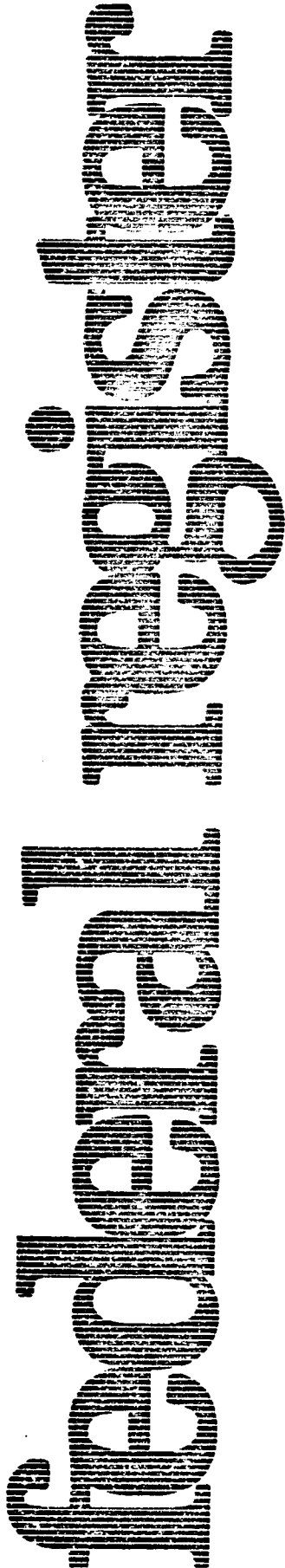


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Friday  
October 30, 1987



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**Part III**

**Environmental  
Protection Agency**

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40 CFR Part 763

**Asbestos-Containing Materials in Schools;  
Final Rule and Notice**

## ENVIRONMENTAL PROTECTION AGENCY

### 40 CFR Part 763

[OPTS-62048E; FRL-3269-8]

#### Asbestos-Containing Materials in Schools

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Final rule.

**SUMMARY:** EPA is issuing a final rule under section 203 of Title II of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2643, to require all local education agencies (LEAs) to identify asbestos-containing materials (ACM) in their school buildings and take appropriate actions to control release of asbestos fibers. The LEAs are required to describe their activities in management plans, which must be made available to all concerned persons and submitted to State Governors. This final rule requires LEAs to use specially-trained persons to conduct inspections for asbestos, develop the management plans, and design or conduct major actions to control asbestos. Exclusions are provided for LEAs which have previously conducted inspections and for LEAs subject to any state requirement at least as stringent as the comparable requirement in this final rule.

**DATES:** In accordance with 40 CFR 23.5, this rule shall be promulgated for purposes of judicial review at 1 p.m. Eastern Standard Time on November 13, 1987. This rule shall be effective on December 14, 1987. The incorporation by reference in the rule is approved by the Director of the Federal Register as of December 14, 1987.

**FOR FURTHER INFORMATION CONTACT:** Edward A. Klein, Director, TSCA Assistance Office (TS-799), Office of Toxic Substances, Environmental Protection Agency, Rm. E-543, 401 M St., SW., Washington, DC 20460, Telephone: (202-554-1404).

#### SUPPLEMENTARY INFORMATION:

##### I. Background

###### A. Description of the Enabling Legislation

On October 22, 1986, President Reagan signed into law the Asbestos Hazard Emergency Response Act (AHERA) which enacted, among other provisions, Title II of the Toxic Substances Control Act (TSCA) 15 U.S.C. sections 2641 through 2654. Section 203 of Title II, 15 U.S.C. 2643, requires EPA to propose rules by April 20, 1987 (180 days after enactment), and

to promulgate final rules by October 17, 1987 (360 days after enactment), regarding: (1) The inspection of all public and private school buildings for ACM; (2) the identification of circumstances requiring response actions; (3) description of the appropriate response actions; (4) the implementation of response actions; (5) the establishment of a reinspection and periodic surveillance program for ACM; (6) the establishment of an operations and maintenance program for friable ACM; (7) the preparation and implementation of asbestos management plans by LEAs and the submission of the management plans to State Governors, who may review the plans and approve or disapprove them; and (8) the transportation and disposal of waste ACM from schools. This final rule implements the Title II requirements to issue the section 203 rules (except for transportation and disposal, as discussed further below).

Section 206 of TSCA Title II, 15 U.S.C. 2646, also requires EPA to issue by April 20, 1987, a final model accreditation plan for persons who inspect for asbestos, develop management plans, and design or conduct response actions. States are required to adopt an accreditation program at least as stringent as the EPA model within 180 days after the beginning of their next legislative session. Accreditation of laboratories which analyze asbestos bulk samples and asbestos air samples is also required by TSCA Title II. The National Bureau of Standards (NBS), U.S. Department of Commerce, is required to establish the bulk sampling accreditation program by October 17, 1987, and the air sampling accreditation program by October 12, 1988.

States were required to notify LEAs by October 17, 1987, regarding where to submit management plans. LEAs must submit those plans to their State no later than October 12, 1988. The plans must include the results of school building inspections and a description of all response actions planned, completed, or in progress. After receiving a management plan, States are allowed 90 days to disapprove the plan. If the plan is disapproved, the State must provide a written explanation of the disapproval and the LEA must revise the plan within 30 days to conform with the State's suggested changes. The 30-day period can be extended to 90 days by the State. LEAs are required to begin implementation of their management plans by July 9, 1989, and to complete implementation in a timely fashion.

Transport and disposal rules under TSCA section 203(h) have not yet been proposed. In accordance with TSCA

section 204(f), therefore, LEAs shall provide for transportation and disposal of asbestos in accordance with the most recent version of EPA's "Asbestos Waste Management Guidance." Applicable provisions of that document are included as Appendix D of this rule. Regulations governing transport of asbestos-containing waste, including school waste already regulated by the National Emission Standard for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61, Subpart M) under the Clean Air Act (42 U.S.C. section 7401, et seq.), were promulgated by the Department of Transportation (DOT) (49 CFR Part, 173 Subpart J). The NESHAP and DOT rules must be followed, according to the "Asbestos Waste Management Guidance." These rules will be sufficient to ensure the proper loading and unloading of vehicles and to ensure the physical integrity of containers.

Section 203(1) requires Department of Defense schools to carry out asbestos identification, inspection and management activities in a manner comparable to the manner in which an LEA is required to carry out such activities. EPA interprets the language of this section which states that such activities shall be carried out "to the extent feasible and consistent with the national security" as recognition that existing agreements with foreign governments may make it difficult to carry out certain provisions of this regulation.

Since this rule has been signed by the EPA Administrator by October 17, 1987, the rule has been promulgated within the statutory time frame required by section 203 of TSCA Title II. In accordance with 40 CFR 23.5, however, solely for purposes of judicial review deadlines under section 19 of TSCA Title I, the rule is considered to be promulgated at 1 p.m. eastern time, 14 days after publication in the **Federal Register**. Thus, the period in which petitions for review of this rule may be filed under section 19 commences 14 days after publication.

##### B. Previous EPA Asbestos Activities

EPA has undertaken a variety of technical assistance and regulatory activities designed to control ACMs in buildings and minimize inhalation of asbestos fibers.

**1. Technical Assistance Program.** Since 1979, EPA staff have assisted schools and other building owners in identifying and controlling ACM in their buildings. Through a cooperative agreement with the American Association of Retired Persons (AARP), EPA has hired architects, engineers, and

other professionals to provide on-site assistance to school officials and other building owners. With AARP assistance, many school officials and building owners have effectively and safely dealt with ACM in ways that are appropriate for the particular situation in their building.

