DEPARTMENT OF THE ARMY
U.S. Army Center for Public Works
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INSTALLATION ASBESTOS MANAGEMENT PROGRAM

1. Purpose. The purpose of this Public Works Technical Bulletin (PWTB) is to provide technical information to Installations for asbestos management.

2. Applicability. This PWTB applies to installation Directorates of Public Works, Directorates of Engineering and Housing, and other engineering activities that operate and maintain Active and Reserve Army facilities.

3. References.

   a. AR420-70, Buildings and Structures, 29 May 1992.

   b. AR200-1, Environmental Protection and Enhancement, 21 February 1997.

4. Discussion. USACPW has developed this PWTB to provide technical information to Installations in implementing an Asbestos Management Program as required by Army Regulation 420-70. This PWTB was developed in coordination with OACSIM, DAJA, USACHPPM, USACE, AEC, CERL, and MACOM's. It provides the latest information on asbestos management and safety procedures.

5. Point of Contact. Questions and/or comments regarding this PWTB should be directed to U.S. Army Center for Public Works, Directorate of Engineering, CECPW-EB, 7701 Telegraph Road, Alexandria, VA 22315-3862, telephone (703)806-5025, FAX (703)806-5041.

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CHAPTER 1
THE INSTALLATION ASBESTOS MANAGEMENT PROGRAM

1-1. Purpose

a. This Public Works Technical Bulletin (PWTB) is provided to assist Department of the Army (DA) facilities personnel in implementing an asbestos management program as required by Army Regulations (AR) 200-1 and AR 420-70. This document provides an in-depth explanation of the steps to be taken to organize and implement the asbestos abatement options.

b. The overall Army policy governing all facilities and activities is as follows:

(1) Comply with all federal, state, and local laws and regulations.

(2) Exclude asbestos from all procurements and uses where asbestos-free substitute materials exist.

(3) Minimize asbestos releases to the utmost extent possible.

(4) Establish and execute asbestos management plans (AMPs).

(5) Establish asbestos management teams (AMTs).

(6) Program and budget resources to identify, manage, and control exposure to asbestos.

(7) Conduct installation surveys to identify the existence, extent, and condition of all asbestos.

(8) Perform an exposure assessment and risk assessment for all locations containing asbestos.

(9) Take immediate corrective action where a possible asbestos related health hazard has been identified.

(10) Notify facility occupants of any asbestos related health hazard identified in their work environment.

(11) Assess the relative health risks for alternative control actions. Asbestos should not be removed for the sole purpose of eliminating asbestos.

(12) Follow the regulations contained in the Asbestos Hazard Emergency Response Act (AHERA) and related US Environmental Protection Agency (USEPA) Regulations when dealing with elementary and secondary schools operated by the Army.

(13) Use all feasible and safe methods to control asbestos-containing materials (ACM) in accordance with established federal, state and local laws. The Local Staff Judge Advocate is available to interpret the obligations and applications of the relevant laws. Army installations are encouraged to establish a small, in-house capability using properly equipped, trained, and certified civilian personnel to accomplish emergency projects or small projects not cost effective to contract. Installations should continue to use contractors to perform large asbestos abatement projects. Installations in the same geographic area should establish capabilities that complement each other. Specific steps will be taken to ensure compliance with federal, state, and local regulations and to assure proper contract development and surveillance, medical support, and oversight.

1-2. Objectives

It is intended that this document provides the information necessary to manage friable and non-friable ACM. A further objective is to identify those procedures that will minimize the release of ACM into the air.

1-3. Scope

USEPA, Occupational Safety and Health Administration (OSHA), and Department of Transportation (DOT) regulations are amended frequently. The Asbestos Management Team (AMT) is advised to review this document to understand Army Policy and to implement it at the installation level. It will be necessary for the AMT to keep abreast of regulatory developments through its review of any changes in Title 29 Code of Federal Regulations (CFR) (Department of Labor), Title 40 CFR (Protection of Environment), and Title 49 CFR (Department of Transportation) contained in the Federal Register. Having facility AMT members attend training classes and seminars on asbestos management is an excellent way to keep current with the new regulations.

1-4. References

Appendix A contains a list of references used in this document.

1-5. Applicability

This PWTB is applicable to all active and reserve DA facilities.

1-6. Regulatory Perspective

a. The control of airborne asbestos-containing dusts in the workplace and to the public has been regulated by both OSHA and the USEPA for the past 25 years. The regulatory history of this substance by these two agencies with regard to building materials has always been somewhat diverse. OSHA's concerns relate to the control of asbestos dusts in the workplace whereas the USEPA was concerned about non-occupational exposures among building occupants from deteriorating asbestos-containing materials. The USEPA's concern focused principally on school children culminating in the passage of AHERA in 1986.

b. On August 10, 1994, (with corrections issued in the Federal Register dated June 29, 1995), OSHA published the final rule on the Occupational Exposure to Asbestos. This rule is applicable to Army activities since it includes specific requirements for building construction involving asbestos as well as custodial or maintenance activities which may result in the disturbance of asbestos.

c. A number of states have enacted varying statewide and local regulations affecting asbestos abatement contractors, environmental laboratories, and industrial hygiene and architect/engineering consultants. Permits and licenses are required for these entities to operate within a particular state after meeting certain training approvals and payment of fees; some states grant reciprocity for firms operating in neighboring states. Since state requirements are so highly variable, the offices should be contacted individually (see appendix B).

d. A review of the current OSHA, DOT and USEPA documents (actual citations) on asbestos is a mandatory requirement.

1-7. Summary of Occupational Safety and Health Administration Exposure Standards and Regulations

a. The first exposure standard passed under OSHA, on May 29, 1971 established a permissible exposure limit (PEL) of 12 fibers/cubic centimeter (f/cc) for an 8-hour time-weighted average (TWA). Over the years, OSHA continued to reduce the occupational exposure level to the present value. These reductions were designed to protect employees from asbestosis and asbestos related diseases. Changes covered all asbestos related industries including construction, emergency temporary standards, medical monitoring, respiratory protection, work practices, unique hazards associated with asbestos removal and demolition projects, training and prohibition of workplace smoking in areas where occupational exposure to asbestos may occur.

b. The current OSHA standard is 0.1 f/cc per 8-hour - weighted average, which went into effect on August 10, 1994 and had a profound impact on asbestos abatement activities at all levels.

(1) The standard addresses in detail the types of worker activity and the materials that are regulated. There are specific regulations on control conditions, specific training requirements for asbestos workers have been expanded, and there are expanded hazard communication procedures especially for multi-employer work sites.

(2) Building materials are either ACM or non-ACM if they have been analyzed by an appropriate method. In the case of materials installed before 1980, they may be classified as presumed asbestos-containing material (PACM) for certain materials.

(3) The strategy for worker protection is based on the fact that the worker is dealing with asbestos rather than on the possibility that the permissible exposure limit (PEL) is exceeded. This important change provides much greater worker protection because, in the majority of cases, a significant exposure occurs before air monitoring results are available.

(4) The regulation holds building owners responsible for informing all who work in a building from outside service personnel, maintenance workers and custodians that ACM or PACM is present.

(5) This regulation, for the first time, reclassifies asbestos related work into four categories:

(a) Class I activities involving the removal of thermal system insulation (TSI), and sprayed on or troweled on or otherwise applied surfacing ACM or PACM.

(b) Class II removal of ACM or PACM which is not TSI or surfacing ACM or PACM.

(c) Class III repair and maintenance operations which are likely to disturb ACM or PACM.

(d) Class IV custodial and housekeeping operations where minimal contact with ACM and/or PACM will occur.

(6) This new designation replaces the older large scale, small scale, short duration system followed in the 1986 OSHA regulation.

(7) The classification of activities is treated uniformly in the general industry standard, the construction standard and the shipyard standard of this regulation.

1-8. Summary of U.S. Environmental Protection Agency Exposure Standards and Regulations

a. The USEPA, under the authority of the Clean Air Act (CAA) of 1970, and specifically in the Toxic Substances Control Act (TSCA), introduced regulations to minimize building occupants' exposure to asbestos dust derived from building materials. All of the USEPA regulations concerning airborne asbestos are derived from the asbestos standard issued under the National Emission Standards for Hazardous Air Pollutants (NESHAP), and in 1973 the use of asbestos in sprayed-on fireproofing for buildings was banned. NESHAP was further amended in 1978 to prohibit the use of asbestos in architectural decorative plasters. The emphasis in the USEPA's program shifted at about this time to the issues of asbestos in schools. A series of guidance documents was issued to superintendents of elementary and secondary schools explaining potential health hazards and the methods available to minimize them. In 1982, the Asbestos Identification and Notification Act was passed directing that all public and private elementary and secondary schools be inspected for ACM. Regulations passed under this Act required local school authorities to maintain the school asbestos surveys at each school and make them available for public inspection. Compliance with this regulation lacked uniformity across the country and, in 1986 the USEPA introduced regulations under the AHERA which were far more rigorous in application and contained substantial penalties for noncompliance. Some highlights of the regulation are as follows:

(1) Training was required for all individuals who were to remove asbestos, inspect buildings for ACM, monitor asbestos abatement projects, supervise asbestos abatement projects, and design asbestos abatement projects. The details of training are contained in the model accreditation program (MAP) portion of the regulation.

(2) Reinspection was required for all elementary and secondary public and private schools. The regulation also specifies a schedule of additional inspections to make certain that any remaining ACM is not deteriorating.

(3) If an asbestos abatement project is undertaken in a school, a detailed protocol must be followed with regard to air sampling, its collection and analysis by transmission electron microscopy (TEM).

b. On November 28, 1990, the Asbestos School Hazard Abatement Reauthorization Act (ASHARA) was enacted to amend certain portions of AHERA to extend certain elements of the school program to public and commercial buildings. For example, an individual conducting inspections and assessments in public and private buildings must have the same training certifications as required under AHERA. ASHARA also requires the USEPA to revise the MAP to increase its hands-on training requirements and to make other changes necessary to extend the MAP to public and commercial buildings. From the earliest days of this technology, most in the field defined asbestos abatement to include one or a combination of: removal, enclosure,

encapsulation, and management in place. The latter, more passive, approach became known as operations and maintenance (O&M), and the USEPA issued a guidance document on this alternative in 1988. The USEPA's sanctioning of the O&M approach greatly tempered the urge on the part of building owners and operators to rush into asbestos removal projects. The O&M option has been adopted by the Army and is an important component of the asbestos management program. Situations will arise, however, where ACM must be disturbed such as in the course of renovation or demolition operation. The more active asbestos abatement options will have to be followed in these cases.

1-9. Summary of U.S. Department of Transportation Exposure Standards and Regulations

In the 1970s and 1980s DOT passed regulations for the packaging, placarding and hauling asbestos and other hazardous materials. The regulations also include a manifest system to account for the amounts of material hauled. These regulations are explained in detail in chapter 12.

1-10. Applicable Regulations and Guidance Materials

Applicable federal regulations are listed in appendix A, under required publications section, but it should be borne in mind that these regulations are changing rapidly. The AMT is advised to monitor the Federal Register to ensure that compliance in this area is up to date.

1-11. Sources of Information on Regulations and Asbestos Hazard Emergency Response Act Training Courses

a. Questions regarding the interpretation of federal regulations and questions concerning requirements at the state level should be addressed to the appropriate offices listed in appendix B.

b. The USEPA provides a list, updated quarterly, of AHERA-accredited training programs. This list is entitled the National Directory of AHERA Accredited Courses (NDAAC) and is available through the NDAAC Clearinghouse at (202) 554-1404 (the TSCA Hotline). Additional USEPA documents, such as the current guidance documents are also available by contacting the hotline.

CHAPTER 2
ASBESTOS: TYPES, USES, AND HEALTH EFFECTS

2-1. Asbestos Defined

a. Asbestos is a term used in commerce to describe a mineral that occurs as fibers. Depending on its grade, asbestos may occur as fibers up to several centimeters in length or as less valuable short fibers. When milled or crushed, the fibers may become exceedingly small fibrils, with fiber widths as small as 0.01 micrometers (μm) (i.e., 0.00001 mm).

b. Within the broad designation asbestos are six distinct mineral species that belong to either the serpentine or amphibole group. These two groups have different crystal structures and chemistry. These OSHA and USEPA regulated asbestos minerals are *italicized* in the description below:

(1) Serpentine group.

Chrysotile (white asbestos) is a hydrated magnesium silicate that accounts for over 95 percent of the asbestos used on the North American continent.

(2) Amphibole group.

(a) *Amosite* (brown asbestos) is a hydrated iron magnesium silicate which accounts for approximately 3-4 percent of the asbestos used in North America. Amosite is an acronym for asbestos mines of South Africa; the proper species name for this mineral is grunerite.

(b) *Crocidolite* (blue asbestos) is a hydrated sodium magnesium iron silicate that was used infrequently in North America, but has found common usage in Europe. Crocidolite is the fibrous variety of the mineral riebeckite.

(c) *Tremolite asbestos - actinolite asbestos* are related hydrated magnesium-iron silicates that were used only rarely in building products. These minerals may be present in industrial-grade talcs.

(d) *Anthophyllite asbestos* is rarely encountered, but may be found in association with tremolite and actinolite.

c. There are two federal definitions for asbestos-containing materials (ACM). The USEPA defines a material to be asbestos-containing if there is one percent or more by weight or area of one or more of the six minerals described above. OSHA, on the other hand, sets the limit at 0.1 percent by weight or area for these six minerals. Products containing more than 0.1 percent by weight asbestos must have warning labels affixed to the outside wrapper or package to meet OSHA regulations. Curiously, the regulations define asbestos-containing on a by weight or area basis; and

yet the USEPA-approved polarized light microscopy (PLM) method for the analysis of both samples determines asbestos content on a by area basis. This disparity has been used successfully in challenging this regulation in the courts. The USEPA NESHAP regulations also use the term regulated asbestos-containing material (RACM) for construction products that are not friable under conditions of normal use; but can become friable under certain conditions. Category I includes asbestos-containing roofing felt, vinyl asbestos floor tile (VAT), gaskets, and valve packing materials. Category I materials become RACM because they become friable through sanding, grinding, aging, weathering or chemical attack, drilling, or sawing. Category II includes asbestos-containing shingles, transite, or other asbestos board. Category II materials become RACM when they are rendered friable through pulverizing or other similar force.

2-2. Use of Asbestos in Building Materials

a. Asbestos became a mineral of growing industrial importance in the early part of the twentieth century, ultimately finding applications in over 3,000 products. The most significant building product applications are described below:

(1) *Pipe lagging.* Asbestos-containing pipe lagging was manufactured in a variety of forms, the most common of which has the appearance of white corrugated cardboard. This product was generally applied to hot and cold water lines to provide thermal insulation and condensation control. (See figure 2-1.) Chrysotile was most frequently used, ranging in concentration from less than 10 percent to greater than 80 percent. The other five regulated asbestos minerals may also be present at lower concentrations.

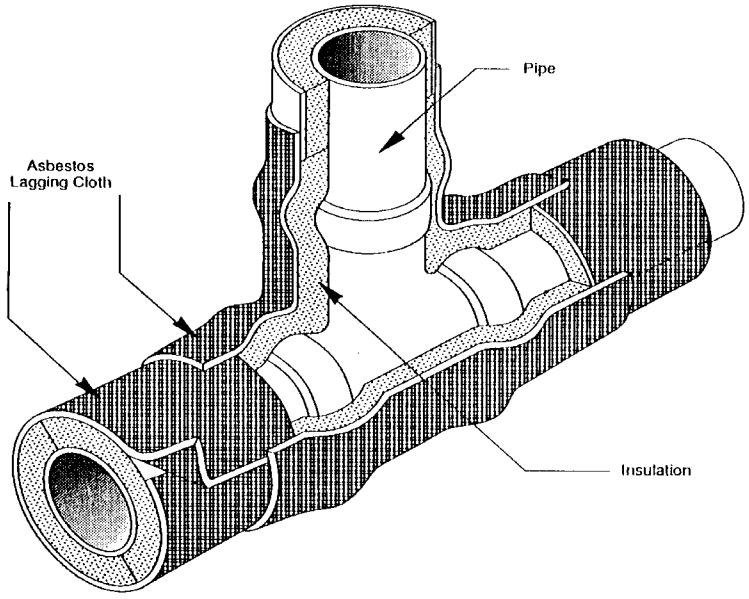

Figure 2-1. Asbestos Lagging Cloth.

(a) High and low pressure steam lines were frequently insulated using magnesia block. The pre-cast block contained long-fiber chrysotile to prevent its falling apart. The asbestos content can be highly variable, but tends to range from 20-50 percent.

(b) Pipe elbows, unions, tees, flanges, and valves were frequently insulated with an asbestos mud or cement. (See figure 2-2.) Chrysotile is most frequently present, typically in a concentration range of 10-50 percent.

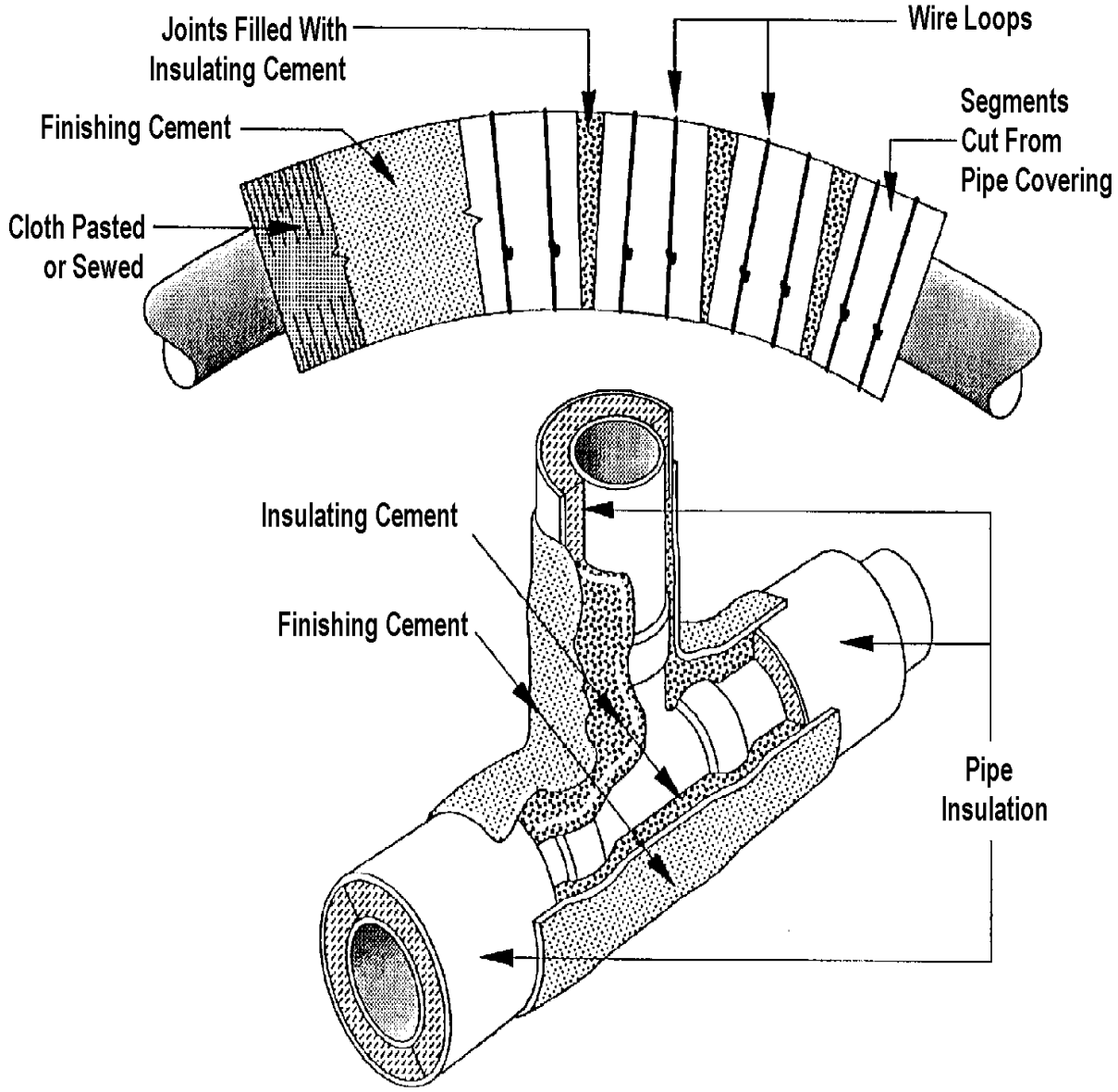

Figure 2-2. Piping Applications of Asbestos Cements.

(c)In addition to asbestos, other phases present may include gypsum/anhydrite, calcite/dolomite, magnesium oxide, and calcium silicates. The laggings may be covered with non-asbestos-containing gauze, canvas, or plaster.

(2) *Boiler/tank lagging.* Thermal insulation in the form of magnesia block having thicknesses up to several inches was widely used. The blocks were held in place with chicken wire, and a hard plaster exterior was applied. Asbestos rope was used in connecting large boiler shells, and asbestos gaskets were used to seal boiler doors and steam drums. In older installations, asbestos may be found in the brick foundation. Asbestos cement may be present on the boiler breechings. (See figure 2-3.)

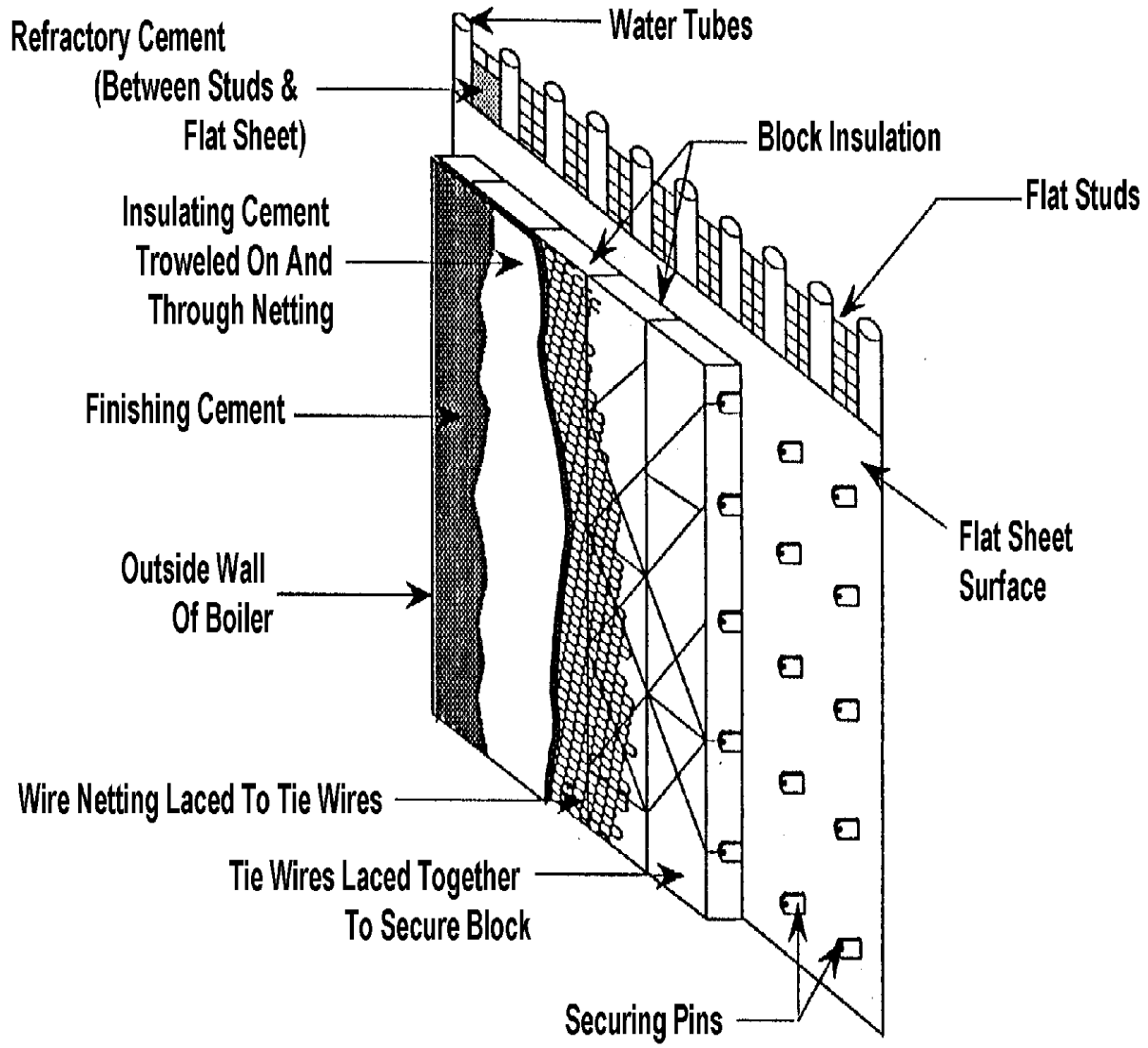

Figure 2-3. Vessel Wall Applications of Cements.

(3) *Sprayed-on fireproofing.* This product was developed in Great Britain in the mid-1930's under the name Limpet. Sprayed on fireproofing grew in popularity from the early 1950's until 1973, when its use was prohibited by the USEPA. When applied to a building's structural steel, a fire rating up to four hours or more could be achieved, depending upon the applied thickness. Chrysotile-bearing fireproofing accounts for the majority of asbestos-containing applications in North America; amosite and crocidolite were widely used in Great Britain and on the European continent. (See figure 2-4.)

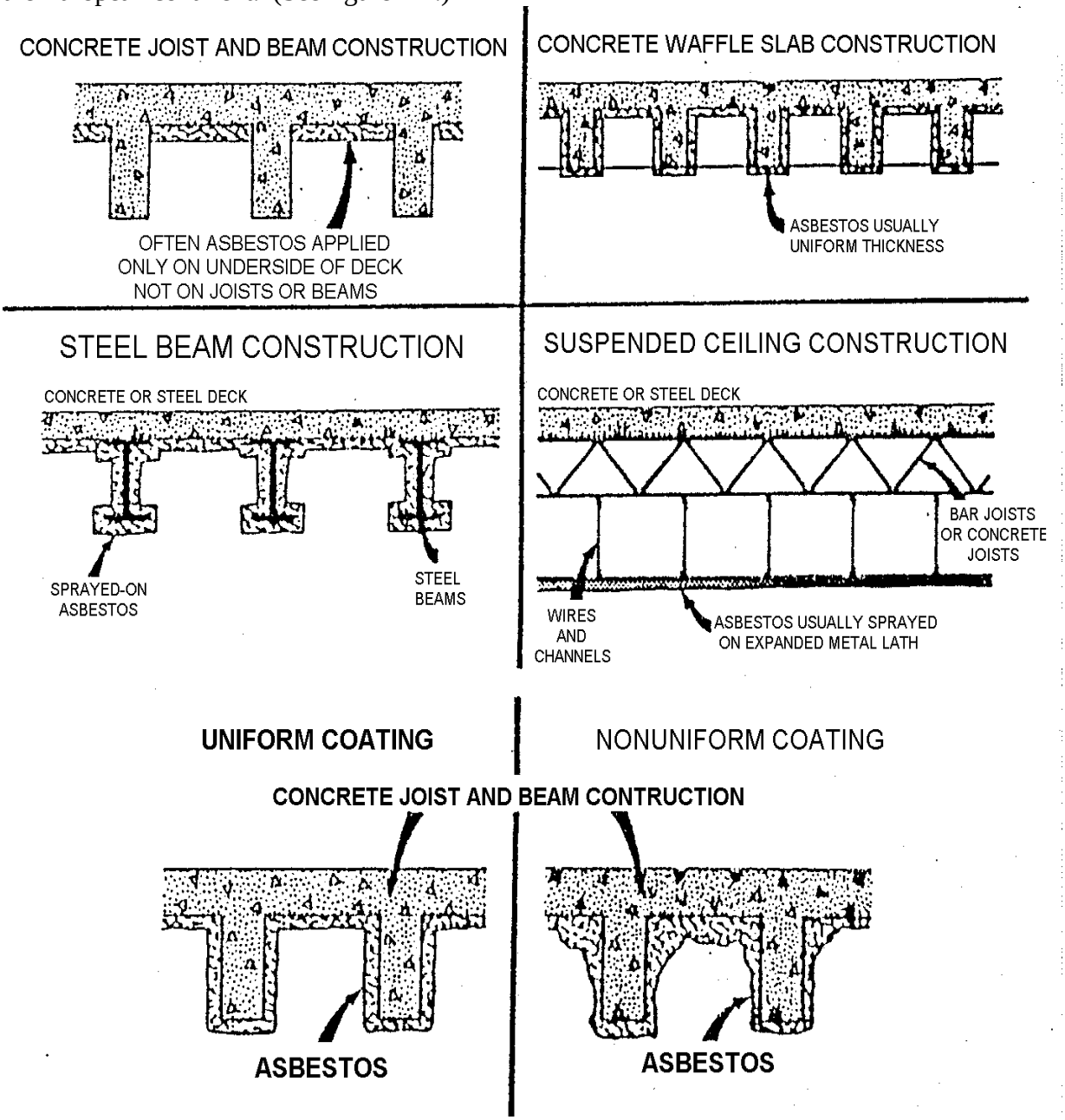

Figure 2-4. Sprayed-on Asbestos-Containing Fireproofing on Joist and Beam, and Concrete Waffle Slab Construction.

(a) In the chrysotile-bearing product, the asbestos content ranges from a few percent to more than 60 percent. Other phases commonly present include glass fiber, perlite, glass wool, gypsum/anhydrite, and cellulose fiber.

(b) Amosite-bearing sprayed-on fireproofing tends to be uniform with respect to asbestos concentration which commonly ranges between 35 percent and 50 percent.

(4) *Plasters.* This category includes ceiling and wall plasters, decorative plaster, and spackling compound. Sprayed-on asbestos-containing ceiling plasters were widely used as a rapid and inexpensive means for finishing ceilings in schools, apartments, and public buildings. This type of ceiling usually consists of a suspended wire lath upon which a rough or scratch or brown coat has been applied. This coat is furrowed to support the finish or veneer coat. The finish coat is usually sprayed or troweled onto the brown coat. The brown coat generally does not contain asbestos; however, it should be analyzed to demonstrate that it is asbestos free. The asbestos content of the finish coat can be extremely variable, even in a small area where the material appears to be homogeneous. In some products, the asbestos was mixed into the plaster at the plant; and in others, the asbestos was added separately at the job site by the plasterer. As a consequence, the asbestos content of these plasters is highly variable and may range from less than one percent (that is, non-asbestos-containing) to over 40 percent or 50 percent in places.

Asbestos appears to have been used infrequently in wall plasters; however, asbestos-containing patching plaster and spackling compound may have been used. The presence of asbestos should be suspected in plaster and sheet rock products greater than 50 years old.

(5) *Vinyl asbestos floor tile (VAT).* The VAT manufactured in North America generally contains typically two or as high as 15 percent asbestos which is distributed within the vinyl matrix. It is common to find that 9" x 9" tiles contain asbestos whereas the 12" x 12" variety do not, but it is important to have both the sizes analyzed by microscope (see chapter 8). By contrast, asbestos-containing floor tiles manufactured in Europe have an asbestos mat backing. Certain floor tile cements or mastics contain several percent asbestos and may still be on the market today.

(6) *Roofing felts.* Built-up roofs frequently have an asbestos-containing felt incorporated into the layers which are ultimately sealed in with tar and washed gravel.

(7) *Asbestos board.* This category includes such products as transite and asbestos shingles. These are hard, durable materials that are generally severely resistant to chemical attack and weathering. Both materials contain approximately 25 to 40 percent asbestos.

(8) *Miscellaneous uses.* Certain textured wall paints have been found to contain low percentages of tremolite, actinolite, anthopholite, and chrysotile. Other miscellaneous uses include electrical wire insulation, window putty, and roofing felt patching material.

(a) Metal fire doors and other fire protection barriers frequently contain a core of asbestos. Corrugated roofing composed of tar impregnated with crocidolite has been encountered in Army facilities in Germany. Many ceiling tiles contain high amounts of asbestos.

(b) The asbestos management control officer (AMCO) should be alert to the possible occurrence of additional ACM.

b. Table 2-1, lists various asbestos-containing products with their approximate asbestos content and the years over which these products were installed. This is not an all inclusive list. Figures 2-5 to 2-8 illustrate some of these applications.

Table 2-1. Asbestos-Containing Materials Found in Buildings*

SUBDIVISION	GENERIC NAME	ASBESTOS(%)	DATES OF USE	BINDER/SIZING
Surfacing material	sprayed- or troweled-on	1-95	1935-1970	sodium silicate, portland cement, organic binders.
Preformed thermal insulating products	batts, blocks, and pipe covering			
	85% magnesia	15	1926-1949	magnesium carbonate
	calcium silicate	6-8	1949-1971	calcium silicate
Textiles	cloth			
	blankets(fire)	100	1910-present	none
	felts:	90-95	1920-present	cotton/wool
	blue stripe	80	1920-present	cotton
	red stripe	90	1920-present	cotton
	green stripe	95	1920-present	cotton
	sheets	50-95	1920-present	cotton/wool
	cord/rope/yarn	80-100	1920-present	cotton/wool
	tubing	80-85	1920-present	cotton/wool
	tape/strip	90	1920-present	cotton/wool
	curtains (theater, welding)	60-65	1945-present	cotton
Cementitious concrete-like products	extrusion panels:	8	1965-1977	portland cement
	corrugated	20-45	1930-present	portland cement
	flat	40-50	1930-present	portland cement
	flexible	30-50	1930-present	portland cement
	flexible perforated	30-50	1930-present	portland cement
	laminated (outer surface)	35-50	1930-present	portland cement
	roof tiles	20-30	1930-present	portland cement
	clapboard and shingles:			
	clapboard	12-15	1944-1945	portland cement
	siding shingles	12-14	unknown-present	portland cement
	roofing shingles	20-32	unknown-present	portland cement
	pipe	12-15	1935-present	portland cement
Paper products	corrugated:			
	high temperature	90	1935-present	sodium silicate
	moderate temperature	35-70	1910-present	starch
	indented	98	1935-present	cotton and organic binder
	millboard	80-85	1925-present	starch, lime, clay
Roofing felts	smooth surface	10-15	1910-present	asphalt

Table 2-1. Asbestos-Containing Materials Found in Buildings (Continued)*

SUBDIVISION	GENERIC NAME	ASBESTOS(%)	DATES OF USE	BINDER/SIZING
	mineral surface	10-15	1910-present	asphalt
	shingles	1	1971-1974	asphalt
	pipeline	10	1920-present	asphalt
Asbestos-containing compounds	caulking putties	30	1930-present	linseed oil
	adhesive (cold applied)	5-25	1945-present	asphalt
	joint compound		1945-1975	asphalt
	roofing asphalt	5	unknown-present	asphalt
	mastics	5-25	1920-present	asphalt
	asphalt tile cement	13-25	1959-present	asphalt
	roof putty	10-25	unknown-present	asphalt
	plaster/stucco	2-10	unknown-present	portland cement
	spackle	3-5	1930-1975	starch, casein, synthetic resins
Asbestos-containing compounds	sealants, fire/water	50-55	1935-present	caster oil or polyisobutylene
	cement, insulation	20-100	1900-1973	clay
	cement, finishing	55	1920-1973	clay
	cement, magnesia	15	1926-1950	magnesium carbonate
Asbestos ebony products		50	1930-present	portland cement
Flooring tile and Sheet Goods	vinyl/asbestos tile	21	1950-present	poly(vinyl)chloride
	asphalt/asbestos tile	26-33	1920-present	asphalt
	sheet goods/resilient	30	1950-present	dry oils
Wallcovering	vinyl wallpaper	6-8	unknown-present	--
Paints and coatings	roof coating	4-7	1900-present	asphalt
	air tight	15	1940-present	asphalt

* The information in this table is taken, with modification, from: Lory EE, Coin DC. February 1981. *Management Procedure for Assessment of Friable Asbestos Insulating Material*. Port Hueneme, CA: Civil Engineering Laboratory Naval Construction Battalion Center. Laboratory aprons, gloves, cord, rope, fire blankets, and curtains may be common in schools.

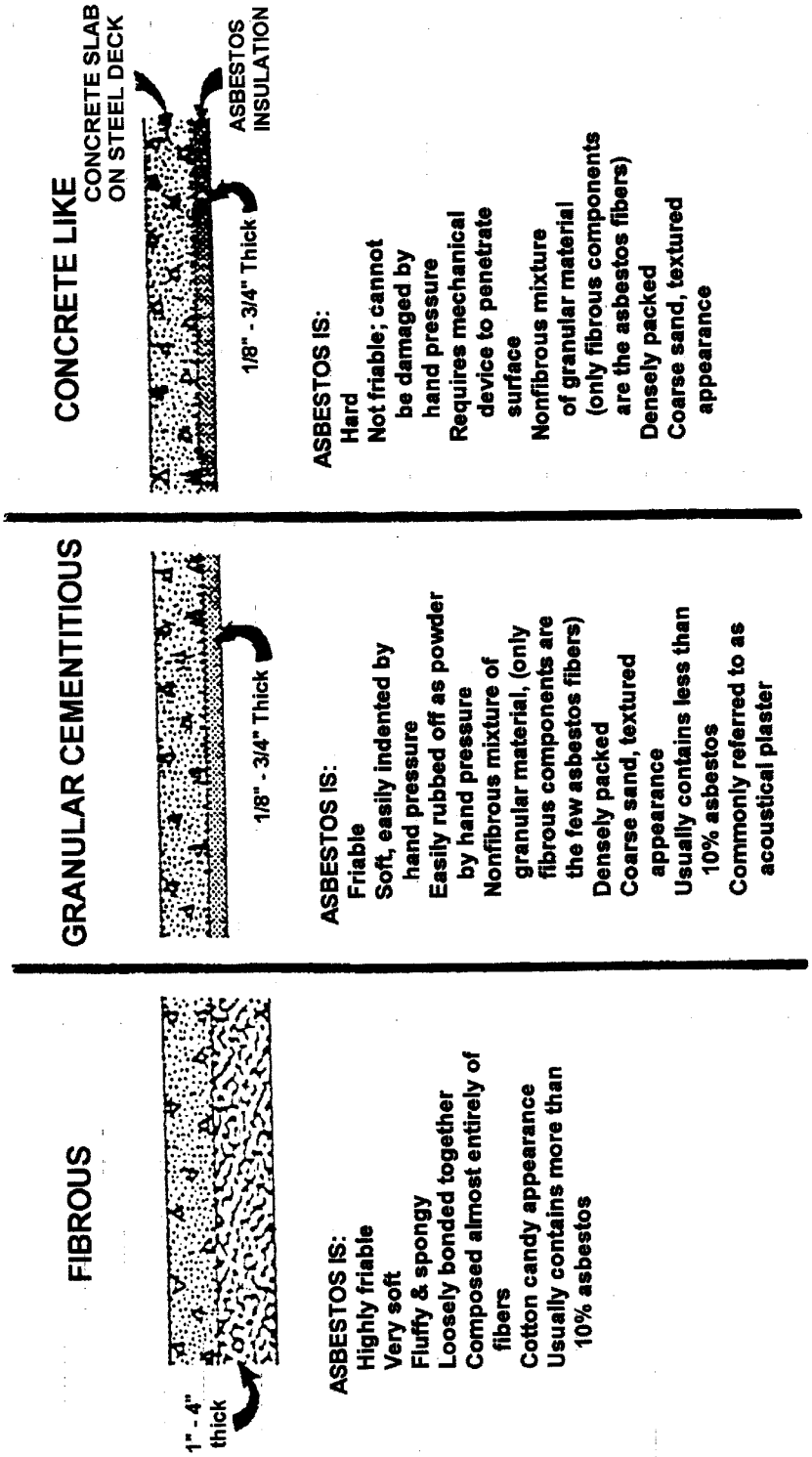

Figure 2-5. Comparison of Properties of Fibrous, Granular Cementitious and Concrete-Like Building Materials.

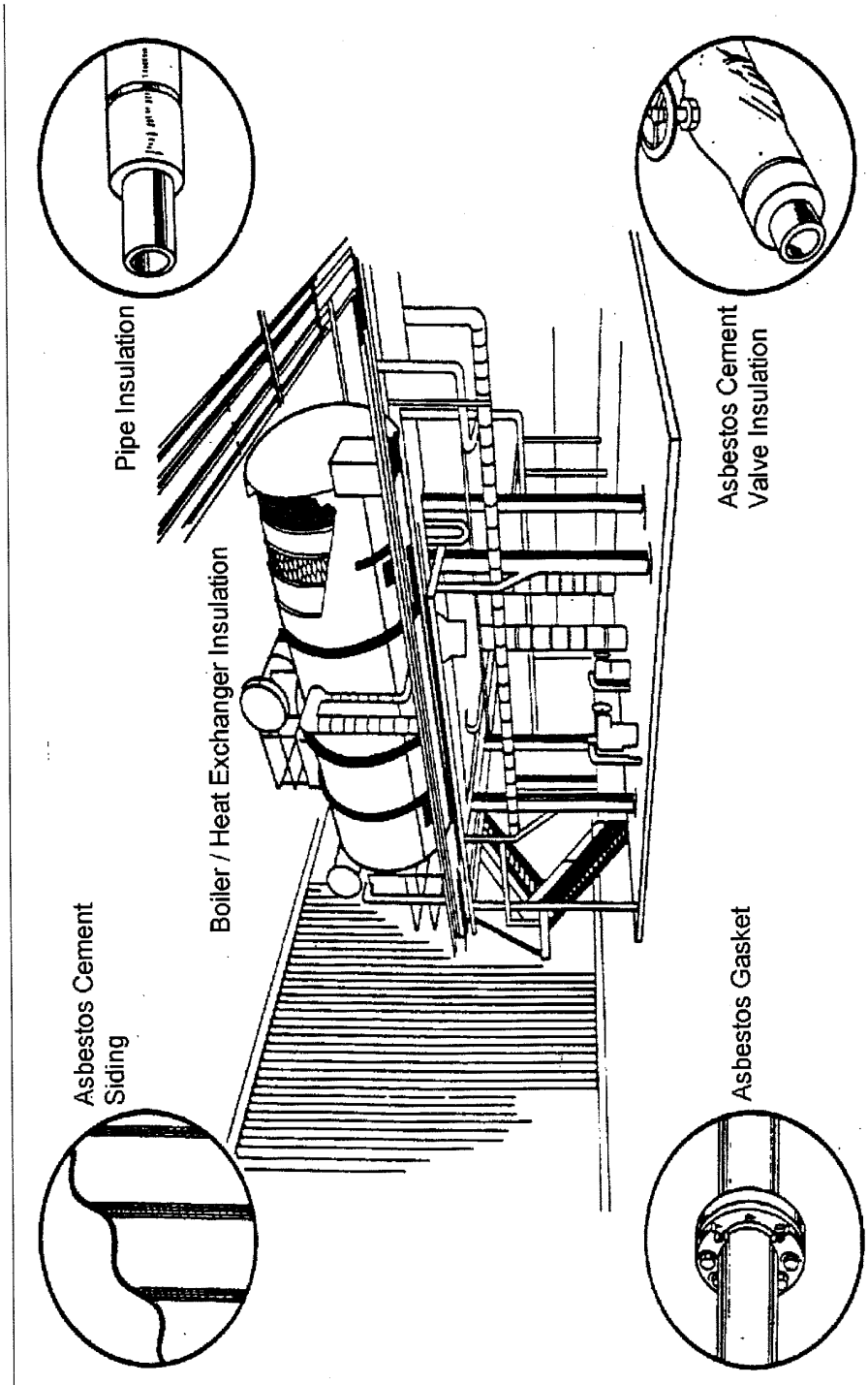

Figure 2-6. Asbestos-Containing Thermal Insulation and Asbestos Siding.

