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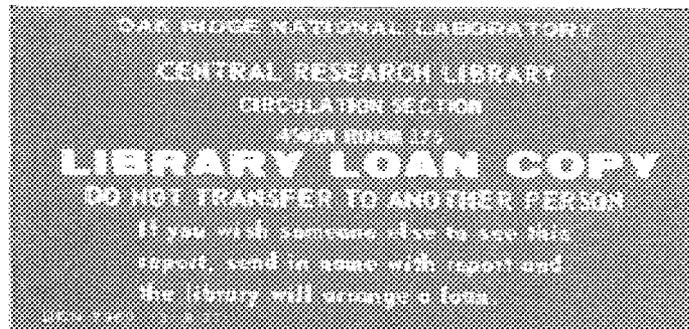


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**ORNL/TM-10745
(DOE/HWP-55)**

**Technical and Economic
Assessment for Asbestos Abatement
Within Facility 20470,
Wright-Patterson Air Force Base, Ohio**

S. M. Gibson
R. B. Ogle



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CHEMICAL TECHNOLOGY DIVISION

TECHNICAL AND ECONOMIC ASSESSMENT FOR ASBESTOS ABATEMENT
WITHIN FACILITY 20470, WRIGHT-PATTERSON AIR FORCE BASE, OHIO

S. M. Gibson
R. B. Ogle

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- M. W. Haskew, J. D. Hill, B. A. Jerome, and C. S. MacDougall for analysis of asbestos samples;
- C. P. McGinnis, B. D. Patton, V. C. A. Vaughen, and E. L. Youngblood for providing timely technical review;
- B. K. Morrow, M. G. Stewart, V. T. Hinkel, J. M. Kraemer, and C. D. King and the Graphics Support staff for professional secretarial, editing, and graphic arts services.

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1. EXECUTIVE SUMMARY

This report presents the results of a technical and economic assessment of available alternatives for asbestos abatement within Facility 20470 at the Wright-Patterson Air Force Base in Dayton, Ohio. The work was carried out by the Oak Ridge National Laboratory, a U.S. Department of Energy laboratory, for the U.S. Department of Defense (DoD) in support of the Installation Restoration Program (IRP). Each alternative was screened on the basis of technical feasibility, environmental impact, economics, and fulfillment of the IRP goals. The four alternatives for study were based on guidance from the U.S. Environmental Protection Agency (EPA) for controlling asbestos-containing materials (ACMs) in buildings. The alternatives are:

Alternative 1: Establishing a special operations and maintenance program

Alternative 2: Enclosure

Alternative 3: Encapsulation with sealants

Alternative 4: Removal, disposal, and replacement

Alternative 1 is designed to (1) clean up asbestos fibers previously released, (2) prevent future releases by minimizing the disturbance or damage of ACM, and (3) monitor the condition of the ACM. This program should continue until all ACM is removed or the building is demolished. Implementation of this alternative will only ensure better control over the environment than now exists. Alternative 2 would involve constructing an airtight ceiling and walls around the sprayed-on asbestos. Building blueprints designating the presence of asbestos behind the enclosure would be maintained to prevent accidental fiber release during building repair or demolition, and signs would be posted to note that ACM is behind the enclosure. Alternative 3 would bind together the asbestos fibers and other material components to offer some resistance to damage from impact. Alternative 4 would remove the ACMs, transport the material to an approved landfill, and reinsulate the containment shell with asbestos-free material. Completion of this alternative would eliminate the need for an Operations and Maintenance Program.

Each of these alternatives was assessed for capability to control the release of asbestos fibers within Facility 20470. Alternatives 1 and 4 were determined to be acceptable, while Alternatives 2 and 3 were found to be unacceptable. Because of the high friability and the apparent delamination of the ACM, enclosure (Alternative 2) is considered inappropriate by EPA standards. Alternative 3 (encapsulation with sealants) was found unacceptable because of the EPA studies that demonstrated that sealants should not be used when friable asbestos materials show evidence of poor cohesive strength and extensive damage.

The environmental and public health impact for each acceptable alternative was evaluated. These considerations focus largely on the highly toxic effects that asbestos fibers have on the human body. Because there is no proven safe level for asbestos exposures, attention should be given to maintaining all human exposures to as low as is reasonably achievable. Alternative 1 has the potential for the highest environmental impact of the two acceptable alternatives because the asbestos will remain in the facility. In Alternative 4, the environmental impacts are short term and focus on the removal of asbestos from the facility. The major impacts for Alternative 4 are waste disposal, occupational exposure, and waste transportation.

Economic assessment of the two acceptable alternatives was based on past experience with similar tasks for Alternative 1. However, a cost estimate for Alternative 4 was not possible without an on-site inspection by the asbestos contractor. For Alternative 4, preliminary price ranges from contractors varied significantly. Based on the conditions that exist within the containment shell for removing the ACMs, it is estimated that the cost will be \$50/ft², and the resulting estimated cost in 1988 dollars for Alternative 4 is \$900,000 with a 15% contingency. Asbestos clean-up costs for Alternative 1 are estimated to be \$34,500, based on 1988 dollars, and the associated annual charge for an Operations and Maintenance Program in 1988 dollars is \$7,500. A 15% contingency rate has been applied to the costs of Alternative 1.

2. INTRODUCTION

The purposes of this study were (1) to make a preliminary assessment of the status of ACMS within the containment shell of Facility 20470 at Wright-Patterson Air Force Base (WPAFB) and (2) to evaluate options that could be used to control or eliminate asbestos exposure pertaining to the containment shell. The study was conducted by Oak Ridge National Laboratory (ORNL), a U.S. Department of Energy Laboratory, for the United States Air Force (USAF) through the Support Contractor Office (SCO) of the Hazardous Waste Remedial Actions Program (HAZWRAP). The SCO is responsible for managing the preparation of the Installation Restoration Program documents for the USAF.

Facility 20470 was originally built to house a nuclear test reactor with the associated experimental facilities. In 1971, the reactor was deactivated and all fuel was removed. Structural materials were entombed in concrete, and the surrounding areas were decontaminated. With the passage of time, it became apparent that relatively extensive maintenance was needed. Thus, a decommissioning option study¹ was made by ORNL at the request of WPAFB. Based on the results of this study, a directive² was issued by the USAF Terrestrial Nuclear Reactor Safety Study Group (TNRSSG) to proceed with the detailed planning and design for opening the entombment and removing the radioactive materials for disposal.

As an intermediate corrective action, the TNRSSG directed the Civil Engineering Squadron of WPAFB to establish an interim plan document for maintenance of Facility 20470 consistent with the selected decommissioning option. The study of options available to control or eliminate asbestos exposure is only one segment of the directed interim maintenance plan. The remaining studies necessary for establishing an interim plan for maintenance are being conducted by the Civil Engineering Squadron of WPAFB. Completion of these studies will result in the formulation of an interim maintenance plan to be prepared by the Civil Engineering Squadron of WPAFB.

Asbestos fibers create concern because of their potential to cause health effects when they are inhaled. Under static conditions, ACMs that are well encapsulated do not release asbestos fibers and therefore do not pose a direct threat. When ACMs are disturbed during maintenance, repair, or renovation, they may become airborne, and in these situations, would be subject to various regulatory requirements.

2.1 REFERENCES

1. S. M. Gibson, Technical and Economic Assessment for Decommissioning the Air Force Nuclear Engineering Center, DOE/HWP-35, Wright-Patterson AFB, Ohio, August 1987.
2. Directorate of Nuclear Surety, Terrestrial Nuclear Reactor Safety Study Group, Special Nuclear Reactor Safety Study for the Air Force Nuclear Engineering Center, USAF TNRSSG 87-2, September 1987.

3. FACILITY DESCRIPTION

Facility 20470 is located 5 miles northeast of the center of the city of Dayton, Ohio, on the WPAFB reservation. The facility site, shown in Figs. 3.1 and 3.2, is located in Area B (controlled access area) on the hillside, east of and overlooking the inactive Wright Field runways and the Air Force museum.

The facility serves as housing for a 10-MW heterogeneous-type reactor and experimental facilities that were deactivated and entombed in 1971. The containment shell, of 9/16-in. steel, is cylindrical, with a hemispherical top. The cylinder is about 82 ft in diameter and about 160 ft in overall height, with about 50 ft being below grade. A support wing partially surrounds the containment building. Figures 3.3 through 3.5 depict the reactor systems, containment shell, and support wing. The ACM, which is the subject of this report, is located in the containment building and serves as insulation for the containment shell.

The assigned custodian of the facility is the Air Force Institute of Technology (AFIT). Responsibility for specialized areas or functions within the facility is under the jurisdiction of various disciplines, including the Base Radiological Hazards Committee, Base Medical Service, and Base Civil Engineering. The Base Civil Engineering has responsibility for asbestos abatement.

The AFIT occupies the building space adjacent to the containment shell and, on occasion, performs experiments within the containment shell. More recently, the hot-cell complex adjacent to the containment shell was used for packaging radioactive waste.

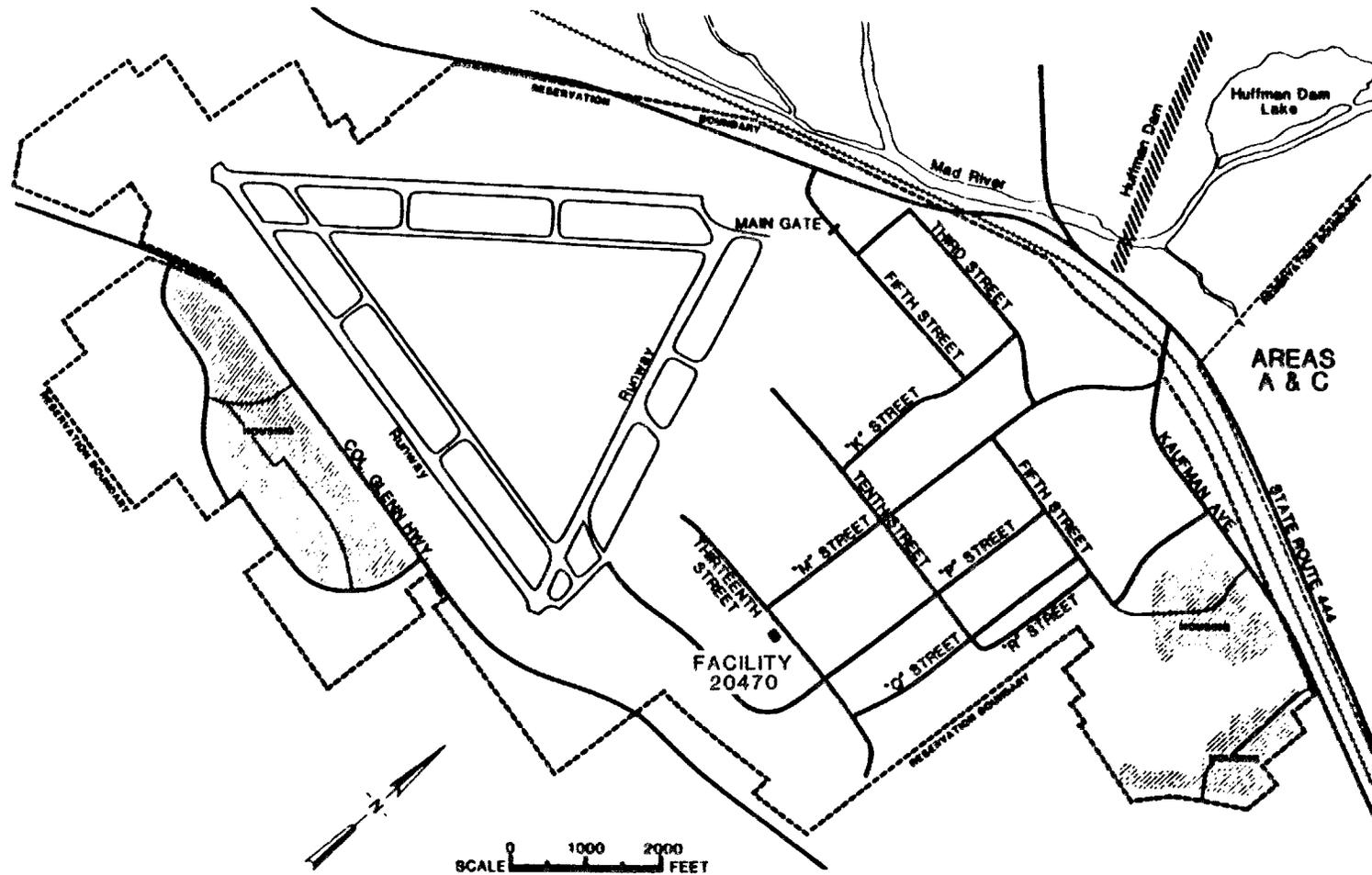


Fig. 3.1. Wright-Patterson AFB site plan - Area B.

ORNL DWG 87-377

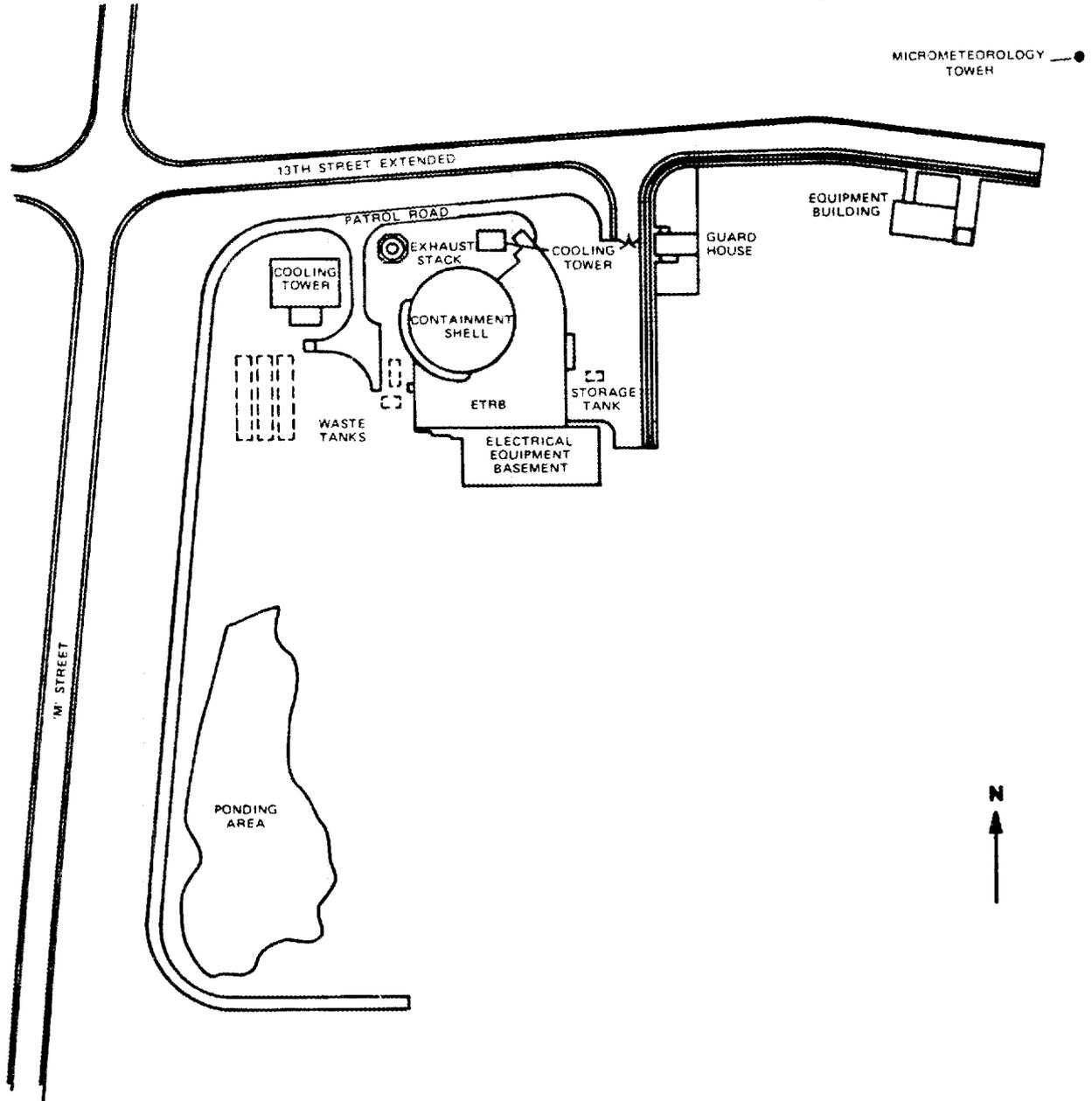
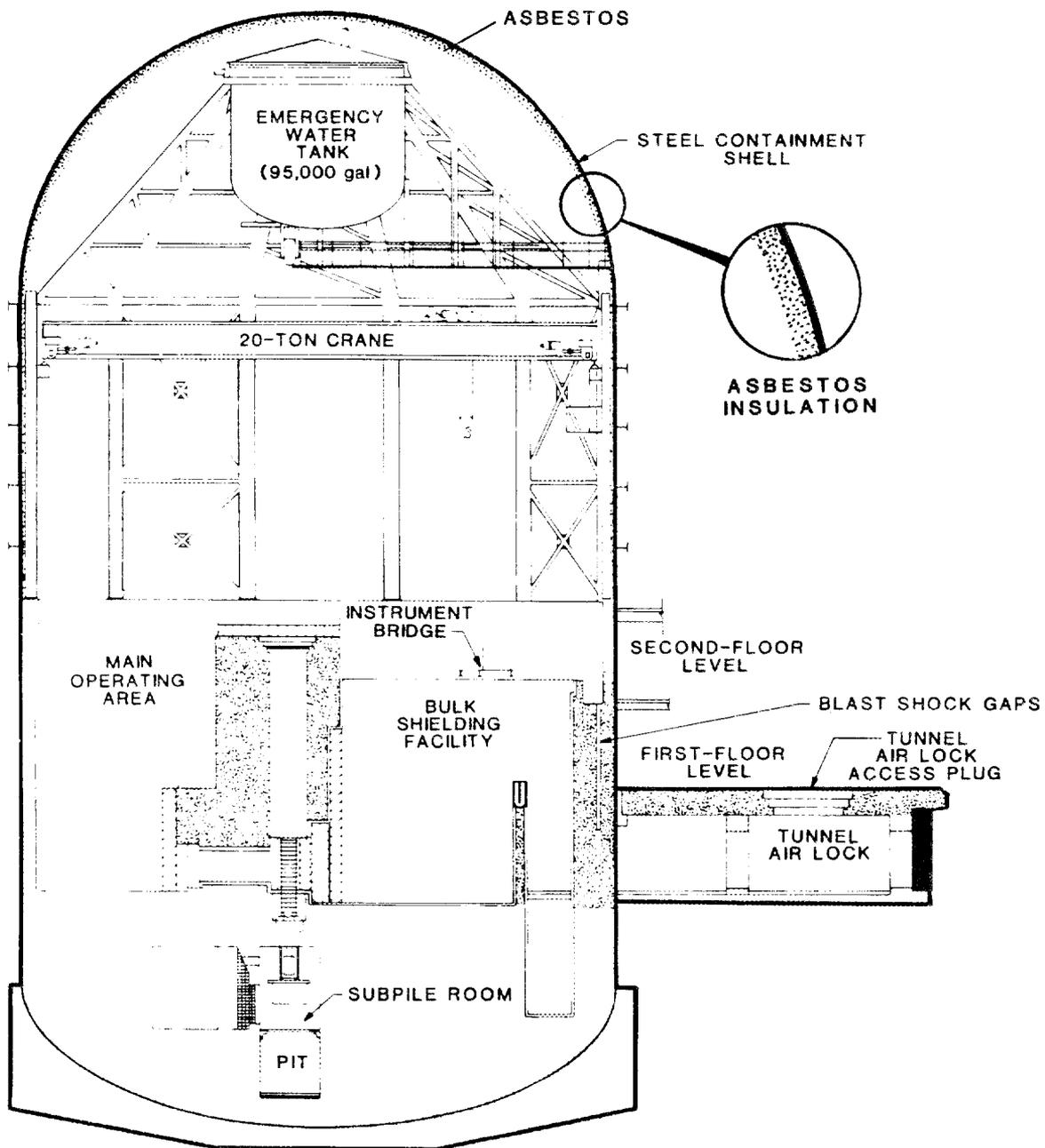


Fig. 3.2. Wright-Patterson AFB Facility 20470.



NORTH-SOUTH SECTION, LOOKING EAST

Fig. 3.3. Containment shell.

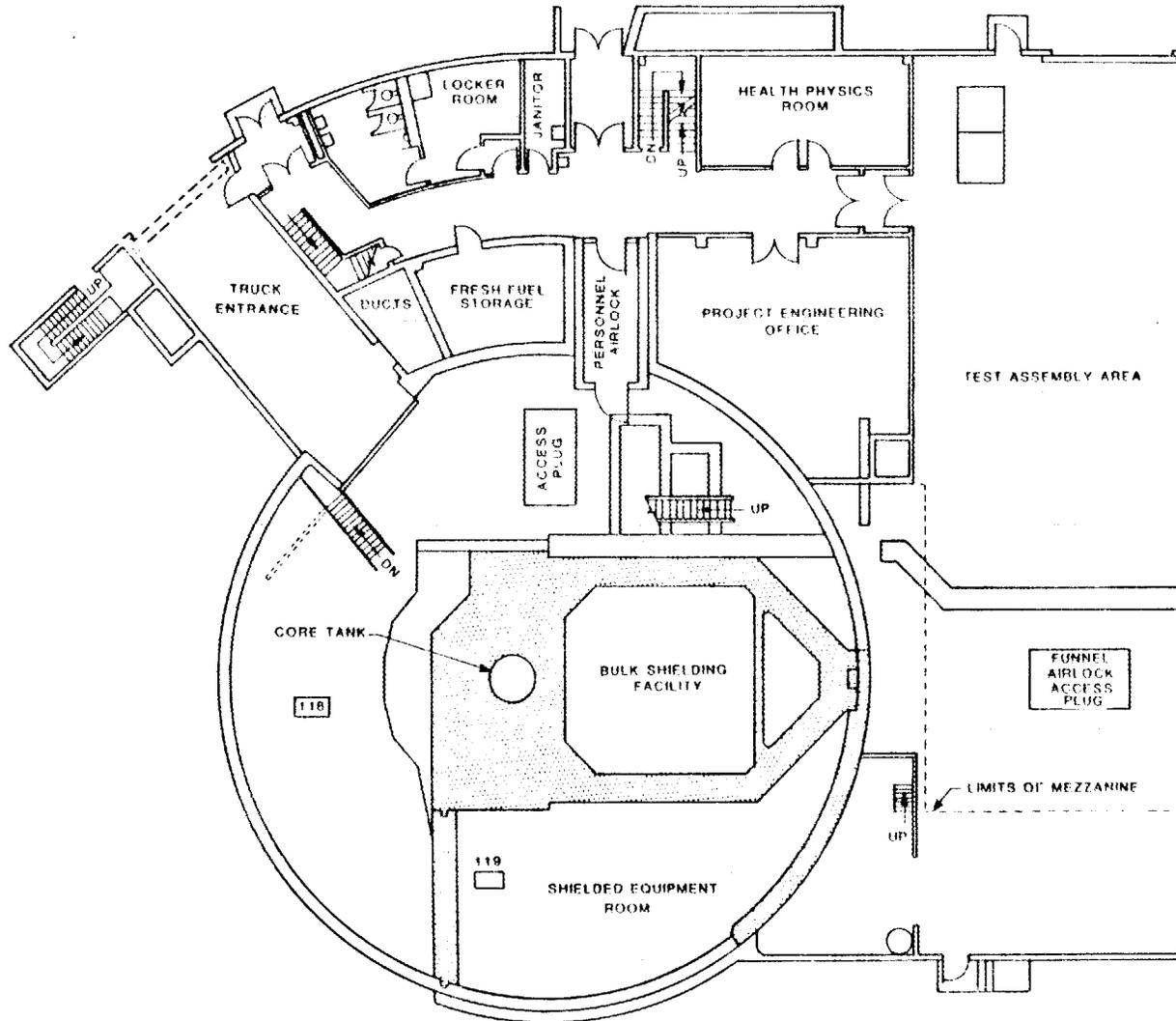


Fig. 3.4. Main floor of Facility 20470.

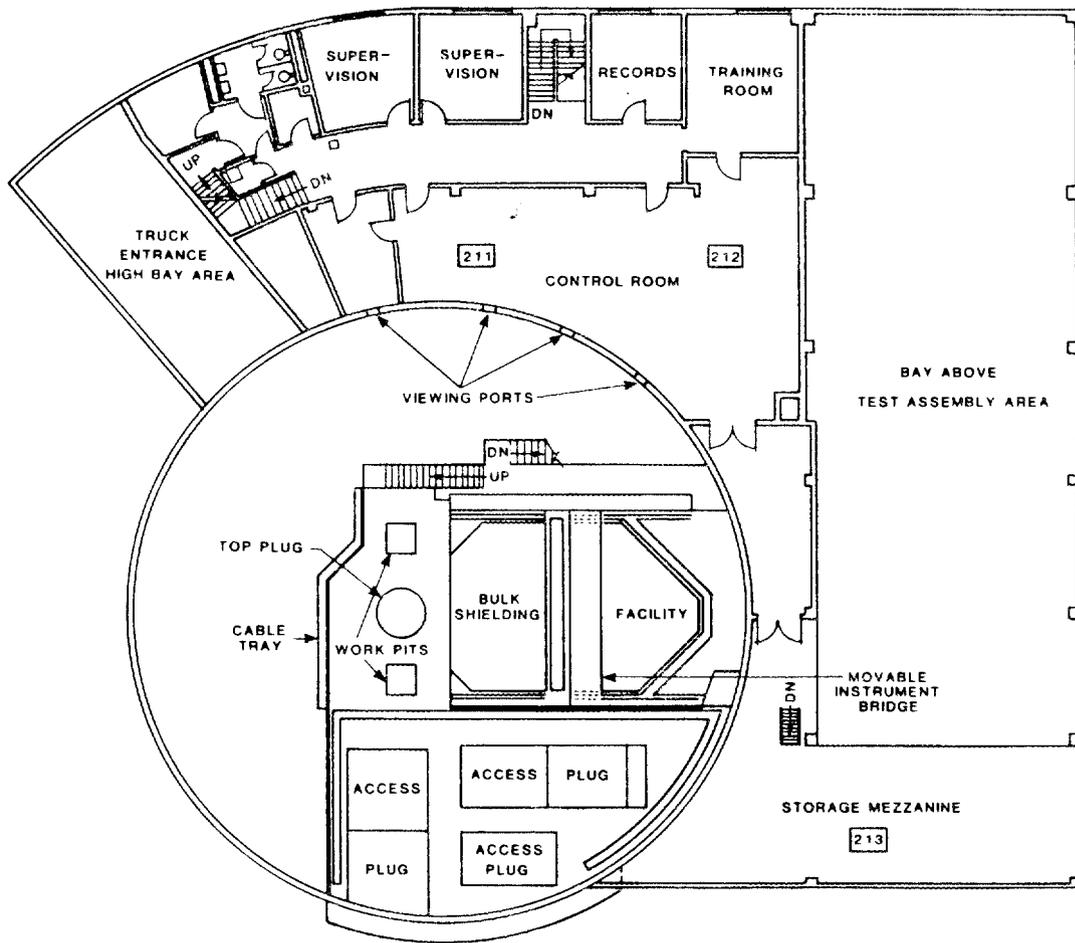


Fig. 3.5. Second floor of Facility 20470.

4. INDUSTRIAL HYGIENE SURVEY OF ASBESTOS-CONTAINING MATERIAL

The ACM in Facility 20470 was assessed for its current condition as well as its potential for future disturbance, damage, or erosion. Factors used to evaluate the current condition included evidence of (1) deterioration or delamination from the underlying surface, (2) physical damage, and (3) water damage. The potential for future disturbance, damage, or erosion of ACM was evaluated by observing (1) the proximity of ACM to an air plenum or a direct airstream; (2) the visibility, accessibility, and degree of activity (air movement, vibration, movement of building occupants, etc.); and (3) the change in building use. Bulk samples of the material were taken to identify and determine the percentage of asbestos present. Air monitoring was conducted to assess asbestos fiber release in the air; however, quantitative air monitoring only measures current conditions and provides no information concerning fiber release potential and future air levels.

4.1 VISUAL INSPECTION

The interior of the containment shell wall for Facility 20470 is insulated with sprayed-on ACM, as depicted in Fig. 4.1. Thus, all of the ACM is exposed to the interior environment. Random measurements as to the thickness of the material averaged from 1.25 to 1.5 in. Results of the visual inspection revealed friable ACM with moderate deterioration or delamination throughout the containment shell. Severe material disturbance was noted on the northwest walls and in the vicinity of the catwalk and ladder. Ankle-deep asbestos-containing debris was found in the catwalk area. Physical damage to the ACM was observed as indicated in Photographs 1 and 3 (Appendix A). In Photograph 1, damage is noted along the vertical pipe; and Photograph 3 depicts the impression of a shoe. All this damage was probably inflicted during routine maintenance procedures. Widespread debris is illustrated in Photograph 4 (Appendix A).

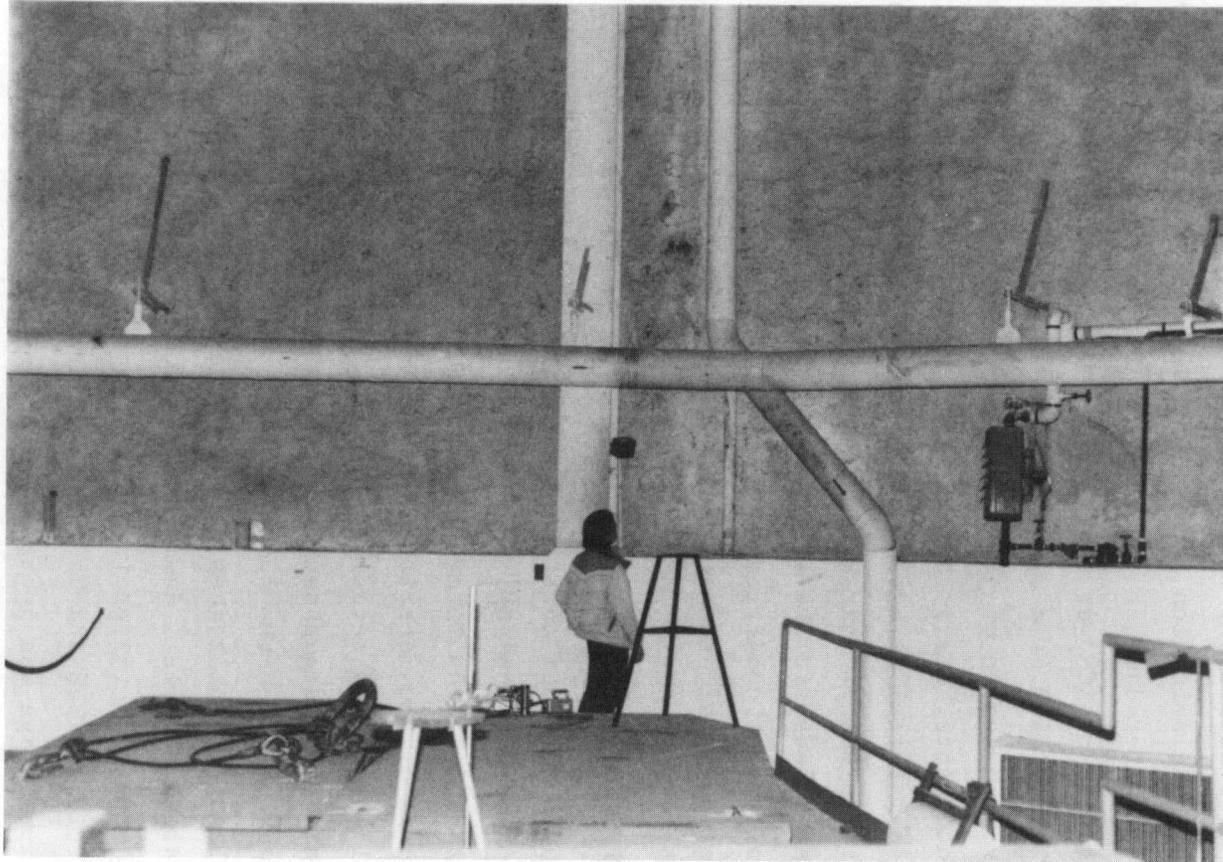


Fig. 4.1. The interior of the containment shell wall (insulated with sprayed-on ACM) for Facility 20470.

In addition to the sprayed-on ACM, it was noted that the low-pressure steam lines were insulated with ACM. Damage to the pipe insulation covering, observed near the heating units, caused friable asbestos to be exposed in the vicinity of the heater (see Appendix A, Photograph 5). No other significant damage to the pipe insulation was noted.

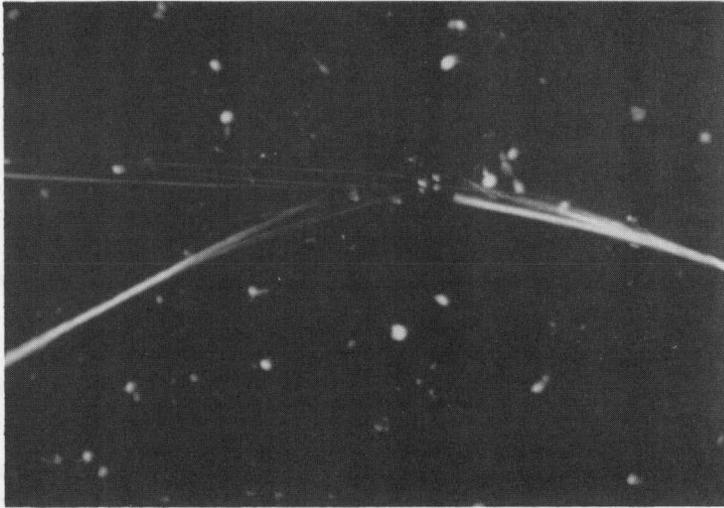
4.2 BULK SAMPLING

Bulk samples of ACM were taken to identify and determine the percentage of asbestos present. These samples were representative of the friable insulation on the containment shell interior and debris that was located within the containment shell. A bulk sample was also taken from the exposed friable pipe insulation. Analysis of the samples confirmed the presence of 5 to 20% asbestos. The asbestos in the bulk samples was identified as chrysotile, except in the case of the friable pipe insulation; the latter was identified as the more hazardous type, amosite. Figures 4.2 and 4.3 illustrate samples of the asbestos fibers, using polarizing light microscopy. Figure 4.2 depicts amosite asbestos taken from the friable pipe insulation, and Fig. 4.3 is representative of chrysotile asbestos found on the containment shell and within the containment shell area.

The bulk samples were also analyzed for the presence of radioactivity; the results are shown in Appendix A. The Nuclear Regulatory Commission was contacted for assistance in determining the significance of the level of radioactivity present. The highest level of alpha activity exhibited in the bulk samples is indicative of Type A nuclear waste. To fully describe the beta/gamma activity, a designation as to the predominant source radionuclide would be necessary. This task is beyond the scope of the present study.

4.3 AIR SAMPLING

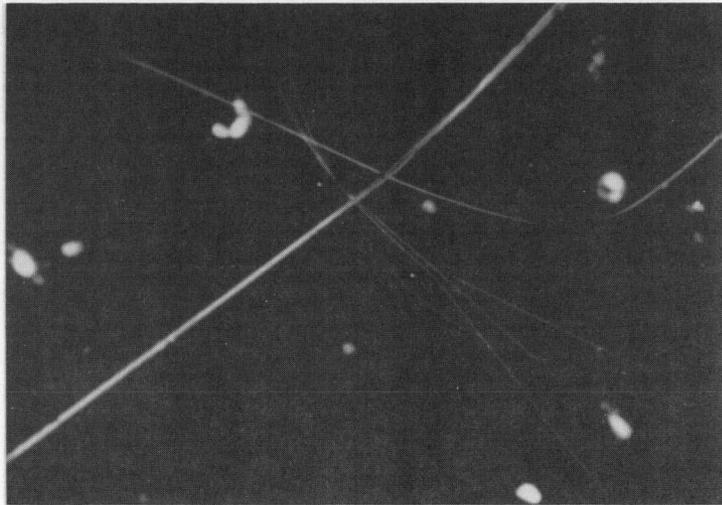
Air monitoring was conducted by taking samples at various locations both within and outside the containment shell. These samples, which are classified as static air samples, were collected under conditions of



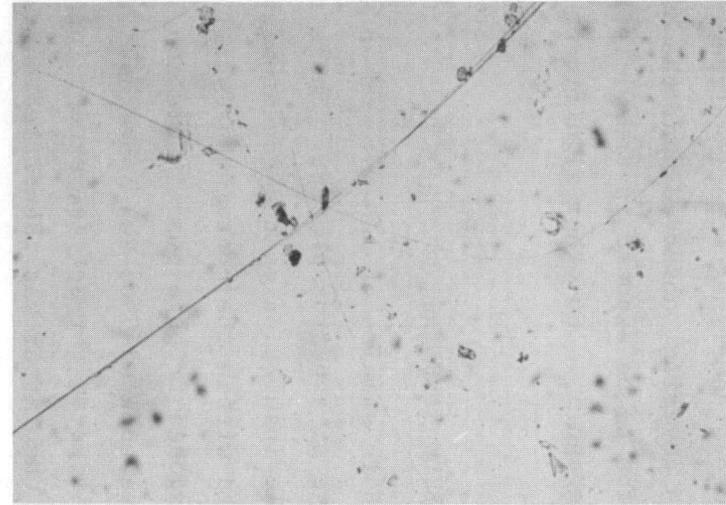
RBO-5 (1.550 Cargille, \ominus), Mag: 100X



RBO-5 (1.550 Cargille, \ominus), Mag: 100X

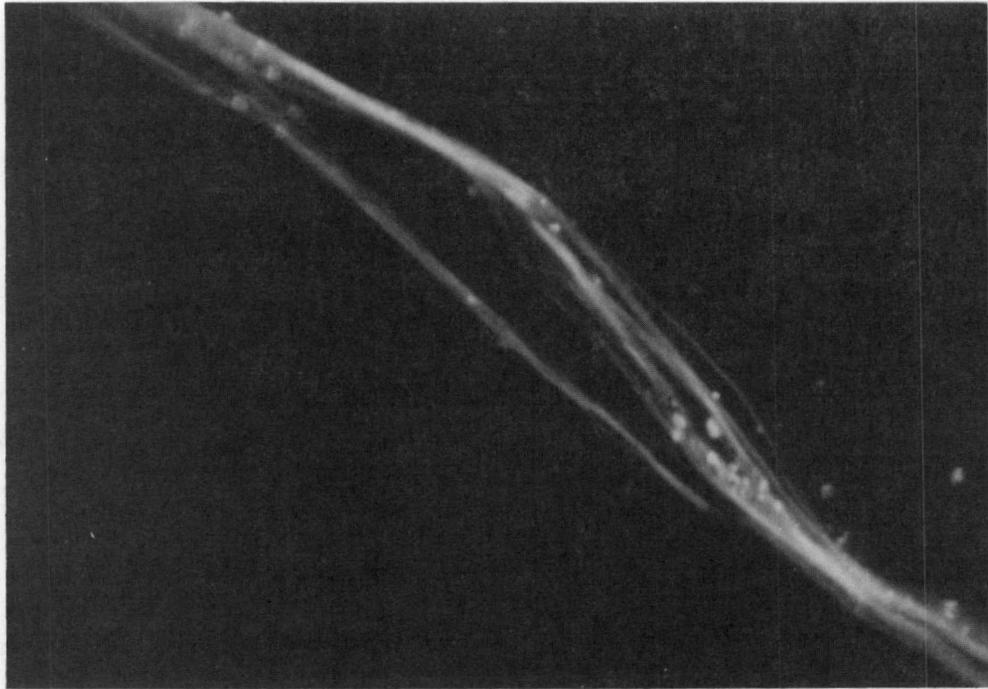


RBO-5 (1.680 Cargille, \ominus), Mag: 100X



RBO-5 (1.680 Cargille, \ominus), Mag: 100X

Fig. 4.2. Amosite asbestos. The fibers show a refractive index of approximately 1.680 and dispersion staining colors of blue and yellow.



RBO-7 (1.550 Cargille, \ominus), Mag: 100X



RBO-7 (1.550 Cargille, \ominus), Mag: 100X

Fig. 4.3. Chrysotile asbestos. The fibers all show refractive indices of approximately 1.550 and dispersion staining colors of magenta and blue.

minimal activity. An obvious criticism of this technique is that it measures current conditions but provides no information about fiber release potential and future air levels. Analytical results indicated levels that were well below the present occupational exposure limit of 0.2 fiber per cm^3 of air in an 8-h work period. However, based on the visual inspection results, employees performing work within the containment shell could be subjected to significant airborne asbestos exposures. For example, activities such as cleaning of floors, equipment maintenance, and climbing to or walking within the catwalk area could produce airborne exposure to asbestos fibers.

4.4 CONCLUSIONS FROM INDUSTRIAL HYGIENE SURVEY

Immediate action should be taken to clean up asbestos debris on the floor, ladder, catwalk, and ledges in the containment area. This work should be conducted by individuals who are medically approved, trained, and protected as required by Occupational Health and Safety Administration (OSHA) regulations, according to Title 29, Code of Federal Regulations, Part 1926.58.

Future work, such as maintenance and inspection activities, should be performed by trained and protected workers. Additionally, periodic monitoring of this facility should be conducted to determine the degree of delamination of asbestos insulation and to evaluate airborne asbestos levels.

At the time of this evaluation, no significant asbestos fiber levels were detected, but the factors that can lead to airborne fiber levels are present and the potential for excessive air levels in the containment area does exist.

A formal Operations and Maintenance Program for controlling occupational exposures should be instituted until more permanent control measures can be enacted. The enclosure or encapsulation of the friable sprayed-on insulation would not be applicable to the existing material that is on the steel containment shell because of the high friability, the depth of the insulation (1.5 in.), and the fact that the insulation is undergoing delamination. However, enclosure or encapsulation can be used to control the risk posed by the broken pipe covering that exposes friable materials.

While an effective Operations and Maintenance Program can ensure that adequate occupational protection is achieved, the recommended control measure is removal of the asbestos-containing insulation. The high exposure rating indicates that a significant ongoing risk is present to those entering the containment area.

5. ALTERNATIVES

The alternatives described below are based on guidance from the EPA for controlling ACMs in buildings. They include:

Alternative 1: Establishing a special operations and maintenance program

Alternative 2: Enclosure

Alternative 3: Encapsulation with sealants

Alternative 4: Removal, disposal, and replacement

Each of these alternatives was assessed for capability to control the release of asbestos fibers within Facility 20470. Alternatives 1 and 4 were determined to be acceptable, while alternatives 2 and 3 were found to be unacceptable.

5.1 ACCEPTABLE ALTERNATIVES

Alternative 1 is designed to (1) clean up asbestos fibers previously released, (2) prevent future releases by minimizing the disturbance or damage of ACM, and (3) monitor the condition of the ACM. This program should continue until all ACM is removed or the building is demolished. Alternative 4 consists of removing the ACM and transporting it to an approved landfill. The containment shell would then be reinsulated with asbestos-free materials.

5.1.1 Alternative 1: Establishing a Special Operations and Maintenance Program

The asbestos that is sprayed on the interior wall of the containment shell of Facility 20470 was determined to be friable. The fibers of friable material are slowly released as the material ages. According to the EPA, several steps should be taken to reduce the level of released fibers and to guard against disturbing or damaging the ACM. These steps are discussed in the paragraphs that follow.