In addition, EPA has published state-of-the-art guidance to help identify and control asbestos in buildings. EPA's principal asbestos guidance document, "Guidance for Controlling Asbestos-Containing Materials in Buildings," (EPA 560/5-85-024, also known as the "Purple Book") was expanded and updated in June 1985, based on recommendations from recognized national experts. The document provides criteria for building owners to use in deciding which abatement method is most appropriate for each particular situation.

An important EPA goal has been to provide training for people involved in all aspects of the identification and control of asbestos. EPA has established five Asbestos Information and Training Centers to provide information concerning the identification and abatement of asbestos hazards and to train people in proper asbestos abatement techniques. The five centers are located at the Georgia Institute of Technology in Atlanta, the University of Kansas in Kansas City, Tufts University in Medford, Massachusetts, the University of Illinois in Chicago, and the University of California at Berkeley. Courses attended by more than 8,000 building owners and managers, maintenance personnel, school officials, architects, consultants, and abatement contractors have been taught at the centers since December 1984.

Finally, because of the large number of asbestos abatement projects and the short-term nature of many of them, EPA believes that contractors should be State-certified and that States should oversee projects to ensure that they are properly performed. EPA has provided models for State certification legislation and start-up funding for the initiation of 38 State oversight programs.

2. *EPA's regulatory program.* In the Federal Register of May 27, 1982 (47 FR 23360), EPA issued a school identification and notification rule (hereinafter called the 1982 Asbestos-in-Schools Rule). This rule required school officials by June 28, 1983, to inspect all school buildings for friable materials, take a minimum of three samples of each type of friable material found, analyze samples using polarized light microscopy (PLM) to determine if asbestos is present, and keep records of

the findings. (40 CFR Part 763, Subpart F)

School district officials who found friable ACM were required to notify employees of the location of the materials, post a notification form in the primary administrative and custodial offices and faculty common rooms, provide maintenance and custodial employees with a guide for reducing asbestos exposure, and notify parent-teacher associations or parents directly of the inspection results.

EPA also issued a rule to protect public employees who perform asbestos abatement work in those States not covered by the current asbestos standard issued by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor. This rule (40 CFR Part 763, Subpart G) complements the OSHA asbestos regulations that protect private sector workers, and public employees in States with OSHA-approved State plans, from exposure to asbestos in occupational settings. The rule requires specific work practices, personal protective equipment, environmental monitoring, medical exams, and other provisions. The EPA rule also includes a provision not in the OSHA rule, i.e., notification to EPA generally 10 days before an asbestos abatement project is begun when public employees are doing the work. OSHA issued revised regulations regarding occupational asbestos exposure published in the Federal Register of June 20, 1986 (51 FR 22612). EPA issued in the Federal Register of February 25, 1987 (52 FR 5618), a revision of its worker protection rule to make it consistent with the new OSHA regulations.

3. *Recent developments.* EPA issued an Advance Notice of Proposed Rulemaking (ANPR) on August 12, 1986 (51 FR 28914), entitled "Asbestos-Containing Materials in Schools: Inspection, Notification, Management Plans and Technical Assistance." The purpose of this ANPR was to solicit comments on the future direction of EPA's program to reduce risks from asbestos in schools and to solicit information about a variety of technical and policy issues.

Prior to enactment of TSCA Title II, EPA had also initiated development of two new guidance documents on asbestos control. One document was being developed to provide more detailed guidance about assessing ACM in buildings and selecting abatement actions. A second document was being developed to provide more detailed guidance about practices and procedures which should be included in

an operations and maintenance program. Both documents had been developed with the assistance of panels of national experts who convened in Washington, DC to discuss technical and operational issues associated with these subjects. The work done in these two guidance documents has been valuable in developing provisions of this rule.

Also, in 1986, EPA, in cooperation with the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, published "A Guide to Respiratory Protection for the Asbestos Abatement Industry" to provide practical guidance in the selection and use of respiratory protection to persons who work in asbestos abatement. The "Guide" also provides information relevant to other work activities, such as maintenance or repair, where the exposure to asbestos or the potential for exposure exists. The "Guide" was updated in September 1986 to include the text of the OSHA June 1986 revision of its asbestos standard.

### C. Development of the Rule

The April 1987 proposed rule was developed through the process of regulatory negotiation, an alternative process for developing regulations in which individuals and groups with negotiable interests directly affected by the rulemaking work together with EPA in a cooperative venture to develop a proposed rule by committee agreement. The negotiation group was established as a Federal Advisory Committee and consisted of representatives of national educational organizations, labor unions, asbestos product manufacturers, the environmental community, asbestos abatement contractors, professional associations of architects, consulting engineers, industrial hygienists, States, and EPA.

After an organizational meeting in Washington, DC on January 23, 1987 (announced in the Federal Register of January 13, 1987, 52 FR 1377), the committee was established with 23 interests represented. Meetings were scheduled on February 5 and 6, February 17 and 18, March 9 and 10, March 26 and 27, and April 1 thru 3. During the March 10, 1987, meeting, the plenary session of the Committee accepted two more parties on the committee, one taking a seat representing State attorneys general, the other (representing big city schools) sharing a seat with a previously seated member representing big city schools.

### Members of Negotiating Committee

The members of the negotiating committee and their interest represented are as follows:

1. Allen Abend, Council of Chief State School Officers.
  2. Bill Borwegen, Service Employees International Union/Jordan Barab, American Federation of State, County, and Municipal Employees (school service employees).
  3. Dr. William Brown, Baltimore City Schools/Michael Young, New York City Law Department (big city schools).
  4. Brian Christopher, Committee on Occupational Safety and Health.
  5. Donald Elisburg, Laborers' International Union and Laborers-AGC Education and Training Fund.
  6. Kellen Flannery, Council for American Private Education.
  7. Steve Hays, asbestos abatement engineer.
  8. Jesse Hill, manufacturers of asbestos pipe and block insulation products.
  9. Edward Kealy, National School Boards Association.
  10. Lloyd A. Kelley, Jr., Superintendent of Schools Rutland S.W. Vermont, Supervisory Union (rural schools).
  11. William Lewis, Manufacturers of asbestos surfacing products.
  12. Lynn MacDonald, Sheet Metal Workers International Association.
  13. Claudia Mansfield, American Association of School Administrators.
  14. Roger Morse, American Institute of Architects.
  15. David Ouimette, Colorado Department of Health (States with developing asbestos programs).
  16. Joel Packer, National Education Association.
  17. Robert Percival, Environmental Defense Fund.
  18. Miriam Rosenberg, National PTA.
  19. Paul Schur, Connecticut Department of Health/Dr. Donald Anderson, Illinois Department of Public Health (States with implemented asbestos programs).
  20. Robert Sheriff, American Industrial Hygienists Association.
  21. David Spinazzolo, Association of Wall and Ceiling Industries (asbestos abatement contractors).
  22. Susan Vogt, U.S. E.P.A.
  23. John Welch, Safe Buildings Alliance (former manufacturers of asbestos products).
  24. Margaret Zaleski, National Association of State Attorneys General.
- Facilitation Team and Executive Secretary
- Owen Olpin, Consultant to EPA  
Eileen B. Hoffman, Federal Mediation & Conciliation Services

Kathy Tyson, U.S. E.P.A. (Executive Secretary)

Leah Haygood, The Conservation Foundation

Dan Dozier, Federal Mediation & Conciliation Services

John Wagner, Federal Mediation & Conciliation Services

The committee met in plenary sessions as well as in four work groups. Each work group focused on a cluster of related issues and reported to the plenary on options and recommendations. The plenary retained all decision-making power of the committee and often gave guidance to work groups. Generally, for each day of a plenary session, work groups convened the day before to prepare reports for the plenary. Neutral facilitators were present at all work group and plenary meetings to assist the negotiations in moving forward.