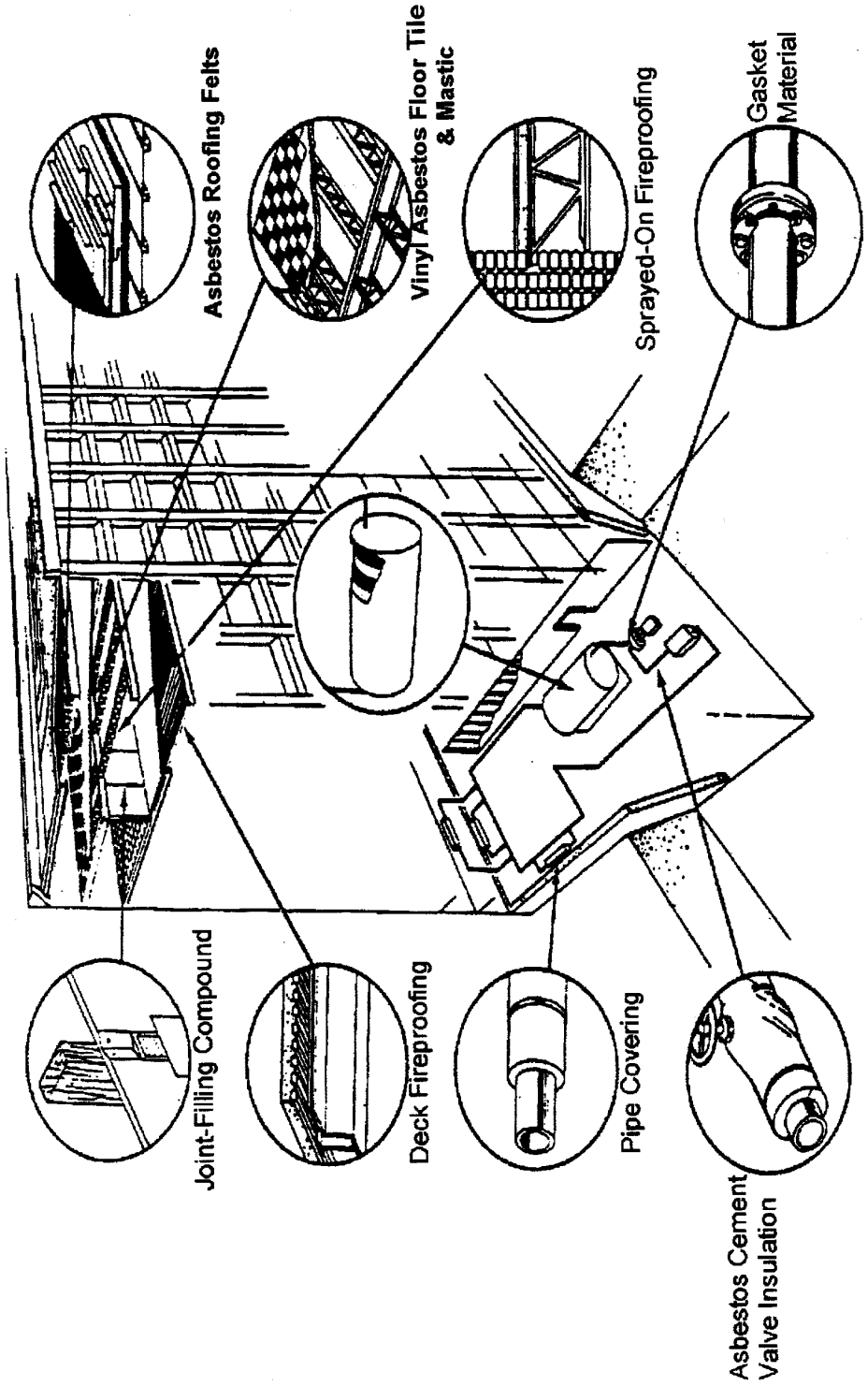

Figure 2-7. Miscellaneous Asbestos-Containing Insulation and Construction Materials.

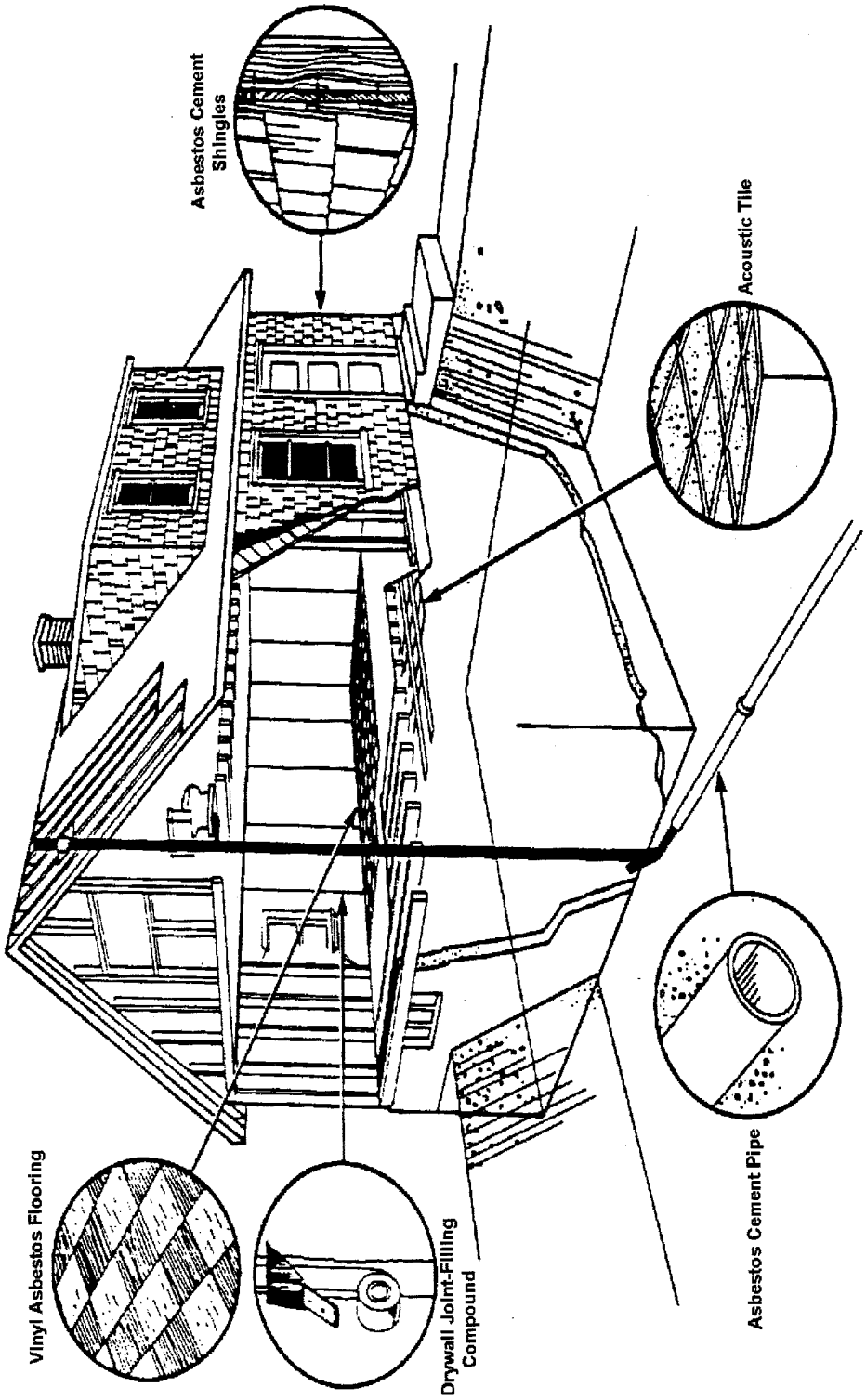

Figure 2-8. Miscellaneous Asbestos-Containing Material (ACM) Found in Both Commercial and Residential Construction.

2.3 Friability and Typical Damage to Asbestos-Containing Material

The term friability is frequently used in the context of ACM. Friable ACM may be crumbled or reduced to a powder under hand pressure or similar small force. Note that under the USEPA definition, the term friable material includes both damaged material and that material which possesses the potential for damage when touched or otherwise disturbed. Examples of damage to friable ACM are shown in figures 2-9 to 2-11.

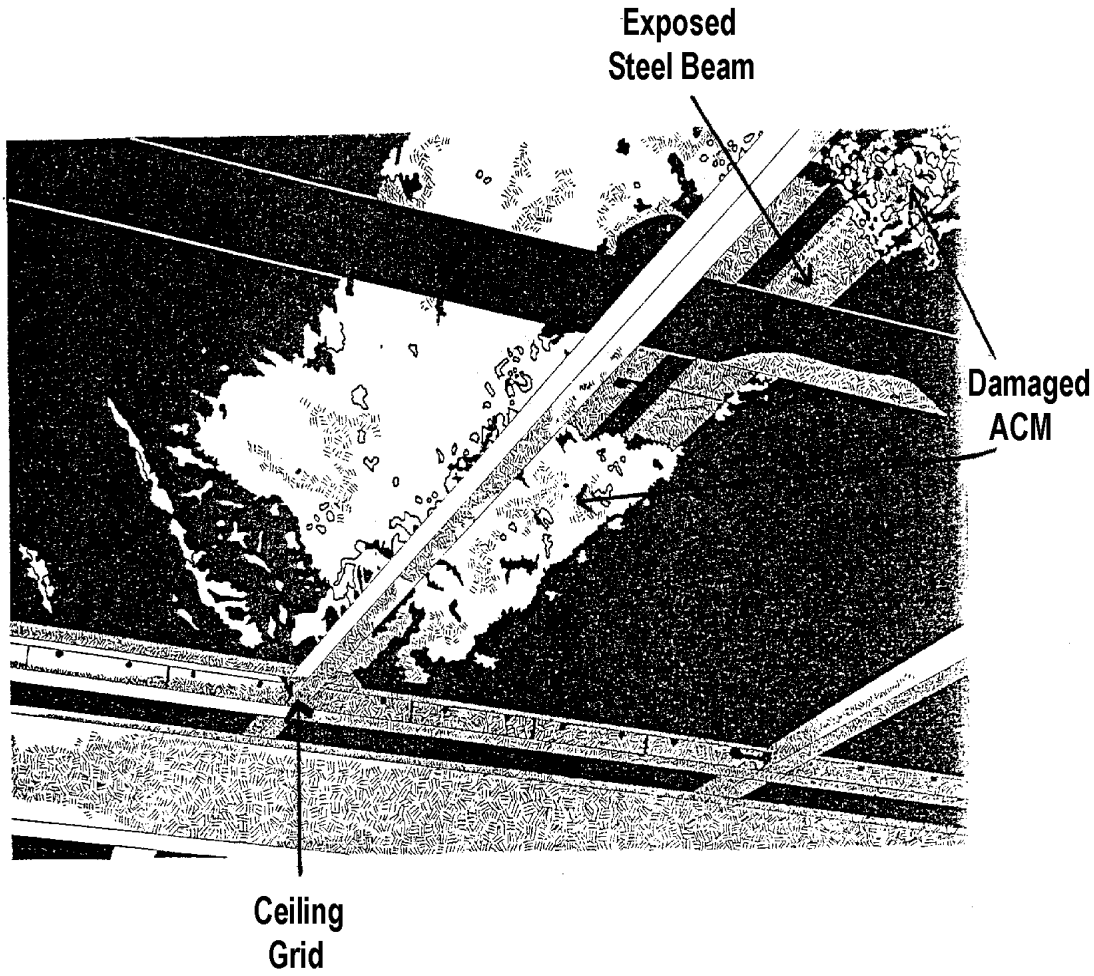

Figure 2-9. Damaged Sprayed-On Asbestos-Containing Fireproofing Applied to Structural Steel.

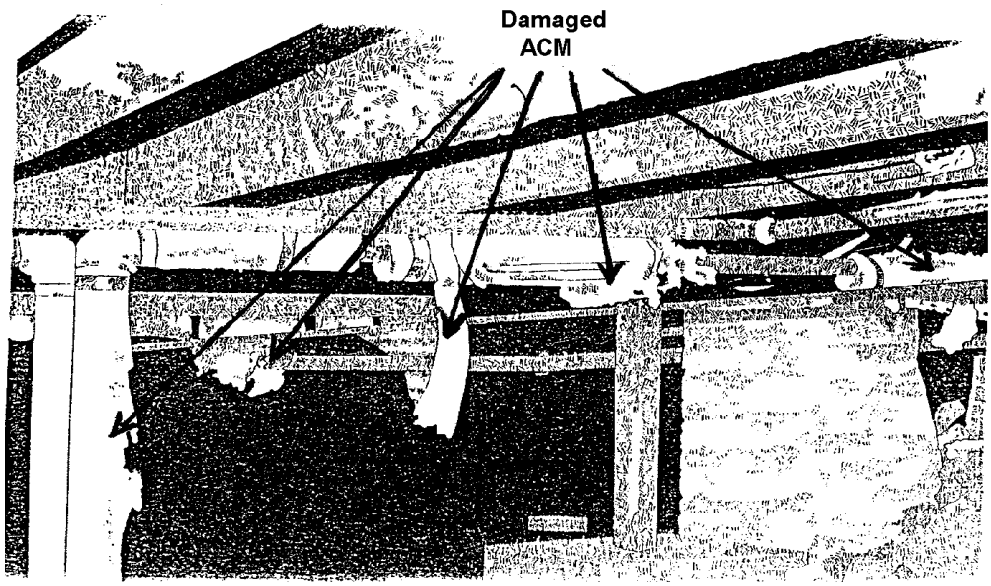

Figure 2-10. Extensively Damaged Pipe Lagging Located in a Damp Crawl-Space.

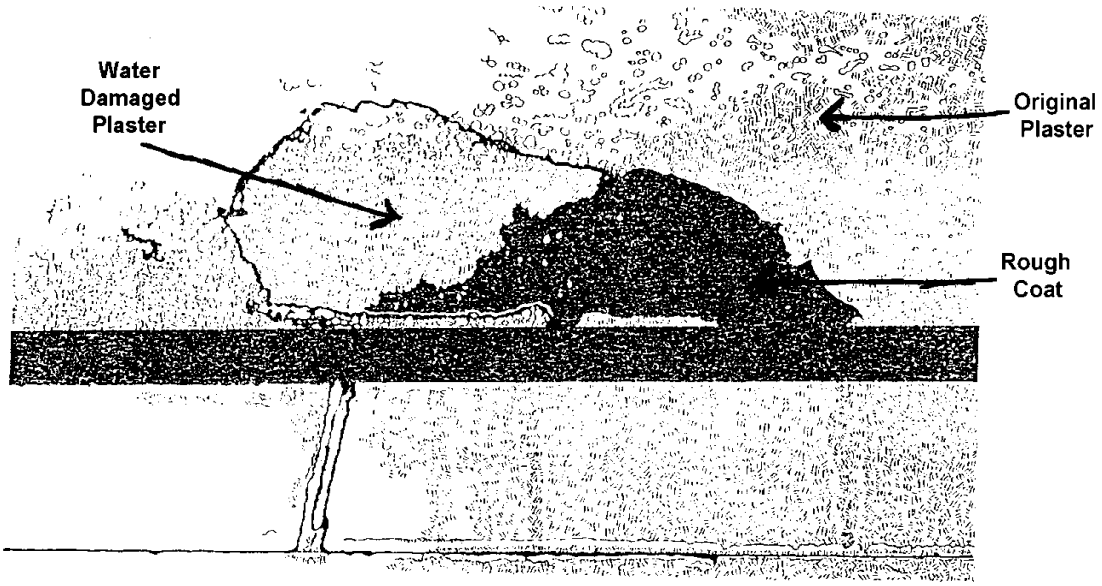

Figure 2-11. Water Damage to a Troweled-on Asbestos-Containing Ceiling Plaster.
The rough (or brown) coat to which the ACM is applied frequently does not contain asbestos; however, this fact should be verified by sampling and analysis.

2-4. Health Effects of Asbestos

a. During the early part of this century, workers in a number of industries were exposed to airborne dusts. While many dusts were not particularly toxic, some were found to have varying degrees of disease-producing potential. Many of the exposures in these dusty trades produced a lung condition known as pneumoconiosis, a general term used to describe a fibrosis (or scarring) of the lung. Specific pneumoconiosis include asbestosis (from asbestos dusts), silicosis (from quartz dusts), coal-miners' pneumoconiosis (from coal dust-- also called black lung), buissinosis (from cotton dusts), and talcosis (from talc dusts). The significant feature for all these dusts is the exceedingly small size of particles and fibers which, when inhaled, result in deposition along the lung's airways and ultimately into the lung's air sacs or alveoli. A feature common to all these diseases is that the lung is the route of entry. When dealing with asbestos or any of these dusts, the object is to protect personnel from breathing them. Inhalation of asbestos dusts has been linked to three lung diseases:

(1) *Asbestosis.* Asbestosis is an irreversible, progressive disease that produces scarring (fibrosis) of the lungs leading to reduced oxygen exchange from the air into the bloodstream and shortness of breath. The degree of disability is related to the intensity and duration of exposure; that is, there is a dose-response relationship reflecting the asbestos lung burden.

(2) *Malignant pleural mesothelioma.* This is a rare, though almost invariably fatal, malignancy that develops in the pleural tissues surrounding the lungs and in the peritoneum. Unlike asbestosis, the risk of mesothelioma is present even at low concentrations of airborne asbestos fiber.

(3) *Lung cancer.* There is a synergistic relationship between asbestos and smoking. Cigarette smoking is the single most important known cause of lung cancer in humans. People who smoke 20 cigarettes per day increase their risk of developing lung cancer by ten-fold (10X) when compared to the non-smoker. Workers exposed to the same level of asbestos as insulation workers historically increase their risk of developing lung cancer by five-fold (5X). These two factors working together have a synergistic effect; the smoker exposed to asbestos fibers is at lease fifty times (50X) more likely to develop lung cancer than the general public.

b. An increased risk of gastrointestinal cancers (stomach and colo-rectal) has also been found among asbestos workers. Unlike most other industrial diseases, asbestosis and mesothelioma have a lengthy latency period between exposure and onset of disease. Latencies range from about 12 years to 30 or 40 years.

c. The asbestos exposures that lead to these illnesses are highly variable.

(1) There may be episodes of acute, high-level exposure

(2) Or there may be periods of chronic, low-level exposure.

(3) Both modes of exposure can result in identical asbestos lung burdens.

CHAPTER 3
IMPLEMENTING AN INSTALLATION ASBESTOS MANAGEMENT PLAN

3-1. Authority and Responsibility for the Installation Asbestos Management Plan

The Installation Commander (IC), who is responsible for implementation and conduct of the AMP, will determine the responsibilities of the various individuals on the AMT. Paragraph 3-5 provides guidance on the assignment of these responsibilities.

3-2. Goals and Policies of AR 420-70 and AR 200-1

The AMP goals and policies are provided in AR 200-1. An AMP will be developed and executed by the AMT. As a minimum, an AMP will include:

a. A complete review of O&M schedules, design plans, and specifications. This task will identify structures that are scheduled for repair, alteration, demolition, or transfer.

b. An installation/CWF-wide (excluding outgrants) survey of all structures.

c. An exposure assessment and risk assessment of each location containing asbestos.

d. Preparation and implementation of an asbestos abatement plan for each location containing asbestos.

e. Preparation and implementation of a special O&M plan for each location containing asbestos.

f. Provisions for worker education/training programs.

g. An environmental impact analysis of the AMP, as described in AR 200-2.

3-3. The Asbestos Management Team

a. In selecting the AMT members, it is essential to choose personnel who, in the normal course of their work, will become aware of pending construction projects. Work orders must be submitted for all construction, including self-help projects. Such a policy will eliminate the unknowing or unintentional disturbance of ACM. In addition, one individual must be selected to review all work

orders to determine whether there is a potential asbestos impact. AR 420-70 and AR 200-1 recommend as a minimum, representatives from the following:

(1) *Directorate of Public Works (DPW*). It is important that the installation facility manager, a knowledgeable person within DPW, serve as AMCO of the AMT. It is the responsibility of this individual to review all construction-related work orders to determine whether there is a potential asbestos impact. This determination is based on either a search through the existing installation asbestos survey database or a direct inspection of the buildings or areas to be impacted by the construction. The AMCO has overall responsibility for development and implementation of all aspects of the asbestos management program.

(2) *Environmental Office.* An environmental coordinator from this office is responsible for arranging and executing the installation asbestos survey and for updating this database. In addition, this individual is responsible for obtaining permits and for submitting notifications to federal, state, and local agencies, as appropriate, in a timely manner.

(3) *Preventive Medicine (PREVMED).* This department provides an industrial hygienist (IH) or environmental science officer whose responsibilities shall include the selection of personal protective equipment (PPE) for asbestos abatement projects, as well as collecting personal and area air samples for government and in-house personnel before and during asbestos abatement projects. This person will also be responsible for reviewing collected post-abatement clearance data and clearing the space for normal occupancy when the clearance standard has been achieved, and serving as the competent person (see glossary, also 29 CFR 1926.1101) for abatement work done with government and in-house personnel. The IH may also provide technical assistance to the contracting officer's representative (COR) and contracting officer (K.O.) when abatement work is to be performed by a contractor. In this situation, the IH's responsibilities include review of contract specifications and the statement of work for issues relating to health and safety, and review of contractor's work plan for compliance with regulations. When using a contractor for abatement work, an outside, independent, certified industrial hygiene consultant should be retained as the competent person. The PREVMED IH will assume a quality assurance role to ensure that the integrity of the containment system is maintained. The IC must provide assurance to the PREVMED IH or other Army competent person that the monitoring process will be carried out with integrity and independence without interference from the asbestos abatement supervisor.

(4) *Safety Office.* An occupational safety and health (OS&H) manager is assigned to the AMT to implement the respiratory protection program (RPP). This individual reviews all work orders having a potential asbestos impact, abatement specifications and contractor's work plans, and occupational health and safety-related issues. In the course of an asbestos abatement project carried out by an in-house team, the OS&H manager inspects the work site and verifies that appropriate safety and OSHA warning signs and a list of emergency telephone numbers are posted (see table 11-2). In addition, both the work site and the construction area immediately outside the containment system are inspected on a daily basis.

b. The individuals listed above form an active working group for the design and execution of specific projects; the entire team, which includes the remaining departments listed below, works together to produce the overall AMP.

(1) *Civilian Personnel Office (CPO).* The representative from this office is concerned with labor issues that may arise when civilian employees are members of the in-house asbestos abatement team.

(2) *Staff Judge Advocate (SJA).* The SJA is to be consulted on any liability or regulatory compliance issues relating to the asbestos abatement project. A determination by the SJA is required on the appropriateness of using Army or civilian personnel on abatement projects, and on the question whether the installation is required to follow state, local, or host-nation regulations.

(3) *Public Affairs Office (PAO).* The representative from this office is responsible for informing Army and civilian personnel about the asbestos abatement project. This activity receives input from the other members of the AMT and notification of affected personnel must be done well in advance of the commencement of the asbestos abatement project.

c. Depending upon the complexity of the asbestos abatement project, other disciplines such as structural engineering and architectural services, may be included on the team.

3-4. Guidance for the Preparation of an Asbestos Management Plan

The AMT, under the direction of its AMCO (or the team leader), should initiate the steps required to create the AMP. The AMP is a formal written document that must be prepared before individual asbestos abatement activities take place. The AMP should define the scope of the asbestos problem (the survey); pre-abatement steps taken to mitigate potential exposures (the O&M plan); and the detailed asbestos abatement plan (if this option is selected). The AMP should include the following actions:

a. Obtain a complete up-to-date inventory of all buildings and structures on the facility.

b. Obtain a copy of the most recent asbestos survey and determine whether it is up to date.

c. If an installation asbestos survey has not been completed, the steps outlined in chapters 5 and 8 should be followed.

d. Determine, through the IC, the short and long-range installation plans that may impact existing structures. That is, identify those buildings that are to be renovated, demolished, or sold.

e. The amount, extent, and condition of ACM found through the installation asbestos survey should be coupled with anticipated plans for these structures to produce an asbestos abatement

priority list. Building use (e.g., family housing) may also affect that building's ranking on the priority list.

f. An interim or long-term O&M program should be established for all installation buildings containing ACM.

g. The AMT must be involved with asbestos abatement planning in the earliest stages of a project and continue through project completion.

h. The AMCO must contact the USEPA Regional Office NESHAP coordinator, state, local (see appendix B), and host-nation agencies, as appropriate, to inform them of the anticipated project. In the case of the USEPA, however, informing them at this stage of the project is not a substitute for the formal notification required by regulation. The on-site competent person, supervisor, and IH should explain to all affected facility personnel, and any potentially affected off-site neighbors, the nature of the proposed project and the precautions that will be followed to protect health and safety.

i. The PREVMED IH must provide direct monitoring support for in-house projects and should serve as the technical assistant to the COR for projects involving an outside asbestos abatement contractor.

j. The AMP must incorporate the steps necessary to ensure that post-abatement clean-up, disposal, and submission of required documents are accomplished before certifying project completion or, in the case of an outside contractor, before final payment is approved.

k. The AMP must also provide for developing and maintaining an asbestos inventory database.

l. The AMP will describe the duties of the individuals on the AMT.

3-5. Coordination Among Asbestos Management Team Members

It is important that members of the AMT work together to complete certain tasks. The AMT should meet quarterly and brief the IC on an as needed basis. The US Army Center for Health Promotion and Preventive Medicine (USACHPPM) has produced a document that discusses this issue in detail, including duties and responsibilities. The document is titled, US Army Environmental Hygiene Agency (AEHA), Technical Guide 157, Installation Asbestos Management Program Assessment Checklists, dated July 1994. This document provides a series of checklists that basically follows the subsequent chapters in this PWTB. Requests for information should be directed to USACHPPM; Aberdeen Proving Ground, MD 21010-5422.

CHAPTER 4
QUALIFICATIONS AND TRAINING

4-1. Asbestos Management Team Training Requirements

a. Unlike most other forms of building management and construction, activities related to asbestos are such that all personnel must be specially qualified and trained. This chapter addresses these requirements for all Army and DA civilian personnel and contractor personnel who will have to deal with ACM. AR 420-70 and AR 200-1 require that AMT personnel directly involved in the management and control of ACM be trained at a level consistent with the USEPA AHERA and ASHARA requirements. Materials in this chapter will, in varying degree, affect contractor personnel who may come into potential contact with ACM in the course of their work or may be directly involved in an asbestos abatement project. As part of the special O&M program, custodial and maintenance staff must attend asbestos awareness and even additional courses as they become increasingly involved with ACM.

b. For the AMT to prepare, coordinate, and execute the AMP, it is necessary that those team members actively involved in the technical aspects of the plan be appropriately trained. The USEPA has established a MAP under AHERA. Courses approved under this plan provide classroom instruction and hands-on training for individuals who will have varying levels of responsibility in the handling of ACM. It is essential that each installation have a sufficient number of appropriately trained personnel to accomplish the work anticipated in the AMP. All construction inspectors, designers, and personnel associated with asbestos contract scopes of work will be trained in the following subjects: building inspection; management planner; and asbestos abatement procedures and practices for workers and supervisors, to meet federal, state, and local requirements. Selection and training of personnel should commence well in advance of anticipated projects.

c. MAP was established as part of the AHERA program (see Federal Register, Vol. 52, No. 83, Thursday, April 30, 1987) establishing minimum training standards for those dealing with ACM in schools. In addition, personnel must meet the requirements of the OSHA August 10, 1994, Final Rule. The authority of this plan was extended under ASHARA (see Federal Register, Vol. 57, No. 93, Wednesday, May 13, 1992), effective November 1992, to include publicly- and privately-owned commercial buildings. The MAP was revised under ASHARA (see Federal Register, Vol. 59, No. 23, Thursday, February 3, 1994) to clarify the type of persons who must be accredited to work in schools, public and commercial buildings, and to increase the minimum number of hours of training including additional hours of hands-on health and safety training for asbestos abatement workers and contractor/supervisors.

d. The following courses are required:

(1) *Building inspection.* Individuals conducting building inspections must complete a 3-day course to obtain certification. Certified inspectors are permitted to conduct ACM inspections, collect bulk samples, and perform assessments of the ACM. When performing an inspection, this training certification and any applicable state licenses must be carried. The leader of each field asbestos survey team must be a certified inspector; however, other individuals on the same team need not be certified. Note that an uncertified individual must not collect bulk samples or perform assessments of ACM. Course topics include:

(a) Federal and state regulations.

(b) Worker protection.

(c) Inspection equipment.

(d) Sampling techniques.

(e) Health effects.

(2) *Management planner.* This 2-day course usually immediately follows the inspector course. Course topics include:

(a) Interpretation of inspection data.

(b) Determining the appropriate response action.

(c) Developing a schedule for implementing the response actions.

(3) *Annual refresher courses for inspectors and management planners.* Inspectors and management planners must complete an annual refresher course to maintain their certifications. Each is a half-day course and, because so many individuals have both certifications, the courses are given back-to-back on the same day.

(4) *Asbestos abatement procedures and practices for workers, supervisors and contractors.* Worker training requires four days, and the supervisor/contractor course requires five days. Course topics include:

(a) Basic asbestos abatement procedures.

(b) Federal and state regulations.

(c) Health effects.

(d) Worker safety in the asbestos industry.

(5) *Procedures and practices for asbestos abatement annual review.* Under the USEPA/AHERA regulations, workers, supervisors, and contractors must attend a one-day refresher course each year. Topics discussed include recent changes in federal and state regulations and recent advances in asbestos abatement technology.

(6) *Project designer.* A specific course has been developed for the project designer; however, this person must have, as a minimum, the supervisor training course. This certification will permit the project designer to develop drawings and specifications for large-scale, long-duration asbestos abatement projects.

(7) *Project monitor.* This person must hold certification at the supervisor's level. The certified project monitor is permitted to collect personal and area air samples and inspect the abatement work being carried out for compliance with regulations and specifications.

e. Both OSHA and the USEPA AHERA regulations refer to the competent person; in the context of this discussion, the competent person is that individual who has taken the full five-day series of courses in accordance with AHERA sections 206 (b)(1) and (c)(a).

f. Under ASHARA, the reauthorization of AHERA, the training and licensing requirements previously applicable to school-related asbestos activities, now apply to all public and private structures namely the interior of public, commercial, and industrial buildings.

4-2. Training of Custodians and Maintenance Workers for Operations and Maintenance Programs

a. Both USEPA and OSHA require a worker training program for all employees who are or may be exposed to fiber levels above the PEL of 0.1 f/cc on an eight hour TWA basis or the excursion limit of one f/cc for a 30-minute period. In addition, it is essential that all custodial and maintenance staff be well informed about the asbestos problem to achieve a successful O&M program. Failure to achieve such cooperation and understanding will result in exposures to airborne asbestos and ultimately lead to a need for asbestos abatement. Included in the custodian and maintenance workers' category are cleaners, janitorial staff, electricians, plumbers, and heating/ventilation workers; that is, those workers who may come into contact with ACM.

b. All custodial staff and maintenance workers, under the AHERA regulations, require 16 hours of training. The training course must address the steps to be taken to avoid the release of asbestos fibers from ACM. Anticipating that they may encounter unusual situations, these workers must also be instructed in the basic concepts of asbestos hazard control. The USEPA recognizes three levels of training at the O&M level for custodial and maintenance workers:

(1) Level I: Awareness training.

(a) This course is for custodians and maintenance workers whose normal duties would not bring them into contact with ACM; they may, however, disturb this material accidentally.

(b) Level I training can range from two to eight hours in length covering the following topics:

- Background information on asbestos.
- Health effects of asbestos.
- Worker protection programs.
- Location of ACM in the building.
- Recognition of ACM damage and deterioration.
- The O&M program for the building.
- Proper response to fiber release episodes.

(2) Level II: O&M training.

(a) This is special O&M training designed for workers involved in general maintenance and asbestos material repair.

(b) At least 16 hours of instruction is required covering Level I topics in more detail, as well as the following:

- Federal, state, and local asbestos regulations.
- Proper asbestos related work practices.
- Descriptions of the proper methods of handling ACM, including waste handling and disposal.
- Respirator use, care, and fit-testing.
- Protective clothing donning, use, and handling.
- Hands-on exercises for techniques such as glove bag work, high-efficiency particulate air (HEPA) vacuum use, and maintenance.

- Appropriate and proper work decontamination practices.

(3) Level III: Abatement worker training.

(a) This training is designed for asbestos abatement workers who will come into direct, intentional contact with ACM to remove, encapsulate, or enclose it. Level III requires from 24 to 32 hours of instruction, and the elements described below are equivalent to the abatement worker training course, approved under the USEPA AHERA model accreditation plan described above. Level III training would be appropriate and necessary for any in-house personnel assigned to asbestos abatement projects.

(b) While Level I and Level II topics should be discussed in Level III instruction, more emphasis is given to the specialized topics listed below:

- Pre-asbestos abatement work activities.
- Work area preparation.
- Establishing decontamination units.
- Personal protection including respirator selection, use of fit-testing, and protective clothing.
- Worker decontamination procedures.
- Safety considerations in the abatement work area.
- A series of practical hands-on exercises.
- Proper handling and disposal of ACM wastes.

c. Each worker must receive a certificate of training for each level of training completed. Copies of these certificates will be required for the records of a specific asbestos abatement project.

d. O&M training by qualified installation personnel is permitted under USEPA regulation, and many training course providers are available who could offer this service on a contract basis.

4-3. Additional Training Material

Additional literature and data are available at the US Army Environmental Center (USAEC) by calling the Army Environmental Information Service (AEIS) at 1-800-872-3845, OCONUS (410) 671-1699, DSN 584-1699. Environmental training support, training and awareness materials, training needs evaluation assistance, and Department of Defense Environmental training directory can be obtained from the Army Environmental Training Support Center by calling (205) 722-5816/5891 or faxing (205) 722-5896.

4-4. Recommended Training Requirements for Department of the Army Personnel Involved with Asbestos Management or Abatement

The training requirements given in paragraph 4-2 above are the USEPA AHERA requirements for schools; training requirements of this depth may not be necessary for all DA personnel who may be engaged in the various aspects of asbestos management or abatement. Table 4-1 lists recommended guidelines.

Table 4-1. Recommended Training for Department of the Army (DA) Personnel Engaged in Asbestos Management or Abatement

Title	Recommended Minimum Level of Training
Asbestos Management Control Officer (AMCO)	Supervisor/contractor, building inspector, and management planner.
AMCO assistants	Supervisor/contractor, building inspector, and management planner.
IH (PREVMED)	Supervisor/contractor, project monitor, building inspector, and management planner.
Installation asbestos survey inspectors	Inspector (The individual designated as the installation survey team leader should also be a certified management planner.)
Safety Office representative	Management planner, project monitor or supervisor/contractor, as responsibilities require.
Public Affairs Office representative	Level I or Level II O&M training as appropriate.
Chief, building maintenance	Supervisor/contractor or asbestos abatement worker, as appropriate.
Chief, custodial services	Level III O&M training.
Maintenance workers (electricians, plumbers, and heating and ventilation specialists)	Level I or Level II O&M training for in-house and contracted personnel. Level III for selected individuals such as master electricians and plumbers.
Custodial staff	Level I or Level II for all in-house and contracted custodial staff. Level III for selected individuals who may be required to deal with ACM on an emergency basis.
Contract scope of work developer/specialist	Supervisor/contractor.

NOTE: *The number of personnel and the level of their training will depend upon the size of the installation, its age, and complexity of activities. The AMCO must determine the extent of training based upon the potential for DA personnel to be exposed to airborne asbestos.*

CHAPTER 5
THE INSTALLATION ASBESTOS SURVEY AND ASSESSMENT

5-1. Organizing and Conducting the Installation Asbestos Survey

a. This survey must be conducted by either AHERA certified in-house personnel or the project may be undertaken on a contract basis by a competent firm. The usual sequence of steps to follow includes:

(1) Obtaining a complete listing and physical description of all buildings and structures within the facility.

(2) Obtaining copies of all reports or databases pertaining to past asbestos surveys or abatement projects.

(3) Performing site inspections of each building and structure.

(4) Collecting and analyzing bulk samples for asbestos.

(5) Assembling the database.

b. Each of these steps is shown in more detail in figure 5-1.

5-2. Components of the Installation Asbestos Survey

a. *Building and structure inventory*. Before commencing the actual site inspections, it is important to obtain a list and physical description of each building or structure to be included in this survey. Additional information, such as the number of square feet, the present use, and future plans for the building, will be useful survey data. As-built drawings or even a reduced footprint of the building are useful in the field when mapping the areas of ACM. Original construction specifications, when available, are notoriously unreliable as sources concerning the presence of ACM. Construction specifications may specify an asbestos-containing product, but the phrase or equivalent is frequently included, so that there is no guarantee that the material is actually an ACM. The only truly reliable approach is to sample the suspect material and have it analyzed.

b. *Review existing facility ACM data*. The presence of ACM in DA buildings has been a topic of concern for well over a decade and a number of facilities had initiated their own surveys. Existing databases may be out of date because of changes in personnel assignments or the press of other commitments. Any previous surveys should be evaluated to determine whether the data is currently relevant, and it may be possible to build upon an existing survey to bring it up to date.

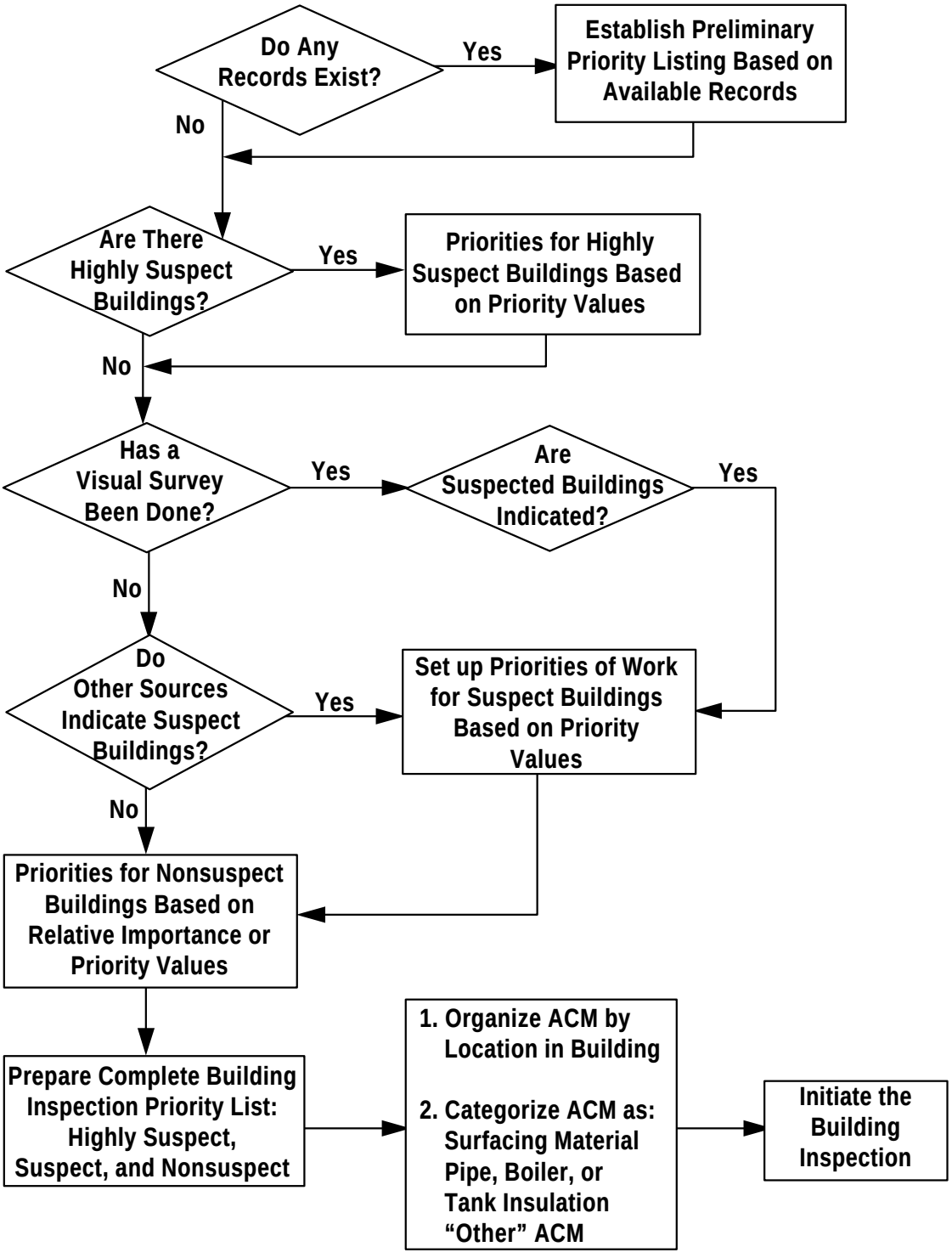

Figure 5-1. Asbestos Survey Flowchart

c. *Conducting site inspections.*

(1) *Walk-through survey.* A thorough walk-through survey should be made of each building. Each building manager should be contacted beforehand to arrange for access into locked spaces. The inspection normally begins in the boiler room and expands to include other functional spaces in the same building. Lagged vertical riser pipes commonly run through closets, store rooms, or other out-of-the-way places. If it is known that the building is to be demolished, it would be prudent, whenever practicable, to break into chases, or walls and ceilings to determine whether ACM is present. Crawl spaces and attics should be checked carefully. For structures built upon a concrete slab, asbestos lagged pipe may be present in below-slab trenches. Building maintenance personnel are often a valuable source of information regarding the details of construction and the locations where ACM may be present. It is important to remember that if a situation is discovered that is immediately dangerous to life or health, the inspector should immediately notify the Safety Office.

(2) *Collection of bulk samples.* Collecting a sufficient number of representative samples of the various types of ACM is a vital part of the survey. These bulk samples should be carefully selected from each type of suspect construction material from locations throughout the functional space. In the case of pipe lagging, for example, the idea is to distribute the bulk sample variants so as to include all variants of pipe lagging having different physical appearances (e.g., change in an outside diameter (OD), covering material, hardness, or color). Additional information on bulk sampling and analysis are contained in chapter 8.

5-3. Army Asbestos-Containing Material Assessment Checklist

a. The Army ACM Checklist in appendix C is divided into two parts.

(1) Part I addresses the extent of existing damage and the potential risk of damage to friable ACM.

(2) Part II addresses exposure potential and associated factors that contribute to health hazards in the occupied functional space being evaluated.

b. Evaluating the extent of damage to the ACM or the potential for damage is an important part of the assessment. This is because, in most cases, damaged ACM will release more airborne asbestos fibers than undamaged ACM under identical conditions. Also, the more extensive the damage, the greater the potential for fiber release.

c. Assessment factors, such as physical damage, water damage, asbestos content, and the attendant value-weighted conditions, in Part I is self-explanatory. Other assessment factors, in Part I and II however, have additional considerations that could influence the evaluators choice of a value-weighted condition. The remainder of this section deals with some additional considerations.

d. The first assessment factor listed in Part I, physical damage to ACM, has the five value-weighted conditions of high, moderate, low, minimal, and none. A consideration for the evaluator should be the age of the ACM. If the age is greater than 30 years, the normal deterioration of the binding agents may have produced a surface material that has a potential for fiber release, per unit of surface area damaged, much greater than for newer and similar surface ACM. An evaluator who would normally rate a certain extent of damage as low for 15-year-old sprayed-on ACM might want to rate the same extent of damage as moderate for a 35-year-old material. The age of the ACM should also be considered when determining the potential for damage from water and routine maintenance or repair. In some assessment algorithms, the design of a roof above the ACM is considered. There is a greater potential for rainwater damage to ACM under a flat roof than under a sloped or hipped roof.

e. In considering the asbestos percent content of ACM factor, the assumption is that as the percentage of asbestos in the ACM increases so does the potential for airborne fiber release. This would undoubtedly be true if the same binding agent were used in all ACM. However, not all ACM is created equal. It is quite possible that an ACM with an easily degraded starch, water-soluble binder and an asbestos content of 15 percent would have a greater fiber release potential than an ACM with 50 percent asbestos and a water-insoluble binder.

f. The evaluator's choice of a value-weighted condition for each assessment factor should be based upon all detailed and relevant information available.

5-4. Guide for Completing the Asbestos-Containing Material Assessment

a. A survey is defined in this manual as the inspection of functional spaces to locate, identify, and measure the amount of ACM present.

b. An assessment further evaluates the ACM in terms of:

(1) Its potential to become airborne, or the actual extent to which it is a source of airborne fibers (damage).

(2) What extent humans are exposed to airborne fibers in the functional spaces of a facility containing asbestos.

c. Army asbestos management programs will include an assessment with any survey conducted.

d. An assessment is used to determine if corrective action is needed, what corrective action to use, and prioritizing the corrective actions. The assessment process includes:

(1) Identifying the type of ACM by taking bulk samples (i.e., wall board, pipe insulation, surface compound, etc.).

(2) Evaluating the potential for fiber release (exposure potential).

(3) Identifying and assessing the current condition of ACM using the following information:

(a) *Physical damage.* If damage is present from vandalism, accidental physical contact, or any other cause. Evidence of debris on horizontal surfaces, hanging material, dislodged chunks, scrapings, indentations, or cracking are indicators of poor conditions. If coated surface gives when slight hand pressure is applied or the material moves up and down with light pushing, then the ACM is no longer tightly bonded to its substrate.