5.1.1.1 Documentation, Education, and Training

The Operations and Maintenance Program Coordinator* should (1) record the exact location of ACM on building documents; (2) inform building occupants, as well as maintenance and custodial workers, about the location of ACM and caution them against disturbing or damaging it, (3) require all maintenance and custodial personnel to wear a half-face respirator with disposable high-efficiency, particulate, cartridge filters, or better, during the initial cleaning or whenever they may come in contact with ACM; and (4) train custodial workers as required by OSHA Regulations (Appendix E).

5.1.1.2 Initial Cleaning

The custodial staff should perform the following tasks:

1. Vacuum all areas containing loose ACM debris using a High Efficiency Particulate Air (HEPA)-filtered vacuum cleaner. Spray the vacuum cleaner bags with water before removal and discard them in sealed plastic bags according to EPA regulations for removal and disposal of asbestos. Discard vacuum filters in a similar manner.
2. Clean all floors within the containment shell with wet mops. Wipe ledges, equipment, etc., with damp cloths. Discard cloths and mopheads in sealed plastic bags according to EPA regulations for the disposal of asbestos waste.

5.1.1.3 Monthly Cleaning

The custodial staff should perform the same tasks listed in Sect. 5.1.1.2.

5.1.1.4 Building Maintenance

The Operations and Maintenance Program Manager* should ensure that the recommended procedures and safety precautions will be followed before authorizing any construction and maintenance work that involves surfacing ACM. In particular, containment barriers should be erected around the work area, and workers should wear coveralls as well as respirators.

*EPA-designated title.

The maintenance staff should:

1. Clear all construction, renovation, maintenance, or equipment repair work with the Operations and Maintenance Program Coordinator in advance.
2. Avoid patching or repairing any damaged surfacing ACM until it has been assessed by the asbestos program manager.
3. Mist the filters leading to the exhaust stack as the filters are removed. Place the filters in plastic bags and dispose of them according to EPA regulations.

5.1.1.5 Periodic Inspection

Periodic inspection of the building should be performed by the building inspectors to check all ACM materials for damage or deterioration at least twice a year, and a report of their findings should be submitted to the Operations and Maintenance Program Manager. The custodial and maintenance staff should inform the Operations and Maintenance Program Manager when damage to ACM is observed or when debris is cleaned up. The building inspectors should investigate the source of debris found by the staff.

5.1.1.6 Miscellaneous

All damaged pipe insulation should be repaired by using non-asbestos plastering. Following this repair, the Operations and Maintenance Program for pipe insulated with asbestos will be the same as that for sprayed-on ACM.

5.1.2 Alternative 4: Removal, Disposal, and Replacement

Alternative 4 will remove the ACM, transport the material to an approved landfill, and reinsulate the containment shell with asbestos-free material. Completion of this alternative will eliminate the need for an Operations and Maintenance Program. The removal, disposal, and replacement tasks will be performed by an outside contractor. Well-designed, detailed contract specifications are necessary to provide overall guidance for the abatement project. An example of recommended

contract specifications for asbestos abatement projects is illustrated in Appendix B. However, specifications must always be developed for each individual project since abatement projects are rarely identical. The state of Ohio has special requirements, in addition to those of OSHA and EPA, which must be observed. These requirements are presented in Appendix C.

Before the contract specifications can be written, it will be necessary to determine whether the abatement project will be performed by wet removal or dry removal. The current decommissioning plan for Facility 20470 forbids the use of water within the containment shell due to the entombed radioactive components. However, if a decision is made to use dry removal, special permission must be granted by the EPA.

5.2 UNACCEPTABLE ALTERNATIVES

Alternatives 2 and 3 are unacceptable. Alternative 2 would involve constructing an airtight ceiling and walls around the sprayed-on asbestos. Building blueprints designating the presence of asbestos behind the enclosure would be maintained to prevent accidental fiber release during building repair or demolition, and signs would be posted to note that ACM is behind the enclosure. Alternative 3 would bind together the asbestos fibers and other material components to offer some resistance to damage from impact. The conditions that prevent these alternatives from being feasible are discussed in Sects. 5.2.1 and 5.2.2.

5.2.1 Alternative 2: Enclosure

Because of the high friability, the significant thickness of the insulation (~1.5 in.), and the apparent delamination of the ACM, enclosure was not considered a favorable alternative. Enclosure is considered inappropriate by EPA standards when the ACM is damaged or deteriorating.

5.2.2 Alternative 3: Encapsulation with Sealants

Encapsulation with sealants has been evaluated by the EPA¹ to determine their effectiveness in controlling the release of asbestos fibers. When applied correctly and under the proper conditions,

sealants can be very effective in controlling airborne asbestos release and can also protect against physical impact. However, results of these studies showed that sealants should not be employed when friable asbestos materials show evidence of poor cohesive strength and extensive damage (e.g., material hanging loose). Furthermore, the application of sealants to friable asbestos should be considered very carefully because the additional weight of a sealant and vibration within the building may cause cohesive failure. For these reasons, Alternative 3 was unacceptable.

5.3 REFERENCE

1. W. Mirick, E. W. Schmidt, C. W. Melton, S. J. Anderson, L. J. Nowacki, and R. Clark, Evaluation of Sealants for Sprayed-On Asbestos-Containing Materials in Buildings, Battelle Columbus Laboratories, Columbus, Ohio, in preparation.

6. EVALUATION OF ACCEPTABLE ALTERNATIVES

The following discussion summarizes the estimated costs for each acceptable alternative, the environmental and public health assessments, and the principal regulatory requirements. The cost of implementing each asbestos control alternative includes compliance with the guidelines set by the various regulatory bodies. These guidelines set standards for protecting the environment, the general public, and on-site workers from exposure to airborne asbestos.

6.1 COST ANALYSIS

6.1.1 Alternative 1: Establishing a Special Operations and Maintenance Program

This alternative includes the tasks necessary to (1) clean up asbestos fibers previously released, (2) prevent future release by minimizing ACM disturbance or damage, and (3) monitor the condition of the ACMs. A special Operations and Maintenance Program would be established and would remain in effect until all ACM has been removed.

A summary of estimated costs associated with Alternative 1 is given in Table 6.1. The cost associated with the initial control of asbestos is a one-time charge; the costs thereafter are incurred from an active Operations and Maintenance Program. The estimated cost in 1988 dollars for cleanup of the asbestos debris and repair of damaged pipe insulation within the facility is \$34,500, which includes a 15% contingency fee.

A continuing Operations and Maintenance Program will be required as long as asbestos remains in the facility. The estimated annual operating cost in 1988 dollars is \$7,500, including a 15% contingency fee. The total cost of the Operations and Maintenance Program depends on the length of time that the asbestos remains in the facility. An estimate of the costs for a 5-year period is given in Table 6.2. The cutoff date for cost accumulation was taken as 1992 since the projected completion date for dismantlement of the entombed reactor is 1992; the dismantlement of the entombed reactor will include the removal of asbestos within the containment shell. Calculations were made for several cost escalation factors.

Table 6.1. Estimated implementation costs for Alternative 1:
establishing a special Operations and Maintenance Program

Basis: 1988 dollars

Asbestos Control	
Initial cleaning and pipe insulation enclosure	\$30,000
Subtotal	30,000
Contingency (15%)	4,500
Total	34,500
Operating and Maintenance Program (Annual cost)	
Documentation, education, training	2,500
Cleaning and maintenance (dependent on delamination rate)	1,000 ^a
Inspection/sampling	<u>3,000</u>
Subtotal	6,500
Contingency (15%)	1,000
Total	7,500

^aCosts are evaluated under current conditions; however, they will increase as the rate of deterioration/delamination increases.

Table 6.2. Estimated accumulated cost for an Operations and Maintenance Program in 1988 dollars (Alternative 1)

Year	Cost
1988	\$ 7500
1989	15000
1990	22500
1991	30000
1992	37500

6.1.2 Alternative 4: Removal, Disposal, and Replacement

Alternative 4 examined the tasks that are necessary to remove all ACMs from the containment shell within Facility 20470. The costs of removing ACMs depend on at least five factors. The first factor is geographic location. Because the removal of ACMs is a highly labor-intensive activity, the cost estimates reflect wage differentials across the country. In addition, the differences in cost may reflect the cost burden associated with state and local regulations. The second factor is the type of asbestos contained in the materials. Contractors, for instance, sometimes quote a higher price for the removal of amosite versus chrysotile asbestos. The third factor involves the type of removal procedure used, that is, whether it could be done in a single phase or if two or more phases would be required. The fourth factor is related to the specific type of application. For example, if the ACM consists of fireproofing insulation on structural steel, removal costs depend on whether the insulation is exposed or requires removal of a ceiling, and whether the ceiling is fixed or stationary. The fifth factor involves the replacement of the ACM. While replacement insulation materials appear to be more-or-less standard in cost, the replacement costs of ceiling materials can vary substantially, depending on the type desired.

For Alternative 4, the following factors exist: (1) the prevailing wage rate within the Dayton area is \$21.68 per hour for asbestos workers and is \$11.86 for hazardous removal helpers; (2) the prevailing type of asbestos is chrysotile, with a small quantity of amosite; (3) the removal of ACMs will be done in phases due to the height of the containment shell and standard asbestos removal techniques; (4) the insulation is exposed; and (5) the ACM will be replaced with a suitable non-asbestos insulation.

Numerous contractors were contacted to obtain a preliminary estimate for removal, disposal, and replacement of ACMs. A cost estimate was not possible without an on-site inspection by the contractor; however, approximate price ranges were given. These price ranges proved

to vary significantly, from \$14 to \$90/ft². Based on the conditions that exist within the containment shell for removing the ACMs, it is estimated that the cost of Alternative 4 will be approximately \$50/ft². An estimated 18,000 ft² of ACMs must be removed, with a 15% contingency. The resulting estimated cost in 1988 dollars of Alternative 4 is \$900,000.

6.2 ENVIRONMENTAL AND PUBLIC HEALTH CONSIDERATIONS

The environmental and public health considerations, which are applied to abatement of ACMs that have been deemed hazardous, focus largely on the highly toxic effects that asbestos fibers have on the human body. OSHA states that it "is aware of no instance in which exposure to a toxic substance has more clearly demonstrated detrimental health effects on humans than has asbestos exposure."¹ Since there is no proven safe level for asbestos exposure, attention should be placed on maintaining all human exposures as low as is reasonably achievable. It is unacceptable, from the environmental health perspective, to create situations that may increase the asbestos risk. Efforts should be placed on minimizing the exposure level and the number of individuals that may be exposed.

In the removal of asbestos from facilities (Alternative 4), certain short-term impacts are incurred (e.g., waste disposal, occupational exposure, and transportation) in exchange for the long-term benefits of eliminating the potential health, safety, and economic costs associated with an Operations and Maintenance Program. A summary environmental comparison of the acceptable alternatives (Alternatives 1 and 4) being considered is presented in Table 6.3.

Alternative 1 (see Sect. 5) has the potential for the highest environmental impact of the two acceptable alternatives because the asbestos will remain in the facility. A strongly enforced Operations and Maintenance Program will be required to maintain the facility in a safe condition. If the asbestos is not properly controlled, there are potential health and safety problems.

Table 6.3. Summary environmental comparison of acceptable alternatives for controlling asbestos within the containment shell

	Alternative 1 Operations and Maintenance Program	Alternative 4 Asbestos Removal
Regulatory requirements	Meets EPA guidance for controlling ACM in buildings	Meets all recommendations and regulations
Advantages	Low initial costs	Eliminates potential health, safety, and economic problems associated with asbestos
	Reduces occupational exposures	Eliminates the need for special Operations and Maintenance Program
	Good temporary control measure	
Disadvantages	Continuing care required for indefinite time	Replacement with substitute material
	Potential health, safety, and economic costs with maintaining asbestos control program	Improper removal may raise fiber levels
	Area access must be regulated	

6.3 REGULATORY REQUIREMENTS

Control of the hazards posed by ACM is mandated on federal facilities. The most significant of these regulations are the EPA and OSHA laws. While federal compliance with EPA regulations is generally mandated by the specific environmental act (e.g., Clean Air Act), federal agencies are required to comply with OSHA standards through the Executive Order Part 1640.

For WPAFB, the primary EPA regulation that applies to the ACM in the containment facility is the National Emission Standards for Hazardous Air Pollutants (NESHAPS). This regulation mandates control of air emissions from ACM, has specific control requirements for removal of asbestos, and requires notification and permitting prior to demolition of ACM. This EPA regulation is enforced by the Regional Air Pollution Control Agency (RAPCA) in Dayton, Ohio. The NESHAPS regulations have been included as Appendix D.

The employees of WPAFB are protected from the asbestos hazard by the OSHA standards. The pertinent OSHA asbestos regulation for operations and maintenance and for removal activities is the 29 CFR 1926.58 regulation, which is included in Appendix E.

6.4 REFERENCE

1. Fed. Regist. 51 (1A), 22615 (June 20, 1986).

7. RECOMMENDATIONS

Two recommendations are made as a result of this study. They are: (1) Alternative 4, is the preferred asbestos abatement plan, and (2) Alternative 1 should be developed and implemented until Alternative 4 is established. The rationale behind these recommendations is explained in Sects. 7.1 and 7.2.

7.1 PREFERRED ASBESTOS ABATEMENT PLAN

To determine a preferred asbestos abatement plan for the containment shell area of Facility 20470 at the WPAFB in Ohio, a technical and economic assessment of available alternatives was evaluated by ORNL for DoD in support of the IRP.

The four alternatives for study were:

Alternative 1: Establishing a special operations and maintenance program

Alternative 2: Enclosure

Alternative 3: Encapsulation with sealants

Alternative 4: Removal, disposal, and replacement

Alternative 1 is designed to (1) clean up asbestos fibers previously released, (2) prevent future releases by minimizing the disturbance or damage of ACM, and (3) monitor the condition of the ACM. This program should continue until all ACM is removed or the building is demolished. Implementation of this alternative will only ensure better control over the environment than now exists. Alternative 2 would involve constructing an airtight ceiling and walls around the sprayed-on asbestos. Building blueprints designating the presence of asbestos behind the enclosure would be maintained to prevent accidental fiber release during building repair or demolition, and signs would be posted to note that ACM is behind the enclosure. Alternative 3 would bind together the asbestos fibers and other material components to offer some resistance to damage from impact. Alternative 4 would remove the ACMs, transport the material to an approved landfill, and reinsulate the containment shell with asbestos-free material. Completion of this alternative would eliminate the need for an Operations and Maintenance Program.

Each alternative was evaluated on the bases of technical feasibility, environmental impact, economics, and fulfillment of the goals of the IRP. From the results of the evaluation, Alternative 4 was chosen as the preferred asbestos abatement plan. At the time of this evaluation, no significant asbestos fiber levels were detected, but the factors that can lead to airborne fiber levels are present, and the potential for excessive air levels in the area does exist. The calculated high exposure rating indicates that a significant ongoing risk is present to those entering the containment area. Alternative 4 will eliminate any potential health, safety, and economic problems associated with maintaining a facility with ACMs by removing all ACMs. Alternatives 2 and 3 were found to be unacceptable. Because of the high friability and the apparent delamination of the ACM, enclosure (Alternative 2) is considered inappropriate by EPA standards. Alternative 3 (encapsulation with sealants) was found unacceptable because of the EPA studies that demonstrated that sealants should not be used when friable asbestos materials show evidence of poor cohesive strength and extensive damage. Alternative 1 (Operations and Maintenance Program) is a temporary control measure that is dependent on the deterioration rate of the ACM and will exclude entry into the containment shell area without close review and adherence to the Operations and Maintenance Program.

7.2 INTERIM PLAN

Immediate action should be taken to clean up asbestos debris on the floor, ladder, catwalk, and ledges in the containment area. This work should be conducted by individuals who are medically approved, trained, and protected as required by OSHA regulations, according to Title 29, Code of Federal Regulations, Part 1926.58.

Future work, such as maintenance and inspection activities, should be performed by trained and protected workers. Additionally, periodic monitoring of this facility should be conducted to determine the degree of delamination of asbestos insulation and to evaluate airborne asbestos levels.

At the time of this evaluation, no significant asbestos fiber levels were detected, but the factors that can lead to airborne fiber levels are present and the potential for excessive air levels in the containment area does exist.

A formal Operations and Maintenance Program for controlling occupational exposures should be instituted until Alternative 4 (removal, disposal, and replacement) is implemented.

Industrial Hygiene Report
Wright-Patterson Air Force Base
Facility 20470
Reactor Containment Area

Appendix A. ASSESSMENT OF ASBESTOS-CONTAINING MATERIAL AT FACILITY
20470 BY OAK RIDGE NATIONAL LABORATORY INDUSTRIAL HYGIENE DEPARTMENT

Appendix A. ASSESSMENT OF ASBESTOS-CONTAINING MATERIAL
AT FACILITY 20470 BY THE OAK RIDGE NATIONAL LABORATORY
INDUSTRIAL HYGIENE DEPARTMENT

A.1 Purpose: The purpose of this report was to present the findings of a limited industrial hygiene survey that was conducted at Wright-Patterson Air Force Base (WPAFB), Facility 20470, on December 14, 1987. This report was designed to present information necessary to ensure the adequate protection of employees who enter and work in the containment area.

Included in the report are:

- a discussion of the nature of the asbestos hazard as related to the occupational environment;
- a description of the methods used in conducting the survey;
- a presentation of the results of the evaluation and analysis;
- a discussion of the results; and
- recommendations based on the results.

A.2 Scope: This industrial hygiene survey was limited to evaluation of the sprayed-on insulation and the pipe insulation found in the area of containment. Since no employees were present in this area, actual personnel exposures were not determined. Activities and significant movement in the containment area would increase the likelihood that airborne asbestos fibers might be present in the environment.

A.3 Nature of the Hazard Asbestos:

Asbestos is a generic name given to fibrous mineral silicates. In the past, these minerals have been widely used in materials that required their characteristic heat and chemical resistance. The most common types of asbestos found in insulation products are chrysotile, amosite, and crocidolite. In recent years, these minerals have received considerable attention because of their high toxicity to humans. Three major diseases are associated with exposure to airborne asbestos fibers:

1. Chronic exposure to high levels of airborne asbestos has been shown to cause a debilitating, and often fatal, lung disorder called asbestosis.
2. Any level of exposure to asbestos increases the risk of lung cancer; there is a dramatic increase in the risk of lung cancer for those who smoke and are exposed to asbestos.
3. Similarly, exposure to asbestos will increase the risk of mesothelioma, a fatal cancer of the lining of the pleural or peritoneal cavity.

Although research has indicated that there is a different degree of risk associated with the various types of asbestos, present governmental regulations do not make a distinction of asbestos by types.

A.4 Methods:

This survey of ACMs was conducted using three methods of evaluation:

1. a visual assessment of the area/insulation,
2. bulk sampling and analysis, and
3. air sampling and analysis.

A visual assessment was conducted to determine the status of building insulation materials that were recognized as having potential for a significant asbestos content. Specific attention was given to those physical and environmental factors that were recognized as increasing the degree of fiber release: (1) evidence of deterioration or delamination from the underlying surface, (2) evidence of physical damage, and (3) evidence of water damage. The potential for future disturbance, damage, or erosion of ACM was evaluated by observing (1) the proximity of ACM to an air plenum or a direct airstream; (2) the visibility, accessibility, and degree of activity (air movement, vibration, movement of building occupants); and (3) the change in building use.

During the visual survey, an assessment work sheet, which was developed by the Environmental Protection Agency's (EPA's) Atlanta Regional Office in January 1981, was completed. This work sheet, "Assessment of Exposure Potential from Asbestos-Containing Materials," was used to determine a numerical degree of hazard rating, which determines appropriate abatement actions.

Bulk insulation samples were collected for analysis of asbestos content, type, and radiological activity. The analysis of the samples for asbestos was performed using EPA-recommended methods of polarizing light and dispersion-staining techniques. The Industrial Hygiene Department at Oak Ridge National Laboratory (ORNL) is a "proficient" participant in the EPA Analytical Proficiency Program.

In addition to asbestos content, the bulk samples were subjected to low-level radiochemical analysis (a test for gross alpha, beta, and gamma activity), which was performed using EPA 900 and 901.1 methods of analysis.

Air samples were collected to determine the prevalent levels of airborne asbestos. The 7400 method, prescribed by the National Institute for Occupational Safety and Health (NIOSH), was followed in collecting air samples with a modified air sampling rate of approximately 20.0 L/min.

The filter samples were analyzed using the NIOSH 7400 method as well as the EPA-recommended transmission electron microscopy techniques for counting and identification of airborne fibers.

"Real-time" analysis of total airborne fibers was performed during this survey using an MIE* Fibrous Aerosol Monitor (FAM-1). This instrument analyzes total airborne fibers and yields results that are comparable to the NIOSH 7400 procedure.

A.5 Survey Results:

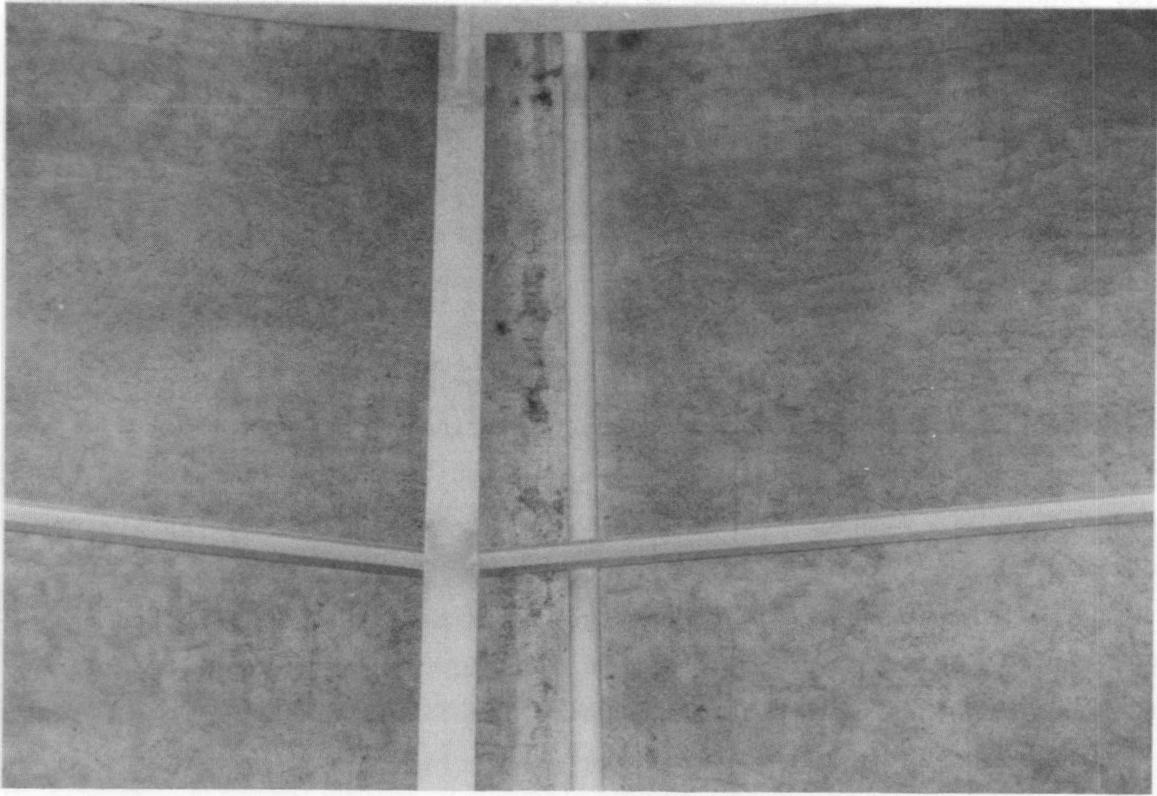
A.5.1 Visual Evaluation

When visually evaluated, the sprayed-on insulation on the interior of the containment shell was found to have the following characteristics:

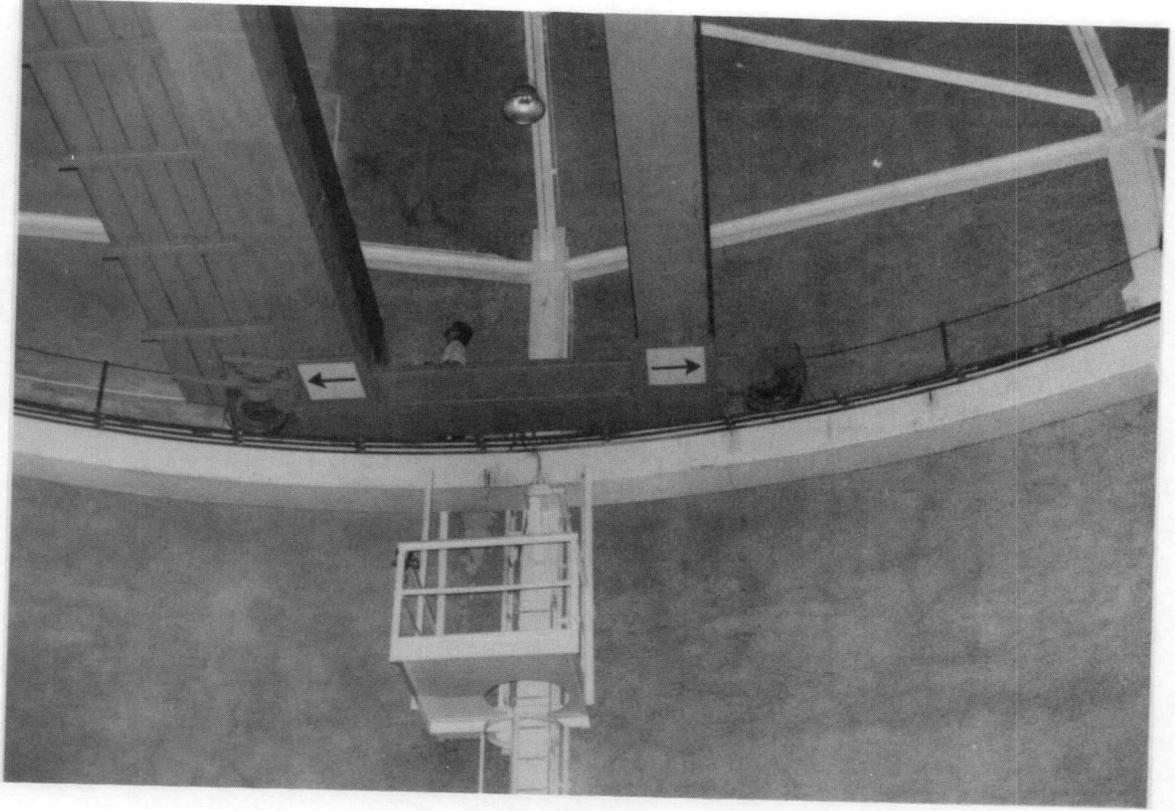
Condition of the material: Widespread moderate damage and severe damage on the Northwest walls and in the vicinity of the catwalk and ladder (see photographs 1, 2, 3, and 4).

Water damage: No damage could be directly attributed to water damage.

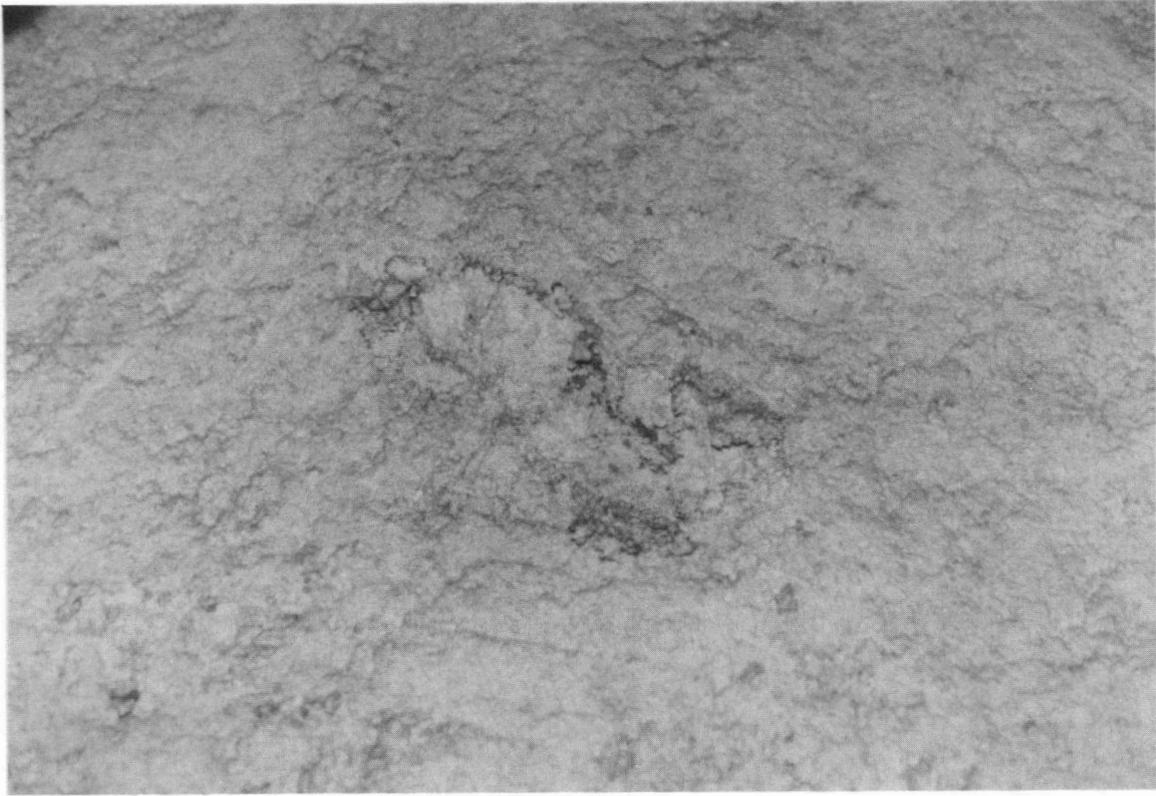
*Monitoring Instruments for the Environment, Inc.



Photograph 1



Photograph 2



Photograph 3



Photograph 4

The entire incident is being investigated in the laboratory. The laboratory is located at the University of California, Berkeley, California. The laboratory is located at the University of California, Berkeley, California. The laboratory is located at the University of California, Berkeley, California.

Exposure number	Exposure date	Exposure time
1	10/1/57	10:00
2	10/1/57	10:15
3	10/1/57	10:30
4	10/1/57	10:45
5	10/1/57	11:00
6	10/1/57	11:15
7	10/1/57	11:30
8	10/1/57	11:45
9	10/1/57	12:00
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96	10/1/57	33:45
97	10/1/57	34:00
98	10/1/57	34:15
99	10/1/57	34:30
100	10/1/57	34:45

Exposed surface area: The entire insulated surface is open or exposed (photograph 2).

Accessibility: The asbestos insulation has obvious damage, and contact is unavoidable in those areas near the catwalk and ladder. Maintenance of steam lines and the ventilation system would result in contact with asbestos insulation (photographs 2 and 5).

Activity and movement: Low to moderate activity would take place in the containment area at this time. This activity would primarily result from maintenance and inspection.

Air plenum or direct air stream: The ventilation system creates air movement on the insulated surfaces.

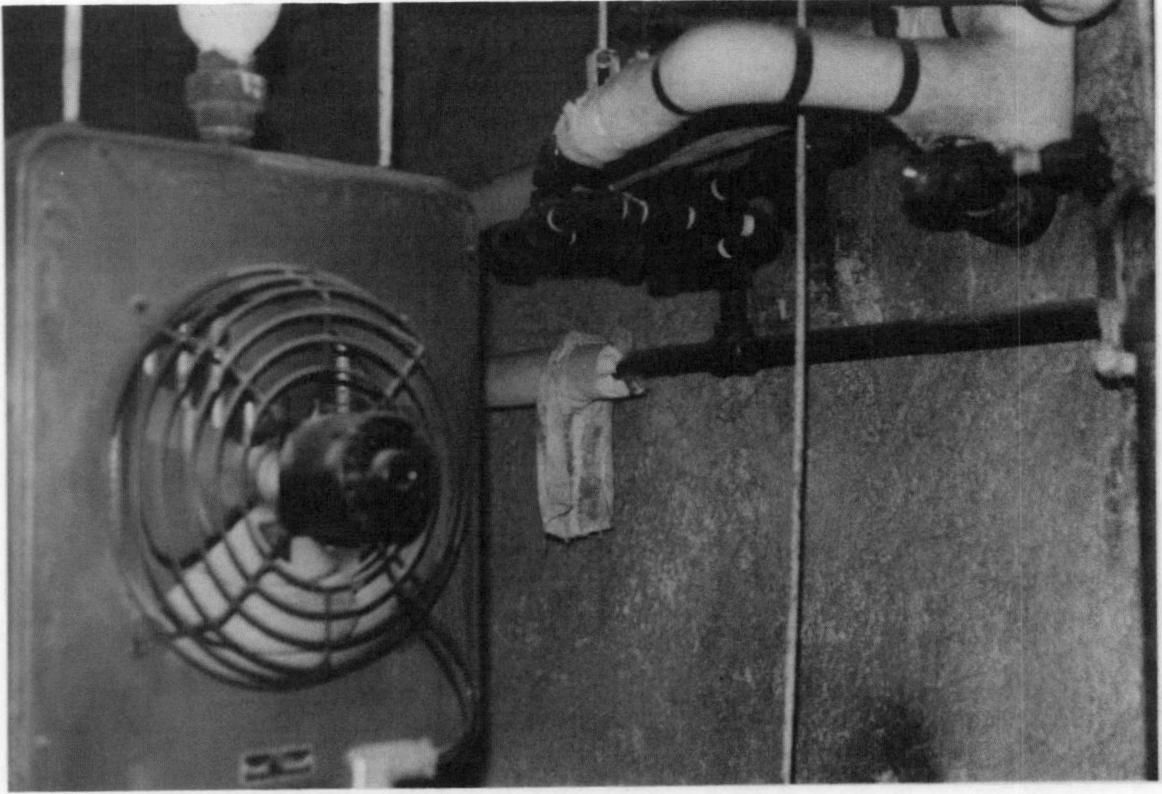
Friability: Insulation is fluffy and spongy and pieces were hanging from the surface (photograph 6).

Asbestos content: The analysis indicated that the percentage of asbestos in the insulation is moderate (i.e., 1 to 50% asbestos).

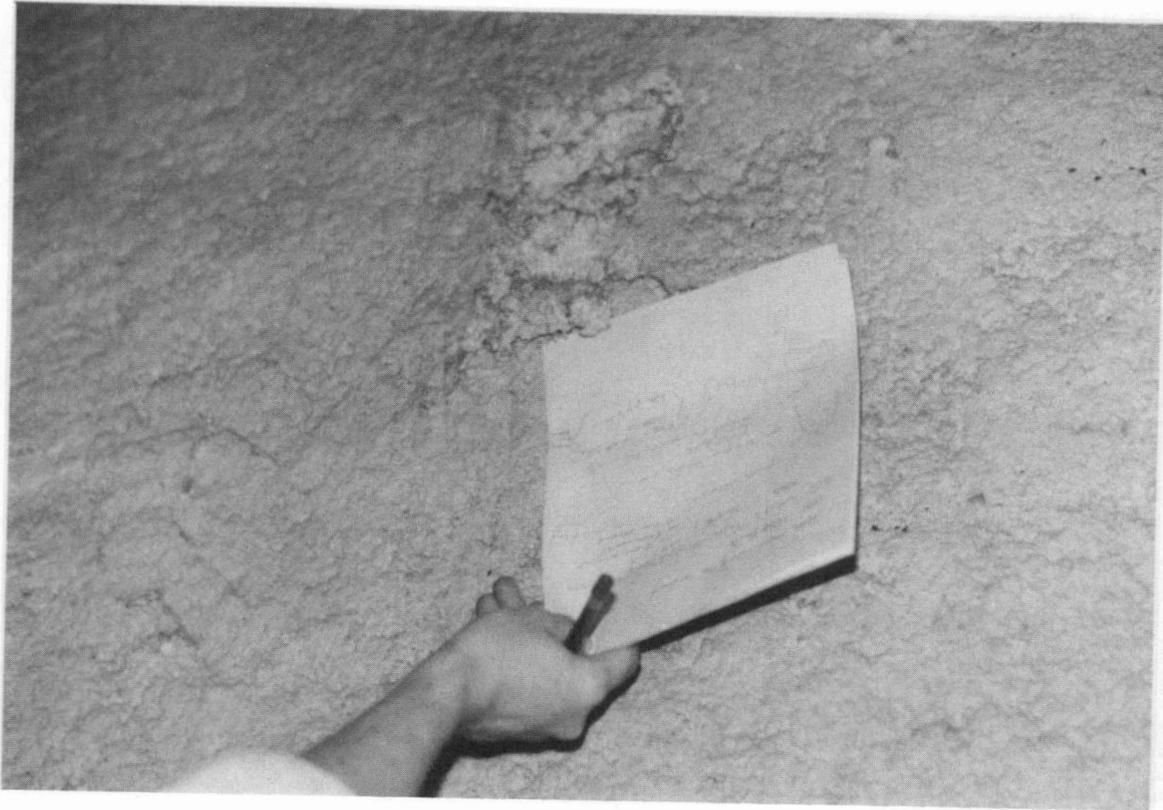
Given the noted observations, an EPA exposure number (index)^{*} was calculated as follows:

	<u>Factors</u>	<u>Possible scores</u>	<u>Assigned score</u>	
1.	Condition	(0,2,5)	5	
2.	Water damage	(0,1,2)	0	
3.	Exposed surface	(0,1,4)	4	Sum = 15
4.	Accessibility	(0,1,4)	4	
5.	Activity/movement	(0,1,2)	1	
6.	Air plenum/air stream	(0,1)	1	
7.	Friability	(1,2,3)	3	
8.	Asbestos content	(0,2,3)	2	Sum = 5
	Product of 2 sums = 75 = exposure number			

^{*}Fed. Regist. 45 (182), 61961 (1980).



Photograph 5



Photograph 6

A.5.2 Evaluation of Asbestos-Containing Pipe Insulation

In addition to the potential hazard posed by the sprayed-on insulation, it was noted that the low-pressure steam lines were insulated with asbestos-containing lagging. Damage to the pipe insulation covering was observed near the heating units. Friable asbestos was exposed in the vicinity of the heater. No other significant damage to the pipe insulation was noted.

A.5.3 Description of Bulk and Air Samples Collected

The following is a description of the industrial hygiene samples that were obtained on December 14, 1987, in the reactor containment building.

Sample No.

- RBO-01 Sample blank, 0.8- μ m mixed cellulose ester filter.
- RBO-02 Air sample (1310 L) taken in the center of the containment building on entombment. Open-faced cassette with 0.8- μ m cellulose ester filter. Sample was collected from 10:58 a.m. to 12:02 p.m.
- RBO-03 Air sample (1146 L) taken at the wall entombment interface at west wall. Open-faced cassette with 0.8- μ m mixed-cellulose ester filter. Sample was collected from 10:00 a.m. to 10:56 a.m.
- RBO-04 Air sample (1167 L) taken outside the reactor containment building using "open-faced" mixed-cellulose ester filter. Sample was collected from 12:22 p.m. to 1:19 p.m.
- RBO-05 Bulk material sample from open friable pipe insulation at south side of the containment building. Pipes were labeled "low-pressure steam line."
- RBO-06 Bulk material sample, debris from floor in front of the air lock inside containment area.
- RBO-07 Bulk material sample, friable insulation on containment shell near west wall/ledge at entombment.
- RBO-08 Same as RBO-07 but taken at catwalk.
- RBO-09 Bulk material; debris fallen on entombment in center of containment building.

*Fed. Regist. 45 (182), 61961 (1980).

A.5.4 Sample AnalysesAir Analysis - NIOSH 7400 Method

<u>Sample No.</u>	<u>Results</u>
RBO-01	Blank - 4 fibers/100 fields
RBO-02	Less than 0.005 f/cm ³ (fibers per cm ³ air sampled)
RBO-03	Less than 0.006 f/cm ³
RBO-04	Less than 0.006 f/cm ³

Air Analysis - Transmission Electron Microscopy
EPA-600/2-77-178 Method

<u>Sample No.</u>	<u>Results</u>
RBO-02	No asbestos fibers counted in 10 grids (6 x 10 ⁻⁵ cm ² per grid)
RBO-03	No asbestos fibers counted in 10 grids (6 x 10 ⁻⁵ cm ² per grid)
RBO-04	No asbestos fibers counted in 10 grids (6 x 10 ⁻⁵ cm ² per grid)

Air Analysis - MIE Fibrous Aerosol Monitor

<u>Sample location</u>	<u>Sample duration</u>	<u>Results</u>
West side on entombment	100 min	0.06 f/cm ³
Center (top of entombment)	10 min	0.06 f/cm ³
Center (top of entombment)	10 min	0.00 f/cm ³
At entrance air lock	10 min	0.00 f/cm ³

Bulk Analysis - Polarizing Light-Dispersion Staining

<u>Sample No.</u>	<u>% Asbestos</u>	<u>Asbestos type</u>
RBO-05	5-10	Amosite
RBO-06	n/a debris sample	Chrysotile
RBO-07	10-20	Chrysotile (~70% fiberglass)
RBO-08	5-10	Chrysotile (~70% fiberglass)
RBO-09	5-10	Chrysotile (~70% fiberglass)

Low-Level Radiochemical Analysis

<u>Sample No.</u>	<u>Gross Alpha</u>	<u>Gross Beta</u>	<u>Gross Gamma</u>
RBO-05	190 <u>+170 Bq/kg</u>	120 <u>+70 Bq/kg</u>	0.27 <u>+0.58 Bq/kg</u>
RBO-06	4.7×10^3 <u>+3.1 x 10³ Bq/kg</u>	5.6×10^3 <u>+2.5 x 10³ Bq/kg</u>	0.14 <u>+0.58 x Bq/kg</u>
RBO-07	620 <u>+380 Bq/kg</u>	710 <u>+280 Bq/kg</u>	0.65 <u>+0.59 Bq/kg</u>
RBO-08	630 <u>+300 Bq/kg</u>	460 <u>+150 Bq/kg</u>	1.8 <u>+0.6 Bq/kg</u>
RBO-09	990 <u>+760 Bq/kg</u>	1.8×10^3 <u>+0.7 x 10³ Bq/kg</u>	0.98 <u>+0.59 Bq/kg</u>

A.6 DISCUSSION OF RESULTS

The visual evaluation and characterization of the sprayed-on insulation on the containment shell were summarized by calculating an exposure number of 75. This numerical rating is indicative of serious potential for human exposure. The widespread asbestos-containing debris poses a high risk of exposure to individuals entering the containment area. These conditions violate present Occupational Safety and Health Administration (OSHA) regulations.

Based on the air samples collected during this evaluation, it is apparent that background asbestos air contamination in the containment area is minimal. All samples indicated levels that were well below present occupational exposure limits (OSHA - 0.2 f/cm³, 8-h TWA*). Caution should be exercised in interpretation of these data because the air samples taken on December 14, 1987, were collected under conditions of minimal employee activity. The only disturbance of insulation and debris occurred during the movement of the people conducting the survey.

*time-weighted average

Employees working in the containment area could incur significant exposures. Activities such as cleaning of floors or equipment or climbing and walking on the catwalk could also produce airborne exposure to asbestos fibers.

Bulk analysis confirmed the presence of a significant percentage of asbestos in all the samples. Asbestos-containing debris was noted on most surfaces in the containment area. The damaged pipe lagging exposed insulation containing amosite asbestos, while the sprayed-on insulation contained a moderate percentage of chrysotile asbestos. The evaluation of bulk materials included an evaluation of the degree of friability and deterioration of these materials. It was apparent that the ACMs were highly friable and were undergoing significant deterioration and delamination. The presence of widespread debris and visible delamination at random locations was evidence of the deterioration of these materials.