At the end of the 2-month negotiating process on April 3, 1987, and after extensive efforts, the committee was in general agreement on the vast majority of issues before it for the purposes of the proposal. Agreement to solicit further comment about alternatives was often important in developing provisions to be included as proposals. At the close of the negotiations, some items remained at issue and were not subject to universal agreement. These consisted of the following: definitions and response actions for damaged and significantly damaged thermal system insulation ACM (relates to being deemed nonfriable in the inspection section) and damaged and significantly damaged friable surfacing and miscellaneous ACM. Also, the definition of asbestos debris and the nature of cleaning practices (initial and routine) for friable ACBM or damaged or significantly damaged thermal insulation under the operations and maintenance section were still at issue. While extending negotiations beyond April 3, 1987, may well have enabled the committee to resolve these issues, the Congressional April 20, 1987, deadline for issuing a proposed rule precluded this possibility. Although *Federal Register* practices precluded the Agency from highlighting these issues in the text of the proposed rule, the public docket contains a copy of the proposed rule which clearly identifies the sections which contain these unresolved issues.

On April 3, 1987, the facilitators prepared, for members' signatures, statements supporting the use of the agreed-on portions of the regulatory language as a basis for a Notice of Proposed Rulemaking. Members representing 20 of the 24 interests seated

on the committee signed these statements. Members representing 4 of the interests seated on the committee did not sign the statements, due to the status of the unresolved issues described above. Mr. Paul Schur, a corepresentative of states with an implemented asbestos program (an interest that did not sign), signed in an individual capacity. All committee members, signatories and non-signatories alike, retained for themselves and for their constituencies all rights which bear on the rulemaking, including the right to comment fully during the public comment period.

Notably, signatories supporting the agreed-on regulatory language as a basis for a Notice of Proposed Rulemaking did so in considering that language as a whole. The proposed rule's agreed-on language was not necessarily ideal from any one party's perspective.

On April 17, 1987, the EPA Administrator signed the proposed rule developed through the negotiated rulemaking process. The proposed rule and the final Model Accreditation Plan were published in the *Federal Register* of April 30, 1987. EPA's decision to use the results of the negotiated rulemaking process as a basis for a proposed rule was explained in the April 30 document (52 FR 15833).

The 60-day public comment period ended on June 29. During this time period, EPA staff conducted 10 Regional briefings on the proposed rule for State officials and a number of additional briefings for interested parties. These parties included school administrators, school board officials and building owners. At the conclusion of the public comment period, the Agency had received over 170 comments on the proposed rule.

Several comments received by EPA requested the Agency to hold a public hearing on the proposed rule. As a result of these comments, EPA conducted public hearings on August 25 and 26. Over 25 individuals representing a variety of groups testified before EPA. The testimony and transcript from the public hearing were included in the rulemaking's docket.

#### *D. Basis for EPA's Decision*

After consideration of the proposed rule and all the evidence in the rulemaking record, including public comments on the proposed rule, EPA has decided to promulgate a final rule which is like the proposal in most respects. A relatively small number of changes have been made from the proposal to reflect public comments. In a number of cases EPA decided not to

make changes suggested by public comments. The Agency discusses its response either in this preamble or elsewhere in the rulemaking docket.

EPA has determined that the regulations being announced in this edition of the *Federal Register* use the least burdensome methods which protect human health and the environment. This determination is supported by the discussion in this preamble and the entire rulemaking record. EPA adopts as the reasoning supporting its final rule the same basic reasoning in the preamble to the proposed rule (52 FR 15833). The provisions of this rule represent a reasonable way to carry out the statutory responsibilities of TSCA Title II.

EPA's analysis of risk placed in the rulemaking record when the proposed rule was issued shows that asbestos in schools could present a risk of concern and that the measures required by this rule are necessary to protect public health and the environment. EPA, as discussed later in this preamble, continues to rely on that risk analysis for support of the final rule. While there may be a wide divergence of opinion as to the actual health effects from asbestos exposure in schools, EPA believes there is little doubt that the decisionmaking process established by this rule needs to be implemented. This process is based on the responsibility of local officials, with input from the local community and with assistance from specially-trained experts, to develop management plans to implement appropriate measures that will abate the risk of asbestos in particular schools depending upon local circumstances.

This decisionmaking process ensures that the costs associated with this rule will be reasonable while protecting health and the environment. EPA has revised its costs somewhat from the analysis in its proposal, but has not changed its decision that these costs are reasonable. The detailed revisions to the Agency's costs analysis are discussed later in this preamble and in the rulemaking record. All public and private schools will experience the cost of a building walkthrough and visual inspecting, which EPA has determined will not exceed a few hundred dollars per school. Many schools, finding no asbestos, will experience no further costs. Most of the remaining schools that find ACM are expected to implement operations and maintenance programs along with training, periodic surveillance and reinspection. EPA has in fact revised downward the cost of the typical school asbestos program. It is

expected that this cost will be about \$5,530 per school year, a cost that is clearly minimal if there is a possibility that adverse health effects may be avoided. EPA also notes that some portion of the cost of the typical school program will not involve expenditures by the schools but are so-called "opportunity costs." These are costs assigned to the time spent by school employees in carrying out the activities required by the regulation. While these are real costs of the program, EPA expects that many schools will be able to conduct the typical school program through use of existing employees. Thus, the costs of the program will appear to the individual school officials and local communities to be somewhat less than EPA's economic analysis shows.

The decisionmaking process, summarized above and discussed in detail elsewhere in the preamble and rulemaking record, will ensure the reasonableness of other more extensive response actions for particular schools.

## II. Provisions of the Final Rule

### A. Introduction

This unit describes the various provisions of the final rule. The changes to the proposed rule made by the Agency based on comments received during the comment period are noted. Following a discussion of applicable regulatory definitions in Unit B and general responsibilities in Unit C., inspections and reinspections, sampling and analysis, and assessment of materials are discussed in Units D., E., and F., respectively. In Unit G., the major elements of the management plan, availability of the plan, and review of the plan by Governors are discussed.

Unit H. describes requirements for response actions to be taken by LEAs under circumstances described in that section. Unit I. explains requirements for training and periodic surveillance, and Unit J. explains air sampling requirements for determining when a response action has been completed.

Unit K. discusses requirements to use accredited persons to inspect buildings for asbestos, develop management plans, and design or conduct response actions. Requirements to protect abatement workers, custodial and maintenance staff, and building occupants are explained in Unit L.

Waivers for all or part of a State asbestos program are described in Unit M., including information required in the waiver request and the process for granting or denying such waivers. Requirements for recordkeeping and enforcement provisions are described in Units N. and O., respectively.

### B. Definitions

Several important definitions (§ 763.83) are discussed below.

"Asbestos-containing building material (ACBM)" encompasses surfacing ACM, thermal system insulation ACM, and miscellaneous ACM in or on interior parts of the school building. These include specified exterior portions of school buildings that, for the purposes of this rule, may fairly be considered interior parts. EPA focused upon interior building materials because, in the Agency's experience, such materials represent a very large percentage of ACM in schools and appear to pose the greatest hazards to occupants.

The definition of "school building," in the rule however, makes it clear that exterior hallways connecting buildings, porticos, and mechanical system insulation are considered to be in a building and are subject to jurisdiction under TSCA Title II. The Agency believes that these exterior areas, by virtue of the accessibility of the ACM found there, warrant inclusion under the rule. Often, these exterior areas are connected to interior areas and could be considered to be a single homogeneous area in terms of a removal project design.

"Asbestos debris" is defined as pieces of ACM that can be identified by color, texture, or composition. The definition also includes dust, if the dust is determined by the accredited inspector to be asbestos-containing. The Agency included dust in the definition based on public comments.