(b) *Water damage*. Inspect the area for visible signs of water damage, such as discoloration of or stains on the ACM; stains on adjacent walls or floors; buckling of the walls or floors; or areas where pieces of the ACM have separated into layers or fallen down, thereby exposing the substrate.

(c) *Deteriorating or delaminating from substrate.* Inspect the area for quality of installation (i.e., separating into layers, adhesive failure) or environmental factors which affect the cohesive strength of ACM.

(d) ACM in poor condition means the binding of the material is losing its integrity as indicated by peeling, cracking, or crumbling of the material.

(4) Identifying potential for future damage, disturbance, or erosion of material, including accessibility of material, frequency the area is used, activity likely to cause damage, and any planned changes to the area.

e. Other important factors that must be included in the assessment of ACM are the inherent friability of the material, percentage of asbestos in the material, where material is located, number of people in the area, the duration of occupancy, location of ACM to air plenum or direct airstream, and importance of the area.

f. In most cases the asbestos material is covered with a protective jacket of cloth, tape, paper, etc. These bonding materials will prevent the material from becoming friable and/or airborne. Most nonfriable materials can be broken without releasing significant quantities or airborne asbestos fibers. Surfacing materials are usually bonded and will not become airborne unless disturbed (i.e. vibration, drilling, etc.). The amount of ACM should be identified as linear feet or square feet. All supporting building documentation should be included in the individual building reports (i.e., building drawings, sampling data, assessment data of homogenous materials per functional area, work sheets, etc.).

g. The evaluator must be minimally an AHERA certified inspector, if he or she is to complete the assessment. Completion of the assessment requires, in accordance with AR 420-70 and AR 200-1, the evaluator to be minimally an AHERA accredited management planner. Prior to commencing survey and assessments of functional spaces in a facility, the evaluator should have participated in AMT meetings during which inspection strategies and plans were discussed and written. Also, the evaluator should be provided and be familiar with any available facility site plans, as-built drawings, previous inspection reports, abatement records, and any other records, reports, plans, or accounts relevant to the ACM survey-assessment.

h. As stated in paragraph 5-3, suggested ACM checklists are provided in two parts in appendix C. Use these checklists for assigning risk and exposure numbers. Using the numbers derived from the checklists, enter the matrix in table 5-1 and find the corresponding assessment index. Then refer to table 5-2 for definition of assessment index. For example, using table 5-1, if the damage/risk potential is 25 and the exposure potential is nine, then the assessment index would be A. This would correspond to an immediate action from the information obtained in table 5-2. The higher risk and exposure numbers and assessment index letters should be used only if there is a high probability of personnel exposure. The assessment scheme in the checklists is identical to the algorithm shown and discussed , with a few exceptions. The weighted numerical values corresponding to assessment choices in the algorithm do not appear in the checklists and some of the line-items contain additional assessment choices. Management planners who want to prioritize functional spaces and, in turn, facilities, based upon a numerical score ranking, should use the values for the assessment choices given and the procedures discussed. In the future, management planners may use a database management system.

i. Once a checklist has been completed for every functional space within a facility, an AHERA-accredited management planner will compile and process the information. This information will allow the management planner to document and/or confirm the existence of homogeneous areas of ACM and prioritize the facility in terms of its asbestos hazards relative to other facilities at an installation.

j. The following asbestos report format should be used:

(1) Survey introduction, general summary of findings, and recommendations.

(2) Individual building information should include the following:

(a) Army ACM Checklist for each functional area and homogenous material.

(b) Description of building use, summary of findings, and recommendations.

(c) Building diagrams showing sample locations with photographs of the sample locations.

(d) Sample results and laboratory certificate of analysis.

(e) Cost estimate for abatement and O&M activities.

5-5. Assembling the Database

a. To have any lasting value, it is essential that the ACM checklists be kept in some orderly fashion and up to date. The AMCO must devise a procedure whereby the AMT is informed of any construction activity that may result in a change in ACM status. Clearly, the responsibilities of the AMT in maintaining a current database are ongoing. The AMT must guard against having work orders slip through without its review and authorization. The system will also break down if unauthorized work is permitted. Accordingly, a mechanism within the AMT must be established for the review of all work orders.

Table 5-1. Determination of an Assessment Index

Each assessment factor in the checklist has one or more value-weighted conditions. For example, for the assessment factor water damage to ACM, the value-weighted conditions are yes, valued at three points and no, valued at zero points. For every value-weighted condition in the checklist, the corresponding point value, in parentheses, follows a line, which is provided for the checkmark, used to indicate the assessment factor condition selected by the evaluator. Following the selection of value-weighted conditions for all assessment factors in part I of the checklist, the sum of the points is determined. The sum is the damage value, entered at the end of part I and is used in the matrix below. The exposure value is similarly determined from data in part II and used as the second entering argument in the matrix.

Using the damage/risk potential and exposure potential values derived from the checklist (Army ACM assessment checklist), as entering arguments, use the matrix below to find the corresponding assessment index.

	Exposure Potential (4<E<43)			
Damage/Risk Potential (1<D<28)	43-26	25-17	16-8	7-4
28-17	A	A	A	B
16-11	A	B	C	D
10-5	A	B	C	E
4-1	A	C	D	F

Table 5-2. Management Corrective Actions

Assessment Index	**Recommended Management Corrective Actions**
A	*Immediate action* - Requires assessment by certified personnel (in-house or contractor) who are experienced in and qualified to conduct asbestos assessments. Possible follow-up actions may include isolation of the area and the restriction of access and/or immediate removal of the ACM. If removal is indicated, action planning should include a detailed survey. This condition will likely involve a near term expenditure of funds. Managers must know exactly what needs to be done to eliminate the asbestos hazard and how to use available funds most effectively.
B	*Action as soon as possible* - Requires assessment by certified personnel (in-house or contractor) who are experienced in and qualified to conduct asbestos assessments. Initiate a special O&M program immediately. Possible follow-up actions may include the limiting of access to the area and the scheduling of removal during periods of low activity in the facility, not waiting for the normal repair and maintenance cycle.

Table 5-2. Management Corrective Actions (continued)

C	*Planned action* - Requires assessment by certified personnel (in-house or contractor) who are experienced in and qualified to program. Initiate a special O&M program. Removal should be scheduled as part of the normal repair and maintenance cycle of a facility, minimizing cost and disturbance.
D	*Repair* - Initiate special O&M using certified personnel. Damaged areas should be repaired, where repair means returning damaged asbestos-containing building materials (ACBM) to an undamaged condition or to an intact state so as to contain fiber release. Schedule removal when practical and cost effective. Take preventive measures to reduce further damage.
E	*Monitoring* - Continue special O&M using certified personnel. Take steps to prevent damage to the ACBM or other ACM. Frequently monitor the condition of all ACM.
F	*Immediate action* - Continue special O&M using certified personnel until major renovation or demolition requires removal or until assessment factors change.

b. In the simplest of arrangements, the ACM checklists may be kept in a loose-leaf binder with tabs separating the information for each building. A more efficient means would be to contact the AEIS to obtain a copy of the current database in use. Utilization of a centralized database source for maintaining specific building information required for asbestos surveys will enable installations to access the system and keep it updated as removals/abatements, etc. take place. More importantly, a statistical analysis of the homogeneous materials in the database system would be performed to limit the amount of asbestos sampling required for future asbestos surveys. This would allow a centralized asbestos program manager to evaluate homogeneous materials used throughout Army installations to determine if this material is required to be sampled in future asbestos surveys. Once a homogeneous material has been identified as being an ACM then additional sampling of this material is not necessary. Additionally, non-ACM can also be eliminated from future asbestos surveys therefore reducing the cost of sampling homogeneous materials which are or are not ACM.

c. It is also important to note that a back up to the database and a current hard copy should be retained in the event of accidental data loss.

5-6. Factors Used in the Assessment Process

a. *Assessment information*. The need for asbestos control beyond a special O&M program depends on the likelihood of fiber release from ACM. It should be noted that the mere presence of ACM does not in itself create a condition that requires its removal. The possibility of fiber release can be assessed by evaluating the material's condition, physical characteristics, and location.

b. *Potential fiber release*. Factors for assessing potential fiber release are described in paragraphs 5-4 and 5-5. The major factors to be considered are briefly reviewed here.

(1) *Current condition of ACM*. If water or physical damage, deterioration, or delamination of the material is evident, then fiber release has occurred, is occurring, or is likely to occur. The appearance of the material and the presence of peeling, cracking, or crumbling material may indicate fiber release.

(2) *Possibility for disturbance or erosion*. Visible, highly accessible materials in areas frequently used or needing periodic maintenance are the most vulnerable to physical damage. Also, in this category are materials subject to vibration from mechanical equipment, sound, or other activities. ACM in an air plenum or near a forced airstream (e.g., air from a heating vent) is likely to suffer surface erosion. In addition, fibers released into an airstream may be transported to other parts of the building, possibly exposing more people. Any planned changes in building use should also be considered when assessing future potential fiber release.

5-7. Exposure Analysis

a. An exposure analysis should be conducted prior to selecting an abatement method. This analysis considers all descriptive and quantitative factors (related to material condition, extent, etc.) compiled during the building asbestos survey and relates them to the potential for occupant exposure to ACM. Prior to the conduct of an exposure analysis, the AMT should establish a written protocol that includes the following:

(1) A procedure for ranking, prioritizing, or rating the visual assessment factors described previously in paragraph 5-4.

(2) Definitions of qualitative judgments, such as high exposure potential or moderate damage.

(3) The relative importance of quantitative data, such as bulk sampling results or air sampling results described in chapter 8.

(4) Assignment of exposure analysis responsibilities to members of the AMT.

b. Some AMTs may find it useful to use an algorithm to provide a quasi-quantitative basis to an otherwise subjective assessment. The recommended assessment method is easy to understand and use; is quantitative enough to provide a measure of hazard severity to allow the prioritization of facilities in terms of the need for corrective action; and provides a listing of factors not readily amenable to quantification, but which should be considered by the IC in final corrective action decision making.

(1) The assessment algorithm presented and discussed here is self-contained and simple to use. The algorithm consists of a checklist (see appendix C), an assessment index matrix, and a table of recommended management actions. In accordance with Army policy, the checklist must be completed by an AHERA certified management planner. The management planner may use

the checklist either in concert with a survey inspection of a functional space or in a separate evaluation of the ACM in a functional space at a later date, following a survey inspection.

(2) The assessment algorithm discussed is a modified US Air Force system that must have the conditions specified in paragraph 5-8 b and is more applicable to small Army installations. The assessment algorithm for large Army installations is found in appendix D. The Army ACM checklist Part I and Part II incorporates AHERA terminology and is the recommended method to use. To use this scheme, a management planner works through the checklist making value judgments for each of the damage/damage potential and exposure situations which are then used in table 5-1 to determine a letter assessment index. For each letter index, a recommended corrective management action is listed in table 5-2.

(3) The assessment algorithm is intended for use by a trained evaluator; that is, someone who is familiar with ACM and knows of the layout and purposes of the facilities. The checklist applies to friable ACM or normally nonfriable ACM which has become friable as a result of damage. The ACM is also further classified as one of the major three types; surface materials, thermal system insulation, and miscellaneous materials. Other nonfriable forms of ACM shall be managed satisfactorily by an O&M program with abatement necessary only as part of facility alteration/repair, maintenance, or demolition.

(4) An asbestos survey, locating, sampling, and measuring homogeneous areas of ACM should be conducted concurrently with the assessment, when possible. The term homogeneous area refers to an area of surface material, thermal system insulation, or miscellaneous material that is uniform in color and texture.

5-8. Management Considerations

a. Even though an assessment index may accurately reflect the existing asbestos health hazard within a functional space, it probably will not be an accurate and complete measure of the AMP. The assessment index takes neither economic nor social factors into consideration. These factors often represent the greatest obstacles to managing and controlling asbestos hazards. A set of appropriate considerations is listed below.

(1) *Cost considerations (estimating cost effectiveness).*

(a) Cost of the abatement (contractor's estimate plus in-house personnel dedication).

(b) Cost of temporarily relocating personnel and equipment for the abatement.

(c) Cost of nonproductivity resulting from relocation of personnel and equipment.

(d) Cost savings in preplanned remodeling, renovation and/or repair projects resulting from abatement activities.

(e) Cost savings associated with enhanced use of functional spaces, in facilities which have been purged of ACM hazards.

(2) *Morale considerations.*

(a) Effect on morale of abatement-related personnel relocation.

(b) Effect of the notification of the need for abatement action on the morale of those individuals who occupy the space. Any abatement action will alert them to the fact that they had been working in a space determined as a high health risk environment.

(3*)* *Miscellaneous considerations.*

(a) Effects of flooding, wind, and fire damage on ACM integrity.

(b) Climatological restrictions of abatements (amended water can freeze, thus making spraying impossible).

(c) Geographical restrictions on abatements (OCONUS facilities may have special problems).

(d) Problems with functional spaces which are controlled areas.

- Unauthorized access and potential compromise of classified materials in high security areas.
- Pilferage in a warehouse.
- Existence of ignition sources (e.g., smoking, non-explosion proof electrical equipment) in or near combustible material storage areas, associated with asbestos abatement workers.

(e) Special facility use (child care centers and hospitals).

(4) Determination of the appropriate option (i.e., abatement or special O&M) for each situation ultimately depends on the experienced professional judgment of the members of the AMT who are charged with this responsibility.

b. Internal discussion and review among members of the AMT are encouraged to ensure that all relevant factors are considered in assessing the potential for release of asbestos from ACM.

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CHAPTER 6

SELECTING ABATEMENT ALTERNATIVES

6-1. Determination of the Need for Abatement

a. As used in this PWTB, the term asbestos abatement is defined as any activity that reduces the risk of exposure to airborne asbestos fiber. According to this definition, asbestos abatement includes O&M activities as well as outright removal, enclosure, or encapsulation.

b. Evaluation of the condition of ACM. If a building contains ACM, the need for asbestos control or abatement beyond a special O&M program must be considered. Three questions must be answered:

(1) Need - Is abatement necessary?

(2) Timing - When should abatement be done?

(3) Method - What abatement method should be used?

(a) The determining factors in answering these questions are provided by the exposure analysis described in paragraph 5-7, which provides an evaluation of the condition of the ACM considering both current and future fiber release potential. The descriptive information necessary for this evaluation must be collected during the building asbestos survey (chapter 5).

(b) A second survey may be necessary if information is lacking. Results of air sampling and settled dust surveys, if performed, are also key elements of the exposure analysis.

6-2. Selection of the Abatement Method

The conclusions of the exposure analysis are used to demonstrate an approach to determine the need for abatement and its timing and to select an abatement method. The three types of ACM, are discussed below.

a. Sprayed-on or troweled-on surfacing materials (friable ACM).

(1) *Need*. Use an exposure analysis process to determine the current condition of the ACM and the potential for future damage, disturbance, or erosion. Table 6-1 shows how these two considerations influence the decision regarding action beyond a special O&M program. Surfacing material in good condition may need no further action if the potential for future disturbance, damage, or erosion is low. However, the material must be inspected regularly to ensure that it

remains in good condition. Further action is needed if the material is damaged or in poor condition, or if there is high potential for future disturbance or erosion.

(2) *Timing*. When further action is necessary, its timing must be carefully considered. A well-planned and executed abatement program is necessary to ensure that the abatement activity itself does not create a hazard. If the ACM is currently in good condition, but the potential for future fiber release is high, the scheduling of asbestos abatement can take advantage of other building plans. For example, renovation work, which requires precautions to control fiber release, provides an opportunity to remove, encapsulate, or enclose ACM. Table 6-1 provides some guidelines for the timing of asbestos abatement, but circumstances will vary from building to building. As one moves through table 6-1 from left to right (from good to poor condition) and from top to bottom (from low to high potential for disturbance, damage, or erosion), the need for immediate action increases. Material in poor condition should be dealt with first. Materials that are in better condition or have a low potential for disturbance or erosion have a lower priority.

(3) *Method*. The choice of abatement method is determined mainly by the condition of the ACM. Surfacing materials can be removed, encapsulated with a sealant, or enclosed within an airtight structure. The three methods are described in more detail below.

b. Pipe, boiler, and tank insulation (friable ACM).

(1) *Need*. Pipe, boiler, and tank insulation typically presents a more localized fiber release problem than surfacing material. The insulated pipes, boilers, ducts, and other equipment are frequently confined to equipment rooms or placed within walls or behind ceilings. Even accessible insulation is localized to the piece of insulated equipment. Thus, the potential for disturbance, damage, or erosion is lower than for surfacing material; frequent inspection can spot any new disturbance, and the damage can be repaired quickly. The condition of the ACM determines the need for further action (table 6-1). If the insulation is intact, no further action is needed other than a special O&M program.

(2) *Timing*. Damaged insulation should be repaired or replaced as soon as possible. Major renovation, such as installation of a new boiler, is a good time to consider replacing pipe and boiler insulation with non-asbestos material. This will eliminate the need for a continuing special O&M program.

(3) *Method*.

(a) Removal.

- Involves cutting and stripping the insulation from pipes (or other equipment) and substituting non-asbestos material.

- Is appropriate where the insulation is extensively damaged or deteriorated.

- Plaster around elbows, valves, and flanges should also be removed and replaced with non-asbestos materials.

(b) Repair.

- Involves patching the damaged insulation or covering it with a new jacket.

- Is appropriate where the insulation has minor damage.

c. Other ACM (nonfriable ACM). A special O&M program is usually all that is needed for other types of ACM, since most ACM in this category is hard and nonfriable and should not readily release asbestos fibers. The only time abatement (primarily removal) should be considered occurs when it becomes necessary as part of building alteration/repair, maintenance, or demolition.

Table 6-1. General Assessment Considerations for Sprayed or Troweled-On Surfacing Materials

	Current Condition of ACM		
Potential for Future Damage, Disturbance, or Erosion	Good[1]	Minor Damage or Deterioration	Poor
Low	No further action now beyond special O&M program	Selective or complete removal as soon as possible	Removal as soon as possible
High[2]	Removal, enclosure, encapsulation during planned alterations or repairs	Selective or complete removal as soon as possible	Removal as soon as possible

Notes: [1] *There is no water damage, physical damage, or deterioration.*
[2] *The ACM is exposed or accessible, in an air plenum or airstream, or subject to vibration.*

6-3. Technological and Economic Considerations

The selection of an appropriate asbestos abatement method requires the consideration of several factors, including: current and future fiber release potential, available technology (see (1) below), economic feasibility (see (2) below), and DA policy. The desire for expedient measures should not be permitted to impact on this process since improper and inappropriate asbestos abatement places

workers and building occupants at risk of exposure to asbestos fibers. It has been well documented that improper ACM removal is more hazardous than leaving the ACM in place. The assessment of fiber release potential relies on using a prescribed method for the evaluation of material integrity, as discussed in paragraphs 5-7 and 5-8. Technological and economic considerations are briefly discussed below.

a. Technological considerations. Each control method poses certain technical considerations that must be taken into account. Table 6-2 presents a sampling of technical issues that should be considered in selecting a control method.

Table 6-2. Technological Considerations in Selection of a Control Method

Control Method	Technological Considerations
Removal	Are replacement materials available? Are replacement materials compatible with respect to engineering design and function for the structure?
Encapsulation	Is an encapsulant available that has been adequately challenged by laboratory and field tests? Can the material support the additional load introduced by the encapsulant?
Enclosure	Can air-tight structures be constructed to meet facility design and operating criteria? Are materials available? Can the facility support the additional weight associated with enclosure construction materials? Can barred access to enclosed structures be justified by engineering standards?

b. *Economic considerations.*

(1) Significant cost saving may be realized by coordinating asbestos abatement with other activities, such as building expansion or alteration/repair, that involve moving walls and doors, installing dropped ceilings, or building rooms for specialized equipment. ACM will be disturbed by expansion or renovation work, necessitating precautions to control fiber release. This investment in worker protection and site containment creates an opportunity to enclose, encapsulate, or remove ACM. On the other hand, when ACM needs immediate action, abatement may be a cost-effective time to repair or replace building systems, for example, by replacing electrical systems, repairing vents and ducts, or installing low-energy lights. Regardless, if alteration, renovation, demolition, or equipment replacement, etc., is contemplated, a comprehensive predesign/project survey shall be completed and made part of the planning process prior to design. Note that this asbestos survey is required under NESHAP to identify RACM prior to renovation or demolition.

(2) Other economic considerations in scheduling asbestos abatement include the following:

(a) Disruption of the pattern of normal building operations. Extensive abatement activities will disrupt building operations. When possible, abatement should coincide with vacations or other periods of low activity.

(b) Comparison of the costs of abatement versus a continuing special O&M program. The initial costs of removal may be higher than other abatement methods. However, removal may be less expensive over the long-term, since the continued presence of ACM requires special O&M practices, periodic reinspection, and repairs. To make this comparison, the costs of near-term removal and disposal should be determined, taking into account facility use costs during the removal period. The life-cycle costs for the abatement methods under consideration should be determined. These costs include initial steps, annual expenses until the facility is closed, and ACM removal and disposal costs at that time. Costs should be escalated to the year of expenditure. The present-worth of such streams of estimates should be calculated using the current interest rate on long-term treasury securities. It can then be determined, on a present worth basis, whether the removal option costs are less than the costs of other abatement or O&M programs under consideration. When more than one abatement program is being considered, these calculations can be used to rank the programs, with the most economically favorable having the lowest present worth or cost in current dollars. Enclosure and encapsulation are options only when the ACM is in good condition, and are primarily temporary measures to reduce the potential for future disturbance or erosion until the ACM is eventually removed. Moreover, in some situations, it may be necessary to erect the same barrier system that would be required for removal to prevent the release and spreading of asbestos fiber. Cost savings may also be achieved if the abatement work is scheduled during a slow or off season period for the outside contractor. Further savings may be had by awarding a contract for the abatement of a specified amount of ACM over a period of time. Table 6-3 presents some additional economic considerations.

Table 6-3. Economic Considerations for Abatement Method Cost Analysis

Abatement Management Options	Economic Considerations
Initial cost (regardless of action taken)	Relocation of people and furniture. Removal and replacement of ceiling tiles. Site preparation and special equipment. Cleanup and testing.
Special O&M program	Custodial services with asbestos present. Visual inspections. Annual air testing (if required).
Enclosure[1]	Initial cost plus enclosure construction and surface coating and special O&M.
Encapsulation[1]	Initial cost and special O&M.
Removal	Initial removal cost plus replacement and disposal.
Note: [1] *Ultimate removal and disposal of ACM are additional costs considered in these options.*	

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CHAPTER 7
HEALTH AND SAFETY DURING ASBESTOS ABATEMENT

7-1. The Army Respiratory Protection Program

Asbestos abatement projects pose unusual hazards not commonly encountered in other types of construction. An effective respiratory protection program (RPP) is required, by OSHA regulation, to ensure that all personnel within the work area are protected. Owing to the temporary nature of the work site, there exist a number of health and safety hazards that would not normally be present in a more permanent work place. Topics in this chapter are of particular interest to the project IH, air monitor and inspector. This chapter also contains certain action items which must be addressed by the AMT.

a. The AMT should consult the Army Respiratory Protection Program (ARPP) (AR 11-34) before attempting to prepare an installation-specific RPP. This document outlines the Army's organization of the program, its applicability and the responsibilities of Army personnel in carrying out the regulation. The installation's RPP must follow the requirements stated in 29 CFR 1910.134, 1926.1101, 1910.1001, American National Standards Institute (ANSI) Z88.2-1992, AR 11-34 and TB MED 502. OSHA regulation [29 CFR 1910.134] requires that a written RPP be provided to all employees who may be exposed to airborne asbestos fiber. The employer must demonstrate the RPP is enforced and updated. The installation program for respiratory protection is based on the current August 1994 standard which dates back to 1986 and earlier standards of 1970, ANSI Z88.2 standard of 1969, and the more recent ANSI standard of 1992 with additional asbestos specific requirements in 1987. Additional National Institute of Occupational Safety and Health (NIOSH) guidance was provided in 1987, when NIOSH released its Respirator Decision Logic; regulations and documents from these three bodies form the basis for the program.

b. The ARPP as a minimum should include:

(1) Written statement of Army policy, including assignment of individual responsibility, accountability, and authority for required activities of the RPP.

(2) Written standard operating procedures governing the selection and use of respirators.

(3) Respirator selection (from NIOSH/Mine Safety and Health Administration (MSHA) -approved and -certified models) on the basis of hazards to which the worker is exposed.

(4) Medical examinations of workers to determine whether they may be assigned an activity where negative pressure respiratory protection is required.

(5) Employee training in the proper use and limitations of respirators and a way to evaluate the skill and knowledge obtained by the worker through this training.

(6) Respirator fit testing.

(7) Regular cleaning and disinfecting of respirators.

(8) Routine inspection of respirators during cleaning, at least once a month and after each use for those respirators designed for emergency use.

(9) Storage of respirators in convenient, clean, and sanitary locations.

(10) Surveillance of work area conditions and degree of employee exposure (e.g., through air monitoring).

(11) Regular inspection and evaluation of the continued effectiveness of the program.

(12) Recognition and resolution of special problems as they affect respirator use (e.g., facial hair, eye glasses, etc.).

(13) All of the above items are required by OSHA if employees wear respirators during work.

c. Respirator selection and use.

(1) Respirator selection for asbestos abatement is regulated under OSHA 1926.1101, and individual states may have additional requirements. This selection should be performed in concert with the Safety and Preventive Medicine Offices.

(2) The appropriate type of respirators must be provided for all classes of asbestos abatement at no cost to the workers where exposure to airborne asbestos may take place. Respiratory protection is required for specific classes of asbestos work. The current promulgated August 1994 OSHA Asbestos Standard is given below in table 7-1.

(3) A higher level of respiratory protection must be provided at the beginning of an abatement project until you can document the worker asbestos exposure for that type of abatement activity. The respiratory protection can be downgraded based on the actual asbestos level.

(4) The following respirator selection rules shall apply:

(a) Single-use, disposable respirators (dust masks) are not permitted in any situation for any asbestos related task that exceed the OSHA exposure limit in any situation.
-

Table 7-1. Respiratory Protection for Asbestos Fibers

Airborne Concentration of Asbestos or Conditions of Use	Required Respirator
Not in excess of one f/cc (10 X PEL), or otherwise as required independent of exposure pursuant to (h)(2)(iv).[c]	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.
Not in excess of five f/cc (50 X PEL).[d]	Full-facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 X PEL)	Any powered air-purifying respirator (PAPR) equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 X PEL)	Full-facepiece supplied air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 X PEL) or unknown concentration	Full-facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus (SCBA).

NOTE: *a. Respirators assigned for high environmental concentrations may be used at lower concentrations or when required respirator use is independent of concentration.*

b. A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 mm in diameter or larger.

c. In addition to the above selection criterion, the employee shall provide a half-mask air purifying respirator, other than a disposable respirator equipped with high efficiency filters, whenever the employee performs the following activities: Class II and III asbestos jobs where the employer does not produce a negative exposure assessment; and class III jobs where TSI or surfacing ACM or PACM is being disturbed.

d. Both qualitative and quantitative fit testings are required.

(b) Full-face or half-mask air-purifying respirators with HEPA filters are permitted only during asbestos associated work such as the cleaning and preparation of an asbestos work area or performance of repairs (e.g., during the use of a glovebag). This type of respirator may be worn during cleanup or other procedures, provided that the protection factors listed in table 7-1 are not exceeded.

(c) Full-facepiece PAPR equipped with NIOSH approved HEPA filters may be used, provided that the requirements listed in table 7-1 are met. PAPR must be provided if requested by the employee with the condition it is not used in situations in access of 10 f/cc.

(d) Full-facepiece Type C supplied-air respirators operated in pressure demand mode with HEPA filtered disconnect protection must be worn when airborne fiber levels exceed those values indicated in table 7-1.

d. Medical surveillance.

(1) The medical surveillance program must be developed in accordance with OSHA regulations 29 CFR 1910.134 and 29 CFR 1926.1101 that state that no employee may be assigned a task requiring the use of a respirator unless it has been determined that the employee is physically able to perform under such conditions. The regulations also require an annual review of the employee's health status. The program will be developed by the installation occupational health clinic. A medical examination will be performed by a licensed physician or by one who is under his or her supervision. This medical examination must take place before the employee is assigned to asbestos related work, and an annual examination is required thereafter. The physician has the final approval authority for asbestos workers. The medical examination will consist of, at a minimum, a chest x-ray (posterior and anterior, 14" x 17"), patient history to elicit symptoms of disease, and pulmonary function tests (including forced vital capacity (FVC) and forced expiratory volume at one second ($FEV_{1.0}$)). No medical examination is required if adequate records show that the employee has been examined in accordance with these requirements within the past year. These requirements have been carried forth into the new 1994 Asbestos Standard virtually unchanged.

(2) The installation Occupational Medicine Service (OCCMED) will perform preplacement examinations and any required follow-up examinations for all DA personnel engaged in asbestos work. TB MED 513 should be consulted for details concerning the medical examinations. OCCMED must provide a letter for each employee successfully passing the medical examination to the AMCO for placement in the permanent project file. OSHA regulations require that this medical information be retained by the employer for a period of 30 years.

(3) For work performed by an outside contractor, it is the contractor's responsibility to have his or her asbestos abatement workers receive medical examinations following the OSHA requirements outlined above. The contractor must provide a letter from the examining physician stating that the employee is medically fit to perform asbestos abatement work.

e. Respirator fit testing.

(1) Any employee who has received medical approval to wear a respirator must receive fit testing to ensure that the respirator seals properly against the face. When initially provided with a respirator, the employee must be instructed on its use, care, and limitations. The OSHA regulation requires that all respirators be fit tested every six months.

(2) Every time an employee dons the respirator he or she must perform a negative and positive pressure test to ensure that the respirator adheres to the face.

(3) The negative fit test is performed by placing the palms of the hands over the air intake of the respirator cartridge(s). While blocking the air intake(s) the wearer should inhale gently, and immediately sense that no air is entering the facepiece and the facepiece should collapse slightly. While holding his or her breath for 10 seconds, the wearer should not detect any leakage of air inward. This procedure meets the requirements of the negative fit test. If a leak is detected, the wearer must adjust the fit of the respirator by adjusting the straps on the head harness and perform the test again. If this test fails again, another respirator should be selected and the fit test should be repeated.

(4) The positive pressure check requires that the palm of the hand be placed gently over the exhalation valve of the respirator. As the wearer exhales gently, there should be resistance to the flow of air around the seal of the facepiece. The respirator fit is considered passing if positive pressure can be built up inside the facepiece without evidence of outward leakage around the facepiece. Remember these two fit tests should be performed every time a respirator is donned.

(5) If the positive and negative fit tests are successful, an irritant smoke (aerosol) is used to test the effectiveness of the respirator fit. This test involves exposing the respirator wearer to an irritant smoke generated from a commercially-available tube of the type used to check air flow in a ventilation system. Tubes containing stannic oxychloride are frequently used to generate a smoke. Some manufacturers provide a smoke tube with the respirator. These tubes are available commercially. The glass tips at both ends of the tube are broken off and a thin stream of smoke will issue from the tube when air is passed through it (i.e., a rubber bulb fitted to one end is squeezed). This qualitative test has the advantage that the subject will react involuntarily to an air leak around the respirator facepiece by coughing or sneezing. Caution must be exercised in using these tubes to prevent injury to either the subject being tested or the IH test. Accordingly, exhaust ventilation should be provided to draw smoke away from the individual conducting the test. Eyewash facilities must be provided in the event that the smoke gets in the eyes of either the individual being tested or the individual administering the test. This test can be used for both air purifying and atmosphere supplying respirators, but the air purifying respirators must be fitted with HEPA TC-21-C filters.

(6) The irritant smoke test is conducted as follows: The individual to be tested dons the respirator and adjusts the straps for a comfortable fit. The wearer then places himself or herself between an exhaust fan and the person administering the test. The wearer is then instructed to

keep his or her eyes shut for the duration of the test (even if a full facepiece is worn). A small amount of smoke is then released toward the respirator from a point of at least two feet away, and the wearer should be observed to determine whether there is any reaction. If there is none, the smoke tube may be moved closer to the subject and a greater smoke density may be released. The smoke tube is moved progressively closer to a point six inches away from the respirator and, if there is still no response from the subject, the smoke from the tube may be directed at areas where leakage may occur (such as at the exhalation valve and around the facepiece seal). Continuing with the test, the subject should now move his or her head while the smoke is administered. The irritating smoke test is considered by the Army to be a more sensitive indicator than isoamyl acetate vapor because of its lower response threshold and positive reaction.

(7) All wearers of negative pressure respirators with facepiece seals must be clean shaven. You are not allowed to have anything interfere with the facepiece-to-face seal, e.g., facial hair, scarring, etc.

(8) Eyeglasses definitely should not be worn inside full facepiece respirators. Contact lenses may pop out if the face is pulled away from the eye by the respirator. The present OSHA regulation does not allow the use of contact lenses inside full facepiece respirators. Corrective lens inserts are available to be fitted into the inside of many facepieces.

(9) The use of respirators in cold weather may result in several problems. Fogging of the respirator may occur in cold climates. This problem can be eliminated through the use of a nose cup. This nose cup deflects the wearer’s breath away from the facepiece lens. If there is stiffening of the facepiece due to the cold or failure of the exhalation valve to operate properly, do not use the respirator. Consult the equipment manufacturer.

(10) If voice communication is required that involves penetrating the rubber of the facepiece, ensure that the additional modification will not void the NIOSH approval.

(a) All of the fit testing procedures described above are considered to be qualitative tests which are generally very satisfactory.

(b) There are situations where OSHA requires quantitative fit testing such as excessive exposure to certain gases and vapors that may be immediately dangerous to life and health. This test requires instrumental measurement of the toxic gas or vapor inside the respirator mask. Commercial devices may be used to obtain a quantitative fit test, but this level of testing is not generally required for asbestos abatement work.

(11) The AMT should consult OSHA 29 CFR 1910.1001 or 29 CFR 1926.1101 for additional fit test maneuvers. One such maneuver is termed the rainbow passage, a paragraph including many consonants which require considerable movement of the mouth and jaw. These

movements in conjunction with a smoke tube challenge provide further evaluation of the respirator fit.

f. Respirator training, maintenance and monitoring.

(1) Training must be provided prior to or at the time of initial assignment and annually thereafter. 29 CFR 1910.134 and 1926.1101 require that training include the following:

(a) Opportunity to handle the respirator.

(b) The purpose and proper fitting, including demonstrations and practice in wearing, adjusting, and determining the fit of the respirator.

(c) Test of facepiece-to-face seal.

(d) A familiarization period of wear in normal air.

(e) Wear the respirator in a test atmosphere.

(f) Methods of recognizing asbestos, tremolite, anthophyllite, and actinolite.

(g) The health effects from exposure to asbestos, tremolite, anthophyllite, and actinolite.

(h) The relationship between smoking and asbestos exposure in producing lung cancer.

(i) Discussion of the engineering and administrative controls in use and why respirators are needed.

(j) Explanation of the nature of the respiratory hazard and what happens if the respirator is not used properly.

(k) Explanation of why a particular type of respirator has been selected.

(l) Discussion of how to recognize and handle emergencies.

(2) All personnel must have a comprehensive knowledge of respirators and respiratory protection practices. This will include, but not necessarily be limited to, the following:

(a) Basic respiratory protection practices.

(b) Structure and operation of the entire respirator program. The supervisor will understand his or her responsibility to facilitate functioning of the program, including maintenance that the workers may be able to do themselves, issuance of respirators, control of their use, and evaluation of the program's effectiveness.

(c) The legal requirements pertinent to the use of respirators.

(3) Inspection, cleaning, maintenance, and storage.

(a) Respirator maintenance must be an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. Employees wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance, as they generally are used infrequently, and then in the most hazardous and demanding circumstances.

(b) The OSHA standard strongly emphasizes the importance of an adequate respirator maintenance program. All programs are required to include at least inspection for defects (including a leak check); cleaning and disinfecting; repair as required; and proper and sanitary storage of equipment.

(4) Inspection procedures. The OSHA standard states that the respirator inspection must include checking of the tightness of the connections; facepiece; valves; connecting tubes; and canisters, filters or cartridges.

(5) Field inspection of air-purifying respirators. Routinely used air-purifying respirators must be checked before and after each use. Each check should include an examination of the facepiece; the head straps or head harness; and the exhalation valve.

(6) To clean and sanitize, any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one-step operation. Reliable, effective disinfectants may be made with readily available household solutions, an example is hypochlorite solution (50 ppm of chlorine) made by adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.

(a) To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140^{o}F, but it should not be less than 120^{o}F to ensure adequate cleaning.

(b) The clean, dry respirator facepieces will be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures

stated above will be performed. Special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve and can cause valve leakage or sticking.

(c) The respirator will be thoroughly inspected and all defects corrected. New filter cartridges and canisters will be installed, and the completely reassembled respirator will visually be inspected for famage.

(d) The inspection of the SCBA devices must include examination of the facepiece, the regulator, and the fully-charged cylinder.

(7) Maintenance and repair.

(a) The OSHA standard states that replacement or repair shall be done by experienced persons using parts designed for that specific respirator. Besides being contrary to OSHA requirements, substitution of parts for a different brand or type of respirator invalidates approval of the device.

(b) Maintenance personnel will be thoroughly trained. They must be aware of the limitations and never try to replace components or make repairs and adjustments beyond the manufacturer's recommendations, unless they have been specially trained by the manufacturer.

(c) An important aspect of any maintenance program is having enough spare parts on hand. Only continual surveillance of replacement rates will determine what parts and quantities must be kept in stock. A recording system to indicate spare parts usage and the inventory on hand will be maintained.

(8) Respirator storage.

(a) OSHA requires that respirators be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and mechanical damage.

(b) Damage and contamination of respirators may take place if they are stored on a workbench or in a tool cabinet or toolbox among heavy tools, greases, and dirt.

(c) Freshly cleaned respirators must be placed in heat-sealed or reusable plastic bags until reissue. They must be stored in a clean, dry location away from direct sunlight. They will be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted set.

(d) Air-purifying respirators kept ready for non-routine or emergency use must be stored in a cabinet with individual compartments.

(e) The storage cabinet must be readily accessible, and all workers will be made aware of its location, as is done for fire extinguishers. Preventing serious injury from the inhalation of a toxic substance depends entirely on how quickly workers can get to the emergency respirators.

(f) Respirators must be stored in a plastic bag inside a rigid container. The OSHA standard suggests that respirators be in their original cartons, but this would provide only minimal protection from mechanical damage.

g. This discussion of the respirator program does not consider the subject of confined space entry (29 CFR 1910.146), a condition which would be very rarely encountered in asbestos abatement projects.

h. As part of the RPP, there are two types of respiratory protection surveillance/auditing procedures.

(1) Monitor to ensure that no workplace changes are taking place which would require different respirators.

(2) Perform follow-up on the workers to ensure they are using the proper respirator for the work conditions. Periodic air monitoring could provide needed information to determine if the respirator chosen affords sufficient protection for the individual. Attention should also be given to proper respirator recordkeeping.

7-2. Personal Protective Equipment

PPE selection should be based upon consultation between the PREVMED and the Installation Safety Offices based on the requirements in the OSHA regulations. Each person who is authorized and qualified to conduct asbestos related work must be provided with appropriate PPE. It is the responsibility of the project supervisor to make certain that any items of PPE that are expended are replaced promptly. Table 7-2 lists and describes the PPE most frequently required for large-scale asbestos removal projects.

7-3. Heat and Cold Stress

a. In conjunction with the OCCMED and PREVMED offices, a heat and cold stress program must be developed. Workers' health must be monitored during workplace conditions of extreme heat or cold.

b. A work/rest regime with 15-minute breaks in an appropriately cool or warm location must be provided each hour.

Table 7-2. Personal Protective Equipment for Large-Scale Asbestos Abatement Projects

Protective head gear	Hard hats are required if there is a significant overhead hazard. Otherwise, a bouffant head cover may be used.
Goggles	Goggles must be available on-site for those whose activities (e.g., overhead asbestos stripping) may result in eye irritation or injury. Suitable goggles may be available which are attachable to the hard hat.
Tyvek suits	Suits with attached booties and elastic cuffs at the wrists must be available in several sizes. The wearer, however, must be sure that the suit is not oversized to cause a tripping hazard. Any excess garment should be taken up and taped. The booties must have a non-skid surface.
Barrier creams	If the ACM also contains glass fiber, skin irritation may result. Applying a barrier cream in the same manner as sun tan lotion before the exposure will prevent this irritation. In high heat and humidity work areas, workers may prefer to wear shorts only, and barrier creams here would provide appropriate protection.
Respirator cartridges	An ample supply of replacement respirator cartridges must be available for all types of air-purifying and PAPR respirators. During actual asbestos removal, these cartridges must be replaced daily or more frequently if they become wet.
Gloves	Cotton gloves must be available for those individuals who handle ACM directly.
Safety shoes	Safety shoes or boots with a steel toe and shank must be worn at all times when there is a risk of foot injury in the work area.

c. Under high heat conditions, workers must be provided with an unlimited supply of water and, if possible, electrolytically-balanced fluids, placed in the clean-room. Fluid consumption should be encouraged to achieve a rate of at least 16 oz. every hour.

d. Under conditions of extreme heat, a heat stress monitoring program will be developed and enforced.

e. In cold weather conditions, warm clothing and gloves will be required to be worn under impervious protective clothing. This clothing and gloves will remain on site.

f. The decontamination unit must be kept reasonably warm and hot water must be provided.

g. The project supervisor or foreman must receive instruction from PREVMED on the recognition and first aid treatment of heat exhaustion, dehydration, prickly heat, heat prostration, frostbite, and possible allergic reactions to extreme heat or cold.

7-4. Electrical and Fire Safety

a. Electrical safety.

(1) Only a licensed electrician is permitted to make any changes to the existing building electrical system in connection with an asbestos abatement project.

(2) All electrical circuits that will not be used during the asbestos abatement project must be locked-out/tagged-out or disabled.

(3) Only a licensed electrician may lock-out/tag-out or render inoperative the electrical circuits described in (2) above. The electrician must test locked-out/tag-out circuits to determine that no shock hazard exists.

(4) In some situations, ACM may have to be removed from transformer vaults or switchgear rooms while the equipment remains in operation. It is far preferable, however, to shut-down all electrical devices. A qualified representative of the local utility should be consulted regarding the use of electrical insulation blankets or other protective equipment. Extreme caution must be exercised when working in proximity to activated electrical equipment.

(5) All electrical tools and equipment must be properly grounded and ground-fault interrupters (GFIs) must be installed in all circuits used during the asbestos abatement activity.

(6) Damaged electrical power and extension cords must be replaced immediately.

(7) All electrical practices must conform with the National Fire Protection Association (NFPA) Electrical Code and the installation electrical safety program.

b. Fire safety.

(1) State or local regulations may permit only fire-retardant polyethylene sheeting to be used in building interiors.

(2) Flammable liquids (such as gasoline) must not be brought into the work area.

(3) Internal combustion engines must not be operated at any time in an asbestos abatement work site.

(4). Good housekeeping must be used to minimize trash.

(5) Type ABC fire extinguishers must be available on the contaminated side of the decontamination unit and at strategic points within the work area (particularly at locations where removal is taking place). All asbestos abatement workers must receive instruction on their use.

(6) Emergency exit signs must remain illuminated and fire exits must not be chained, locked, or obstructed in any manner. All exits from the work area will be marked and directional arrows will be posted as necessary.

(7) No welding or open flames are permitted within the abatement barrier or enclosure.

(8) If the AMCO or IH determine that there may be significant risk to non-construction building occupants (e.g., hospital patients and staff) during off-shift periods, a fire watch may be required.

(9) A list of emergency telephone numbers must be posted on the clean side of the decontamination unit or at a telephone available to project personnel. A map must also be posted with the emergency telephone list showing the route to the medical services building, medical center, or hospital.

(10) Coordination with the installation fire department must ensure that local fire requirements are adequately addressed in the asbestos abatement plan.

c. First aid procedures.

(1) On abatement projects, a consultation with the OCCMED office is necessary. There must be at least two persons on site who are trained in cardiopulmonary resuscitation (CPR) and first aid.

(2) A first aid kit whose contents have been inspected and approved by OCCMED must be available in the clean room of the decontamination unit.

(3) An injured worker must not be detained inside the work area for reasons of decontamination; however, gross ACM should be removed, and the respirator should be left in place provided that it does not compromise the worker's immediate health. If necessary, the barrier or enclosure may be opened to allow removal of an injured worker.

(4) It should be noted that the emergency response section of the asbestos abatement health and safety plan will contain details on emergency procedures.