The samples that were collected for bulk asbestos analysis were also analyzed for the presence of radioactivity. The primary responsibility for regulation of the safety and health aspects of radioactive materials resides with the Nuclear Regulatory Commission (NRC). The NRC was contacted for assistance in determining the significance of the level of radioactivity present in these samples. The highest level of alpha activity exhibited in these samples would be indicative of Type A nuclear waste. To fully describe the beta and gamma activity, a designation of the predominant source radionuclide would be necessary; and such a study is beyond the scope of this industrial-hygiene-oriented survey.

Recommendations

Immediate action should be taken to clean up asbestos debris on the floor, ladder, catwalk, and ledges in the containment area. This work should be conducted by individuals who are medically approved, trained, and protected as required by OSHA regulations, according to Title 29, Code of Federal Regulations, Part 1926.58.

Future work, such as maintenance and inspection activities, should be performed by trained and protected workers. Additionally, periodic

monitoring of this facility should be conducted to determine the degree of delamination of asbestos insulation and to evaluate airborne asbestos levels.

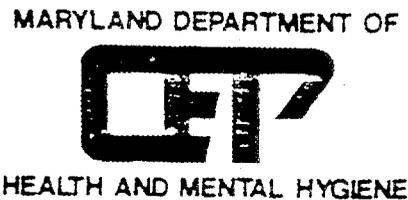
At the time of this evaluation, no significant asbestos fiber levels were detected, but the factors that can lead to airborne fiber levels are present, and the potential for excessive air levels in the containment area does exist.

A formal Operations and Maintenance Program for controlling occupational exposures should be instituted until more permanent control measures can be enacted. The enclosure or encapsulation of the friable sprayed-on insulation would not be applicable to the material that is applied to the steel containment shell because of the high friability, the depth of the insulation (1.5 in.), and the fact that the insulation is undergoing delamination. Enclosure or encapsulation can be used to control the risk posed by the broken pipe covering that exposes friable materials.

While an effective Operations and Maintenance Program can ensure that adequate occupational protection is achieved, the recommended control measure is removal of the asbestos-containing insulation. The high exposure rating indicates that a significant ongoing risk is present to those entering the containment area. Additionally, it should be noted that asbestos materials must be removed from the building before final demolition.

Appendix B. RECOMMENDED CONTRACT SPECIFICATIONS FOR ASBESTOS
ABATEMENT PROJECTS

Recommended Contract Specifications for Asbestos Abatement Projects



STATE OF MARYLAND
DEPARTMENT OF HEALTH AND MENTAL HYGIENE
OFFICE OF ENVIRONMENTAL PROGRAMS
SCIENCE AND HEALTH ADVISORY GROUP

WILLIAM M. EICHBAUM
ASSISTANT SECRETARY

April, 1985

RECOMMENDED CONTRACT SPECIFICATIONS
FOR ASBESTOS ABATEMENT PROJECTS

Division of Environmental Disease Control
Science and Health Advisory Group
Office of Environmental Programs
Maryland Department of Health and Mental Hygiene

William M. Eichbaum
Assistant Secretary

In partial fulfillment of the
requirements for the United States
Environmental Protection Agency
TSCA Cooperative Agreement
Project CX812288-01-0

EPA Project Officers

Pamela R. Harris

Stephen Schanemann

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NOTICE

The material in this document has been reviewed by the Maryland Department of Health and Mental Hygiene, Office of Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Department of Health and Mental Hygiene or the United State Environmental Protection Agency, nor does mention of trade names of commerical products constitute endorsement or recommendations for use.

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PART 1 - General Information

1.1 Bidding Requirements

1.1.1 Site Investigation

1.1.1.1 By submitting a bid, the Contractor acknowledges that he has investigated and satisfied himself as to a) the conditions affecting the work, including but not limited to physical conditions of the site which may bear upon site access, handling and storage of tools and materials, access to water, electric or other utilities or otherwise affect performance of required activities; b) the character and quantity of all surface and subsurface materials or obstacles to be encountered in so far as this information is reasonably ascertainable from an inspection of the site, including exploratory work done by the Building Owner or a designated consultant, as well as information presented in drawings and specifications included with this contract. Any failure by the Contractor to acquaint himself with available information will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Building Owner is not responsible for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Building Owner.

1.1.1.2 No bids will be accepted from any Contractor who has not inspected the job site either in person or through a qualified designated representative.

1.1.1.3 Bidders shall attend a pre-bid meeting to be held [Insert time, place]. Attendance at this meeting by the Bidder or his qualified representative is a mandatory prerequisite for the acceptance of a bid from that Contractor.

1.1.1.4 Bidders are advised to take representative samples of the material for analysis. Abatement procedures and equipment will vary depending on material composition. This should be reflected in bid proposals.

1.1.2 Discrepancies

1.1.2.1 Should a Bidder find discrepancies in the plans and/or specifications or should he be in doubt as to the meaning or intent of any part thereof, he must, no later than () days prior to the bid opening, request clarification from the Building Owner. Discrepancies with regard to conflicts between the Contract Documents

and applicable Federal, State or Local regulations or requirements shall be included herein. Failure to request such clarification is a waiver to any claim by the Bidder for expense made necessary by reason of later interpretation of the Contract Documents by the Building Owner.

1.1.2.2 Explanations desired by a prospective Bidder regarding the contract drawings [Insert drawings in Appendix], specifications or other bid documents shall be requested in writing from the Building Owner no later than [] days prior to the bid opening. Requests shall include the contract number and name and shall be directed to [insert address]

1.1.2.3 Oral explanations or instruction will not be binding. Only written addenda are binding. Any addenda resulting from these requests will be mailed to all listed holders of the Bid Document no later than [] days prior to the bid opening. The Bidder shall acknowledge the receipt of all addenda.

1.1.3 Modification and Withdrawal of Bids

1.1.3.1 Withdrawal or modifications to bids are effective only if written notice thereof is filed prior to time of bid opening and at the place specified in the Notice to Bidders. A notice of withdrawal or modifications to a bid must be signed by the Contractor or his designated representative.

1.1.3.2 No withdrawal or modifications shall be accepted after the time for opening of proposals.

1.1.4 Bid Security

1.1.4.1 Each Bidder must furnish a bid bond issued by a reputable security company with his proposal. The bond must be in an amount not less than [] percent of the amount of the base bid. Other security may be acceptable as agreed to by the Building Owner.

1.1.4.2 Insurance requirements- The Contractor shall purchase and maintain insurance that will protect him from claims that may arise out of or result from his activities under this Contract, whether those activities are performed by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable.

1.1.4.2.1 Bidders shall submit proof of coverage under the Workman's Compensation insurance system of the State of [] or other similar benefit acts.

1.1.4.2.2 Bidders shall submit a certificate of general liability insurance for personal injury, occupational disease and sickness or death and property damage. Insurance shall include "Occurrence" claim provisions. Minimum acceptable coverage is:

\$1,000,000 Combined Single Limit for Bodily Injury and
Property Damage or

\$500,000 Bodily Injury and \$250,000 Property Damage (each
occurrence)

(NOTE: Building Owner must determine the appropriate coverage for specific projects. Insurance policies of this nature routinely explicitly prohibit recovery for incidents involving toxic substances. Contractor must be able to document that he has notified his insurance carrier of the nature of his work involvement with asbestos and that the coverage in effect specifically includes an endorsement for asbestos abatement activities. The Building Owner should consult with his insurance carriers and legal representatives for any specific provisions that they may require for the abatement contract or for insurance coverage and to review Bidder submissions.)

1.1.4.2.3 The Building Owner shall provide vehicle liability and property damage insurance for the duration of the project.

1.1.4.2.4 (Any additional insurance requirements)

1.1.4.2.5 If the Owner permits the Contractor to use any of the Owner's equipment tools or facilities, such use will be gratuitous and the Contractor shall release the Owner from any responsibility arising from claims for personal injuries, including death, arising out of the use of such equipment, tools, or facilities irrespective of the condition thereof or any negligence on the part of the Owner in permitting their use.

1.1.4.3 Should the Bidder to whom the contract is awarded fail or be unable to execute the contract for any reason within [] days after notification of award, then an amount equal to the difference between the acceptable bid price, and that of the next highest Bidder shall be paid to the Building Owner as liquidated damages.

and applicable Federal, State or Local regulations or requirements shall be included herein. Failure to request such clarification is a waiver to any claim by the Bidder for expense made necessary by reason of later interpretation of the Contract Documents by the Building Owner.

1.1.2.2 Explanations desired by a prospective Bidder regarding the contract drawings [Insert drawings in Appendix], specifications or other bid documents shall be requested in writing from the Building Owner no later than [] days prior to the bid opening. Requests shall include the contract number and name and shall be directed to [insert address]

1.1.2.3 Oral explanations or instruction will not be binding. Only written addenda are binding. Any addenda resulting from these requests will be mailed to all listed holders of the Bid Document no later than [] days prior to the bid opening. The Bidder shall acknowledge the receipt of all addenda.

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1.1.3.2 No withdrawal or modifications shall be accepted after the time for opening of proposals.

1.1.4 Bid Security

1.1.4.1 Each Bidder must furnish a bid bond issued by a reputable security company with his proposal. The bond must be in an amount not less than [] percent of the amount of the base bid. Other security may be acceptable as agreed to by the Building Owner.

1.1.4.2 Insurance requirements- The Contractor shall purchase and maintain insurance that will protect him from claims that may arise out of or result from his activities under this Contract, whether those activities are performed by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable.

1.1.4.2.1 Bidders shall submit proof of coverage under the Workman's Compensation insurance system of the State of [] or other similar benefit acts.

1.1.4.4 As a prerequisite to signing the contract and prior to the expiration of () days following notification of award, the Bidder shall have furnished Performance and Payment Bonds and Certificates of Insurance.

1.1.5 Licenses and Qualifications

1.1.5.1 Bidders must be licensed as required by Construction Firm Law of [include citation from appropriate regulations] (where applicable)

1.1.5.2 Bidders must be licensed as required by the [regulatory agency] for the purpose of removal, encapsulation, enclosure, demolition and maintenance of structures or components covered by or composed of asbestos-containing materials [include citation from appropriate regulation].

1.1.5.3 Bidders shall demonstrate prior experience on asbestos abatement projects of similar nature and scope through the submission of letters of reference from the Building Owner's including the name, address and telephone number of contact person (someone specifically familiar with the Contractor's work) for at least three (3) previous users of service. Include descriptions of projects, locations, and records of all air monitoring data that were generated during the project.

1.1.5.4 Bidders shall submit a notarized statement, signed by an officer of the company, containing the following information:

1.1.5.4.1 A record of any citations issued by Federal, State or Local regulatory agencies relating to asbestos abatement activity. Include projects, dates, and resolutions.

1.1.5.4.2 A list of penalties incurred through non-compliance with asbestos abatement project specifications including liquidated damages, overruns in scheduled time limitations and resolutions.

1.1.5.4.3 Situations in which an asbestos related contract has been terminated including projects, dates and reasons for terminations.

1.1.5.4.4 A listing of any asbestos-related legal proceedings/claims in which the Contractor (or employees scheduled to participate in this project) have participated or are currently involved. Include descriptions of role, issue and resolution to date.

1.1.6 The Building Owner reserves the right to reject bids for any reason that serves the best interests of the Building Owner or building occupants. The Building Owner also reserves the right to waive any technicality or irregularity in a bid. Failure to submit requested information/documentation or the submission of incorrect information/documentation will result in automatic disqualification of bid package.

1.2 Definitions

- 1.2.1 Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, repair, demolition and renovation activities.
- 1.2.2 ACGIH - American Conference of Governmental Industrial Hygienists
6500 Glenway Avenue Building D-5
Cincinnati, Ohio 45211
- 1.2.3 AIHA - American Industrial Hygiene Association.
475 Wolf Ledges Parkway
Akron, Ohio 44311
- 1.2.4 Airlock - A system for permitting ingress and egress with minimum air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways separated by a distance of at least 3 feet such that one passes through one doorway into the airlock, allowing the doorway sheeting to overlap and close off the opening before proceeding through the second doorway, thereby preventing flow-through contamination.
- 1.2.5 Air monitoring - The process of measuring the fiber content of a known volume of air collected during a specific period of time. The procedure normally utilized for asbestos follows the NIOSH Standard Analytical Method for Asbestos in Air P&CAM 239 or Method 7400. For clearance air monitoring, electron microscopy methods may be utilized for lower detectability and specific fiber identification.
- 1.2.6 Air Sampling Professional - The professional contracted or employed by the Building Owner to supervise and/or conduct air monitoring and analysis schemes. This individual may also function as the Asbestos Project Manager, if qualified. Supervision of air sampling and evaluation of results should be performed by an individual certified in the Comprehensive Practice of Industrial Hygiene (C.I.H.) and having specialized experience in air sampling for asbestos. Other acceptable

Air Sampling Professionals include Environmental Engineers, Architects, chemists and Environmental Scientists or others with equivalent experience in asbestos air monitoring. This individual shall not be affiliated in any way other than through this contract with the Contractor performing the abatement work.

- 1.2.7 Amended water - Water to which a surfactant has been added.
- 1.2.8 ANSI - American National Standards Institute
1430 Broadway
New York, New York 10018
- 1.2.9 Asbestos means the asbestiform varieties of serpentine (chrysotile), riebeckite (crocidolite), cummingtonite - grunerite (amosite), anthrophyllite, and actinolite, and tremolite.
- 1.2.10 Asbestos containing material (ACM)-Material composed of asbestos of any type and in an amount greater than 1% by weight, either alone or mixed with other fibrous or non-fibrous materials
- 1.2.11 Asbestos containing waste material - asbestos containing material or asbestos contaminated objects requiring disposal.
- 1.2.12 Asbestos Project Manager (also known as Clerk-of-the Works or Competent Person.)-An individual qualified by virtue of experience and education, designated as the Owner's representative and responsible for overseeing the asbestos abatement project. [If an Asbestos Project Manager has been selected, he may be specifically designated here.] See Section 4.3
- 1.2.13 ASTM - American Society For Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103
- 1.2.14 Authorized visitor - The Building Owner [and any designated representatives] and any representative of a regulatory or other agency having jurisdiction over the project.
- 1.2.15 Building Owner - The Owner or his authorized representative.
- 1.2.16 Certified Industrial Hygienist - (CIH) - An industrial hygienist certified in Comprehensive Practice by the American Board of Industrial Hygiene. (See Section 1.2.3 for address)
- 1.2.17 Clean room - An uncontaminated area or room which is a part of the worker decontamination enclosure system with provisions for storage of worker's street clothes and clean protective equipment.

- 1.2.18 Contractor - The individual and/or business with which the Building Owner arranges to perform the asbestos abatement. It is recommended that wherever asbestos abatement is part of a larger project, the asbestos work be contracted separately and distinctly from other contract work. When this is not possible, the Contractor is responsible for the proper completion of project activities in accordance with this contract specifications even where a subcontractor has been retained to perform the actual abatement.
- 1.2.19 Curtained doorway - A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms, typically constructed by placing two overlapping sheets of plastic over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. Other effective designs are permissible.
- 1.2.20 Decontamination enclosure system - A series of connected rooms, separated from the work area and from each other by air locks, for the decontamination of workers and equipment.
- 1.2.21 Demolition - The wrecking or taking out of any load-supporting structural member of a facility together with any related handling operations.
- 1.2.22 Encapsulant - A liquid material which can be applied to asbestos containing material which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).
- 1.2.23 Encapsulation - The application of an encapsulant to asbestos containing materials to control the release of asbestos fibers into the air.
- 1.2.24 Enclosure - The construction of an air-tight, impermeable, permanent barrier around asbestos containing material to control the release of asbestos fibers into the air.
- 1.2.25 EPA - U.S. Environmental Protection Agency
401 M Street S.W.
Washington, D.C. 20460
- 1.2.26 Equipment decontamination enclosure system - That portion of a decontamination enclosure system designed for controlled transfer of

- materials and equipment into or out of the work area, typically consisting of a washroom and holding area.
- 1.2.27 Equipment room - A contaminated area or room which is part of the worker decontamination enclosure system with provisions for storage of contaminated clothing and equipment.
- 1.2.28 Facility - Any institutional, commercial or industrial structure, installation or building.
- 1.2.29 Facility component - Any pipe, duct, boiler, tank, reactor, turbine or furnace at or in a facility or any structural member of a facility.
- 1.2.30 Fixed object - A piece of equipment or furniture in the work area which cannot be removed from the work area.
- 1.2.31 Friable asbestos - Asbestos containing material which can be crumbled to dust, when dry, under hand pressure.
- 1.2.32 Glovebag technique - A method with limited applications for removing small amounts of friable asbestos-containing material from HVAC ducts, short piping runs, valves, joints, elbows, and other non-planar surfaces in a non-contained (plasticized) work area. The glovebag assembly is a manufactured or fabricated device consisting of a glovebag (typically constructed of 6 mil transparent polyethylene or polyvinylchloride plastic), two inward projecting longsleeves, an internal tool pouch, and an attached, labeled receptacle for asbestos waste. The glovebag is constructed and installed in such a manner that it surrounds the object or material to be removed and contains all asbestos fibers released during the process. All workers who are permitted to use the glovebag technique must be highly trained, experienced and skilled in this method.
- 1.2.33 HVAC - Heating, ventilation and air conditioning system
- 1.2.34 HEPA filter - A high efficiency particulate air filter capable of removing particles >0.3 microns in diameter with 99.97% efficiency
- 1.2.35 HEPA vacuum - A vacuum system equipped with HEPA filtration
- 1.2.36 Holding area - A chamber in the equipment decontamination enclosure located between the washroom and an uncontaminated area. The holding area comprises an airlock.
- 1.2.37 Movable object - A piece of equipment or furniture in the work area which can be removed from the work area.
- 1.2.38 Negative pressure ventilation system - A portable exhaust system equipped with HEPA filtration and capable of maintaining a constant

low velocity air flow into contaminated areas from adjacent uncontaminated areas.

- 1.2.39 NESHAPS - The National Emission Standards for Hazardous Air Pollutants
(40 CFR Part 61)
- 1.2.40 NIOSH - The National Institute for Occupational Safety and Health
CDC - NIOSH
Building J N.E. Room 3007
Atlanta, Ga. 30333
- 1.2.41 OSHA - The Occupational Safety and Health Administration
200 Constitution Avenue
Washington, D.C. 20210
- 1.2.42 Outside air - The air outside buildings and structures.
- 1.2.43 Plasticize - To cover floors and walls with plastic sheeting as herein specified.
- 1.2.44 Prior experience - Experience required of the contractor on asbestos projects of similar nature and scope to insure capability of performing the asbestos abatement in a satisfactory manner. Similarities shall be in areas related to material composition, project size, abatement methods required, number of employees and the engineering, work practice and personal protection controls required.
- 1.2.45 Removal - The stripping of any asbestos containing materials from surfaces or components of a facility.
- 1.2.46 Renovation - Altering in any way one or more facility components. Operations in which load-supporting structural members are wrecked or taken out are excluded.
- 1.2.47 Shower room - A room between the clean room and the equipment room in the worker decontamination enclosure with hot and cold or warm running water controllable at the tap and suitably arranged for complete showering during decontamination.
- 1.2.48 Staging area - Either the holding area or some area near the waste transfer airlock where containerized asbestos waste has been placed prior to removal from the work area.
- 1.2.49 Strip - To take off friable asbestos materials from any part of facility
- 1.2.50 Structural member - Any load-supporting member of a facility, such as beams and load-supporting walls or any non-load-supporting member, such

as ceilings and non-load-supporting walls.

- 1.2.51 Surfactant - A chemical wetting agent added to water to improve penetration.
- 1.2.52 Visible emissions - Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments.
This does not include condensed uncombined water vapor.
- 1.2.53 Waste transfer airlock - A decontamination system utilized for transferring containerized waste from inside to outside of the work area.
- 1.2.54 Wet cleaning - The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with water and afterwards thoroughly decontaminated or disposed of as asbestos contaminated waste.
- 1.2.55 Work area - Designated rooms, spaces, or areas of the project in which asbestos abatement actions are to be undertaken or which may become contaminated as a result of such abatement actions. A contained work area is a work area which has been sealed, plasticized, and equipped with a decontamination enclosure system. A non-contained work area is an isolated or controlled-access work area which has not been plasticized nor equipped with a decontamination enclosure system.
- 1.2.56 Worker decontamination enclosure - A decontamination system consisting of a clean room, a shower room, and an equipment room separated from each other and from the work area airlocks and contained doorways.
This system is used for all worker events and exist in the work area and for equipment and waste pass out for small jobs.

1.3 Scope of Work

- 1.3.1 This specification covers the abatement of exposure to asbestos hazards from building structures and components listed in 1.3.2. It is the intent of the Contract Documents to show all of the work necessary to complete the project.
- 1.3.2 [Provide a descriptive list of all locations of asbestos containing materials to be abated, including potential add-ons and deletions].
Identify precisely, preferably with drawings, the location of asbestos-containing materials and the types of abatement to be performed. Also provide details regarding the work necessary to restore the project to some specified condition.
- 1.3.3 [Insert other requirements such as general conditions, supplementary general conditions, etc. whenever applicable].

1.4. Description of Work

- 1.4.1 The work specified herein shall be the [removal] [and] [encapsulation] [and] [enclosure] of asbestos containing materials by competent persons trained, knowledgeable and qualified in the techniques of abatement, handling and disposal of asbestos-containing and asbestos-contaminated materials and the subsequent cleaning of contaminated areas, who comply with all applicable Federal, State, and Local regulations and are capable of and willing to perform the work of this Contract.
- 1.4.2 [Provide details concerning abatement measures for each area mentioned in 1.3.2, if more than one technique is to be used during the scope of the Contract].
- 1.4.3 The Contractor shall supply all labor, materials, services, insurance, permits and equipment necessary to carry out the work in accordance with all applicable Federal, State and Local regulations and these specifications.
- 1.4.4 [Provide details on special conditions at the site which must be considered by the Contractor when performing the asbestos abatement (e.g. high temperatures, equipment that must remain in operation, other toxic substances in the air, running through pipes or contaminating surfaces)].
- 1.4.5 The Contractor is responsible for restoring the work area and auxiliary areas utilized during the abatement to conditions equal to or better than original. Any damages caused during the performance of abatement activities shall be repaired by the Contractor (e.g. paint peeled off by barrier tape, nail holes, water damage, broken glass) at no additional expense to the Building Owner.
- 1.4.6 Related work specified elsewhere. (This related work should be specified elsewhere but mentioned here. This would include work such as the replacement of materials for Fireproofing insulation, on soundproofing purposes, work on electrical or mechanical systems, painting, air monitoring, and the installation of new ceiling panels.

1.5 Applicable Standards and Guidelines

1.5.1 General requirements

- 1.5.1.1 All work under this contract shall be done in strict accordance with all applicable Federal, State and Local regulations, standards and codes governing asbestos abatement and any other trade work done in conjunction with the abatement.

1.5.1.2 The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists the most stringent requirements shall be utilized.

1.5.1.3 Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5.2 shall be available at the worksite in the clean change area of the worker decontamination system.

1.5.2 Specific requirements

1.5.2.1 Occupational Safety and Health Administration (OSHA)

1.5.2.1.1 Title 29 Code of Federal Regulations Section 1910.1001 - General Industry Standard For Asbestos.

1.5.2.1.2 Title 29 Code of Federal Regulations Section 1910.134 General Industry Standard For Respiratory Protection.

1.5.2.1.3 Title 29 Code of Federal Regulations Section 1926 Construction Industry

1.5.2.1.4 Title 29 Code of Federal Regulations Section 1910.2 Access to Employee Exposure and Medical Records

1.5.2.1.5 Title 29 Code of Federal Regulations Section 1910.1200 Hazard Communication

1.5.2.2 Environmental Protection Agency (EPA)

1.5.2.2.1 Title 40 Code of Federal Regulations Part 61 Subparts A and M (Revised Subpart B) - National Emission Standard For Asbestos.

1.5.2.3 [Include citations for any State or Local regulations that apply to any phase of the asbestos abatement (e.g. Licensing regulations; disposal requirements.)]

1.5.2.4 [Title of other guidelines, codes, or documents with which the abatement Contractor must comply or be familiar.]

1.6 Submittals and Notices

1.6.1 Contractor shall:

1.6.1.1 Prior To Commencement of Work:

1.6.1.1.1 Should abatement projects involving greater than 160 linear feet of pipe insulation or 260 square feet of sprayed, throwed or otherwise applied material or covering or composing building structures or components, send written notification in accordance with 40 CFR Part 61.146 of Subpart

- M, to the appropriate State or Federal air pollution control agency responsible for the enforcement of the National Emission Standard for Asbestos at least ten (10) days prior to the commencement of any on-site project activity. Provide Building Owner with a copy of the notice. [Attach copy of notification forms and list of air pollution control agencies] [Also notify in writing, with a copy to the Building Owner.]
- 1.6.1.1.2 Submit proof satisfactory to the Building Owner that required permits, site location and arrangements for transport and disposal of asbestos containing waste materials have been made. Obtain and submit a copy of handling procedures and list of protective equipment utilized for asbestos disposal at the landfill, signed by the landfill Owner. (Required for all abatement projects.)
- 1.6.1.1.3 Submit documentation satisfactory to the Building Owner that the Contractor's employees, including foremen, supervisors and any other company personnel or agents who may be exposed to airborne asbestos fibers or who may be responsible for any aspects of abatement activities, have received adequate training that includes, at a minimum, information in Part 4 Section 4.1 of this document.
- 1.6.1.1.4 Submit documentation from a physician that all employees or agents who may be exposed to airborne asbestos in excess of background level have been provided with an opportunity to be medically monitored to determine whether they are physically capable of working while wearing the respirator required without suffering adverse health effects. In addition, document that personnel have received medical monitoring as required in OSHA 29 CFR 1910.1001 (j). The Contractor must be aware of and provide information to the examining physician about unusual conditions in the workplace environment (e.g. high temperatures, humidity, chemical contaminants) that may impact on the employee's ability to perform work activities.
- 1.6.1.1.5 Submit to the Building Owner, shop drawings for layout and construction of decontamination enclosure systems and barriers for isolation of the work area as detailed in this specification and required by applicable regulations. (The Building

Owner may wish to specify these layouts in the specifications.)

- 1.6.1.1.6 With the Building Owner, inspect the premises wherein all abatement and abatement related activities will occur and submit a statement signed by both, agreeing on building and fixture condition prior to the commencement of work.
- 1.6.1.1.7 Submit manufacturer's certification that HEPA vacuums, negative pressure ventilation units and other local exhaust ventilation equipment conform to ANSI Z9.2-79.
- 1.6.1.1.8 When rental equipment is to be used in abatement areas or to transport asbestos contaminated waste, a written notification concerning intended use of the rental equipment must be provided to the rental agency with a copy submitted to the Building Owner.
- 1.6.1.1.9 Document NIOSH approvals for all respiratory protective devices utilized on site. Include manufacturer certification of HEPA filtration capabilities for all cartridges and filters.
- 1.6.1.1.10 Submit pre-abatement air sampling results (if conducted-these samples are optional, since the Contractor rarely has access to the site prior to job initiation.) Include location of samples, name of Air Sampling Professional, equipment, and methods utilized for sampling and analysis. (See sections 1.6.2.1.2 and 4.4.3.1)
- 1.6.1.1.11 Submit documentation of respirator fit-testing for all Contractor employees and agents who must enter the work area. This fit-testing shall be in accordance with qualitative procedures as detailed in the OSHA Lead Standard 29 CFR 1910.1025 Appendix D Qualitative Fit Test Protocol or be quantitative in nature.
- 1.6.1.2 During Abatement Activities
 - 1.6.1.2.1 Submit weekly (or as otherwise required by the Building Owner) job progress reports detailing abatement activities. Include review of progress with respect to previously established milestones and schedules, major problems and action taken, injury reports, equipment breakdown and bulk material and air sampling results conducted by Contractor's Air Sampling Professional.

- 1.6.1.2.2 Submit copies of all transport manifests, trip tickets and disposal receipts for all asbestos waste materials removed from the work area during the abatement process.
 - 1.6.1.2.3 Submit daily, copies of worksite entry logbooks with information on worker and visitor access.
 - 1.6.1.2.4 Submit logs documenting filter changes on respirators, HEPA vacuums, negative pressure ventilation units, and other engineering controls.
 - 1.6.1.2.5 Submit results of bulk material analysis and air sampling data collected during the course of the abatement including OSHA compliance air monitoring results.
 - 1.6.1.2.6 Submit results of materials testing conducted during the abatement for purposes of utilization during abatement activities (e.g. testing of encapsulant for depth of penetration, testing of substitute materials for adherence to encapsulated surfaces)
 - 1.6.1.2.7 Post in the clean room area of the worker decontamination enclosure a list containing the names, addresses, and telephone numbers of the Contractor, the Building Owner, the Asbestos Project Officer, the General Superintendent, the Air Sampling Professionals, the testing laboratory and any other personnel who may be required to assist during abatement activities (e.g. Safety Officer, Building Maintenance Supervisor, Energy Conservation Officer).
- 1.6.2 Owner Shall
- 1.6.2.1 Prior to Commencement of Work:
 - 1.6.2.1.1 Notify occupants of work areas that may be disrupted by the abatement of project dates and requirements for relocation. Arrangements must be made prior to start, for relocation of desks, files, equipment and personal possessions to avoid unauthorized access into the work area. (Note: Notification of all building occupants and users is recommended in order to prevent unnecessary or unauthorized access to the contaminated work area.)
 - 1.6.2.1.2 Submit to the Contractor, results of pre-abatement air sampling (if conducted) including location of samples, names of the Air Sampling Professional, equipment utilized and

method of analysis. (It is recommended that the Building Owner take the responsibility for obtaining pre-abatement air sampling.)

- 1.6.2.1.3 Document that Owner's employees who will be required to enter the work area during abatement have received training equal to that detailed in Part 4, Section 4.1. (This training may be provided by the Contractor's or the Owner's training consultant at the Owner's discretion.)
- 1.6.2.1.4 Provide to the Contractor information concerning access, shut-down and protection requirements of certain equipment and systems in the work area.

1.6.2.2 During Abatement

- 1.6.2.2.1 Submit to the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. These sample results are for information only. They serve only to monitor Contractor performance during the project and shall not release the Contractor from any responsibility to sample for OSHA compliance.

1.7 Site Security

- 1.7.1 The work area is to be restricted only to authorized, trained, and protected personnel. These may include the Contractor's employees, employees of Subcontractors, Owner employees and representatives, State and local inspectors and any other designated individuals. A list of authorized personnel shall be established prior to job start and posted in the clean room of the worker decontamination facility.
- 1.7.2 Entry into the work area by unauthorized individuals shall be reported immediately to the Building Owner by the Contractor.
- 1.7.3 A log book shall be maintained in the clean-room area of the worker decontamination system. Anyone who enters the work area must record name, affiliation, time in, and time out for each entry.
- 1.7.4 Access to the work area shall be through a single worker decontamination system located at [designate a location at the worksite]. All other means of access (doors, windows, hallways, etc.) shall be blocked or locked so as to prevent entry to or exit from the work area. The only exceptions for this rule are the waste pass-out airlock which shall be sealed except during the removal of containerized asbestos

waste from the work area, and emergency exits in case of fire or accident. Emergency exits shall not be locked from the inside, however, they shall be sealed with polyethylene sheeting and tape until needed.

- 1.7.5 Contractor should have control of site security during abatement operations whenever possible, in order to protect work efforts and equipment.
- 1.7.6 Contractor will have Owner's assistance in notifying building occupants of impending activity and enforcement of restricted access by Owner's employees.

1.8 Emergency Planning

- 1.8.1 Emergency planning shall be developed prior to abatement initiation and agreed to by Contractor and Owner.
- 1.8.2 Emergency procedures shall be in written form and prominently posted in the clean change area and equipment room of the worker decontamination area. Everyone prior to entering the work area must read and sign these procedures to acknowledge receipt and understanding of work site layout, location of emergency exits and emergency procedures.
- 1.8.3 Emergency planning shall include written notification of police, fire and emergency medical personnel of planned abatement activities, work schedule and layout of work area, particularly barriers that may affect response capabilities.
- 1.8.4 Emergency planning shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, trips and falls, confined spaces and heat related injury. Written procedures shall be developed and employee training in procedures shall be provided.
- 1.8.5 Employees shall be trained in evacuation procedures in the event of workplace emergencies.
 - 1.8.5.1 For non-life-threatening situations - employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers if necessary, before exiting the workplace to obtain proper medical treatment.
 - 1.8.5.2 For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, remove him from the workplace and secure proper medical treatment.

1.8.6 Telephone numbers of all emergency response personnel shall be prominently posted in the clean change area and equipment room, along with the location of the nearest telephone.

1.9 Pre-Start Meeting

1.9.1 The successful Bidder shall attend a pre-start job meeting (insert time, location). Attending this meeting will be representatives of the Owner and the Owner's agents along with testing/monitoring personnel (eg. Asbestos Project Manager, Air Sampling Professional) who will actually participate in the Owner's testing/monitoring program.

1.9.2 The Contractor and supervisory personnel who will provide on-site direction of the abatement activities must attend. The Contractor's Air Sampling Professional shall also attend.

1.9.3 At this meeting the Contractor shall provide all submittals as required in Section 1.6. In addition he shall be prepared to provide detailed information concerning:

1.9.3.1 Preparation of work area

1.9.3.2 Personal protective equipment including respiratory protection and protective clothing

1.9.3.3 Employees who will participate in the project, including delineation of experience, training, and assigned responsibilities during the project.

1.9.3.4 Decontamination procedures for personnel, work area and equipment.

1.9.3.5 Abatement methods and procedures to be utilized

1.9.3.6 Required air monitoring procedures

1.9.3.7 Procedures for handling and disposing of waste materials.

1.9.3.8 Procedures for final decontamination and cleanup.

1.9.3.9 A sequence of work and performance schedule.

1.9.3.10 Procedures for dealing with heat stress.

1.9.3.11 Emergency procedures

PART 2 - Materials and Equipment

2.1 Materials

2.1.1 General (all abatement projects)

- 2.1.1.1 Deliver all materials in the original packages, containers or bundles bearing the name of the manufacturer and the brand name (where applicable).
- 2.1.1.2 Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Replacement materials shall be stored outside of the work area until abatement is completed.
- 2.1.1.3 Damaged, deteriorating or previously used materials shall not be used and shall be removed from the worksite and disposed of properly.
- 2.1.1.4 Polyethylene sheeting for walls and stationary objects shall be a minimum of 4-mil thick. For floors and all other uses sheeting of at least 6-mil thickness shall be used in widths selected to minimize the frequency of joints.
- 2.1.1.5 [Method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and Building Owner and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of duct tape or other waterproof tape, furring strips, spray glue, staples, nails, screws or other effective procedures capable of sealing adjacent sheets of polyethylene and capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions (including the use of amended water).]
- 2.1.1.6 Polyethylene sheeting utilized for worker decontamination enclosure shall be opaque white or black in color.
- 2.1.1.7 [Special materials required to protect objects in the work area should be detailed (e.g. plywood over carpeting or hardwood floors to prevent damage from scaffolds and falling material)].
- 2.1.1.8 Disposal bags shall be of 6 mil polyethylene, pre-printed with labels as required by EPA regulation 40 CFR 61.152 (b)(i)(iv) or OSHA requirement 29 CFR 1910.1001 (g)(2)(ii).
- 2.1.1.9 Disposal drums shall be metal or fiberboard with locking ring tops.

- 2.1.1.1.10 Stick-on labels as per EPA or OSHA requirements (see 2.1.1.2.7) for disposal drums.
- 2.1.1.1.11 Warning signs as required by OSHA 29 CFR 1910.1001 (g)(1)(11) or as proposed in 29 CFR 190.1001 Asbestos Proposed Rule, Federal Register and Vol. 49, Tuesday April 10, 1984 (recommended).

2.1.2 Removal

- 2.1.2.1 Surfactant (wetting agent) shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion of 1 fluid ounce to 5 gallons of water or as specified by manufacturer. (An equivalent surfactant shall be understood to mean a material with a surface tension of 29 dynes/cm as tested in its properly mixed concentration, using ASTM method D1331-56- "Surface and Interfacial Tension of Solutions of Surface Active Agents.") Where work area temperature may cause freezing of the amended water solution, the addition of ethylene glycol in amounts sufficient to prevent freezing is permitted.
- 2.1.2.2 (Specify encapsulating agent to be applied to surfaces from which asbestos containing material has been stripped.) (It will be necessary to test the adhesion if new material is to be applied to the encapsulated substrate. Some manufacturers of replacement materials will not provide a material warranty on products applied over painted, encapsulated or otherwise coated surfaces. Without proper testing, the material may "fail" and require replacement at the Owner's expense.)
- 2.1.2.3 Replacement spray or trowel-applied fire proofing must be [ULI] [ULC] labeled and listed, asbestos-free [mineral/fiber] [cementitious] material to provide the degree of fire protection as required by applicable building codes.
- 2.1.2.4 Replacement spray or trowel applied thermal insulation and acoustical material shall be asbestos-free and provide performance characteristics equal to or better than the original material, and should be evaluated and selected by the Building Owner prior to abatement. (See Section 2.1.2.2)

2.1.3 Encapsulation

2.1.3.1 Encapsulation materials shall be [specify bridging or penetrating] type and conform with the following characteristics:

2.1.3.1.1 Encapsulants should not be solvent-based or utilize a vehicle (the liquid in which the solid parts of the encapsulant are suspended) consisting of hydrocarbons.

2.1.3.1.2 Encapsulants shall not be flammable.

2.1.3.1.3 Other [specify additional requirements] (Note: Encapsulation may significantly alter the acoustical characteristics of a material, the fire rating of a material, or the bond of the material to the substrate. These factors must be considered during the abatement method selection process)

2.1.3.2 Additional materials as necessary for removal, as specified in 2.1.2

2.1.4 Enclosure

2.1.4.1 Enclosure materials shall be [specify] and conform with the following characteristics.

2.1.4.1.1 The enclosures shall be constructed of materials such that when the enclosure is completed there is limited potential for impact damage to the enclosure and no potential for fiber release.

2.1.4.1.2 Other [Specify, where fire, thermal or sound performance related assemblies are required for enclosure projects. The applicable [ASTM] [ANSI] [CSA] [ILII] [other] material, installation, application, specifications or recommended practice should be specified]

2.1.4.2 Additional materials as necessary for removal, as specified in 2.1.2

2.2 Equipment

2.2.1 General (all abatement projects)

2.2.1.1 A sufficient quantity of negative pressure ventilation units equipped with HEPA filtration and operated in accordance with ANSI Z9.2-79 (local exhaust ventilation requirements) and EPA guidance document EPA 560/5-83-002 Guidance for Controlling Friable Asbestos-Containing Materials in Buildings Appendix F: Recommended Specifications and Operating Procedures For the Use of

Negative Pressure Systems for Asbestos Abatement shall be utilized so as to provide one workplace air change every 15 minutes.

To calculate total air flow requirement:

$$\text{Total ft}^3/\text{min} = \frac{\text{Vol. of work area (in ft}^3\text{)}}{15 \text{ min}}$$

To calculate the number of units needed for the abatement:

$$\text{Number of units needed} = \frac{[\text{Total ft}^3/\text{min}]}{[\text{Capacity of unit in ft}^3/\text{min}]}$$

If air-supplied respirators are utilized, estimate the volume of supplied air and add to workplace air volume when calculating ventilation requirements. For small enclosures and glove bags, a HEPA filtered vacuum system may be utilized to provide negative air pressure.

- 2.2.1.2 Type "C" air supplied respirators in positive pressure or pressure demand mode with full facepieces and HEPA filtered disconnect protection are recommended by the U.S. EPA for all full shift abatement work until the successful completion of final clearance air monitoring. Powered air purifying respirators equipped with HEPA filters and full facepieces or respirators with a higher NIOSH assigned protection factor may be used for inspection or repair work of less than 1 hour duration per day. A sufficient supply of charged replacement batteries and filters and a flow test meter shall be available in the clean change area for use with powered air purifying respirators. Air purifying respirators with dual high-efficiency (HEPA) filters may be utilized during work area preparation activities. (See Section 3.3.2.3). Air purifying respirators with dual high-efficiency (HEPA) filters may be utilized during work area preparation activities. Spectacle kits and eyeglasses must be provided for employees who wear glasses and who must wear full facepiece respirators. Respirators shall be provided that have been tested and approved by the National Institute of Occupational Safety and Health for use in asbestos contaminated atmospheres.

- 2.2.1.3 Compressed air systems shall be designed to provide air volumes and pressures to accommodate respirator manufacture's specifications. The compressed air systems shall have a receiver of adequate capacity to allow escape of all respirator wearers from contaminated areas in the event of compressor failure. Compressors must meet the requirements of 29 CFR 1910.134 (d). Compressors must have an in-line carbon monoxide monitor and periodic inspection of the carbon monoxide monitor must be evidenced. Documentation of adequacy of compressed air systems/respiratory protection system must be retained on site. This documentation will include a list of compatible components with the maximum number and type of respirators that may be used with the system. Periodic testing of compressed air shall insure that systems provide air of sufficient quality (Grade D breathing air as described in Compressed Gas Association Commodity Specifications G-7.1)
- 2.2.1.4 Full body disposable protective clothing, including head, body and foot coverings (unless using footwear as described in 2.2.1.6) consisting of material impenetrable by asbestos fibers (Tyvek^R or equivalent) shall be provided to all workers and authorized visitors in sizes adequate to accommodate movement without tearing.
- 2.2.1.5 Additional safety equipment (e.g. hard hats meeting the requirements of ANSI Standard Z89.1-1981, eye protection meeting the requirements of ANSI Standard Z87.1-1979, safety shoes meeting the requirements of ANSI Standard Z41.1-1967, disposable PVC gloves), as necessary, shall be provided to all workers and authorized visitors.
- 2.2.1.6 Non-skid footwear shall be provided to all abatement workers. Disposable clothing shall be adequately sealed to the footwear to prevent body contamination.
- 2.2.1.7 If launderable clothing is to be worn underneath disposable protective clothing, it shall be provided by the Contractor to all abatement workers. (It is recommended that launderable clothing be a unique, specific color to enable it to be distinguished from general purpose blue, gray or black coveralls which are commonly worn.) Laundering must occur in accordance with 29 CFR 1910.1001 (d) (4) (iii) however, (it is preferable that the following

procedures be utilized:

- 2.2.1.7.1 Launderers must be trained in proper techniques for handling asbestos contaminated clothing and provided with personal protective equipment consisting of appropriate respirators and disposable clothing for use when needed.
- 2.2.1.7.2 Machines used for laundering asbestos contaminated clothing shall be isolated and restricted for such use.
- 2.2.1.7.3 Washers shall be equipped with filters to remove asbestos fibers from discharged water (See Section 3.1.2.7)
- 2.2.1.7.4 Dryers shall be isolated and restricted for use with asbestos contaminated fabrics and have HEPA filtered exhaust.
- 2.2.1.7.5 Machine maintenance shall be performed by protected individuals (as per 2.2.1.7.1.)
- 2.2.1.8 A sufficient supply of disposable mops, rags and sponges for work area decontamination shall be available.
- 2.2.2 Removal
 - 2.2.2.1. A sufficient supply of scaffolds, ladders, lifts and hand tools (e.g. scrapers, wire cutters, brushes, utility knives, wire saws, etc.) shall be provided as needed.
 - 2.2.2.2 Sprayers with pumps capable of providing 500 pounds per square inch (psi) at the nozzle tip at a flow rate of 2 gallons per minute for spraying amended water.
 - 2.2.2.3 Rubber dustpans and rubber squeegees shall be provided for cleanup.
 - 2.2.2.4 Brushes utilized for removing loose asbestos containing material shall have nylon or fiber bristles, not metal.
 - 2.2.2.5 A sufficient supply of HEPA filtered vacuum systems shall be available during cleanup.
- 2.2.3 Encapsulation
 - 2.2.3.1 Encapsulants shall be sprayed using airless spray equipment. Nozzle pressure should be adjustable within the 400 to 1500 psi range. [This can be specified depending on the encapsulant's viscosity and solids content. Tip size shall also be specified based on manufacturer's recommendations]
 - 2.2.3.2 Additional support equipment as needed. [specify when known] (See Section 2.2.2)

2.2.3.3 The nature of the encapsulant may effect the requirements for respiratory protection. Vapors that may be given off during encapsulant application must be taken into account when selecting respirators, if types other than air supplied are used.