"Damaged or significantly damaged thermal system insulation ACM" is defined as ACM on pipes, boilers, and other similar components and equipment where the insulation has lost its structural integrity or its covering in whole or in part, is crushed, water-stained, gouged, punctured, missing or not intact such that it is not able to contain fibers. Damage may further be illustrated by occasional punctures, gouges, or other signs of physical injury to ACM; occasional water damage on the protective coverings/jackets; or exposed ACM ends or joints. Asbestos debris originating from adjacent ACBM may also indicate damage. This definition allows that, even though the insulation is marred, scratched or otherwise marked, it may not be, in the judgment of the accredited expert, damaged so as to release fibers. This definition varies from the proposed rule's language by providing more specific guidance on the physical characteristics that may constitute

damage. An accredited inspector shall classify this material based upon a determination of damage or significant damage (§§ 763.85 and 763.88) and an accredited management planner shall recommend in writing appropriate response actions (§ 763.93).

"Damaged friable surfacing ACM" is defined as ACM which has deteriorated or sustained physical injury such that the cohesion of the material or its adhesion to the substrate is inadequate, or which, for any other reason, lacks fiber cohesion or adhesion qualities. Such damage or deterioration may be illustrated by the separation of ACM into layers; separating of ACM from the substrate; flaking, blistering, or crumbling of the ACM surface; water damage; or significant or repeated water stains, scrapes, gouges, mars, or other signs of physical injury on the ACM. Asbestos debris originating from adjacent ACBM may also indicate damage. The definition allows that such surfacing material may show signs of water damage or physical injury without, in the judgment of the accredited expert, always demonstrating a lack of fiber cohesion or adhesion. This definition varies from the proposed rule's language by providing more specific guidance on the physical characteristics that may constitute damage. Accredited experts will classify material based upon a determination of damage and recommend appropriate response actions (§§ 763.85, 763.88, and 763.93).

"Miscellaneous ACM" includes a wide variety of materials in buildings, such as vinyl flooring, fire-resistant gaskets and seals, and asbestos cement. Damage to these materials is defined by the same cohesion and adhesion (if appropriate) properties as surfacing materials. The Agency believes this definition is sufficiently general to provide a reasonable approach to assessing damage to so wide a range of materials.

"Significantly damaged friable surfacing ACM" is defined as material in a functional space where the damage is extensive and severe. (The definition of significantly damaged friable miscellaneous ACM closely parallels the definition for significantly damaged surfacing ACM.) Again, this determination of significant damage will be made by accredited experts (§§ 763.85, 763.88, and 763.93).

This definition is a function of two major factors. The first factor deals with extent, or scope, of damage across a functional space. The Agency, in draft guidance, suggested that damage evenly distributed across one-tenth of a functional space or localized over one-

quarter represented significant damage (See Seventh Draft Report, "Guidance for Assessing and Managing Exposure to Asbestos in Buildings," November 7, 1986, p. 9). This represents a level of damage which a panel of experts, convened by the Agency, believed was generally, although perhaps not always, unreasonable to repair or restore.

The second factor involves the degree or severity of the damage itself. A major delamination of asbestos material, for instance, constitutes damage which is more severe than slight marks or mars. ACM, in the accredited expert's judgment, may be so severely damaged that there is no feasible means of restoring it to an undamaged condition.

Material has potential for significant damage as opposed to only potential for damage if it is subject to major or continuing disturbance, due to factors such as accessibility (i.e., subject to disturbance by school building occupants or workers in the course of the normal activities), or, under certain circumstances, vibration or air erosion. For example, material within reach of students above an entrance is clearly accessible. Thermal system insulation running along the base of a wall in a boiler room is also accessible. Material on the ceiling of a school auditorium, beyond the reach of students, is not. ACM on a high school gymnasium ceiling, which might be reached with basketballs or other objects, is subject to either classification, although an LEA might be well advised in this instance to implement a preventive measure to avoid disturbance.

EPA believes a wide range of "preventive measures" exist. One example is the installation of a stop to prevent a door from striking (and damaging) thermal system insulation ACM behind it. Another might involve restricting access of a corridor with surfacing ACM on a low ceiling, where students continually marred and vandalized the material. The problem of high school students hitting the gym ceiling with basketballs may be eliminated by a policy prohibiting such activities, if it can be effectively implemented. LEAs, in consultation with maintenance staff and, if desired, accredited experts, will identify a variety of creative and effective means of eliminating potential damage or significant damage to ACM.

If, however, such preventive measures cannot be effectively implemented, other response actions, including removal, will be required. The Act is clear that EPA, as part of its rulemaking, direct LEAs to mitigate those circumstances which involve potential for significant damage.

Based on public comments, the Agency added the terms "air erosion" and "vibration" to increase the specificity of the "potential significant damage" definition in the rule.

The "enclosure" definition requiring an airtight, impermeable, permanent barrier around ACBM to prevent the release of asbestos fibers into the air does not contemplate a vacuum-sealed area which is impossible to access. Instead, this definition, based on the National Institute of Building Sciences (NIBS)' "Model Guide Specifications, Asbestos Abatement in Buildings," July 18, 1986, is associated with precise engineering specifications, found in section 09251 and elsewhere in the NIBS' Model Guide, to construct enclosures sufficient to prevent fiber release. Also, this term, from the standpoint of permanence, is not intended to apply to mini-enclosures described in the EPA worker protection rule or Appendix B of the regulation, as these enclosures are used temporarily for repair or abatement activities.

"Functional space" is a term of art used by the accredited expert to appropriately characterize an area as containing "significantly damaged friable surfacing ACM" or "significantly damaged friable miscellaneous ACM." The "functional space" may be a room, group of rooms, or a homogeneous area, as determined appropriate by the accredited expert. Note that the functional space includes the area above a dropped ceiling as well as crawl spaces.

### C. LEA General Responsibilities

The final rule requires LEAs to designate a person to carry out certain duties and ensure that such person receives training adequate to perform the duties.

Section 763.84 requires LEAs to ensure that: (1) Inspections, reinspections, periodic surveillance and response action activities are carried out in accordance with the final rule; (2) custodial and maintenance employees are properly trained as required by this final rule; (3) workers and building occupants are informed annually about inspections, response actions, and post-response action activities including reinspections and periodic surveillance; (4) short-term workers (e.g., telephone repair workers) who may come in contact with asbestos in a school are provided information about locations of asbestos-containing building material (ACBM); (5) warning labels are posted as required by this final rule; and (6) management plans are available for review and that parent, teacher, and

employee organizations are notified of the availability of the plan.

Lastly, LEAs shall consider whether any conflict of interest may arise from the interrelationship among accredited personnel (e.g., the management planner and abatement contractor) used by the LEAs and whether that should influence the LEA's selection of accredited personnel. EPA added this provision after reviewing public comments.

#### *D. Inspections and Reinspections*

1. *Inspections.* Section 763.85 requires LEAs to have an accredited inspector visually inspect all areas of each school building to identify locations of all friable and nonfriable suspected ACBM, determine friability by touching, and either sample the suspected ACBM or assume that suspected materials contain asbestos. The inspector must then develop an inventory of areas where samples are taken or material is assumed to contain asbestos. Finally, the accredited inspector is required to assess the physical condition of friable known or assumed ACBM as required under § 763.88.

2. *Exclusions.* Section 763.99 defines conditions that would exclude an LEA from all or part of the initial inspection. The accredited inspector is a key element in the exclusion process. For all inspection exclusions, areas previously identified as having friable ACM or nonfriable ACM that has become friable have to be assessed as required under § 763.88. All information regarding inspection exclusions shall be placed in the management plan.

Five types of exclusions for LEAs are provided in the final rule. First, LEAs do not need to have an initial inspection conducted in specific areas of a school where ACBM has already been identified. Second, if previous sampling of a specific area of the school indicated that no ACM was present, and the sampling was done in substantial compliance with the final rule, the LEA does not have to perform an initial inspection of that area. Third, LEAs do not have to inspect specific areas of schools where records indicate that all ACM was removed. Fourth, LEAs can receive an inspection exclusion for schools built after October 12, 1980 (the date when management plans are to be submitted to Governors), if no ACBM was specified for use in the school. Fifth, States that receive a waiver from the inspection requirements of the rule can grant exclusions to schools that had performed inspections in substantial compliance with the rule.

