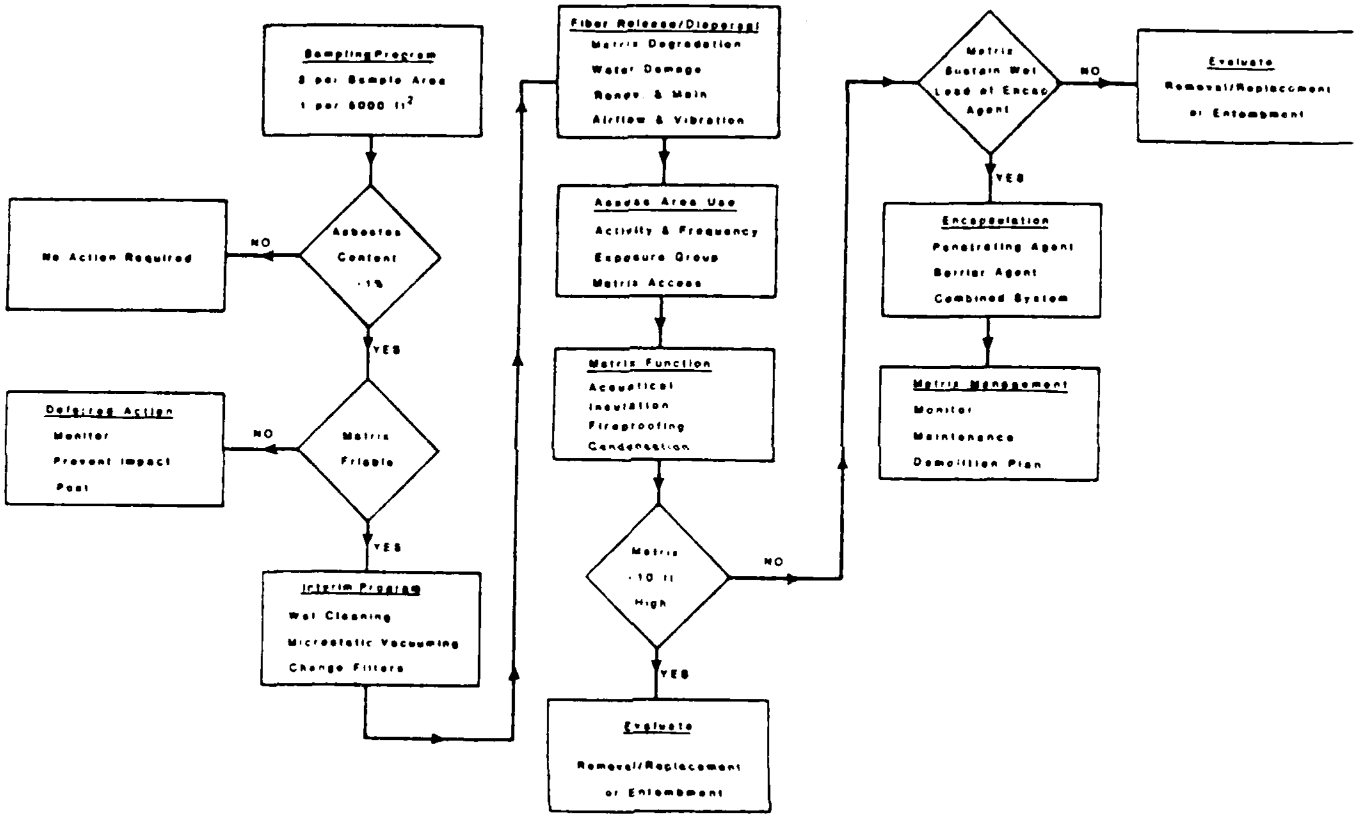
ASBESTOS IS:

1. Hard
2. Not friable; can not be damaged by hand pressure
3. Requires mechanical device to penetrate surface
4. Non-fibrous mixture of granular material, (only fibrous components are the asbestos fibers)
5. Densely packed
6. Coarse sand, textured appearance