2.2.4 Enclosure

2.2.4.1 [Specify tools to be used to install enclosure supports and enclosures.] Hand tools equipped with HEPA filtered local exhaust ventilation shall be utilized during the installation of enclosures and supports if there is any need to disturb asbestos containing materials during this process. (As an alternative asbestos material may be partially removed following proper removal procedures prior to the installation of supports and enclosures.)

2.2.4.2 Additional support equipment as needed. [specify when known (See Section 2.2.2 and 2.2.3)]

2.3 Substitutions

2.3.1 Approval Required:

- 2.3.1.1 The Contract is based on the materials, equipment and methods described in the Contract Documents.
- 2.3.1.2 The Building Owner will consider proposals for substitutions of materials, equipment and methods only when such proposals are accompanied by full and complete technical data and all other information required by the Owner to evaluate the proposed substitution.
- 2.3.1.3 Do not substitute materials, equipment or methods unless such substitution has been specifically approved for this work by the Building Owner.

2.3.2 "Or equal":

- 2.3.2.1 Where the phrase "or equal" or "or equal as approved by the Owner" occurs in the Contract Document, do not assume that materials, equipment or methods will be approved by the Owner unless the item has been specifically approved for this work by the Owner.
- 2.3.2.2 The decision of the Owner shall be final.

2.3.3 Separate substitute bids: Bidders may, if they wish, submit completely separate bids using materials and methods other than those described

in the Contract Documents, provided that all substitutions are clearly identified and described, and that the Bid in all other respects is in accordance with the provisions of the Contract Documents.

2.3.4 Availability of specified items:

- 2.3.4.1. Verify prior to bidding that all specified items will be available in time for installation during orderly and timely progress of the work.
- 2.3.4.2 In the event that specified items will not be so available, notify the Owner prior to receipt of bids.
- 2.3.4.3 Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

Part 3 - Execution3.1 Preparation3.1.1 Work Areas

- 3.1.1.1 Post caution signs meeting the specifications of OSHA 29 CFR 1910.1001 (g) (1) (ii) at any location and approaches to a location where airborne concentrations of asbestos may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from the work area to permit an employee to read the sign and take the necessary protective measures to avoid exposure. Additional signs may need to be posted following construction of workplace enclosure barriers
- 3.1.1.2 Shut down and lock out electric power to all work areas. Provide temporary power and lighting. Insure safe installation (including ground faulting) of temporary power sources and equipment by compliance with all applicable electrical code requirements and OSHA requirements for temporary electrical systems. All costs for electric shall be paid for by the Owner.
- 3.1.1.3 Shut down and lock out all heating, cooling and air conditioning system (HVAC) components that are in, supply or pass through the work area. (Note: Interiors of existing duct work may require decontamination. This may be done during the pre-cleaning phase of operations before the ductwork is sealed off or during the final cleaning phase prior to reengagement of the system. Appropriate equipment and control measures shall be utilized to prevent contamination of building spaces during this operation. Adequate cleaning of ductwork may sometimes be accomplished by drawing high volumes of air through the system using the HEPA filtered negative pressure ventilation units.) Investigate the work area and agree on preabatement condition with Building Owner. Seal all intake and exhaust vents in the work area with tape and 6-mil polyethylene. Also seal any seams in system components that pass through the work area. Remove all HVAC system filters and place in labeled 6-mil polyethylene bags for staging and eventual disposal as asbestos contaminated waste.
- 3.1.1.4 The Contractor shall provide sanitary facilities for abatement personnel outside of the enclosed work area maintain them in a clean

and sanitary condition throughout the project.

- 3.1.1.5 The Owner will provide water for construction purposes. Contractor shall connect to existing Owner system.
- 3.1.1.6 Preclean all movable objects within the work area using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the work area and carefully stored in an uncontaminated location. (Carpeting, drapes, clothing, upholstered furniture and other fabric items may be disposed of as asbestos contaminated waste or cleaned as asbestos contaminated items utilizing HEPA vacuum techniques and off-premises steam cleaning. Since adequate cleaning of severely contaminated fabric is difficult, the Building Owner must carefully consider whether this option is an appropriate one).
- 3.1.1.7 Preclean all fixed objects in the work area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. Careful attention must be paid to machinery behind grills or gratings where access may be difficult but contamination significant. Also pay particular attention to wall, floor and ceiling penetrations behind fixed items. After precleaning, enclose fixed objects in 4 mil polyethylene sheeting and seal securely in place with tape. Objects (e.g. permanent fixtures, shelves, electronic equipment, laboratory tables, sprinklers, alarm systems, closed circuit TV equipment and computer cables) which must remain in the work area and that require special ventilation or enclosure requirements should be designated here along with specified means of protection. (Contract the manufacturer for special protection requirements). Control panels, gauges etc. in the work area may require Owner access during abatement. These shall be designated and enclosures constructed with access flaps sealed with waterproof tape.)
- 3.1.1.8 Preclean all surfaces in the work area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos containing materials during the pre-cleaning phase.
- 3.1.1.9 Seal off all windows, doorways elevator openings, corridor entrances, drains, ducts, grills, grates, diffusers, skylights and any other openings between the work area and uncontaminated areas

outside of the work area (including the outside of the building, tunnels and crawl spaces) with 4 mil polyethylene sheeting and tape (See Section 3.1.4 - Isolating work area from occupied areas)

- 3.1.1.10 Cover floors in the work area with polyethylene sheeting.
- 3.1.1.10.1 Floor shall be covered with two layers of 6 mil (minimum) sheeting. (Floors requiring special protection should be specified. Carpeting, hardwood flooring and tile floors may be damaged by leaks of water, ladder feet, scaffold wheels etc. Additional layers of protection such as plywood, canvas dropcloths or extra plastic sheeting may be required by the Owner.) Additional layers of sheeting may be utilized as drop cloths to aid in cleanup of bulk materials
- 3.1.1.10.2 Plastic shall be sized to minimize seams. If the floor area necessitates seams, those on successive layers of sheeting shall be staggered to reduce the potential for water to penetrate to the flooring material. A distance of at least 6 feet between seams is sufficient. Do not locate any seams at wall/floor joints.
- 3.1.1.10.3 Floor sheeting shall extend at least 12" up the sidewalls of the work area.
- 3.1.1.10.4 Sheeting shall be installed in a fashion so as to prevent slippage between successive layers of material. (Vinyl sheeting may be used for improved traction on floors.)
- 3.1.1.11 Cover walls in the work area with polyethylene sheeting. Walls that are non-porous and will not be damaged by water, surfactant, encapsulath do not necessarily need protection. They can be decontaminated using HEPA vacuums and wet cleaning techniques. Walls with mortar joints (e.g. tile) are considered porous. In addition, openings through these walls to uncontaminated areas of the building must be sealed as described in Section 3.1.1.9.
- 3.1.1.11.1 Walls shall be covered with two layers of 4 mil polyethylene sheeting.
- 3.1.1.11.2 Plastic shall be sized to minimize seams. Seams shall be staggered and separated by a distance of at least 6 feet.
- 3.1.1.11.3 Wall sheeting shall overlap floor sheeting by at least 12 inches beyond the wall/floor joint to provide a better seal against water damage and for negative pressure.

3.1.1.1.4 Wall sheeting shall be secured adequately to prevent it from falling away from the walls. This will require additional support/attachment when negative pressure ventilation systems are utilized.

3.1.2 Worker decontamination enclosure systems.

- 3.1.2.1 Worker decontamination enclosure systems shall be provided at all locations where workers will enter or exit the work area. One system at a single location for each contained work over is preferred. These systems may consist of existing rooms outside of the work area, if the layout is appropriate, that can be enclosed in plastic sheeting and are accessible from the work area. When this situation does not exist, enclosure systems may be constructed out of metal, wood or plastic support as appropriate.
- 3.1.2.2 Plans for construction, including materials and layout, shall be submitted as shop drawings and approved, in writing by the Building Owner prior to work initiation. Worker decontamination enclosure systems constructed at the worksite shall utilize 6 mil opaque black or white polyethylene sheeting or other acceptable materials for privacy. Detailed descriptions of portable, pre-fabricated units, if used, must be submitted for the Building Owner's approval. Plans must include floor plan (in accordance with 3.1.2.3) with dimensions, materials, size, thickness, plumbing and electrical utilities.
- 3.1.2.3 The worker decontamination enclosure system shall consist of at least a clean room, a shower room, and an equipment room, each separated from each other and from the work area by airlocks.
- 3.1.2.4 Entry to and exit from all airlocks and decontamination enclosure system chambers shall be through curtained doorways consisting of two sheets of overlapping polyethylene sheeting. One sheet shall be secured at the top and left side, the other sheet at the top and right side. Both sheets shall have weights attached to the bottom to insure that they hang straight and maintain a seal over the doorway when not in use. Doorway designs, providing equivalent protection and acceptable to the Building Owner may be utilized.

- 3.1.2.5 Access between any two rooms in the decontamination enclosure system shall be through an airlock with at least 3 feet separating each curtained doorway. Pathways into (from clean to contaminated) and out from (contaminated to clean) the work area shall be clearly designated
- 3.1.2.6 Clean room shall be sized to adequately accommodate the work crew. Benches shall be provided as well as hooks for hanging up street clothes. (lockers may be provided for valuables, however, workers may be requested to secure valuables in their cars). Shelves for storing respirators shall also be provided in this area. Clean work clothes (if required under disposables), clean disposable clothing, replacement filters for respirators, towels and other necessary items shall be provided in adequate supply at the clean room. A location for postings shall also be provided in this area. Whenever possible, a lockable door shall be used to permit access into the clean room from outside the work area. Lighting, heat and electricity shall be provided as necessary for comfort. This space shall not be used for storage of tools equipment or materials, (except as specifically designated) or as office space.
- 3.1.2.7 Shower room shall contain one or more showers as necessary to adequately accommodate workers. Each shower head shall be supplied with hot and cold water adjustable at the tap. The shower enclosure shall be constructed to ensure against leakage of any kind. An adequate supply of soap, shampoo and towels shall be supplied by the Contractor and available at all times. Shower water shall be drained, collected and filtered through a system with at least 0.5-1.0 micron particle size collection capability. (Note: A system containing a series of several filters with progressively smaller pore sizes is recommended to avoid rapid clogging of filtration system by large particles.)
- 3.1.2.8 The equipment room shall be used for storage of equipment and tools at the end of a shift after they have been decontaminated using a HEPA filtered vacuum and/or wet cleaning techniques as appropriate. Replacement filters (in sealed containers until used) for HEPA vacuums and negative pressure ventilation

equipment, extra tools, containers of surfactant and other materials and equipment that may be required during the abatement may also be stored here as needed. A walk-off pan (a small children's swimming pool or equivalent filled with water shall be located in the work area just outside the equipment room for workers to clean off foot coverings after leaving the work area and prevent excessive contamination of the worker decontamination enclosure system. A drum lined with a labeled 6 mil polyethylene bag for collection of disposable clothing shall be located in this room. Contaminated footwear (e.g. rubber boots, other reusable footwear) shall be stored in this area for reuse the following workday.

- 3.1.3 Waste Container pass-out airlock (usually required only for large jobs) and emergency exits.
- 3.1.3.1 The waste container pass-out airlock shall be constructed at some location away from the worker decontamination enclosure system. Wherever possible, this shall be located where there is direct access from the work area to the outside of the building.
 - 3.1.3.2 This airlock system shall consist of an airlock, a container staging area, and another airlock with access to outside the work area.
 - 3.1.3.3 The waste container pass-out airlock shall be constructed in similar fashion to the worker decontamination enclosure system using similar materials and airlock and curtain doorway designs.
 - 3.1.3.4 This airlock system shall not be used to enter or exit the work-site.
 - 3.1.3.5 Emergency exits shall be established and clearly marked with duct tape arrows or other effective designations to permit easy location from anywhere within the work area. They shall be secured to prevent access from uncontaminated areas and still permit emergency exiting. These exits shall be properly sealed with polyethylene sheeting which can be cut to permit egress if needed. These exits may be the worker decontamination enclosure, the waste pass-out airlock and/or other alternative exits satisfactory to fire officials.
- 3.1.4 Isolation of the work area from occupied areas of the building [Building owner must clearly identify all areas that will be occupied].

- 3.1.4.1 The contaminated work area shall be separated from uncontaminated, occupied areas of the building by the construction of air tight barriers.
- 3.1.4.2 Walls shall be constructed of wood or metal framing to support barriers in all openings larger than 4' x 8'.
- 3.1.4.3 A sheathing material (plywood, drywall) of at least 3/8" thickness shall be applied to work side of barrier.
- 3.1.4.4 Cover both sides of partition with a double layer of 6 mil polyethylene sheeting with staggered joints and seal in place.
- 3.1.4.5 Caulk edges of partition at floor, ceiling, walls and fixtures to form an air tight seal.
- 3.1.5 Maintenance of workplace barriers and worker decontamination enclosure systems.
 - 3.1.5.1 Following completion of the construction of all polyethylene barriers and decontamination system enclosures, allow overnight settling to insure that barriers will remain intact and secured to walls and fixtures before beginning actual abatement activities.
 - 3.1.5.2 All polyethylene barriers inside the workplace, in the worker decontamination enclosure system, in the waste container pass-out airlock and at partitions constructed to isolate the work area from occupied areas shall be inspected at least twice daily, prior to the start of each day's abatement activities and following the completion of the day's abatement activities. Document inspections and observations in the daily project log.
 - 3.1.5.3 Damage and defects in the enclosure system are to be repaired immediately upon discovery.
 - 3.1.5.4 Use smoke tubes to test the effectiveness of the barrier system when directed by Building Owner.
 - 3.1.5.5 At any time during the abatement activities after barriers have been erected, if visible material is observed outside of the work area or if damage occurs to barriers, work shall immediately stop, repairs be made to barriers, and debris/residue cleaned up using appropriate HEPA vacuuming and wet mopping procedures.
 - 3.1.5.6 If air samples collected outside of the work area during abatement activities indicate airborne fiber concentrations greater than 0.01 f/cc or pre-measured background levels (whichever is lower)

work shall immediately stop for inspection and repair of barriers. Cleanup of surfaces outside of the work area using HEPA vacuums or wet cleaning techniques may be necessary.

- 3.1.5.7 Install and initiate operation of negative pressure ventilation equipment as needed to provide one air change in the work area every 15 minutes. (See Section 2.2.1.1) Openings made in the enclosure system to accommodate these units shall be made airtight with tape and/or caulking as needed. If more than one unit is installed, they should be turned on one at a time, checking the integrity of wall barriers for secure attachment and need for additional reinforcement. Insure that adequate power supply is available to satisfy the requirements of the ventilating units. Negative pressure ventilation units shall be exhausted to the outside of the building whenever feasible. They shall not be exhausted into occupied areas of the building. Twelve inch extension ducting shall be used to reach from the work area to the outside when required. Careful installation, air monitoring and daily inspections shall be done to insure that the ducting does not release fibers into uncontaminated building areas.
- 3.1.7 Once constructed and reinforced as necessary, with negative pressure ventilation units in operation as required, test enclosure for leakage utilizing smoke tubes. Repair or reconstruct as needed.
- 3.1.8 Clearly identify and maintain emergency and fire exits from the work area.
- 3.1.9 Remove, clean and enclose in polyethylene the ceiling mounted objects such as lights and other items that may interfere with the abatement process and were not previously cleaned and sealed off. Utilize localized spraying of amended water and/or HEPA vacuums to reduce fiber dispersal during the removal of these fixtures.
- 3.1.10 Removal of building structural components
 - 3.1.10.1 After isolation of work area as described in previous sections and initiation of negative pressure ventilation, remove ceiling [tiles] [panels] within the work area carefully. If panels are to be reused, vacuum them with a HEPA filtered vacuum cleaner and carefully damp sponge and wrap cleaned [tiles] [panels] in 4 mil polyethylene sheeting and seal with tape. Store as designated by building owner (preferably outside of the work area). If [tiles]

(panels) are to be discarded it is not necessary to clean them, but wrap in a similar fashion and stage for disposal in the waste container pass-out airlock. (Disposal is preferred over re-use when tiles or panels are composed of porous materials because of difficulties in adequate cleaning.)

- 3.1.10.2 Where suspended ceiling T-grid components must be removed to perform the abatement, HEPA vacuum and wet-sponge each piece after removal from hangers. Wrap clean grid pieces in 4-mil polyethylene sheeting and seal with tape. Store as designated by Building Owner or in waste staging area if designated for disposal.
- 3.1.10.3 When removal of ceiling grid suspension system is not necessary for accessibility, to the asbestos containing materials leave the system in place and clean properly following completion of abatement.
- 3.1.10.4 (Remove plaster/drywall ceilings including lathe, furring channel system, wire mesh, ties, clips, screws, nails and other accessory items as necessary and dispose of as asbestos contaminated waste material. Plaster ceiling may actually contain asbestos. They should be tested.) As work progresses, spray ceiling materials and debris with amended water to keep wet until containerized for disposal.)
- 3.1.11 Commencement of work shall not occur until:
 - 3.1.11.1 Enclosure systems have been constructed and tested
 - 3.1.11.2 Negative pressure ventilation systems are functioning adequately
 - 3.1.11.3 All pre-abatement submissions, notifications, postings and permits have been provided and are satisfactory to the Building Owner (See Section 1.6)
 - 3.1.11.4 All equipment for abatement, clean-up and disposal are on hand
 - 3.1.11.5 All worker training (and certification) is completed
 - 3.1.11.6 Contractor receives written permission from Building Owner to commence abatement.
- 3.1.12 Alternative Procedures
 - 3.1.12.1 Procedures described in this specification are to be utilized at all times.
 - 3.1.12.2 If specified procedures cannot be utilized, a request must be made in writing to the Building Owner providing details of the problem encountered and recommended alternatives

3.1.12.3 Alternative procedures shall provide equivalent or greater protection than procedures that they replace.

3.1.12.4 Any alternative procedure must be approved in writing by the Building Owner prior to implementation.

3.2 Workplace Entry and Exit Procedures

3.2.1 Personnel entry and exit

3.2.1.1 All workers and authorized personnel shall enter the work area through the worker decontamination enclosure system

3.2.1.2 All personnel who enter the work area must sign the entry log, located in the clean room, upon entry and exit.

3.2.1.3 All personnel, before entering the work area, shall read and be familiar with all posted regulations, personal protection requirements (including workplace entry and exit procedures) and emergency procedures. A sign-off sheet shall be used to acknowledge that these have been reviewed and understood by all personnel prior to entry.

3.2.1.4 All personnel shall proceed first to the clean room, remove all street clothes and appropriately don respiratory protection (as deemed adequate for the job conditions) and launderable and/or disposable coveralls, head covering and foot covering. Hard hats, eye protection and gloves shall also be utilized if required. Clean respirators and protective clothing shall be provided and utilized by each person for each separate entry into the work area.

3.2.1.5 Personnel wearing designated personal protective equipment shall proceed from the clean room through the shower room and equipment room to the main work area.

3.2.1.6 Before leaving the work area all personnel shall remove gross contamination from the outside of respirators and protective clothing by brushing and/or wet wiping procedures. (Small HEPA vacuums with brush attachments may be utilized for this purpose, however, larger machines may tear the suits) Each person shall clean bottoms of protective footwear in the walk-off pan just prior to entering the equipment room.

3.2.1.7 Personnel shall proceed to equipment room where they remove all protective equipment except respirators. Deposit disposable (and launderable) clothing into appropriately labeled containers for disposal (and laundering)

- 3.2.1.8 Reusable, contaminated footwear shall be stored in the equipment room when not in use in the work area. Upon completion of abatement it shall be disposed of as asbestos contaminated waste. (rubber boots may be decontaminated at the completion of the abatement for reuse)
- 3.2.1.9 Still wearing respirators, personnel shall proceed to the shower area, clean the outside of the respirators and the exposed face area under running water prior to removal of respirator and shower and shampoo to remove residual asbestos contamination. Various types of respirators will require slight modification of these procedures. An airline respirator with HEPA filtered disconnect protection may be disconnected in the equipment room and work into the shower. A powered air-purifying respirator facepiece will have to be disconnected from the Filter/power pack assembly which is not waterproof, upon entering the shower. A dual cartridge respirator may be worn into the shower. Cartridges must be ^{re}placed for each new entry into the work area.
- 3.2.1.10 After showering and drying off, proceed to the clean room and don clean disposable (and/or launderable) clothing if there will be later re-entry into the work area or street clothes if it is the end of the work shift.
- 3.2.1.11 These procedures shall be posted in the clean room and equipment room.
- 3.2.2 Waste container pass-out procedures
- 3.2.2.1 Asbestos contaminated waste that has been containerized shall be transported out of the work area through the waste container pass-out airlock (or through the worker decontamination enclosure if a separate airlock has not been constructed)
- 3.2.2.2 Waste pass-out procedures shall utilize two teams of workers, an "inside" team and an "outside" team.
- 3.2.2.3 The inside team wearing appropriate protective clothing and respirators for inside the work area shall clean the outside, including bottoms, of properly labeled containers (bags, drums, or wrapped components) using HEPA vacuums and wet wiping techniques and transport them into the waste container pass-out airlock. No worker from the inside team shall further exit the work area through this airlock .

- 3.2.2.4 The outside team, wearing a different color protective clothing and appropriately assigned respirators, shall enter the airlock from outside the work area, enclose the drums in clean, labeled, 6 mil polyethylene bags and remove them from the airlock to the outside. No worker from the outside team shall further enter the work area through this airlock.
- 3.2.2.5 The exit from this airlock shall be secured to prevent unauthorized entry.

3.3 Personnel Protection Requirements

3.3.1 Training

- 3.3.1.1 Prior to commencement of abatement activities all personnel who will be required to enter the work area or handle containerized asbestos containing materials must have received adequate training in accordance with Part 4 Section 4.1 of this document.
- 3.3.1.2 Special on-site training on equipment and procedures unique to this job site shall be performed as required.
- 3.3.1.3 Training in emergency response and evacuation procedures shall be provided

3.3.2 Respiratory Protection

- 3.3.2.1 All respiratory protection shall be provided to workers in accordance with the submitted written respiratory protection program, which includes all items in OSHA 29 CFR 1910.134 (b) (1-11). This program shall be posted in the clean room of the worker decontamination enclosure system
- 3.3.2.2 Workers shall be provided with personally issued, individually identified (marked with waterproof designations) respirators.
- 3.3.2.3 Respirators shall be selected that meet the following level of protection requirements:
- Each Building Owner (in conjunction with an industrial hygienist) must decide on the levels of respiratory protection that will be required for asbestos abatement activities. Those level and specific requirements should be inserted here. (The U.S. EPA recommends that Type "C" air-supplied respirators in positive pressure or pressure demand mode with full facepieces and HEPA filtered disconnect protection be provided to all full-shift

so permits. Powered air-purifying respirators shall be tested for adequate flow as specified by the manufacturer.

3.3.2.4.2 Workers shall be given a qualitative fit test in accordance with procedures detailed in the OSHA Lead Standard (29 CFR 1910.1025, Appendix D, Qualitative Fit Test Protocols) for all respirators to be used on this abatement project. An appropriately administered quantitative fit test may be substituted for the qualitative fit test.

3.3.2.4.3 Documentation of adequate respirator fit must be provided to the Building Owner.

3.3.2.5 No one wearing a beard shall be permitted to don a respirator and enter the work area.

3.3.2.6 Additional respirators (minimum of 2 of each type) and training on their donning and use must be available at the work site for authorized visitors who may be required to enter the work area.

3.3.3 Protective Clothing

3.3.3.1 Disposable clothing including head, foot and full body protection shall be provided in sufficient quantities and adequate sizes for all workers and authorized visitors.

3.3.3.2 [Launderable clothing, if required, shall be provided in sufficient quantities and adequate sizes for all workers and authorized visitors].

3.3.3.3 Hard hats, protective eyewear, gloves, rubber boots and/or other footwear shall be provided as required for workers and authorized visitors. Safety shoes may be required for some activities.

3.4 Removal Procedures

3.4.1 Clean and isolate the work area in accordance with Section 3.1

3.4.2 Wet all asbestos containing material with an amended water solution using equipment capable of providing a fine spray mist, in order to reduce airborne fiber concentrations when the material is disturbed. Saturate the material to the substrate, however, do not allow excessive water to accumulate in the work area. Keep all removed material wet enough to prevent fiber release until it can be containerized for disposal. If work area temperatures are below 32°F and amended water is subject to freezing, dry removal permits and procedures must be utilized (See 2.1.2.1). Maintain a high humidity in the work area by misting or spraying to assist in fiber

settling and reduce airborne concentrations. Wetting procedures are not equally effective on all types of asbestos containing materials but, shall none-the-less be used in all cases.

- 3.4.3 Saturated asbestos containing material shall be removed in manageable sections. Removed material should be containerized before moving to a new location for continuance of work. Surrounding areas shall be periodically sprayed and maintained in a wet condition until visible material is cleaned up.
- 3.4.4 Material removed from building structures or components shall not be dropped or thrown to the floor. Material should be removed as intact sections or components whenever possible and carefully lowered to the floor. If this cannot be done for materials greater than 50 feet above the floor, a dust-tight chute shall be constructed to transport the material to containers on the floor or the material may be containerized at elevated levels (e.g. on scaffolds) and carefully lowered to the ground by mechanical means. For materials between 15 and 50 feet above the ground they may be containerized at elevated levels or dropped onto inclined chutes or scaffolding for subsequent collection and containerization.
- 3.4.5 Containers (6-mil polyethylene bags or drums) shall be sealed when full. (Wet material can be exceedingly heavy. Double bagging of waste material usually necessary. A determination of need for single or double bags must be made early in the abatement process and agreed to by the Building Owner.) Bags shall not be overfilled. They should be securely sealed to prevent accidental opening and leakage by tying tops of bags in an overhand knot or by taping in gooseneck fashion. Do not seal bags with wire or cord. (Bags may be placed in drums for staging and transportation to the landfill. Bags shall be decontaminated on exterior surfaces by wet cleaning and HEPA vacuuming before being placed in clean drums and sealed with locking ring tops).
- 3.4.6 Large components removed intact may be wrapped in 2 layers of 6-mil polyethylene sheeting secured with tape for transport to the landfill.
- 3.4.7 Asbestos containing waste with sharp-edged components (e.g. nails, screws, metal lath, tin sheeting) will tear the polyethylene bags and sheeting and shall be placed into drums for disposal.

- 3.4.8 After completion of all stripping work, surfaces from which asbestos containing materials have been removed shall be wet brushed and sponged or cleaned by some equivalent method to remove all visible residue
- 3.4.9 Clean-up shall proceed in accordance with Section 3.7
- 3.4.10 After the work area has been rendered free of visible residues, a thin coat of a satisfactory encapsulating agent shall be applied to all surfaces in the work area including structural members, building components and plastic sheeting on walls, floors and covering non-removable items, to seal in non-visible residue. (Note: 1) High temperature components such as boilers and pipes may not permit the applicaiton of some encapsulants. 2) If insulation or acoustical materials are to be reapplied to the abated area, be certain that the encapsulant selected will permit good adhesion to the substrate. A small area should be tested before application)
- 3.4.11 Special circumstances (e.g. live electrical equipment, high amosite content of material, materials previously coated with an encapsulant or paint) may prohibit the adequate use of wet methods to reduce fiber concentrations. For these situations, a dry removal may be required. The contractor will have to acquire of special permits, different from those mentioned herein from the NESHAP enforcement agency.
- 3.5 Encapsulation Procedures
- 3.5.1 Clean and isolate the work area in accordance with section 3.1
- 3.5.2 Repair damaged and missing areas of existing [sprayed] [troweled] materials with non-asbestos containing subsitutes [specify]. Material must adhere adequately to existing surfaces and provide an adequate base for application of encapsulating agents. Filler material shall be applied in accordance with manufacturer's recommended specifications.
- 3.5.3 Remove loose or hanging asbestos containing materials in accordance with the requirements of Section 3.4.
- 3.5.4 Bridging-type encapsulants
- 3.5.4.1 Apply bridging-type encapsulants to provide [] inches of minimum dry film thickness over sprayed asbestos surfaces
- 3.5.4.2 When using a bridging-type encapsulant use a different color for each coat. Use [color] for final coat.

3.5.5 Penetrating-type encapsulants

- 3.5.5.1 Apply penetrating-type encapsulant to penetrate existing sprayed asbestos materials to a depth of [] inches.
 - 3.5.5.2 Apply penetrating-type encapsulant to penetrate existing sprayed asbestos materials uniformly to substrate
 - 3.5.5.3 During treatment with a penetrating-type encapsulant, the Contractor shall remove selected random core samples of the asbestos-containing materials in the presence of the Owner to check the depth of penetration.
- 3.5.6 Apply encapsulants using airless spray equipment (See Section 2.2.1.9 Equipment - Encapsulation)
- 3.5.7 Clean-up shall be in accordance with Section 3.7
- 3.5.8 Encapsulated asbestos containing materials shall be designated appropriately [specify format - labels, signs or color codes and frequency location of indicators] in order to warn building maintenance personnel in the event that they are required to disturb the materials.

3.6 Enclosure Procedures

- 3.6.1 Clean and isolate the work area in accordance with Section 3.1
- 3.6.2 Spray areas that will be disturbed during the installation of hangers or other support/framing materials for the enclosure with water containing the specified surfactant. Keep these areas damp to reduce airborne fiber concentrations.
- 3.6.3 Remove loose or hanging asbestos containing materials in accordance with the requirements of Section 3.4.
- 3.6.4 After installation of hangers and other fixing devices and before installation of enclosure, repair damaged areas of fireproofing/thermal insulation materials as required using a non-asbestos containing replacement material. Prepare surfaces and apply replacement material in accordance with manufacturer's recommendations.
- 3.6.5 (Specify enclosure procedures) and include the following requirements:
 - 3.6.5.1 Use hand tools equipped with HEPA filtered local exhaust ventilation to drill, cut into or otherwise disturb asbestos containing materials during the installation of support systems for the enclosures. (Alternatively, these areas of material could be removed prior to installation of supports.)

- 3.6.5.2 Use materials that are impact resistant and that will provide an air-tight barrier once construction is complete.
 - 3.6.5.3 Lower utilities as necessary and reinstall in a manner which permits proper utilization and does not disturb the integrity of the enclosures. Utility maintenance should not require the enclosure to be opened or disturbed. (If it does, an alternative abatement strategy is indicated)
 - 3.6.7 Enclosed asbestos containing materials shall be designated appropriately (Specify format - sign, label, color code and frequency/location of indicators) in order to warn building maintenance personnel in the event that they are required to disturb the enclosure.
- 3.7 Clean-up Procedure
- 3.7.1 Remove and containerize all visible accumulations of asbestos containing material and asbestos contaminated debris utilizing rubber dust pans and rubber squeegees to move material around. Do not use metal shovels to pick up or move accumulated waste. Special care shall be taken to minimize damage to floor sheeting.
 - 3.7.2 Wet clean all surfaces in the work area using rags, mops and sponges as appropriate. (Note: Some HEPA vacuums might not be wet-dry vacuums. To pick up excess water and gross wet debris, a wet-dry shop vacuum may be used. This will be contaminated and require cleaning prior to removal from the work area.)
 - 3.7.3 Remove the cleaned outer layer of plastic sheeting from walls and floors. Windows, doors, HVAC system vents and all other openings shall remain sealed. The negative pressure ventilation units shall remain in continuous operation. Decontamination enclosure systems shall remain in place and be utilized.
 - 3.7.4 After cleaning the work area, wait at least 24 hours to allow fibers to settle and HEPA vacuum and wet clean all objects and surfaces in the work area again.
 - 3.7.5 Remove all containerized waste from the work area and waste container pass-out airlock.
 - 3.7.6 Decontaminate all tools and equipment and remove at the appropriate time in the cleaning sequence.
 - 3.7.7 Inspect the work area for visible residue. If any accumulation of residue is observed, it will be assumed to be asbestos and the 24 hour settling period/cleaning cycle repeated.

- 3.6.5.2 Use materials that are impact resistant and that will provide an air-tight barrier once construction is complete.
- 3.6.5.3 Lower utilities as necessary and reinstall in a manner which permits proper utilization and does not disturb the integrity of the enclosures. Utility maintenance should not require the enclosure to be opened or disturbed. (If it does, an alternative abatement strategy is indicated)
- 3.6.7 Enclosed asbestos containing materials shall be designated appropriately (Specify format - sign, label, color code and frequency/location of indicators) in order to warn building maintenance personnel in the event that they are required to disturb the enclosure.
- 3.7 Clean-up Procedure
- 3.7.1 Remove and containerize all visible accumulations of asbestos containing material and asbestos contaminated debris utilizing rubber dust pans and rubber squeegees to move material around. Do not use metal shovels to pick up or move accumulated waste. Special care shall be taken to minimize damage to floor sheeting.
- 3.7.2 Wet clean all surfaces in the work area using rags, mops and sponges as appropriate. (Note: Some HEPA vacuums might not be wet-dry vacuums. To pick up excess water and gross wet debris, a wet-dry shop vacuum may be used. This will be contaminated and require cleaning prior to removal from the work area.)
- 3.7.3 Remove the cleaned outer layer of plastic sheeting from walls and floors. Windows, doors, HVAC system vents and all other openings shall remain sealed. The negative pressure ventilation units shall remain in continuous operation. Decontamination enclosure systems shall remain in place and be utilized.
- 3.7.4 After cleaning the work area, wait at least 24 hours to allow fibers to settle and HEPA vacuum and wet clean all objects and surfaces in the work area again.
- 3.7.5 Remove all containerized waste from the work area and waste container pass-out airlock.
- 3.7.6 Decontaminate all tools and equipment and remove at the appropriate time in the cleaning sequence.
- 3.7.7 Inspect the work area for visible residue. If any accumulation of residue is observed, it will be assumed to be asbestos and the 24 hour settling period/cleaning cycle repeated.

3.7.8 The work area shall be cleaned until it is in compliance with State and Local requirements and any more stringent criteria agreed upon by the Contractor and Owner prior to initiation of abatement activities (criteria should be in the form of visual inspections and airborne fiber concentrations). Additional cleaning cycles shall be provided, as necessary, at no cost to the Building Owner until these criteria have been met.

3.7.9 Following the satisfactory completion of clearance air monitoring remaining barriers may be removed and properly disposed of. A final visual inspection by the Owner shall insure that no contamination remains in the work area. Unsatisfactory conditions may require additional cleaning and air monitoring. (See section 3.10 Reestablishment of the Work Area).

3.8 Clearance Air Monitoring

3.8.1 Following the completion of clean-up operations, the Contractor shall notify the Building Owner that work areas are ready for clearance air monitoring.

3.8.2 The Owner shall then arrange for an Air Monitoring Professional to sample the air in the work area for airborne fiber concentrations.

3.8.3 (Note: The use of TEM (Transmission Electron Microscopy) is highly recommended for clearance air monitoring. Availability of this analytical service may be limited, however, and turn around time for sample analysis may be significantly longer than the NIOSH methods.) The air sampling shall otherwise be conducted using sampling pumps calibrated at a flow rate of at least two and not more than 4 liters per minute using collection media and procedures in accordance with NIOSH Standard Analytical Method P&CAM 239 or 7400, as available. Air volumes shall be sufficient to provide reliable results down to a concentration of 0.01 fibers per cubic centimeter of air (f/cc) or lower. (Minimum air volumes of 3000 liters shall be collected) for P&CAM 239 and 1000 liters for method 7400. Volume requirements for electron microscope methods should be discussed with the analytical laboratory)

3.8.4 [The number of samples that are required and the specific locations where they shall be taken should be established by the Building Owner in conjunction with an industrial hygienist before abatement activity begins.]

- 3.8.5 Aggressive sampling shall be performed with (specify number) portable fans circulating air in the work area to simulate actual use conditions. Negative pressure ventilation units shall not be utilized for this purpose.
- 3.8.6 Air Samples shall be analyzed by (Phase Contrast Microscopy) (See Part 4 Section 4.5 Laboratory Services) (Transmission Electron Microscopy)
- 3.8.7 All samples at all locations shall indicate concentrations of airborne fibers less than 0.01 f/cc for release of the work area.
- 3.8.8 Areas exceeding this level shall be recleaned using procedures in Section 3.7 and retested until satisfactory levels are obtained.

(Implementations Suggestions:

The following is excerpted from A Review of the Scientific Basis for EPA: School Asbestos Hazard Program with Recommendations to State Health Officials. Published by the centers for Disease Control in October, 1984).

When air samples are collected after an asbestos abatement, the "action level" should conform with a policy of lowest feasible level. The concept of an environmental "action level" is not the same as that of a permissible exposure limit that is precisely monitored for compliance with regulatory standards. As used here it is consistent with a policy of recommending that asbestos exposures be reduced to the lowest feasible level. It is readily measured by the NIOSH #7400 for asbestos in air; and it should be helpful to those who must make risk management decisions when the general public is potentially exposed to asbestos.

An "action level" of 0.01 f/c.c. may be useful as a guidelines for monitoring a building with potentially hazardous asbestos surfaces, as part of a comprehensive program or during abatement work, maintenance, etc. It is not a recommended "occupancy" or "safe" level.

Using the NIOSH Method #7400 including modified rules for counting only fibers with aspect ratios of 5:1 or more in a 1,000 liter air sample will permit detection and quantification of about 0.01 f/c.c. if a coefficient of variation of 25% is considered acceptable for risk-management decisions. This variability is reasonable, since the conversion factor used to convert mass concentration to fiber

concentrations in environmental risk assessments has such a large uncertainty factor.

3.9 Disposal Procedures

- 3.9.1 As the work progresses, to prevent exceeding available storage capacity on site, sealed and labeled containers of asbestos containing waste shall be removed and transported to the prearranged disposal location.
- 3.9.2 Disposal must occur at an authorized site in accordance with regulatory requirements of NESHAP and applicable State and Local guidelines and regulations.
- 3.9.3 All dump receipts, trip tickets, transportation manifests or other documentation of disposal shall be delivered to the Building Owner for his records. A recommended recordkeeping format utilizes a chain of-custody form which includes the names and addresses of the Generator (Building Owner), Contractor, pickup site, and disposal site, the estimated quantity of the asbestos waste and the type of containers used. The form should be signed by the Generator, the Contractor, and the Disposal Site Operator, as the responsibility for the material changes hands. If a separate hauler is employed, his name, address, telephone number and signature should also appear on the form.
- 3.9.4 Transportation to the landfill
 - 3.9.4.1 Once drums, bags and wrapped components have been removed from the work area, they shall be loaded into an enclosed truck for transportation.
 - 3.9.4.2 When moving containers, utilize hand trucks, carts and proper lifting techniques to avoid back injuries. Trucks with lift gates are helpful for raising drums during truck loading.
 - 3.9.4.3 The enclosed cargo area of the truck shall be free of debris and lined with 6-mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting shall be installed first and extend up the sidewalls. Wall sheeting shall be overlapped and taped into place.
 - 3.9.4.4 Drums shall be placed on level surfaces in the cargo area and packed tightly together to prevent shifting and tipping. Large structural components shall be secured to prevent shifting and bags placed on top. Do not throw containers into truck cargo area.

- 3.9.4.5 Personnel loading asbestos containing waste shall be protected by disposable clothing including head, body and foot protection and at a minimum, half-facepiece, air-purifying, dual cartridge respirators equipped with high efficiency filters.
- 3.9.4.6 Any debris or residue observed on containers or surfaces outside of the work area resulting from clean-up or disposal activities shall be immediately cleaned-up using HEPA filtered vacuum equipment and/or wet methods as appropriate.
- 3.9.4.7 Large metal dumpsters are sometimes used for asbestos waste disposal. These should have doors or tops that can be closed and locked to prevent vandalism or other disturbance of the bagged asbestos debris and wind dispersion of asbestos fibers. Unbagged material shall not be placed in these containers, nor shall be used for non-asbestos waste. Bags shall be placed, not thrown, into these containers to avoid splitting.
- 3.9.5 Disposal at the landfill
 - 3.9.5.1 Upon reaching the landfill, trucks are to approach the dump location as closely as possible for unloading of the asbestos containing waste.
 - 3.9.5.2 Bags, drums and components shall be inspected as they are off-loaded at the disposal site. Material in damaged containers shall be repacked in empty drums or bags as necessary. (Local requirements may not allow the disposal of asbestos waste in drums. Check with appropriate agency and institute appropriate alternative procedures.)
 - 3.9.5.3 Waste containers shall be placed on the ground at the disposal site, not pushed or thrown out of trucks (weight of wet material could rupture containers).
 - 3.9.5.4 Personnel off-loading containers at the disposal site shall wear protective equipment consisting of disposable head, body and foot protection and, at a minimum, half-facepiece, air-purifying, dual cartridge respirators equipped with high efficiency filters.
 - 3.9.5.5 Following the removal of all containerized waste, the truck cargo area shall be decontaminated using HEPA vacuums and/or wet methods to meet the no visible residue criteria. Polyethylene sheeting shall be removed and discarded along with contaminated cleaning materials and protective clothing, in bags or drums at the

disposal site.

- 3.9.5.6 If landfill personnel have not been provided with personal protective equipment for the compaction operation by the landfill operator, Contractor shall supply protective clothing and respiratory protection for the duration of this operation.

3.10 Reestablishment of the Work Area and Systems

- 3.10.1 Reestablishment of the work area shall only occur following the completion of clean-up procedures and after clearance air monitoring has been performed and documented to the satisfaction of the Building Owner
- 3.10.2 Polyethylene barriers shall be removed from walls and floors at this time, maintaining decontamination enclosure systems and barriers over doors, windows, etc. as required.
- 3.10.4 The Contractor and Owner shall visually inspect the work area for any remaining visible residue. Evidence of contamination will necessitate additional cleaning requirements in accordance with Section 3.7
- 3.10.5 Additional air monitoring shall be performed in accordance with Section 3.8 if additional clean-up is necessary.
- 3.10.6 Following satisfactory clearance of the work area, remaining polyethylene barriers may be removed and disposed of as asbestos contaminated waste.
- 3.10.7 At the discretion of the Contractor, mandatory requirements for personal protective equipment may be waived following the removal of all barriers.
- 3.10.8 Resecure mounted objects removed from their former positions during area preparation activities.
- 3.10.9 Relocate objects that were removed to temporary locations back to their original positions.
- 3.10.10 Reestablish HVAC, mechanical and electrical systems in proper working order. Remove contaminated HVAC system filters and dispose of as asbestos contaminated waste. Decontaminate filter assembly using HEPA vacuums and wet cleaning techniques. Install new filters in HVAC systems. Dispose of old filters.
- 3.10.11 Repair all areas of damage that occurred as a result of abatement activities.