3. *Reinspections.* Section 763.85(b) requires LEAs to have accredited inspectors conduct reinspections at least

once every 3 years. The inspector must reinspect all known or assumed ACBM and shall determine by touching whether nonfriable material has become friable since the last inspection. The inspector may sample any newly friable materials or continue to assume the material to be ACM. The inspector shall record changes in the material's conditions, sample locations, and the inspection date for inclusion in the management plan. In addition, the inspector must assess newly friable known or assumed ACBM, reassess the condition of friable known or assumed ACBM, and include assessment and reassessment information in the management plan.

Section 763.85(c) states that thermal system insulation that has retained its structural integrity and that has an undamaged protective jacket or wrap is treated as nonfriable. Based on public comments, EPA changed the wording in this section from "deemed" nonfriable to "treated as" nonfriable.

#### *E. Sampling and Analysis*

1. *Sampling.* Section 763.86 permits the LEA to assume that suspected ACBM is ACM. If the LEA does not assume suspected ACBM to be ACM, the LEA shall use an accredited inspector to collect bulk samples for analysis.

EPA expects that a school is likely to sample only friable suspected ACBM. For nonfriable suspected ACBM, EPA anticipates most schools will assume this material contains asbestos. However, the final rule does not preclude a school from sampling all of its suspected ACBM, both friable and nonfriable. Sampling of friable surfacing materials should follow the guidance provided in the EPA publication "Simplified Sampling Scheme for Friable Surfacing Materials" (EPA 560/5-85-030a). To determine whether an area of surfacing material contains asbestos, sufficient samples shall be taken in a statistically random manner to provide data representative of each homogeneous area being sampled.

In most cases, sampling of thermal system insulation requires an accredited inspector to take at least three randomly distributed samples per homogeneous area. The final rule includes three exceptions to this requirement for sampling of thermal system insulation. First, an accredited inspector can determine through visual inspection that the material is non-ACM (e.g., fiberglass). Second, only one sample is required for patched homogeneous areas of thermal system insulation. Third, an accredited inspector needs to collect an appropriate number of samples to

determine whether cement or plaster tees are ACM.

For friable miscellaneous material or nonfriable suspected ACBM, an accredited inspector must collect bulk samples in an appropriate manner.

2. *Analysis.* Section 763.87 requires analysis of bulk samples by laboratories accredited by NBS. In the period before NBS has developed its accreditation program, laboratories which have received interim accreditation from EPA may be used to analyze samples. The interim program is explained in a notice in the *Federal Register* (52 FR 33470, September 3, 1987). After receiving the sample results, the LEA must consider an area to contain asbestos if asbestos is present in any sample in a concentration greater than 1 percent. Compositing of samples (mixing several samples together) is prohibited.

The 1982 EPA rule "Asbestos in Schools: Identification and Notification", 40 CFR 763, Subpart F, required analysis of bulk asbestos samples by PLM and provides a protocol for analysis in its Appendix A to Subpart F. EPA requires use of the same PLM method for this final rule. As it develops the accreditation process for laboratories performing analysis of bulk samples, NBS will consider whether to change the PLM protocol. If NBS recommends changes, EPA will amend this rule accordingly.

#### *F. Assessment*

Section 763.88 outlines a general assessment procedure to be conducted by an accredited inspector during each inspection or reinspection. The accredited inspector is required to classify ACBM and suspected ACBM assumed to be ACM in the school building into broad categories appropriate for response actions. In addition, after reviewing public comments, the Agency decided to require the inspector to give reasons in the written assessment supporting his classification decisions. Assessment may include a variety of considerations, including the location and amount of material, its condition, accessibility, potential for disturbance, known or suspected causes of damage, or preventive measures which might eliminate the reasonable likelihood of damage. The LEA is directed to select an accredited management plan developer who, after a review of the results of the inspection and the assessment, shall recommend in writing appropriate response actions.

### G. Management Plans

Section 763.93 requires LEAs to develop an asbestos management plan for each school under its administrative control or direction. The plan must be developed by an accredited asbestos management planner. Some of the major components required in the plan include: A description of inspections and response actions; an assurance that accredited persons were used to conduct inspections, develop management plans, and design or conduct response actions; and a plan for reinspection, periodic surveillance, and operations and maintenance.

Each LEA is required to maintain a copy of the management plan in its administrative office, and each school is required to maintain a copy of the school's management plan in the school's administrative office. These plans are to be made available for inspection by the public without cost or restriction. LEAs must notify in writing, parent, teacher, and employee organizations of the availability of management plans upon submission of the plan to the State and at least once each school year. The requirement for written notification was added after the Agency reviewed comments from the public. In addition, based on public comments received on the proposed rule, the Agency has included in the final rule a requirement that in the absence of any such organizations, the LEA shall provide written notice to that group (e.g., parents) of the availability of the management plan.

Section 763.93 requires LEAs to submit their management plans to their States on or before October 12, 1988. Each LEA must begin implementation of its management plan on or before July 9, 1989, and complete implementation of the plan in a timely fashion.

### H. Response Actions

The final rule identifies five major response actions—in § 763.91 operations and maintenance (O&M) and in § 763.90, repair, encapsulation, enclosure and removal—and describes appropriate conditions under which they may be selected by the LEA. The final rule also identifies the steps which shall be taken to properly conduct and complete the response actions.

The LEA is required to select and implement in a timely manner the appropriate response action. The response action selected shall be sufficient to protect human health and the environment. From among the response actions that protect human health and the environment, the LEA

may select the response action that is least burdensome.

LEAs are required to use accredited persons to design or conduct response actions. Section 763.90 specifically provides that nothing in the rule shall be construed to prohibit the removal of ACM from a school building at any time, should removal be the preferred response action of the LEA.

Different response actions are required for each of the five major categories of damaged or potentially damaged ACM. These categories are:

1. Damaged or significantly damaged thermal system insulation ACM.
2. Damaged friable surfacing or miscellaneous ACM.
3. Significantly damaged friable surfacing or miscellaneous ACM.
4. Friable surfacing or miscellaneous ACM, and thermal system insulation ACM which has potential for significant damage; and
5. Friable surfacing or miscellaneous ACM, thermal system insulation ACM which has potential for damage.

In each of the categories above, procedures for appropriately controlling or abating the hazards posed by the ACM are set forth. For damaged or significantly damaged thermal system insulation, the LEA must at least repair the damaged area. If it is not feasible, due to technological factors, to repair the damaged material, it must be removed. Further, the LEA must maintain all thermal system insulation in an intact state and undamaged condition. If damaged friable surfacing or miscellaneous ACM is present, the LEA shall encapsulate, enclose, remove, or repair the damaged area. After selecting the appropriate response actions that protect human health and the environment, the LEA may consider local circumstances, including occupancy and use patterns within the school building, and economic concerns, such as short- and long-term costs. When friable surfacing or miscellaneous ACM is significantly damaged, the LEA must immediately isolate the functional space and then must remove the material in the functional space, unless enclosure or encapsulation would be sufficient to contain fibers.

Response actions for ACM with potential for damage and potential for significant damage emphasize O&M and preventive measures to eliminate the reasonable likelihood that damage will occur. When potential damage is possible, the LEA must at least implement an O&M program. If there is potential for significant damage and preventive measures cannot be effectively implemented, response

actions other than O&M or area isolation may be required.