APPENDIX C

DECISION DIAGRAM FOR THE BUILDING INSPECTION PROCESS

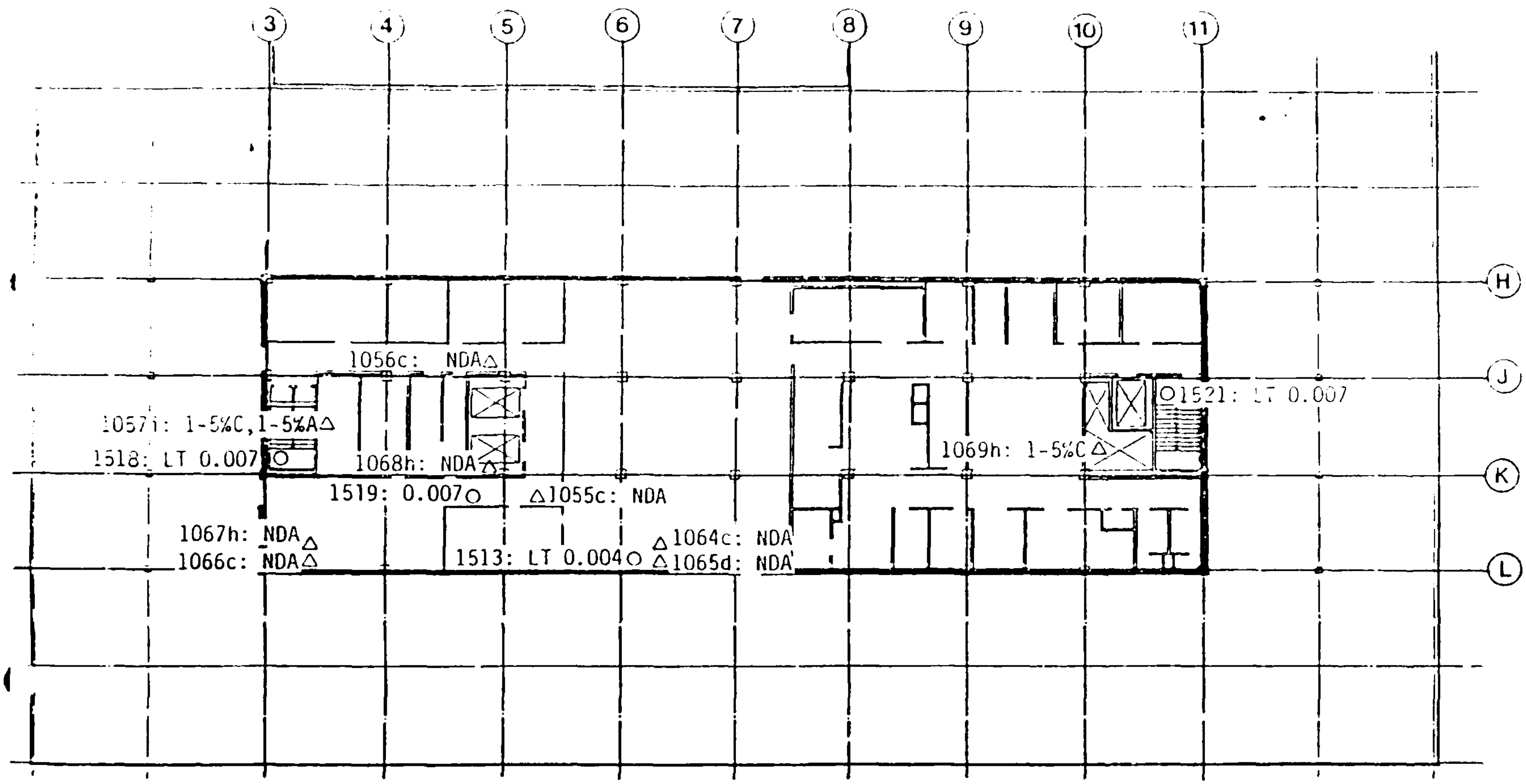
Source: Dyer, James S., "An Asbestos Hazard Index for Managing Friable Asbestos Insulating Material," Policy Studies Review Vol. 1, No. 4 (May 1982), p. 660.



Sampling Program
3 per Sample Area
1 per 5000 ft²
Asbestos
Content
1%
NO
No Action Required
YES
Matrix
Friable
NO
Deferred Action
Monitor
Prevent Impact
Post
YES
Interim Program
Wet Cleaning
Microstatic Vacuuming
Change Filters
Fiber Release/Dispersal
Matrix Degradation
Water Damage
Renov. & Main
Airflow & Vibration
Assess Area Use
Activity & Frequency
Exposure Group
Matrix Access
Matrix Function
Acoustical
Insulation
Fireproofing
Condensation
Matrix
10 ft
High
NO
YES
Evaluate
Removal/Replacement
or Entombment
Matrix
Sustain Wet
Load of Encap
Agent
NO
Evaluate
Removal/Replacement
or Entombment
YES
Encapsulation
Penetrating Agent
Barrier Agent
Combined System
Matrix Management
Monitor
Maintenance
Demolition Plan