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CHAPTER 8
BULK AND AIR SAMPLING AND ANALYSIS

8-1. Importance of Sampling

a. Laboratory determination of asbestos content in building materials is an extremely important step in the development of the AMP. It is not always possible, even for an experienced person, to determine whether suspect building material actually contains asbestos. Accordingly, bulk samples must be collected in a valid manner and must be tested using an approved method by a qualified laboratory.

b. Similarly, airborne asbestos fiber levels, either during or following asbestos abatement, can not be judged with the naked eye. This assessment must be performed using a microscope.

8-2. Laboratory Qualifications

a. Laboratories chosen for the analysis of bulk and air samples must be selected on the basis of proven competence and rapid turn-around of sample results. For bulk sample analysis, laboratories must participate in the National Voluntary Laboratory Accreditation Program (NVLAP) and demonstrate successful performance on recent proficiency tests. The NVLAP also provides accreditation for laboratories performing air clearance analysis by transmission electron microscopy (TEM). The USEPA established NVLAP to perform a quality assurance function for the AHERA asbestos-in-schools program. Worker protection sampling and non-school post-abatement clearance sampling may be carried out for analysis by phase contrast microscopy (PCM). In this case, laboratories carrying out PCM analysis must demonstrate competence through participation in the NIOSH Proficiency Analytical Testing (PAT) Program and be accredited by the American Industrial Hygiene Association.

b. Certain samples may prove to be difficult to analyze because of low friability or borderline asbestos content. It is good practice to have more than one laboratory examine the samples in these situations.

c. Some Army installations may have polarized and phase contrast microscopes available; however, any individual using this equipment must complete the appropriate training course in microscopic analysis. Bulk and air sample analyses carried out by an installation based laboratory must not be considered valid unless the laboratory is NVLAP and PAT program accredited. An installation-based field laboratory, though lacking accreditation, may be used for preliminary testing prior to formal post-abatement air clearance testing.

8-3. Bulk Sample Collection

a. Collecting a sufficient number of representative samples of the various types of ACM is a vital part of the survey. These bulk samples should be carefully selected from each type of suspect construction material from locations throughout the functional space. In the case of pipe lagging, for example, the idea is to distribute the bulk sample variants so as to include all variants of pipe lagging having different physical appearances (e.g., change in an OD, covering material, hardness, or color).

b. Suspect ACM that is either sprayed or troweled onto ceilings, structural members, or walls should be sampled randomly. Following the USEPA protocol, the homogeneous surface is first identified. A homogeneous surface is that which possesses a continuously applied material having the same color and texture. A minimum of three samples must be collected from each homogeneous surface. When it is necessary to sample large areas of homogeneous sprayed or troweled ACM, it is important that the samples be collected randomly. The USEPA's document entitled Asbestos in Buildings Simplified Sampling Scheme for Friable Surfacing Materials describes a technique for statistically random selection of sampling points.

c. It is extremely important to obtain a representative sample. Full-thickness samples of pipe, boiler and tank coverings should be collected. If the material appears to be layered, each layer should be separated for analysis as a separate sample (it is convenient to give the sample a single number and the layers from within that sample location letters a, b, c, etc.).

d. Sample bottles are available commercially from the supporting laboratory. A knife, a laboratory cork-borer, or some type of proprietary sampling device may be used to obtain the sample; however, care must be taken to avoid creating a dust. A spray bottle containing water and a small amount of detergent should be used to wet down the sampling location before and during the sample collection process. A damp rag should be available to clean up any ACM debris that has fallen. Bridging encapsulants should be applied, when appropriate, to seal any penetrations into the ACM. An adhesive label should be affixed to each canister, indicating the name of the facility, the building and room numbers, location within the room, and a sample ID number.

e. The field survey kit should consist of the following:

(1) A clipboard (preferably with a hinged cover) and writing materials including indelible markers.

(2) Bulk sample canisters and adhesive labels (can be pre-printed).

(3) Spray bottle containing water and a small amount of detergent.

(4) Damp rags for post-sampling cleanup.

(5) A sharp, long-bladed knife and/or a coring tool for collecting the bulk sample.

(6) Bridging encapsulants.

(7) Flashlight and tape measure.

(8) Respirator equipped with HEPA filters (see paragraph 7-1 for the requirements for selecting, fitting, and maintaining respirators).

(9) Camera for documenting ACM which is in less than good condition where sample ID labels may not survive.

(10) A kit bag, with a shoulder strap, for the above items.

8-4. Analysis of Bulk Samples for Asbestos

a. Asbestos in bulk samples is most readily identified by means of the PLM, a method used by geologists and chemists to identify minerals and other crystalline materials. The method is straight forward and rapid in the hands of a trained microscopist and the detection limit is well below the one percent lower concentration limit used to define asbestos-containing by the USEPA. PLM is the primary analytical method used by the USEPA for asbestos identification and it must be used (with the exceptions noted below) for the analysis of all Army bulk samples. Dispersion staining, used in conjunction with PLM, may be helpful in asbestos identification. X-ray defraction analysis (XRD) may be particularly helpful for some samples, but this technique is seldom necessary. XRD has a limit of detection ranging between one and approximately three percent depending upon the concentration of interfering elements such as iron and manganese. Scanning electron microscopy (SEM) in the Energy dispersive spectrometry (EDS) mode may be useful in determining the elemental composition of some phases. The PCM has no role in the identification of asbestos in bulk samples; and other methods such as infrared (IR) spectroscopy and chemical staining (the K^2 test) either lacks sensitivity or is non specific. Use of these methods is not permitted for the analysis of Army bulk samples.

b. Quantitative estimation of asbestos by PLM is commonly accomplished by calibrated visual estimation or by point counting. In the first method, the trained microscopist compares the areal volume of asbestos present in a sample with reference to slides or photographs of samples having known asbestos concentrations. This method is rapid and reliable. Point counting, by contrast, entails the tallying of asbestos fibers in a 400-point examination of the sample mounted on a microscope slide. This method is tiresome and is considerably more expensive. Point counting is required under AHERA regulation in schools where the sample is friable and contains less than 10 percent asbestos; however, this method is not incorporated into the NVLAP laboratory inspection program. Accordingly, quantitative estimation of asbestos may be made by calibrated

visual estimation at all Army installations with the exception of school buildings where the USEPA AHERA requirements prevail.

c. VAT and other nonfriable organically bound materials such as roofing felts often present problems when preparing such samples for PLM analysis. The organic tar-like matrix is opaque to the transmitted light of the PLM, and it is therefore necessary to dissolve or remove the organic matrix in order to detect the possible presence of asbestos. Dimethyl formamide and other chemicals have been used as solvents for VAT; however, their high toxicity has lead to better methods. One current procedure involves removal of the organic matrix by low-temperature plasma ashing followed by acid washing. The residue is then first examined by PLM followed by the preparation of a sample grid for analysis by TEM. This procedure, or a similar variant, must be used in the analysis of VAT and other nonfriable organically bound materials.

d. Typical asbestos analysis laboratory reports should indicate the name of the laboratory, the analyst's name, and the date of analysis. Each sample must be fully identified with both the field ID number as well as a number assigned by the laboratory.

e. The condition of the samples should be noted:

(1) Is the sample homogeneous or are discrete layers visible?

(2) Is the sample friable?

f. The actual analysis must indicate whether asbestos is or is not present; and, if it is, the mineral species (e.g., chrysotile, amosite, etc.) must be indicated. When asbestos is present, the estimated percentage concentration must be given. All other phases such as glass fiber, mineral wool, calcite, gypsum/anhydrite, perlite, etc., must also be identified along with their estimated percent abundances. All of these materials are mechanical mixtures so the percentage of asbestos, even in a visually homogeneous material may vary among samples from a few percent to several tens of percent depending on the product type and the manufacturer. Some plasters such as ceiling plaster are notorious for this variability in asbestos content which may range from zero percent to over 30 percent within the same room. It may be necessary to resample or collect additional samples where there is any ambiguity.

8-5. Airborne Asbestos Sampling

a. Air sampling and analysis for airborne fibers are the most reliable means available to determine whether asbestos fiber is present and, if so, whether the airborne fiber concentrations are in excess of occupational health and environmental standards. These techniques are also employed to determine whether fiber releases from damaged ACM have occurred in the past and, at the conclusion of an asbestos abatement project, whether the space is sufficiently clean to permit reoccupancy.

b. *Sampling methods.* The choice of sampling method depends upon the purpose of the sample and the regulatory requirements that may dictate the technique. Basically, the issue is that of sample volume: battery-operated pumps are used to collect smaller air volumes for rapid evaluation of respiratory protection requirements, and 120 VAC-powered pumps are used to collect the larger air volumes required for routine monitoring and final clearance.

(1) *Personal sampling*. Personal samples are collected from within the breathing zone of the potentially exposed individual so that compliance with OSHA and other standards may be evaluated. The personal sampling pump is battery-operated and must be calibrated at a flow rate of 2.0 liters/minute (L/min.) (see calibration method described below). The breathing zone is defined as that volume of air within a one-foot radius of the nose and mouth. Typically, the filter cassette is attached to the subject's clothing on the lapel with the open face filter facing downward to prevent gross physical damage. The pump itself should be tamper resistant and the IH administering the sampling must generally monitor the procedure to understand the nature of the activities giving rise to the exposure.

(2) *Area sampling*. Samples collected to characterize ambient airborne fiber levels tend to require higher volumes and flow rates exceeding the capacity of most battery-operated pumps. Air volumes of several thousand liters are necessary in order to achieve the level of detection required for post-abatement clearance. Volumetric flow rates exceeding the range of 10 to 15 L/min should not be used because of the potential for damage to the filter. Air flow may be controlled either through a critical orifice or a needle valve; the former tending to give greater flow stability over time. Air samples must be collected in an open-face configuration with the open face pointed downward at an angle of 45^{o} from the horizontal and at a height of four feet above the floor (following the AHERA protocol). Area sampling pumps should be placed as close as practicable to the potential source of airborne fiber. Depending upon the velocity of air circulating within the space, significant differences in airborne fiber concentrations can be anticipated.

(3) *Pump calibration*. Calibration of the volumetric air flow rate must be carried out in the laboratory and field to ensure accurate results. In the laboratory, the convenient soap-bubble calibrator (illustrated in figure 8-1) is inexpensive and simple to use. The inverted burette is first wetted and then, with the pump attached and operating, a single bubble is drawn into the burette from a beaker containing a dilute solution of soap or detergent in water. A suitable well-defined soap film is selected and the time required for its passage between the zero mark and the 1,000 ml mark is recorded. Calculation of the flow rate is shown in figure 8-1. If the bubble being observed during its movement up the burette breaks or coalesces with other bubbles, a fresh bubble should be generated. Commercial versions of this apparatus are available.

(4) *Rotameters.* For field use, another alternative for calculating pumps are precision rotameters. The rotameter should be selected so that the flow rate to be measured falls somewhere within the mid-scale - readings from the extreme ends of the scale will be inaccurate.

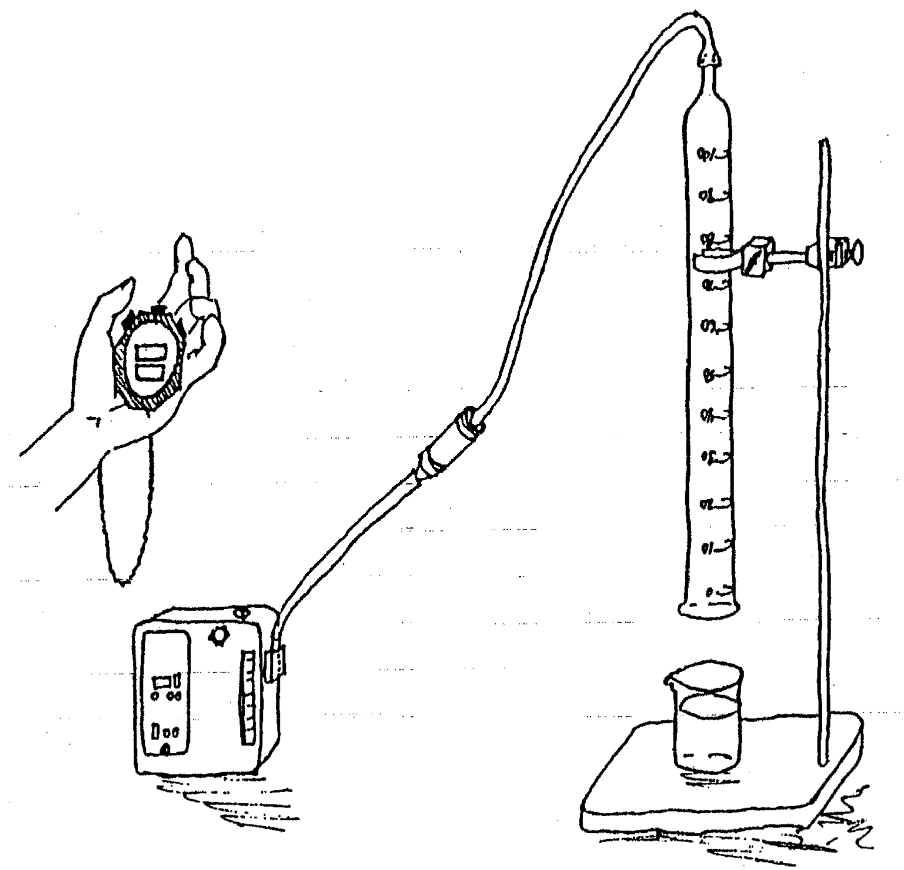
A rotameter is a practical means for calibrating high-volume pumps. The small rotameter incorporated into some personal air sampling pumps lacks the required accuracy and must not be used.

(5) *Filters and cassettes*. The NIOSH 7400 Method requires that a mixed cellulose ester (MCE) filter having a 25 mm diameter and a nominal pore size opening of 0.8 micrometers (μm) be used. The filter is supported in a cassette with a five μm backing filter. The cassette is fitted with a carbon-containing cowl to dissipate any static charge. There are two possible filter media choices if the analysis is to be performed by TEM. The AHERA protocol requires a 0.45 μm MCE or a 0.4 μm polycarbonate filter. Both filter types are supported with a five μm backing.

(6) *Wipe samples*. There is no federally-recognized standard procedure for wipe samples, but this technique may be useful for evaluating the asbestos content of settled dusts. A horizontal surface of known area is completely wiped using a 37 mm diameter MCE filter. The collected dust must be analyzed by PLM or, more definitively, by TEM or SEM. The results are expressed in units of fibers/meter^2 or fibers/sq. ft. Interpretation of the results is difficult because the settled fiber concentration is related to the proximity of the source and the length of time over which the fibers settled on the surface. The technique does demonstrate, however, that airborne asbestos was present in the space if asbestos is present in the settled dust.

(7) *Sampling schedule*. A brief description of air sampling procedures involving asbestos abatement projects are discussed in this chapter. For more details about specific processes involving asbestos abatement refer to the most current OSHA asbestos standards or consult with state and local authorities for specific procedures that may apply.

(a) *Personal samples*. Personal samples serve to protect the worker at two stages. At the beginning of a project, a 30-minute two L/min sample is collected to determine if adequate respiratory protection is provided. This is a recommended practice. Note that under the new 1994 OSHA Asbestos Standard that respirators are now selected on the basis of activity rather than an initial measure of an airborne fiber concentration. During asbestos abatement, routine sampling (both personal and area) provide continued protection and ensure that the respirators being used are appropriate for the dust levels generated.



$$\text{FLOWRATE} = \frac{\text{VOLUME}}{\text{TIME}}$$

$$= \frac{\text{LITERS}}{\text{MINUTE}}$$

$$= \frac{\text{MEASURED VOLUME (L)}}{\text{MEASURED TIME (s)}} \text{ X } \frac{\text{60 SEC.}}{\text{1 MIN.}}$$

$$= \frac{\text{(1 L) (60 SEC.)}}{\text{MEASURED TIME (s)}}$$

$$= \frac{60}{\text{MEASURED TIME (s)}}$$

Figure 8-1. Calibrating Volumetric Air Flow Using a Soap-Bubble Meter

(b) *Pre-abatement (background) Samples*. Before an asbestos abatement project begins, collect outdoor ambient air background samples. The ambient air background samples shall be used as the clearance standard. These samples shall be compared to the aggressive air samples [as discussed in (d) (4) of this paragraph] to determine if additional cleanup measures are required.

(c) *Post-abatement (clearance) Samples*. For certain asbestos abatement projects (i.e., large-scale asbestos removal operations)(para. 9-4), containment barriers are required to be erected. These barriers are installed to isolate the abatement area from the rest of the building, to prevent the escape of asbestos fibers into the adjacent work areas. Clearance aggressive air sampling must be performed inside the containment barriers following a thorough cleanup of the abatement area. Prior to conducting clearance aggressive air sampling, ensure that a final inspection of the area has been conducted by the "Competent Person" to verify that all visible residue has been removed from surfaces in the abatement area. The use of clearance aggressive air sampling methods for small-scale short duration asbestos removal operations (para. 9-4) (i.e., asbestos pipe insulation removal involving the use of glovebags) is not required.

(1) Before starting the sampling pumps, direct the exhaust from an electric one-horsepower leaf blower against all walls, ceilings, floors, ledges and other surfaces in the abatement area. This should take at least 5 minutes per 1000 square feet of floor space.

(2) Place a 20-inch electric fan in the center of the abatement area. Use one fan per 10,000 cubic feet of room space. Place the fan on slow speed and point it toward the ceiling.

(3) Start the sampling pumps and sample for the required volume. Check with the analytical laboratory as to the volume they require to obtain the detection limit.

(4) Compare the results of the clearance aggressive air samples to the ambient air background samples. If the clearance sample results exceed the ambient background sample results, then the abatement area must be recleaned and retested until the criterion is met.

(d) *Personal and Area Samples.* Both personal and area samples should be collected routinely in the course of asbestos removal. A field-portable PCM is extremely useful for the rapid evaluation of routine air samples; however, final clearance samples must be analyzed by an accredited laboratory. Area samples should be collected in those zones where the generation of an asbestos dust is anticipated and at critical points, such as the decontamination unit, where asbestos fiber may drift outside the barrier.

c. AHERA regulations provide an option in the selection of TEM or PCM, depending upon the size of the project. For those projects involving the abatement of less than 160 square feet or 260 linear feet of ACM, PCM may be used with a clearance level of less than 0.01 f/cc. For quantities of ACM greater than these amounts, transmission electron microscopy must be used in the determination of air quality with a clearance level of less than 70 structures/mm^2 (or less than

background). The appropriateness of the more expensive TEM analysis is also a matter of judgement on the part of the IH. TEM clearance would be appropriate in situations where individuals occupy the space for long periods of time (e.g., living quarters, offices, etc.) and PCM may be entirely appropriate for interiors of structures such as garages, warehouses, etc. Note that some states may require TEM clearance regardless of building use.

d. If the AHERA TEM protocol is to be followed for the clearance of post-abatement work area, the protocol requires that a minimum of five samples be collected inside the work area, five samples outside the work area and, in addition, two field blanks and one laboratory blank must also be provided. Each of the two field blanks is opened for a brief instant in the work area and is then closed and sealed. The laboratory blank must remain sealed and must be returned to the laboratory unopened. The Z-test[1] is then used to compare the asbestos structure concentrations in the inside and outside samples. If there is no statistically-significant difference between the inside and outside samples, the space may be cleared for re-occupancy; however, if a significant difference does exist, the space must be recleaned and retested. If there is any doubt that the space will pass the clearance test, it may be advisable to use PCM methods beforehand because of the rapid turnaround and low cost of the latter method. In some circumstances, the Z-test may indicate that the outside airborne concentration is actually higher than that inside. General construction activities may have raised an asbestos-containing dust and it may be necessary to collect the outside sample from locations totally outside the building.

8-6. Analytical Methods

a. *PCM*. PCM is the technique required to demonstrate compliance with OSHA exposure limits to asbestos. Phase contrast illumination permits the observations of particles (including fibers) as small as approximately 0.25 to 0.30 μm. The method does not, however, permit the identification of the particle. Therefore, the analysis yields a total fiber count which will include both asbestos and non-asbestos fibers. In an asbestos using workplace, this limitation in the method may not be serious because the result will tend to err on the side of increased worker protection. One must never attempt to use PCM for the identification of asbestos in bulk samples; the polarized light microscope is designed for this purpose.

b. *NIOSH 7400*. NIOSH 7400 replaces the older Physical & Chemical Analytical Method #239 (P&CAM #239). Among other details, the older method used a different set of fiber counting rules, a different graticule and a larger 37 mm diameter MCE filter. The fiber counting procedure used under the newer NIOSH 7400 gives better precision among laboratories participating in the PAT program; NIOSH 7400 must be used for the PCM analysis of air samples at all Army installations.

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[1] This is a mathematical procedure to test whether the inside samples differ significantly from the outside samples. Z-test is described in USEPA 560/5-85-024 (Purple Book).

c. *TEM.* This technique is the most reliable for the identification of asbestos fiber in air samples. An asbestos fiber is identified on the basis of its morphology, chemistry and selected area electron diffraction pattern. The USEPA AHERA TEM analytical protocol is highly standardized and, through the NVLAP program, interlaboratory agreement is quite good. Following the AHERA counting rules, asbestos fibers must have a length of at least 0.5 μm and an aspect (length/width) ratio of five to one or greater. Asbestos fibers having widths as small as 0.1 μm may be identified under good observing conditions. With respect to fiber chemistry, the TEM is equipped with an EDS which permits analysis of the characteristic wave lengths emitted from atoms in the fiber as it is bombarded with electrons. Chrysotile, for example, must exhibit a magnesium and silicon peak in a correct five to three ratio; and similarly for tremolite, peaks for calcium, magnesium and silicon must be present. In selected area electron diffraction (SAED) mode the fiber is again placed in the electron beam and the electrons are then diffracted from atomic planes in the crystalline fiber to produce a pattern that is unique to the particular crystal structure. The report of analysis must reflect all three determinations if asbestos is present in the sample.

d. *Intersecting Fibers.* In addition to individual fibers, the analyst may encounter several intersecting fibers that resemble jack straws, fiber bundles (closely parallel fibers), ill-defined clumps and matrices. Collectively, these asbestos bodies are termed structures. The current clearance standard under the USEPA AHERA regulations requires that the airborne concentration of asbestos fiber collected under aggressive conditions be equal to or less than 70 structures/mm^2. Such a concentration may arise from the detection of one structure in ten TEM grid openings in an air sample of 1,200 liters. The detection limit, which should also be given in the report of analysis, should be at least 0.005 structures/mm^2.

e. *SEM.* SEM techniques are not widely used in the US because no federally-recognized standard procedure has been adopted. Air samples analyzed by this technique give results that are only slightly better than those obtained by PCM. Therefore, SEM must not be used for air sample analysis.

CHAPTER 9
ASBESTOS OPERATIONS AND MAINTENANCE PROCEDURES

9-1. Distinction Between Operations and Maintenance and Abatement

A special operations and maintenance (O&M) program should immediately be implemented if the laboratory analysis of bulk samples confirms the presence of asbestos in sampled materials. Such a program is designed to: clean up asbestos fibers that have been released during the building's use; minimize disturbance of or damage to ACM; prevent the release of fibers; periodically monitor the condition of ACM in the building; and inform building employees of the proper methods of working with ACM. The special O&M program must remain in effect until all ACM is removed or the building is demolished. This O&M program is not an abatement action, its purpose is to manage the asbestos situation until an abatement action becomes necessary or feasible. AR 200-1 does require that an O&M program be used whenever possible.

9-2. Nature of Operations and Maintenance Procedures Involving Asbestos-Containing Material

a. The main participants in the O&M program are the AMCO or the AMT leader and the functional managers (e.g., chief, O&M; chief, buildings and grounds; or chief, utilities). The AMCO is responsible for furnishing technical advice in developing and monitoring the special O&M program. The functional manager must cooperate and actively support the program since the functional manager and staff will be primarily responsible for its implementation.

b. The effectiveness of an O&M program is dependent on the following factors:

(1) Awareness of building occupants and workers to the presence and condition of the ACM and to the actions and rationale of building management in dealing with ACM.

(2) Training of custodial and maintenance personnel in proper cleaning and maintaining building areas with ACM. Under these circumstances, custodial service contracts and other building service contracts will have to be modified to include provisions for training, protective clothing, and respiratory equipment.

(3) Implementation of a system to initially and periodically clean building areas with ACM using special methods.

(4) Development of a procedure to coordinate with the responsible member of the AMT before building demolition, renovation, or repairs are started in areas containing ACM.

(5) Formulation of a schedule for periodic reinspection of ACM areas.

c. USEPA recommends distinct O&M programs for surfacing material; pipe, boiler, and tank insulation; and other ACM. Under special O&M conditions, a HEPA-filtered vacuum cleaner must be available to the custodial crew.

9-3. Conduct of Operations and Maintenance Procedures Involving Asbestos-Containing Material

a. Special practices for sprayed or troweled-on surfacing materials. ACM that is sprayed or troweled-on surfaces is often the main source of airborne asbestos fibers in a building. Areas covered by ACM tend to be large. If the material is friable, fibers are slowly released as the material ages. To reduce the level of released fibers and to guard against disturbing or damaging the ACM, the following measures should be taken:

(1) Documentation of ACM, education of building occupants, and training of functional manager.

(a) Record the exact location of ACM on building documents (including plans and drawings) - see chapter 5.

(b) Inform all maintenance and custodial workers about the location of ACM and caution them against disturbing or damaging the ACM (e.g., by stripping floor tile, hanging plants or mobiles from the ceiling, or pushing furniture against walls). Be sure to give this information to new occupants and employees.

(c) Post warning signs if required.

(d) Require all maintenance and custodial personnel to wear the recommended respirator (consult the Safety Office or the industrial hygiene staff, PREVMED) during the initial cleaning and whenever they come in contact with ACM.

(e) Train custodial and maintenance workers in the proper methods for cleaning and handling areas with ACM.

(2) Initial cleaning.

(a) To be done by custodial staff if surfacing ACM is found in air handling rooms, in a particular room, or throughout a building.

(b) Steam-clean all carpets in affected areas throughout the building or vacuum them with a HEPA-filtered vacuum cleaner, but never with a conventional vacuum cleaner. Used vacuum cleaner bags shall be placed in sealed plastic bags according to USEPA and OSHA regulations for removal and disposal as ACM contaminated waste. Discard vacuum filters in the same manner.

(c) HEPA-vacuum all curtains and books in affected areas. Bag and dispose of the vacuum bags and filters as described above.

(d) Mop all noncarpeted floors in affected areas with wet mops. Wipe all shelves and other horizontal surfaces with damp cloths. Use a mist spray bottle to keep cloths damp. Discard cloths and mopheads as described above.

(3) Monthly cleaning - custodial staff.

(a) Spray with amended water any debris found near surfacing ACM and place the debris in plastic bags using a dust pan. Rinse the pan with water in a utility sink. Report the presence of debris immediately to the functional manager.

(b) HEPA - vacuum all carpets.

(c) Wet-mop all other floors and wipe all other horizontal surfaces with damp cloths.

(d) Dispose all debris, filters, mopheads, and cloths in OSHA labeled plastic bags. Dispose as ACM contaminated waste in accordance with USEPA and OSHA requirements.

(4) Building maintenance - functional manager.

(a) Ensure that recommended procedures and safety precautions will be followed before authorizing construction and maintenance work involving sprayed-on or troweled-on ACM surfacing materials.

(b) Erect containment barriers (except for minor repair and replacement using the glove bag technique) around the work area, and direct workers to wear coveralls as well as respirators if airborne fiber levels are expected to exceed the OSHA PEL action level. In practical terms, it must be assumed that this action level will be exceeded and all affected workers must wear appropriate respiratory protection.

(5) Building maintenance - maintenance staff.

(a) Coordinate all construction, maintenance, or equipment repair work with the functional manager in advance.

(b) Avoid patching or repairing any damaged surfacing ACM until it has been assessed by the AMCO.

(c) Mist HVAC filters with amended water from a spray bottle as they are removed from the ventilation system. Place the filters in OSHA labeled plastic bags and dispose as ACM contaminated waste in accordance with USEPA, OSHA, and DOT requirements.

(6) Periodic inspection - functional manger.

(a) Inspect all ACM materials for damage or deterioration at least once a year and report findings to the AMCO.

(b) Investigate the source of debris found by the custodial staff.

(7) Periodic inspection - custodial and maintenance staff

(a) Inform the AMCO and functional manager when damage to ACM is observed or when debris is cleaned up.

(b) If custodial services are provided on a contract basis, the above tasks should be included in the contract's scope of work.

b. Special practices for pipe, boiler, and tank insulation.

(1) Asbestos-containing pipe, boiler, and tank insulation is typically a less significant source of airborne asbestos fiber than surfacing ACM. Protective jackets around such insulation, if undamaged, will prevent fiber release. Thus, the special O&M program for this ACM focuses on alerting workers to its location, inspecting the protective jacket (and pipe joints or elbows) for damage, and taking precautions prior to building construction activities. The program also includes repair and selected special cleaning practices.

(2) Documentation of ACM, education of building occupants, and training of functional manager.

(a) Record the exact location of asbestos-containing insulation on building documents (including plans and drawings), if not accomplished during the building survey.

(b) Inform maintenance and custodial workers about the location of asbestos-containing insulation and caution them about disturbing it.

(c) Require all maintenance and custodial personnel to wear the recommended respirator (consult industrial hygiene staff) during initial cleaning and whenever ACM is encountered.

(d) Train custodial and maintenance workers in the proper methods for cleaning and handling ACM.

(3) Initial cleaning - custodial staff.

(a) Clean carpets in rooms containing heating, cooling, air handling, and similar equipment that has asbestos-containing insulation. Use a HEPA-filtered vacuum cleaner or steam cleaner. Discard filters in sealed plastic bags according to USEPA regulations for removal and disposal of ACM.

(b) Wet-mop all other floors in rooms with asbestos-containing insulation. Wipe all shelves and other horizontal surfaces with damp cloths. Use a mist spray bottle to keep cloths damp. Discard cloths and mopheads in sealed plastic bags according to USEPA regulations for removal and disposal of ACM.

(c) HEPA-vacuum all curtains in rooms with asbestos-containing insulation and discard vacuum filters in sealed plastic bags according to USEPA regulations for removal and disposal of ACM.

(4) Semi-annual cleaning - custodial staff.

(a) Spray with water any debris found near asbestos-containing insulation and place the debris in a plastic bag using a dustpan. Clean the pan with water in a utility sink. Immediately report the presence of debris to the functional manager.

(b) HEPA-vacuum all carpets in rooms with asbestos-containing insulation.

(c) Wet-mop all other floors in rooms with asbestos-containing insulation and dust all other horizontal surfaces with damp cloths.

(d) Seal all debris, vacuum bags, vacuum filters, cloths, and mopheads in OSHA labeled plastic bags and dispose of as ACM contaminated waste in accordance with USEPA and OSHA requirements.

(5) Building maintenance - functional manager.

(a) Ensure that recommended procedures and safety precautions will be followed before authorizing construction and maintenance work involving pipe and boiler insulation. Specifically, containment barriers or bags should be positioned around the work area, and workers should wear coveralls and recommended respirators. It may be assumed that the PEL may be exceeded and, therefore, respiratory protection is required. Insulation damaged during construction and maintenance activities should be repaired with non-asbestos mastic, new protective jackets, or replacement insulation.

(b) Authorize the repair of minor insulation damage with non-asbestos mastic, new protective jackets, or non-asbestos insulation following recommended repair techniques and precautions.

(c) Confer with AMCO before authorizing any large-scale abatement. The concept of large and small scale projects defined under USEPA Regulation has now been replaced by the activity classification of OSHA (Federal Register, August 10, 1994).

(6) Building maintenance - maintenance staff.

(a) Coordinate construction, maintenance, or equipment repair work with the functional manager in advance. (See chapter 10 for USEPA requirements for construction work that involves ACM removal.)

(b) Avoid patching and repair work on insulation until the ACM has been assessed by the functional manager.

(7) Periodic inspection - functional manager.

(a) Inspect all insulation for damage or deterioration at least once a year, and report findings to the AMCO.

(b) Investigate the source of debris found by the custodial staff.

(8) Periodic inspection - custodial and maintenance staff.

(a) Inform the functional manager when damage to the insulation is observed or when debris is cleaned up.

c. Special practices for other ACM.

(1) Most ACM that is neither surfacing material nor pipe, boiler, or tank insulation is hard and nonfriable. This type of ACM releases fibers only when disturbed (e.g., cut, drilled, sawed) or damaged. The objectives of the following procedures are to alert workers to the location of such ACM and to avoid its disturbance or damage.

(2) Documentation of ACM, education of building occupants, and training of functional manager.

(a) Record the exact location of these types of ACM on building documents (including plans and specifications), if not accomplished during the building survey.

(b) Inform maintenance and custodial workers about the location of ACM and caution them about disturbance or damage.

(c) Train maintenance workers to safely handle ACM.

(3) Building maintenance, responsibilities of functional manager.

(a) Ensure that recommended procedures and safety precautions will be followed before authorizing construction or maintenance work involving ACM.

(b) Direct personnel to erect containment barriers around work areas. Make sure that all tools are equipped with HEPA-filtered vacuum devices.

(4) Building maintenance - maintenance staff.

(a) Obtain authorization for all construction, renovation, maintenance, or equipment repair work from the functional manager in advance.

(b) Avoid removing or sanding floor tiles containing asbestos. If tiles are removed, do not sand the asbestos backing material that remains on the floor.

(5) Periodic inspection, responsibilities of functional manager. Inspect all ACM for damage or deterioration at least once a year and report findings to the AMCO.

(6) Periodic inspection by custodial and maintenance staff. Report any ACM damage to the functional manager.

(7) Record keeping by functional manager. All forms, reports, and contract specifications and agreements applicable to special O&M procedures must be filed and maintained on site for an indefinite period of time. Copies of reports and actions should be provided to AMCO to update and maintain survey and records database. Copies should also be furnished to the AEIS.

9-4. Differentiating Large-Scale and Small-Scale Projects

a. It is sometimes extremely difficult to distinguish large- from small-scale projects; however, there are some features of both which may be helpful in making this distinction. Small-scale projects would include those where asbestos abatement is only an incidental part of the overall construction project. Emergency repairs to boilers, tanks, pipes, and associated plumbing would, in general, fall into the small-scale category. Such situations can usually be handled by using one glove bag or one large plastic garbage bag. Also, a localized asbestos abatement that can be handled by existing trained, qualified in-house personnel could be included in the small-scale category.

b. On the other hand, large-scale projects tend to be characterized by the presence of significant amounts of ACM that require notification to the USEPA (and perhaps other agencies) in advance of construction. Such projects would tend to occupy a significant percentage of the overall construction time, and additional trained asbestos abatement workers would have to be assigned to the project.

c. There will be situations in a gray area where it is difficult to decide whether this is a small- or large-scale project, and it is the responsibility of the AMT to make this determination, keeping in mind the overall objectives of an asbestos control program. The scale and time duration of projects is a USEPA classification that is useful in conveying an image of the magnitude of a project; however, OSHA has done away with this concept for purposes of worker protection. In a very effective approach to worker protection, OSHA divides work activities into four Classes (see chapter 1 for highlights of new regulation in Federal Register, August 10, 1994). A Class III activity, for example, refers to maintenance activities where occasional handling of ACM is required that is only incidental to the repair problem at hand. A Class III activity requires a specific level of training and respiratory protection. If, on the other hand, an individual's job is to remove ACM from various locations, the activity would be classified as Class I. This class of activity would require much more extensive training and respiratory protection. OSHA still recognizes that the distinction between activity classes may become blurred at times; however, OSHA urges that we use common sense and sound professional judgement in deciding the activity class required to protect workers.

CHAPTER 10
ASBESTOS ABATEMENT PREPARATIONS

10-1. Asbestos Abatement Alternatives

a. The four asbestos abatement techniques generally recognized include removal, encapsulation, enclosure, and repair. In most circumstances, all four will require the construction of barriers and a containment system including HEPA-blowers to provide a negative pressure for the space. Because of the cost incurred in constructing the barrier system, most building owners will opt for the removal option. Each technique is considered in turn.

(1) *Removal*. Removal is the most frequently chosen alternative, for there will be no future need for O&M at the conclusion of the construction. If ACM, such as thermal insulation, is to be significantly disturbed, then removal would be a sensible choice. If the construction calls for extensive renovations, including relocation or replacement of pipes, or in the case of a complete building demolition, a complete removal project would be required. If the ACM is sprayed-on fireproofing or troweled on plaster, the work area will require containment; on the other hand, a barrier system may not be required for the removal of thermal insulation from pipes following the glove bag technique. Preparations for the removal of VAT may only require polyethylene barriers at the doorways to the space, but the required practices for VAT removal tend to vary from state to state. The AMCO should consult with the appropriate state or local agency for this type of work. This is also true for the removal of roofing felts, asbestos house shingles, and similar materials. The acceptable end result of removal is a completely clean surface, free of any ACM fragments.

(2) *Encapsulation*. In the late 1970s, it was hoped that encapsulating agents would serve to preserve sprayed-on fireproofing and asbestos-containing plasters.

(a) Two types of encapsulants were considered, the bridging type formed a membrane over the surface of the ACM; and the penetrant type was designed to soak into the ACM matrix and bind it to the substrate.

(b) The results were not entirely satisfactory for either of the two types, and this particular use of encapsulants fell into disfavor generally.

(c) Both types added considerable weight to the fireproofing or plaster, causing these materials to separate from the substrate. Also, the durability of these encapsulants over decades of time was not known.

- The term tack-down encapsulant is frequently used in asbestos abatement work and should not be confused with the types previously mentioned. At the conclusion of an asbestos removal, the polyethylene sheeting applied to the

floor and walls is first washed down and then sprayed with a tack-down encapsulant. After treatment, the space is left vacant for 24 hours to permit fibers to settle and the encapsulant to dry. When the encapsulant is dry, the polyethylene sheeting can be removed without creating a dust.

- A third use of the term may apply to various types of coverings that may be placed on thermal insulation systems such as pipes and boilers. Wettable fiberglass is widely used and when it has cured, a very hard surface results. Sheet metal and plastic have also been used for this purpose, but in the latter case, the fire-retardant qualities of the material should be checked.

(3) *Enclosure.* This alternative generally involves the construction of drywall soffits around structural steel beams, and drywall on asbestos-containing plaster ceilings. Enclosures are also used to box-in spaces that cannot be reached by the abatement workers.

(4) *Repair*. Repair consists of returning damaged ACM to a nonfriable undamaged condition, or to an intact state, through limited replacement.

b. It is possible to use all four techniques in a single project; however, the structure will still contain ACM and that fact will have to be maintained in the records. Complete removal is, by far, the best alternative when circumstances permit.

10-2. Liaison with Federal, State and Local Agencies

At an early stage in the development of the AMP, the SJA representative to the AMT must obtain a determination regarding the installation's compliance with state, local, or host-nation regulations. Following this determination, the AMCO or the PAO representative to the AMT should contact these regulatory agencies to inform them of planned asbestos abatement activities. Contact with these agencies is not only a courtesy, but it is also an efficient way to determine whether the AMP is at variance with state or local regulations.

10-3. Use of In-House and Outside Contract Personnel for Asbestos Abatement Projects

a. The use of in-house personnel as mentioned in paragraph 1-1 for asbestos abatement work is an attractive approach and is encouraged by the Army because:

(1) The personnel are available for rapid response.

(2) Their use may be very cost-effective for many types of projects.

(3) Cooperation including manpower sharing between nearby facilities is strongly recommended.

b. Disadvantages include:

(1) Potential liabilities to the government arising from physical injuries or exposures to airborne asbestos.

(2) Maintaining a sufficiently-sized, trained workforce for projects which may take place over a time span of many years.

(3) Maintaining IH, physicians, and other support staff, on long term and large projects.

c. On the other hand, a competent outside contractor has the following advantages:

(1) A pool of licensed, trained workers to draw upon to provide an appropriate level of effort on the project.

(2) The variety and quantity of equipment required for the different types of abatement projects.

(3) The experience in asbestos abatement and related trades to carry out the work efficiently.

(4) The required OSHA asbestos worker medical records would not have to be maintained by the Army.

d. The disadvantage includes possible higher abatement costs.

e. The advantages of these two approaches may be maximized using a strategy which combines an in-house asbestos abatement team for small or emergency projects with an outside asbestos abatement contractor for those projects requiring a large labor force and a good deal of equipment. The reader is referred to Army policy concerning the use of in-house personnel in chapter 1.

10-4. Notifications

a. The NESHAP regulations require the owner or operator of a facility to notify the USEPA when more than 160 linear feet or 260 square feet ACM is to be disturbed as a result of either renovation or demolition (see appendix E). Requirements for alternative control methods for Class I activities are found in 29 CFR 1926.1101(g)(6)(iii).

b. Note that the dividing of a project into a series of smaller jobs in order to avoid the notification requirements above is not permitted. State and local notification requirements vary widely, especially with respect to the number of days required for advance notice. The appropriate agencies listed in appendix B along with state and local agencies should be consulted

at an early stage in the planning process. A blank USEPA Notification Form is provided in appendix F. The information required may also be provided in a letter; the information required is as follows:

(1) Note if it is the original or an update notification.

(2) Name, address, and telephone number of facility owner, operator, and asbestos removal contractor owner and operator.

(3) Note whether it addresses demolition or renovation.

(4) Description of facility (size, age, present and prior uses).

(5) Procedures used to detect (including analytical methods) Category I and Category II RACM. The term RACM is defined in the NESHAP [40CFR 61M] as ACM that, under conditions of normal use, is nonfriable. Category I pertains to asphalt roofing felts, VAT, gaskets, and packing materials that release asbestos fibers into the air if the material is ground, sanded, drilled, or sawed. Category II refers to nonfriable asbestos shingles, transite, and other asbestos board. Category II materials may create an asbestos dust if subjected to forces which cause the material to disintegrate.

(6) Estimate of the approximate amount of RACM to be removed.

(7) Estimate of the approximate amount of Category I and Category II nonfriable ACM that will not be removed.

(8) Location of affected facility (street address, building/room/floor number, city, county, and state).

(9) Scheduled starting and completion dates for asbestos removal work.

(10) Scheduled starting and completion dates for renovation or demolition.

(11) Description of demolition or renovation work to be done.

(12) Description of work practices and engineering controls to be employed.

(13) Name and location of waste disposal site for asbestos contaminated waste materials.

(14) Training certification of at least one person for supervising the removal.

(15) Name, address, and telephone number of waste hauler.

(16) For mandated demolitions of structurally unsound buildings, note the name, title, and authority of the state or local government representative who ordered the demolition, date of order, and date demolition was ordered to begin. Attach a copy of the order to the notification. Under these circumstances, notification should be made as soon as possible and not more than one day after the beginning of the demolition project.

(17) For emergency renovations, note the date and hour of the emergency, a description of the sudden, unexpected event, and an explanation of how the event caused an unsafe condition, equipment damage, or unreasonable financial burden.

(18) Description of procedures to be followed if unexpected RACM is found, or Category II nonfriable ACM becomes pulverized or reduced to powder.

c. Notifications must be updated as necessary, including when the amount of asbestos affected changes by at least 20 percent.

10-5. Asbestos Abatement Project Planning and Design

a. The basic steps in asbestos abatement project planning and design are as follows:

(1) Consult with the legal office (SJA) to determine which local and state regulatory jurisdictions are applicable.

(2) Early in the development stages of the management/abatement endeavor, and throughout its development, work closely with the appropriate USEPA/OSHA or state agency personnel.

(3) Establish and maintain a record keeping system for all applicable steps followed.

(4) Decide on control method.

(5) Decide whether to use in-house personnel or contracted personnel.

(6) If the project is a large-scale abatement, secure appropriate engineering plans and specifications prepared by a certified asbestos project designer. The asbestos abatement guidance detail sheets (see appendix A) will also be useful in the preparation of the specification. The installation asbestos survey should also be reviewed to determine the type, quantity and extent of ACM; if such data does not exist, the proposed project space should be surveyed immediately. For large-scale projects, it is advisable to re-inspect the space to ensure that no ACM has been overlooked or that conditions have changed since the previous inspection. If an outside contractor is to be used, be sure to have that contractor inspect the project for ACM before his or her bid is submitted. This step will avoid any later claims for extras that may result if the installation asbestos survey underestimated the quantities of ACM.

(7) Coordinate project with PREVMED to determine air monitoring and COR responsibilities.

(8) If using in-house personnel, proceed with or verify medical surveillance and training.