Part 4 Support Activities and Personnel

4.1 Training

- 4.1.1 Training shall be provided by the Contractor to all employees or agents who may be required to disturb asbestos containing or asbestos contaminated materials for abatement and auxiliary purposes and to all supervisory personnel who may be involved in planning, execution or inspection of abatement projects.
- 4.1.2 Training shall provide, at a minimum, information on the following topics:
- 4.1.2.1 The health hazards of asbestos including the nature of various asbestos related diseases, routes of exposure, known dose-response relationships, the synergistic relationship between asbestos exposure and cigarette smoking, latency periods for disease and health basis for standards.
 - 4.1.2.2 The physical characteristics of asbestos including fiber size, aerodynamic properties, physical appearance and uses.
 - 4.1.2.3 Employee personal protective equipment including the types and characteristics of respirator classes, limitations of respirators, proper selection, inspection, donning, use, maintenance and storage of respirators, field testing the face-piece-to-face seal (positive and negative pressure fitting tests), qualitative and quantitative fit testing procedures, variations between laboratory and field fit factors, factors that affect respirator fit (e.g. facial hair), selection and use of disposable clothing, use and handling of launderable clothing, non-skid shoes, gloves, eye protection and hard hats.
 - 4.1.2.4 Medical monitoring requirements for workers including required and recommended tests, reasons for medical monitoring and employee access to records.
 - 4.1.2.5 Air monitoring procedures and requirements for workers including description of equipment and procedures, reasons for monitoring, types of samples and current standards with recommended changes.
 - 4.1.2.6 Work practices for asbestos abatement including purpose, proper construction and maintenance of air-tight plastic barriers, job set-up of airlocks, worker decontamination systems and waste transfer airlocks, posting of warning signs, engineering controls electrical and ventilation system lockout, proper working techni-

gues, waste clean-up, storage and disposal procedures.

- 4.1.2.7 Personal hygiene including entry and exit procedures for the work area, use of showers and prohibition of eating, drinking, smoking and chewing in the work area.
- 4.1.2.8 Special safety hazards that may be encountered including electric hazards, air contaminants (CO, wetting agents, encapsulants, materials from Owner's operation), fire and explosion hazards, scaffold and ladder hazards, slippery surfaces, confined spaces, heat stress and noise.
- 4.1.2.9 Workshops affording both supervisory personnel and abatement workers the opportunity to see (and experience) the construction of containment barriers and decontamination facilities.
- 4.1.2.10 Supervisory personnel shall, in addition, receive training or contract specifications, liability insurance and bonding, legal considerations related to abatement, establishing respiratory protection medical surveillance programs, EPA OSHA [and State] recordkeeping requirements, and other topics as requested by the Building Owner.
- 4.1.3 Training must be provided by individuals qualified by virtue of experience and education to discuss the topic areas in 4.2
- 4.1.4 Training is to have occurred within 12 months prior to the initiation of abatement activities.
- 4.1.5 Contractor must document training by providing date of training, training entity, course outline, and names and qualifications of trainers.

4.2 Medical Monitoring

- 4.2.1 Medical Monitoring must be provided by the Contractor to any employee or agent that may be exposed to asbestos in excess of background levels during any phase of the abatement project. (Due to the synergistic effects between smoking and asbestos exposure, it is highly recommended that only non-smokers be employed in positions which may require them to enter asbestos contaminated atmospheres.
- 4.2.2 Medical monitoring shall include at a minimum:
 - 4.2.2.1 A work/medical history to elicit symptomatology of respiratory disease.
 - 4.2.2.2 A chest x-ray (posterior - anterior, 14 x 13 inches) evaluated by a Certified B-reader.

4.2.2.3 A pulmonary function test, including forced vital capacity (FVC) and forced expiratory volume at one second (FEV₁), administered and interpreted by a Certified Pulmonary Specialist.

4.2.3 Employees shall be given an opportunity to be evaluated by a physician to determine their capability to work safely while breathing through the added resistance of a respirator. (Examining physicians shall be aware of the nature of respiratory protective devices and their contributions to breathing resistance. They shall also be informed of the specific types of respirators the employee shall be required to wear and the work he will be required to perform, as well as special workplace conditions such as high temperatures, high humidity, and chemical contaminants to which he may be exposed.)

4.3 Asbestos Project Manager

4.3.1 The Asbestos Project Manager shall be the Owner or a designated representative paid by the owner. (also known as Clerk-of-the-works or Competent Person this person could be an administrator, architect, engineer, industrial hygienist or other individuals(s) possessing the qualifications detailed in section 4.3.2.)

4.3.2 The Asbestos Project Manager shall be able to demonstrate through special education, training, skills, knowledge or experience satisfactory to the Building Owner to indicate the ability to carry out the following activities as required:

- 4.3.2.1 Assist in decision making regarding selection of procedures
- 4.3.2.2 Assist in writing contract specifications for the abatement
- 4.3.2.3 Assist in evaluation of bids and selection of a contractor
- 4.3.2.4 Enforce contract specifications
- 4.3.2.5 Tour work area with the Contractor and agree on pre-abatement conditions of the work area
- 4.3.2.6 Inspect and sign off on barriers and decontamination enclosure systems.
- 4.3.2.7 Observe activities at all times during the course of abatement.
- 4.3.2.8 Meet with the Contractor daily to review work progress and solve problems or adjust procedures as appropriate.
- 4.3.2.9 Perform bulk material or air sampling and all workplace inspection clearance inspections for the Building Owner.
- 4.3.2.10 Report on abatement to the Building Owner.
- 4.3.2.11 Request, review and maintain Contractor submittals.

- 4.3.2.12 Provide training and or respirator fit testing to personnel.
- 4.3.3 The Asbestos Project Manager shall have the authority to stop any job activities if they are not being performed in accordance with applicable regulations or guidelines or the requirements of this specification. These will be reported to the Owner with description of activity, reason for stopping it and alternatives for correcting the problem.
- (Note: The Asbestos Project Manager should be selected as early as possible prior to selection of the Contractor to enable participation during the pre-bid conference, walk-through, and pre-construction conference.)
- 4.3.4 The Asbestos Project Manager shall be covered by adequate liability insurance to protect against errors and omissions in the performance of support activities. [Building Owner may insert minimum requirements based on individual projects.]

4.4 Air Sampling Professional (ASP)

- 4.4.1 The Air Sampling Professional shall conduct all air sampling for the Building Owner.
- 4.4.2 The ASP shall conduct air sampling in accordance with the NIOSH Standard Analytical Method for Asbestos in Air P&CAM 239 and/or Method 7400 or other acceptable methods as otherwise agreed upon.
- 4.4.3 It is recommended that the following schedule be utilized for air sampling during the project (in addition to OSHA compliance monitoring):
- 4.4.3.1 Pre-abatement sampling - A sufficient number of air samples shall be collected prior to the start of abatement activities in order to determine prevalent airborne concentrations. Samples should be taken both inside and outside of the work area and buildings to establish existing levels under normal activity conditions.
- 4.4.3.2 Sampling during the abatement project:
- 4.4.3.2.1 The following schedule of samples shall be required on a daily basis, once abatement activities begin (The following are recommended minimums. The size of the abatement activity will impact on the number of samples necessary to adequately monitor the Contractor's activities. Decisions on the number of samples should be made with the advice of the Air Sampling Professional):
- 2 Area Samples (inside the work area)
 - 2 Personal Samples (inside the work area)

2 Area Samples (outside the work area in uncontaminated areas of the building. One of these shall be at the entrance to the worker decontamination enclosure.)

1 Area Sample (outside the building)

1 Area Sample (at the exhaust of negative pressure ventilation equipment.)

4.4.3.2.2 Samples shall be collected at a sampling rate of 2 liters/min. A minimum acceptable air volume is 480 liters.

4.4.3.3 Post-Abatement (clearance) air sampling shall be conducted following the cleaning phase of work, once the no visible residue criterion has been met. A sufficient number of samples shall be collected aggressively (with portable fans circulating air in the work area to simulate actual use conditions) to determine post-abatement air concentrations. An adequate volume of air to provide accuracy to 0.01 fibers/cc is required.

4.4.4 The Air Sampling Professional shall be experienced and knowledgeable about the methods for asbestos air sampling and be able to select representative numbers and locations of samples.

4.5.5 The Air Sampling Professional shall have adequate liability insurance to protect against errors and omissions in the performance of support activities. [Building Owner may insert minimum requirements based on individual projects.]

4.5 Laboratory Services

4.5.1 Laboratory utilized for analyzing air samples by NIOSH shall be satisfactory participants in the NIOSH Proficiency Analytical testing (PAT) program asbestos analysis.

4.5.2 Laboratories used for bulk material identification shall be satisfactory participants in the EPA quality assurance program for bulk asbestos analysis.

4.5.3 The period of time permitted between the collection of air samples and the availability of results shall be less than 24 hours for samples collecting during abatement activities. Timetables for results of pre-abatement and clearance air samples shall be established by the Building Owner. (On-site analytical capabilities are preferred for immediate results of sampling. This provides the Building Owner with a timely

review of Contractor performance and a more rapid awareness of hazardous exposure conditions which can be corrected. This service may not be readily available, however. Real-time monitoring instruments provide some support in this matter as long as their limitations are clearly understood and the Contractor and Building Owner agree in advance on how the results are to be used. These devices do not meet current OSHA monitoring requirements and should not be used in place of sampling as described in Section 4.4.3.2).

Appendix C. SPECIAL REQUIREMENTS BY THE STATE OF OHIO
FOR ASBESTOS ABATEMENT PROJECTS

APPENDIX C. SPECIAL REQUIREMENTS BY THE STATE OF OHIO
FOR ASBESTOS ABATEMENT PROJECTS

OHIO

- Public Law:** House Bill 589
Enacted Dec. 15, 1986
Effective March 17, 1987
- Scope:** The measure provides for licensing, certification, and liability of persons who engage in activity involving removal, renovation, enclosure, repair, or encapsulation of friable asbestos-containing materials in an amount greater than 50 lineal feet or 50 square feet. The licensing and certification requirements apply to businesses and public entities, but not a homeowner or to a business or the employees of a business engaging in asbestos abatement activities solely at its own place of business, nor do they apply in emergencies that are sudden, unexpected events and not planned asbestos abatement projects.
- The law empowers the Department of Health to develop comprehensive programs and policies for control and prevention of non-occupational exposure to friable asbestos-containing material.
- For persons licensed or certified under the Act, liability for an injury to an individual or property caused by or related to asbestos abatement activities is limited to acts or omissions that can be shown to have been negligent. It limits liability incurred by a person who contracts with an asbestos abatement contractor or specialist.
- Administration:** Public Health Council, Department of Health
- Enforcement:** Violations of Public Health Council standards of acceptable conduct for licensees and certificate holders engaged in asbestos abatement activities can result in a reprimand, suspension or revocation of a license or certificate, or denial of an application or renewal of a license or certificate. The Department of Health is responsible for enforcing standards adopted by the council.
- The Department of Health may deny or revoke approval to sponsor training courses on the health and safety aspects of asbestos abatement if the sponsor fails to meet the standards set forth in the statute or by rules.

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Enforcement: At the request of the Department of Health, the attorney general may bring action for civil penalties and injunctions against any person thought to be in violation of the law or rules. Civil penalties up to \$5,000 can be assessed against violators for each day of violation. Criminal penalties also can be brought. On conviction of a first offense, the person is subject to a fine between \$10,000 and \$25,000, imprisonment from one to two years, or both. For a second or subsequent offense, a conviction can bring a fine of from \$20,000 to \$40,000, imprisonment from two to four years, or both.

Financing: All civil and criminal penalties and all fees and other funds collected under the law must be deposited in the Asbestos Abatement Licensing Fund. The Department of Health is responsible for administering grants from the federal government and other public and private sources.

Standards:

Contractor and Worker Standards: The Public Health Council must adopt criteria and procedures for certification of asbestos abatement specialists, asbestos hazard evaluation specialists, or other categories the council may create. Asbestos abatement specialists are persons responsible for the supervision of asbestos hazard abatement activities, such as architects, engineers, project supervisors and foremen, employees of school districts or other public entities, and others, who coordinate or directly supervise asbestos hazard abatement activities performed by school district, governmental, or other public employees in school district, governmental, or other public buildings. Asbestos hazard evaluation specialists are persons such as health professionals, industrial hygienists, private consultants, or others, responsible for the evaluation of health hazards associated with the presence of friable asbestos materials or for establishing or monitoring procedures in asbestos abatement activities in protecting the public health from the hazards associated with exposure to asbestos and whose responsibilities include the performance of air and bulk sampling.

The certificate is issued by the Department of Health or by a training institution affirming that the individual seeking a certificate has successfully completed approved training and other requirements in accordance with the rules adopted by the Public Health Council. Certificates are valid for one year, and renewal requires successful completion of a Department of Health-approved course.

An asbestos abatement contractor's license issued by the Department of Health and renewable yearly is required of a business or public entity engaging in abatement activities. To qualify for a contractor's license, each employee of the business or public entity applying for a license who will come in contact with asbestos or be responsible for an

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asbestos abatement project must be familiar with state and federal standards for asbestos abatement projects and demonstrate capability to comply with those standards, and must have successfully completed a course of instruction and passed an examination approved by the Department of Health. The contractor must provide at least one certified asbestos hazard abatement specialist for each project.

The Department of Health must be satisfied that, in addition to meeting any other requirements adopted by the Public Health Council, the contractor:

- Has access to at least one state-approved asbestos disposal site;
- Is sufficiently qualified to safely remove asbestos, possesses a work program that prevents the contamination or recontamination of the environment and protects the public health from asbestos exposure;
- Possesses evidence of certification of each individual employee or agent who will be responsible for others who may come in contact with friable asbestos materials;
- Has evidence of workers' training;
- Has prior successful experience in asbestos abatement or equivalent experience as required by Public Health Council rules; and
- Has a worker protection program consistent with requirements of the Public Health Council or the federal Occupational Health and Safety Administration, as applicable.

Applications for a contractor's license must include:

- A description of the protective clothing and respirators that will be used;
- A description of the procedures for the selection, utilization, handling, removal, and disposal of clothing to prevent contamination or recontamination of the environment or to protect the public;
- The name and address of each asbestos disposal site that might be used;
- A description of the site decontamination procedures that will be used;
- A description of the asbestos hazard abatement procedures to be employed;
- A description of the procedures to be used for handling waste containing asbestos;
- A description of the air monitoring procedures that will be used; and
- A description of the final cleanup procedures the business or public entity will use.

A person may sponsor a course or a review course on the health and safety aspects of asbestos hazard abatement projects if Department of Health approval is obtained. Approval may be won or retained for the course if the sponsor:

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- Provides 10 hours of instruction, including coverage of such topics as recognition of asbestos, health hazards, worker protection, work practices, respirator use and care, and federal and state requirements and procedure standards;
- Provides each student with at least 15 minutes of individual instruction consisting of respirator fit tests and respirator use;
- Ensures the course is given or supervised by an industrial hygienist;
- Provides an examination approved by the department;
- Issues to each student who completes the course and passes the examination a certificate in accordance with Public Health Council rules;
- Provides a minimum three-day course to asbestos hazard abatement specialists and evaluation specialists, and supervisors of abatement projects; and
- Provides a minimum five-hour review course.

Persons licensed, certified, or otherwise approved under the laws of another state and performing functions similar to those of an asbestos abatement contractor, an abatement specialist, or an evaluation specialist may apply to the Department of Health for licensing or certification. A license or certificate will be awarded on the discretion of the Department.

Inspections: Levels of asbestos exposure or other circumstances constituting a public health emergency requiring the Department of Health to issue an emergency order shall be determined by rules adopted by the Public Health Council.

Evaluations of the health hazards associated with the presence of friable asbestos materials, made to determine the need for an asbestos hazard abatement project, must be conducted by an asbestos hazard evaluation specialist, and the activities of that specialist shall be specified in rules adopted by the Public Health Council.

The Department of Health must conduct an onsite inspection of a licensee's procedures at least once a year during an actual abatement project.

The Department of Health may issue an order requiring any action necessary to meet a public health emergency involving asbestos. Immediate compliance with the order is required of any person to whom the order is directed.

Abatement Procedures: The Public Health Council is required to adopt rules for work practices that reduce the risk of contamination of the environment, worker protection equipment and practices, action levels, project clearance levels and other requirements that asbestos hazard abatement contractors, asbestos hazard abatement specialists, and other persons involved with asbestos hazard abatement activities must follow to protect the public.

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The Department of Health is required to prohibit and prevent improper asbestos abatement procedures and require modification or alteration of procedures if they are not in compliance with the provisions of the law and any rules promulgated by the Public Health Council.

Before engaging in an asbestos abatement project, an asbestos abatement contractor must:

- Prepare a written respiratory protection program and make it available to the Department of Health and workers at the job site;
- Ensure that each worker involved in the abatement project has been examined within the preceding year and has been declared by a physician to be physically capable of working while wearing a respirator; and
- Ensure that each employee who will come in contact with asbestos or who will be responsible for an asbestos abatement project has taken the required training course or review course.

An asbestos abatement contractor who intends to engage in an asbestos hazard abatement project that is a National Emission Standard for Hazardous Air Pollutants source must notify the Ohio Environmental Protection Agency. At least five days before beginning an asbestos abatement project, the contractor must notify the Department of Health of the intent to begin a project.

During the course of an abatement project, the abatement contractor and the asbestos hazard abatement specialist must conduct each project in accordance with rules adopted by the Public Health Council for decontamination procedures, project containment procedures, and asbestos fiber dispersal methods. The contractor must provide workers with appropriate disposable and protective clothing and equipment, including respirators, and the specialist must ensure that the workers use those items properly. The specialist must ensure that there is no smoking, eating, or drinking in the project work area.

Records: Each asbestos hazard abatement contractor must maintain records of each project for at least 20 years and make these records available to the Department of Health. The records shall include:

- The name, address, and social security number of the person who supervised the abatement project;
- The names and social security numbers of all workers at the job site;
- The location and description of the project and the amount of asbestos-containing material that was removed;
- The starting and completion dates of each project;
- A summary of the procedures that were used to comply with all applicable standards; and
- The name and address of each asbestos disposal site used.

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To obtain or retain approval from the Department of Health to conduct courses on the health and safety aspects of asbestos abatement, a person seeking such approval must be able to maintain lists of students trained and the dates on which training occurred for at least 20 years and make this information available to the department upon request.

Consumer Information and Studies: The Department of Health is required to collect and disseminate health education information relating to the safe management of asbestos hazards.

A legislative oversight committee on asbestos abatement is created to review abatement activity by private entities and examine permissible regulation allowed the state over business entities and to report its findings to the Assembly within one year.

Appendix D. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY NATIONAL
EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPS)
ASBESTOS REGULATIONS (40 CFR 61, SUBPART M)

**Appendix C. USEPA National Emission Standards for Hazardous Air Pollutants
(NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M)**

AUTHORITY: Secs. 112 and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7412, 7601(a)).

SOURCE: 49 FR 13661, Apr. 5, 1984, unless otherwise noted.

§ 61.140 Applicability.

The provisions of this subpart are applicable to those sources specified in §§ 61.142 through 61.153.

§ 61.141 Definitions.

All terms that are used in this subpart and are not defined below are given the same meaning as in the Act and in Subpart A of this part.

Active waste disposal site means any disposal site other than an inactive site.

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

Asbestos means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite.

Asbestos-containing waste materials means any waste that contains commercial asbestos and is generated by a source subject to the provisions of this subpart. This term includes asbestos mill tailings, asbestos waste from control devices, friable asbestos waste material, and bags or containers that previously contained commercial asbestos. However, as applied to demolition and renovation operations, this term includes only friable asbestos waste and asbestos waste from control devices.

Asbestos material means asbestos or any material containing asbestos.

Asbestos mill means any facility engaged in converting, or in any intermediate step in converting, asbestos ore into commercial asbestos. Outside

storage of asbestos material is not considered a part of the asbestos mill.

Asbestos tailings means any solid waste that contains asbestos and is a product of asbestos mining or milling operations.

Asbestos waste from control devices means any waste material that contains asbestos and is collected by a pollution control device.

Commercial asbestos means any asbestos that is extracted from asbestos ore.

Demolition means the wrecking or taking out of any load-supporting structural member of a facility together with any related handling operations.

Emergency renovation operation means a renovation operation that was not planned but results from a sudden, unexpected event. This term includes operations necessitated by nonroutine failures of equipment.

Fabricating means any processing of a manufactured product that contains commercial asbestos, with the exception of processing at temporary sites for the construction or restoration of facilities.

Facility means any institutional, commercial, or industrial structure, installation, or building (excluding apartment buildings having no more than four dwelling units).

Facility component means any pipe, duct, boiler, tank, reactor, turbine, or furnace at or in a facility; or any structural member of a facility.

Friable asbestos material means any material containing more than 1 percent asbestos by weight that hand pressure can crumble, pulverize, or reduce to powder when dry.

Inactive waste disposal site means any disposal site or portion of it where additional asbestos-containing waste material will not be deposited and where the surface is not disturbed by vehicular traffic.

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

Outside air means the air outside buildings and structures.

Particulate asbestos material means finely divided particles of asbestos material.

Planned renovation operations means a renovation operation, or a number of such operations, in which the amount of friable asbestos material that will be removed or stripped within a given period of time can be predicted. Individual nonscheduled operations are included if a number of such operations can be predicted to occur during a given period of time based on operating experience.

Remove means to take out friable asbestos materials from any facility.

Renovation means altering in any way one or more facility components. Operations in which load-supporting structural members are wrecked or taken out are excluded.

Roadways means surfaces on which motor vehicles travel. This term includes highways, roads, streets, parking areas, and driveways.

Strip means to take off friable asbestos materials from any part of a facility.

Structural member means any load-supporting member of a facility, such as beams and load supporting walls; or any nonload-supporting member, such as ceilings and nonload-supporting walls.

Visible emissions means any emissions containing particulate asbestos material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.142 Standard for asbestos mills.

Each owner or operator of an asbestos mill shall either discharge no visible emissions to the outside air from that asbestos mill or use the methods specified by § 61.154 to clean emissions

containing particulate asbestos material before they escape to, or are vented to, the outside air.

§ 61.143 Standard for roadways.

No person may surface a roadway with asbestos tailings or asbestos-containing waste material on that roadway, unless it is a temporary roadway on an area of asbestos ore deposits.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.144 Standard for manufacturing.

(a) *Applicability.* This section applies to the following manufacturing operations using commercial asbestos.

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

(2) The manufacture of cement products.

(3) The manufacture of fireproofing and insulating materials.

(4) The manufacture of friction products.

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

(6) The manufacture of floor tile.

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

(8) The manufacture of plastics and rubber materials.

(9) The manufacture of chlorine.

(10) The manufacture of shotgun shell wads.

(11) The manufacture of asphalt concrete.

(b) *Standard.* Each owner or operator of any of the manufacturing operations to which this section applies shall either:

(1) Discharge no visible emissions to the outside air from these operations or from any building or structure in which they are conducted; or

(2) Use the methods specified by § 61.154 to clean emissions from these operations containing particulate asbestos material before they escape to, or are vented to, the outside air.

§ 61.145 Standard for demolition and renovation: Applicability.

The requirements of §§ 61.146 and 61.147 apply to each owner or operator

of a demolition or renovation operation as follows:

(a) If the amount of friable asbestos materials in a facility being demolished is at least 80 linear meters (260 linear feet) on pipes or at least 15 square meters (160 square feet) on other facility components, all the requirements of §§ 61.146 and 61.147 apply, except as provided in paragraph (c) of this section.

(b) If the amount of friable asbestos materials in a facility being demolished is less than 80 linear meters (260 linear feet) on pipes and less than 15 square meters (160 square feet) on other facility components, only the requirements of paragraphs (a), (b), and (c) (1), (2), (3), (4), and (5) of § 61.146 apply.

(c) If the facility is being demolished under an order of a State or local governmental agency, issued because the facility is structurally unsound and in danger of imminent collapse, only the requirements in § 61.146 and in paragraphs (d), (e), (f), and (g) of § 61.147 apply.

(d) If at least 80 linear meters (260 linear feet) of friable asbestos materials on pipes or at least 15 square meters (160 square feet) of friable asbestos materials on other facility components are stripped or removed at a facility being renovated, all the requirements of §§ 61.146 and 61.147 apply.

(1) To determine whether paragraph (d) of this section applies to planned renovation operations involving individual nonscheduled operations, predict the additive amount of friable asbestos materials to be removed or stripped over the maximum period of time a prediction can be made, not to exceed 1 year.

(2) To determine whether paragraph (d) of this section applies to emergency renovation operations, estimate the amount of friable asbestos materials to be removed or stripped as a result of the sudden, unexpected event that necessitated the renovation.

(e) Owners or operators of demolition and renovation operations are exempt from the requirements of §§ 61.05(a), 61.07, and 61.09.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.146 Standard for demolition and renovation: Notification requirements.

Each owner or operator to which this section applies shall:

(a) Provide the Administrator with written notice of intention to demolish or renovate.

(b) Postmark or deliver the notice as follows:

(1) At least 10 days before demolition begins if the operation is described in § 61.145(a);

(2) At least 20 days before demolition begins if the operation is described in § 61.145(b);

(3) As early as possible before demolition begins if the operation is described in § 61.145(c);

(4) As early as possible before renovation begins.

(c) Include the following information in the notice:

(1) Name and address of owner or operator.

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

(3) Estimate of the approximate amount of friable asbestos material present in the facility in terms of linear feet of pipe, and surface area on other facility components. For facilities described in § 61.145(b), explain techniques of estimation.

(4) Location of the facility being demolished or renovated.

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

(6) Nature of planned demolition or renovation and method(s) to be used.

(7) Procedures to be used to comply with the requirements of this Subpart.

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

(9) For facilities described in § 61.145(c), the name, title, and authority of the State or local governmental representative who has ordered the demolition.

(Approved by the Office of Management and Budget under control number 2000-0284.)

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.147 Standard for demolition and renovation: Procedures for asbestos emission control.

Each owner or operator to whom this section applies shall comply with the following procedures to prevent emissions of particulate asbestos material to the outside air:

(a) Remove friable asbestos materials from a facility being demolished or renovated before any wrecking or dismantling that would break up the materials or preclude access to the materials for subsequent removal. However, friable asbestos materials need not be removed before demolition if:

(1) They are on a facility component that is encased in concrete or other similar material; and

(2) These materials are adequately wetted whenever exposed during demolition.

(b) When a facility component covered or coated with friable asbestos materials is being taken out of the facility as units or in sections:

(1) Adequately wet any friable asbestos materials exposed during cutting or disjoining operations; and

(2) Carefully lower the units or sections to ground level, not dropping them or throwing them.

(c) Adequately wet friable asbestos materials when they are being stripped from facility components before the members are removed from the facility. In renovation operations, wetting that would unavoidably damage equipment is not required if the owner or operator:

(1) Asks the Administrator to determine whether wetting to comply with this paragraph would unavoidably damage equipment, and, before beginning to strip, supplies the Administrator with adequate information to make this determination; and

(2) When the Administrator does determine that equipment damage would be unavoidable, uses a local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping and removal of the friable asbestos materials. The system must exhibit no visible emissions to the outside air or be designed and operated in accordance with the requirements in § 61.154.

(d) After a facility component has been taken out of the facility as units or in sections, either:

(1) Adequately wet friable asbestos materials during stripping; or

(2) Use a local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping. The system must exhibit no visible emissions to the outside air or be designed and operated in accordance with the requirements in § 61.154.

(e) For friable asbestos materials that have been removed or stripped:

(1) Adequately wet the materials to ensure that they remain wet until they are collected for disposal in accordance with § 61.152; and

(2) Carefully lower the materials to the ground or a lower floor, not dropping or throwing them; and

(3) Transport the materials to the ground via dust-tight chutes or containers if they have been removed or stripped more than 50 feet above ground level and were not removed as units or in sections.

(f) When the temperature at the point of wetting is below 0°C (32°F):

(1) Comply with the requirements of paragraphs (d) and (e) of this section. The owner or operator need not comply with the other wetting requirements in this section; and

(2) Remove facility components coated or covered with friable asbestos materials as units or in sections to the maximum extent possible.

(g) For facilities described in § 61.145(c), adequately wet the portion of the facility that contains friable asbestos materials during the wrecking operation.

§ 61.148 Standard for spraying.

The owner or operator of an operation in which asbestos-containing materials are spray applied shall comply with the following requirements:

(a) Use materials that contain 1 percent asbestos or less on a dry weight basis for spray-on application on buildings, structures, pipes, and conduits, except as provided in paragraph (c) of this section.

(b) For spray-on application of materials that contain more than 1 percent

asbestos on a dry weight basis on equipment and machinery, except as provided in paragraph (c) of this section:

(1) Notify the Administrator at least 20 days before beginning the spraying operation. Include the following information in the notice:

(i) Name and address of owner or operator.

(ii) Location of spraying operation.

(iii) Procedures to be followed to meet the requirements of this paragraph.

(2) Discharge no visible emissions to the outside air from the spray-on application of the asbestos-containing material or use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(c) The requirements of paragraphs (a) and (b) of this section do not apply to the spray-on application of materials where the asbestos fibers in the materials are encapsulated with a bituminous or resinous binder during spraying and the materials are not friable after drying.

(d) Owners and operators of sources subject to this section are exempt from the requirements of §§ 61.05(a), 61.07, and 61.09.

(Approved by the Office of Management and Budget under control number 2000-0264.)

§ 61.149 Standard for fabricating.

(a) *Applicability.* This section applies to the following fabricating operations using commercial asbestos:

(1) The fabrication of cement building products.

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

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

(b) *Standard.* Each owner or operator of any of the fabricating operations to which this section applies shall either:

(1) Discharge no visible emissions to the outside air from any of the operations or from any building or structure in which they are conducted; or

(2) Use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

§ 61.150 Standard for insulating materials.

After the effective date of this regulation, no owner or operator of a facility may install or reinstall on a facility component any insulating materials that contain commercial asbestos if the materials are either molded and friable or wet-applied and friable after drying. The provisions of this paragraph do not apply to spray-applied insulating materials regulated under § 61.148.

§ 61.151 Standard for waste disposal for asbestos mills.

Each owner or operator of any source covered under the provisions of § 61.142 shall:

(a) Deposit all asbestos-containing waste material at waste disposal sites operated in accordance with the provisions of § 61.156; and

(b) Discharge no visible emissions to the outside air from the transfer of asbestos waste from control devices to the tailings conveyor, or use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air. Dispose of the asbestos waste from control devices in accordance with § 61.152(b) or paragraph (c) of this section; and

(c) Discharge no visible emissions to the outside air during the collection, processing, packaging, transporting, or deposition of any asbestos-containing waste material, or use one of the disposal methods specified in paragraphs (c) (1) or (2) of this section, as follows:

(1) Use a wetting agent as follows:

(i) Adequately mix all asbestos-containing waste material with a wetting agent recommended by the manufacturer of the agent to effectively wet dust and tailings, before depositing the material at a waste disposal site. Use the agent as recommended for the

particular dust by the manufacturer of the agent.

(ii) Discharge no visible emissions to the outside air from the wetting operation or use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(iii) Wetting may be suspended when the ambient temperature at the waste disposal site is less than -9.5°C (15°F). Determine the ambient air temperature by an appropriate measurement method with an accuracy of $\pm 1^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$), and record it at least hourly while the wetting operation is suspended. Keep the records for at least 2 years in a form suitable for inspection.

(2) Use an alternative disposal method that has received prior approval by the Administrator.

§ 61.152 Standard for waste disposal for manufacturing demolition, renovation, spraying, and fabricating operations.

Each owner or operator of any source covered under the provisions of §§ 61.144 and 61.149 shall:

(a) Deposit all asbestos-containing waste material at waste disposal sites operated in accordance with the provisions of § 61.156; and

(b) Discharge no visible emissions to the outside air during the collection, processing (including incineration), packaging, transporting, or deposition of any asbestos-containing waste material generated by the source, or use one of the disposal methods specified in paragraphs (b)(1), (2), or (3) of this section, as follows:

(1) Treat asbestos-containing waste material with water:

(i) Mix asbestos waste from control devices with water to form a slurry; adequately wet other asbestos-containing waste material; and

(ii) Discharge no visible emissions to the outside air from collection, mixing, and wetting operations, or use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air; and

(iii) After wetting, seal all asbestos-containing waste material in leak-tight containers while wet; and

(iv) Label the containers specified in paragraph (b)(1)(iii) as follows:

CAUTION

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

Alternatively, use warning labels specified by Occupational Safety and Health Standards of the Department of Labor, Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.1001(g)(2)(ii).

(2) Process asbestos-containing waste material into nonfriable forms:

(i) Form all asbestos-containing waste material into nonfriable pellets or other shapes; and

(ii) Discharge no visible emissions to the outside air from collection and processing operations, or use the methods specified by § 61.154 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(3) Use an alternative disposal method that has received prior approval by the Administrator.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.153 Standard for inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations.

Each owner or operator of any inactive waste disposal site that was operated by sources covered under § 61.142, § 61.144, or § 61.149 and received deposits of asbestos-containing waste material generated by the sources, shall

(a) Comply with one of the following:

(1) Either discharge no visible emissions to the outside air from an inactive waste disposal site subject to this paragraph; or

(2) Cover the asbestos-containing waste material with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, and grow and maintain a cover of vegetation on

the area adequate to prevent exposure of the asbestos-containing waste material; or

(3) Cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted nonasbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste; or

(4) For inactive waste disposal sites for asbestos tailings, apply a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. Use the agent as recommended for the particular asbestos tailings by the manufacturer of the dust suppression agent. Obtain prior approval of the Administrator to use other equally effective dust suppression agents. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

(b) Unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as follows, or comply with paragraph (a)(2) or (a)(3) of this section.

(1) Display warning signs at all entrances and at intervals of 100 m (330 feet) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements for 51 cm x 38 cm (20" x 14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation
Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block
Do Not Create Dust	1.9 cm (¾ inch) Sans Serif, Gothic or Block
Breathing Asbestos is Hazardous to Your Health.	14 Point Gothic.

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

(2) Fence the perimeter of the site in a manner adequate to deter access by the general public.

(3) Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access by the general public.

(c) The owner or operator may use an alternative control method that has received prior approval of the Administrator rather than comply with the requirements of paragraph (a) or (b) of this section.

§ 61.154 Air-cleaning.

(a) The owner or operator who elects to use air-cleaning, as permitted by §§ 61.142, 61.144, 61.147(c)(2), 61.147(d)(2), 61.148(b)(2), 61.149(b), 61.151(b), 61.151(c)(1)(ii), 61.152(b)(1)(ii), and 61.152(b)(2) shall:

(1) Use fabric filter collection devices, except as noted in paragraph (b) of this section, doing all of the following:

(i) Operating the fabric filter collection devices at a pressure drop of no more than .995 kilopascal (4 inches water gage), as measured across the filter fabric; and

(ii) Ensuring that the airflow permeability, as determined by ASTM Method D737-75, does not exceed 9 m³/min/m² (30 ft³/min/ft²) for woven fabrics or 11³/min/m² (35 ft³/min/ft²) for felted fabrics, except that 12 m³/min/m² (40 ft³/min/ft²) for woven and 14 m³/min/m² (45 ft³/min/ft²) for felted fabrics is allowed for filtering air from asbestos ore dryers; and

(iii) Ensuring that felted fabric weighs at least 475 grams per square meter (14 ounces per square yard) and is at least 1.6 millimeters (one-sixteenth inch) thick throughout; and

(iv) Avoiding the use of synthetic fabrics that contain fill yarn other than that which is spun.

(2) Properly install, use, operate, and maintain all air-cleaning equipment authorized by this section. Bypass devices may be used only during upset or emergency conditions and then only for so long as it takes to shut down the operation generating the particulate asbestos material.

(b) There are the following exceptions to paragraph (a)(1):

(1) If the use of fabric creates a fire or explosion hazard, the Administrator may authorize as a substitute the use of wet collectors designed to operate with a unit contacting energy of at least 9.95 kilopascals (40 inches water gage pressure).

(2) The Administrator may authorize the use of filtering equipment other than that described in paragraphs (a)(1) and (b)(1) of this section if the owner or operator demonstrates to the Administrator's satisfaction that it is equivalent to the described equipment in filtering particulate asbestos material.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

§ 61.155 Reporting.

(a) Within 90 days after the effective date of this subpart, each owner or operator of any existing source to which this subpart applies shall provide the following information to the Administrator, except that any owner or operator who provided this information prior to April 5, 1984 in order to comply with § 61.24 (which this section replaces) is not required to resubmit it.

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

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

(i) If the fabric device uses a woven fabric, the airflow permeability in $m^3/min/m^2$ and; if the fabric is synthetic, whether the fill yarn is spun or not spun; and

(ii) If the fabric filter device uses a felted fabric, the density in g/m^3 , the minimum thickness in inches, and the airflow permeability in $m^3/min/m^2$.

(3) For sources subject to §§ 61.151 and 61.152:

(i) A brief description of each process that generates asbestos-containing waste material; and

(ii) The average weight of asbestos-containing waste material disposed of, measured in kg/day; and

(iii) The emission control methods used in all stages of water disposal; and

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

(4) For sources subject to § 61.153:

(i) A brief description of the site; and

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

(b) The information required by paragraph (a) of this section must accompany the information required by § 61.10. The information described in this section must be reported using the format of Appendix A of this part.

(Approved by this Office of Management and Budget under control number 2000-0264)

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414))

§ 61.156 Active waste disposal sites.

To be an acceptable site for disposal of asbestos-containing waste material under §§ 61.151 and 61.152, an active waste disposal site must meet the requirements of this section.

(a) Either there must be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited, or the requirements of paragraph (c) or (d) of this section must be met.

(b) Unless a natural barrier adequately deters access by the general public, either warning signs and fencing must be installed and maintained as follows, or the requirements of paragraph (c)(1) of this section must be met.

(1) Warning signs must be displayed at all entrances and at intervals of 100 m (330 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material is deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements of 51 cm × 36 cm (20" × 14") upright

format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation
Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block.
Do Not Create Dust	1.9 cm (3/4 inch) Sans Serif, Gothic or Block.
Breathing Asbestos is Hazardous to Your Health.	14 Point Gothic.

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

(2) The perimeter of the disposal site must be fenced in a manner adequate to deter access by the general public.

(3) Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access by the general public.

(c) Rather than meet the no visible emission requirement of paragraph (a) of this section, an active waste disposal site would be an acceptable site if at

the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material which was deposited at the site during the operating day or previous 24-hour period is covered with either.

(1) At least 15 centimeters (6 inches) of compacted nonasbestos-containing material, or

(2) A resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. This agent must be used as recommended for the particular dust by the manufacturer of the dust suppression agent. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

(d) Rather than meet the no visible emission requirement of paragraph (a) of this section, an active waste disposal site would be an acceptable site if an alternative control method for emissions that has received prior approval by the Administrator is used.

(Secs. 112 and 301(a) of the Clean Air Act as amended (42 U.S.C. 7412, 7601(a))

Appendix E. OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION (OSHA)
ASBESTOS REGULATIONS (29 CFR 1926.58)

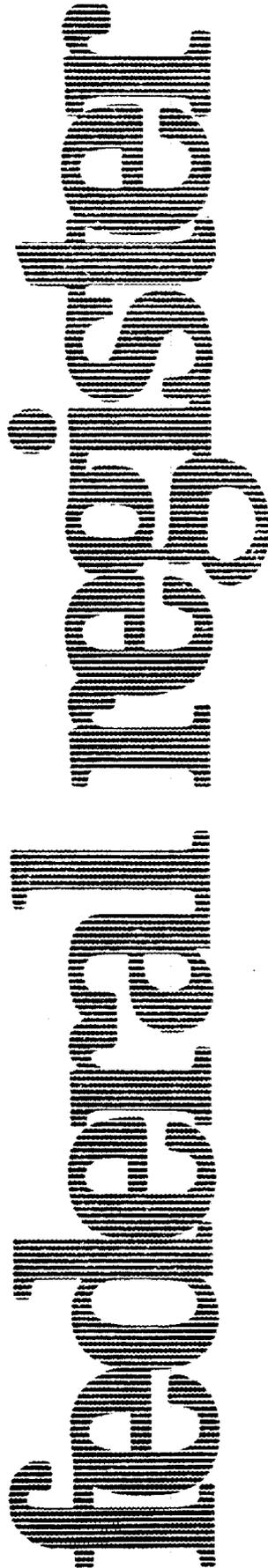
Friday
June 20, 1986

Part II

Department of Labor

**Occupational Safety and Health
Administration**

**29 CFR Parts 1910 and 1926
Occupational Exposure to Asbestos,
Tremolite, Anthophyllite, and Actinolite;
Final Rules**



relate to asbestos exposure; the employee's representative level of exposure to asbestos, tremolite, anthophyllite, and actinolite; a description of any personal protective and respiratory equipment used; and information from previous medical examinations of the affected employee that is not otherwise available to the physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, if required.

The employer is required to obtain a written opinion from the examining physician containing the results of the medical examination; the physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of exposure-related disease; any recommended limitations on the employee or on the use of personal protective equipment; and a statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions related to asbestos, tremolite, anthophyllite, and actinolite exposure that require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to exposure to asbestos, tremolite, anthophyllite, and actinolite, and a copy of the opinion must be provided to the affected employee.

PART 1926—[AMENDED]

5. An authority citation is added to Subpart D of Part 1926, to read as follows:

Authority: Secs. 4, 6, 8 Occupational Safety and Health Act of 1970, 29 U.S.C. 853, 855, 857; Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act), 40 U.S.C. 333, and Secretary of Labor's Orders 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable. Sections 1926.55(c) and 1926.58 also issued under 29 CFR Part 1911.

6. Paragraph (c) of § 1926.55 is hereby revised to read as follows:

§ 1926.55 Gases, vapors, fumes, dusts, and mists.

(c) Paragraphs (a) and (b) of this section do not apply to the exposure of employees to airborne asbestos, tremolite, anthophyllite, or actinolite dust. Whenever any employee is exposed to airborne asbestos, tremolite, anthophyllite, or actinolite dust, the requirements of § 1926.58 of this title shall apply.

7. A new § 1926.58 is added to Subpart D to read as follows:

§ 1926.58 Asbestos, tremolite, anthophyllite, and actinolite.

(a) *Scope and application.* This section applies to all construction work as defined in 29 CFR 1910.12(b), including but not limited to the following:

(1) Demolition or salvage of structures where asbestos, tremolite, anthophyllite, or actinolite is present;

(2) Removal or encapsulation of materials containing asbestos, tremolite, anthophyllite, or actinolite;

(3) Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos, tremolite, anthophyllite, or actinolite;

(4) Installation of products containing asbestos, tremolite, anthophyllite, or actinolite;

(5) Asbestos, tremolite, anthophyllite, and actinolite spill/emergency cleanup; and

(6) Transportation, disposal, storage, or containment of asbestos, tremolite, anthophyllite, or actinolite or products containing asbestos, tremolite, anthophyllite, or actinolite on the site or location at which construction activities are performed.

(b) *Definitions.* "Action level" means an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals of 0.1 fiber per cubic centimeter (f/cc) of air calculated as an eight (8)-hour time-weighted average.

"Asbestos" includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that has been chemically treated and/or altered.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee

"Authorized person" means any person authorized by the employer and required by work duties to be present in regulated areas.

"Clean room" means an uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

"Competent person" means one who is capable of identifying existing asbestos, tremolite, anthophyllite, or actinolite hazards in the workplace and who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f). The duties of the competent person include at least the following: establishing the negative-pressure enclosure, ensuring its integrity, and controlling entry to and exit from the enclosure; supervising any employee exposure monitoring required by the standard; ensuring that all employees working within such an enclosure wear the appropriate personal protective equipment, are trained in the use of appropriate methods of exposure control, and use the hygiene facilities

and decontamination procedures specified in the standard; and ensuring that engineering controls in use are in proper operating condition and are functioning properly.

"Decontamination area" means 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, tremolite, anthophyllite, or actinolite.