APPENDIX D

EXAMPLE OF ASBESTOS SAMPLE LABORATORY TEST RESULTS



Laboratory Test Results

4 October 1985
Second Floor
Sheet 4 of 6
[redacted] Project #84-0141A

Legend: ○Air △Bulk

Sample Number: Test Result

○1532: 0.08 fibers/cc
△1004h: 5-30%C

Where bulk sample was taken — Asbestos Type

Abbreviations

i:insulation
t:top of ceiling
h:horizontal surface
s:sample piece of ceiling material
p:plaster
c:carpet
d:drapes
l:lining
LT:Less Than
NDA:No Detected Asbestos
C:Chrysotile Asbestos
A:Amosite Asbestos

APPENDIX E

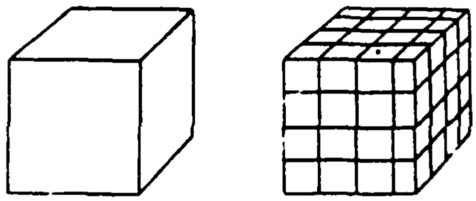
HOW ASBESTOS FIBERS ARE MEASURED

Source: United States Environmental Protection Agency, Guidance for Controlling Asbestos-Containing Materials in Buildings, 1985 ed., Washington, D.C.: U.S. Environmental Protection Agency, 1985, p. B-1.

Length

1 meter (m)	= 39.37 inches or 3.28 feet
100 centimeters (cm)	= 1 meter
1,000,000 micrometers (μm)	= 1 meter

Volume



1 cubic m (m^3) = 35.3 cubic feet

1,000,000 cm^3 = 1 m^3

1,000 cm^3 = 1 liter

Weight (mass)

454 grams (g) = 1 pound

1,000,000,000 nanograms (ng) = 1 gram

Concentration (mass contained in a stated volume)

2 fibers per cm^3 (the current 8-hour OSHA industrial standard) means that 2 fibers are present in each cm^3 of air. Since there are 1,000,000 cm^3 in 1 m^3, there would be 2,000,000 fibers in a m^3.

If each fiber is chrysotile asbestos (density of 0.0026 ng/μm^3) and is just long and thick enough to be detected by the NIOSH procedure for determining compliance with the OSHA standard (5 μm in length and 0.3 μm in diameter), it would weight 0.0092 ng:

Mass = $\pi/4$ (diameter)^2 (length) (density)

$$\pi/4\ (0.3\ \mu m)^2\ (5\ \mu m)\ (0.0026\ ng/\mu m^3) = 0.0092\ ng$$

A total of 2,000,000 of these fibers would weigh about 1,800 ng.

APPENDIX F

ASBESTOS HAZARD INDEX

Source: Dyer, James S., "An Asbestos Hazard Index for Managing Friable Asbestos Insulating Material," Policy Studies Review Vol. 1, No. 4 (May 1982), p. 662.

Level-of-Exposure Elements				Level-of-Exposure Factors Based on Following Asbestos Contents (Item 5)		
Item 1 Material Friability	Item 2 Occupant Accessibility	Item 3 Material Condition	Item 4 Level of Activity	Low (1% - 9%)	Medium (10% - 39%)	High (40% - 100%)
Low	Low	Good	Low	0.0002	0.0011	0.0031
Low	Low	Poor	Moderate	0.0031	0.018	0.050
Low	Moderate	Poor	Low	0.18	1.0	2.8
Low	High	Good	High	5.8	33.0	92.0
Moderate	Low	Good	Low	0.065	0.37	1.0
Moderate	Moderate	Good	Low	21.0	120.00	330.0
Moderate	Moderate	Good	Moderate	120.0	690.0	1,900.0
Moderate	High	Good	Moderate	330.0	1,900.0	5,300.0
Moderate	High	Good	High	1,900.0	11,000.0	30,000.0
High	Low	Good	Moderate	2.1	12.0	33.0
High	Moderate	Poor	Low	330.0	1,900.0	5,300.0
High	Moderate	Poor	High	11,000.0	62,000.0	170,000.0
High	High	Poor	Low	920.0	5,300.0	1,400.0

*Note: The complete table containing 54 entries appears in Lory and Coin (1981).

APPENDIX G

REGIONAL ENVIRONMENTAL PROTECTION AGENCY OFFICES

APPENDIX G.