(9) Prepare an asbestos abatement specification for both in-house or contracted work. For contracted work, a pre-bid site inspection should be made, and the contractor must submit his or her bid based upon the mandatory site inspection and the provisions of the specifications. The competency of the contractor is to be judged on the basis of demonstrated experience on projects of similar size and complexity, his or her record of regulatory infractions, fines, or suspension of license. The contractor's having adequate liability insurance and demonstrated financial solvency are additional factors to be considered when awarding a contract.

(10) If using in-house personnel, review and secure disposal plans. The disposal plans must be reviewed with and be approved by the USEPA regional office and the appropriate state and local agencies before the project begins. If an outside contractor is to be used, he or she must submit the disposal plan and the name of the landfill to the COR beforehand.

(11) Inform building occupants of planned activities. This is the responsibility of the PAO.

(12) Conduct background air sampling.

(13) Make appropriate notifications if removal is to precede a renovation or demolition.

(14) Select, acquire, and inspect appropriate PPE. The selection and inspection of equipment must be performed by the PREVMED IH and the representative from the Safety Office. (If this is a contracted project, this would be done by the contractor).

(15) Obtain recommendations from the PREVMED IH and the representative from the Safety Office. Acquire appropriate respirators and have personnel properly fit tested. (If this is a contracted project, this would be done by the contractor).

(16) Review the layout of the asbestos abatement project with the in-house supervisor or the contractor's supervisor. The space must be provided with hot and cold running water and adequate electrical service. The project boundaries must be defined so that barriers do not unnecessarily interfere with essential non-construction traffic or cut off the construction space from natural exits (e.g., loading docks, or exits to the outside) where the decontamination units may best be located. Careful project design at this stage may result in a savings in labor and expendable materials. For example, glove bagging of thermal insulation on pipes may be done without the need for a barrier system, provided that non-construction personnel are not potentially exposed and the abatement workers have suitable respiratory protection. In situations

where the piping is complex or is present in such amounts as to make glove bagging impractical, it may be feasible to construct a tent-like enclosure or a lean-to when the piping is against a wall. This approach avoids the unnecessary and time-consuming construction of a complete enclosure system for the entire room.

(17) Prepare the work area.

(18) Have ready materials and supplies for extreme climate conditions, as appropriate. (If this is a contracted project, this would be done by the contractor).

(19) Proceed with the abatement.

(20) Update O&M Program, the AMP, and all other applicable records, as appropriate.

(21) It is absolutely necessary to have a competent person (see glossary) available on-site at all times to monitor the work. This monitoring would include, particularly, air sampling and the determination that all safety and health requirements are being followed. For a project being completed by in-house personnel, this monitoring shall be provided through the Safety Office with assistance from PREVMED industrial hygiene staff. For abatement projects being completed by an outside contractor, the industrial hygiene monitoring shall be provided by that contractor and these monitoring activities shall be reviewed by the PREVMED IH or safety office representative.

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CHAPTER 11
ASBESTOS ABATEMENT MANAGEMENT AND TECHNIQUES

11-1. Determination and Selection of Management Protocol

a. Whether the project is carried out on an in-house or contracted basis, the AMCO and other members of the AMT will assume a high level of responsibility and involvement in the abatement project. There are, however, important differences in the management procedures for the two approaches.

b. Projects carried out by in-house personnel.

(1) The AMCO is responsible for ensuring that prospective asbestos abatement workers have been trained (see chapter 4) and have received the required medical surveillance and respirator fit-testing (see chapter 7).

(2) The AMT must determine whether the project is of such a size that in-house personnel can staff the project adequately. This consideration would also include an analysis of the schedule of construction to see whether the staffing level is sufficient to complete the project within the allotted time.

(3) The AMT must select a qualified and trained supervisor (see chapter 4), PREVMED IH, Safety Office representative, and an air monitoring technician for the project. The air monitoring technician and the laboratory performing the analysis of membrane filters must be totally independent of the project because of the obvious potential for conflict of interest. To avoid this problem, the air monitoring technician and the analytical laboratory must be retained by outside contract. The analytical results must be made immediately available to the PREVMED IH and Safety Office representative for review.

c. Projects completed through contracted services.

(1) There is a markedly different focus in the manner of project management when the asbestos abatement project is carried out by outside contractors.

(2) The AMT assumes a more hands off approach in the actual execution of the work and assumes more of a quantity assurance role in project management. Specific issues include:

(a) The degree of interaction of AMT members with contractor personnel. The COR is the only one authorized to interact with the contractor on matters relating to the interpretation of the scope of work or the specification. Members of the AMT must not individually direct the work of the contractor or agree to changes or deviations from the specifications in the absence of the COR. The AMT must not provide the contractor with direct

industrial hygiene or medical services that would cause the government to assume legal liability. In projects undertaken either jointly or simultaneously using DOD and contractor personnel, the work parties should be separated to avoid having the contractor's supervisors directing the work of government employees. Similarly, AMT personnel must not directly supervise the contractor's employees.

(b) A situation may arise where DA personnel and a contractor's employees are working side-by-side. Here, the issue of allowing the work of government personnel to be supervised by a civilian contractor must be examined. In most cases, the two work forces within the construction site should work apart, and their work should be supervised by different individuals.

11-2. Preparing a Scope of Work or Specification

a. Whether the work is carried out in-house or by contracted services, the level of worker protection and quality of the work must be maintained. It is a must to provide explicit written directions for either type of work force to ensure that these goals are met.

b. *Scope of work.*

(1) A scope of work must be prepared when the asbestos abatement is to be carried out by in-house personnel.

(2) This document must be written specifically for the abatement project and, in matters of execution, training, safety and health, particular reference to the appropriate sections of this TM must be included. Alternatively, the scope of work may incorporate by reference Section 02080 of the Guide Specification For Military Construction.

c. *Construction specification.* A written specification and prepared plans must be provided to the asbestos abatement contractor in advance of the submission of the bid. To assist in the preparation of the specification, the user should also refer to the US Army Corps of Engineers pamphlet which provides asbestos abatement guideline detail sheets (setup and response action) used in conjunction with the Guide Specification for Military Construction (CEGS). Some issues relating to the specification are:

(1) It is a good practice to require that prospective bidders attend a compulsory pre-bid conference and (if appropriate) conduct a walk-through survey. In this way, all contractors will be bidding on the same construction requirements (the specification) and the same explanation of the work required. Of equal importance is the need for the prospective contractor to determine, personally, the amount of asbestos present. If reliance is placed on the quantities of ACM noted in the installation asbestos site survey, the contractor may file a claim for extra payment if additional ACM is discovered in the course of the abatement project. Contract provisions may limit such claims, however. In such cases the government will solicit bids on a unit price basis

for a specified quantity of ACM. This type of contract may be somewhat cumbersome, however, because it is often difficult to determine the exact quantity of ACM removed. For example, the bags removed from the site for disposal may contain non-asbestos materials as well as ACM. If additional ACM is discovered during the abatement project, a modification to the contract may be required. A careful inventory of all ACM will be needed before bids are solicited in order to obtain adequate funding.

(2) The specification should require that the contractor retain his or her own outside IH or air monitor. However, it is strongly recommended that the outside IH be hired by the government. This allows the separation of responsibility of the AMT from the contractor's activities. In this instance, the AMT's responsibilities begin at the barrier or enclosure to the project; and its responsibilities focus on the safety and health of DA personnel. This does not relieve the contractors from provision of adequate health and safety for their workers.

(3) It is a good practice to include in the specification a provision that final payment to the contractor cannot be made until all validated dump receipts or weigh bills, copies of worker training certificates and medical approvals, and other related documents have been received.

11-3. Pre-Abatement Preparations.

Just before asbestos abatement takes place, the following steps should be taken:

a. The PAO must notify all affected individuals who normally occupy the space which will shortly undergo asbestos abatement. These individuals may be notified either through their supervisors, through meetings, or through the distribution of a memorandum.

b. The latter means of communications may also be used to inform occupants of the space that they should remove all personal effects, sensitive or breakable objects, and any other movable items that they will require at their temporary worksite.

c. Items that cannot be moved may be secured and left in place for external cleaning by the asbestos abatement team.

d. Certain non-moveable items which must remain in operation during the abatement must be protected. Techniques for accomplishing this are discussed in paragraph 11-7.

e. Certain small-scale projects may not require the construction of a barrier system; however, non-abatement workers must be removed from the abatement area until air monitoring indicates that the area is safe for re-entry.

f. The building manager and the project supervisor or contractor's representative must tour the area noting any pre-existing damage. This step aids in resolving later damage claims at the end of the project. In the case of contracted work, this inspection should be included in the

specification. Some contractors make very effective use of a video camera recorder to photograph the condition of walls, floor tile, and other furnishings in order to settle potential disputes. If this technique is used, the COR must be provided with a copy of this recording.

11-4. Small-Scale Abatement Techniques

a. This section is particularly applicable to the small-scale abatement and repair projects discussed in chapter 9.

b. Once having completed the applicable steps in paragraph 11-5, the actual abatement may commence using techniques that will minimize the release of airborne asbestos to the extent practicable.

c. It is useful to have all the supplies and materials required for a small-scale abatement or repair job on hand at all times. These materials can then be kept on a crash cart or other conveyance for convenient movement from site to site. A suggested list of supplies and materials that should be maintained and replenished, as necessary, for use on small-scale projects is given in table 11-1.

(1) In one approach, the area immediately adjacent to the abatement site may be roped off using barrier tape or by locking doors, etc. In some situations, additional barriers may be required; it is the responsibility of the abatement designer to ensure that personnel will not be exposed to asbestos contaminated dusts.

(2) Clean-up steps in a small-scale project include:

(a) Lay out a sheet of 6 mil. polyethylene sheeting beneath the location of the abatement or repair.

(b) Thoroughly saturate the ACM using the amended water; several applications may be required.

(c) Small amounts of crumbling or deteriorating ACM should be carefully removed, kept saturated with amended water, and dropped into a bucket of water. CAUTION: Individuals performing these steps must wear appropriate respiratory protection and PPE (see chapter 7).

(d) All loose debris must be removed and any ragged ends (e.g., ragged ends of asbestos-containing pipelagging) must be sealed off.

Table 11-1
Supplies and Materials for Small-Scale Asbestos Abatement or Repair Projects

• Polyethylene sheeting, 6-mil, rolls 12'x200'.
• Tyvek suits, disposable, assorted sizes.
• Booties and head covers, disposable.
• HEPA vacuum cleaner, approved for use with ACM.
• Extra filters for HEPA vacuum cleaner.
• Bridging encapsulants.
• Duct tape, rolls (do not use masking tape).
• Assorted tools: knives, scrapers, hacksaws, etc.
• Amended water: 50% solution of polyethylene ester and polyethylene ether or equivalent (such as AQUA-GRO).
• Spray bottles for amended water.
• Buckets.
• Assorted rags for cleaning off pipes and surfaces.
• ACM disposal bags, with OSHA warning label.
• Barrier tape and OSHA warning signs.
• Glovebags.
• Cart or wagon to store the above materials.
NOTE: Respirators and replaceable cartridges, safety glasses, gloves and hard hats are items that the Level III O&M abatement worker should keep as personal equipment (see chapter 7).

(e) All ACM debris must be placed in a plastic bag bearing the OSHA asbestos warning label. It is important that this material be kept in a wet condition; failure to dispose of the ACM in a wet condition has resulted in many federal and state citations.

(f) If appropriate, the HEPA vacuum cleaner can be used to clean up any dust or loose debris and the polyethylene sheeting must be sprayed with amended water prior to its being rolled up and placed in the disposal bag.

(g) Once the asbestos condition is abated and cleared, the barrier tape or other impediment to regular traffic may be removed.

d. Glovebag removal methods are popular for the removal of thermal insulation from pipes because, if conducted properly, there is no need to erect an extensive barrier system. This technique is particularly well-suited for most O&M procedures. In use, the open end of the glovebag is wrapped around the pipe insulation where it is stapled in place and sealed with duct

tape. Most glovebags are designed to handle insulation diameters up to 10 to 12 inches. Once the bag has been installed around the thermal insulation, a smoke tube should be used to inject smoke into the bag and, when the bag is squeezed, there should be no release of smoke which would indicate a leak. One general drawback with this removal method is the limited length of pipelagging that can be removed with one bag. Since there is a strong likelihood that airborne asbestos contamination will result if the bag is slid along the pipe, most specifications (and state and local regulations) sensibly require that these bags may not be moved along the length of the pipe. Some glovebag manufacturers, however, claim that their products are designed to allow progressive movement of a single bag along the length of the pipe without causing exterior contamination. Some bags are specifically designed for removal of ACM from valves and tees, for pipes having exceptionally large diameters, and for high-temperature steam lines 150 to 180^{o}F. Prior to sealing the bag in place, the asbestos abatement worker should place all tools and wetting materials into the interior pouch provided.

(1) The thermal insulation must be thoroughly saturated with amended water and the ACM debris must be kept wet as it is stripped away from the pipe and falls to the bottom of the bag. Stripped pipe lengths should be thoroughly cleaned with water and rags before rinsing down the upper portion of the bag. Once this has been accomplished, the lower portion of the bag containing the wet ACM must now be evacuated using a HEPA vacuum cleaner attached to the port provided on the bag. The lower portion of the collapsed bag is then sealed with duct tape; and, at this point, the entire glovebag assembly may be removed from the pipe. Any remaining exposed ends of the asbestos-containing thermal insulation must now be sealed off or taped with duct tape as appropriate.

(2) If the project supervisor wishes to slide a partially-filled glovebag along the pipe, the competent person must determine and certify that this procedure is being carried out properly without the release of asbestos fiber into the atmosphere. The IH's opinion must be based on area or breathing zone air samples. Glovebag practices are currently under OSHA scrutiny and it is important that the competent person determine that the most current regulation is being followed.

11-5. Large-Scale Asbestos Removal Project Measures

a. Advance preparations.

(1) Removal of furniture and non-fixed items. If the ACM is sprayed-on fireproofing or if the ACM has suffered extensive damage, it is important to remove any settled asbestos fiber before the furniture is moved. Personnel performing this task are considered to be asbestos abatement workers and they must have appropriate respiratory protection and PPE (see chapter 7). All desks, chairs, filing cabinets, and the like must be wiped down with damp cloths; the cloths must be rinsed out frequently in a bucket of hot water (the addition of a cleaning agent is optional). Alternatively, a HEPA vacuum may be used.

(2) Protecting non-moveable items. Items that are too heavy to move or would not suffer water damage may either be left in place uncovered or they may be wrapped and sealed in six mil. polyethylene sheeting. Multiple layers of polyethylene sheeting individually taped in place may be required to protect equipment that cannot be moved but could be damaged by moisture. It may be feasible to place a desiccating agent (such as calcium chloride or similar material) inside the equipment before it is sealed with polyethylene sheeting.

(3) Maintaining equipment in operation.

(a) Certain equipment inside an abatement work area may have to be kept in continuous operation. Refrigeration chillers, pumps, and potentially even computers may have to remain in operation during construction. It is possible to build a temporary plywood enclosure which is then sealed with caulking and polyethylene sheeting taped in place; cooling air may be provided via a flexible duct connected to a blower drawing air from a location outside the containment system. It may not be necessary to filter the air if it is coming from a clean source. Equipment operated in this manner must be inspected frequently to make certain that there is no thermal overload or other equipment malfunction.

(b) In some situations, operating equipment may have to be monitored on a routine basis by maintenance personnel or watch engineers. It may be feasible to construct an enclosure with a tunnel leading to the barrier perimeter so that these personnel will not have to receive medicals and respirator fit-tests in order to carry out their duties.

b. Barriers and enclosures.

(1) A suitable barrier or enclosure system is required whenever there is the possibility of an uncontrolled release of asbestos fiber into the building's atmosphere. Figures 11-1 and 11-2 gives examples of various project layouts.

(2) There is some art involved in the proper installation of an enclosure system and a few suggested practices follow:

(a) Installing polyethylene sheeting on floors and walls.

- Six mil. polyethylene sheeting seems to be the most effective material for covering floors and walls. Thicker sheeting tends to be too heavy to be held in place on walls with duct tape and two mil. sheeting is too easily torn and does not generally handle well. Fire protection considerations are of paramount importance during planning and execution of abatement operations. Some local regulations may require the polyethylene sheeting to be fire retardant. If state or local regulations permit the use of polyethylene sheeting as a perimeter barrier to the work area, opaque sheeting may be

selected to prevent alarming passersby. Note that some states and local regulations require that, in addition to polyethylene sheeting, an exterior layer of plywood is required to protect the work space from being compromised by unauthorized entry or vandalism. Some regulations require a locked door at the work area entry.

- As a general practice, the polyethylene sheeting is first installed on the floor. The sheeting should be laid down as a large, continuous piece; a patchwork of smaller sheets taped together will tear quickly and result in water damage to the floor. The sheeting should extend 18 to 24 inches up the wall to prevent water leakage. For large spaces where more than one large sheet of polyethylene is required, there should be at least a six foot overlap. High traffic areas should be protected by several layers of sheeting; and, if wheeled equipment such as scaffolds or carts are to be used, the sheeting should be protected by plywood. Note that wood floors and vinyl tile are very easily damaged by water. If the floor is a non-porous concrete, no floor covering is necessary.

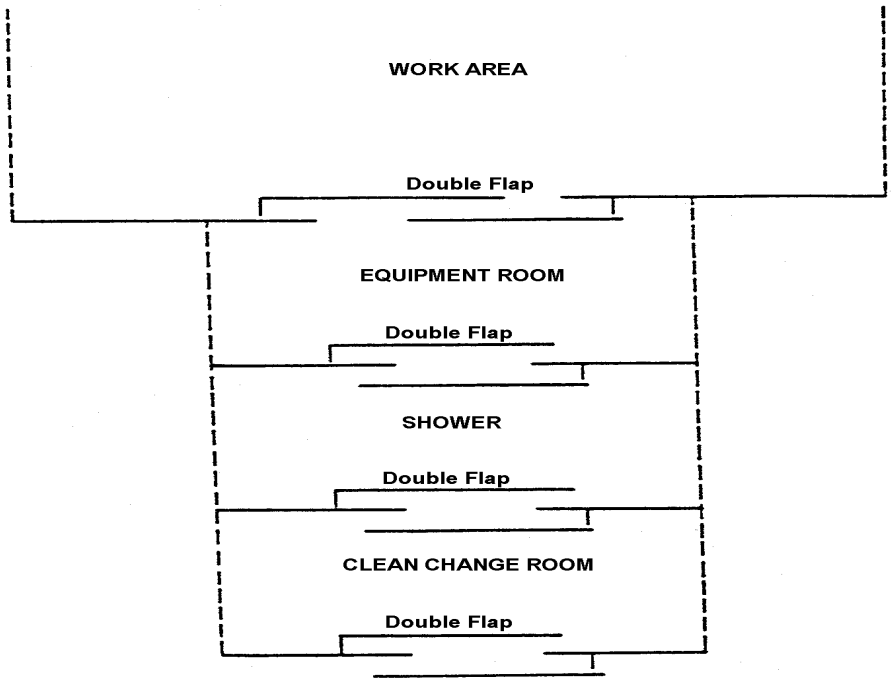

Figure 11-1. Typical Decontamination Facility Layout

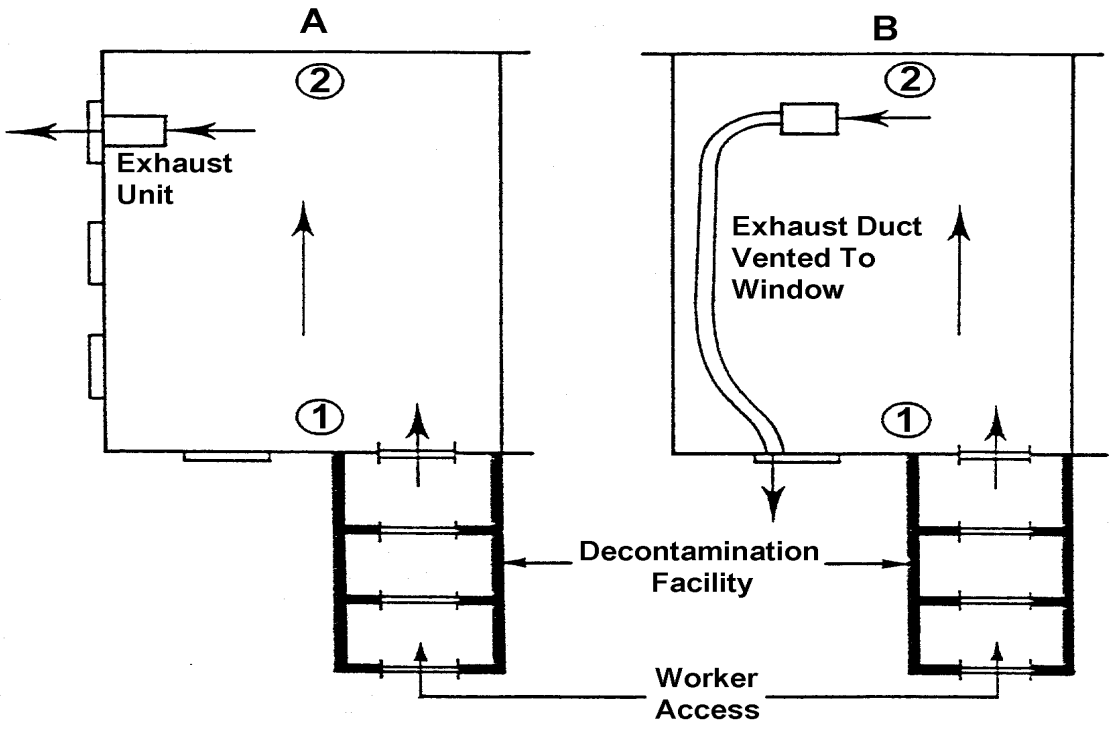

Figure 11-2. Examples of Pressure-Differential Systems.

KEY: *A. Single room work area with multiple windows*
B. Single room work area with single window.
Arrows denote direction of air flow.
Circled numbers indicate progression of abatement sequence.

- When entering the worksite, authorized personnel must first sign in and then enter the clean changing room. Street clothes are removed and stored in the lockers that must be provided. The worker then dons a clean Tyvek suit of appropriate size. The worker then puts on other PPE and his or her personal respirator. The fit of the respirator must be checked using the procedures contained in chapter 7. The worker then passes through the remaining chambers into the work area. When leaving the work area, the worker removes his or her contaminated garments and disposes of them in the receptacle provided. With the respirator still in place, the worker then passes into the shower and thoroughly washes while preventing the respirator from getting wet. The respirator is removed, and the worker then washes his or her hair thoroughly. The worker then passes into the clean chamber to towel off and to change back into street clothes. The worker is forbidden to remove potentially contaminated items such as work boots from the work site. In fact, work boots must remain on the contaminated side of the decontamination unit. The worker must then clean, sanitize, and dry his or her respirator and place it in a protective plastic bag.

- A negative air pressure environment must be provided in the work area of large-scale projects. There must be a sufficient number of HEPA blowers (see figure 11-3) to provide a minimum of four air changes per hour. The blowers must be exhausted to a point outside the building whenever possible. The HEPA blower units must be operated 24 hours a day during the construction period whenever there is a potential for release of asbestos.

(b) Electrical and water requirements.

- During the preparation stage, a qualified electrician must ascertain the power requirements for the project and, if necessary, install additional lines and boxes to meet these needs. The electrician must also determine that all circuits are properly grounded. The supervisor is responsible for making certain that GFIs are available for all electrical equipment to be used during the project. The electrician must also lock-out any circuits or electrical equipment that may pose a hazard to abatement workers particularly in a wet environment.

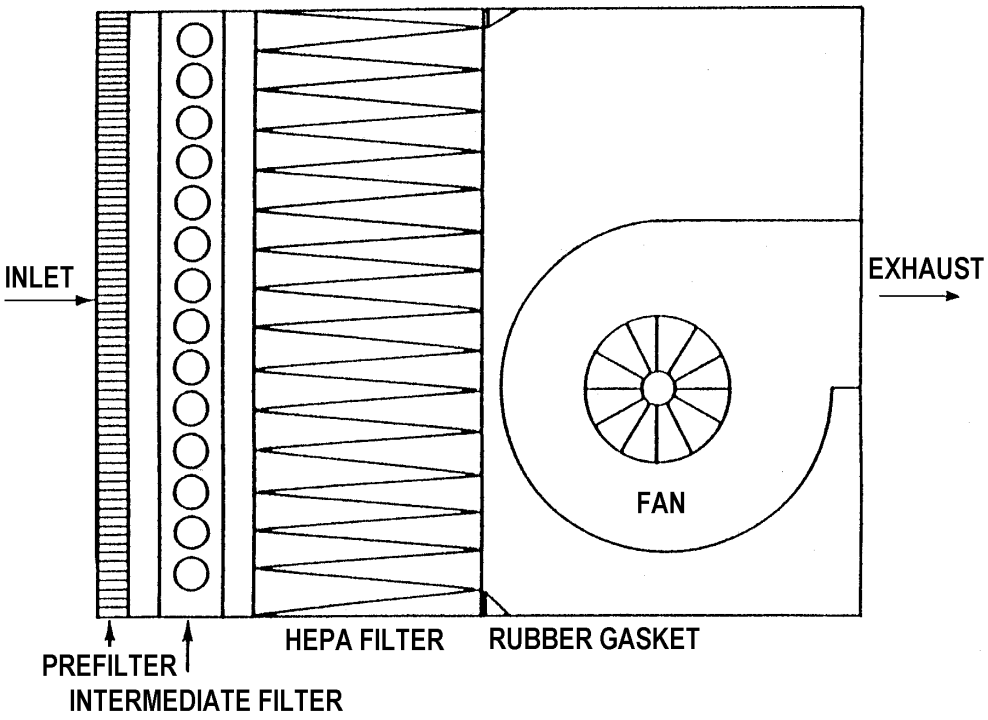

Figure 11-3. Sample HEPA-Filtered Exhaust System

- The supervisor must ascertain the hot and cold water needs for the decontamination unit(s) and in the work space. All hoses and fittings must be in good condition in order to avoid potential water damage. It is helpful if the water valves are in a convenient location so that they may be turned off at the end of a work shift to avoid accidental water damage in the event of an unnoticed leak.

(c) Removal procedures.

- The standard of cleanliness and completeness of all asbestos abatement projects requires that there be no residue of visible ACM on any surface included in the project scope of work. Some techniques helpful in the removal process are described below.

- Hand tools commonly used for asbestos removal include wide-blade metal scrapers (for sprayed-on fireproofing), assorted knives (including linoleum knives), and possibly fine-toothed saws for the removal of thermal insulation.

- High-pressure power washers must not be used for the removal of sprayed-on fireproofing. Although the pressurized water jet is more than sufficient to

dislodge the fireproofing, the high amount of energy involved not only reduces the material to a finer grain size, but also tends to spatter it all over, thereby making the final cleaning process much more difficult.

- In many situations, a small amount of water applied to VAT will serve to separate the tiles from the floor. VAT may also be separated from the mastic by chilling it with dry ice. The tiles may be lifted very easily once they have become thoroughly cooled. Liquid air is also used with the same effect at considerable greater cost however. Using the above techniques, the tiles may be carefully loosened by a sidewalk ice scraper. Several proprietary devices are on the market which heat the VAT and soften the underlying mastic cement. Some mastic cements contain asbestos and, under certain circumstances, this ACM may have to be removed. Some of this cement may be removed in the process of lifting the VAT; cement residues may be removed by scraping (but sanding or grinding must not be used). Another proprietary device reduces the VAT into smaller fragments via chipping. This method is to be generally discounted because of the high levels of asbestos fibers generated. However, if it is used, the work area must be under full asbestos abatement containment. Appropriate ventilation and personal protection are an absolute must if solvents are used.

- Chrysotile is the most common asbestos mineral present in ACM; however, amosite is found in some sprayed-on fireproofing. Certain physical properties of amosite make it difficult to saturate with amended water in a manner which will control the airborne fiber level. Ethylene glycol must not be used as a wetting agent due to the toxicity of the vapor. Safer wetting agents able to saturate and suppress airborne fiber levels are now available on the market.

- Internal combustion engines are strictly prohibited from the work area. Not only is there a very serious risk of carbon monoxide poisoning, there is also an extreme fire hazard. Similarly, no flammable liquids such as gasoline are permitted within the work area.

11-6. Asbestos-Containing Material Waste Handling

a. As ACM debris is lowered to the floor, it is essential that it be kept water-saturated and not be allowed to dry out. The level of saturation should be such that the water is pressed out when a handful of the ACM is squeezed. The ACM may have to be sprayed with water almost continuously to keep it in a saturated condition.

b. The ACM debris must not be allowed to accumulate on the floor. A full-time crew must be assigned to bagging the ACM debris to prevent it from accumulating. Actual stripping or removal of ACM should stop well before the end of a shift to provide sufficient time to bag all fallen debris. Under no circumstances may fallen debris be left on the floor overnight.

c. It is essential that the ACM be water-saturated when it is placed in the disposal bags. A water hose must be readily available to keep the ACM saturated.

d. HEPA vacuum must not be used to pick up wet debris because the moisture will damage the filters; wet-dry vacuum cleaners should not be used because the fine asbestos fibers may pass through the filter.

e. ACM disposal bags must be closed with duct tape and washed off before being transported to the decontamination unit. At the decontamination unit, the bags are washed off again before being passed out of the work area. Some state and local regulations may require double bagging.

f. A dumpster that may be closed and locked should be placed at a location as close as possible to the decontamination unit to minimize transit distances through occupied spaces. Bags containing ACM debris must not be dropped down chutes unless it can be demonstrated that the bags will not be broken open. Bags containing ACM debris must not be mixed with other non-asbestos construction waste. Metal ceiling grid must not be included with the ACM waste.

11-7. Project Monitoring

Project monitoring must be carried out daily by a qualified inspector or IH (see chapter 4 for training requirements). The work site monitoring may have to be on a continuous basis if the project is complex, if there is a high potential for a release of asbestos fibers outside the work area (e.g., amosite is being removed), or if the workers lack experience or are not compliant with regulations or the specification. It is the project monitor's responsibility to maintain work area monitoring reports which must be made part of the permanent record at the end of the project. An example checklist is given in table 11-2 below; items that are checked only at the beginning of the project are marked with an asterisk (*). The items marked with an asterisk (*) in table 11-2 must be repeated whenever there are significant changes in the work area or when new workers join the abatement team.

Table 11-2. Work Area Monitoring Report

*	**Notification of authorities confirmed.**
*	**Training program for workers confirmed.**
*	**Medical examinations for workers confirmed.**
*	**Baseline air samples taken.**
	Posting of warning signs.
	Posting of OSHA and USEPA regulations.
	Existence of emergency medical and contamination plans.
	Posting of emergency telephone numbers.
*	**Respirator fit test program.**
*	**Shut down of HVAC confirmed.**
*	**Shut down of mechanical systems confirmed.**
	Special precautions in areas of live electricity.
	Provision for temporary lighting.
	Provision for electrical supply and GFIs.
	Cleaning of articles removed from work area.
	Adequate protection of articles left in work area.
	Walls, required layers and thickness of polyethylene sheeting.
	Floor, required layers and thickness of polyethylene sheeting.
	Openings closed off, barriers supported
	Adequate number of HEPA blowers
	Placement of HEPA blowers to provide airflow.
	Exhaust of HEPA blowers to outside.
	Test of negative pressure (if instrument installed).
	Recorder present.
	Fire extinguishers provided.
	Emergency, exits, indicators in confined spaces.
*	**Proper 3-chambered decontamination unit.**
	Shower effective, pump, filter, hot water, soap, towels.
	Supply of coveralls, head covers, booties.
	Proper respiratory protection, air purifying, PAPR, C-Line.
	Supply of filters
	Daily entry log

Supervisor - Name: _____

Foreman - Name: _____

Prepared by: _____

Date: _____

PLACE IN PERMANENT RECORD JOB FILE

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CHAPTER 12
ABATEMENT CLEANUP, ASBESTOS WASTE DISPOSAL, PROJECT MONITORING AND RECORD KEEPING

12-1. Post-Abatement Activities

a. The asbestos abatement cleanup and clearance processes directly follow ACM removal, but these aspects are considered in chapter 7 because of the unique health concerns. Many of the activities outlined in this chapter require the close cooperation of the asbestos abatement team and the IH or inspector.

b. The criteria for cleanliness and approval of the abatement project require that there be no visible ACM debris either on the original surface where it was applied or anywhere within the construction site. All surfaces must be totally free of ACM fragments, adhering particles, or settled dust. One must be able to wipe a hand across any surface and not see or feel any particulate.

c. Gross and fine cleaning.

(1) It is assumed that all of the gross ACM debris was picked up, bagged, and properly removed from the work area as discussed in chapter 11. The supervisor must now pass through the entire work site and inspect the area in detail to make certain that no debris remains. The more detailed this inspection, the more quickly problem areas can be identified and corrected, and the more quickly the project can be completed. The foreman and several workers should accompany the supervisor to remove small amounts of debris on the spot. Any remaining grit must be removed either through HEPA vacuuming or by washing down with water. Similarly, all polyethylene sheeting on the walls must be either HEPA vacuumed or washed down.

(2) The above steps must be repeated until a clean condition is achieved; two such cleanings are typical. At this point, all abatement equipment must be decontaminated and removed from the work site; however, all barriers, including the polyethylene sheeting must remain in place until the work site has successfully passed all inspections and the final air test.

d. Inspections.

(1) The inspector must be an individual who:

(a) Is competent, trained, or otherwise qualified to perform the inspection.

(b) Has no employment, financial, or other conflict of interest that might bias the outcome.

(2) The inspector must make a detailed survey of the entire work site with particular attention being paid to corners, crevices, and hard-to-reach spaces (see figure 12-1). Prior to air testing, the supervisor may elect to apply a lock-down encapsulant to the polyethylene. The lock-down encapsulant must be allowed to dry thoroughly before the air clearance steps of the next section are undertaken.

e. Clearance air samples (Aggressive sampling technique).

(1) Air clearance represents the last point of control before the work area is released for normal occupancy. Technical details of the air sampling process are given in chapter 8.

(2) Air clearance may not be required, for some small-scale, short-duration projects; however, the PREVMED IH or Safety Office representative may, at his or her discretion, require that these tests be made. All large-scale projects involving barrier systems and decontamination units must undergo the air clearance process before being released.

(3) As required by the current OSHA construction standard for asbestos, ensure that aggressive air sample results for an abatement area, meet the clearance levels specified by AHERA in CFR Part 763, Subpart E, (less than 0.01 f/cc or not greater than the ambient background level) prior to allowing reoccupancy of the area. See Chapter 8, Section 8-5, Item b (6)(d) for details involving aggressive air sampling.

(4) Under no circumstances shall aggressive air sampling be performed prior to or following an abatement procedure, outside of a containment area, where there is a potential for disturbing asbestos material that results in the contamination of personal or business related items (i.e., in housing, offices, dining areas, day care facilities). If preabatement samples are desired to establish a background level of space, ensure that air samples are collected using passive sampling techniques. Passive sampling implies monitoring an area as it is, without creating any additional disturbance in the air.

(5) Clearance air sample analysis. If the building is a school, ensure that clearance air samples meet the AHERA clearance standards [0.01 f/cc or 70 structures/mm^2 (or less than ambient air background samples)] and are analyzed using TEM. For other buildings, consult with the state and local authorities to determine whether air clearance by PCM is sufficient. Some states may require air clearance by TEM. TEM analysis is also recommended in situations where individuals occupy the space for long periods of time (i.e., living quarters, offices, etc.) and also under particularly dusty conditions where more complete information is necessary to distinguish asbestos fibers from other fibers.

(6) AHERA regulations provide an option in the selection of TEM or PCM, depending upon the size of the project. For those projects involving the abatement of less than 160 square feet or 260 linear feet of ACM, PCM may be used with a clearance level of less than 0.01 f/cc (or less than background). For quantities of ACM greater than these amounts, TEM must be used in

the determination of air quality with a clearance level of less than 70 structures/mm^2 (or less than background).

(7) The air clearance results must be reviewed by the PREVMED IH and Safety Office representative and, if the work area passes the test criteria, the IH may, with the concurrence of the AMCO, direct that the area be restored to its normal condition. The HEPA blowers, and decontamination units and all polyethylene sheeting on walls and floors may now be removed.

f. ACM waste disposal and transport.

(1) Removal of ACM from the work site must be a continuous process; bags of debris must not be allowed to accumulate at the decontamination unit.

(2) Bags may be either decontaminated and passed through the decontamination unit or they may be decontaminated and passed through a materials handling unit used exclusively for bags and equipment.

(3) As each bag is decontaminated, it must be double-bagged and sealed separately with duct tape.

(4) The disposal container should be placed as close as possible to the decontamination unit to minimize potential releases of ACM into the air. If transit through an occupied area is unavoidable, the bags must be moved in a sealed cart. In this situation, the movement of the bags must not occur during normal business hours.

(5) The COR must have an accurate daily tally of bags removed from the work site and placed in the dumpster. Further, the COR must inspect the loaded dumpster, before it is removed from the site, to determine how full it is. The contractor must not be permitted to combine ACM wastes from the installation with debris from other projects. Similarly, any ACM debris removed from the installation must be transported directly to the approved sanitary landfill. Temporary storage of the debris in the contractor's yard or at any other location must not be permitted.

(6) The dumpster or trailer must be locked and must be opened only when ACM debris is being placed in it. Steps must be taken to ensure that the containers are tamper-proof and are in secure locations.

(7) Each bag containing ACM debris must bear the OSHA asbestos warning label; bags may be purchased with the OSHA label imprinted on them.

(8) Bags of ACM debris must not be dropped from heights or dropped down chutes unless, in the latter case, it can demonstrated that the bags will not break open.

(9) The supervisor and foreman play an important role in ensuring that all ACM debris has been removed from the work site (including contaminated HEPA filters for the blowers and vacuums), and in determining that all shipping papers are accurately completed (including an accurate estimate of the amount of ACM debris being removed from the installation).

(10) The container used to ship the ACM debris must bear the proper DOT label.

(11) ACM debris must be totally segregated from other general construction debris.

(12) NESHAP regulations are particularly relevant for renovation and demolition projects. Emission controls are mandatory, and there shall be no visible emissions to the outside air during ACM disposal. This does not apply to non-friable Category I or Category II (see glossary) regulated ACM that has not become friable during the renovation or demolition. If necessary, water spraying or other controls may be required to suppress the dust (i.e., visible emission).

(13) If a building is being demolished with non-friable RACM (e.g., VAT) in place, it must be thoroughly wetted down immediately following demolition and before handling or transport. The AMT must contact state and local agencies to determine their policies on the handling and disposal of ACM during demolition. There may be special requirements for the disposal of certain ACM with general construction waste. The wastes do not have to be sealed or wrapped; they may be transported and disposed of in bulk.

(14) DOT, under 49 CFR Sections 171, 172, and 173, specify the packaging and shipping requirements for asbestos-containing debris. Asbestos is listed as white asbestos (chrysotile, actinolite, anthophyllite, or tremolite), blue asbestos (crocidolite) and brown asbestos (amosite).

(a) According to subsection 173.216, asbestos (white, blue or brown) must be packaged:

- In rigid, leak-tight packaging, such as metal, plastic, or fiber drums, portable tanks, hopper-type rail cars, or hopper-type motor vehicles.

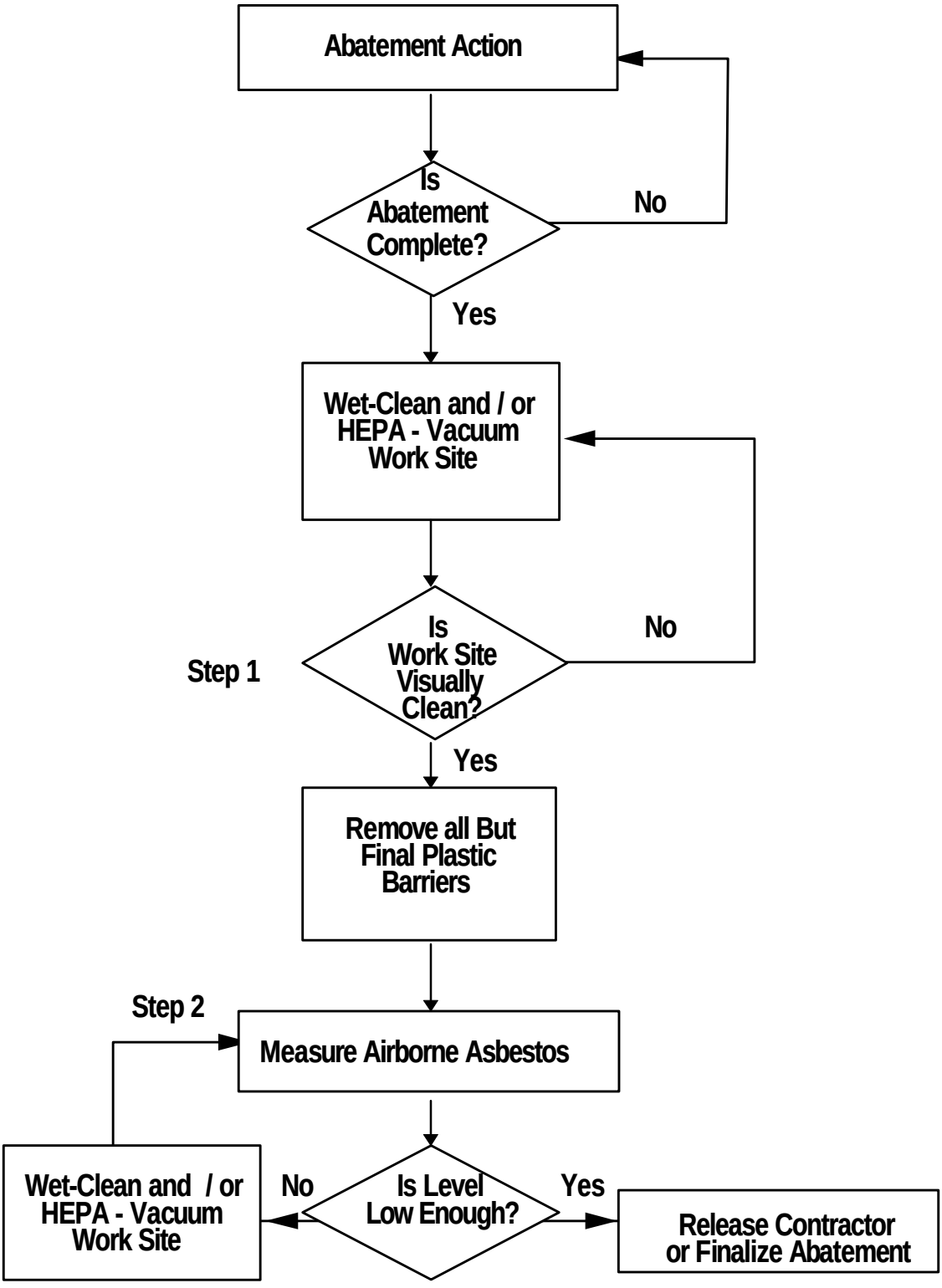

Fig 12-1. Process for Release of the Contractor/Finalizing the Abatement Project

- In bags or other non-rigid packaging in closed freight containers, motor vehicles, or rail cars that are loaded by and for the exclusive use of the consignor and unloaded by the consignee.

- In bags or other non-rigid packaging which are dust-proof. If these are transported by means other than by private carrier by highway, the packaging must be on pallets and grouped together (e.g., shrink-wrapped, strapped).

- In bags or other non-rigid packaging which are dust and sift-proof in strong outside fiberboard or wooden boxes.

- Asbestos wastes must not be offered or accepted for transportation unless it is packaged in accordance with the requirements stated above.

(b) Asbestos wastes must be transported to a facility that is permitted by USEPA to accept asbestos wastes.

(15) Marking and labeling.

(a) Asbestos (and waste asbestos) is listed by DOT as a hazard Class 9 material (miscellaneous hazardous material), and therefore requires a Class 9 label. Class 9 means a material which presents a hazard during transportation but which does not meet the definition of any other hazard class.

(b) Each package and container of asbestos waste should also be marked with the following information:

- Waste asbestos.

- UN2590 for white asbestos; or UN2212 for blue or brown asbestos.

- The name and address of both the generator and disposal facility, unless the waste is transported only by highway, and only by one vehicle, or is part of a larger load that is shipped directly from generator to disposal facility.

(c) For large bulk packages (volume size of 1000 gallons or more), the markings must be at each end and each side; for bulk packages less than 1000 gallons, the markings must be on at least two opposing sides. Markings on bulk packages must be clearly visible, whether directly on the package or on a tag or label; letters must be at least two inches high.