Section 763.91 requires the LEA to implement an operations, maintenance and repair (O&M) program for any school building in which friable ACM is present or assumed to be present in the building. Any material identified as nonfriable ACM or nonfriable assumed ACM which is rendered or is about to be rendered friable as a result of activities performed in the school building shall be treated as friable. For example, if nonfriable ACM wallboard was about to be sanded, operations and maintenance procedures would be required. The O&M program, which must be documented in the LEA management plan, consists of worker protection (summarized in Unit II.K.), cleaning, operations and maintenance activities (also in Unit II.K.), and fiber release episodes.

An initial cleaning is required, which employs wet methods and is conducted at least once after completion of the inspection and before the initiation of a response action other than an O&M activity. In addition, the rule also requires that an accredited management planner make a written recommendation to the LEA regarding whether additional cleaning is needed. The recommendation on additional cleaning was added to the rule based on public comments.

The final rule requires that O&M activities (other than small-scale, short-duration activities) which disturb asbestos shall be designed and conducted by persons accredited to do such work. (A discussion of what constitutes small-scale, short-duration projects is given in Appendix B to Subpart E.) Finally, procedures are provided for responding to fiber release episodes—the uncontrolled or unintentional disturbance of ACM. For minor episodes (i.e., those involving 3 square or linear feet or less of ACM), basic cleaning and containment practices for O&M staff are listed. For larger amounts, accredited personnel are required to respond.

### I. Training and Periodic Surveillance

The LEA shall ensure that all members of its maintenance and custodial staff receive at least 2 hours of awareness training. The LEA must also ensure that staff who conduct any activities which will disturb ACM receive an additional 14 hours of training. Specific topics to be covered in the 2-hour and 14-hour training courses are listed in § 763.92(a).

Section 763.92(b) requires periodic surveillance to be performed at least



once every 6 months. The LEA may use unaccredited personnel such as custodians or maintenance workers to conduct surveillance activities. Periodic surveillance requires checking known or assumed ACBM to determine if the ACBM's physical condition has changed since the last inspection or surveillance. The date of the surveillance and any changes in the condition of the ACBM must be added to the management plan.

#### *J. Completion of Response Actions*

After performing a thorough visual inspection, air testing is used to determine if a response action has been completed (§ 763.90(i)). Clearance air monitoring will not be required for small-scale, short-duration projects. Phase Contrast Microscopy (PCM) is allowed for response actions involving 260 linear or 160 square feet or less, the amounts used to trigger removal requirements under EPA's NESHAP (40 CFR Part 61, Subpart M).

Section 763.90 requires the use of transmission electron microscopy (TEM) for most removal, enclosure, and encapsulation response actions. Laboratories are to be accredited by the National Bureau of Standards (NBS). Until NBS develops its program, LEAs shall use laboratories that use the interim protocol described in Appendix A to this Subpart E. EPA continues to believe that TEM is the method of choice for air sample analysis because, unlike PCM, TEM analysis can distinguish asbestos from other fibers and detect the small thin fibers found at abatement sites. Therefore the use of TEM will significantly improve the adequacy of cleanup and is recommended over PCM when available. However, due to limited availability of microscopes for air sample analysis and the cost and time associated with TEM analysis, the final rule allows a phase-in period for the TEM requirement. For 2 years after the rule becomes effective, LEAs may choose to use PCM for response actions comprising 3,000 square or 1,000 linear feet or less. For 1 year after this, LEAs may use PCM for clearance of projects of 1,500 square or 500 linear feet or less. LEAs retain full discretion to require use of TEM at any time for any project.

The criterion for determining whether a response action is complete when using PCM will require multiple samples (minimum of five) with clearance allowed only if all of the individual samples are below the limit of reliable quantitation of the PCM method (0.01 fibers/cm<sup>3</sup>). The rule requires persons to use the NIOSH 7400 method for PCM clearance.

The rule has a three-step process for using TEM to determine successful completion of a removal response action. The first step is a careful visual inspection, as mentioned above. The two steps that follow involve a sequential evaluation of the five samples taken inside the worksite and five samples taken outside the worksite. Both sets of samples must be taken at the same time to ensure that atmospheric conditions are the same and that the comparisons are valid. The inside samples are analyzed first. If the average concentration of the inside samples does not exceed the filter background contamination level (discussed in detail in Appendix A to Subpart E), then the removal is considered complete.

Step three is taken if the average concentration of the samples taken inside the worksite are greater than the filter background contamination level. In this case, an encapsulation, enclosure, or removal response action is considered complete when the average of five samples taken inside the worksite is not significantly larger than the average of five samples taken outside the worksite. A statistical comparison using the Z-Test must be used to determine whether the two averages are significantly different. (A discussion on how to compare measured levels of airborne asbestos with the Z-Test is given in Appendix A to Subpart E.) If the concentrations are not significantly different, then the response action is considered complete. If the inside average concentration is significantly higher, recleaning is required and new air samples must be collected and evaluated after the worksite has been cleaned and reinspected.

#### *K. Use of Accredited Persons*

Section 206 of Title II of TSCA requires accreditation of persons who:

1. Inspect for ACM in school buildings.
2. Prepare management plans for such schools.
3. Design or conduct response actions with respect to friable ACM in such schools (other than O&M activities).

Section 206 of Title II of TSCA required EPA to develop a Model Contractor Accreditation Plan by April 20, 1987. The Agency met this deadline and the model plan was published in the *Federal Register* of April 30, 1987 (52 FR 15875). The plan appears as Appendix C to Subpart E. A notice listing EPA approved courses appears elsewhere in this issue of the *Federal Register*.

Persons can receive accreditation from a State that has instituted an

accreditation program at least as stringent as the requirements of the Model Plan. In addition, persons in States that have not yet developed programs at least as stringent as the Model Plan can receive accreditation by passing an EPA-approved training course and exam that are consistent with the Model Plan. The Model Plan requires persons seeking accreditation to take an initial course, pass an examination, and participate in continuing education.

#### *L. Worker and Occupant Protection*

Worker protection requirements for removal, encapsulation and/or enclosure response actions are already in effect under the EPA worker protection rule (40 CFR Part 763, Subpart G); and the OSHA construction standard (29 CFR 1926.58). EPA's NESHAP standard, although designed to protect outdoor air, also provides incidental protection to workers.

Essentially, under § 763.91, the regulation extends coverage of EPA's worker protection rule at 40 CFR 763.121 to maintenance and custodial personnel in schools who perform O&M activities but are not covered by OSHA's construction standard or an asbestos regulation under an OSHA approved State plan. The EPA worker protection rule itself extended the same protections as the OSHA construction standard to asbestos abatement workers who are employees of State and local governments and who are not otherwise covered by OSHA regulation or OSHA approved State plans. This final rule further extends these standards to O&M workers who are LEA employees. These regulations basically establish a Permissible Exposure Limit (PEL) of 0.2 fibers per cubic centimeter (f/cm<sup>3</sup>) over an 8-hour period for abatement project workers exposed to airborne asbestos and an action level of 0.1 f/cm<sup>3</sup> which triggers a variety of worker protection practices. These practices include air monitoring, regulated work areas, engineering and work practice controls, respiratory protection and protective clothing, hygiene facilities and practices, worker training, medical surveillance, and recordkeeping requirements.

As an alternative, however, OSHA's standard allows employers to institute the provisions of its Appendix G in the case of small-scale, short-duration projects rather than comply with the full worker protection standard. Appendix B to Subpart E is an adaptation of OSHA's Appendix G and, thus, allows more flexibility in dealing with minor (small-scale, short-duration) projects.

None of the requirements of the OSHA standard or the EPA worker protection rule would apply if asbestos concentrations are below the action level (0.1 f/cm<sup>3</sup>). There are, however, fairly stringent requirements established by OSHA and adopted by EPA for purposes of this rule to show that levels are below this action level for any activity, including small-scale, short-duration projects. These requirements are discussed in the following paragraphs.