Regional Environmental Protection Agency Offices

Region 1
(617) 223-0585
JFK Federal Building
Boston, MA 02203

Maine, Vermont,
New Hampshire,
Connecticut,
Massachusetts,
Rhode Island

Region 2
(201) 321-6668
Woodbridge Avenue
Edison, NJ 08837

New York
New Jersey
Puerto Rico
Virgin Islands

Region 3
(215) 597-9859
841 Chestnut Street
Philadelphia, PA 19107

Pennsylvania
Maryland
Delaware
Virginia
West Virginia
District of Columbia

Region 4
(404) 881-3864
345 Courtland Street NE
Atlanta, GA 30365

Georgia
Alabama
Mississippi
Florida
North Carolina
South Carolina
Tennessee
Kentucky

Region 5
(312) 886-6006
230 S. Dearborn Street
Chicago,IL 60604

Indiana
Ohio
Illinois
Michigan
Wisconsin
Minnesota

Region 6
(214) 767-2734
Interfirst Two Building
Dallas, TX 75270

Texas
New Mexico
Oklahoma
Arkansas
Louisiana

Region 7
(913) 236-2835
726 Minnesota Avenue
Kansas City, KS 66101

Kansas
Missouri
Nebraska
Iowa

Region 8
(303) 293-1742
One Denver Place
999 18th Street
Denver, CO 80202

Colorado
Utah
Wyoming
Montana
North Dakota
South Dakota

Region 9
(415) 974-8588
215 Fremont Street
San Francisco, CA 94105

California
Nevada
Arizona
Hawaii
Guam, Am. Samoa

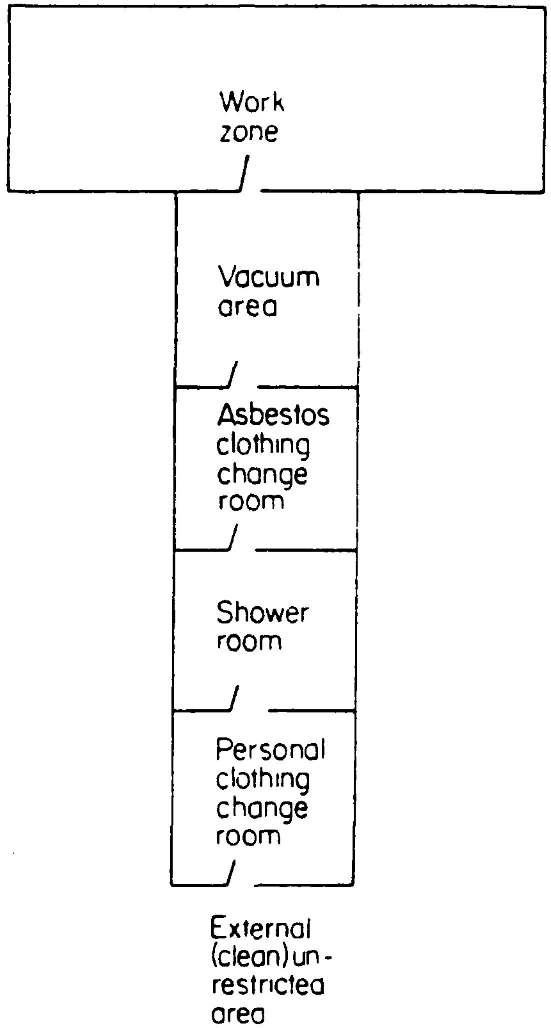
Region 10
(206) 442-2870
1200 Sixth Avenue
Seattle, WA 98101

Washington
Oregon
Idaho
Alaska

APPENDIX H

ASBESTOS REMOVAL AIR LOCK SYSTEM

Source: Michaels, L., and Chissick, S.S., Asbestos: Properties, Applications, and Hazards, (New York: John Wiley and Sons, 1979): 497.


Work zone
Vacuum area
Asbestos clothing change room
Shower room
Personal clothing change room
External (clean) un-restrictea area

APPENDIX I

CERTIFICATE OF WORKER'S ACKNOWLEDGEMENT

APPENDIX I.
CERTIFICATE OF WORKER'S ACKNOWLEDGEMENT

PROJECT NAME________________________________ DATE______________
PROJECT ADDRESS____
CONTRACTOR____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS 50 TIMES GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These things are to have been done at no cost to you. By signing this certificate you are assuring the owner that your employer has met these obligations to you.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. I have a copy of the written respiratory protection manual issued by my employer. I have been equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course included the following:

- Physical characteristics of asbestos
- Health hazards associated with asbestos
- Respiratory protection
- Use of protective equipment
- Negative air systems
- Work practices (including hands on or on-job training)
- Personal decontamination procedures
- Air monitoring, personal and area

MEDICAL EXAMINATION: I have had a medical examination within the last 12 months which was paid for by my employer. This examination included: chest x-ray, health history and pulmonary function tests.

Signature______________________________________

Printed Name___________________________________

Social Security Number_________________________

Witness____

Source: National Institute of Building Science, Model Guide Specifications: Asbestos Abatement in Buildings, Task Force Report, Washington, D.C., March 1, 1986, p. 01561-7.

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