"Demolition" means the wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos, tremolite, anthophyllite, or actinolite products.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Employee exposure" means that exposure to airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals, that would occur if the employee were not using respiratory protective equipment.

"Equipment room (change room)" means a contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

"Fiber" means a particulate form of asbestos, tremolite, anthophyllite, or actinolite, 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

"High-efficiency particulate air (HEPA) filter" means a filter capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 micrometers in diameter or larger.

"Regulated area" means an area established by the employer to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed or can reasonably be expected to exceed the permissible exposure limit. The regulated area may take the form of (1) a temporary enclosure, as required by paragraph (e)(6) of this section, or (2) an area demarcated in any manner that minimizes the number of employees exposed to asbestos, tremolite, anthophyllite, or actinolite.

"Removal" means the taking out or stripping of asbestos, tremolite, anthophyllite, or actinolite or materials containing asbestos, tremolite, anthophyllite, or actinolite.

"Renovation" means the modifying of any existing structure, or portion thereof, where exposure to airborne asbestos, tremolite, anthophyllite, actinolite may result.

"Repair" means overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates where asbestos, tremolite, anthophyllite, or actinolite is present.

"Tremolite, anthophyllite and actinolite" means the non-asbestos form of these minerals, and any of these minerals that have been chemically treated and/or altered.

(c) *Permissible exposure limit (PEL).* The employer shall ensure that no employee is exposed to an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of 0.2 fiber per cubic centimeter of air as an eight (8) hour time-weighted average (TWA), as determined by the method prescribed in Appendix A of this section, or by an equivalent method.

(d) *Communication among employers.* On multi-employer worksites, an employer performing asbestos, tremolite, anthophyllite, or actinolite work requiring the establishment of a regulated area shall inform other employers on the site of the nature of the employer's work with asbestos, tremolite, anthophyllite, or actinolite and of the existence of and requirements pertaining to regulated areas.

(e) *Regulated areas—(1) General.* The employer shall establish a regulated area in work areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed or can reasonably be expected to exceed the permissible exposure limit prescribed in paragraph (c) of this section.

(2) *Demarcation.* The regulated area shall be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit.

(3) *Access.* Access to regulated areas shall be limited to authorized persons or to persons authorized by the Act or regulations issued pursuant thereto.

(4) *Respirators.* All persons entering a regulated area shall be supplied with a respirator, selected in accordance with paragraph (h)(2) of this section.

(5) *Prohibited activities.* The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated area.

(6) *Requirements for asbestos removal, demolition, and renovation operations.* (i) Wherever feasible, the employer shall establish negative-pressure enclosures before commencing removal, demolition, and renovation operations.

(ii) The employer shall designate a competent person to perform or supervise the following duties:

- (A) Set up the enclosure;
- (B) Ensure the integrity of the enclosure;
- (C) Control entry to and exit from the enclosure;
- (D) Supervise all employee exposure monitoring required by this section;
- (E) Ensure that employees working within the enclosure wear protective clothing and respirators as required by paragraphs (i) and (h) of this section and;
- (F) Ensure that employees are trained in the use of engineering controls, work practices, and personal protective equipment;
- (G) Ensure that employees use the hygiene facilities and observe the decontamination procedures specified in paragraph (j) of this section; and
- (H) Ensure that engineering controls are functioning properly.

(iii) In addition to the qualifications specified in paragraph (b) of this section, the competent person shall be trained in all aspects of asbestos, tremolite, anthophyllite, or actinolite abatement, the contents of this standard, the identification of asbestos, tremolite, anthophyllite, or actinolite and their removal procedures, and other practices for reducing the hazard. Such training shall be obtained in a comprehensive course, such as a course conducted by an EPA Asbestos Training Center, or an equivalent course.

(iv) *Exception:* For small-scale, short-duration operations, such as pipe repair, valve replacement, installing electrical conduits, installing or removing drywall, roofing, and other general building maintenance or renovation, the employer is not required to comply with the requirements of paragraph (e)(6) of this section.

(f) *Exposure monitoring—(1) General.* (i) Each employer who has a workplace or work operation covered by this standard shall perform monitoring to determine accurately the airborne concentrations of asbestos, tremolite, anthophyllite, actinolite or a combination of these minerals to which employees may be exposed.

(ii) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA of each employee.

(iii) Representative 8-hour TWA employee exposure shall be determined on the basis of one or more samples representing full-shift exposure for employees in each work area.

(2) *Initial monitoring.* (i) Each employer who has a workplace or work operation covered by this standard, except as provided for in paragraphs (f)(2)(ii) and (f)(2)(iii) of this section, shall perform initial monitoring at the initiation of each asbestos, tremolite, anthophyllite, actinolite job to accurately determine the airborne concentrations of asbestos, tremolite, anthophyllite, or actinolite to which employees may be exposed.

(ii) The employer may demonstrate that employee exposures are below the action level by means of objective data demonstrating that the product or material containing asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals cannot release airborne fibers in concentrations exceeding the action level under those work conditions having the greatest potential for releasing asbestos, tremolite, anthophyllite, or actinolite.

(iii) Where the employer has monitored each asbestos, tremolite, anthophyllite, or actinolite job, and the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (f)(2)(i) of this section.

(3) *Periodic monitoring within regulated areas.* The employer shall conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area. *Exception:* When all employees within a regulated area are equipped with supplied-air respirators operated in the positive-pressure mode, the employer may dispense with the daily monitoring required by this paragraph.

(4) *Termination of monitoring.* If the periodic monitoring required by paragraph (f)(3) of this section reveals that employee exposures, as indicated by statistically reliable measurements, are below the action level, the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

(5) *Method of monitoring.* (i) All samples taken to satisfy the monitoring requirements of paragraph (f) of this section shall be personal samples

collected following the procedures specified in Appendix A.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (f) of this section shall be evaluated using the OSHA Reference Method (ORM) specified in Appendix A, or an equivalent counting method.

(iii) If an equivalent method to the ORM is used, the employer shall ensure that the method meets the following criteria:

(A) Replicate exposure data used to establish equivalency are collected in side-by-side field and laboratory comparisons;

(B) The comparison indicates that 90 percent of the samples collected in the range 0.5 to 2.0 times the permissible limit have an accuracy range of plus or minus 25 percent of the ORM results with a 95 percent confidence level as demonstrated by a statistically valid protocol; and

(C) The equivalent method is documented and the results of the comparison testing are maintained.

(iv) To satisfy the monitoring requirements of paragraph (f), employers shall rely on the results of monitoring analysis performed by laboratories that have instituted quality assurance programs that include the elements prescribed in Appendix A:

(6) *Employee notification of monitoring results.* (i) The employer shall notify affected employees of the monitoring results that represent that employee's exposure as soon as possible following receipt of monitoring results.

(ii) The employer shall notify affected employees of the results of monitoring representing the employee's exposure in writing either individually or by posting at a centrally located place that is accessible to affected employees.

(7) *Observation of monitoring.* (i) The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite conducted in accordance with this section.

(ii) When observation of the monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite requires entry into an area where the use of protective clothing or equipment is required, the observer shall be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

(g) *Methods of compliance.*—(1) *Engineering controls and work practices.* (i) The employer shall use one or any combination of the following control methods to achieve compliance

with the permissible exposure limit prescribed by paragraph (c) of this section:

(A) Local exhaust ventilation equipped with HEPA filter dust collection systems;

(B) General ventilation systems;

(C) Vacuum cleaners equipped with HEPA filters;

(D) Enclosure or isolation of processes producing asbestos, tremolite, anthophyllite, or actinolite dust;

(E) Use of wet methods, wetting agents, or removal encapsulants to control employee exposures during asbestos, tremolite, anthophyllite, or actinolite handling, mixing, removal, cutting, application, and cleanup;

(F) Prompt disposal of wastes contaminated with asbestos, tremolite, anthophyllite, or actinolite in leak-tight containers; or

(G) Use of work practices or other engineering controls that the Assistant Secretary can show to be feasible.

(ii) Wherever the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the limit prescribed in paragraph (c), the employer shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (h) of this section.

(2) *Prohibitions.* (i) High-speed abrasive disc saws that are not equipped with appropriate engineering controls shall not be used for work related to asbestos, tremolite, anthophyllite, or actinolite.

(ii) Compressed air shall not be used to remove asbestos, tremolite, anthophyllite, or actinolite or materials containing asbestos, tremolite, anthophyllite, or actinolite unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

(iii) Materials containing asbestos, tremolite, anthophyllite, or actinolite shall not be applied by spray methods.

(3) *Employee rotation.* The employer shall not use employee rotation as a means of compliance with the exposure limit prescribed in paragraph (c) of this section.

(h) *Respiratory protection.*—(1) *General.* The employer shall provide respirators, and ensure that they are used, where required by this section. Respirators shall be used in the following circumstances:

(i) During the interval necessary to install or implement feasible engineering and work practice controls;

(ii) In work operations such as maintenance and repair activities, or other activities for which engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the exposure limit; and

(iv) In emergencies.

(2) *Respirator selection.* (i) Where respirators are used, the employer shall select and provide, at no cost to the employee, the appropriate respirator as specified in Table D-4, and shall ensure that the employee uses the respirator provided.

(ii) The employer shall select respirators from among those jointly approved as being acceptable for protection by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(iii) The employer shall provide a powered, air-purifying respirator in lieu of any negative-pressure respirator specified in Table D-4 whenever:

(A) An employee chooses to use this type of respirator; and

(B) This respirator will provide adequate protection to the employee.

TABLE D-4.—RESPIRATORY PROTECTION FOR ASBESTOS, TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE FIBERS

Airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals	Required respirator
Not in excess of 2 f/cc (10 X PEL).	1. Half-mask air-purifying respirator equipped with high-efficiency filters.
Not in excess of 10 f/cc (50 X PEL).	1. Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 20 f/cc (100 X PEL).	1. Any powered air purifying respirator equipped with high efficiency filters. 2. Any supplied-air respirator operated in continuous flow mode.
Not in excess of 200 f/cc (1000 X PEL).	1. Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 200 f/cc (> 1,000 X PEL) or unknown concentration.	1. Full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus.

NOTE: a. Respirators assigned for higher environmental concentrations may be used at lower concentrations.

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

(3) *Respirator program.* (i) Where respiratory protection is used, the employer shall institute a respirator program in accordance with 29 CFR 1910.134(b), (d), (e), and (f).

(ii) The employer shall permit each employee who uses a filter respirator to

change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of filter elements for this purpose.

(iii) Employees who wear respirators shall be permitted to leave work areas to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.

(iv) No employee shall be assigned to tasks requiring the use of respirators if, based on his or her most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or of other employees will be impaired by the use of a respirator. Such employee shall be assigned to another job or given the opportunity to transfer to a different position the duties of which he or she is able to perform with the same employer, in the same geographical area, and with the same seniority, status, and rate of pay he or she had just prior to such transfer, if such a different position is available.

(4) *Respirator fit testing.* (i) The employer shall ensure that the respirator issued to the employee exhibits the least possible facepiece leakage and that the respirator is fitted properly.

(ii) Employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every 6 months thereafter for each employee wearing a negative-pressure respirator. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, and shall be conducted in accordance with Appendix C. The tests shall be used to select facepieces that provide the required protection as prescribed in Table 1.

(i) *Protective clothing—(1) General.* The employer shall provide and require the use of protective clothing, such as coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite or a combination of these minerals that exceed the permissible exposure limit prescribed in paragraph (c) of this section.

(2) *Laundering.* (i) The employer shall ensure that laundering of contaminated clothing is done so as to prevent the release of airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the exposure limit prescribed in paragraph (c) of this section.

(ii) Any employer who gives contaminated clothing to another person

for laundering shall inform such person of the requirement in paragraph (i)(2)(i) of this section to effectively prevent the release of airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the exposure limit prescribed in paragraph (c) of this section.

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

(4) *Protective clothing for removal, demolition, and renovation operations.*

(i) The competent person shall periodically examine worksuits worn by employees for rips or tears that may occur during performance of work.

(ii) When rips or tears are detected while an employee is working within a negative-pressure enclosure, rips and tears shall be immediately mended, or the worksuit shall be immediately replaced.

(j) *Hygiene facilities and practices—*

(1) *General.* (i) The employer shall provide clean change areas for employees required to work in regulated areas or required by paragraph (j)(1) of this section to wear protective clothing.

Exception: In lieu of the change area requirement specified in paragraph (j)(1)(i), the employer may permit employees engaged in small scale, short duration operations, as described in paragraph (e)(6) of this section, to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the area where maintenance was performed.

(ii) The employer shall ensure that change areas are equipped with separate storage facilities for protective clothing and street clothing, in accordance with section 1910.141(e).

(iii) Whenever food or beverages are consumed at the worksite and employees are exposed to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit, the employer shall provide lunch areas in which the airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals are below the action level.

(2) *Requirements for removal, demolition, and renovation operations—*

(i) *Decontamination area.* Except for small scale, short duration operations, as described in paragraph (e)(6) of this section, the employer shall establish a decontamination area that is adjacent and connected to the regulated area for the decontamination of employees contaminated with asbestos, tremolite,

anthophyllite, or actinolite. The decontamination area shall consist of an equipment room, shower area, and clean room in series. The employer shall ensure that employees enter and exit the regulated area through the decontamination area.

(ii) *Clean room.* The clean room shall be equipped with a locker or appropriate storage container for each employee's use.

(iii) *Shower area.* Where feasible, shower facilities shall be provided which comply with 29 CFR 1910.141(d)(3). The showers shall be contiguous both to the equipment room and the clean change room, unless the employer can demonstrate that this location is not feasible. Where the employer can demonstrate that it is not feasible to locate the shower between the equipment room and the clean change room, the employer shall ensure that employees:

(A) Remove asbestos, tremolite, anthophyllite, or actinolite contamination from their worksuits using a HEPA vacuum before proceeding to a shower that is not contiguous to the work area; or

(B) Remove their contaminated worksuits, don clean worksuits, and proceed to a shower that is not contiguous to the work area.

(iv) *Equipment room.* The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective clothing and equipment.

(v) *Decontamination area entry procedures.* (A) the employer shall ensure that employees:

(1) Enter the decontamination area through the clean room;

(2) Remove and deposit street clothing within a locker provided for their use; and

(3) Put on protective clothing and respiratory protection before leaving the clean room.

(B) Before entering the enclosure, the employer shall ensure that employees pass through the equipment room.

(vi) *Decontamination area exit procedures.* (A) Before leaving the regulated area, the employer shall ensure that employees remove all gross contamination and debris from their protective clothing.

(B) The employer shall ensure that employees remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.

(C) The employer shall ensure that employees do not remove their respirators in the equipment room.

(D) The employer shall ensure that employees shower prior to entering the clean room.

(E) The employer shall ensure that, after showering, employees enter the clean room before changing into street clothes.

(k) *Communication of hazards to employees*—(1) *Signs.* (i) Warning signs that demarcate the regulated area shall be provided and displayed at each location where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals may be in excess of the exposure limit prescribed in paragraph (c) of this section. Signs shall be posted at such a distance from such a location that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.

(ii) The warning signs required by paragraph (k)(1)(i) of this section shall bear the following information:

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

(iii) Where minerals in the regulated area are only tremolite, anthophyllite or actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(2) *Labels.* (i) Labels shall be affixed to all products containing asbestos, tremolite, anthophyllite, or actinolite and to all containers containing such products, including waste containers. Where feasible, installed asbestos, tremolite, anthophyllite, or actinolite products shall contain a visible label.

(ii) Labels shall be printed in large, bold letters on a contrasting background.

(iii) Labels shall be used in accordance with the requirements of 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard, and shall contain the following information:

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

(iv) Where minerals to be labeled are only tremolite, anthophyllite and actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(v) Labels shall contain a warning statement against breathing airborne asbestos, tremolite, anthophyllite, or actinolite fibers.

(vi) The provisions for labels required by paragraphs (k)(2)(i)–(k)(2)(iv) do not apply where:

(A) asbestos, tremolite, anthophyllite, or actinolite fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that, during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these mineral fibers in excess of the action level will be released, or

(B) asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is present in a product in concentrations less than 0.1 percent by weight.

(3) *Employee information and training.* (i) The employer shall institute a training program for all employees exposed to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the action level and shall ensure their participation in the program.

(ii) Training shall be provided prior to or at the time of initial assignment, unless the employee has received equivalent training within the previous 12 months, and at least annually thereafter.

(iii) The training program shall be conducted in a manner that the employee is able to understand. The employer shall ensure that each such employee is informed of the following:

(A) Methods of recognizing asbestos, tremolite, anthophyllite, and actinolite;

(B) The health effects associated with asbestos, tremolite, anthophyllite, or actinolite exposure;

(C) The relationship between smoking and asbestos, tremolite, anthophyllite, and actinolite in producing lung cancer;

(D) The nature of operations that could result in exposure to asbestos, tremolite, anthophyllite, and actinolite, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures, and any necessary instruction in the use of these controls and procedures;

(E) The purpose, proper use, fitting instructions, and limitations of

respirators as required by 29 CFR 1910.134;

(F) The appropriate work practices for performing the asbestos, tremolite, anthophyllite, or actinolite job; and

(G) Medical surveillance program requirements.

(H) A review of this standard, including appendices.

(4) *Access to training materials.* (i) The employer shall make readily available to all affected employees without cost all written materials relating to the employee training program, including a copy of this regulation.

(ii) The employer shall provide to the Assistant Secretary and the Director, upon request, all information and training materials relating to the employee information and training program.

(1) *Housekeeping*—(1) *Vacuuuming.* Where vacuuming methods are selected, HEPA filtered vacuuming equipment must be used. The equipment shall be used and emptied in a manner that minimizes the reentry of asbestos, tremolite, anthophyllite, or actinolite into the workplace.

(2) *Waste disposal.* Asbestos waste, scrap, debris, bags, containers, equipment, and contaminated clothing consigned for disposal shall be collected and disposed of in sealed, labeled, impermeable bags or other closed, labeled, impermeable containers.

(m) *Medical surveillance*—(1) *General*—(i) *Employees covered.* The employer shall institute a medical surveillance program for all employees engaged in work involving levels of asbestos, tremolite, anthophyllite, actinolite or a combination of these minerals, at or above the action level for 30 or more days per year, or who are required by this section to wear negative pressure respirators.

(ii) *Examination by a physician.* (A) The employer shall ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and are provided at no cost to the employee and at a reasonable time and place.

(B) Persons other than such licensed physicians who administer the pulmonary function testing required by this section shall complete a training course in spirometry sponsored by an appropriate academic or professional institution.

(2) *Medical examinations and consultations*—(i) *Frequency.* The employer shall make available medical examinations and consultations to each employee covered under paragraph

(m)(1)(i) of this section on the following schedules:

(A) Prior to assignment of the employee to an area where negative-pressure respirators are worn;

(B) When the employee is assigned to an area where exposure to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals may be at or above the action level for 30 or more days per year, a medical examination must be given within 10 working days following the thirtieth day of exposure;

(C) And at least annually thereafter.

(D) If the examining physician determines that any of the examinations should be provided more frequently than specified, the employer shall provide such examinations to affected employees at the frequencies specified by the physician.

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

(ii) *Content.* Medical examinations made available pursuant to paragraphs (m)(2)(i)(A)-(m)(2)(i)(C) of this section shall include:

(A) A medical and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems.

(B) On initial examination, the standardized questionnaire contained in Appendix D, Part 1, and, on annual examination, the abbreviated standardized questionnaire contained in Appendix D, Part 2.

(C) A physical examination directed to the pulmonary and gastrointestinal systems, including a chest roentgenogram to be administered at the discretion of the physician, and pulmonary function tests of forced vital capacity (FVC) and forced expiratory volume at one second (FEV₁). Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E.

(D) Any other examinations or tests deemed necessary by the examining physician.

(3) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this standard and Appendices D, E, and I;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's representative exposure level or anticipated exposure level;

(iv) A description of any personal protective and respiratory equipment used or to be used; and

(v) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

(4) *Physician's written opinion.* (i) The employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

(A) The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, tremolite, anthophyllite, or actinolite;

(B) Any recommended limitations on the employee or on the use of personal protective equipment such as respirators; and

(C) A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions that may result from asbestos, tremolite, anthophyllite, or actinolite exposure.

(ii) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos, tremolite, anthophyllite, or actinolite.

(iii) The employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.

(n) *Recordkeeping—(1) Objective data for exempted operations.* (i) Where the employer has relied on objective data that demonstrate that products made from or containing asbestos, tremolite, anthophyllite, or actinolite are not capable of releasing fibers of asbestos, tremolite, anthophyllite, or actinolite or a combination of these minerals, in concentrations at or above the action level under the expected conditions of processing, use, or handling to exempt such operations from the initial monitoring requirements under paragraph (f)(2) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) The record shall include at least the following information:

(A) The product qualifying for exemption;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of asbestos, tremolite, anthophyllite, or actinolite;

(D) A description of the operation exempted and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos, tremolite, anthophyllite, or actinolite as prescribed in paragraph (f) of this section.

Note: The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

(ii) This record shall include at least the following information:

(A) The date of measurement;

(B) The operation involving exposure to asbestos, tremolite, anthophyllite, or actinolite that is being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of protective devices worn, if any; and

(F) Name, social security number, and exposure of the employees whose exposures are represented.

(iii) The employer shall maintain this record for at least thirty (30) years, in accordance with 29 CFR 1910.20.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (m) of this section, in accordance with 29 CFR 1910.20.

(ii) The record shall include at least the following information:

(A) The name and social security number of the employee;

(B) A copy of the employee's medical examination results, including the medical history, questionnaire responses, results of any tests, and physician's recommendations.

(C) Physician's written opinions;

(D) Any employee medical complaints related to exposure to asbestos, tremolite, anthophyllite, or actinolite; and

(E) A copy of the information provided to the physician as required by paragraph (m) of this section.

(iii) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with 29 CFR 1910.20.

(4) *Training records.* The employer shall maintain all employee training records for one year beyond the last date of employment by that employer.

(5) *Availability.* (i) The employer, upon written request, shall make all records required to be maintained by this section available to the Assistant Secretary and the Director for examination and copying.

(ii) The employer, upon request, shall make any exposure records required by paragraphs (f) and (n) of this section available for examination and copying to affected employees, former employees, designated representatives, and the Assistant Secretary, in accordance with 29 CFR 1910.20(a)-(e) and (g)-(i).

(iii) The employer, upon request, shall make employee medical records required by paragraphs (m) and (n) of this section available for examination and copying to the subject employee, anyone having the specific written consent of the subject employee, and the Assistant Secretary, in accordance with 29 CFR 1910.20.

(6) *Transfer of records.* (i) The employer shall comply with the requirements concerning transfer of records set forth in 29 CFR 1910.20 (b).

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the Director at least 90 days prior to disposal and, upon request, transmit them to the Director.

(o) *Dates—(1) Effective date.* This section shall become effective [insert date 30 days from publication in the Federal Register]. The requirements of the asbestos standard issued in June 1972 (37 FR 11318), as amended, and published in 29 CFR 1910.1001 (1985) remain in effect until compliance is achieved with the parallel provisions of this standard.

(2) *Start-up dates.* (i) The requirements of paragraphs (c) through (n) of this section, including the engineering controls specified in paragraph (g)(1) of this section, shall be complied with by [insert date 210 days from publication in the Federal Register].

(p) *Appendices.* (1) Appendices A, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

(2) Appendices B, F, G, H, and I to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

Appendix A to § 1926.58—OSHA Reference Method—Mandatory

This mandatory appendix specifies the procedure for analyzing air samples for asbestos, tremolite, anthophyllite, and actinolite and specifies quality control procedures that must be implemented by laboratories performing the analysis. The sampling and analytical methods described below represent the elements of the available monitoring methods (such as the NIOSH 7400 method) which OSHA considers to be essential to achieve adequate employee exposure monitoring while allowing employers to use methods that are already established within their organizations. All employers who are required to conduct air monitoring under paragraph (f) of the standard are required to utilize analytical laboratories that use this procedure, or an equivalent method, for collecting and analyzing samples.

Sampling and Analytical Procedure

1. The sampling medium for air samples shall be mixed cellulose ester filter membranes. These shall be designated by the manufacturer as suitable for asbestos, tremolite, anthophyllite, and actinolite counting. See below for rejection of blanks.

2. The preferred collection device shall be the 25-mm diameter cassette with an open-faced 50-mm extension cowl. The 37-mm cassette may be used if necessary but only if written justification for the need to use the 37-mm filter cassette accompanies the sample results in the employee's exposure monitoring record.

3. An air flow rate between 0.5 liter/min and 2.5 liters/min shall be selected for the 25-mm cassette. If the 37-mm cassette is used, an air flow rate between 1 liter/min and 2.5 liters/min shall be selected.

4. Where possible, a sufficient air volume for each air sample shall be collected to yield between 100 and 1,300 fibers per square millimeter on the membrane filter. If a filter darkens in appearance or if loose dust is seen on the filter, a second sample shall be started.

5. Ship the samples in a rigid container with sufficient packing material to prevent dislodging the collected fibers. Packing material that has a high electrostatic charge on its surface (e.g., expanded polystyrene) cannot be used because such material can cause loss of fibers to the sides of the cassette.

6. Calibrate each personal sampling pump before and after use with a representative filter cassette installed between the pump and the calibration devices.

7. Personal samples shall be taken in the "breathing zone" of the employee (i.e., attached to or near the collar or lapel near the worker's face).

8. Fiber counts shall be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.

9. The microscope shall be fitted with a Walton-Beckett eyepiece graticule calibrated

for a field diameter of 100 micrometers (+/- 2 micrometers).

10. The phase-shift detection limit of the microscope shall be about 3 degrees measured using the HSE phase shift test slide as outlined below.

a. Place the test slide on the microscope stage and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

Note.—The slide consists of seven sets of grooved lines (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7, seven being the least visible. The requirements for asbestos, tremolite, anthophyllite, and actinolite counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 and 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.

11. Each set of samples taken will include 10 percent blanks or a minimum of 2 blanks. The blank results shall be averaged and subtracted from the analytical results before reporting. Any samples represented by a blank having a fiber count in excess of 7 fibers/100 fields shall be rejected.

12. The samples shall be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.

13. Observe the following counting rules.

a. Count only fibers equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.

b. Count all particles as asbestos, tremolite, anthophyllite, and actinolite that have a length-to-width ratio (aspect ratio) of 3:1 or greater.

c. Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle, shall receive the count of one half (½). Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.

14. Blind recounts shall be conducted at the rate of 10 percent.

Quality Control Procedures

1. Intralaboratory program. Each laboratory and/or each company with more than one microscopist counting slides shall establish a statistically designed quality assurance program involving blind recounts and

comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In a company with more than one laboratory, the program shall include all laboratories, and shall also evaluate the laboratory-to-laboratory variability.

2. Interlaboratory program. Each laboratory analyzing asbestos, tremolite, anthophyllite, and actinolite samples for compliance determination shall implement an interlaboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory shall participate in round robin testing at least once every 6 months with at least all the other laboratories in its interlaboratory quality assurance group. Each laboratory shall submit slides typical of its own workload for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

3. All individuals performing asbestos, tremolite, anthophyllite, and actinolite analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos, tremolite, anthophyllite, and actinolite dust or an equivalent course.

4. When the use of different microscopes contributes to differences between counters and laboratories, the effect of the different microscope shall be evaluated and the microscope shall be replaced, as necessary.

5. Current results of these quality assurance programs shall be posted in each laboratory to keep the microscopists informed.

Appendix B to § 1926.58—Detailed Procedure for Asbestos Tremolite, Anthophyllite, and Actinolite Sampling and Analysis—Non-Mandatory

This appendix contains a detailed procedure for sampling and analysis and includes those critical elements specified in Appendix A. Employers are not required to use this procedure, but they are required to use Appendix A. The purpose of Appendix B is to provide a detailed step-by-step sampling and analysis procedure that conforms to the elements specified in Appendix A. Since this procedure may also standardize the analysis and reduce variability, OSHA encourages employers to use this appendix.

Asbestos, Tremolite, Anthophyllite, and Actinolite Sampling and Analysis Method

Technique: Microscopy, Phase Contrast.
Analyte: Fibers (Manual count).

Sample Preparation: Acetone/triacetin method.

Calibration: Phase-shift detection limit about 3 degrees.

Range: 100 to 1300 fibers/mm² filter area.
Estimated Limit of Detection: 7 fibers/mm² filter area.

Sampler: Filter (0.8–1.2 um mixed cellulose ester membrane, 25-mm diameter).

Flow Rate: 0.5 l/min to 2.5 l/min (25-mm cassette); 1.0 l/min to 2.5 l/min (37-mm cassette).

Sample Volume: Adjust to obtain 100 to 1300 fibers/mm².

Shipment: Routine.

Sample Stability: Indefinite.

Blanks: 10% of samples (minimum 2).

Standard Analytical Error: 0.25.

Applicability: The working range is 0.02 f/cc (1920-L air sample) to 1.25 f/cc (400-L air sample). The method gives an index of airborne asbestos, tremolite, anthophyllite, and actinolite fibers but may be used for other materials such as fibrous glass by inserting suitable parameters into the counting rules. The method does not differentiate between asbestos, tremolite, anthophyllite, and actinolite and other fibers. Asbestos, tremolite, anthophyllite, and actinolite fibers less than ca. 0.25 um diameter will not be detected by this method.

Interferences: Any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chain-like particles may appear fibrous. High levels of nonfibrous dust particles may obscure fibers in the field of view and raise the detection limit.

Reagents

1. Acetone.
2. Triacetin (glycerol triacetate), reagent grade.

Special Precautions

Acetone is an extremely flammable liquid and precautions must be taken not to ignite it. Heating of acetone must be done in a ventilated laboratory fume hood using a flameless, spark-free heat source.

Equipment

1. Collection device: 25-mm cassette with 50-mm extension cowl with cellulose ester filter, 0.8 to 1.2 mm pore size and backup pad.

Note.—Analyze representative filters for fiber background before use and discard the filter lot if more than 5 fibers/100 fields are found.

2. Personal sampling pump, greater than or equal to 0.5 L/min, with flexible connecting tubing.

3. Microscope, phase contrast, with green or blue filter, 8 to 10X eyepiece, and 40 to 45X phase objective (total magnification ca 400X); numerical aperture = 0.65 to 0.75.

4. Slides, glass, single-frosted, pre-cleaned, 25 x 75 mm.

5. Cover slips, 25 x 25 mm, no. 1½ unless otherwise specified by microscope manufacturer.

6. Knife, #1 surgical steel, curved blade.

7. Tweezers.

8. Flask, Guth-type, insulated neck, 250 to 500 mL (with single-holed rubber stopper and elbow-jointed glass tubing, 16 to 22 cm long).

9. Hotplate, spark-free, stirring type; heating mantle; or infrared lamp and magnetic stirrer.

10. Syringe, hypodermic, with 22-gauge needle.

11. Graticule, Walton-Beckett type with 100 um diameter circular field at the specimen plane (area = 0.00785 mm²), (Type C-22).

Note.—The graticule is custom-made for each microscope.

12. HSE/NPL phase contrast test slide, Mark II.

13. Telescope, ocular phase-ring centering.

14. Stage micrometer (0.01 mm divisions).

Sampling

1. Calibrate each personal sampling pump with a representative sampler in line.

2. Fasten the sampler to the worker's lapel as close as possible to the worker's mouth. Remove the top cover from the end of the cowl extension (open face) and orient face down. Wrap the joint between the extender and the monitor's body with shrink tape to prevent air leaks.

3. Submit at least two blanks (or 10% of the total samples, whichever is greater) for each set of samples. Remove the caps from the field blank cassettes and store the caps and cassettes in a clean area (bag or box) during the sampling period. Replace the caps in the cassettes when sampling is completed.

4. Sample at 0.5 L/min or greater. Do not exceed 1 mg total dust loading on the filter. Adjust sampling flow rate, Q (L/min), and time to produce a fiber density, E (fibers/mm²), of 100 to 1300 fibers/m² [3.85 x 10⁴ to 5 x 10⁵ fibers per 25-mm filter with effective collection area (A_c = 365 mm²)] for optimum counting precision (see step 21 below). Calculate the minimum sampling time,

t_{minimum} (min) at the action level (one-half of the current standard), L (f/cc) of the fibrous aerosol being sampled:

$$t_{\min} = \frac{(Ac)(E)}{(Q)(L)10^3}$$

5. Remove the field monitor at the end of sampling, replace the plastic top cover and small end caps, and store the monitor.

6. Ship the samples in a rigid container with sufficient packing material to prevent jostling or damage. NOTE: Do not use polystyrene foam in the shipping container because of electrostatic forces which may cause fiber loss from the sampler filter.

Sample Preparation

Note.—The object is to produce samples with a smooth (non-grainy) background in a medium with a refractive index equal to or less than 1.46. The method below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison. Other mounting techniques meeting the above criteria may also be used, e.g., the nonpermanent field mounting technique used in P & CAM 239.

7. Ensure that the glass slides and cover slips are free of dust and fibers.

8. Place 40 to 60 ml of acetone into a Guth-type flask. Stopper the flask with a single-hole rubber stopper through which a glass tube extends 5 to 8 cm into the flask. The portion of the glass tube that exits the top of the stopper (8 to 10 cm) is bent downward in an elbow that makes an angle of 20 to 30 degrees with the horizontal.

9. Place the flask in a stirring hotplate or wrap in a heating mantle. Heat the acetone gradually to its boiling temperature (ca. 58°C).

Caution.—The acetone vapor must be generated in a ventilated fume hood away from all open flames and spark sources. Alternate heating methods can be used, providing no open flame or sparks are present.

10. Mount either the whole sample filter or a wedge cut from the sample filter on a clean glass slide.

a. Cut wedges of ca. 25 percent of the filter area with a curved-blade steel surgical knife using a rocking motion to prevent tearing.

b. Place the filter or wedge, dust slide up, on the slide. Static electricity will usually keep the filter on the slide until it is cleared.

c. Hold the glass slide supporting the filter approximately 1 to 2 cm from the glass tube port where the acetone vapor is escaping from the heated flask. The acetone vapor stream should cause a condensation spot on the glass slide ca. 2 to 3 cm in diameter. Move the glass slide gently in the vapor stream. The filter should clear in 2 to 5 sec. If the filter curls, distorts, or is otherwise rendered unusable, the vapor stream is probably not strong enough. Periodically wipe the outlet port with tissue to prevent liquid acetone dripping onto the filter.

d. Using the hypodermic syringe with a 22-gauge needle, place 1 to 2 drops of triacetin on the filter. Gently lower a clean 25-mm square cover slip down onto the filter at a slight angle to reduce the possibility of forming bubbles. If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours.

e. Glue the edges of the cover slip to the glass slide using a lacquer or nail polish.

Note.—If clearing is slow, the slide preparation may be heated on a hotplate (surface temperature 50°C) for 15 min to hasten clearing. Counting may proceed immediately after clearing and mounting are completed.

Calibration and Quality Control

11. Calibration of the Walton-Beckett graticule. The diameter, d_c (mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

a. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.

b. Set the appropriate interpupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.

c. Install the 40 to 45 X phase objective.

d. Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.

e. Measure the magnified grid length, L_o (μm), using the stage micrometer.

f. Remove the graticule from the microscope and measure its actual grid length, L_s (mm). This can best be accomplished by using a stage fitted with verniers.

g. Calculate the circle diameter, d_c (mm), for the Walton-Beckett graticule:

$$d_c = \frac{L_s \times D}{L_o}$$

Example: If $L_o = 108 \mu\text{m}$, $L_s = 2.93 \text{ mm}$ and $D = 100 \text{ mm}$, then $d_c = 2.71 \text{ mm}$.

h. Check the field diameter, D (acceptable range $100 \text{ mm} \pm 2 \text{ mm}$) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (mm^2).

12. Microscope adjustments. Follow the manufacturer's instructions and also the following:

a. Adjust the light source for even illumination across the field of view at the condenser iris.

Note.—Kohler illumination is preferred, where available.

b. Focus on the particulate material to be examined.

c. Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.

d. Use the telescope ocular supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric.

13. Check the phase-shift detection limit of the microscope periodically.

a. Remove the HSE/NPL phase-contrast test slide from its shipping container and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

Note.—The slide consists of seven sets of grooves (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7. The requirements for counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 to 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image quality deteriorates, clean the microscope optics and, if the problem persists, consult the microscope manufacturer.

14. Quality control of fiber counts.

a. Prepare and count field blanks along with the field samples. Report the counts on each blank. Calculate the mean of the field blank counts and subtract this value from each sample count before reporting the results.

Note 1.—The identity of the blank filters should be unknown to the counter until all counts have been completed.

Note 2.—If a field blank yields fiber counts greater than 7 fibers/100 fields, report possible contamination of the samples.

b. Perform blind recounts by the same counter on 10 percent of filters counted (slides relabeled by a person other than the counter).

15. Use the following test to determine whether a pair of counts on the same filter should be rejected because of possible bias. This statistic estimates the counting repeatability at the 95% confidence level.

Discard the sample if the difference between the two counts exceeds $2.77 (F)S_r$, where F = average of the two fiber counts and S_r = relative standard deviation, which should be derived by each laboratory based on historical in-house data.

Note.—If a pair of counts is rejected as a result of this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts.

16. Enroll each new counter in a training course that compares performance of counters on a variety of samples using this procedure.

Note.—To ensure good reproducibility, all laboratories engaged in asbestos, tremolite, anthophyllite, and actinolite counting are required to participate in the Proficiency Analytical Testing (PAT) Program and should routinely participate with other asbestos, tremolite, anthophyllite, and actinolite fiber counting laboratories in the exchange of field samples to compare performance of counters.

Measurement

17. Place the slide on the mechanical stage of the calibrated microscope with the center of the filter under the objective lens. Focus the microscope on the plane of the filter.

18. Regularly check phase-ring alignment and Kohler illumination.

19. The following are the counting rules:

a. Count only fibers longer than 5 μm. Measure the length of curved fibers along the curve.

b. Count only fibers with a length-to-width ratio equal to or greater than 3:1.

c. For fibers that cross the boundary of the graticule field, do the following:

1. Count any fiber longer than 5 μm that lies entirely within the graticule area.

2. Count as ½ fiber any fiber with only one end lying within the graticule area.

3. Do not count any fiber that crosses the graticule boundary more than once.

4. Reject and do not count all other fibers.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 fields regardless of fiber count.

20. Start counting from one end of the filter and progress along a radial line to the other end, shift either up or down on the filter, and continue in the reverse direction. Select fields randomly by looking away from the eyepiece briefly while advancing the mechanical stage. When an agglomerate covers ca. ½ or more of the field of view, reject the field and select another. Do not report rejected fields in the number of total fields counted.

Note.—When counting a field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count.

Calculations

21. Calculate and report fiber density on the filter, E (fibers/mm²); by dividing the total fiber count, F , minus the mean field blank count, B , by the number of fields, n ; and the field area, A_f (0.00785mm² for a properly calibrated Walton-Beckett graticule):

$$E = \frac{F - B}{(n)(A_f)} \text{ fibers/mm}^2$$

22. Calculate the concentration, C (f/cc), of fibers in the air volume sampled, V (L), using the effective collection area of the filter, A_c (385 mm² for a 25-mm filter):

$$C = \frac{(E)(A_c)}{V(10^3)}$$

Note.—Periodically check and adjust the value of A_c , if necessary.

Appendix C to § 1926.58—Qualitative and Quantitative Fit Testing Procedures—Mandatory

Qualitative Fit Test Protocols

I. Isoamyl Acetate Protocol

A. Odor threshold screening.

1. Three 1-liter glass jars with metal lids (e.g. Mason or Bell jars) are required.

2. Odor-free water (e.g. distilled or spring water) at approximately 25 °C shall be used for the solutions.

3. The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1-liter jar and shaking for 30 seconds. This solution shall be prepared new at least weekly.

4. The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but shall not be connected to the same recirculating ventilation system.

5. The odor test solution is prepared in a second jar by placing 0.4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. Shake for 30 seconds and allow to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution may be used for only one day.

6. A test blank is prepared in a third jar by adding 500 cc of odor free water.

7. The odor test and test blank jars shall be labelled 1 and 2 for jar identification. If the labels are put on the lids they can be periodically peeled, dried off and switched to maintain the integrity of the test.

8. The following instructions shall be typed on a card and placed on the table in front of the two test jars (i.e. 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of

these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

9. The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

10. If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test may not be used.

11. If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

B. Respirator Selection.

1. The test subject shall be allowed to pick the most comfortable respirator from a selection including respirators of various sizes from different manufacturers. The selection shall include at least five sizes of elastomeric half facepieces, from at least two manufacturers.

2. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject should understand that the employee is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape and, if fit properly and used properly will provide adequate protection.

4. The test subject holds each facepiece up to the face and eliminates those which obviously do not give a comfortable fit. Normally, selection will begin with a half-mask and if a good fit cannot be found, the subject will be asked to test the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are noted; the most comfortable mask is donned and worn at least five minutes to assess comfort. All donning and adjustments of the facepiece shall be performed by the test subject without assistance from the test conductor or other person. Assistance in assessing comfort can be given by discussing the points in #6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- Positioning of mask on nose.

- Room for eye protection.
 - Room to talk.
 - Positioning mask on face and cheeks.
7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed.
 - Strap tension.
 - Fit across nose bridge.
 - Distance from nose to chin.
 - Tendency to slip.
 - Self-observation in mirror.
8. The test subject shall conduct the conventional negative and positive-pressure fit checks before conducting the negative- or positive-pressure test the subject shall be told to "seat" the mask by rapidly moving the head from side-to-side and up and down, while taking a few deep breaths.

9. The test subject is now ready for fit testing.

10. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

11. The employee shall be given the opportunity to select a different facepiece and be retested if the chosen facepiece becomes increasingly uncomfortable at any time.

C. Fit test.

1. The fit test chamber shall be similar to a clear 55 gal drum liner suspended inverted over a 2 foot diameter frame, so that the top of the chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

2. Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

3. After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

4. A copy of the following test exercises and rainbow passage shall be taped to the inside of the test chamber:

Test Exercises

- i. Breathe normally.
- ii. Breathe deeply. Be certain breaths are deep and regular.
- iii. Turn head all the way from one side to the other. Inhale on each side. Be certain movement is complete. Do not bump the respirator against the shoulders.
- iv. Nod head up-and-down. Inhale when head is in the full up position (looking toward ceiling). Be certain motions are complete and made about every second. Do not bump the respirator on the chest.
- v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement.

Alternative passages which serve the same purpose may also be used.

- vi. Jogging in place.
- vii. Breathe normally.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

5. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

6. Upon entering the test chamber, the test subject shall be given a 6 inch by 5 inch piece of paper towel or other porous absorbent single ply material, folded in half and wetted with three-quarters of one cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

7. Allow two minutes for the IAA test concentration to be reached before starting the fit-test exercises. This would be an appropriate time to talk with the test subject, to explain the fit test, the importance of cooperation, the purpose for the head exercises, or to demonstrate some of the exercises.

8. Each exercise described in #4 above shall be performed for at least one minute.

9. If at any time during the test, the subject detects the banana-like odor of IAA, the test has failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

10. If the test is failed, the subject shall return to the selection room and remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber, and again begin the procedure described in the c(4) through c(8) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

11. If a person cannot pass the fit test described above wearing a half-mask respirator from the available selection, full facepiece models must be used.

12. When a respirator is found that passes the test, the subject breaks the face seal and takes a breath before exiting the chamber. This is to assure that the reason the test subject is not smelling the IAA is the good fit of the respirator facepiece seal and not olfactory fatigue.

13. When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test. To keep the area from becoming contaminated, the used towels shall be kept in a self-sealing bag so there is no significant IAA concentration buildup in the test chamber during subsequent tests.