(d) The containers or wrapping of asbestos-containing waste materials from renovation or demolition projects must be clearly and legibly labeled as follows (this is required in addition to the DOT requirements stated above):

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

(e) Wrapped or containerized asbestos waste materials to be transported from the facility must also be labeled with the name of the waste generator and the location at which the waste was generated (i.e., the facility renovated or demolished).

(16) Shipping papers.

(a) Shipping papers must accompany a shipment of asbestos-containing waste and must include a description of the waste material. The supervisor must check that the shipping papers are clearly filled out, in English, and without using abbreviations, codes or symbols. If other wastes are to be shipped along with the asbestos-containing waste, the asbestos waste must be listed first, and must be clearly denoted from other entries as being a hazardous material.

(b) The shipping papers must include:

- Description of the waste which includes: waste asbestos; hazard class 9; for white asbestos wastes (packing group III and UN2590); for blue or brown asbestos wastes (packing group II, UN2212, and total quantity of waste). This is to be presented as follows: Waste asbestos, 9, UN2590, PG III, 2000 pounds; this may be followed by the type of packaging and the destination.

- The name of the shipper (if shipping by water).

- An emergency response telephone number (24-hour number).

- Special notation if the shipment includes empty packaging which formerly contained asbestos waste, for example, RESIDUE: Last contained asbestos waste. The packaging must also be labeled as such: Packing group II - indicates that the degree of danger presented by the material is medium; Packing group III - indicated that the degree of danger presented by the material is minor.

- Unless transported by the shipper as a private carrier (and not transferred from one carrier to another) or in a cargo tank supplied by the carrier, one of the following certifications are to be included on the shipping papers:

  * This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of DOT.

  * I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and are in all respects in proper condition for transport by _____, according to applicable international and national governmental regulations.

- Waste shipment records must be maintained for renovation/demolition projects. These must include the following information:

  * Name, address, and telephone number of the generator.

  * Name and address of the local, state, or USEPA regional office responsible for administering the asbestos NESHAP program.

  * Approximate quantity (cubic yards).

  * Name and telephone number of the disposal site operator.

  * Name and physical site location of the disposal site.

  * Date transported.

  * Name, address, and telephone number of the transporter(s).

  * Certification that the contents are fully and accurately described by shipping name, and that they are classified, packed, marked and labeled in accordance with applicable regulations.

(18) The disposal site operator/owner must receive a copy of the shipment record upon delivery of the wastes. The disposal facility must then send a copy of the shipment record to the generator within 35 days of receipt of the shipment. Should a follow-up phone call regarding the record not result in receipt of the record within 45 days of shipping, the generator (the government) must submit a written report to the administering agency. This report must include a copy of the shipment record (as it was initiated with the original transporter) for which

confirmation of delivery is not received, a letter explaining the efforts taken to locate the waste shipment, and results of those efforts. All waste shipment records must be retained permanently.

(19) Current DOT regulations do not require the waste asbestos transportation vehicle to have a placard, as long as the vehicle remains in the United States. The supervisor is advised to contact the SJA regarding applicable host nation regulations.

(20) Disposal facilities. For renovation/demolition projects (under the NESHAP regulations), asbestos-containing waste materials must be deposited at an USEPA-approved site. This site may be either a waste disposal site or a site that converts RACM and asbestos-containing waste materials into non-asbestos material. This disposal requirement does not apply to Category I non-friable ACM that is not RACM.

(21) Emergency response information. The shipping papers should include a 24-hour emergency response telephone number. The entity responsible for transportation of the wastes (i.e., the transportation contractor) also has further responsibilities for providing emergency response information and receiving specific training.

12-2. Emergency Spill Cleanup Requirements

a. 40 CFR Subchapter J, Superfund, Emergency Planning, and Community Right to Know Programs establishes the asbestos emergency cleanup requirements. Part 300.405 (b) (National Oil and Hazardous Substances Pollution Contingency Plan) mandates the reporting of releases to NRC. Part 302 (Reportable Quantities) Table 302.4 provides information on reportable quantities (i.e., 1 pound of friable forms of asbestos) of hazardous materials. Part 372.85 (Toxic Chemical Release Reporting Guidance) provides information on some forms that may be used in reporting chemical releases. [40 CFR Subchapter J can be accessed through the internet at http://epa.gov, click on Laws and Regulations, then on CFR Title 40: Protection of Environment and then on Chapter 1. Environmental Protection Agency and select Subchapter J].

b. Chapters 3,4, and 5 of AR200-1, dated 21 February 1997 provide guidance on setting up hazardous waste spill control procedures and reporting criteria. [AR200-1 can be accessed through the internet at (http://denix.cecer.army.mil/denix/Public/Policy/Army/ar200-1.htm)]. This internet is case sensitive and must be entered exactly as provided.

c. The U.S. Army reporting form for hazardous waste spills is included in Appendix G. Installations must record local times, as requested. Installations must provide a detailed description of all information requested.

12-3. Record Keeping

a. A complete record of asbestos abatement construction is not only required by government regulation, but it is also necessary for tracking of past projects as they occur over the years. In

addition, a detailed record of construction activities will be invaluable in the settling of contract disputes or health-related litigation.

b. Before a work site can be certified to be safe for re-occupancy, the entire space must undergo a series of cleaning, inspections, and re-inspections to the point where final air monitoring can be conducted. The disposal of ACM wastes is strictly regulated under both the USEPA and the DOT. A careful inventory of ACM removal from the site must be kept and an accurate record of its transport to the disposal site, and its actual burial must be kept. These tracking steps are required by law and, by law, the government still owns the ACM debris even though it has been removed from the installation. Record keeping is a vital element of the abatement process. If the abatement is carried out by in-house personnel, the AMT is responsible for gathering and maintaining the medical records for all personnel who were potentially exposed to airborne asbestos. OSHA regulations require that these medical records be maintained for a period of thirty years. Dump receipts, indicating the total weights of ACM delivered, must be obtained by the AMT. Any final payments to an outside abatement contractor must be contingent upon the AMT's receiving all dump receipts and related documents. Finally, the installation asbestos survey must be updated to reflect any changes in the asbestos status resulting from the project.

c. A checklist of the most likely documents to be generated during a project is developed in this chapter; however, this checklist is not necessarily complete in all respects and additional materials may be added to the record.

d. In many cases, building interior renovations may not involve the entire building. A complete, detailed record describing or illustrating the extent of the abatement will save much effort and cost when a building is further renovated or demolished years later.

e. The AMCO must decide upon the best physical location for these records. It may be preferable to archive the asbestos abatement record with all other contract documents relating to the project. Some facilities may prefer an arrangement where the asbestos abatement project file is archived in an engineering office within DEH or DPW. Whatever location is selected, the AMT must be aware of the existence of the asbestos abatement project file and the information in the file must be updated and readily available to those responsible for building alteration.

f. It is essential that a complete record of the asbestos abatement project be assembled and maintained by the AMT in the installation engineering department within DEH or DPW. If the construction was carried out by an outside contractor, all contract documents must be kept in the Contracts Office. A complete copy of the contract documents will be provided to the engineering department for the permanent record. A checklist of documents that must be collected and maintained in the asbestos abatement project file is given in table 12-1.

g. If an outside contractor is used, it is strongly recommended that final payment be contingent upon the receipt of all necessary documents in his or her possession. Careful record

keeping is necessary in the event that there is a future dispute or litigation over the project. All records pertaining to an asbestos abatement should be kept in a permanent file and maintained indefinitely. If, at some point in the future, an installation is closed or converted to civilian use, these documents will be valuable for determining the status of ACM in the buildings. Also, for in-house projects, OSHA regulation requires that medical records be kept for a thirty-year period. Be sure to update the installation asbestos survey to reflect the changes in ACM status. Any asbestos database that is used, must be updated promptly at the conclusion of any abatement project.

Table 12-1. Checklist of Record Keeping Items

(Ensure all submittals are legible)

EPA notification.
OSHA notification.
State and local notification/where applicable.
Required permits or licenses.
Correspondence between federal, state, and local agencies concerning this project.
Complete specification and scope of work for the project including any amendments to it.
Complete set of drawings or schematics illustrating contract scope of work.
Copy of the contract with the successful bidder.
O&M Program, specifying work practices & procedures (if applicable).
Building inspection/assessment report (and re-inspection reports).
Notification measures for building occupants.
Signs used for posting warnings.
Work permit system (for O&M program).
Maintenance work authorization form (for O&M program).
Evaluation of work form (for O&M program).
Contractors' licensing, qualifications and information (review of).
Photocopies of all government and contractor personnel asbestos training certificates.
Personal protective clothing & equipment program.
Respiratory protection program.
Medical surveillance program.
Personnel training records.
Photocopies of all government and contractor personnel medical examinations and approvals for asbestos related work as required by OSHA regulations (See 29 CFR 1910.1001).
Air sampling results (personal & area).
Work area monitoring reports (see table 11-2).
Data supporting exemption of initial monitoring (if applicable).
Basis of abatement measure selection.
Materials, methods, & procedures used (for abatement project).
Project plans & specifications (for removal project).
Notification (for renovation/demolition project; some states require notification for all removal projects).
Temperature records (for renovation/demolition).
Waste handling (bagging; quantities; security).

Table 12-1. Checklist of Record Keeping Items (continued)

Transportation (shipping records).
Asbestos waste disposal documents showing the hauler, date, time, location, and weight (or volume) of waste disposed. A photocopy of the haulers license must also be provided.
Designation of Army work classification.
Reports of personal air sampling results to individuals.
Activities of QC/QA teams' review of contracted work at installation.

APPENDIX A
REFERENCES

Section I
Required Publications

Department of the Army

AR 11-34, The Army Respiratory Protection Program, Headquarters, Department of the Army, Washington, DC, 15 February 1990. (Cited in para 7-1.)

AR 200-1, Environmental Protection and Enhancement, 21 February 1997. (Cited in paras 3-2, 3-3, 4-1, 5-4, and 9-1.)

AR 420-70, Buildings and Structures, 10 October 1997. (Cited in para 3-2, 3-3, 5-4.)

TB MED 502 (DALM 1000.2) Occupational and Environmental Health, Respiratory Protection Program, February, 1982. (Cited in para 7-1.)

TB MED 513, Occupational and Environmental Health Guidelines for the Evaluation and Control of Asbestos Exposure, 15 December 1986. (Cited in paras 7-1, and 8-5.)

US Army Corps. of Engineers, CEMP-RT, Pamphlet No. 1110-1-11, Asbestos Abatement Guidance Detail Sheets. (Cited in para 11-2.)

Nongovernment Publications

American National Standard For Respiratory Protection, (ANSI Z88.2-1992), American National Standards Institute, 11 West 42nd Street, New York, NY 10036. (Cited in para 7-1.)

U.S. Environmental Protection Agency, Department of Labor and Department of Transportation

Asbestos in Buildings Simplified Sampling Scheme for Friable Surfacing Materials, USEPA, Exposure Evaluation Division, Office of Toxic Substances, October, 1985. (Cited in para. 8-3.)

OSHA 29 CFR 1910, 1915, 1926, Respiratory Protection, 15 November 1994. (Cited in paras 7-1.)

OSHA 29 CFR 1926.1101, Asbestos, 1 July 1996. (Cited in para. 7-1.)

DOT 49 CFR 171, General Information, Regulations and Definitions for Regulations, 9 July 1992. (Cited in para. 12-1.)

DOT 49 CFR 172, Hazardous Substances, 20 June 1994. (Cited in paras 12-1.)

DOT 49 CFR 172, Use of Hazardous Materials Tables, and Communications, 15 May 1992. (Cited in para 12-1.)

DOT 49 CFR 173, Shippers - General Requirements for Shipments and Packaging, 23 October 1992. (Cited in para 12-1.)

OSHA 29 CFR Part 1910, et al 71. Occupational Exposure to Asbestos; Corrections; Final Rule, 29 June 1995. (Cited in para 1-6.)

OSHA 29 CFR Parts 1910, et al. Occupational Exposure to Asbestos; Final Rule, 10 August 1994. (Cited in paras 1-6, 9-3, and 9-4.)

OSHA 29 CFR 1910.134, Respiratory Protection, April 1984. (Cited in para 7-1.)

USEPA Notice of Advisory, Advisory Regarding Availability of an Improved Asbestos Bulk Sample Analysis Test Method; Supplementary Information of Bulk Sample Collection and Analysis, 1 August 1994.

USEPA 20T-2003, Managing Asbestos in Place: A Building Owner's Guide to Operations and Maintenance Programs for Asbestos-Containing Materials, July 1990. (Green Book)

USEPA 40 CFR 61, Asbestos NESHAP Clarification of Intent, 28 July 1995. (Cited in paras 10-4.)

USEPA 40 CFR 61, Asbestos NESHAP Clarification Regarding Analysis of Multi-Layered Systems, 5 January 1994.

USEPA 40 CFR 61, Interpretative Rule for Roof Removal Operations Under the Asbestos NESHAP, 17 June 1994.

USEPA 40 CFR 61, National Emission Standards for Hazardous Air Pollutants, Final Rule, 20 November 1990.

USEPA 40 CFR 763, Asbestos-Containing Materials in Schools; Identification and Notification Rule, 1982.

USEPA 40 CFR 763, Asbestos Hazard Emergency Response Act, 1987. (Cited in paras 4-1.)

USEPA 40 CFR 763, Asbestos Model Accreditation Plan, 3 February 1994. (Cited in paras 4-1.)

USEPA 40 CRF 763, Asbestos Worker Protection; Asbestos-Containing Materials in Schools; Proposed Amendment, 1 November 1994.

USEPA 560/5-85-024, USEPA Guidance for Controlling Asbestos-Containing Materials in Buildings, June 1985. (Purple Book) (Cited in para 8-5.)

Section II
Related Publications

Department of the Army

AR 40-5, Health and Environment, 15 October 1990.

DA PAM 420-8, Facilities Engineering Management Handbook, 15 March 1985.

USAEHA TG No. 157. The Installation Asbestos Management Program Assessment Checklist. (July 1994).

US Army Corps of Engineers, Guide Specification for Military Construction, CEGS-02080 (January 1997).

Other Nongovernment and Government Publications

ACGIH, Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs).

Asbestos: An Information Resource, National Cancer Institute, May 1978.

Asbestos in Construction, Alteration, Repair, and Demolition, Vol. 1: Location and Identification of Asbestos Materials, Construction Safety Association of Ontario, 1986.

Chatfield, E.J., Measurement of Asbestos Fiber Concentrations in Ambient Atmospheres, Ontario Research Foundation, 1983.

Chesson, J., et al., Evaluation of Asbestos Abatement Techniques, Phase 1: Removal, Final Report, USEPA Environmental Monitoring Systems Laboratory, 1986.

Encyclopedia of Occupational Safety and Health, International Labor Organization, 1983.

Environmental Statutes, Government Institutes, Inc., 1985.

National Institute of Building Sciences, Guidance Manual: Asbestos Operations & Maintenance Work Practices, September 1992.

Peters, George A., and Barbara J. Peters, Source Book on Asbestos Disease: Medical, Legal, and Engineering Aspects, Garland STPM Press, 1980.

Schlecht, Paul C., and Stanley A. Shulman, "Performance of Asbestos Fiber Counting Laboratories in NIOSH Proficiency Analytical Testing (PAT) Program," American Industrial Hygiene Association Journal, Vol. 47, No. 5, 1986.

Study of Army Asbestos Abatement Workforce Options, 21 January 1992.

Yamate, G., S.C. Agarwal, and R.D. Gibbons, Methodology for the Measurement of Airborne Asbestos by Electron Microscopy, Draft Report, USEPA Contract No. 68-02-3266, 1984.

USACERL Technical Report 97/64, Construction Productivity Advancement Research (CPAR) Program, Destruction of Asbestos-Containing Materials Using Plasma Arc Technology, March 1997.

EM 385-1-1. Safety and Health Requirements Manual, US Army Corps of Engineers, 3 September 1996.

APPENDIX B
LIST OF GOVERNMENT AGENCIES RESPONSIBLE FOR ASBESTOS RELATED REGULATIONS

B-1.US Department of Labor, Occupational Safety & Health Administration (OSHA) Regional Offices

Region I (CT*, MA, ME, NH, RI, VT*)
133 Portland St.
1st Floor
Boston, MA 02114
(617) 565-7164

Region II (NJ, NY*, PR*, VI*)
201 Varick St., Room 670
New York, NY 10014
212-337-2378

Region III (DC, DE, MD*, PA, VA*, WV)
Gateway Building, Suite 2100
3535 Market St.
Philadelphia, PA 19104
215-596-1201

Region IV (AL, FL, GA, KY*, MS, NC*, SC, TN*)
1375 Peachtree St., NE
Suite 587
Atlanta, GA 30367
404-347-3573

Region V (IL, IN*, MI*, MN*, OH, WI)
230 S. Dearborn St.
Room 3244
Chicago, IL 60604
312-353-2220

Region VI (AR, LA, NM*, OK, TX)
525 Griffin St., Room 602
Dallas, TX 75202
214-767-4731

Region VII (IA*, KS, MO, NE)
911 Walnut St., Room 406
Kansas City, MO 64106
816-426-5861

Region VIII (CO, MT, ND, SD, UT*, WY*)
Federal Building - Suite 1690
1999 Broadway
Denver, CO 80202-5716
303-391-5858

Region IX (American Samoa, AZ*, CA*, GUAM, HI*, NV*, Trust Territories of the Pacific)
71 Stevenson St., 4th Floor
San Francisco, CA 94105
415-744-6670

Region IX (AK*, ID, OR*, WA*)
1111 Third Avenue, Suite 715
Seattle, WA 98101-3212
(206) 553-5930

* These states and territories operate their own OSHA-approved job safety and health programs (Connecticut and New York plans cover public employees only). States with approved programs must have a standard that is identical to, or at least effective, as the federal standard.

B-2.Regional Asbestos Coordinator=s (RACs)

Region I
JFK Federal Bldg.
Boston, MA 02203
617-565-3836
Fax (617) 565-4939

Region II
2890 Woodbridge Ave.
Building 5
Edison, NJ 08837
908-321-6671 or 6665
Fax (908) 321-6757

Region III
841 Chestnut Building
Philadelphia, PA 19107
215-597-3160
Fax (215) 597-3156

Region IV
345 Courtland St., NE
Atlanta, GA 30365
404-347-3555 x4168
Fax (404) 347-3059

Region V
230 S. Dearborn St.
Chicago, IL 60604
312-886-6879
Fax (312) 353-4342

Region VI
1445 Ross Ave.
Dallas, TX 75202
214-665-7581
Fax (214) 665-2164

Region VII
726 Minnesota Ave.
Kansas City, KS 66101
913-551-7391
Fax (913) 551-7065

Region VIII
999 18th St., Suite 500
Denver, CO 80202
303-293-1442
Fax (303) 293-1229

Region IX
75 Hawthorne St.
San Francisco, CA 94105
415-744-1127
Fax (415) 744-1073

Region X
1200 Sixth Ave.
Seattle, WA 98101
206-553-4762
Fax (206) 553-8338

B-3.US Environmental Protection Agency (USEPA) Regional National Emission Standards For Hazardous Air Pollutants (NESHAP) Offices

Region I
JFK Federal Building, Room 2203
Boston, MA 02203
617-565-3241
Fax (617) 565-4939

Region II
290 Broadway, 21st Floor
New York, NY 10007-1866
212-637-4042
Fax (212) 637-3998

Region III
841 Chestnut Street
Philadelphia, PA 19107
215-597-1970
Fax (215) 597-3156

Region IV
345 Courtland Street, N.E.
Atlanta, GA 30365
404-347-3555, x4172
Fax (404) 347-3059

Region V
77 W. Jackson Blvd.
Chicago, IL 60604
312-353-4370
Fax (312) 886-0617

Region VI
1445 Ross Ave., 12th Floor, Room 1200
Dallas, TX 75202
214-655-7296
Fax (214) 665-2164

Region VII
726 Minnesota Ave.
Kansas City, KS 66101
913-551-7391
Fax (913) 551-7065

Region VIII
999 18th St., Suite 500
Denver, CO 80202
303-312-6967
Fax (303) 293-1229

Region IX
75 Hawthorne St.
San Francisco, CA 94105
415-744-1145
Fax (415) 744-1076

Region X
1200 Sixth St.
Seattle, WA 98101
206-553-1757
Fax (206) 553-0110

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APPENDIX C
ARMY ASBESTOS - CONTAINING MATERIAL CHECKLIST

Part 1: Damage Assessment

Installation:_____ Bldg/Rm No.: _____

Facility/Office: _____ Inspector Name/Date: _____

Functional Area: _____

Physical. Assess damage based on evidence of surface accumulation; or the condition of the sprayed-on or troweled-on surface materials; or physical deterioration or delamination of materials using hand pressure.

____(0) None	* Non-asbestos materials; or no damage or evidence of material fallout; or material is in fair to good condition; or nonfriable ACM, (i.e., floor tile, wallboard, etc.); or (ACM) with less than one percent.
____(1) Minimal	* Isolated and very small areas (less than 10 percent) of material damage or fallout; or controlled space and accessed by maintenance personnel only; or uncontrolled/unoccupied space.
____(2) Low	* Visible evidence of some surface accumulation; or controlled space and accessed by maintenance personnel only; or uncontrolled/ unoccupied space.
____(3) Moderate	* Visible evidence of small areas (less than 10 percent) of surface accumulation; or controlled space and accessed by maintenance personnel only; or uncontrolled/ unoccupied space.
____(5) High	* Visible evidence of widespread surface accumulation; or uncontrolled space and easily accessed by occupants.

Water.

____(0) None	No water damage.
____(1) Minor	Visible water damage (less than 10 percent) of ACM.

____(2) Major Visible water damage (greater than 10 percent) of ACM.
Part I: Damage Assessment. *(Continued)*

*** Note:** If any one or a combination of these criteria are met, assign the corresponding value and line out the criteria that do not apply.

Proximity to items for repair. If both A and B apply, score the one with the highest rating. (Check all that apply. Maximum of 3 points.)

A. *Sprayed-on or troweled-on.* Could the friable ACM be damaged by routine maintenance activities?

____ (0) No routine maintenance is performed within the areas.

____ (1) Equal to or greater than five ft.

____ (2) Equal to or greater than one ft but less than five ft.

____ (3) Less than one ft from routine maintenance areas or a ceiling panel contaminated with ACM must be removed.

B. *Pipe, boiler, or duct insulation.* Could damage occur as a result of routine maintenance or by occupants of building.

____ (0) No.

____ (3) Yes.

Type of ACM.

____ (0) * Non-asbestos materials; or nonfriable ACM, (i.e., floor tile, wallboard, etc.) in good to fair condition; or ACM with less than one percent.

____ (1) Miscellaneous ACM (i.e. ceiling tiles, etc).

____ (1) * Boiler; or pipe insulation; or other ACM insulation materials (not accessible to occupants).

____ (2) Nonfriable ACM (i.e., floor tile, wall board, etc.) in poor condition.

____ (2) * Boiler; or pipe insulation; or other ACM insulation materials (accessible to occupants).

Part I: Damage Assessment *(Continued)*

____ (3) * ACM on exterior of supply ducts; or capable of being introduced into air ducts (i.e. deteriorated ACM located in area of air ducts; or above suspended ceilings).

____ (4) * Sprayed-on; or troweled-on surface ACM (accessible to occupants).

*** Note:** If any one or a combination of these criteria are met assign the corresponding value and line out the criteria that does not apply.

Percent asbestos.

____ (0) Less than one percent ACM.

____ (1) One to 30 percent ACM.

____ (2) 31 to 50 percent ACM.

____ (3) Greater than 50 percent ACM.

Note: If the percent asbestos content is less than one percent or nonfriable asbestos (in good to fair condition) then the total for percent asbestos category will be zero (0).

DAMAGE (D) TOTAL_____(Max 20, Min 0)

Bulk sample results should be reported using the following format:

Sample No.	Type Asbestos	%	Source

Analysis performed by (Lab/Name/Date)_____

Part II: Exposure Assessment

Material friability. USEPA definition: hand pressure can crumble, pulverize, or reduce to power when dry.

____ (0) Nonfriable Material (i.e., floor tile, wall board, binder's, etc.) in good to fair condition.

Part II: Exposure Assessment *(Continued)*

____ (1) Low Friability Material difficult to crumble by hand.

____ (2) Moderate Friability Material fairly easy to dislodge and crush.

____ (3) High Friability Material easily reduced to powder; or broken by hand.

Occupant accessibility to ACM fibers.

____ (0) Low Accessibility * Materials are not exposed; or totally isolated by permanent barrier; or accessible only during infrequent, occasional maintenance activity; or no air flow from the friable insulating material location to occupants of the building, or storage areas.

____ (1) Moderate Accessibility * Only a small percent of material exposed; or material above a suspended ceiling; or material contacted during maintenance or repair; or material exposed, but not accessible to activity of normal occupants.

____ (4) High Accessibility * A large percent of material exposed; or material accessible to occupants; or airborne transport during normal activities.

*** Note:** If any one or a combination of these criteria are met assign the corresponding value and line out the criteria that does not apply.

Activity/use.

____ (0) None No activity/storage activities.

____ (1) Low Infrequent maintenance activities only.

____ (2) Moderate Frequent maintenance activities only.

____ (3) High Normal occupant activities.

Air stream/plenum.

____ (0) None No perceptible air flow in the room or area.

____ (1) Present Air flow and no evidence of ACM present.

Part II: Exposure Assessment *(Continued)*

____ (2) Present ACM is exposed to perceptible or occasional air streams.

____ (3) Present *Air flow and evidence of ACM present in supply ducts/ plenum; or recirculated; or subjected to routine turbulence; or abrupt air movement.

Area of visible surface or damaged ACM.

____ (0) Less than 10 cubic or linear feet (small areas should be repaired as soon as possible).

____ (1) 10 to 100 cubic or linear feet.

____ (2) 100 to 1000 cubic or linear feet.

____ (3) Greater than 1000 cubic or linear feet.

For occupied facilities only.

Population. This involves defining average occupancy as the total number of building occupants and outside visitor traffic into a room or area during an eight hour period. For example, a reception area in a DEH shop has one person assigned to the area. There are 15 individuals (including the receptionist) assigned to the building. They have approximately 240 customers (visitors) in the building during an eight hour period. On average, each customer (visitor) is serviced and departs the building within 30 minutes.

*** Note:** If any one or a combination of these criteria are met assign the corresponding value and line out the criteria that does not apply.

(outside visitors x time spent/8 hours) in area/room + building occupants = average occupancy

Example: ([240 visitors x 0.5 hours]/ 8 hours) + 15 occupants=30. .....Score as 2

____ (1) Less than nine or for corridors.

____ (2) 10 to 200.

____ (3) 201 to 500.

____ (4) 501 to 1000.

Part II: Exposure Assessment *(Continued)*

____ (5) Greater than 1000.

____ (5) Medical facilities, youth centers, child care facilities, or residential buildings, regardless of the population, will be assigned to this category.

For unoccupied facilities only.

____ (0) No ACM or less than one percent.

____ (1) Nonfriable ACM in good or fair condition.

____ (2) Nonfriable ACM in poor condition.

____ (3) Friable ACM in good condition.

____ (5) Friable ACM with visible evidence of damage.

EXPOSURE (E) TOTAL_____(Max 26, Min 0) Inspection (Date)_____

Note: Provide any other relevant information on observations in the space provided below. If additional space is needed attach additional pages as necessary.

APPENDIX D
ASSESSMENT ALGORITHM FOR LARGE ARMY INSTALLATIONS

Section I. Introduction

D-1. Scope

For large Army installations, a modified US Navy assessment system has been devised and utilized to enable installations to not only locate and identify ACM but to determine the relative risk factors that can assist in prioritizing asbestos abatement actions. This document provides another suggested methodology for performing the sometimes difficult asbestos survey and assessment tasks. A typical large Army installation is portrayed as the illustrative example in the following sections.

D-2. Inspections

a. Inspections were performed by identification and sampling of homogeneous materials following the protocol established by the AHERA and delineated in CFR, Title 40 (Protection of Environment); Part 763 (ACM in schools) and in a manner considered to be in accordance with general industry practices, with regard to appropriate health and safety measures. Sampling of materials differ from the AHERA requirements in that both friable and non-friable materials have been addressed. Each suspect homogeneous material has been sampled.

b. Homogeneous materials were identified by trained AHERA inspectors and were determined by visual assessment of each suspect building material based on color, texture, marking, patterns and other visually pertinent criteria. Any suspect ACM identified was evaluated for potential for friability, potential for disturbance, accessibility, frequency and type of occupancy of the given area, condition and air-flow. This data was used in a modified version of the algorithm described in Technical Report R883, “Management Procedure for Assessment of Friable Asbestos Insulating Material.”

c. The asbestos surveys were comprehensive in nature. Every attempt was made to assess all areas including, but not limited to, crawl spaces, plenums, chases and other areas. Certain areas may be deemed as inaccessible. Inaccessible areas could include spaces within concrete block walls, above certain plaster ceilings, within fire doors, within mechanical devices, areas designated as secured or sterile areas, locked rooms or spaces, areas authorities request not be accessed or disturbed, or areas deemed by the survey personnel to pose a imminent health or safety risk.

d. If areas could not be accessed, representative areas were examined to estimate if suspect ACMs are present. Any known inaccessible room or area is clearly noted. Any area reviewed in a representative manner, or any area not accessed is clearly identified with appropriate explanation and or notions.

e. F*acility description.*The Building A4305 project site is located on Susquehanna Avenue at Installation X. The project is currently utilized as a dormitory and classroom facility for an Army National Guard sponsored Youth Corps. Improvements consist of a single structure ranging in height from one to three stories. The general building construction consists of poured concrete foundation; cinder block and mortar exterior walls; reinforced concrete slab flooring system and cinder block and mortar exterior walls; reinforced concrete slab flooring system and cinder block and gypsum interior walls. The facility was originally constructed in the early 1950's with a major remodification in the 1970's that included, but not necessarily limited to, modifications to interior partition walls and the heating, ventilation and air conditioning systems.

f. *Inspector accreditation.*

(1) Inspections by: Accredited USEPA AHERA inspectors by name _____ conducted the ACBM survey.

(2) Assessments by: Accredited USEPA AHERA inspectors by name _____ conducted the ACBM survey assessment.

g. *Methodology.*

(1) Inspection methodology. Prior to the building survey a preliminary walk through is conducted so that the inspectors may familiarize and orient themselves with the building layout. It is important to know beforehand whether there are rooms or areas that are inaccessible so that they may be made accessible at the time of the survey. It is also important to know which areas of a building are inhabited so that arrangements may be made to evacuate areas if needed. A walk through allows inhabitants to know in advance what the inspectors will be doing.

(2) The survey is conducted room by room including hallways, rest rooms, mechanical rooms, etc. Sample Room Inventory Sheets are shown at D-6. The inspectors' survey is intended to identify each homogeneous area. A homogeneous area contains suspected ACM that is uniform in texture and color and appears identical in every other respect. According to the AHERA regulations, the homogeneous materials fall into one of three categories. These categories are thermal system insulation (TSI), Surfacing Materials (SM), and Miscellaneous (MISC).

(3) In each area a visual inspection is performed. The inspectors record and document all visually identifiable building materials such plaster, cinder block and concrete, as well as tiles and carpeting. Included in this inspection is a documentation of suspect ACM. Special attention is made to the friability, accessibility, condition, activity and quantity of suspect ACM. These evaluation criteria are explained in further detail in section IIA. All quantities are estimated or approximations unless otherwise indicated.

(4) No destructive inspection is performed. Carpet may be lifted to observe what lies beneath and ceiling tiles are raised to inspect plenums. Areas which are suspected of containing asbestos which cannot be visually inspected without destructive methods are noted as such. Inaccessible areas include the following types of areas:

(a) Spaces completely enclosed or covered with wall board, plaster, plywood or other similar wall surfacing or covering materials.

(b) Locked, secured or sterile areas.

(c) Areas defined as permit-required confined spaces in the CFR, Title 29 (Labor); Part 1910 (OS&H Standards); Section 146 (Permit-Required Confined Spaces).

(d) Space which would require excessive destructive measures (i.e. cutting, hammering, removing, etc.). To gain access.

(e) Specific areas which could not be accessed for inspection inspected include:

(f) Area 129 space beneath steps on the first floor west side.

(g) Room 106B due to no key being available. It has been assumed that the room is consistent with room 106A.

(h) Room 151 flooring beneath glued carpeting. It has been assumed that tile is present beneath the carpeting.

(g) Ventilation ducting system that runs throughout the building. The ducting was accessible through small ports. Inspection was made at those points however full access was not possible at the time of the inspection.

(h) Once a room has been surveyed and the appropriate samples taken and information recorded, the next room is surveyed.

(5) *Sample selection and collection methodology.*

(a) The prime objective in determining sample locations for each homogeneous area is to get a fair representation of a suspect material. Using a random sampling scheme may avoid the pitfalls associated with taking samples in similar locations or within a small area when the homogeneous material is prevalent throughout a sampling area. At D-7 is a Homogeneous Area Sampling Sheet.

(b) A random sampling scheme involves dividing a sampling area into roughly nine equal parts. A random number diagram is used to determine in which parts of the sampling

area, the samples are to be taken. If nine samples are to be taken then one is taken in each part. More typically three samples are required and they are taken in a random manor from 3 of the nine parts.

(c) In instances where the random sampling scheme in not practiced due to irregular shaped area, samples are taken where they are first identified and then two more samples are taken in locations where the material is accessible and in different areas in other parts of a building such walls, wings, locations on other floors, so that samples are distributed evenly through the sampling area.

(d) All samples are collected into six mil or greater, sealable plastic bags and marked with a unique number. Every effort is made to collect samples in a manner that minimized the potential release of asbestos fibers. Sampling is conducted under controlled conditions. The area is thoroughly wetted, and plastic sheeting drop cloths are used, as well as other industry recognized control standards. Additionally, the labeling and sampling sheet indicated a general description of the material, location, date, and surveyors initials. Sampling points are properly repaired or resealed utilizing wettable cloth and/or encapsulating and/or quick drying cementitious materials.

(6) *Sample numbering.* Sample numbers contain the number of the building, the room number from where the sample was taken, and abbreviation of the homogeneous area and the sample number. Example, 3072/115 CT5-1. Building #3072 in room 115. The homogeneous area is ceiling tile number 5 and the sample number is 1. The homogeneous area and sample number give a unique number and often a sample will be referred to by these two components. The full sample number shown above may be referred to as CT5-1 or as 115 CT-5.

h. *Inventory of homogeneous areas.*

(1) Homogeneous material. Indicates the assigned homogeneous material number.

(2) Description. A verbal description of the visual characteristic of the homogeneous material.

(3) AHERA category. Indicates the homogeneous material classification in AHERA terms of TSI, SM or MISC.

(4) Friability level. Indicates the friability level based on the risk assessment criteria described in section II of this report.

(5) Asbestos level. Indicates the asbestos level based on the risk assessment criteria described in section II of this report. The maximum content percentage of the asbestos sample analysis is used to determine asbestos level.

(6) Photograph number. Indicated the roll and frame of the photograph taken of the homogeneous material while conducting the field survey.

(7) Inspector. The initials of the inspectors involved with the inspection.

(8) General comments. Any comments deemed appropriate by the inspector. If no comment is deemed necessary, write in no comment.

(9) Sample number. The individual sample number assigned for the sample collected of the homogeneous material.

(10) Sample date. The date which the individual sample was collected.

(11) Asbestos maximum range. The high range of total asbestos content from the sample analysis. The range is from zero to 100 indicating zero to 100 percent. Two other numbers are used as follows:

(a) 888 *Sample not submitted* - A sample collected and submitted to the laboratory for analysis. This group of samples could include extra samples collected beyond the required number of samples under AHERA regulations or samples collected for archival purposes.

(b) 999 *Sample not analyzed* - Samples collected and submitted to the laboratory for analysis, but not analyzed because another sample collected for the homogeneous area was determined to have greater than one (>1%) asbestos content and the positive stop method was utilized for each homogeneous area.

(12) Sample description. A verbal description indicating the sample collection location.

Page:_____of_____

Room Inventory Sheet

Project #:_____

Inspector(s):_____

Building: **Room:** **Date:** **Time:**

Sample #	Momo. Area	Quant.	Units	% Damg.	Access.	Cond.	Activity	# Occup.	Duration	Comments

General Room Description:

Ceilings:

Floors:

Walls:

Other:

Accessability:
0 = Not Accessable
1 = Infrequently
2 = Occasonally
3 = Frequently

Condition:
0 = Good
1 = Damaged
2 = Soom Damaged

Activity:
0 = Disturbance Unlikely
1 = Disturbance Infrequently
2 = Disturbance Occsaonally
3 = Disturbance Frequently

Project #:_____
Inspector(s):_____
Page:_____of_____

Homogeneous Area Sampling Sheet

Homogeneous Area #:	Category: SM	TSI	MSC

Description:

Acessibility: **Activity:** **Friability:** **Photo Frame:**

Sample Number	Date	Sample Location Description	Results (% Asbestos)

Comments:

Section II. Risk Assessment

D-3. Data Collection Methodology and Criteria

a. The following criteria are required to establish the asbestos hazard index for the Navy Algorithm. Since the potential health hazard of friable asbestos is linked to an occupant's level of exposure, the criteria to be used include friability, how much total asbestos there is, its damage, how accessible the material is to occupants, whether it is disturbed through vibration or occupant activity, how many occupants there are in an assigned area and how long they are in the assigned area. The condition and potential for damage criteria are not used for the algorithm but are required for the AHERA protocol.

b. *Homogeneous AHERA material classification type.*

(1) *TSI* - Includes insulation on hot and cold water pipes and pipes for chilled water and steam.

(2) *SM* - Substances which are troweled on such as plaster or mortar.

(3) *MSC* - Those materials which are not thermal insulation or troweled on such as ceiling and floor tile and gypsum board.

c. *Quantity/units.* Most of the surveyed materials are measured in square feet. Exceptions to this are ceiling tile which are counted by tile (dimensions of each type of tile are provided) and pipe insulation which is measured in linear feet.

LFLinear Feet
SFSquare Feet
EAEach
TILETiles

d. *Percent units damaged*. This criteria is used to describe the percentage of units that would need to be removed in order to remove all damaged components. Because materials removal can be small and localized, such as floor tile or pipe runs, percent damaged and percent units damaged correspond. However, a material such as ceiling tile, which would require removal of a complete tile even if only damaged in a small area, will not correspond directly between percent units damaged and percent damaged. This criteria will assist specification writers or planners in the estimation of abatement or repairs.

e. *Occupant accessibility level.*

0 Non-accessible - Materials are not exposed, totally isolated by permanent barrier. Example: Material behind a plaster or gypsum board.

1 Low accessibility - Materials are accessible only during infrequent, occasional maintenance activity, low air flow from the material location to occupants of the building. Example: Materials in a locked high voltage transformer room.

2 Moderate accessibility - Only a small percentage of material exposed, material above a suspended ceiling; material contacted only during maintenance or repair, material exposed, but not accessible to activity of normal occupants. Example: Floor tile underneath carpet or another layer of floor tile.

3 High accessibility - A large percentage of material exposed; material accessible to occupants or airborne transport during normal activities. Example: Floor tile, TSI pipes which are within reach of building occupants.

f. *Condition level.*

0 Good condition - Deterioration and/or damage not visible; or minor damage evident only in isolated areas.

1 Damaged condition - Deterioration and/or damage over more than 10 percent of a surface if damage is evenly distributed or more than 25 percent if the damage is localized.

2 Significantly damaged surface - Deterioration and/or damage over more than 10 percent of a surface if damage is evenly distributed or more than 25 percent if the damage is localized.

g. *Level of activity.*

0 No activity - No routine or unusual disturbances by vibrations or physical contact are expected. Example: An insulated low pressure hot water pipe through a sealed pipe chase.

1 Low activity - Some routine disturbance by vibration or physical contact. Example: A seldom used closet or plaster ceilings in a building heated by radiator (no forced air).

2 Moderate activity - Moderate disturbances occur in rooms with vibrating machines, high noise levels or strenuous activity by occupants; turbulent air streams from ducts and vents carrying across the material. Example: People walking on floor tile; any material exposed in an occupied room where it comes into physical contact or vibration from building occupants. Floor tile beneath the other materials still subjected to the stresses of walking above them.

3 High activity - Heavy disturbances caused by noise and vibrations from manufacturing equipment or forklifts in plenum and return air systems; vibrations from external noises. Example: Materials attached to heating or air conditioning units, heavy automobile traffic, buildings near airports or large weapons testing facilities.

h. *Material friability level.*

0 Non friable - Cannot be crumbled by hand. Example: Resilient floor tile.

1 Low friability - Material difficult to crumble by hand. Example: White coat plaster.

2 Moderate friability - Material fairly easily to dislodge and crush. Example: Corrugated paper pipe insulation.

3 High friability - Material easily reduced to powder or broken by hand. Example: Block asbestos insulation.

i. *Asbestos content level.*

0 No asbestos detected - Asbestos not detected or below one percent (1%) using the AHERA interim method.

1 Low asbestos - Asbestos detected at one to nine percent (1 - 9%) using the AHERA interim method.

2 Medium asbestos - Asbestos detected at ten to thirty-nine percent (10 - 39%) using the AHERA interim method.

3 High asbestos - Asbestos detected at forty to one-hundred percent (40 - 100%) using the AHERA interim method.

j. *Number of occupants*. The number of assigned occupants in a room was determined by the number of work stations or available seating in a room. Common areas such as hallways and bathrooms were given an occupancy seating in a room. Common areas such as hallways and bathrooms were given an occupancy number equal to the approximate number of people working in the building. Men’s rest rooms and women’s rest rooms were each given one-half the total occupancy.

k. *Duration of exposure*. The duration of exposure is equal to the length of time in a 40 hour week that an individual is present in an assigned location.

l. *Potential for damage factor*. The potential for damage factor of a homogeneous material is a calculated figure based on accessibility and activity in regards to the homogeneous materials. Activity and accessibility do not contribute equally to the calculation of the potential damage factor, however, activity is weighted as three times more critical than accessibility. The potential damage factor is calculated using the following formula: ((Accessibility) + 3(Activity)) ¸ 4 = (Potential Damage Factor).

m. *Potential for damage level.*

0 No potential for damage - Calculated potential damage factor between 0.0 and 1.5. Damage to the material is not expected unless deliberate measures are taken to expose and damage the identified material.

1 Potential for damage - Calculated potential damage factor between 1.75 and 2.25. Damage to the material is not expected; however, there is strong possibility that the identified material could become damaged.

2 High potential for damage - Calculated potential damage factor between 2.5 and 3.0. Damage to the material is expected. There is a strong possibility that the identified material could become damaged and when damaged possibly significantly damaged.

n. *AHERA response category.*

0 Non-ACM - This is not a true AHERA response category but has been designated for algorithm calculation purposes.

1 Damaged or significantly damaged TSI ACBM - At least repair the damaged area. Remove the damaged material if it is not feasible, due to technological factors, to repair the damage. Maintain all TSI ACM and its covering in an intact state and undamaged condition.

2 Damaged friable surfacing ACBM - Encapsulate, enclose, removal or repair of the damaged materials in the least burdensome manner, in order to protect human health and the environment.

3 Significantly damaged friable surfacing material - Isolate the functional space and restrict access, unless isolation is not necessary to protect human health or the environment. Remove, enclose, encapsulate sufficiently to protect human health and the environment.

4 Damaged and significantly damaged friable miscellaneous ACBM - If damaged, encapsulate, enclose, removal or repair of the damaged materials in the least burdensome manner, in order to protect human health and the environment. If significantly damaged, isolate the functional space and restrict access, unless isolation is not necessary to

protect human health or the environment. Remove, enclose, encapsulate sufficiently to protect human health and the environment.

5 ACBM with potential for damage - Implement an O&M program to maintain the ACM intact and in good condition.

6 ACBM with significant potential for damage - Implement an O&M program to maintain the ACM intact and in good condition. Institute preventative measures to eliminate reasonable likelihood that the ACM will become significantly damaged. If appropriate, remove, enclose, encapsulate or repair the ACM to protect human health and the environment.

7 Remaining friable ACBM or friable suspected ACBM - Implement an O&M program to maintain the ACM intact and in good condition.

8 Remaining non-friable ACBM or non-friable suspected ACBM - This is not a true AHERA response category but has been designated for algorithm calculation purposes. Implement an O&M program to maintain the ACM intact and in good condition.