Employers who have a workplace or work operation covered by the EPA worker protection rule must perform initial monitoring to determine the airborne concentrations of asbestos to which employees may be exposed. If employers can demonstrate that employee exposures are below the action level (0.1 f/cm<sup>3</sup>) by means of objective data, then initial monitoring is not required. If initial monitoring indicates that employee exposures are below the PEL, then periodic monitoring is not required.

The exemption from monitoring in § 763.121(f)(2)(iii) of the worker protection rule for employers who have historical monitoring data is included in recognition of the fact that many employers have conducted or are currently conducting exposure monitoring. This exemption would prevent these employers from having to repeat monitoring activity for O&M activities that are substantially similar to previous jobs for which monitoring was conducted.

However, for purposes of this rule, EPA requires that such monitoring data must have been obtained from projects conducted by the employer that meet the following conditions:

1. The data upon which judgments are based are scientifically sound and collected using methods that are sufficiently accurate and precise.
2. The processes and work practices in use when the historical data were obtained are essentially the same as those to be used during the job for which initial monitoring will not be performed.
3. The characteristics of the ACM being handled when the historical data were obtained are the same as those on the job for which initial monitoring will not be performed.
4. Environmental conditions prevailing when the historical data were obtained are the same as for the job for which initial monitoring will not be performed.

When OSHA issued the final asbestos standard on June 20, 1986 (51 FR 22664), it published data from routine facility maintenance which "demonstrates a potential for exposure of maintenance personnel to concentrations exceeding

0.5 f/cm<sup>3</sup> (fibers per cubic centimeter)." OSHA further stated:

With the exception of wet handling, which is feasible in only very limited situations due to problems such as electrical wiring, and the use of HEPA vacuums for the clean-up of any debris generated during maintenance activities, OSHA believes that there do not appear to be any feasible engineering controls or work practices available to reduce these potential exposure to levels below the 0.2 f/cm<sup>3</sup> PEL and that respirators will be required to comply with the 0.2 f/cm<sup>3</sup> PEL.

LEAs are required, under the provisions of § 763.91 of this rule, to ascertain, through monitoring procedures or historic monitoring data, and to document that these levels have not been reached.

Under § 763.91, basic occupant protection requirements are established (regardless of air level) for any O&M activity in a school building which disturbs ACBM. Primarily, access must be restricted, signs posted, and air movement outside the area modified. Necessary work practices shall be implemented to contain fibers, the area shall be properly cleaned after the activity is completed, and asbestos debris must be disposed of in a proper manner.

Section 763.95 requires the LEA to attach warning labels immediately adjacent to any friable and nonfriable ACBM or suspected ACBM in routine maintenance areas, such as boiler rooms, until the material is removed. They shall read, in large size or bright colors, as follows: CAUTION: ASBESTOS. HAZARDOUS. DO NOT DISTURB WITHOUT PROPER TRAINING AND EQUIPMENT.

#### *M. Waiver for State Programs*

Section 763.98 provides a procedure to implement the statutory provision that a State can receive a waiver from some or all of the requirements of the final rule if the State has established and is implementing or intends to implement a program of asbestos inspection and management at least as stringent as the requirements of the final rule. The rule requests specific information to be included in the waiver request submitted to EPA, establishes a process for reviewing waiver requests, and sets forth procedures for oversight and rescission of waivers granted to States.

The final rule requires States seeking waivers to submit requests to the Regional Administrator for the EPA Region in which the State is located. Within 30 days of receiving a waiver request, EPA must determine whether the request is complete. Within 30 days after determining that a request is

complete, EPA will issue in the **Federal Register** a notice that announces receipt of the request and solicit written comments from the public. Comments must be submitted within 60 days. If, during the comment period, EPA receives a written objection to the State's request or a written request for a public hearing, EPA will schedule a public hearing (as is required by TSCA Title II) to be held in the affected State after the close of the comment period. EPA will issue a notice in the **Federal Register** announcing its decision to grant or deny, in whole or in part, a request for waiver within 30 days after the close of the comment period or within 30 days following a public hearing.

#### *N. Recordkeeping*

Section 763.94 requires that LEAs collect and retain various records which are not part of the information submitted to the Governor in the management plan. Records required by the rule include those pertaining to certain events which occur after the submission of the management plan, including: Response actions and preventive measures; fiber release episodes; periodic surveillance; and various operations and maintenance activities. Records required must be maintained in a centralized location in the administrative office of the school and the local education agency.

For each homogeneous area where all ACBM has been removed, the LEA shall retain such records for 3 years after the next reinspection.

#### *O. Enforcement*

TSCA Title II, section 207(a) provides civil penalties of up to \$5,000 per day for violations of Title II of TSCA when an LEA fails to conduct inspections in a manner consistent with the final rule, knowingly submits false information to the Governor, or fails to develop a management plan in a manner consistent with the final rule, knowingly submits false information to the Governor, or fails to develop a management plan in a manner consistent with this rule. TSCA Title II, section 16 provides civil penalties of up to \$25,000 per day for violations of Title I of TSCA when a person other than an LEA violates the final rule. Criminal penalties may be assessed if any violation committed by any person (including a LEA) is knowing or willful.

The rule provides a process for filing complaints by citizens and requires that such complaints be investigated and responded to within a reasonable period

of time consistent with the nature of the violation alleged.

#### *P. Transport and Disposal*

Section 203(h) of TSCA Title II requires EPA to promulgate regulations which prescribe standards for transportation and disposal of asbestos-containing waste material. The final rule on transport and disposal was to be issued by October 17, 1987, as part of the final regulations under TSCA Title II. EPA had planned to use revised NESHAP regulations on disposal of asbestos waste to satisfy the requirements of section 203(h) of Title II. However, completion of the NESHAP revision has been delayed.

Accordingly, under section 204(a) of Title II, LEAs shall carry out the requirements described in section 204(f). Section 204(f) states that "the local education agency shall provide for the transportation and disposal of asbestos in accordance with the most recent version of the Environmental Protection Agency's "Asbestos Waste Management Guidance" (or any successor to such document)." Under TSCA Title I, section 151(D), as amended by AHERA section 3, EPA may enforce the provisions of section 204(f). The chapters of the waste management guidance document which pertain to transport and disposal have been printed in this *Federal Register* notice as Appendix D to Subpart E.

EPA intends to issue the revised asbestos NESHAP as a proposed rule under section 203(h) of TSCA Title II to govern transport and disposal of asbestos waste from schools. Section 204(f) will be in effect until a final rule under section 203(h) is promulgated. Further, EPA also intends that the NESHAP waste disposal rules will ultimately regulate asbestos emissions from waste disposal when they are promulgated.

### **III. Response to Public Comments**

This unit discusses EPA's responses to the most significant issues raised in the comments received from the public. A more comprehensive version of EPA's response to comments received has been placed in the public record.

Comments and responses are organized in this unit according to the relevant section of the regulation.

#### *A. Scope and Purpose*

Comments were received regarding three aspects of the Scope and Purpose section (§ 763.80). Comments from a group of technical practitioners, which included architects, engineers, and consultants involved in asbestos control, suggested that preschool nurseries, colleges, and universities should be

included in the schools covered by the regulation. A second issue raised in the comments recommended that nonfriable materials not be subject to the inspection and management plan requirements of the regulation. Third, many commenters expressed concerns that the October 12, 1988, deadline for submitting management plans to States could not be met.

On all three of these issues, the statutory language of Title II is clear and the regulation reflects the statute. Title II only gives EPA authority to regulate "local education agencies." The definition of "local education agency" in section 202(7) refers only to public and private elementary and secondary schools. Section 203 of Title II requires inspection for "asbestos-containing materials" which includes both friable and nonfriable asbestos (see section 202). Management plan provisions of Title II also refer to "asbestos-containing material." Finally, section 205(a) of Title II specifies that "720 days after enactment" of this title (i.e., October 12, 1988) local education agencies must submit management plans to the Governors of their States. Based on the comments received, EPA is concerned about the ability of LEAs to complete and submit management plans by October 12, 1988. The deadline, however, is prescribed in the statute.