14. At least two facepieces shall be selected for the IAA test protocol. The test

subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

15. Persons who have successfully passed this fit test with a half-mask respirator may be assigned the use of the test respirator in atmospheres with up to 10 times the PEL of airborne asbestos. In atmospheres greater than 10 times, and less than 100 times the PEL (up to 100 ppm), the subject must pass the IAA test using a full face negative pressure respirator. (The concentration of the IAA inside the test chamber must be increased by ten times for QIIFT of the full facepiece.)

16. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

- (1) Weight change of 20 pounds or more.
- (2) Significant facial scarring in the area of the facepiece seal.
- (3) Significant dental changes; i.e.: multiple extractions without prothesis, or acquiring dentures.
- (4) Reconstructive or cosmetic surgery, or
- (5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping.

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

- (1) Name of test subject.
- (2) Date of testing.
- (3) Name of the test conductor.
- (4) Respirators selected (indicate manufacturer, model, size and approval number).
- (5) Testing agent.

II. Saccharin Solution Aerosol Protocol

A. Respirator Selection.

Respirators shall be selected as described in section IB (respirator selection) above, except that each respirator shall be equipped with a particulate filter.

B. Taste Threshold Screening.

1. An enclosure about head and shoulders shall be used for threshold screening (to determine if the individual can taste saccharin) and for fit testing. The enclosure shall be approximately 12 inches in diameter by 14 inches tall with at least the front clear to allow free movement of the head when a respirator is worn.

2. The test enclosure shall have a three-quarter inch hole in front of the test subject's

nose and mouth area to accommodate the nebulizer nozzle.

3. The entire screening and testing procedure shall be explained to the test subject prior to conducting the screening test.

4. During the threshold screening test, the test subject shall don the test enclosure and breathe with open mouth with tongue extended.

5. Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

6. The threshold check solution consists of 0.83 grams of sodium saccharin, USP in water. It can be prepared by putting 1 cc of the test solution (see C 7 below) in 100 cc of water.

7. To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then is released and allowed to fully expand.

8. Ten squeezes of the nebulizer bulb are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

9. If the first response is negative, ten more squeezes of the nebulizer bulb are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

10. If the second response is negative ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

11. The test conductor will take note of the number of squeezes required to elicit a taste response.

12. If the saccharin is not tasted after 30 squeezes (Step 10), the saccharin fit test cannot be performed on the test subject.

13. If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

14. Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

15. The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least every four hours.

C. Fit test.

1. The test subject shall don and adjust the respirator without the assistance from any person.

2. The fit test uses the same enclosure described in IIB above.

3. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

4. The test subject shall don the enclosure while wearing the respirator selected in section IB above. This respirator shall be properly adjusted and equipped with a particulate filter.

5. The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

6. A second DeVilbiss Model 40 Inhalation Medication Nebulizer is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

7. The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

8. As before, the test subject shall breathe with mouth open and tongue extended.

9. The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure using the same technique as for the taste threshold screening and the same number of squeezes required to elicit a taste response in the screening. (See B8 through B10 above.)

10. After generation of the aerosol read the following instructions to the test subject. The test subject shall perform the exercises for one minute each.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are deep and regular.

iii. Turn head all the way from one side to the other. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete. Inhale when head is in the full up position (when looking toward the ceiling). Do not bump the respirator on the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

11. At the beginning of each exercise, the aerosol concentration shall be replenished using one-half the number of squeezes as initially described in C9.

12. The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected.

13. If the saccharin is detected the fit is deemed unsatisfactory and a different respirator shall be tried.

14. At least two facepieces shall be selected by the IAA test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

15. Successful completion of the test protocol shall allow the use of the half mask tested respirator in contaminated atmospheres up to 10 times the PEL of asbestos. In other words this protocol may be used to assign protection factors no higher than ten.

16. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more.

(2) Significant facial scarring in the area of the facepiece seal.

(3) Significant dental changes; i.e., multiple extractions without prosthesis, or acquiring dentures.

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping.

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent.

III. Irritant Fume Protocol

A. Respirator selection.

Respirators shall be selected as described in section IB above, except that each respirator shall be equipped with a combination of high-efficiency and acid-gas cartridges.

B. Fit test.

1. The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize the subject with the characteristic odor.

2. The test subject shall properly don the respirator selected as above, and wear it for at least 10 minutes before starting the fit test.

3. The test conductor shall review this protocol with the test subject before testing.

4. The test subject shall perform the conventional positive pressure and negative pressure fit checks (see ANSI Z88.2 1980). Failure of either check shall be cause to select an alternate respirator.

5. Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part #5645, or equivalent. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure air pump set to deliver 200 milliliters per minute.

6. Advise the test subject that the smoke can be irritating to the eyes and instruct the subject to keep the eyes closed while the test is performed.

7. The test conductor shall direct the stream of irritant smoke from the tube

towards the faceseal area of the test subject. The person conducting the test shall begin with the tube at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

8. The test subject shall be instructed to do the following exercises while the respirator is being challenged by the smoke. Each exercise shall be performed for one minute.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are deep and regular.

iii. Turn head all the way from one side to the other. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete and made every second. Inhale when head is in the full up position (looking toward ceiling). Do not bump the respirator against the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

vi. Jogging in Place.

vii. Breathe normally.

9. The test subject shall indicate to the test conductor if the irritant smoke is detected. If smoke is detected, the test conductor shall stop the test. In this case, the tested respirator is rejected and another respirator shall be selected.

10. Each test subject passing the smoke test (i.e., without detecting the smoke) shall be given a sensitivity check of smoke from the same tube to determine if the test subject reacts to the smoke. Failure to evoke a response shall void the fit test.

11. Steps B4, B9, B10 of this fit test protocol shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agents.

12. At least two facepieces shall be selected by the IAA test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

13. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the PEL of asbestos.

14. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

15. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

16. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

17. Qualitative fit testing shall be repeated at least every six months.

18. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

- (1) Weight change of 20 pounds or more.
- (2) Significant facial scarring in the area of the facepiece seal.
- (3) Significant dental changes; i.e., multiple extractions without prosthesis, or acquiring dentures.
- (4) Reconstructive or cosmetic surgery, or
- (5) Any other condition that may interfere with facepiece sealing.

C. Recordkeeping.

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

- (1) Name of test subject.
- (2) Date of testing.
- (3) Name of test conductor.
- (4) Respirators selected (indicate manufacturer, model, size and approval number).
- (5) Testing agent.

Quantitative Fit Test Procedures

1. General.

a. The method applies to the negative-pressure nonpowered air-purifying respirators only.

b. The employer shall assign one individual who shall assume the full responsibility for implementing the respirator quantitative fit test program.

2. Definition.

a. "Quantitative Fit Test" means the measurement of the effectiveness of a respirator seal in excluding the ambient atmosphere. The test is performed by dividing the measured concentration of challenge agent in a test chamber by the measured concentration of the challenge agent inside the respirator facepiece when the normal air purifying element has been replaced by an essentially perfect purifying element.

b. "Challenge Agent" means the air contaminant introduced into a test chamber so that its concentration inside and outside the respirator may be compared.

c. "Test Subject" means the person wearing the respirator for quantitative fit testing.

d. "Normal Standing Position" means standing erect and straight with arms down along the sides and looking straight ahead.

e. "Fit Factor" means the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. Apparatus.

a. *Instrumentation.* Corn oil, sodium chloride or other appropriate aerosol generation, dilution, and measurement systems shall be used for quantitative fit test.

b. *Test chamber.* The test chamber shall be large enough to permit all test subjects to freely perform all required exercises without distributing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air yet uniform in concentration throughout the chamber.

c. When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particular filter supplied by the same manufacturer.

d. The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000.

e. The combination of substitute air-purifying elements (if any), challenge agent, and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of PEL to the challenge agent at any time during the testing process.

f. The sampling port on the test specimen respirator shall be placed and constructed so that there is no detectable leak around the port, a free air flow is allowed into the sampling line at all times and so there is no interference with the fit or performance of the respirator.

g. The test chamber and test set-up shall permit the person administering the test to observe one test subject inside the chamber during the test.

h. The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent constant within a 10 percent variation for the duration of the test.

i. The time lag (interval between an event and its being recorded on the strip chart) of the instrumentation may not exceed 2 seconds.

j. The tubing for the test chamber atmosphere and for the respirator sampling port shall be the same diameter, length and material. It shall be kept as short as possible. The smallest diameter tubing recommended by the manufacturer shall be used.

k. The exhaust flow from the test chamber shall pass through a high-efficiency filter before release to the room.

l. When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

4. Procedural Requirements

a. The fitting of half-mask respirators should be started with those having multiple sizes and a variety of interchangeable cartridges and canisters such as the MSA Comfo II-M, Norton M, Survivair M, A-O-M, or Scott-M. Use either of the tests outlined below to assure that the facepiece is properly adjusted.

(1) *Positive pressure test.* With the exhaust port(s) blocked, the negative pressure of slight inhalation should remain constant for several seconds.

(2) *Negative pressure test.* With the intake port(s) blocked, the negative pressure slight

inhalation should remain constant for several seconds.

b. After a facepiece is adjusted, the test subject shall wear the facepiece for at least 5 minutes before conducting a qualitative test by using either of the methods described below and using the exercise regime described in 5.a., b., c., d. and e.

(1) *Isoamyl acetate test.* When using organic vapor cartridges, the test subject who can smell the odor should be unable to detect the odor of isoamyl acetate squirted into the air near the most vulnerable portions of the facepiece seal. In a location which is separated from the test area, the test subject shall be instructed to close her/his eyes during the test period. A combination cartridge or canister with organic vapor and high-efficiency filters shall be used when available for the particular mask being tested. The test subject shall be given an opportunity to smell the odor of isoamyl acetate before the test is conducted.

(2) *Irritant fume test.* When using high-efficiency filters, the test subject should be unable to detect the odor of irritant fume (stannic chloride or titanium tetrachloride ventilation smoke tubes) squirted into the air near the most vulnerable portions of the facepiece seal. The test subject shall be instructed to close her/his eyes during the test period.

c. The test subject may enter the quantitative testing chamber only if she or he has obtained a satisfactory fit as stated in 4.b. of this Appendix.

d. Before the subject enters the test chamber, a reasonably stable challenge agent concentration shall be measured in the test chamber.

e. Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half-mask and 1 percent for a full facepiece.

f. A stable challenge agent concentration shall be obtained prior to the actual start of testing.

(1) Respirator restraining straps may not be overtightened for testing. The straps shall be adjusted by the wearer to give a reasonably comfortable fit typical of normal use.

5. *Exercise Regime.* Prior to entering the test chamber, the test subject shall be given complete instructions as to her/his part in the test procedures. The test subject shall perform the following exercises, in the order given, for each independent test.

a. *Normal Breathing (NB).* In the normal standing position, without talking, the subject shall breathe normally for at least one minute.

b. *Deep Breathing (DB).* In the normal standing position the subject shall do deep breathing for at least one minute pausing so as not to hyperventilate.

c. *Turning head side to side (SS).* Standing in place the subject shall slowly turn his/her head from side between the extreme positions to each side. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

d. *Moving head up and down (UD).*

Standing in place, the subject shall slowly move his/her head up and down between the extreme position straight up and the extreme position straight down. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

e. *Reading (R).* The subject shall read out slowly and loud so as to be heard clearly by the test conductor or monitor. The test subject shall read the "rainbow passage" at the end of this section.

f. *Grimace (G).* The test subject shall grimace, smile, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.

g. *Bend over and touch toes (B).* The test subject shall bend at the waist and touch toes and return to upright position. Repeat for at least 30 seconds.

h. *Jogging in place (J).* The test subject shall perform jog in place for at least 30 seconds.

i. *Normal Breathing (NB).* Same as exercise a.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

6. The test shall be terminated whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepieces. The test subject may be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate. (See paragraph 4.h.).

7. *Calculation of Fit Factors.*

a. The fit factor determined by the quantitative fit test equals the average concentration inside the respirator.

b. The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.

c. The average peak concentration of the challenge agent inside the respirator shall be the arithmetic average peak concentrations for each of the nine exercises of the test which are computed as the arithmetic average of the peak concentrations found for each breath during the exercise.

d. The average peak concentration for an exercise may be determined graphically if there is not a great variation in the peak concentrations during a single exercise.

8. *Interpretation of Test Results.* The fit factor measured by the quantitative fit testing shall be the lowest of the three protection factors resulting from three independent tests.

9. *Other Requirements.*

a. The test subject shall not be permitted to wear a half-mask or full facepiece mask if the minimum fit factor of 100 or 1,000, respectively, cannot be obtained. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

b. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

c. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

d. The test subject shall be given the opportunity to wear the assigned respirator for one week. If the respirator does not provide a satisfactory fit during actual use, the test subject may request another QNFT which shall be performed immediately.

e. A respirator fit factor card shall be issued to the test subject with the following information:

(1) Name.

(2) Date of fit test.

(3) Protection factors obtained through each manufacturer, model and approval number of respirator tested.

(4) Name and signature of the person that conducted the test.

f. Filters used for qualitative or quantitative fit testing shall be replaced weekly, whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily or sooner if there is any indication of breakthrough by the test agent.

10. In addition, because the sealing of the respirator may be affected, quantitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e.: multiple extractions without prosthesis, or acquiring dentures,

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

11. *Recordkeeping.*

A summary of all test results shall be maintained for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of the test conductor.

(4) Fit factors obtained from every respirator tested (indicate manufacturer, model, size and approval number).

Appendix D to § 1926.58—Medical Questionnaires; Mandatory

This mandatory appendix contains the medical questionnaires that must be administered to all employees who are exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the action level, and who will therefore be included in their employer's medical surveillance program. Part 1 of the appendix contains the Initial Medical Questionnaire, which must be obtained for all new hires who will be covered by the medical surveillance requirements. Part 2 includes the abbreviated Periodical Medical Questionnaire, which must be administered to all employees who are provided periodic medical examinations under the medical surveillance provisions of the standard.

BILLING CODE 4510-26-M

Part 1
INITIAL MEDICAL QUESTIONNAIRE

1. NAME _____
2. SOCIAL SECURITY #
3. CLOCK NUMBER
4. PRESENT OCCUPATION _____
5. PLANT _____
6. ADDRESS _____
7. _____
(Zip Code)
8. TELEPHONE NUMBER _____
9. INTERVIEWER _____
10. DATE _____
11. Date of Birth _____
Month Day Year
12. Place of Birth _____
13. Sex
1. Male
2. Female
14. What is your marital status?
1. Single 4. Separated/
2. Married Divorced
3. Widowed
15. Race
1. White 4. Hispanic
2. Black 5. Indian
3. Asian 6. Other
16. What is the highest grade completed in school? _____
(For example 12 years is completion of high school)

OCCUPATIONAL HISTORY

- 17A. Have you ever worked full time (30 hours per week or more) for 6 months or more? 1. Yes 2. No
- IF YES TO 17A:
- B. Have you ever worked for a year or more in any dusty job? 1. Yes 2. No
3. Does Not Apply

- Specify job/industry _____ Total Years Worked _____
- Was dust exposure: 1. Mild 2. Moderate 3. Severe
- C. Have you ever been exposed to gas or chemical fumes in your work? 1. Yes 2. No
- Specify job/industry _____ Total Years Worked _____
- Was exposure: 1. Mild 2. Moderate 3. Severe
- D. What has been your usual occupation or job--the one you have worked at the longest?
1. Job occupation _____
2. Number of years employed in this occupation _____
3. Position/job title _____
4. Business, field or industry _____

(Record on lines the years in which you have worked in any of these industries, e.g. 1960-1969)

- Have you ever worked:
- | | YES | NO |
|---|--------------------------|--------------------------|
| E. In a mine?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| F. In a quarry?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| G. In a foundry?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| H. In a pottery?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| I. In a cotton, flax or hemp mill?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| J. With asbestos?..... | <input type="checkbox"/> | <input type="checkbox"/> |

18. PAST MEDICAL HISTORY

- | | YES | NO |
|---|--------------------------|--------------------------|
| A. Do you consider yourself to be in good health? | <input type="checkbox"/> | <input type="checkbox"/> |
| If "NO" state reason _____ | | |
| B. Have you any defect of vision?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| If "YES" state nature of defect _____ | | |
| C. Have you any hearing defect?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| If "YES" state nature of defect _____ | | |

D. Are you suffering from or have you ever suffered from:

- a. Epilepsy (or fits, seizures, convulsions)?
- b. Rheumatic fever?
- c. Kidney disease?
- d. Bladder disease?
- e. Diabetes?
- f. Jaundice?

19. CHEST COLDS AND CHEST ILLNESSES

19A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time) 1. Yes ___ 2. No ___
3. Don't get colds ___

20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? 1. Yes ___ 2. No ___

IF YES TO 20A:

B. Did you produce phlegm with any of these chest illnesses? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more? Number of illnesses ___
No such illnesses ___

21. Did you have any lung trouble before the age of 16? 1. Yes ___ 2. No ___

22. Have you ever had any of the following?

1A. Attacks of bronchitis? 1. Yes ___ 2. No ___

IF YES TO 1A:

B. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. At what age was your first attack? Age in Years ___
Does Not Apply ___

2A. Pneumonia (include bronchopneumonia)? 1. Yes ___ 2. No ___

IF YES TO 2A:

B. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. At what age did you first have it? Age in Years ___
Does Not Apply ___

3A. Hay Fever?

1. Yes ___ 2. No ___

IF YES TO 3A:

B. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. At what age did it start? Age in Years ___
Does Not Apply ___

23A. Have you ever had chronic bronchitis? 1. Yes ___ 2. No ___

IF YES TO 23A:

B. Do you still have it? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

D. At what age did it start? Age in Years ___
Does Not Apply ___

24A. Have you ever had emphysema? 1. Yes ___ 2. No ___

IF YES TO 24A:

B. Do you still have it? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

D. At what age did it start? Age in Years ___
Does Not Apply ___

25A. Have you ever had asthma? 1. Yes ___ 2. No ___

IF YES TO 25A:

B. Do you still have it? 1. Yes ___ 2. No ___
3. Does Not Apply ___

C. Was it confirmed by a doctor? 1. Yes ___ 2. No ___
3. Does Not Apply ___

D. At what age did it start? Age in Years ___
Does Not Apply ___

E. If you no longer have it, at what age did it stop? Age stopped ___
Does Not Apply ___

26. Have you ever had:

A. Any other chest illness? 1. Yes ___ 2. No ___

If yes, please specify _____

- B. Any chest operations? 1. Yes ___ 2. No ___
 If yes, please specify _____
- C. Any chest injuries? 1. Yes ___ 2. No ___
 If yes, please specify _____
- 27A. Has a doctor ever told you that you had heart trouble? 1. Yes ___ 2. No ___
 IF YES TO 27A:
 B. Have you ever had treatment for heart trouble in the past 10 years? 1. Yes ___ 2. No ___
 3. Does Not Apply ___
- 28A. Has a doctor ever told you that you had high blood pressure? 1. Yes ___ 2. No ___
 IF YES TO 28A:
 B. Have you had any treatment for high blood pressure (hypertension) in the past 10 years? 1. Yes ___ 2. No ___
 3. Does Not Apply ___
29. When did you last have your chest X-rayed? (Year) 25 ___ 26 ___ 27 ___ 28 ___
30. Where did you last have your chest X-rayed (if known)? _____
 What was the outcome? _____

FAMILY HISTORY

11. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:
- | | FATHER | | | MOTHER | | |
|-------------------------------|-------------------|-------------------|------------------|-------------------|------------------|----------------|
| | 1. Yes | 2. No | 3. Don't Know | 1. Yes | 2. No | 3. Don't Know |
| A. Chronic Bronchitis? | ___ | ___ | ___ | ___ | ___ | ___ |
| B. Emphysema? | ___ | ___ | ___ | ___ | ___ | ___ |
| C. Asthma? | ___ | ___ | ___ | ___ | ___ | ___ |
| D. Lung cancer? | ___ | ___ | ___ | ___ | ___ | ___ |
| E. Other chest conditions | ___ | ___ | ___ | ___ | ___ | ___ |
| F. Is parent currently alive? | ___ | ___ | ___ | ___ | ___ | ___ |
| G. Please Specify | ___ Age if Living | ___ Age if Living | ___ Age at Death | ___ Age if Living | ___ Age at Death | ___ Don't Know |
| | ___ Age at Death | ___ Age at Death | ___ Don't Know | ___ Age at Death | ___ Don't Know | |
| | ___ Don't Know | ___ Don't Know | | ___ Don't Know | | |

- H. Please specify cause of death _____
- COUGH**
- 32A. Do you usually have a cough? (Count a cough with first smoke or on first going out of doors. Exclude clearing of throat.) (If no, skip to question 32C.) 1. Yes ___ 2. No ___
- B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week? 1. Yes ___ 2. No ___
- C. Do you usually cough at all on getting up or first thing in the morning? 1. Yes ___ 2. No ___
- D. Do you usually cough at all during the rest of the day or at night? 1. Yes ___ 2. No ___
- IF YES TO ANY OF ABOVE (32A, B, C, or D), ANSWER THE FOLLOWING: IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO NEXT PAGE.
- E. Do you usually cough like this on most days for 3 consecutive months or more during the year? 1. Yes ___ 2. No ___
 3. Does not apply ___
- F. For how many years have you had the cough? Number of years ___
 Does not apply ___
- 33A. Do you usually bring up phlegm from your chest? 1. Yes ___ 2. No ___
 (Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) (If no, skip to 33C)
- B. Do you usually bring up phlegm like this as much as twice a day 4 or more days out of the week? 1. Yes ___ 2. No ___
- C. Do you usually bring up phlegm at all on getting up or first thing in the morning? 1. Yes ___ 2. No ___
- D. Do you usually bring up phlegm at all during the rest of the day or at night? 1. Yes ___ 2. No ___
- IF YES TO ANY OF THE ABOVE (33A, B, C, or D), ANSWER THE FOLLOWING: IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO 34A.
- E. Do you bring up phlegm like this on most days for 3 consecutive months or more during the year? 1. Yes ___ 2. No ___
 3. Does not apply ___

F. For how many years have you had trouble with phlegm?

Number of years ___
Does not apply ___

EPISODES OF COUGHS AND PHLEGM

34A. Have you had periods of episodes of (increased) cough and phlegm lasting for 1 week or more each year?
(For persons who usually have cough and/or phlegm)

1. Yes ___ 2. No ___

IF YES TO 34A

B. For how long have you had at least 1 such episode per year?

Number of years ___
Does not apply ___

WHEEZING

35A. Does your chest ever sound wheezy or whistling

- 1. When you have a cold?
- 2. Occasionally apart from colds?
- 3. Most days or nights?

1. Yes ___ 2. No ___
1. Yes ___ 2. No ___
1. Yes ___ 2. No ___

IF YES TO 1, 2, or 3 in 35A

B. For how many years has this been present?

Number of years ___
Does not apply ___

36A. Have you ever had an attack of wheezing that has made you feel short of breath?

1. Yes ___ 2. No ___

IF YES TO 36A

B. How old were you when you had your first such attack?

Age in years ___
Does not apply ___

C. Have you had 2 or more such episodes?

1. Yes ___ 2. No ___
3. Does not apply ___

D. Have you ever required medicine or treatment for the (se) attack(s)?

1. Yes ___ 2. No ___
3. Does not apply ___

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A.
Nature of condition(s) _____

38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill?

1. Yes ___ 2. No ___

IF YES TO 38A

B. Do you have to walk slower than people of your age on the level because of breathlessness?

1. Yes ___ 2. No ___
3. Does not apply ___

C. Do you ever have to stop for breath when walking at your own pace on the level?

1. Yes ___ 2. No ___
3. Does not apply ___

D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level?

1. Yes ___ 2. No ___
3. Does not apply ___

E. Are you too breathless to leave the house or breathless on dressing or climbing one flight of stairs?

1. Yes ___ 2. No ___
3. Does not apply ___

TOBACCO SMOKING

39A. Have you ever smoked cigarettes? (No means less than 20 packs of cigarettes or 12 oz. of tobacco in a lifetime or less than 1 cigarette a day for 1 year.)

1. Yes ___ 2. No ___

IF YES TO 39A

B. Do you now smoke cigarettes (as of one month ago)

1. Yes ___ 2. No ___
3. Does not apply ___

C. How old were you when you first started regular cigarette smoking?

Age in years ___
Does not apply ___

D. If you have stopped smoking cigarettes completely, how old were you when you stopped?

Age stopped ___
Check if still smoking ___
Does not apply ___

E. How many cigarettes do you smoke per day now?

Cigarettes per day ___
Does not apply ___

F. On the average of the entire time you smoked, how many cigarettes did you smoke per day?

Cigarettes per day ___
Does not apply ___

G. Do or did you inhale the cigarette smoke?

1. Does not apply ___
2. Not at all ___
3. Slightly ___
4. Moderately ___
5. Deeply ___

40A. Have you ever smoked a pipe regularly? (Yes means more than 12 oz. of tobacco in a lifetime.)

1. Yes ___ 2. No ___

13. RECENT MEDICAL HISTORY

13A. Do you consider yourself to be in good health? Yes ___ No ___
 If NO, state reason _____

13B. In the past year, have you developed:

	Yes	No
Epilepsy?	___	___
Rheumatic fever?	___	___
Kidney disease?	___	___
Bladder disease?	___	___
Diabetes?	___	___
Jaundice?	___	___
Cancer?	___	___

14. CHEST COLDS AND CHEST ILLNESSES

14A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time)
 1. Yes ___ 2. No ___
 3. Don't get colds ___

15A. During the past year, have you had any chest illnesses that have kept you off work, indoors at home, or in bed?
 1. Yes ___ 2. No ___
 3. Does Not Apply ___

IF YES TO 15A:

15B. Did you produce phlegm with any of these chest illnesses?
 1. Yes ___ 2. No ___
 3. Does Not Apply ___

15C. In the past year, how many such illnesses with (increased) phlegm did you have which lasted a week or more?
 Number of illnesses ___
 No such illnesses ___

16. RESPIRATORY SYSTEM

In the past year have you had:

	<u>Yes or No</u>	<u>Further Comment on Positive Answers</u>
Asthma	___	
Bronchitis	___	
Hay Fever	___	
Other Allergies	___	

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Yes or No Further Comment on Positive Answers

Pneumonia _____
 Tuberculosis _____
 Chest Surgery _____
 Other Lung Problems _____
 Heart Disease _____
 Do you have:

Yes or No Further Comment on Positive Answers

Frequent colds _____
 Chronic cough _____
 Shortness of breath when walking or climbing one flight or stairs _____
 Do you:
 Wheeze _____
 Cough up phlegm _____
 Smoke cigarettes _____ Packs per day ___ How many years ___

Date _____

Signature _____

Appendix E to § 1926.58—Interpretation and Classification of Chest Roentgenograms—Mandatory

(a) Chest roentgenograms shall be interpreted and classified in accordance with a professionally accepted classification system and recorded on a Roentgenographic Interpretation Form, *Form CSD/NIOSH (M) 2.8.

(b) Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconioses.

(c) All interpreters, whenever interpreting chest roentgenograms made under this section, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

Appendix F to 1926.58—Work Practices and Engineering Controls for Major Asbestos Removal, Renovation, and Demolition Operations—Non-Mandatory

This is a non-mandatory appendix designed to provide guidelines to assist employers in complying with the requirements of 29 CFR 1926.58. Specifically, this appendix describes the equipment, methods, and procedures that should be used in major asbestos removal projects conducted to abate a recognized asbestos hazard or in preparation for building renovation or demolition. These projects require the construction of negative-pressure temporary enclosures to contain the asbestos material and to prevent the exposure of bystanders and other employees at the worksite. Paragraph (e)(6) of the standard requires that "... [W]henver feasible, the employer shall establish negative-pressure enclosures before commencing asbestos* removal, demolition, or renovation operations." Employers should also be aware that, when conducting asbestos removal projects, they may be required under the National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61, Subpart M, or EPA regulations under the Clean Water Act.*

Construction of a negative-pressure enclosure is a simple but time-consuming process that requires careful preparation and execution; however, if the procedures below are followed, contractors should be assured of achieving a temporary barricade that will protect employees and others outside the enclosure from exposure to asbestos and minimize to the extent possible the exposure of asbestos workers inside the barrier as well.

The equipment and materials required to construct these barriers are readily available and easily installed and used. In addition to

an enclosure around the removal site, the standard requires employers to provide hygiene facilities that ensure that their asbestos contaminated employees do not leave the work site with asbestos on their persons or clothing; the construction of these facilities is also described below. The steps in the process of preparing the asbestos removal site, building the enclosure, constructing hygiene facilities, removing the asbestos-containing material, and restoring the site include:

- (1) Planning the removal project;
- (2) Procuring the necessary materials and equipment;
- (3) Preparing the work area;
- (4) Removing the asbestos-containing material;
- (5) Cleaning the work area; and
- (6) Disposing of the asbestos-containing waste.

Planning the Removal Project

The planning of an asbestos removal project is critical to completing the project safely and cost-effectively. A written asbestos removal plan should be prepared that describes the equipment and procedures that will be used throughout the project. The asbestos abatement plan will aid not only in executing the project but also in complying with the reporting requirements of the USEPA asbestos regulations (40 CFR 61, Subpart M), which call for specific information such as a description of control methods and control equipment to be used and the disposal sites the contractor proposes to use to dispose of the asbestos containing materials.

The asbestos abatement plan should contain the following information:

- A physical description of the work area;
- A description of the approximate amount of material to be removed;
- A schedule for turning off and sealing existing ventilation systems;
- Personnel hygiene procedures;
- Labeling procedures;
- A description of personal protective equipment and clothing to be worn by employees;
- A description of the local exhaust ventilation systems to be used;
- A description of work practices to be observed by employees;
- A description of the methods to be used to remove the asbestos-containing material:
 - The wetting agent to be used;
 - A description of the sealant to be used at the end of the project;
 - An air monitoring plan;
 - A description of the method to be used to transport waste material; and
 - The location of the dump site.

Materials and Equipment Necessary for Asbestos Removal

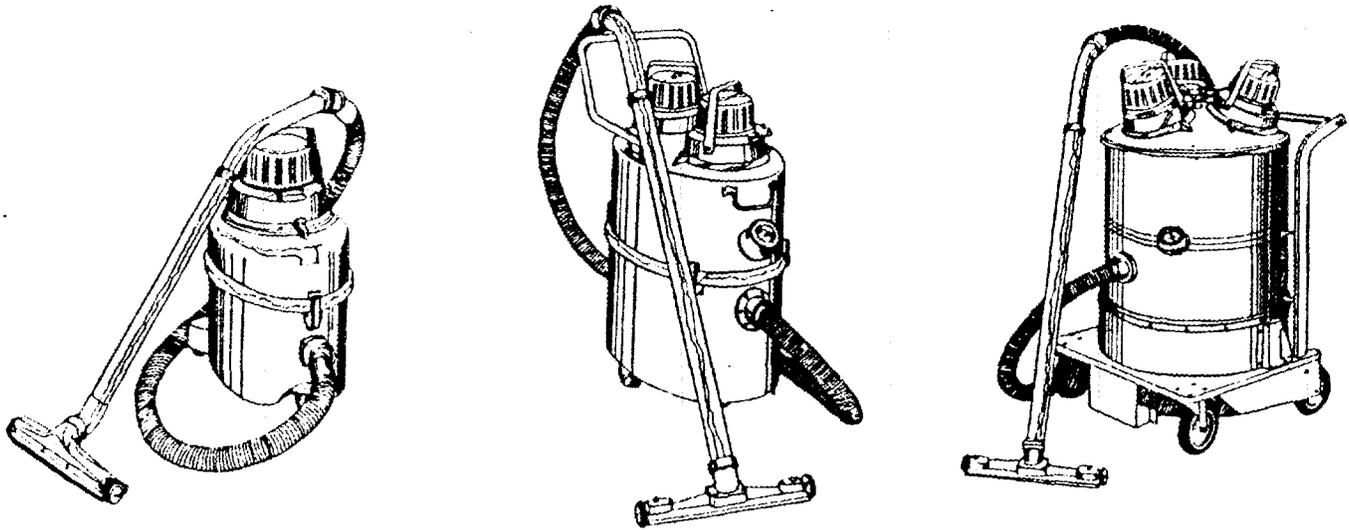
Although individual asbestos removal projects vary in terms of the equipment required to accomplish the removal of the material, some equipment and materials are common to most asbestos removal operations. Equipment and materials that should be available at the beginning of each project are: (1) rolls of polyethylene sheeting; (2) rolls of gray duct tape or clear plastic tape; (3) HEPA filtered vacuum(s); (4) HEPA-filtered portable ventilation system(s); (5) a wetting agent; (6) an airless sprayer; (7) a portable shower unit; (8) appropriate respirators; (9) disposable coveralls; (10) signs and labels; (11) pre-printed disposal bags; and (12) a manometer or pressure gauge.

Rolls of Polyethylene Plastic and Tape. Rolls of polyethylene plastic (6 mil in thickness) should be available to construct the asbestos removal enclosure and to seal windows, doors, ventilation systems, wall penetrations, and ceilings and floors in the work area. Gray duct tape or clear plastic tape should be used to seal the edges of the plastic and to seal any holes in the plastic enclosure. Polyethylene plastic sheeting can be purchased in rolls up to 12-20 feet in width and up to 100 feet in length.

HEPA-Filtered Vacuum. A HEPA-filtered vacuum is essential for cleaning the work area after the asbestos has been removed. Such vacuums are designed to be used with a HEPA (High Efficiency Particulate Air) filter, which is capable of removing 99.97 percent of the asbestos particles from the air. Various sizes and capacities of HEPA vacuums are available. One manufacturer, Nilfisk of America, Inc.*, produces three models that range in capacity from 5.25 gallons to 17 gallons (see Figure F-1). All of these models are portable, and all have long hoses capable of reaching out-of-the-way places, such as areas above ceiling tiles, behind pipes, etc.

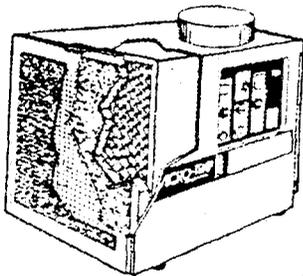
Exhaust Air Filtration System. A portable ventilation system is necessary to create a negative pressure within the asbestos removal enclosure. Such units are equipped with a HEPA filter and are designed to exhaust and clean the air inside the enclosure before exhausting it to the outside of the enclosure (See Figure F-2). Systems are available from several manufacturers. One supplier, Micro-Trap, Inc.*, has two ventilation units that range in capacity from 600 cubic feet per minute (CFM) to 1,700 CFM. According to the manufacturer's literature, Micro-Trap* units filter particles of 0.3 micron in size with an efficiency of 99.99 percent. The number and capacity of units required to ventilate an enclosure depend on the size of the area to be ventilated.

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.



Source: Product Catalog, Asbestos Control Technologies, Inc., Maple Shade, N.J., 1985.

Figure F-1. HEPA Filtered Vacuums



Source: Product Catalog, Asbestos Control Technologies, Inc., Maple Shade, N.J., 1985.

Figure F-2. Portable Exhaust Ventilation System with HEPA Filter

Wetting Agents. Wetting agents (surfactants) are added to water (which is then called amended water) and used to soak asbestos-containing materials; amended water penetrates more effectively than plain water and permits more thorough soaking of the asbestos-containing materials. Wetting the asbestos-containing material reduces the number of fibers that will break free and become airborne when the asbestos-containing material is handled or otherwise disturbed. Asbestos-containing materials should be thoroughly soaked before removal is attempted; the dislodged material should feel spongy to the touch. Wetting agents are generally prepared by mixing 1 to 3 ounces of wetting agent to 5 gallons of water.

One type of asbestos, amosite, is relatively resistant to soaking, either with plain or amended water. The work practices of choice when working with amosite containing material are to soak the material as much as possible and then to bag it for disposal immediately after removal, so that the material has no time to dry and be ground into smaller particles that are more likely to liberate airborne asbestos.

In a very limited number of situations, it may not be possible to wet the asbestos-containing material before removing it. Examples of such rare situations are: (1)

Removal of asbestos material from a "live" electrical box that was oversprayed with the material when the rest of the area was sprayed with asbestos-containing coating; and (2) removing asbestos-containing insulation from a live steam pipe. In both of these situations, the preferred approach would be to turn off the electricity or steam, respectively, to permit wet removal methods to be used. However, where removal work must be performed during working hours, i.e., when normal operations cannot be disrupted, the asbestos-containing material must be removed dry. Immediate bagging is then the only method of minimizing the amount of airborne asbestos generated.

Airless Sprayer. Airless sprayers are used to apply amended water to asbestos-containing materials. Airless sprayers allow the amended water to be applied in a fine spray that minimizes the release of asbestos fibers by reducing the impact of the spray on the material to be removed. Airless sprayers are inexpensive and readily available.

Portable Shower. Unless the site has available a permanent shower facility that is contiguous to the removal area, a portable shower system is necessary to permit employees to clean themselves after exposure to asbestos and to remove any asbestos contamination from their hair and bodies. Taking a shower prevents employees from leaving the work area with asbestos on their clothes and thus prevents the spread of asbestos contamination to areas outside the asbestos removal area. This measure also protects members of the families of asbestos workers from possible exposure to asbestos. Showers should be supplied with warm water and a drain. A shower water filtration system to filter asbestos fibers from the shower water is recommended. Portable shower units are readily available, inexpensive, and easy to install and transport.

Respirators. Employees involved in asbestos removal projects should be provided with appropriate NIOSH-approved respirators. Selection of the appropriate respirator should be based on the

concentration of asbestos fibers in the work area. If the concentration of asbestos fibers is unknown, employees should be provided with respirators that will provide protection against the highest concentration of asbestos fibers that can reasonably be expected to exist in the work area. For most work within an enclosure, employees should wear half-mask dual-filter cartridge respirators. Disposable face mask respirators (single-use) should not be used to protect employers from exposure to asbestos fibers.

Disposable Coveralls. Employees involved in asbestos removal operations should be provided with disposable impervious coveralls that are equipped with head and foot covers. Such coveralls are typically made of Tyvek.¹ The coverall has a zipper front and elastic wrists and ankles.

Signs and Labels. Before work begins, a supply of signs to demarcate the entrance to the work area should be obtained. Signs are available that have the wording required by the final OSHA standard. The required labels are also commercially available as press-on labels and pre-printed on the 6-mil polyethylene plastic bags used to dispose of asbestos-containing waste material.

Preparing the Work Area

Preparation for constructing negative-pressure enclosures should begin with the removal of all movable objects from the work area, e.g., desks, chairs, rugs, and light fixtures, to ensure that these objects do not become contaminated with asbestos. When movable objects are contaminated or are suspected of being contaminated, they should be vacuumed with a HEPA vacuum and cleaned with amended water, unless they are made of material that will be damaged by the wetting agent; wiping with plain water is recommended in those cases where amended water will damage the object. Before the asbestos removal work begins, objects that

¹ Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

cannot be removed from the work area should be covered with a 6-mil-thick polyethylene plastic sheeting that is securely taped with duct tape or plastic tape to achieve an air-tight seal around the object.

Constructing the Enclosure

When all objects have either been removed from the work area or covered with plastic, all penetrations of the floor, walls, and ceiling should be sealed with 6-mil polyethylene plastic and tape to prevent airborne asbestos from escaping into areas outside the work area of from lodging in cracks around the penetrations. Penetrations that require sealing are typically found around electrical conduits, telephone wires, and water supply and drain pipes. A single entrance to be used for access and egress to the work area should be selected, and all other doors and windows should be sealed with tape or be covered with 6-mil polyethylene plastic sheeting and securely taped. Covering windows and unnecessary doors with a layer of polyethylene before covering the walls provides a second layer of protection and saves time in installation because it reduces the number of edges that must be cut and taped. All other surfaces such as support columns, ledges, pipes, and other surfaces should also be covered with polyethylene plastic sheeting and taped before the walls themselves are completely covered with sheeting.

Next a thin layer of spray adhesive should be sprayed along the top of all walls surrounding the enclosed work area, close to the wall-ceiling interface, and a layer of polyethylene plastic sheeting should be stuck to this adhesive and taped. The entire inside surfaces of all wall areas are covered in this manner, and the sheeting over the walls is extended across the floor area until it meets in the center of the area, where it is taped to form a single layer of material encasing the entire room except for the ceiling. A final layer of plastic sheeting is then laid across the plastic-covered floor area and up the walls to a level of 2 feet or so; this layer provides a second protective layer of plastic sheeting over the floor, which can then be

removed and disposed of easily after the asbestos-containing material that has dropped to the floor has been bagged and removed.

Building Hygiene Facilities

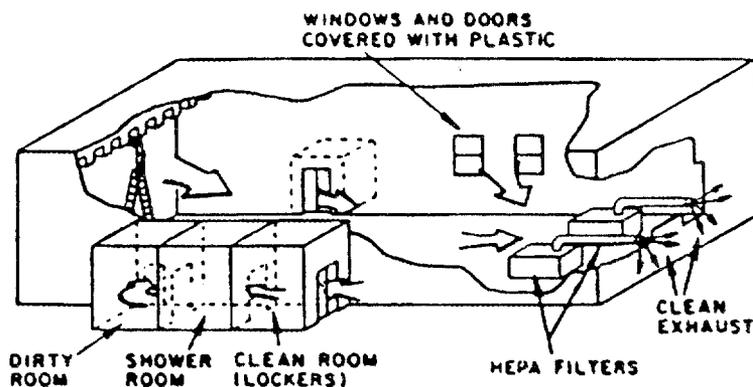
Paragraph (j) of the final standard mandates that employers involved in asbestos removal, demolition, or renovation operations provide their employees with hygiene facilities to be used to decontaminate asbestos-exposed workers, equipment, and clothing before such employees leave the work area. These decontamination facilities consist of:

- (1) A clean change room;
- (2) A shower; and

(3) An equipment room.

The clean change room is an area in which employees remove their street clothes and don their respirators and disposable protective clothing. The clean room should have hooks on the wall or be equipped with lockers for the storage of workers' clothing and personal articles. Extra disposable coveralls and towels can also be stored in the clean change room.

The shower should be contiguous with both the clean and dirty change room (see Figure F-3) and should be used by all workers leaving the work area. The shower should also be used to clean asbestos-contaminated equipment and materials, such as the outsides of asbestos waste bags and hand tools used in the removal process.



Source: EPA 1985. Asbestos Waste Management Guidance (EPA/530-SW-85-007).

Figure F-3. Cutaway View of Enclosure and Hygiene Facilities

The equipment room (also called the dirty change room) is the area where workers remove their protective coveralls and where equipment that is to be used in the work area can be stored. The equipment room should be lined with 6-mil-thick polyethylene plastic sheeting in the same way as was done in the

work area enclosure. Two layers of 6-mil polyethylene plastic sheeting that are not taped together from a double flap or barrier between the equipment room and the work area and between the shower and the clean change room (see Figure F-4).