D-4. Algorithm Calculation Description

a. The risk is calculated by using a modified version of the algorithm described in Technical Report R883 from the Civil Engineering Laboratory, Naval Construction Battalion Center at Port Hueneme, CA 93043 and titled, "Management Procedure for Assessment of Friable Asbestos Insulating Materials." The risk algorithm is fully described in chapter 5 of the report.

b. The algorithm determines an exposure factor based on the friability level, accessibility level, condition level, activity level and percentage of asbestos. The exposure factors are presented in attachment B of this report.

c. The hazard factor is determined by utilizing the exposure factor, the number of occupants, and duration of exposure using the following calculation:

((Exposure Factor) x (Number of Occupants) x (Duration of Exposure ¸ 168)) = Hazard Factor

D-5. Sample Reports

a. Utilizing the Army asbestos checklist at attachment A, an USEPA certified inspector would perform the survey and risk assessment on the checklist items with the data collection methodology and criteria defined in section A of this appendix. The exposure factors would be extracted from the asbestos exposure charts shown in attachment B which detail the matrices based on friability, accessibility, condition, activity and percent asbestos content.

b. Assessment lists by room, by homogeneous area and by hazard factor can be generated to completely define the extent of the asbestos hazard problem. Sample lists are depicted at attachment C. In this manner buildings on the installation can be ranked with a post-wide standing (algorithm assessment ranking) based on the totals from each room/homogeneous area. Each building would then have an algorithm summation of a specific number e.g. 5991 which is the sum of all prioritization factors from each homogeneous area within the building. This is shown at attachment D. In summary, the highest algorithm ranking via the highest building algorithm summation number will establish a prioritization scheme for asbestos abatement for the installation.

Attachment A
Army Asbestos Checklist

Room Number

Homogeneous Area

Quantity

Percent Units Damaged

Occupant Accessibility Level

Condition Level

Activity Level

Material Friability Level

Asbestos Content Level

Number of Occupants

Duration of Exposure

Exposure Factor

Hazard Factor

Potential for Damage Level

AHERA Material Classification

AHERA Response Category

Attachment B
Asbestos Exposure Factors

FRIAB.	ACCESS	CONDI	ACTIV	ASBESTOS 0%	ASBESTOS 1-9%	ASBESTOS 10-39%	ASBETOS 40-100%
0	0	0	0	0	0.0002	0.0011	0.0031
0	0	0	1	0	0.0002	0.0011	0.0031
0	0	0	2	0	0.0011	0.0065	0.018
0	0	0	3	0	0.0065	0.037	0.102
0	0	1	0	0	0.0002	0.0011	0.0031
0	0	1	1	0	0.0002	0.0011	0.0031
0	0	1	2	0	0.0011	0.0065	0.018
0	0	1	3	0	0.0065	0.037	0.102
0	0	2	0	0	0.0056	0.0031	0.0087
0	0	2	1	0	0.0056	0.0031	0.0087
0	0	2	2	0	0.0031	0.018	0.05
0	0	2	3	0	0.018	0.1	0.28
0	1	0	0	0	0.0002	0.0011	0.0031
0	1	0	1	0	0.0002	0.0011	0.0031
0	1	0	2	0	0.0011	0.0065	0.018
0	1	0	3	0	0.0065	0.037	0.102
0	1	1	0	0	0.0002	0.0011	0.0031
0	1	1	1	0	0.0002	0.0011	0.0031
0	1	1	2	0	0.0011	0.0065	0.018
0	1	1	3	0	0.0065	0.037	0.102
0	1	2	0	0	0.0056	0.0031	0.0087
0	1	2	1	0	0.0056	0.0031	0.0087
0	1	2	2	0	0.0031	0.018	0.05
0	1	2	3	0	0.018	0.1	0.28
0	2	0	0	0	0.065	0.37	1
0	2	0	1	0	0.065	0.37	1
0	2	0	2	0	0.37	2.1	5.8
0	2	0	3	0	2.1	12	33
0	2	1	0	0	0.065	0.37	1
0	2	1	1	0	0.065	0.37	1.
0	2	1	2	0	0.37	2.1	5.8
0	2	1	3	0	2.1	12	33
0	2	2	0	0	0.18	1	2.8
0	2	2	1	0	0.18	1	2.8
0	2	2	2	0	1	5.8	16
0	2	2	3	0	5.8	33	92
0	3	0	0	0	0.18	12	2.8
0	3	0	1	0	0.18	1	2.8
0	3	0	2	0	1	5.8	16.2
0	3	0	3	0	5.8	33	92
0	3	1	0	0	0.18	1	2.8
0	3	1	1	0	0.18	1	2.8
0	3	1	2	0	1	5.8	16.2
0	3	1	3	0	5.8	33	92
0	3	2	0	0	0.497	2.8	7.9
0	3	2	1	0	0.497	2.8	7.9
0	3	2	2	0	2.8	16.3	45
0	3	2	3	0	16	92	260
1	0	0	0	0	0.0002	0.0011	0.0031
1	0	0	1	0	0.0002	0.0011	0.0031
1	0	0	2	0	0.0011	0.0065	0.018
1	0	0	3	0	0.0065	0.037	0.102
1	0	1	0	0	0.0002	0.0011	0.0031
1	0	1	1	0	0.0002	0.0011	0.0031
1	0	1	2	0	0.0011	0.0065	0.018
1	0	1	3	0	0.0065	0.037	0.102
1	0	2	0	0	0.0056	0.0031	0.0087
1	0	2	1	0	0.0056	0.0031	0.0087
1	0	2	2	0	0.0031	0.018	0.05
1	0	2	3	0	0.018	0.1	0.28
1	1	0	0	0	0.0002	0.0011	0.0031
1	1	0	1	0	0.0002	0.0011	0.0031
1	1	0	2	0	0.0011	0.0065	0.018
1	1	0	3	0	0.0065	0.037	0.102
1	1	1	0	0	0.0002	0.0011	0.0031
1	1	1	2	0	0.0011	0.0065	0.018

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FRIAB.	ACCESS	CONDI	ACTIV	ASBESTOS 0%	ASBESTOS 1-9%	ASBESTOS 10-39%	ASBETOS 40-100%
1	1	1	3	0	0.0065	0.037	0.102
1	1	2	0	0	0.0056	0.0031	0.0087
1	1	2	1	0	0.0056	0.0031	0.0087
1	1	2	2	0	0.0031	0.018	0.05
1	1	2	3	0	0.018	0.1	0.28
1	2	0	0	0	0.065	0.37	1
1	2	0	1	0	0.065	0.37	1
1	2	0	2	0	0.37	2.1	5.8
1	2	0	3	0	2.1	12	33
1	2	1	0	0	0.065	0.37	1
1	2	1	1	0	0.065	0.37	1
1	2	1	2	0	0.37	2.1	5.8
1	2	1	3	0	2.1	12	33
1	2	2	0	0	0.18	1	2.8
1	2	2	1	0	0.18	1	2.8
1	2	2	2	0	1	5.8	16
1	2	2	3	0	5.8	33	92
1	3	0	0	0	0.18	1	2.8
1	3	0	1	0	0.18	1	2.8
1	3	0	2	0	1	5.8	16.2
1	3	0	3	0	5.8	33	92
1	3	1	0	0	0.18	1	2.8
1	3	1	1	0	0.18	1	2.8
1	3	1	2	0	1	5.8	16.2
1	3	1	3	0	5.8	33	92
1	3	2	0	0	0.497	2.8	7.9
1	3	2	1	0	0.497	2.8	7.9
1	3	2	2	0	2.8	16.3	45
1	3	2	3	0	16	92	260
2	0	0	0	0	0.065	0.37	1
2	0	0	1	0	0.065	0.37	1
2	0	0	2	0	0.37	2.1	5.8
2	0	0	3	0	2.1	12	33
2	0	1	0	0	0.065	0.37	1
2	0	1	1	0	0.065	0.37	1
2	0	1	2	0	0.37	2.1	5.8
2	0	1	3	0	2.1	12	33
2	0	2	0	0	0.18	1	2.8
2	0	2	1	0	0.18	1	2.8
2	0	2	2	0	1	5.8	16
2	0	2	3	0	5.8	33	92
2	1	0	0	0	0.065	0.37	1
2	1	0	1	0	0.065	0.37	1
2	1	0	2	0	0.37	2.1	5.8
2	1	0	3	0	2.1	12	33
2	1	1	0	0	0.065	0.37	1
2	1	1	1	0	0.065	0.37	1
2	1	1	2	0	0.37	2.1	5.8
2	1	1	3	0	2.1	12	33
2	1	2	0	0	0.18	1	2.8
2	1	2	1	0	0.18	1	2.8
2	1	2	2	0	1	5.8	16
2	1	2	3	0	5.8	33	92
2	2	0	0	0	21	120	330
2	2	0	1	0	21	120	330
2	2	0	2	0	120	690	1900
2	2	0	3	0	690	3900	11000
2	2	1	0	0	21	120	330
2	2	1	1	0	21	120	330
2	2	1	2	0	120	690	1900
2	2	1	3	0	690	3900	11000
2	2	2	0	0	58	330	920
2	2	2	1	0	58	330	920
2	2	2	2	0	330	1900	5300
2	2	2	3	0	1900	11000	30000
2	3	0	0	0	58	330	920
2	3	0	1	0	58	330	920
2	3	0	2	0	330	1900	5300
2	3	0	3	0	1900	11000	30000
2	3	1	0	0	58	330	920

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FRIAB	ACCESS	CONDI	ACTIV	ASBESTOS 0%	ASBESTOS 1-9%	ASBESTOS 10-39%	ASBESTOS 40-100%
2	3	1	1	0	58.	330.	920
2	3	1	2	0	330.	1900.	5300.
2	3	1	3	0	1900.	11000.	30000.
2	3	2	0	0	160.	380.	2600.
2	3	2	1	0	160.	380.	2600.
2	3	2	2	0	380.	5300.	15000.
2	3	2	3	0	5300.	30000.	83000.
3	0	0	0	0	0.37	2.1	5.8
3	0	0	1	0	0.37	2.1	5.8
3	0	0	2	0	2.1	12.	33.
3	0	0	3	0	12.	63.	190.
3	0	1	0	0	0.37	2.1	5.8
3	0	1	1	0	0.37	2.1	5.8
3	0	1	2	0	2.1	12.	33.
3	0	1	3	0	12.	63.	190.
3	0	2	0	0	1	5.8	16.2
3	0	2	1	0	1	5.8	16.2
3	0	2	2	0	5.8	33.	92.
3	0	2	3	0	33.	190.	530.
3	1	0	0	0	0.37	2.1	5.8
3	1	0	1	0	0.37	2.1	5.8
3	1	0	2	0	2.1	12.	33.
3	1	0	3	0	12.	69.	190.
3	1	1	0	0	0.37	2.1	5.8
3	1	1	1	0	0.37	2.1	5.8
3	1	1	2	0	2.1	12.	33.
3	1	1	3	0	12.	69.	190.
3	1	2	0	0	1	5.8	16.2
3	1	2	1	0	1	5.8	16.2
3	1	2	2	0	5.8	33.	92.
3	1	2	3	0	33.	190.	530.
3	2	0	0	0	120.	690.	1900.
3	2	0	1	0	120.	690.	1900.
3	2	0	2	0	690.	3900.	11000.
3	2	0	3	0	3900.	22000.	62000.
3	2	1	0	0	120.	690.	1900.
3	2	1	1	0	120.	690.	1900.
3	2	1	2	0	690.	3900.	11000.
3	2	1	3	0	3900.	22000.	62000.
3	2	2	0	0	3300.	1900.	5300.
3	2	2	1	0	330.	19000.	5300.
3	2	2	2	0	1900.	11000.	30000.
3	2	2	3	0	11000.	62000.	170000.
3	3	0	0	0	330.	1900.	5300.
3	3	0	1	0	330.	1900.	5300.
3	32	0	2	0	1900.	11000.	30000.
3	3	0	3	0	11000.	62000.	170000.
3	3	1	0	0	330.	1900.	5300.
3	3	1	1	0	330.	1900.	5300.
3	3	1	2	0	1900.	11000.	30000.
3	3	1	3	0	11000.	62000.	170000.
3	3	2	0	0	920.	5300.	15000.
3	3	2	1	0	920.	5300.	15000.
3	3	2	2	0	5300.	30000.	83000.
3	3	2	3	0	30000.	170000.	470000.

Attachment C List by Room

ROOM NUMBER	HOMOGENEOUS AREA	QUANTITY	ACCESSIBILITY LEVEL	CONDITION LEVEL	ACTIVITY LEVEL	FRIABILITY LEVEL	ASBESTOS LEVEL	NUMBER OF OCCUPANTS	DURATION OF EXPSURE	EXPOSURE FACTOR	HAZARD FACTOR	POENTIAL FOR DAMAGE FACTOR	POTETIAL FOR DAMAGE LEVEL	AHERA MATERAL CLASSIFICATION	AHERA RESONSE CATEGORY
1	BB	17 SF	3	0	1	0	0	2	0.5	0	0	1.5	0	MSC	0
1	FT7	75 SF	2	1	1	0	1	2	0.5	0.06	0	1.25	0	MSC	8
1	FT 8	75 SF	2	1	1	0	2	2	0.5	0.37	0	1.25	0	MSC	8
1	PC	150 SF	2	0	1	1	0	2	0.5	0	0	1.25	0	SM	0
1	TG1	7 SF		1	1	0	0	2	0.5	0	0	1	0	SM	0
1	TSI3	20 LF	2	0	1	1	1	2	0.5	0.06	0	1.25	0	TSI	7
10	BB	35 SF	3	0	1	0	0	2	5	0	0	1.5	0	MSC	0
10	FT3	520 SF	3	0	1	0	0	2	5	0	0	1.5	0	MSC	0
10	TSI1	40 LF	1	0	1	3	3	2	5	5.8	0.34	1	0	TSI	7
10	TSI12	40 LF	1	0	1	3	3	2	5	5.8	0.34	1	0	TSI	7
10	TSI3	3 LF	1	0	1	1	1	2	5	0	0	1	0	TSI	7
101	CTI	46TILES	3	0	2	2	0	10	1	0	0	2.25	1	MSC	0
101	FT5	300 SF	1	0	1	0	2	10	1	0	0	1	0	MSC	8
101	SCT2	300 EA	1	0	1	1	1	10	1	0	0	1	0	MSC	7
101	TSI2	5 LF	3	0	2	3	3	10	1	30000	1785.71	2.25	1	TSI	5
101	TSI3	5 LF	3	0	2	1	1	10	1	1	0.05	2.25	1	TSI	5
102	CTI	197TILE	3	0	2	2	0	6	40	0	0	2.25	1	MSC	0
102	FT6	1728 SF	1	0	1	0	1	6	40	0	0	1	0	MSC	8
102	SPC	1728 SF	1	0	1	0	0	6	40	0	0	1	0	MSC	0
102	TSI3	220 LF	3	0	2	1	1	6	40	1	1.42	2.25	1	TSI	5
103	CTI	153TILES	3	0	2	2	0	6	40	0	0	2.25	1	MSC	0
103	FT6	1440 SF	1	0	1	0	1	6	40	0	0	1	0	MSC	8
103	PW	1380 SF	1	0	1	2	0	6	40	0	0	1	0	SM	0
103	SPC	1440 SF	1	0	1	0	0	6	40	0	0	1	0	MSC	0
103	VGA81	1380 SF	3	0	1	2	0	6	40	0	0	1.5	0	MSC	0
104	CTI	28 EA	2	0	1	2	0	1	40	0	0	1.25	0	MSC	0
104	FT6	150 SF	1	1	0	0	1	1	40	0	0	0.25	0	MSC	8
104	PW	480 SF	3	0	2	2	0	1	40	0	0	2.25	1	SM	0
104	SPC	150 SF	2	0	0	0	0	1	40	0	0	0.5	0	MSC	0
104	TSI3	22 LF	3	0	2	1	1	1	40	1	0.23	2.25	1	TSI	5
105	CTI	32TILES	3	1	2	2	0	1	40	0	0	2.25	1	MSC	0
105	EM	4 LF	2	0	2	3	3	1	40	11000	2619.04	2	1	TSI	5
105	FT6	300 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8
105	PW	630 SF	1	0	1	2	0	1	40	0	0	1	0	SM	0
105	SPC	300 SF	1	0	1	0	0	1	40	0	0	1	0	MSC	0
105	TSI2	25 LF	3	0	2	3	3	1	40	30000	7142.85	2.25	1	TSI	5
105	VG81	630 SF	3	0	1	2	0	1	40	0	0	1.5	0	MSC	0
106	BB	8 SF	3	0	2	0	0	100	40	0	0	2.25	1	MSC	0
106	FT9	150 SF	3	0	2	0	1	100	40	1	23.8	2.25	1	MSC	5
106	SPC	150 SF	2	0	0	0	0	100	40	0	0	0.5	0	MSC	0
107	CTI	32TILES	3	0	2	2	0	2	40	0	0	2.25	1	MSC	0
107	FT6	300 SF	1	0	1	0	1	2	40	0	0	1	0	MSC	8
107	PW	630 SF	3	0	2	2	0	2	40	0	0	2.25	1	SM	0
107	SPC	300 SF	1	0	1	0	0	2	40	0	0	1	0	MSC	0
107	TSI3	20 LF	3	0	2	1	1	2	40	1	0.47	2.25	1	TSI	5
107	VG81	630 SF	3	0	1	2	0	2	40	0	0	1.5	0	MSC	0
108	EM	11 LF	2	0	2	3	3	100	40	11000	261904.76	2	1	TSI	5
108	G8	150 SF	3	0	1	2	0	100	40	0	0	1.5	0	MSC	0
108	PC	250 SF	1	0	1	1	0	100	40	0	0	1	0	SM	0
108	TSI1	45 LF	2	0	2	3	3	100	40	11000	261904.76	2	1	TSI	5
109	CTI	75TILES	3	0	1	2	0	6	40	0	0	1.5	0	MSC	0

List by Hazard Factor

ROOM NUMBER	HOMOGENEOUS AREA	QUANTITY	ACCESSIBILITY	CONDITION LEVEL	ACTIVITY LEVEL	FRIABILITY LEVEL	ASBESTOS LEVEL	NUMBER OF OCCUPANTS	DURATION OF EXPOSURE	EXPOSURE FACTOR	HAZARD FACTOR	POTENTIAL FOR DAMAGE FACTOR	POTENTIAL FOR DAMAGE LEVEL	AHERA MATERIAL CLASSIFICATION	AHERA RESPONSE CATEGORY
1	BB	17 SF	3	0	1	0	0	2	0.5	0	0	1.5	0	MSC	0
10	BB	35 SF	3	0	1	0	0	2	5	0	0	1.5	0	MSC	0
106	BB	8 SF	3	0	2	0	0	100	40	0	0	2.25	1	MSC	0
1A	BB	10 SF	3	0	1	0	0	2	0.5	0	0	1.5	0	MSC	0
7	BB	10 SF	3	0	2	0	0	10	40	0	0	2.25	1	MSC	0
9	BB	50 SF	3	0	2	0	0	3	40	0	0	2.25	1	MSC	0
BH	BB	16 SF	3	0	2	0	0	200	40	0	0	2.25	1	MSC	0
BH	BB	110 SF	3	0	1	0	0	200	40	0	0	1.5	0	MSC	0
SH1	BB	5 SF	3	0	2	0	0	200	40	0	0	2.25	1	MSC	0
101	CTI	46TILES	3	0	2	2	0	10	1	0	0	2.25	1	MSC	0
102	CTI	197TILE	3	0	2	2	0	6	40	0	0	2.25	1	MSC	0
103	CTI	153TILES	3	0	2	2	0	6	40	0	0	2.25	1	MSC	0
104	CTI	28 EA	2	0	1	2	0	1	40	0	0	1.25	0	MSC	0
105	CTI	32TILES	3	1	2	2	0	1	40	0	0	2.25	1	MSC	0
107	CTI	32TILES	3	0	2	2	0	2	40	0	0	2.25	1	MSC	0
109	CTI	75TILES	3	0	1	2	0	6	40	0	0	1.5	0	MSC	0
6	DC1	30 SF	2	0	1	2	2	1	5	120	3.57	1.25	0	MSC	7
105	EM	4 LF	2	0	2	3	3	1	40	11000	2619.04	2	1	TSI	5
108	EM	11 LF	2	0	2	3	3	100	40	11000.00	261904.76	2	1	TSI	5
110	EM	2 LF	3	0	2	3	3	2	30	30000.00	10714.28	2.25	1	TSI	5
115B	EM	4 LF	1	0	1	3	3	2	40	5.8	2.76	1	0	TSI	7
2	EM	100 LF	3	1	2	3	3	10	40	30000	71428.57	2.25	1	TSI	1
4	EM	15 LF	3	0	1	3	3	4	40	5300	5047.61	1.5	0	TSI	7
6	EM	14 LF	2	1	2	3	3	1	5	11000	327.38	2	1	TSI	1
8	EM	15 LF	3	0	2	3	3	2	0.5	30000	178.57	2.25	1	TSI	5
9	EM	20 LF	2	0	1	3	3	3	40	1900	1357.14	1.25	0	TSI	7
BH	EM	30 LF	3	0	1	3	3	200	40	5300	252380.95	1.5	0	TSI	7
2	FT1	3600 SF	0	1	1	0	1	10	40	0	0	0.75	0	MSC	8
NWH1	FT10	520 SF	1	0	1	0	2	200	40	0	0.05	1	0	MSC	8
110	FTI1	80 SF	3	0	2	0	0	2	30	0	0	2.25	1	MSC	0
1A	FT2	150 SF	3	0	1	0	0	2	0.5	0	0	1.5	0	MSC	0
7	FT2	544 SF	3	0	2	0	0	1	40	0	0	2.25	1	MSC	0
8	FT2	360 SF	3	0	1	0	0	2	0.5	0	0	1.5	0	MSC	0
9	FT2	1200SF	3	0	2	0	0	3	40	0	0	2.25	1	MSC	0
BH	FT2	1420SF	3	1	2	0	0	200	40	2	2	2.25	1	MSC	0
10	FT3	520 SF	3	0	1	0	0	2	5	0	0	1.5	0	MSC	0
BH	FT3	225 SF	3	0	2	0	0	200	40	0	0	2.25	1	MSC	0
11	FT4	360 SF	3	0	1	0	1	6	40	0.18	0.25	1.5	0	MSC	8
9	FT4	150 SF	2	1	1	0	1	3	40	0.06	0.04	1.25	0	MSC	8
101	FT5	300 SF	1	0	1	0	2	10	1	0	0	1	0	MSC	8
8	FT5	420 SF	3	1	1	0	2	2	0.5	1	0	1.5	0	MSC	8
BH	FT5	3 SF	3	2	2	0	2	200	40	16.29	776.19	2.25	1	MSC	5
102	FT6	1728SF	1	0	1	0	1	6	40	0	0	1	0	MSC	8
103	FT6	1440SF	1	0	1	0	1	6	40	0	0	1	0	MSC	8
104	FT6	150 SF	1	1	0	0	1	1	40	0	0	0.25	0	MSC	8
105	FT6	300 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8
107	FT6	300 SF	1	0	1	0	1	2	40	0	0	1	0	MSC	8
109	FT6	640 SF	1	1	1	0	1	6	40	0	0	1	0	MSC	8
111	FT6	300 SF	1	0	1	0	1	2	40	0	0	1	0	MSC	8
111A	FT6	320 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8
112	FT6	300 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8
112A	FT6	300 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8
113A	FT6	300 SF	1	0	1	0	1	1	40	0	0	1	0	MSC	8

Attachment D
Algorithm Assessment Ranking

Building Number: A120 Algorithm Assessment Ranking: 18
Building Desc: Four Story Masonry
Building Use: Research
Algorithm Summation: 5991

Area Number: 6
Description: Room 112, Mailroom, Rms. 113, 114, 105, 134, 130, 135, 135A, 137, 13, 138, Basement Hall, 3A, 3B, 3C, 3D, 3E, Restrooms, Continued in Comments
Construction Material: Domestic Hot Water Pipe Insulation
Prioritization Factor: 1692

Area Number: 7
Description: Same as Homo Area, B6
Construction Material: Pipe Fitting Insulation
Prioritization Factor: 1260

Area Number: 26
Description: First Floor Mailroom
Construction Material: Domestic Hot Water Pipe Insulation
Prioritization Factor: 936

Area Number: 8
Description: Interior Partitions of Rooms 113, 114, Mailroom, Entire New Wing of Second Floor
Construction Material: Smooth Wall
Prioritization Factor: 668

Area Number: 3
Description: On all Ceilings of First and Second Floor of old Wing above suspended tiles in places, basement hallway
Construction Material: Ceiling Tile
Prioritization Factor: 264

Area Number: 17
Description: Interior Walls of Flight Simulator Area
Construction Material: Smooth Wall
Prioritization Factor: 144

Area Number: 10
Description: Laser Lab
Construction Material: Other Non-Friable ACBM
Prioritization Factor: 124

Area Number: 22
Description: Rooms 8C, 232
Construction Material: Expansion Joint
Prioritization Factor: 117

Area Number: 1
Description: Building Foyer, First Floor Hallway, Rooms 120, 123, Basement Hallway and Room 105, 110, 111, Continued in Comments
Construction Material: VAT
Prioritization Factor: 99

Area Number: 5
Description: Wall in Front of Rms. 112, 113, Mailroom, 121, First Floor Vault, Rooms 123, 8A, 8C
Construction Material: VAT
Prioritization Factor: 99

Area Number: 14
Description: Hallways in Front of Rooms 130-135, Rooms 122, 141, 230A, 232, Entire New Wing of Second Floor
Construction Material: VAT
Prioritization Factor: 99

Area Number: 25
Description: Floor Tile
Construction Material: VAT
Prioritization Factor: 99

Area Number: 2
Description: First Floor Hallway, Second Floor Hallway and all Third Floor
Construction Material: VAT
Prioritization Factor: 90

Area Number: 4
Description: First Floor Hallway and Basement Hallway
Construction Material: VAT
Prioritization Factor: 90

Area Number: 18
Description: Backrooms, Closets of Flight Simulator, Rooms 134, 135, 8D
Construction Material: VAT
Prioritization Factor: 90

Area Number: 23
Description: Boiler Room, Mechanical Room
Construction Material: Pipe Gasket
Prioritization Factor: 84

Area Number: 13
Description: Rooms 130
Construction Material: VAT
Prioritization Factor: 66

Area Number: 21
Description: All Halls
Construction Material: VAT
Prioritization Factor: 60

Area Number: 24
Description: Rooms 122, 122A
Construction Material: VAT
Prioritization Factor: 60

Area Number: 28
Description: Roof
Construction Material: Roof Felt
Prioritization Factor: 50

Area Number: 15
Description: Hallways (All), Rooms on Third Floor, Except in Tax Area Rm.
Construction Material: VAT
Prioritization Factor: 0

APPENDIX E
DECISION TREE FOR ASBESTOS REMOVAL

Section I
US Army Corps of Engineers Asbestos Removal Project Decision Tree

E-1. Purpose

a. In the course of repair, renovation or demolition of Army buildings and other structures, Army project personnel are frequently confronted by ACM. Federal, state and, occasionally, local regulations impose strict requirements for the handling of ACM, and provide specific guidance for preparing an asbestos removal project.

b. This document presents a decision tree (figure E-1, pages E-3, E-4, E-5) with accompanying notes for the design, execution and final clearances of an asbestos removal project.

E-2. Objectives

a. This document highlights the critical decisions to be made in executing an asbestos abatement program. Clearly, there is an emphasis on asbestos removal, however, more passive options, such as an O&M approach, may also be feasible. This document is intended to help the AMCO in deciding whether the anticipated project should be undertaken by in-house personnel or by an outside asbestos abatement contractor. The AMCO should consult the SJA at the earliest stages of project planning to determine whether the facility is required to comply with the federal, state and local regulations. The facility K.O. should decide whether the asbestos related work is to be performed by in-house personnel or by an outside asbestos abatement contractor. This decision may be based upon the perceived risk to workers health or on the overall magnitude of the abatement project. For example, in-house personnel may be used for small projects and the asbestos abatement contractor may be used for large or complex projects. The distinction between small and large is largely a matter of judgement; and, other factors such as the immediacy for project completion or the capital outlay for the needed equipment may be considered also. It is also important that the AMCO contact the cognizant federal, state and local agencies during the early planning phase to inform them of the anticipated project. Speaking with agency personnel during the early planning stages may help in avoiding procedures or activities that are not acceptable.

b. The reader should consult the USEPA's "Purple Book" and "Green Book" for more detailed guidance on the control of ACM in buildings.

E-3. General Comments

The following assumptions are made:

a. The anticipated project is clearly identified as either a repair, renovation or demolition of the building or structure.

b. The presence of ACM has been positively confirmed in the building. It is assumed that bulk samples have been collected from each suspect material and that the samples have been analyzed by PLM. Documentation of these analyses should be available before the project commences.

c. Arrangements have been made for the relocation of personnel and the temporary storage of furniture, files and all other movable items.

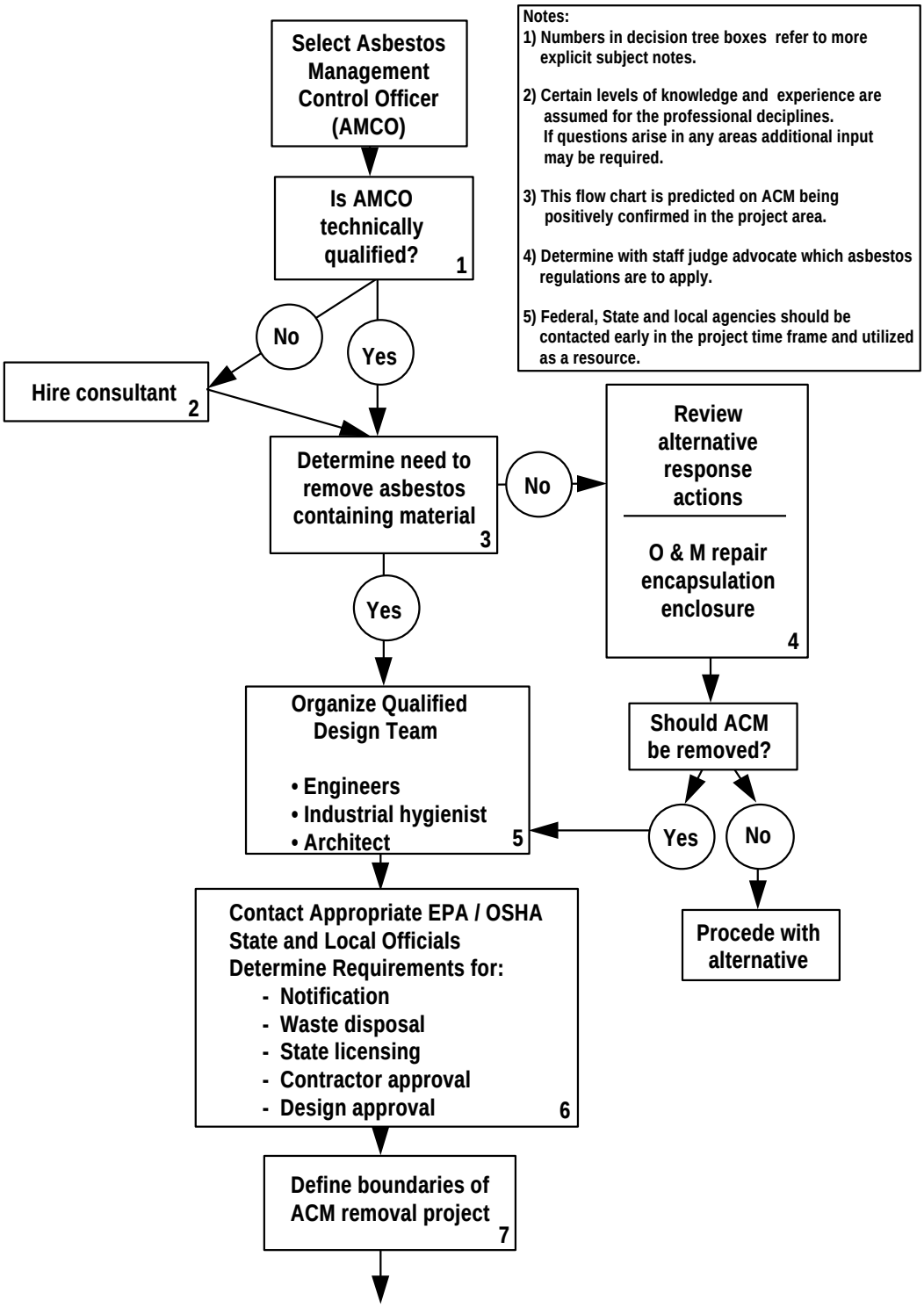

Figure E-1 - Decision Tree

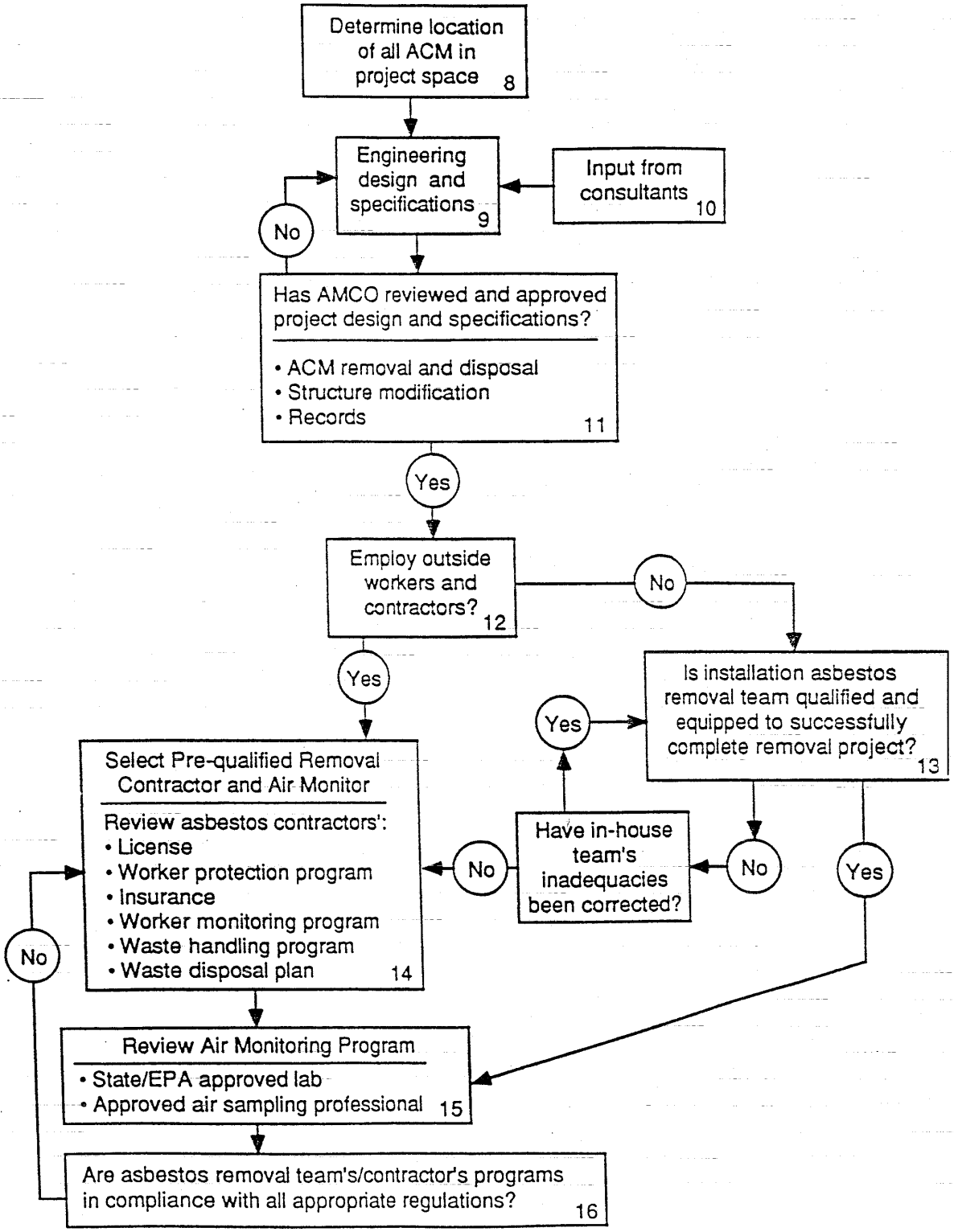

Figure E-1 - Decision Tree (Continued)

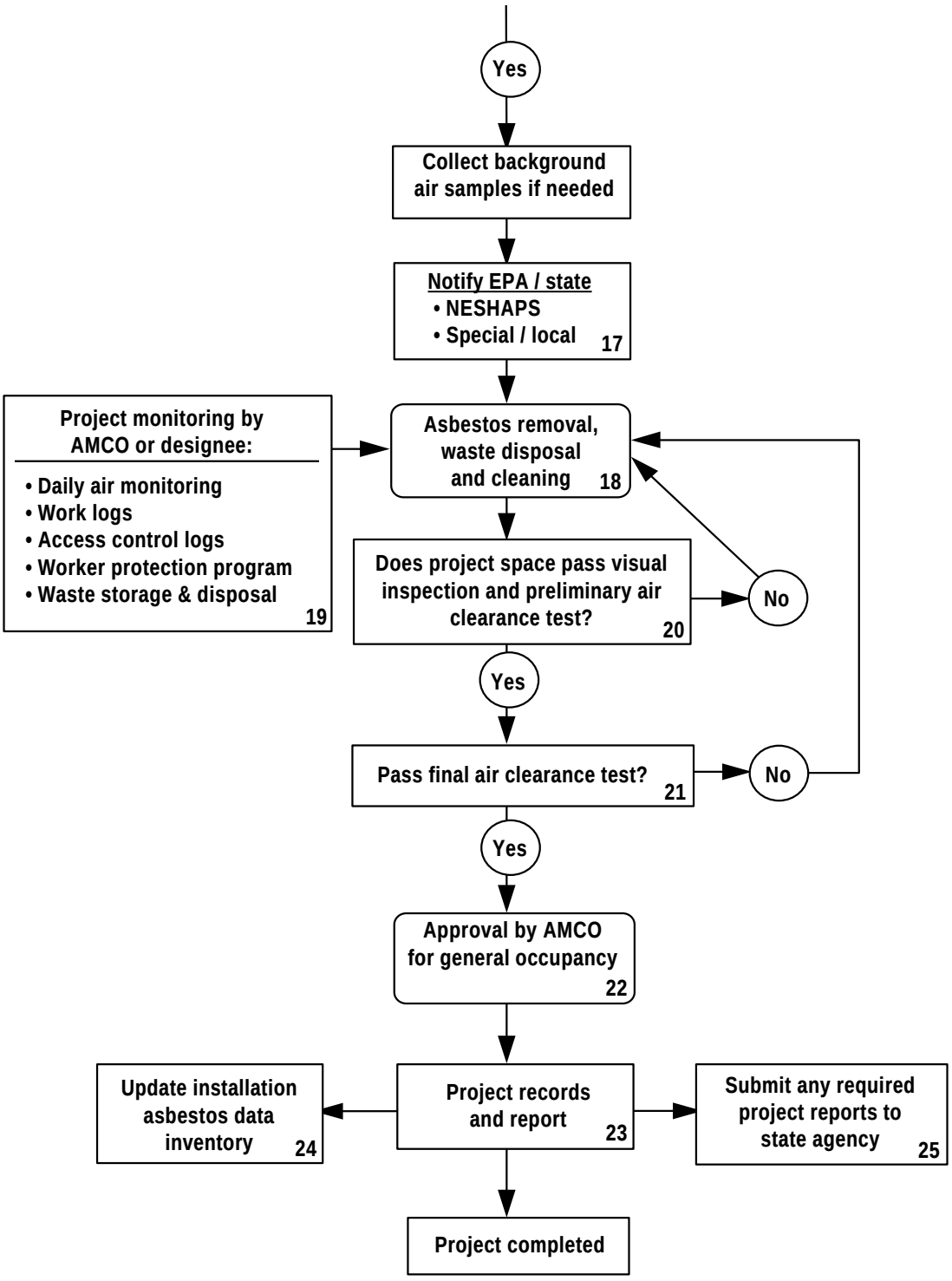

Figure E-1 - Decision Tree (Continued)

Section II

Notes to Accompany the Decision Tree

Note 1: Is AMCO technically qualified?

l. The AMCO must meet any federal, state and local training requirements for the supervision of asbestos removal projects. Under the AHERA, the USEPA requires specific training courses which vary according to the specific tasks.

2. The AMCO should read Asbestos Regulatory Directory, which lists the relevant federal, state and local agencies having jurisdiction over asbestos abatement projects.

3. The AMCO should have prior experience with asbestos abatement projects having a comparable complexity to the current project.

NOTE 2: Hire consultant.

l. If it is determined that a qualified in-house AMCO is not available, or state regulations prohibit direct design and supervision of an asbestos removal project, it may be necessary to hire a consultant.

2. The consultant must have, as a minimum, the qualifications comparable to those listed in note l.

3. Additional consultant capabilities may be useful for the smooth flow of the project. Design and engineering, industrial hygiene, project monitoring (clerk-of-the works), air monitoring, and laboratory services may all be available through a single consulting firm and will be a greater convenience to you.

4. Some states (e.g., New York) do not allow the same organization to survey, design, and monitor the same project.

NOTE 3: Determine need to remove ACM.

1. The AMCO should review the objectives of the project. The results of previous asbestos surveys should be examined and the project area visited and reviewed to make certain that all ACM has been located. This step is particularly important if the building is to be extensively renovated or demolished.

2. Careful attention should be paid to the completeness of bulk sampling and analysis. Have a sufficient number of samples been collected to characterize each suspect material adequately? The homogeneity in the asbestos content for each type of ACM (e.g., spray-on fireproofing, floor tile, pipe covering) should be examined carefully. If asbestos is not present in some samples of

the same material, more than one commercial product may be present, and additional bulk sampling may be appropriate, thus avoiding a needless removal. Questions of this nature should be resolved, at this time, through correspondence with the USEPA regional offices.

3. If facility policy requires removal of all ACM during construction, the YES decision branch should be followed.

4. If consideration of an alternative remedy is feasible, the NO decision branch should be followed.

NOTE 4: Review alternative response actions.

l. There are five response actions which may be used singly or combined to effect an asbestos abatement. Selection of the most beneficial methods may also follow a decision tree.

2. O&M plan: This option may be pursued if the ACM is in good condition and the proposed construction/operation will not damage it. The USEPA "Green Book" provides explicit details for establishing and maintaining an O&M program.

3. Repair: If the ACM is only slightly damaged, and the proposed construction will not cause any further damage, the ACM may be repaired. This work, however, must be performed by qualified personnel or a qualified outside contractor.

4. Encapsulation: This option is very rarely chosen because its success depends upon the long-term stability of the encapsulating agent. The agent may be a polymer or latex based paint and, typically, the service life of such materials is not fully known. Encapsulation may be appropriate for the short-term protection of certain types of ACM; however, this alternative is generally discouraged as long-term measure. The added weight of an encapsulant on sprayed-on fireproofing, for example, may hasten the delamination of the fireproofing from its substrate.

5. Enclosure: This approach is designed to separate the ACM from building occupants through construction of a plaster or drywall soffet, wall or other barrier. This approach is generally used only for confined spaces or in areas of limited access where removal is prohibitive.

NOTE 5: Organize qualified design team.

l. Depending on the complexity of the project design, it may be necessary to draw expertise from several technical disciplines.

2. Engineers: A structural engineer will be required to review and approve any structural changes to be made in the building. Similarly, modifications to the HVAC or electrical systems may require the review and approval of a mechanical electrical engineer.

3. IH: The services of this individual should be sought for review and approval of worker health and safety issues. In particular, the IH should review the worker protection and air monitoring programs.

4. Architect: This specialty may be required if there are significant design elements to the project, such as relocation of load bearing walls, doors, and on matters relating to construction and fire codes.

NOTE 6: Contact EPA/State officials and determine requirements.

l. Notification: Under the NESHAP regulations, the USEPA Regional NESHAP coordinator must be notified at least 20 days before an asbestos abatement project commences.

The USEPA NESHAP coordinator requires information concerning the amount of asbestos to be removed, the contractor performing the work, and the site selected for waste disposal. If the work is to be performed by inhouse personnel, this fact must be made known to the NESHAP coordinator.

State notification requirements will vary across the country.

Local or municipal agencies may also require notification. For example, a local ordinance may require notification of local fire department.

2. Waste disposal: A state-approved landfill that will accept the ACM waste must be selected and identified at the time of federal and state notification. Locations of approved landfill sites can be obtained from either the USEPA regional asbestos coordinator (RAC) or from the appropriate state authorities.

3. State licensing contractor approval and design approval: It is important to make absolutely certain that the project will be in total regulatory compliance - the asbestos removal is to be designed, executed and monitored by in-house personnel. State regulations vary widely on this point.

NOTE 7: Determine boundaries of ACM removal project.

l. This is the beginning of the design phase of the project. For most types of construction, the precise definition of the project boundary is not too important; however, minimizing the area under strict control of an asbestos abatement becomes very significant in terms of cost because of the labor and materials required to establish proper containment. Therefore, careful attention should be paid to minimizing the asbestos abatement area. An outer construction perimeter must be established for the entire project.

NOTE 8: Determine location of all ACM in project space.

l. Failure to locate all ACM within the project boundary may have a very significant effect on the success of the project. If additional ACM is discovered in the course of actual asbestos removal, the removal of this newly discovered ACM may result in an expensive cost extra. If this ACM is discovered after a building has been demolished, all the construction debris may have to be disposed as asbestos waste in an USEPA approved sanitary landfill.

2. Previous building surveys may be little more than cursory inspections, and as such do not catalogue all asbestos for construction purposes. Therefore, it may be necessary to perform additional bulk sampling to characterize fully all suspect materials.

3. As will be explained below, if an outside contractor is retained, it is important that this contractor locate and identify all ACM in the space in order to avoid later claims.

NOTE 9: Engineering, design & specifications.

l. A carefully written design & specification should always be prepared, regardless of the size of the project.

2. Design of the ACM aspects of the project should consider the following:

a. Is the building to be renovated or demolished? ACM can be removed from a building at less cost if the structure is to be demolished.

b. The ACM containment area should be minimized to reduce cost.

c. Location of decontamination unit(s) must be planned so there is no interference with other construction. The decontamination unit for ACM waste containing bags must be convenient to the outside disposal receptacle.

d. Is the water supply for showers and removal equipment sufficient? Is there a sufficient hot water supply for the showers?

e. Can the existing power supply handle the anticipated electrical loads from the removal equipment? If necessary, allowance should be made for an electrician to install electrical boxes having higher current capacities.

f. What are the construction site security needs? Industrial fencing should be installed if there is a risk of unauthorized entry.

g. Is protected space nearby available for the contractor to store equipment and supplies?

h. What security clearance steps must be taken for workers to enter the facility?

i. What measures must be taken to protect equipment? Some equipment, such as HVAC blowers and refrigeration equipment must be kept in operation during ACM removal; and watertight, ventilated housings can be provided. Work to be performed near transformers or electrical distribution systems must not take place unless satisfactory safety precautions are set in place by a qualified individual.

This is not an exhaustive list and is provided only for general guidance.

3. Construction specifications may be obtained from several sources and, depending upon project complexity, may be readily modified to suit the requirements of the project. Example specifications may be obtained from the US Army Corps of Engineers, the National Institute of Building Sciences (NIBS) or through an industrial hygiene or asbestos engineering consultant.

NOTE 10: Input from consultants.

l. Experienced consultants can provide valuable assistance rapidly for a project design and preparation of the specifications.

2. A consulting team consisting of a variety of specialties should be considered for complex projects having a need for structural and mechanical engineering and architectural services.

3. The consultant should have a knowledge of local asbestos abatement contractors.

4. The consultant should have access to a properly accredited analytical laboratory.

NOTE 11: Has AMCO reviewed and approved project design and specifications?

1. This important step allows the AMCO to review the design and specifications and decide whether all aspects of the ACM removal have been addressed.

2.. Careful consideration at this point will avoid later changes which might lead to project delays and increased cost.

NOTE 12: Employ outside workers and contractors?

l. The decision to utilize facility personnel or outside workers employed by a contractor should be made by the highest authority at the facility. There are several issues of concern in making this decision:

a. Liability of the government in the event that a worker accidentally inhales asbestos dust.

b. Adequacy of onsite ACM removal equipment.

NOTE 13: Is installation asbestos removal team qualified and equipped to complete removal contract?

US Department of Labor, OSHA regulations require that all workers engaged in the removal of ACM undergo medical screening, training, and be provided with certain protective equipment.

2. Many states require further training, certification, and licensing.

3. Requirements l and, often, 2 above must be met regardless of the size of the project.

4. Certain specialized equipment is required for the removal of ACM, the type and quantity depending upon the size of the project. A list may include one or more of the following:

a. Protective gear: Hard hats, gloves, Tyvek coveralls, safety boots with a steel toe and shank, and goggles.

b. Respiratory protection: NIOSH approved respirators having a protection factor commensurate with the airborne asbestos fiber level anticipated. The respirators, in increasing order of protection, include half-mask respirators, full-face respirators, powered air purifying respirators, and supplied-air respirators. The selection of the appropriate level of respiratory protection should be contained in the specification.

c. Equipment & tools: HEPA-filtered vacuum units, HEPA blowers, scrapers, knives, wire brushes, cloth rags, buckets, shovels, brooms, and GFI. Disposable supplies would include polyethylene sheeting (four- and six-mil thickness), suitably labeled six-mil polyethylene bags for ACM disposal, duct tape, required OSHA warning signs, glove bags, plywood sheet and 2" x 4" studs, and hardware.

NOTE 14: Select pre-qualified removal contractor and air monitor.

l. For projects of a certain size or complexity, it may be more efficient and cost effective to enter into a contract with an outside entity.

2. The items indicated in figure E-1, box 14 should be reviewed for completeness.

NOTE 15: Review air monitoring program.

l. The outside ACM-removal contractor and air monitor should be independent of one another and have no potential conflict of interest.

2. If the ACM is to be removed from a school, a NVLAP* participating laboratory must be used. For non-school projects, a laboratory accredited by the American Industrial Hygiene Association (AIHA) may be used.

3. Laboratories performing asbestos analyses may also require a state license.

4. Air monitoring personnel assigned to the project must be trained in the tasks required, and, in certain states, a certificate of training and licensing is mandated.

5. A person trained in industrial hygiene, such as a certified IH, must be available to make decisions concerning use of respirators or changes in the air monitoring protocol.

NOTE 16: Are asbestos removal team/contractor's programs in compliance with all appropriate regulations?

1. At this point, the AMCO should make certain that all licenses and certifications are complete and valid.

2. A copy of each worker's training certificate and state license should be collected for inclusion in the final report.

3. Likewise, a copy of each worker' s medical examination should be collected for the final report.

4. The in-house project team or the outside contractor must not be permitted to start the project until all documentation is complete.

NOTE 17: Notify USEPA/state.

l. At this point, formal notification to the USEPA NESHAP coordinator must occur, since the ACM removal team/contractor and the waste disposal site have been selected.

2. The USEPA requires a 20-day notification period before any ACM removal may take place; therefore, the AMCO should submit this notification as soon as the required information becomes available.

3. States may have a different notification period and additional information may be required before approval is granted.

NOTE 18: Asbestos removal, waste disposal and cleaning.

l. This document does not include the actual steps to be followed when removing ACM. If the ACM is removed by an outside contractor, the actual removal should follow a "performance

specification." That is, the AMCO should have only minimal involvement with the removal process. The AMCO, however, should monitor the perimeter of the project to ensure the health and safety of non-ACM removal personnel.

NOTE 19: Project monitoring by AMCO or designee.

1. The level of AMCO project monitoring depends upon the type of ACM removal contract. As stated in note 18, the AMCO should have very little involvement if an outside contractor is performing the work. If an in-house team is used, the AMCO should be fully involved in all aspects of the ACM removal on a daily basis. The items identified in figure E-1, box 19 indicate, at a minimum, the areas requiring daily attention.

NOTE 20: Does project space pass visible inspection and preliminary air clearance test?

1. This step begins the initial phase of project completion. If ACM removal is complete, there should be no visible debris of any kind on the previously insulated surfaces or on the polyethylene sheeting covering the walls and floor. The contractor must reclean the space should it fail the visual test.

2. If the visual test passes, preliminary air tests may be conducted to determine whether the spaces inside and outside the project barrier meet the regulatory requirements. This is a cost effective step when ACM is removed from a school, because the AHERA regulations require final air clearance by TEM. PCM is useful for preliminary clearance because of its lower cost.

NOTE 21: Pass final air clearance test?

1. This step may have been completed in the immediately preceding step if federal and state regulations permit clearance by PCM.

2. If this is a school project, however, air sample collection and analysis by TEM should be performed now.

3. The air sampling and analysis protocol is contained in the USEPA AHERA regulations.

4. If the project space fails to pass the air quality criterion, the ACM removal team/contractor must return to the space to reclean it.

NOTE 22: Approval by AMCO for general occupancy.

l. This step represents the point of last control exercised by the AMCO in determining whether a space can be occupied safely.

2. The AMCO should inspect the project and prepare a punch list and review it with the ACM removal team or contractor.

3. It is the responsibility of the AMCO to make certain the contractor provides all documents required by the specification, and provides the landfill receipts for all ACM debris removed from the site.

4. If all requirements of the specification have been met and the team/contractor has corrected all items contained in the punch list, then the team/contractor may be released from the project.

NOTE 23: Project records & report.

l. Keep all written materials pertaining to the ACM removal project in one place.

2. Prepare a final report containing a description of the project, the amount of ACM removed, and the schedule for removal. The report should also contain appendices for the daily work logs, entry/egress logs, activity logs and air monitoring reports. The appendices must also contain copies of workers' licenses and certifications and medical screening reports. OSHA regulations require that the medical reports be retained for 30 years. An appendix must also be provided for copies of dump receipts for all ACM materials.

3. This report should be bound, if possible, and it should be kept with a copy of the construction specification and drawings.

NOTE 24: Updated installation asbestos data inventory.

l. An asbestos inventory should be maintained and updated to ensure that non-asbestos materials are not accidentally removed in the future.

NOTE 25: Submit any required project reports to state agency.

l. Certain state agencies may require submission of data concerning completion of an ACM removal project.

Section II
Decision Thought Process for Demolition of Buildings with ACM a Hypothetical Illustrative Example

The following example is provided to demonstrate a decision thought process which could be used at an Army installation.

One hundred sixty-five (165), two-story, World War II era barracks have been identified for demolition by the installation's DEH. It appears, after a careful survey of the buildings, that all of them contain three types of potential ACM as described in the new USEPA asbestos rule: (Final Rule, National Emissions Standards for Hazardous Air Pollutants; Asbestos NESHAP Revision, USEPA, Federal Register, Vol. 55, No. 224 pp. 48406-48433, 20 Nov. 90) friable pipe insulation, nonfriable floor tile, and nonfriable cement siding. Bulk samples of each type have been collected by the installation, either in-house or by contract and forwarded to a laboratory accredited by the NIST for analysis of asbestos. The samples were analyzed using approved techniques described in the revised USEPA asbestos rule, and the laboratory results indicate the following: the pipe insulation contains from 10 to 15 percent asbestos, the floor tile contains from 5 to 20 percent asbestos, and the cement siding contains 20 to 25 percent asbestos. With these results, we can categorize the ACM according to the revised USEPA rule: the pipe insulation is friable ACM, the floor tiles are Category I nonfriable ACM, and the siding is Category II nonfriable ACM.

The DEH calls a meeting of his/her installation AMT and makes these comments: "The revised USEPA asbestos rule cited above permits me, under some circumstances, to leave certain categories of ACM in place during demolition. With these 165 buildings to be demolished, significant project cost savings could be realized if I don't have to remove all the ACM prior to demolition. I am directing you to find the answer to the following question within one week: 'What ACM do I have to remove prior to remove demolition and what ACM can be left in place during demolition?'" The AMT immediately responds and indicates that the friable asbestos pipe insulation will have to be removed, with appropriate precautions for friable asbestos, prior to demolition. However, for the ACM floor tile and ACM cement siding, the decision process is not that straightforward. The AMT indicates that they would conduct an evaluation of these two categories of ACM according to the requirements of the revised USEPA asbestos rule and get back with the DEH within the desired time frame. After consulting the USEPA guidance document cited USEPA Booklet, Asbestos NESHAP Regulated Asbestos-Containing Materials Guidance, Publication No. USEPA 340/1-90-018, Dec. 90, the AMT sets out to answer the following questions:

Question a. Do the state and local regulatory authorities allow Category I and Category II nonfriable ACM to be left in place during demolition (under some specific circumstances)? If yes, are the state/local requirements more stringent than those of the USEPA (also considering requirements for disposal of the resultant demolition debris)? Are the state/local requirements the same as those contained in the current regulations?

Question b. Will the ACM be (during demolition) or has it been (in the past) subjected to sanding, grinding, cutting, or abrading? Will the building be demolished by intentional burning?

Question c. Is the ACM is poor condition (see USEPA asbestos regulation)?

Question d. Is the ACM friable?

In our example, the AMT took the following actions to answer each of the questions posed above:

Answer a. Coordinated with the appropriate state and local regulatory authorities to determine if there were any prohibitions or more stringent regulatory requirements for Category I and Category II nonfriable ACM than those imposed by the USEPA. In our example, the state and local requirements governing the demolition of buildings containing nonfriable ACM, and subsequent disposal of the demolition debris, were the same as USEPA's requirements. The state and local jurisdiction do allow Category I and Category II nonfriable ACM to be left in place during demolition depending upon the answer to the remaining three questions.

Answer b. Conducted a historical review of past O&M activities associated with the floor tile and coupled this information with an evaluation of the probable mechanical actions that would impact upon the floor tile if left in place during demolition. This provided enough information to answer the questions concerning sanding, grinding, cutting, abrading, or demolition by intentional burning. If the answer concerning any of these activities had turned out to be yes, the floor tile would have to be removed with appropriate precautions prior to demolition. In our example, the answer was no, so the team moved on the next question.

Answer c. Determined the condition of the floor tile. Please note the USEPA asbestos rule's definition: In poor condition means the binding of the material is losing its integrity as indicated by peeling, cracking, or crumbling of the material. Also note that the word broken does not appear in this definition. In this regard the preamble to the new USEPA asbestos rule states: Most nonfriable materials can be broken without releasing significant quantities of airborne asbestos fibers. It is only when the material is extensively damaged, i.e., crumbled, pulverized, or reduced to powder, that the potential for significant release is greatly increased. In our example, the AHERA-accredited inspector, during the bulk sample collection procedure, conducted a walk-through of the buildings to be demolished and visually inspected the floor tile. The inspector recorded, by location and condition (peeling, cracking, or crumbling), the floor tile that were in poor condition. Based on this survey, 32 of the 165 buildings had floor tile either partially or totally in poor condition. Twelve of these buildings had floor tile with extensive peeling or cracking to the point of being considered crumbling and friable. All floor tile that is in poor condition and friable must be removed with appropriate precautions prior to demolition. In the other 20 buildings, floor tile showed minor peeling or cracking. Following friability tests as described in d (1), (2), and (3) below, the floor tile in only 10 of these 20 buildings was determined to be friable. Often, cost considerations may dictate removal of all the floor tile on a

floor where some portions have been identified as being in poor condition and friable (or not visibly in poor condition but determined to be friable), since partial removal could be just as expensive.

Answer d. Friability test.

(1) To determine whether the floor tile and cement siding are friable, the AMT reviewed the results of the bulk sample collection procedure which included a step for a test of friability. For floor tiles, the sample collection procedure consisted of the inspector removing (while wearing tight-fitting plastic or rubber gloves) two small samples (approximately 1 - 2" x 1 - 2") from a representative number of homogeneous tiles on each floor of each building. In addition, the inspector collected separate mastic samples from the same sampled areas. If more than one layer of floor tile was identified, similar samples of layered floor tile and mastic were also collected. The collected samples were separated into two sets. One set was placed in individual sample collection containers, properly labeled and forwarded to the NIST-accredited laboratory for asbestos analysis.

(2) The duplicate set was used to perform a friability determination in the following manner: Samples that were representative of homogeneous tile types on each floor were placed in a single clear plastic (large size) ziplock sandwich bag that had an affixed OSHA asbestos warning label. The bags were sealed tight. An adhesive sample label was affixed to these bags to indicate the collector's name, sample collection date, location where sample was collected, and a box to be checked off for friable or nonfriable, after the friability test.

(3) The friability test was conducted by an AHERA-accredited inspector or management planner by carefully opening the bag, inserting the gloved dominant hand (i.e., right hand for right-handed person) into the bag up to the wrist, closing the upper portion of the bag around the wrist, using a rubber band or masking tape, picking up one sample piece at a time and placing it between the thumb and fingers, forcefully applying hand pressure and rubbing all surfaces of the sample back and forth for a minimum of 20 seconds, and visually observing, through the clear bag, any signs of the sample being crumbled, pulverized, or reduced to powder by hand pressure. Please note that this friability test is valid only if the sample is dry. If crumbling, pulverizing, or reduction to powder by hand pressure was observed, the floor tile, representative of the area where the sample had been collected, will have to be removed with appropriate precautions for friable asbestos prior to demolition. If the floor tiles were determined by this test not to be friable, they could be left in place during demolition. In our example, bulk samples of floor tile from 153 buildings were tested for friability (in the remaining 12 buildings, there was no need for such a test, because the floor tiles were visually determined to be crumbling and friable). Of these 153 buildings, 138 had floor tiles determined to be not friable, as a result of the friability tests. Therefore, these floor tiles can be left in place during demolition. The person performing the test checked the appropriate box (friable or nonfriable) on the label of the sample container and preserved the samples for any necessary future documentation needs.

The AMT carried out a similar survey and assessment for the Category II nonfriable asbestos cement siding. In our example, the answer to the previous four questions turned out to be favorable for potential regulatory flexibility (i.e., leaving the ACM in place during demolition). However, the revised USEPA rule classifies asbestos cement siding as Category II nonfriable ACM, and therefore this additional question needs to be answered:

Question e. Is the probability low that the ACM will be crumbled, pulverized, or reduced to powder during demolition?

Answer e. Asbestos cement siding.

(1) In answering this question pertaining to Category II nonfriable ACM, the AMT conducted a comprehensive evaluation of the mechanical processes to include methods of building demolition, mechanical forces impacting upon the siding during demolition, handling, out-loading, and transportation. Unless such an evaluation concluded that the probability is low that the materials will become crumbled, pulverized or reduced to powder during demolition, the siding would have to be removed, with special precautions for friable ACM, prior to building demolition. If the evaluation showed that such impacts would not occur, then the siding could remain in place during demolition.

(2) In our example, the AMT determined that the siding would probably be pulverized by the mechanical forces of the dozer tracks running over the siding that had been pushed to the ground. Therefore, the team indicated that the siding would have to be removed, with special precautions, prior to demolition.

(3) With the approval of the USEPA/state/local regulatory authorities, a pilot test was initiated, with the appropriate precautions for friable asbestos, to determine if a particular wet mechanical removal procedure would expose workers or non-occupational persons to asbestos fibers or otherwise affect the environment. For this pilot test, the USEPA guidance document cited in USEPA Booklet, Asbestos NESHAP Adequately - Wet Guidance, Publication No. USEPA 340/1-90-019, Dec. 90, was consulted. Documentation of worst-case airborne concentrations (determined by personal and environmental sampling) and visual inspection of the broken siding pieces indicated that there would be no adverse human or environmental exposures. Also, the pilot test indicated that the mechanical removal technique employed produced no evidence that the siding would become crumbled, pulverized, or reduced to powder during demolition. Because the pilot test produced results that were acceptable to the USEPA/state/local regulatory enforcement authorities, the AMT determined that this wet method of mechanical removal could be employed, with only limited controls, for the 165 buildings. This would result in significant cost savings over hand-removal techniques.

The AMT met with the DEH within a week, as directed. Members of the team presented the DEH with a written report of their findings and recommendations, which can be summarized as follows:

a. Friable pipe insulation in all 165 buildings will have to be removed with appropriate precautions prior to demolition.

b. In 12 of the 32 buildings determined to have floor tile in poor condition, the floor tiles will have to be removed with appropriate precautions prior to demolition, because the tiles are crumbling (by definition, crumbling ACM is considered friable). The floor tiles in 15 of the remaining 153 buildings will have to be removed with appropriate precautions prior to demolition, based on the friability tests performed.

c. In 138 buildings, the floor tiles were determined not to be friable and can be left in place during demolition.

d. The assessment of the siding shows that it will have to be removed prior to demolition. The pilot test, however, has yielded results which indicate that a wet mechanical procedure can be employed where few controls are required for the removal of the siding from the 165 buildings. This technique would yield significant cost savings over hand removal techniques.

The IC, based on the recommendation of the DEH, concluded that a three-tiered approach appears to be the most cost-effective method to demolish the buildings. In phase I, the friable pipe insulation and the friable floor tile will be removed with special precautions by a state-licensed asbestos abatement contractor. In phase II, the nonfriable asbestos cement siding will be removed by a general contractor using a wet mechanical removal method, with limited operational controls to safeguard health. These operational controls, including some monitoring of emissions, will be specified by a special clause in the contract. Phase III entails the demolition and disposal of the buildings, with nonfriable ACM tile left in place, by a general contractor.

In conclusion, it is important to note that in all instances, regardless of whether the floor tiles and siding are removed prior to demolition or left in place, the appropriate USEPA/state regulatory enforcement authorities must be notified in advance of the proposed action, in accordance with the requirements of the revised USEPA asbestos rule.

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APPENDIX F
US ENVIRONMENTAL PROTECTION AGENCY (USEPA) NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPS) NOTIFICATION OF DEMOLITION AND RENOVATION

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NOTE

This form must be completed and submitted if the amount of ACM to be disturbed is equal to or greater than 160 square feet or 260 linear feet.

NOTIFICATION OF DEMOLITION AND RENOVATION

OPERATOR PROJECT #	POSTMARK	DATE RECEIVED	NOTIFICATION #

I. TYPE OF NOTIFICATION (O-ORIGINAL R-REVISED C-CANCELLED):					WPR Notice?
II. FACILITY INFORMATION (IDENTIFY OWNER, REMOVAL CONTRACTOR, AND OTHER OPERATOR)					
Owner name:					
Address:					
City:		State:			Zip:
Contact;					Tel:
REMOVAL CONTRACTOR:					
Address:					
City:		State:			Zip:
Contact:					Tel:
OTHER OPERATOR:					
Address:					
City:		State:			Zip:
Contact:					Tel:
III. TYPE OF OPERATION (D=DEMO O=ORDER DEMO R= RENOVATION E=EMER. RENOVATION):					
IV. IS ASBESTOS PRESENT? (YES/NO)					
V. FACILITY DESCRIPTION (INCLUDE BUILDING NAME, NUMBER AND FLOOR OR ROOM NUMBER)					
Bldg name:					
Address:					
City:		State:			Zip:
Site location:					
Building size:	Num of floors:			Age in years;	
Present use:		Prior use:			
VI. PROCEDURE, INCLUDING ANALYTICAL METHOD, IF APPROPRIATE, USED TO DETECT THE PRESENCE OF ASBESTOS MATERIAL:					

VII. APPROXIMATE AMOUNT OF ASBESTOS, INCLUDING:	RACM TO BE REMOVED	NONFRIABLE ASBESTOS MATERIAL NOT TO BE REMOVED		INDICATE UNIT OF MEASUREMENT BELOW	
1. REGULATED ACM TO BE REMOVED 2. CATEGORY I ACM NOT REMOVED 3. CATEGORY II ACM NOT REMOVED		CAT ICATII		UNIT	
PIPES				LnFt:	Ln m:

SURFACE AREA				SqFt:	Sq m:
VOL RACM OFF FACILITY COMPONENT				CuFt:	Cu m:
VIII. SCHEDULED DATES ASBESTOS REMOVAL (MM/DD/YY)START:COMPLETE:					
IX. SCHEDULED DATES DEMO / RENOVATION (MM/DD/YY)START:COMPLETE:					

NOTIFICATION OF DEMOLITION AND RENOVATION (continued)

X. DESCRIPTION OF PLANNED DEMOLITION OR RENOVATION WORK, AND METHOD (S) TO BE USED:		
XI. DESCRIPTION OF WORK PRACTICES AND ENGINEERING CONTROLS TO BE USED TO PREVENT EMISSIONS OF ASBESTOS AT THE DEMOLITION AND RENOVATION SITE:		
XII. WASTE TRANSPORTER #1		
Name:		
Address:		
City:	State:	Zip:
Contact Person:		Telephone:
WASTE TRANSPORTER #2		
Name:		
Address:		
City:	State:	Zip:
Contact Person:		Telephone:
XIII. WASTE DISPOSAL SITE		
Name:		
Location:		
City:	State:	Zip:
Contact Person:	Telephone:	
XIV. IF DEMOLITION ORDERED BY A GOVERNMENT AGENCY, PLEASE IDENTIFY THE AGENCY BELOW:		
Name:	Title:	
Authority:		
Date of Order (MM/DD/YY) :	Date Ordered to Begin (MM/DD/YY) :	
XV. FOR EMERGENCY RENOVATIONS		
Date and Hour of Emergency (MM/DD/YY) :		
Description of the Sudden, Unexpected Event:		
Explanation of how the event caused unsafe conditions or would cause equipment damage or an unreasonable financial burden:		
XVI. DESCRIPTION OF PROCEDURES TO BE FOLLOWED IN THE EVENT THAT UNEXPECTED ASBESTOS IS FOUND OR PREVIOUSLY NONFRIABLE ASBESTOS MATERIAL BECOMES CRUMBLED, PULVERIZED, OR REDUCED TO POWDER.		
XVII. I CERTIFY THAT AN INDIVIDUAL TRAINED IN THE PROVISIONS OF THIS REGULATION (40 CFR PART 61, SUBPART M) WILL BE ON-SITE DURING THE DEMOLITION OR RENOVATION AND EVIDENCE THAT THE REQUIRED TRAINING HAS BEEN ACCOMPLISHED BY THIS PERSON WILL BE AVAILABLE FOR INSPECTION DURING NORMAL BUSINESS HOURS. (Required 1 year after promulgation) _____ _____ (Signature of Owner/Operator) (Date)		
XVIII. I CERTIFY THAT THE ABOVE INFORMATION IS CORRECT. _____ _____ (Signature of Owner/Operator) (Date)		

APPENDIX G

TELEPHONIC NOTIFICATION OF POLLUTION INCIDENT (ALL TIMES ARE LOCAL)

DATE/TIME REPORT RECEIVED

1. INSTALLATION NAME:

2. COMMANDER:

3. DISCOVERY DATE & TIME:

4. PERSON REPORTING:

5. PERSON RECEIVING REPORT:

6. SEVERITY:

7. TYPE & AMOUNT OF MATERIAL & SOURCE:

8. PERSONAL INJURIES/PROPERTY LOSS:

9. CAUSE OF SPILL:

10. EQUIPMENT/FACILITY INVOLVED:

11. NAME OF RECEIVING STREAM OR WATERS:

12. DURATION/MAGNITUDE OF POLLUTION PRODUCED/RELEASED:

    a. Has source of material been stopped?(Yes)/(No)/(N/A)

    b. Has released material been retained?(Yes)/(No)/(N/A)

    c. Did material reach navigable waters?(Yes)/(No)/(N/A)

    d. Did Material pass installation boundaries?(Yes)/(No)/(N/A)

    e. Is NPDES permit points involved?(Yes)/(No)/(N/A)

    f. Is sampling being taken for legal records?(Yes)/(No)/(N/A)

NOTE: Circle appropriate answer to questions.

13. DAMAGE/IMPACT ON SURROUNDINGS:

14. REMEDIAL ACTION TAKEN & DISPOSITION OF HAZARDOUS MATERIALS:

15. REMEDIAL ACTION PLANNED:

16. DATE OF REMEDIAL ACTION COMPLETION:

17. NOTIFICATIONS:

    a. USEPA (Yes)/(No) DATE & TIME:
    b. STATE (Yes)/(No) DATE & TIME:
    c. COAST GUARD/NRC (Yes)/(No) DATE & TIME:
    d. HIGHER HQ (Yes)/(No) DATE & TIME:

18. REACTION BY MEDIA/PUBLIC:

19. DOLLAR VALUE OF MATERIAL SPILLED:

20. COST OF CLEANUP ACTIVITIES:

GLOSSARY

Section 1
Abbreviations

m	Micrometers
ACBM	Asbestos-containing building material
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos-containing material
AEHA	US Army Environmental Hygiene Agency
AEIS	Army Environmental Information Service
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
AMCO	Asbestos management control officer
Amosite	Asbestos mines of South Africa
AMP	Asbestos management plan
AMT	Asbestos management team
ANSI	American National Standards Institute
AR	Army Regulation
ARPP	Army Respiratory Protection Program
ASHARA	Asbestos School Hazardous Abatement Reauthorization Act
BEI	Biological exposure indices
CAA	Clean Air Act
CEGS	Corps of Engineers Guidelines and Specifications
CFR	Code of Federal Regulations
COR	Contracting officer s representative
CPO	Civilian Personnel Office
CPR	Cardiopulmonary resuscitation
CWF	Civil works facility
DA	Department of the Army
DA PAM	Department of the Army Pamphlet

DEH	Directorate of Engineering and Housing
DOT	U.S. Department of Transportation
DPW	Directorate of Public Works
DSN	Defense Switched Network
EDS	Energy dispersive spectrometry or spectrometer
EL	Excursion limit
ER	Engineering regulation
f/cc	Fibers per cubic centimeter
$FEV_{1.0}$	Forced expiratory volume at one second
FVC	Forced vital capacity
GFI	Ground fault interrupters
HEPA	High-efficiency particulate air
IC	Installation Commander
ID	Identification
IH	Industrial hygienist
IR	Infrared
K.O.	Contracting officer
L/min	Liters per minute
MAP	Model accreditation program
MCE	Mixed cellulose ester
mm.	Millimeters
MSHA	Mine Safety and Health Administration
NDAAC	National Directory of AHERA Accredited Courses
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NIBS	National Institute of Building Services
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
O&M	Operations and maintenance

OCCMED	Occupational Medicine Services
OCONUS	Outside the Continental United States
OD	Outside diameter
OS&H	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
P&CAM	Physical and Chemical Analytical Method #239
PACM	Presumed asbestos-containing material
PAO	Public Affairs Office
PAPR	Powered air purifying respirators
PAT	Proficiency analytical testing
PWTB	Public Works Technical Bulletin
PCM	Phase contrast microscopy
PEL	Permissible exposure limit
PLM	Polarized light microscopy or microscope
PPE	Personal protective equipment
ppm	Parts per million
PREVMED	Preventive Medicine
RAC	Regional asbestos coordinator
RACM	Regulated asbestos-containing material
RPP	Respiratory protection program
SAED	Selected area electron diffraction
SCBA	Self-contained breathing apparatus
SEM	Scanning electron microscopy
SJA	Staff Judge Advocate
TB	Technical Bulletin
TB MED	Technical Bulletin Medical
TEM	Transmission electron microscopy
TLV	Threshold limit values
TM	Technical manual
TSCA	Toxic Substances Control Act

TSI	Thermal system insulation
TWA	Time-weighted average
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEC	U.S. Army Environmental Center
USEPA	U.S. Environmental Protection Agency
VAT	Vinyl asbestos floor tile
XRD	X-ray defraction

Section II
Terms

Abatement	Asbestos control beyond a special O&M program.
Accessible	The material is subject to disturbance by school building occupants or custodial or maintenance personnel in the course of their normal activities.
Air plenum	Any space used to convey air in a building or structure. The space above a suspended ceiling is often used as an air plenum.
Algorithm	A formal numerical procedure for assessing suspect material; results are given a numerical score.
Asbestos	A group of naturally occurring minerals that separate into fibers. There are six asbestos minerals used commercially: chrysotile, amosite, crocidolite, anthopholite, tremolite, and actinolite. Also includes any of these minerals that has been chemically treated and/or altered.
Asbestos abatement	Procedures to control fiber release from ACM in a building or to remove it entirely. These may involve removal, encapsulation, repair, enclosure, and encasement programs.
Asbestos-containing building material (ACBM)	Surfacing ACM, TSI ACM, or miscellaneous ACM found in or on interior structural ACBM members or other parts of a school building. This definition is used in the AHERA regulations for school buildings.
Asbestos-containing material (ACM)	(USEPA) Any material containing more than 1% by weight of the regulated asbestos minerals. (OSHA) Any ACM product containing more than 0.1% by weight regulated asbestos. (See also RACM).
Asbestos Hazard Emergency Response Act (AHERA)	USEPA regulations governing asbestos in public and private elementary and secondary schools (grades K - 12).
Asbestos program manager	A designated representative who supervises all aspects of the facility asbestos management and control program.

Asbestos School Hazard Abatement Reauthorization Act (ASHARA)	USEPA regulation enacted 28 November 1992 which extended accreditation requirements for inspectors, contractor/supervisors, designers, and workers to public and commercial buildings.
Category I non-friable ACM	Asbestos-containing packings, gaskets, resilient floor covering andasphalt roofing products containing more than one percent asbestos.
Category II non-friable	Any material, excluding Category I nonfriable ACM, containing more ACM than one percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. Example: asbestos/cement products.
Cementitious	Friable materials that are densely packed and nonfibrous.
Class I asbestos work	Involves removal of surfacing materials sprayed or troweled or otherwise to surfaces, and removal of TSI. Surfacing materials include, for example, decorative plaster on ceilings or acoustical ACM on decking or fireproofing on structural members. TSI includes, for example, ACM applied to pipes, boilers, tanks and ducts. Based on the record, OSHA has determined that the prevalence of these materials and their likelihood of significant fiber release when disturbed, requires rigorous control methods which OSHA has set out in the standards.
Class II asbestos work	Involves removal of any other ACM - which is not TSI or surfacing ACM. Examples of Class II work are removal of floor or ceiling tiles, siding, roofing, and transite panels. USEPA refers to these materials as miscellaneous ACM in the Green Book.
Class III asbestos work	Is defined as repair and maintenance activities involving intentional disturbance of ACM/PACM. Class III is limited to incidental cutting away of small amounts (less than a single standard waste bag) of ACM/PACM, for example, to access an electrical box for repair.
Class IV work	Is defined as maintenance and custodial activities during which employees contact ACM and PACM and activities to clean up waste and debris containing ACM and PACM. This includes dusting surfaces, vacuuming carpets, mopping floors, cleaning up ACM or PACM materials from TSI or surfacing ACM/PACM. Workers may contact ACM or PACM when performing a wide variety of routine jobs that result in incidental disturbance, such as changing a battery in a smoke detector attached to a ceiling

	containing ACM or PACM, polishing floors containing asbestos, and changing a light bulb in a fixture attached to an asbestos containing ceiling.
Clean room	An uncontaminated room having facilities for storage of employees' street clothing and uncontaminated materials and equipment.
Competent person	In addition to the old definition in 29 CFR 1926.32(f), i.e., one who is capable of identifying existing and predicted hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and Class II work who is specially trained in a training course which meets the criteria of USEPA s MAP (40 CFR part 763) for supervisor, or its equivalent and, for Class III and Class IV work, who is trained in a manner consistent with USEPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(2).
Containment	Isolation of the work area from the rest of the building to prevent escape of asbestos fibers.
Damaged friable miscellaneous ACM	Friable miscellaneous ACM which has deteriorated or deteriorated or sustained physical injury such that the internal structure (cohesion) of the material is inadequate or, if applicable which has delaminated such that its bond to the substrate (adhesion) is inadequate or which for any other reason lacks fiber cohesion or adhesion qualities. Such damage or deterioration may be illustrated by the separation of ACM into layers; separation of ACM from the substrate; flaking, blistering, or crumbling of the ACM surface; water damage; significant or repeated water stains, scrapes, gouges, mars or other signs of physical injury on the ACM. Asbestos debris originating from the ACBM in question may also indicate damage.
Damaged friable surfacing ACM	Friable surfacing ACM which has deteriorated or sustained physical injury such that the internal structure (cohesion) of the material is inadequate or which has delaminated such that its bond to the substrate (adhesion) is inadequate, or which, for any other reason, lacks fiber cohesion or adhesion qualities. Such damage or deterioration may be illustrated by the separation of ACM into layers; separation of ACM from the substrate; flaking, blistering, or crumbling of the ACM surface; water stains, scrapes, gouges, mars or other signs of physical injury on the ACM. Asbestos debris originating from the ACBM in question may also indicate damage.
Damaged or	TSI ACM on pipes, boilers, tanks, ducts, and other TSI equipment where the

significantly damaged thermal system insulation ACM	insulation has lost its structural integrity, or its covering, in whole or in part, is crushed, water-stained, gouged, punctured, missing, or not intact such that it is not able to contain fibers. Damage may be further illustrated by occasional punctures, gouges or other signs of physical injury to ACM; occasional water damage on the protective overings/jackets; or exposed ACM ends or joints. Asbestos debris originating from the ACBM in question may also indicate damage.
Decontamination area	An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment contaminated with asbestos.
Delaminate	To separate into layers. As used here, to separate from the substrate adhesion.
Delamination	Separation of one layer from another.
Demolition	The wrecking or taking out of any load-supporting structural member, including destruction of an entire building, and any related razing, removing, or stripping of asbestos products; this may include the destruction of an entire building.
Desiccating agent	A material that is used to remove moisture.
Employee exposure	Exposure to airborne asbestos that would occur if the employee were using respiratory protective equipment.
Encapsulation	The application of a material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of the fibers.
Enclosure	The construction of an air-tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers into the air. Also, the temporary, negative pressure enclosure constructed for large-scale ACM removal projects.
Equipment room (change room)	Contaminated room within the decontamination area, adjacent to the work area, that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.
Excursion limit	An airborne concentration of asbestos of 1.0 f/cc of air as averaged over a

(EL)	sampling period of thirty (30) minutes.
Exposure assessment	An assessment performed by a competent person which predicts whether exposure levels during the planned asbestos work can be expected to exceed the PELs and if so, whether additional monitoring and other precautions are required.
Fiber	A particulate form of asbestos, 5 m or longer, with a length-to-diameter ratio of at least 3 to 1.
Fibrous	Spongy, fluffy, composed of long strands of fibers.
Friable	Capable of being crumbled, pulverized, or reduced to powder by hand pressure. This may also include previously non-friable material which becomes broken or damaged by mechanical force.
Functional manager	Manager of specific areas within the Department of Public Works at an installation. (e.g. chief, O&M; chief, buildings and grounds).
Functional space	A room, group of rooms, or homogeneous area (including crawl spaces or the space between a dropped ceiling and the floor or roof deck above), such as classroom(s), a cafeteria, gymnasium, hallway(s), designated by a person accredited to prepare management plans, design abatement projects, or conduct response actions.
Generator	In the context of this PWTB, the government is considered to be the generator of the ACM waste. Ownership of the ACM waste continues even after disposal in an approved sanitary landfill.
Glovebag	A polyethylene or polyvinyl chloride bag-like enclosure affixed around an asbestos-containing source (most often, TSI) so that the material may be removed while minimizing release of airborne fibers to the surrounding atmosphere.
High-efficiency particulate air (HEPA) filter	A filter capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 m in diameter or larger.
Homogenous	Similar in appearance and texture.
Homogenous (work site)	Contains only one type of ACM and only one type of abatement method was used.

Human exposure	The presence of people in an area where levels of an airborne contaminant are elevated. A more technical definition sometimes found in scientific literature is: The total amount of airborne contaminant inhaled by a person, typically approximated by the product of concentration and duration.
Industrial hygienist (IH)	A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards.
Lock-down encapsulant	A liquid that is sprayed onto the polyethylene sheeting forming the enclosure or barrier to an asbestos work site. This material may be applied only after the polyethylene sheeting has been thoroughly cleaned. When dry, this material traps any dust particles that may remain on the sheeting.
Material exposure	The amount or fraction of material visible.
Medical surveillance	A periodic comprehensive review of a worker's health status. The required elements of an acceptable medical surveillance program are listed in the OSHA standards for asbestos.
Miscellaneous ACM	Interior ACBM on structural components, structural members or fixtures, such as floor and ceiling tiles; does not include surfacing material or TSI.
Miscellaneous material	Interior building material on structural components, structural members or fixtures, such as floor and ceiling tiles, and does not include surfacing material or TSI.
Model Accreditation Program (MAP)	USEPA rule which clarifies the types of persons who must be accredited to work with asbestos in schools and public and commercial buildings. This rule also specifies the number of hours of training required for asbestos abatement personnel. (See 40 CFR 763).
National Emission Standard for Hazardous Air Pollutants (NESHAP)	USEPA rules under the CAA. Subpart M of this standard applies to asbestos.
National Institute for Occupational Safety and	Established by the OSHA of 1970. Primary functions of NIOSH are to conduct research, issue technical information, and test and certify respirators. NIOSH also publishes analytical methods for air samples.

Health (NIOSH)

Operations and maintenance (O&M)	A program of work practices to maintain friable ACBM in good condition, ensure clean up of asbestos fibers previously released, and (O&M) prevent further release by minimizing and controlling ACBM disturbance or damage.
Peak levels	Levels of airborne contaminant which are much higher than average and occur for short periods of time in response to sudden release of the contaminant.
Permissible exposure limits (PELs)	The OSHA eight (8) hour time-weighted average limit for airborne concentration of asbestos is 0.1 f/cc. The OSHA excursion limit for airborne concentration of asbestos is 1.0 f/cc as averaged over a sampling period of thirty (30) minutes.
Personal air samples	An air sample taken with a sampling pump directly attached to the worker with the collecting filter and cassette placed in the worker's breathing zone. These samples are required by the OSHA asbestos standards and the USEPA Worker Protection Rule.
Phase contrast microscopy (PCM)	An optical microscopic technique used for the counting of fibers in air s
Potential damage	Circumstances in which: (1) Friable ACBM is in an area regularly used by building occupants, including maintenance personnel, in the course of their normal activities. (2) There are indications that there is a reasonable likelihood that the material or its covering will become damaged, deteriorated, or delaminated due to factors such as changes in building use, changes in operations and maintenance practices, changes in occupancy, or recurrent damage.
Potential significant damage	Circumstances in which: (1) Friable ACBM is in an area regularly used by building occupants, including maintenance personnel, in the course of their normal activities. (2) There are indications that there is a reasonable likelihood that the material or its covering will become significantly damaged, deteriorated, or delaminated due to factors such as changes in building use, changes in O&M practices, changes in occupancy, or recurrent damage. (3) The material is subject to major or continuing disturbance, due to factors including, but not limited to, accessibility or, under certain circumstances, vibration or air erosion.

Prevalent levels	Levels of airborne contaminant occurring under normal conditions.
Prevalent level samples	Air samples taken under normal conditions (also known as ambient background samples).
Preventive measures	Actions taken to reduce disturbance of ACBM or otherwise eliminate the reasonable likelihood of the material's becoming damaged or significantly damaged.
Regulated area	An area established by the employer to demarcate areas where airborne concentrations of asbestos or a combination of these minerals exceed or can reasonably be expected to exceed the PEL.
Regulated asbestos-containing materials (RACM)	As defined under NESHAPS, includes two categories of non-friable ACM. Category I includes VAT, roofing felts, gaskets and packings which may release asbestos into the air if they are sanded, drilled or sawed. Category II includes asbestos board, transite, and asbestos shingles which may release asbestos if ground into dust or are subjected to similar forces.
Removal	The taking out or stripping of asbestos or materials containing asbestos.
Renovation	The modifying of any existing structure, or portion thereof.
Repair	Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates; returning damaged ACBM to an undamaged condition or to an intact state so as to prevent fiber release.
Resolution	A term used to describe the performance of a microscope. For example, if a PCM (or any other microscope) is used to examine two closely-spaced lines, the resolution of the instrument is defined as the minimum distance between the two lines when observed by a microscopist having normal vision. The resolution of the PCM is approximately 0.2523.0 m and that of a PLM is approximately 0.720.8 m.
Response action	A method implemented to protect human health and the environment from friable ACBM.
Risk	The likelihood of developing a disease as a result of exposure to a contaminant.
Risk assessment	The interpretation and evaluation of physical assessment data in order to set abatement priorities and rank areas for response actions. These priorities and rankings are based on anticipated exposure to asbestos fibers.

Significantly damaged friable miscellaneous ACM	Damaged friable miscellaneous ACM where the damage is extensive and severe.
Significantly damaged friable surfacing ACM	Damaged friable surfacing ACM in a functional space where the damage is extensive and severe.
Substrate	An underlying layer or substance.
Surfacing ACM	ACM that is sprayed-on, troweled-on or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.
Synergistic	An action of two (or more) substances to achieve an effect of which is individually incapable.
Thermal system insulation (TSI)	ACM applied to pipes, fittings, boilers, breaching, tanks, ducts or other interior structural components to prevent heat loss or gain or water condensation.
Time-weighted average (TWA)	In air sampling, this refers to the average air concentration of contaminants during a particular sampling period.
Transmission electron microscopy (TEM)	A method of microscopic analysis which utilizes an electron beam that is focused onto a thin sample. As the beam penetrates (transmits) through the sample, the difference in densities produces an image on a fluorescent screen from which samples can be identified and counted. Used for analyzing air samples for asbestos.

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