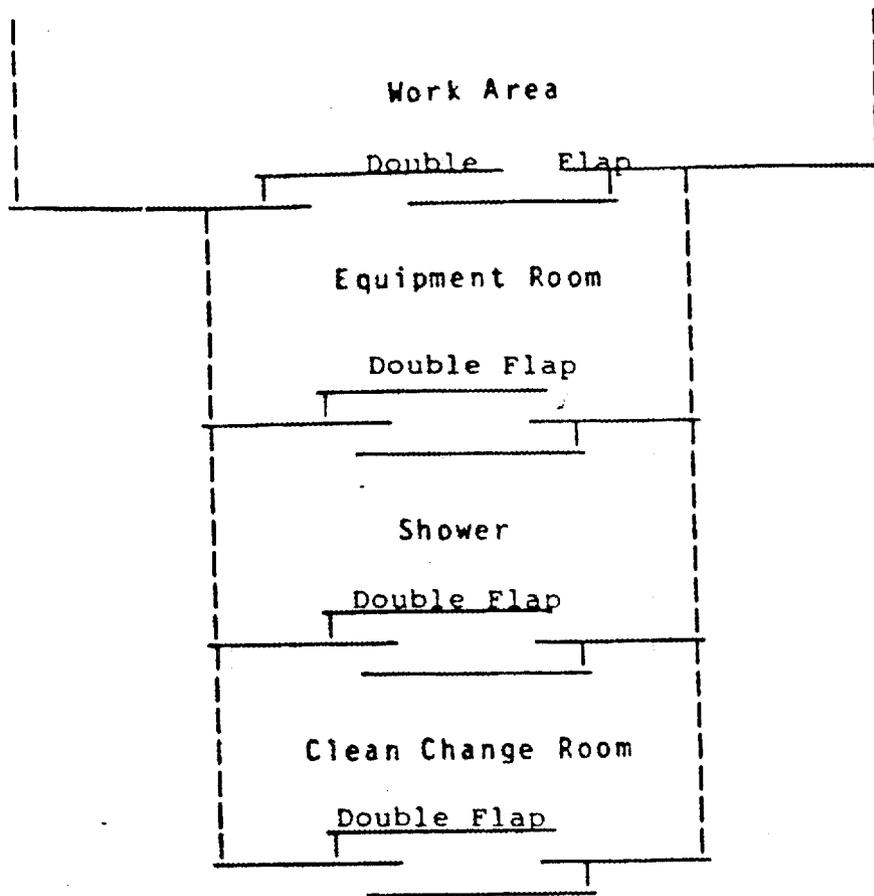


Figure F-4. Typical Hygiene Facility Layout

When feasible, the clean change room, shower, and equipment room should be contiguous and adjacent to the negative-pressure enclosure surrounding the removal area. In the overwhelming number of cases, hygiene facilities can be built contiguous to the negative-pressure enclosure. In some cases, however, hygiene facilities may have to be located on another floor of the building where removal of asbestos-containing materials is taking place. In these instances, the hygiene facilities can in effect be made to be contiguous to the work area by constructing a polyethylene plastic "tunnel" from the work area to the hygiene facilities.

Such a tunnel can be made even in cases where the hygiene facilities are located several floors above or below the work area: the tunnel begins with a double flap door at the enclosure, extends through the exit from the floor, continues down the necessary number of flights of stairs and goes through a double-flap entrance to the hygiene facilities, which have been prepared as described above. The tunnel is constructed of 2-inch by 4-inch lumber or aluminum struts and covered with 6-mil-thick polyethylene plastic sheeting.

In the rare instances when there is not enough space to permit any hygiene facilities

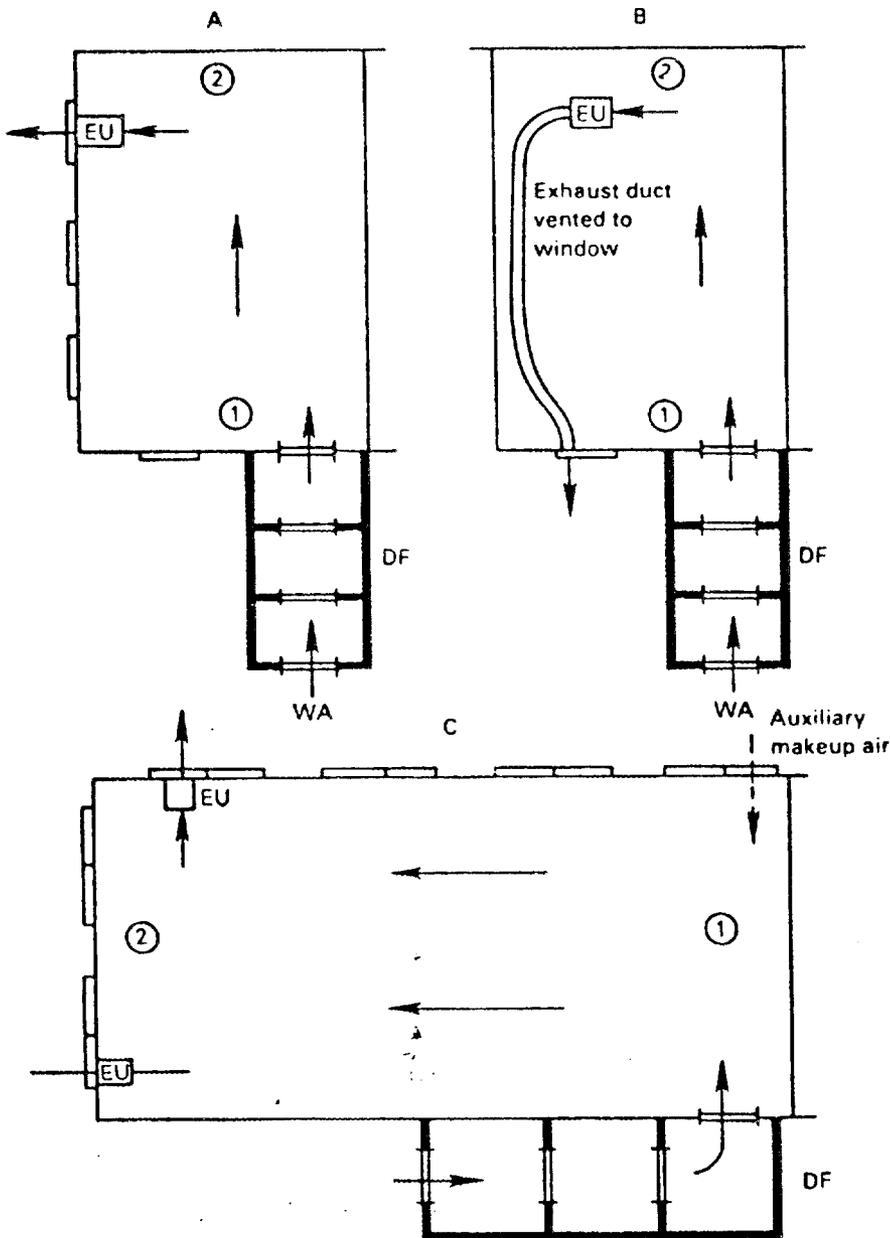
to be built at the work site, employees should be directed to change into a clean disposable worksuit immediately after exiting the enclosure (without removing their respirators) and to proceed immediately to the shower. Alternatively, employees could be directed to vacuum their disposable coveralls with a HEPA-filtered vacuum before proceeding to a shower located a distance from the enclosure.

The clean room, shower, and equipment room must be sealed completely to ensure that the sole source of air flow through these areas originates from uncontaminated areas outside the asbestos removal, demolition, or renovation enclosure. The shower must be drained properly after each use to ensure that contaminated water is not released to uncontaminated areas. If waste water is inadvertently released, it should be cleaned up as soon as possible to prevent any asbestos in the water from drying and becoming airborne in areas outside the work area.

Establishing Negative Pressure Within the Enclosure

After construction of the enclosure is completed, a ventilation system(s) should be installed to create a negative pressure within the enclosure with respect to the area outside the enclosure. Such ventilation systems must be equipped with HEPA filters to prevent the release of asbestos fibers to the environment outside the enclosure and should be operated 24 hours per day during the entire project until the final cleanup is completed and the results of final air samples are received from the laboratory. A sufficient amount of air should be exhausted to create a pressure of -0.02 inches of water within the enclosure with respect to the area outside the enclosure.

These ventilation systems should exhaust the HEPA-filtered clean air outside the building in which the asbestos removal, demolition, or renovation is taking place (see Figure F-5). If access to the outside is not available, the ventilation system can exhaust the HEPA-filtered asbestos-free air to an area within the building that is as far away as possible from the enclosure. Care should be taken to ensure that the clean air is released either to an asbestos-free area or in such a way as not to disturb any asbestos-containing materials.



Source: EPA 1985. Guidance for Controlling Asbestos-Containing materials in Buildings (EPA 560/5-85-024).

Figure F-5. Examples of Negative Pressure Systems. DF, Decontamination Facility; EU, Exhaust Unit; WA, Worker Access; A, Single-room work area with multiple windows; B, Single-room work area with single window near entrance; C, Large single-room work area with windows and auxiliary makeup air source (dotted arrow). Arrows denote direction of air flow. Circled numbers indicate progression of removal sequence.

samples should be collected from those workers who can reasonably be expected to have the highest potential exposure to asbestos.

Removing Asbestos Materials

Paragraph (e)(6)(iii) requires that employers involved in asbestos removal, demolition, or renovation operations designate a competent person to:

- (1) Set up the enclosure;
- (2) Ensure the integrity of the enclosure;
- (3) Control entry to and exit from the enclosure;
- (4) Supervise all employee exposure monitoring required by this section;
- (5) Ensure the use of protective clothing and equipment;
- (6) Ensure that employees are trained in the use of engineering controls, work practices, and personal protective equipment;
- (7) Ensure the use of hygiene facilities and the observance of proper decontamination procedures; and
- (8) Ensure that engineering controls are functioning properly.

The competent person will generally be a Certified Industrial Hygienist, an industrial hygienist with training and experience in the handling of asbestos, or a person who has such training and experience as a result of on-the-job training and experience.

Ensuring the integrity of the enclosure is accomplished by inspecting the enclosure before asbestos removal work begins and prior to each work shift throughout the entire period work is being conducted in the enclosure. The inspection should be conducted by locating all areas where air might escape from the enclosure; this is best accomplished by running a hand over all seams in the plastic enclosure to ensure that no seams are ripped and the tape is securely in place.

The competent person should also ensure that all unauthorized personnel do not enter the enclosure and that all employees and other personnel who enter the enclosure have the proper protective clothing and equipment. He or she should also ensure that all employees and other personnel who enter the enclosure use the hygiene facilities and observe the proper decontamination procedures (described below).

Proper work practices are necessary during asbestos removal, demolition, and renovation to ensure that the concentration of asbestos fibers inside the enclosure remains as low as possible. One of the most important work practices is to wet the asbestos-containing material before it is disturbed. After the asbestos-containing material is thoroughly wetted, it should be removed by scraping (as in the case of sprayed-on or troweled-on ceiling material) or removed by cutting the metal bands or wire mesh that support the asbestos-containing material on boilers or pipes. Any residue that remains on the surface of the object from which asbestos is being removed should be wire brushed and wet wiped.

Bagging asbestos waste material promptly after its removal is another work practice control that is effective in reducing the airborne concentration of asbestos within the

A manometer or pressure gauge for measuring the negative pressure within the enclosure should be installed and should be monitored frequently throughout all work shifts during which asbestos removal, demolition, or renovation takes place. Several types of manometers and pressure gauges are available for this purpose.

All asbestos removal, renovation, and demolition operations should have a program

for monitoring the concentration of airborne asbestos and employee exposures to asbestos. Area samples should be collected inside the enclosure (approximately four samples for 5000 square feet of enclosure area). At least two samples should be collected outside the work area, one at the entrance to the clean change room and one at the exhaust of the portable ventilation system. In addition, several breathing zone

enclosure. Whenever possible, the asbestos should be removed and placed directly into bags for disposal rather than dropping the material to the floor and picking up all of the material when the removal is complete. If a significant amount of time elapses between the time that the material is removed and the time it is bagged, the asbestos material is likely to dry out and generate asbestos-laden dust when it is disturbed by people working within the enclosure. Any asbestos-

contaminated supplies and equipment that cannot be decontaminated should be disposed of in pre-labeled bags; items in this category include plastic sheeting, disposable work clothing, respirator cartridges, and contaminated wash water.

A checklist is one of the most effective methods of ensuring adequate surveillance of the integrity of the asbestos removal enclosure. Such a checklist is shown in Figure F-6. Filling out the checklist at the beginning

of each shift in which asbestos removal is being performed will serve to document that all the necessary precautions will be taken during the asbestos removal work. The checklist contains entries for ensuring that:

- The work area enclosure is complete;
- The negative-pressure system is in operation;
- Necessary signs and labels are used;

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Asbestos Removal, Renovation, and
Demolition Checklist

Date: _____ Location: _____

Supervisor _____ Project # _____
Work Area (sq. ft.) _____

	Yes	No
I. Work site barrier		
Floor covered	_____	_____
Walls covered	_____	_____
Area ventilation off	_____	_____
All edges sealed	_____	_____
Penetrations sealed	_____	_____
Entry curtains	_____	_____
II. Negative Air Pressure		
HEPA Vac _____ Ventilation system _____		
Constant operation	_____	_____
Negative pressure achieved	_____	_____
III. Signs		
Work area entrance	_____	_____
Bags labeled	_____	_____
IV. Work Practices		
Removed material promptly bagged	_____	_____
Material worked wet	_____	_____
HEPA vacuum used	_____	_____
No smoking	_____	_____
No eating, drinking	_____	_____
Work area cleaned after completion	_____	_____
Personnel decontaminated each departure	_____	_____
V. Protective Equipment		
Disposable clothing used one time	_____	_____
Proper NIOSH-approved respirators	_____	_____
VII. Showers		
On site	_____	_____
Functioning	_____	_____
Soap and towels	_____	_____
Used by all personnel	_____	_____

Figure F-6. Checklist

- Appropriate work practices are used;
- Necessary protective clothing and equipment are used; and
- Appropriate decontamination procedures are being followed.

Cleaning the Work Area

After all of the asbestos-containing material is removed and bagged, the entire work area should be cleaned until it is free of all visible asbestos dust. All surfaces from which asbestos has been removed should be cleaned by wire brushing the surfaces, HEPA vacuuming these surfaces, and wiping them with amended water. The inside of the plastic

enclosure should be vacuumed with a HEPA vacuum and wet wiped until there is no visible dust in the enclosure. Particular attention should be given to small horizontal surfaces such as pipes, electrical conduits, lights, and support tracks for drop ceilings. All such surfaces should be free of visible dust before the final air samples are collected.

Additional sampling should be conducted inside the enclosure after the cleanup of the work area has been completed. Approximately four area samples should be collected for each 5000 square feet of enclosure area. The enclosure should not be

dismantled unless the final samples show asbestos concentrations of less than the final standard's action level. EPA recommends that a clearance level of 0.01 f/cc be achieved before cleanup is considered complete.

A clearance checklist is an effective method of ensuring that all surfaces are adequately cleaned and the enclosure is ready to be dismantled. Figure F-7 shows a checklist that can be used during the final inspection phase of asbestos abatement, removal, or renovation operations.

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Appendix G to § 1926.58—Work Practices and Engineering Controls for Small-Scale, Short-Duration Asbestos Renovation and Maintenance Activities—Non-Mandatory

This appendix is not mandatory, in that construction industry employers may choose to comply with all of the requirements of OSHA's final rule for occupational exposure to asbestos in the construction industry.

§ 1926.58. However, employers wishing to be exempted from the requirements of paragraphs (e)(6) and (f)(2)(ii)(B) of § 1926.58 shall comply with the provisions of this appendix when performing small-scale, short-duration renovation or maintenance activities. OSHA anticipates that employers in the electrical, carpentry, utility, plumbing, and interior construction trades may wish to avail themselves of the final standard's exemptions for small-scale, short-duration renovation and maintenance operations.

Definition of Small Scale, Short-Duration Activities

For the purposes of this appendix, small-scale, short-duration renovation and maintenance activities are tasks such as, but not limited to:

- Removal of asbestos-containing insulation on pipes;
- Removal of small quantities of asbestos-containing insulation on beams or above ceilings;
- Replacement of an asbestos-containing gasket on a valve;
- Installation or removal of a small section of drywall;
- Installation of electrical conduits through or proximate to asbestos-containing materials.

Evidence in the record (see the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, for specific citations) suggests that the use of certain engineering and work practice controls is capable of reducing employee exposures to asbestos to levels below the final standard's action level (0.1 f/cc). Several controls and work practices, used either singly or in combination, can be employed effectively to reduce asbestos exposures during small maintenance and renovation operations. These include:

- Wet methods;
- Removal methods

- Use of Glove bags
- Removal of entire asbestos insulated pipes or structures
- Use of mini-enclosures

- Enclosure of asbestos materials; and
- Maintenance programs.

This appendix describes these controls and work practices in detail.

Preparation of the Area Before Renovation or Maintenance Activities

The first step in preparing to perform a small-scale, short-duration asbestos renovation or maintenance task, regardless of the abatement method that will be used, is the removal from the work area of all objects that are movable to protect them from asbestos contamination. Objects that cannot be removed must be covered completely with a 6-mil-thick polyethylene plastic sheeting before the task begins. If objects have already been contaminated, they should be thoroughly cleaned with a High Efficiency Particulate Air (HEPA) filtered vacuum or be wet wiped before they are removed from the work area or completely encased in the plastic.

Wet Methods

Whenever feasible, and regardless of the abatement method to be used (e.g., removal, enclosure, use of glove bags), wet methods must be used during small-scale, short duration maintenance and renovation activities that involve disturbing asbestos-containing materials. Handling asbestos materials wet is one of the most reliable methods of ensuring that asbestos fibers do not become airborne, and this practice should therefore be used whenever feasible. As discussed in the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, wet methods can be used in the great majority of workplace situations. Only in cases where asbestos work must be performed on live electrical equipment, on live steam lines, or in other areas where water will seriously damage materials or equipment may dry removal be performed. Amended water or another wetting agent should be applied by means of an airless sprayer to minimize the extent to which the asbestos-containing material is disturbed.

Asbestos-containing materials should be wetted from the initiation of the maintenance

or renovation operation and wetting agents should be used continually throughout the work period to ensure that any dry asbestos-containing material exposed in the course of the work is wet and remains wet until final disposal.

Removal of Small Amount of Asbestos-Containing Materials

Several methods can be used to remove small amounts of asbestos-containing materials during small-scale, short-duration renovation or maintenance tasks. These include the use of glove bags, the removal of an entire asbestos-covered pipe or structure, and the construction of mini-enclosures. The procedures that employers must use for each of these operations if they wish to avail themselves of the final rule's exemptions are described in the following sections.

Glove Bags

As discussed in the Summary and Explanation section of the preamble for paragraph (g), Methods of Compliance, evidence in the record indicate that the use of glove bags to enclose the work area during small-scale, short-duration maintenance or renovation activities will result in employee exposures to asbestos that are below the final standard's action level of 0.1 f/cc. This appendix provides requirements for glove-bag procedures to be followed by employers wishing to avail themselves of the standard's exemptions for each activities. OSHA has determined that the use of these procedures will reduce the 8 hour time weighted average (TWA) exposures of employees involved in these work operations to levels below the action level and will thus provide a degree of employee protection equivalent to that provided by compliance with all provisions of the final rule.

Glove Bag Installation. Glove bags are approximately 40-inch-wide times 64-inch-long bags fitted with arms through which the work can be performed (see Figure G-1(A)). When properly installed and used, they permit workers to remain completely isolated from the asbestos material removed or replaced inside the bag. Glove bags can thus provide a flexible, easily installed, and quickly dismantled temporary small work area enclosure that is ideal for small-scale asbestos renovation or maintenance jobs.

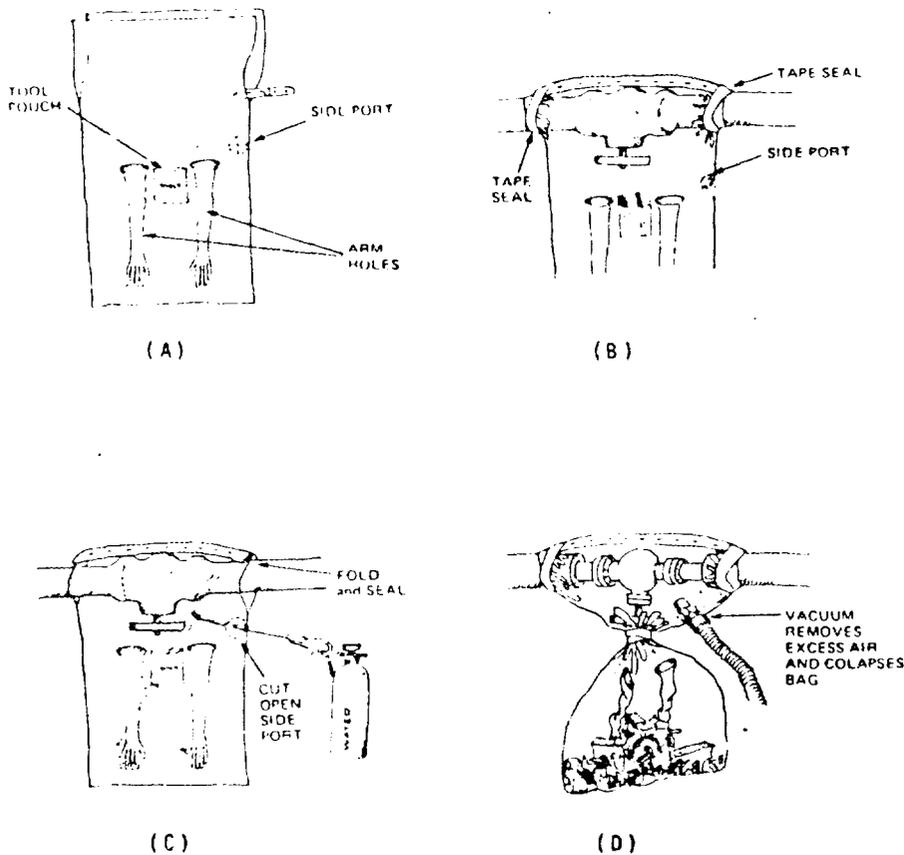


Figure G-1. Diagrams Showing Proper Use of Glove Bags in Small-Scale, Short-Duration Maintenance and Renovation Operations.

These bags are single use control devices that are disposed of at the end of each job. The bags are made of transparent 6-mil-thick polyethylene plastic with arms of Tyvek* material (the same material used to make the disposable protective suits used in major asbestos removal, renovation, and demolition operations and in protective gloves). Glove bags are readily available from safety supply stores or specialty asbestos removal supply houses. Glove bags come pre-labeled with the asbestos warning label prescribed by OSHA and EPA for bags used to dispose of asbestos waste.

Glove Bag Equipment and Supplies. Supplies and materials that are necessary to use glove bags effectively include:

- (1) Tape to seal the glove bag to the area from which asbestos is to be removed;
- (2) Amended water or other wetting agents;
- (3) An airless sprayer for the application of the wetting agent;

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

(4) Bridging encapsulant (a paste-like substance for coating asbestos) to seal the rough edges of any asbestos-containing materials that remain within the glove bag at the points of attachment after the rest of the asbestos has been removed;

(5) Tools such as razor knives, nips, and wire brushes (or other tools suitable for cutting wire, etc.);

(6) A HEPA filter-equipped vacuum for evacuating the glove bag (to minimize the release of asbestos fibers) during removal of the bag from the work area and for cleaning any material that may have escaped during the installation of the glove bag; and

(7) HEPA-equipped dust cartridge respirators for use by the employees involved in the removal of asbestos with the glove bag.

Glove Bag Work Practices. The proper use of glove bags requires the following steps:

(1) Glove bags must be installed so that they completely cover the pipe or other structure where asbestos work is to be done. Glove bags are installed by cutting the sides of the glove bag to fit the size of the pipe from which asbestos is to be removed. The glove

bag is attached to the pipe by folding the open edges together and securely sealing them with tape. All openings in the glove bag must be sealed with duct tape or equivalent material. The bottom seam of the glove bag must also be sealed with duct tape or equivalent to prevent any leakage from the bag that may result from a defect in the bottom seam (Figure G-1(B)).

(2) The employee who is performing the asbestos removal with the glove bag must don a half mask dual-cartridge HEPA-equipped respirator; respirators should be worn by employees who are in close contact with the glove bag and who may thus be exposed as a result of small gaps in the seams of the bag or holes punched through the bag by a razor knife or a piece of wire mesh.

(3) The removed asbestos material from the pipe or other surface that has fallen into the enclosed bag must be thoroughly wetted with a wetting agent (applied with an airless sprayer through the pre-cut port provided in most glove bags or applied through a small hole cut in the bag) (Figure G-1(C)).

(4) Once the asbestos material has been thoroughly wetted, it can be removed from the pipe, beam or other surface. The choice of tool to use to remove the asbestos-containing material depends on the type of material to be removed. Asbestos-containing materials are generally covered with painted canvas and/or wire mesh. Painted canvas can be cut with a razor knife and peeled away from the asbestos-containing material underneath. Once the canvas has been peeled away, the asbestos-containing material underneath may be dry, in which case it should be re-sprayed with a wetting agent to ensure that it generates as little dust as possible when removed. If the asbestos-containing material is covered with wire mesh, the mesh should be cut with nips, tin snips, or other appropriate tool and removed.

A wetting agent must then be used to spray any layer of dry material that is exposed beneath the mesh, the surface of the stripped underlying structure, and the inside of the glove bag.

(5) After removal of the layer of asbestos-containing material, the pipe or surface from which asbestos has been removed must be thoroughly cleaned with a wire brush and wet wiped with a wetting agent until no traces of the asbestos containing material can be seen.

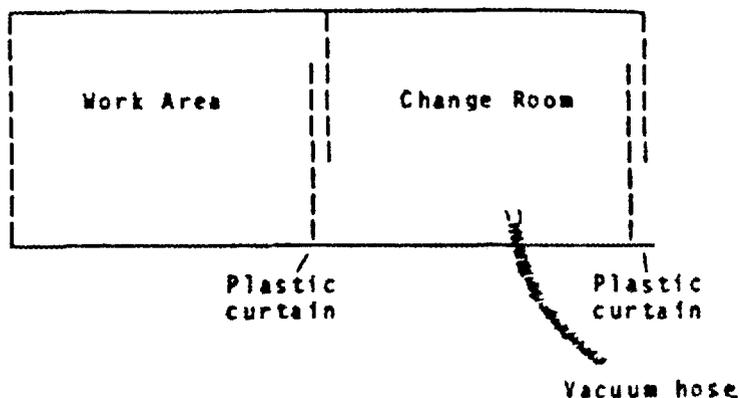
(6) Any asbestos containing insulation edges that have been exposed as a result of the removal or maintenance activity must be encapsulated with bridging encapsulant to ensure that the edges do not release asbestos fibers to the atmosphere after the glove bag has been removed.

(7) When the asbestos removal and encapsulation have been completed, a vacuum hose from a HEPA filtered vacuum must be inserted into the glove bag through the port to remove any air in the bag that may contain asbestos fibers. When the air has been removed from the bag, the bag should be squeezed tightly (as close to the top as possible), twisted, and sealed with tape, to keep the asbestos materials safely in the bottom of the bag. The HEPA vacuum can

then be removed from the bag and the glove

bag itself can be removed from the work area to be disposed of properly (Figure G-1(D)).

Top View



Side View

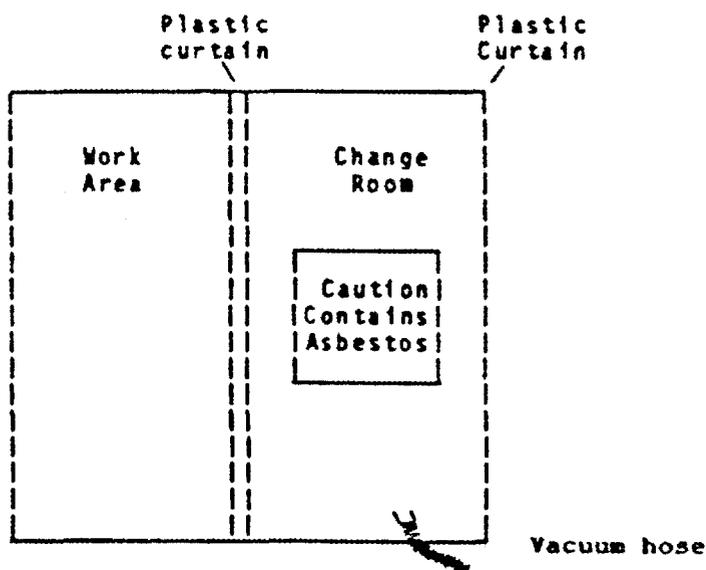


Figure G-2. Schematic of Mini-enclosure

Mini-Enclosures

In some instances, such as removal of asbestos from a small ventilation system or from a short length of duct, a glove bag may not be either large enough or of the proper shape to enclose the work area. In such cases, a mini-enclosure can be built around the area where small-scale, short-duration asbestos maintenance or renovation work is to be performed (Figure G-2). Such an

enclosure should be constructed of 6-mil-thick polyethylene plastic sheeting and can be small enough to restrict entry to the asbestos work area to one worker.

For example, a mini-enclosure can be built in a small utility closet when asbestos-containing duct covering is to be removed. The enclosure is constructed by:

(1) Affixing plastic sheeting to the walls with spray adhesive and tape;

(2) Covering the floor with plastic and sealing the plastic covering the floor to the plastic on the walls;

(3) Sealing any penetrations such as pipes or electrical conduits with tape; and

(4) Constructing a small change room (approximately 3 feet square) made of 6-mil-thick polyethylene plastic supported by 2-inch by 4-inch lumber (the plastic should be attached to the lumber supports with staples or spray adhesive and tape).

The change room should be contiguous to the mini enclosure, and is necessary to allow the worker to vacuum off his protective coveralls and remove them before leaving the work area. While inside the enclosure, the worker should wear Tyvek¹ disposable coveralls and use the appropriate HEPA filtered dual cartridge respiratory protection.

The advantages of mini-enclosures are that they limit the spread of asbestos contamination, reduce the potential exposure of bystanders and other workers who may be working in adjacent areas, and are quick and easy to install. The disadvantage of mini-enclosures is that they may be too small to contain the equipment necessary to create a negative pressure within the enclosure; however, the double layer of plastic sheeting will serve to restrict the release of asbestos fibers to the area outside the enclosure.

Removal of Entire Structures

When pipes are insulated with asbestos-containing materials, removal of the entire pipe may be more protective, easier, and more cost-effective than stripping the asbestos insulation from the pipe. Before such a pipe is cut, the asbestos-containing insulation must be wrapped with 6-mil polyethylene plastic and securely sealed with duct tape or equivalent. This plastic covering will prevent asbestos fibers from becoming airborne as a result of the vibration created by the power saws used to cut the pipe. If possible, the pipes should be cut at locations that are not insulated to avoid disturbing the asbestos. If a pipe is completely insulated with asbestos-containing materials, small sections should be stripped using the glove-bag method described above before the pipe is cut at the stripped sections.

Enclosure

The decision to enclose rather than remove asbestos-containing material from an area depends on the building owner's preference, i.e., for removal or containment. Owners consider such factors as cost effectiveness, the physical configuration of the work area, and the amount of traffic in the area when determining which abatement method to use.

If the owner chooses to enclose the structure rather than to remove the asbestos-containing material insulating it, a solid structure (airtight walls and ceilings) must be built around the asbestos covered pipe or structure to prevent the release of asbestos-containing materials into the area beyond the enclosure and to prevent disturbing these

¹ Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

materials by casual contact during future maintenance operations.

Such a permanent (i.e., for the life of the building) enclosure should be built of new construction materials and should be impact resistant and airtight. Enclosure walls should be made of tongue-and-groove boards, boards with spine joints, or gypsum boards having taped seams. The underlying structure must be able to support the weight of the enclosure. (Suspended ceilings with laid-in panels do not provide airtight enclosures and should not be used to enclose structures covered with asbestos-containing materials.) All joints between the walls and ceiling of the enclosure should be caulked to prevent the escape of asbestos fibers. During the installation of enclosures, tools that are used (such as drills or rivet tools) should be equipped with HEPA-filtered vacuums. Before constructing the enclosure, all electrical conduits, telephone lines, recessed lights, and pipes in the area to be enclosed should be moved to ensure that the enclosure will not have to be re-opened later for routine or emergency maintenance. If such lights or other equipment cannot be moved to a new location for logistic reasons, or if moving them will disturb the asbestos-containing materials, removal rather than enclosure of the asbestos-containing materials is the appropriate control method to use.

Maintenance Program

An asbestos maintenance program must be initiated in all facilities that have asbestos-containing materials. Such a program should include:

- Development of an inventory of all asbestos-containing materials in the facility;
- Periodic examination of all asbestos-containing materials to detect deterioration;
- Written procedures for handling asbestos materials during the performance of small-scale, short-duration maintenance and renovation activities;
- Written procedures for asbestos disposal; and
- Written procedures for dealing with asbestos-related emergencies.

Members of the building's maintenance engineering staff (electricians, heating/air conditioning engineers, plumbers, etc.) who may be required to handle asbestos-containing materials should be trained in safe procedures. Such training should include at a minimum:

- Information regarding types of asbestos and its various uses and forms;
- Information on the health effects associated with asbestos exposure;
- Descriptions of the proper methods of handling asbestos-containing materials; and
- Information on the use of HEPA-equipped dual cartridge respiratory and other personal protection during maintenance activities.

Prohibited Activities

The training program for the maintenance engineering staff should describe methods of handling asbestos-containing materials as well as routine maintenance activities that are prohibited when asbestos-containing materials are involved. For example, maintenance staff employees should be instructed:

- Not to drill holes in asbestos-containing materials;
- Not to hang plants or pictures on structures covered with asbestos-containing materials;
- Not to sand asbestos-containing floor tile;
- Not to damage asbestos-containing materials while moving furniture or other objects;
- Not to install curtains, drapes, or dividers in such a way that they damage asbestos-containing materials;
- Not to dust floors, ceilings, moldings or other surfaces in asbestos-contaminated environments with a dry brush or sweep with a dry broom;
- Not to use an ordinary vacuum to clean an asbestos-containing debris;
- Not to remove ceiling tiles below asbestos-containing materials without wearing the proper respiratory protection, clearing the area of other people, and observing asbestos removal waste disposal procedures;
- Not to remove ventilation system filters dry; and
- Not to shake ventilation system filters.

Appendix H to § 1926.58—Substance Technical Information for Asbestos, Non-Mandatory

I. Substance Identification

A. Substance: "Asbestos" is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysotile, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.

B. Asbestos, tremolite, anthophyllite, and actinolite are used in the manufacture of heat-resistant clothing, automotive brake and clutch linings, and a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet, and fire-resistant drywall. Asbestos, tremolite, anthophyllite, and actinolite are also present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls.

C. The potential for an asbestos-containing product to release breathable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if crumbled. Materials such as vinyl asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken during demolition operations.

D. Permissible exposure: Exposure to airborne asbestos, tremolite, anthophyllite, and actinolite fibers may not exceed 0.2 fibers per cubic centimeter of air (0.2 f/cc) averaged over the 8-hour workday.

II. Health Hazard Data

A. Asbestos, tremolite, anthophyllite, and actinolite can cause disabling respiratory

disease and various types of cancers if the fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these diseases generally do not appear for 20 or more years after initial exposure.

B. Exposure to asbestos, tremolite, anthophyllite and actinolite has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

III. Respirators and Protective Clothing

A. Respirators: You are required to wear a respirator when performing tasks that result in asbestos, tremolite, anthophyllite and actinolite exposure that exceeds the permissible exposure limit (PEL) of 0.2 f/cc. These conditions can occur while your employer is in the process of installing engineering controls to reduce asbestos, tremolite, anthophyllite and actinolite exposure, or where engineering controls are not feasible to reduce asbestos, tremolite, anthophyllite and actinolite exposure. Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos, tremolite, anthophyllite and actinolite fiber concentrations do not exceed 2 f/cc; otherwise, air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos, tremolite, anthophyllite and actinolite work. For effective protection, respirators must fit your face and head snugly. Your employer is required to conduct fit tests when you are first assigned a respirator and every 6 months thereafter. Respirators should not be loosened or removed in work situations where their use is required.

B. Protective Clothing: You are required to wear protective clothing in work areas where asbestos, tremolite, anthophyllite, and actinolite fiber concentrations exceed the permissible exposure limit (PEL) of 0.2 f/cc to prevent contamination of the skin. Where protective clothing is required, your employer must provide you with clean garments. Unless you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, your employer must also provide a change room and separate lockers for your street clothes and contaminated work clothes. If you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, and where it is feasible to do so, your employer must provide a clean room, shower, and decontamination room contiguous to the work area. When leaving the work area, you must remove contaminated clothing before proceeding to the shower. If the shower is not adjacent to the work area, you must vacuum your clothing before proceeding to change the room and shower. To prevent inhaling fibers in contaminated change rooms and showers, leave your respirator on until you leave the shower and enter the clean change room.

IV. Disposal Procedures and Cleanup

A. Wastes that are generated by processes where asbestos, tremolite, anthophyllite, and actinolite is present include:

1. Empty asbestos, tremolite, anthophyllite, and actinolite shipping containers.
2. Process wastes such as cuttings, trimmings, or reject materials.
3. Housekeeping waste from sweeping or vacuuming.
4. Asbestos fireproofing or insulating material that is removed from buildings.
5. Asbestos-containing building products removed during building renovation or demolition.
6. Contaminated disposable protective clothing.

B. Empty shipping bags can be flattened under exhaust hoods and packed into airtight containers for disposal. Empty shipping drums are difficult to clean and should be sealed.

C. Vacuum logs or disposable paper filters should not be cleaned, but should be sprayed with a fine water mist and placed into a labeled waste container.

D. Process waste and housekeeping waste should be wetted with water or a mixture of water and surfactant prior to packaging in disposable containers.

E. Asbestos-containing material that is removed from buildings must be disposed of in leak-tight 6-mil thick plastic bags, plastic-lined cardboard containers, or plastic-lined metal containers. These wastes, which are removed while wet, should be sealed in containers before they dry out to minimize the release of asbestos, tremolite, anthophyllite, and actinolite fibers during handling.

V. Access to Information

A. Each year, your employer is required to inform you of the information contained in this standard and appendices for asbestos. In addition, your employer must instruct you in the proper work practices for handling asbestos-containing materials, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to asbestos. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure, and, if you are exposed above the permissible limit, he or she is required to inform you of the actions that are being taken to reduce your exposure to within the permissible limit.

C. Your employer is required to keep records of your exposures and medical examinations. These exposure records must be kept for at least thirty (30) years. Medical records must be kept for the period of your employment plus thirty (30) years.

D. Your employer is required to release your exposure and medical records to your physician or designated representative upon your written request.

Appendix I to § 1926.56—Medical Surveillance Guidelines for Asbestos, Tremolite, Anthophyllite, and Actinolite, Non-Mandatory

I. Route of Entry

Inhalation ingestion.

II. Toxicology

Clinical evidence of the adverse effects associated with exposure to asbestos, tremolite, anthophyllite, and actinolite, is present in the form of several well-conducted epidemiological studies of occupationally exposed workers, family contacts of workers, and persons living near asbestos, tremolite, anthophyllite, and actinolite mines. These studies have shown a definite association between exposure to asbestos, tremolite, anthophyllite, and actinolite and an increased incidence of lung cancer, pleural and peritoneal mesothelioma, gastrointestinal cancer, and asbestosis. The latter is a disabling fibrotic lung disease that is caused only by exposure to asbestos. Exposure to asbestos, tremolite, anthophyllite, and actinolite has also been associated with an increased incidence of esophageal, kidney, laryngeal, pharyngeal, and buccal cavity cancers. As with other known chronic occupational diseases, disease associated with asbestos, tremolite, anthophyllite, and actinolite generally appears about 20 years following the first occurrence of exposure. There are no known acute effects associated with exposure to asbestos, tremolite, anthophyllite, and actinolite.

Epidemiological studies indicate that the risk of lung cancer among exposed workers who smoke cigarettes is greatly increased over the risk of lung cancer among non-exposed smokers or exposed nonsmokers. These studies suggest that cessation of smoking will reduce the risk of lung cancer for a person exposed to asbestos, tremolite, anthophyllite, and actinolite but will not reduce it to the same level of risk as that existing for an exposed worker who has never smoked.

III. Signs and Symptoms of Exposure-Related Disease

The signs and symptoms of lung cancer or gastrointestinal cancer induced by exposure to asbestos, tremolite, anthophyllite, and actinolite are not unique, except that a chest X-ray of an exposed patient with lung cancer may show pleural plaques, pleural calcification, or pleural fibrosis. Symptoms characteristic of mesothelioma include shortness of breath, pain in the walls of the chest, or abdominal pain. Mesothelioma has a much longer latency period compared with lung cancer (40 years versus 15-20 years), and mesothelioma is therefore more likely to be found among workers who were first exposed to asbestos at an early age. Mesothelioma is always fatal.

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Symptoms include shortness of breath, coughing, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. The diagnosis of asbestosis is based on a history of exposure to asbestos, the presence of characteristics radiologic changes, end-inspiratory crackles (rales), and other clinical features of fibrosing lung disease. Pleural plaques and thickening are observed on X-rays taken during the early stages of the disease. Asbestosis is often a progressive disease even in the absence of continued exposure, although this appears to be a highly

individualized characteristic. In severe cases, death may be caused by respiratory or cardiac failure.

IV. Surveillance and Preventive Considerations

As noted above, exposure to asbestos, tremolite, anthophyllite, and actinolite has been linked to an increased risk of lung cancer, mesothelioma, gastrointestinal cancer, and asbestosis among occupationally exposed workers. Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as a cancer, from exposure to asbestos, tremolite, anthophyllite, and actinolite do not presently exist. However, some tests, particularly chest X-rays and pulmonary function tests, may indicate that an employee has been overexposed to asbestos, tremolite, anthophyllite, and actinolite, increasing his or her risk of developing exposure related chronic diseases. It is important for the physician to become familiar with the operating conditions in which occupational exposure to asbestos, tremolite, anthophyllite, and actinolite is likely to occur. This is particularly important in evaluating medical and work histories and in conducting physical examinations. When an active employee has been identified as having been overexposed to asbestos, tremolite, anthophyllite, and actinolite, measures taken by the employer to eliminate or mitigate further exposure should also lower the risk of serious long-term consequences.

The employer is required to institute a medical surveillance program for all employees who are or will be exposed to asbestos, tremolite, anthophyllite, and actinolite at or above the action level (0.1 fiber per cubic centimeter of air) for 30 or more days per year and for all employees who are assigned to wear a negative-pressure respirator. All examinations and procedures must be performed by or under the supervision of a licensed physician, at a reasonable time and place, and at no cost to the employee.

Although broad latitude is given to the physician in prescribing specific tests to be included in the medical surveillance program, OSHA requires inclusion of the following elements in the routine examination:

- (i) Medical and work histories with special emphasis directed to symptoms of the respiratory system, cardiovascular system, and digestive tract.
- (ii) Completion of the respiratory disease questionnaire contained in Appendix D.
- (iii) A physical examination including a chest roentgenogram and pulmonary function test that includes measurement of the employee's forced vital capacity (FVC) and forced expiratory volume at one second (FEV₁).
- (iv) Any laboratory or other test that the examining physician deems by sound medical practice to be necessary.

The employer is required to make the prescribed tests available at least annually to those employees covered; more often than specified if recommended by the examining physician; and upon termination of employment.

The employer is required to provide the physician with the following information: A copy of this standard and appendices; a description of the employee's duties as they relate to asbestos exposure; the employee's representative level of exposure to asbestos, tremolite, anthophyllite, and actinolite; a description of any personal protective and respiratory equipment used; and information from previous medical examinations of the affected employee that is not otherwise available to the physician. Making this information available to the physician will aid in the evaluation of the employee's health

in relation to assigned duties and fitness to wear personal protective equipment, if required.

The employer is required to obtain a written opinion from the examining physician containing the results of the medical examination; the physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of exposure-related disease; any recommended limitations on the employee or on the use of personal protective equipment; and a statement that the employee has been

informed by the physician of the results of the medical examination and of any medical conditions related to asbestos, tremolite, anthophyllite, and actinolite exposure that require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to exposure to asbestos, tremolite, anthophyllite, and actinolite, and a copy of the opinion must be provided to the affected employee.

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