#### *B. Definitions*

1. *Asbestos containing building material.* In general, union groups and education groups urged the incorporation into the rule of all exterior ACM and other asbestos material such as asbestos gloves. Conversely, several school administration groups argued to limit the rule to interior areas only and not to include asbestos gloves and other such materials within the scope of the rule.

TSCA Title II was designed to provide school children and school employees with a safe environment while attending classes or working inside school buildings. The statute in several places specifically authorizes EPA to regulate asbestos "in" school buildings. Furthermore, an extension to all exterior areas would result in only small health benefits since most exterior ACM is enclosed in solid matrices such as cement, is nonfriable, and is not generally disturbed. Dealing with exterior materials would constitute an expensive undertaking for schools in terms of inspection and management plan development for such small health benefits. The Agency believes the proposed rule's coverage of all interior areas and a few specified exterior areas that function similar to interior areas

protects the health of building occupants.

EPA also interprets TSCA Title II as not including nonbuilding asbestos products within the scope of the rule. The definition of friable ACM in the statute (section 202(6)) refers to ACM applied on ceilings, walls, structural members, piping, duct work, or any other part of a building. At no point does the statute cite as examples nonbuilding materials such as asbestos gloves. If certain schools such as vocational schools have other types of asbestos products in their buildings (e.g. automobile brake linings) they may want to voluntarily address these issues in a fashion similar to the AHERA requirements.

2. *Asbestos debris.* A number of commenters have sought to have dust included in the definition of asbestos debris. Some other commenters favor expanding the definition of asbestos debris to include dust in the immediate vicinity of friable ACM. Other commenters representing former asbestos manufacturers and schools argued that dust should not be included as part of the definitions of asbestos debris or as evidence of damage.

The Agency believes that an accredited expert be allowed to exercise judgment in determining whether asbestos fibers or dust constitute damage. EPA believes that accredited experts can determine whether dust has originated from adjacent ACM. The Agency maintains, however, that not all dust in schools is ACM. An accredited person on-the-scene in a school building can make the determination of damage due to the presence of dust based on training and experience. As a result, EPA has included in the final rule's definitions of asbestos debris the flexibility for the accredited inspectors to determine dust to be asbestos containing.

3. *Significantly damaged friable surfacing and miscellaneous ACM.* Many commenters thought that significantly damaged asbestos should be defined to be damage that is either extensive "or" severe, rather than extensive "and" severe as in the proposal. These commenters included education groups and unions. They believe that either condition can pose a significant health threat.

The Agency disagrees with the comments. Significantly damaged friable surfacing and miscellaneous ACM must refer to the most severely damaged areas where the damage is also widespread. Damage that is widespread or only severe is of concern, but should not necessarily require a response

action of the same magnitude as those situations where both are present.

4. *Operations and maintenance.* Many commenters recommended that O&M apply to all ACBM, not just friable ACBM. Some of these commenters were primarily concerned with the need for periodic surveillance of all ACBM, not just friable ACBM as suggested by the proposed rule's definition.

The Agency disagrees with the recommendation to extend O&M to nonfriable ACBM. Section 203(f) states that O&M is for friable ACBM. Periodic surveillance (see section 203(g) and training requirements (see generally section 206), however, apply to all ACM. The final rule makes clear these statutory distinctions. Section 763.91 dealing with O&M refers to friable asbestos and § 763.92 dealing with periodic surveillance and training apply to all ACM (including friable and nonfriable materials).

5. *Potential damage and potential significant damage.* Many groups commented on these definitions. A group representing former asbestos manufacturers argue that the best indicator of potential damage is evidence of past damage. Some union groups and State attorneys general commented that in addition to accessibility, potential significant damage ought to include air erosion and vibration as disturbance factors.

The Agency believes adding the terms air erosion and vibration increases the specificity of the rule and clarifies the original intent of the proposed regulation. As a result, the Agency accepts the comments regarding air erosion and vibration and has added definitions for each of these terms. EPA believes that whether past damage is the best indicator of potential damage is irrelevant to defining potential damage. As asbestos material ages, it may become more susceptible to damage. The Agency, accordingly, believes that all circumstances must be considered in assessing potential damage.

6. *Repair and enclosure.* A sizable number of commenters suggested that EPA change the wording of both of these definitions to require the preventing of fiber release. In the proposed rule, repair "contained" fiber release and enclosure "controlled" fiber release. In addition, another commenter suggested adding the requirements of inaccessibility and permanence for enclosed ACM. One commenter wanted to expand the enclosure definition to account for spray applied enclosures.

EPA agrees with the recommendation regarding fiber release. Preventing fiber release clarifies the intent of the repair definition. An enclosure is an airtight,

impermeable, permanent barrier and as such must by definition prevent the release of fibers.

7. *Vibration and air erosion.* Several commenters suggested these terms be defined in the rule.

EPA agrees with the commenters and has added definitions for both terms.

#### C. LEA Responsibilities

Several issues in this section were commented upon by LEAs, education associations, school administrators and school board groups and state government officials.

Comments were received on the requirement in the proposed rule for the LEA to designate a person to ensure that the requirements of this section are properly implemented. Some commenters felt that this requirement was unnecessary while other commenters felt that the requirement of the proposed rule was sufficiently flexible to allow for differences in size and capabilities of LEAs. Some commenters favored appointment of an asbestos program manager with more stringent training or qualification requirements for that person. EPA has retained for the final rule the requirement for a designee to ensure proper implementation of LEA responsibilities. This approach provides the benefits of having a single overseer for the asbestos program without the added burden of more stringent training or qualification requirements.

Many parties commented on the requirement that LEAs ensure that short-term workers (telephone repair workers, administrators, etc.) who may come in contact with asbestos are "instructed in safe work practices" regarding ACM. Commenters felt that this placed an undue burden on LEAs and that the responsibility for this kind of instruction for short-term workers rests with their employer. EPA agrees with these comments and has eliminated this requirement while retaining the provision that LEAs ensure that short-term workers are provided information about the locations of ACBM.

The potential for conflicts of interest between accredited inspectors, management planners, and persons who design or conduct abatement actions also was discussed by a variety of commenters. Some commenters suggested that EPA should require the accredited persons to sign a conflict of interest statement certifying no party has a financial relationship with other parties involved in the inspection, development of the management plan, or performance of the response action. The Agency recommends that LEAs consider requesting a full financial disclosure

from all potential accredited professions. It may be more efficient for LEAs to use the same firm to conduct the inspections and develop the management plans to promote continuity in the process. However, LEAs should be wary of employing one firm to develop both the management plan and conduct response actions, since the management planner's recommendations about response actions could be influenced by the potential profitability of the recommendation. A similar conflict of interest problem could exist when an abatement firm and an air monitoring firm are directly or indirectly connected. The air monitoring firm could conceivably provide false results that indicate a building is safe for reoccupancy and the abatement contractor has successfully completed the job. EPA has modified the LEA responsibilities section of the rule to specifically state that LEAs must consider conflict of interest issues. However, any resolution of such issues is solely at the discretion of the LEA.

#### D. Inspections and Reinspections

Comments received on this section dealt with three subjects: the scope of the inspection; the standardization of the inspection; and the inspection process itself.

Regarding the scope of the inspection comments were received on whether dormitories should be included in the inspection requirement. EPA concurs with the comments supporting the proposed rule's language including dormitories in the inspection. The Agency believes this is a reasonable extension of the definition of school building since the intent of AHERA is to protect children while attending school. Comments were also received regarding incorporation into the rule of all exterior ACM and other asbestos-containing products. As described in the "Definitions" part of this Unit, EPA believes these additions are unwarranted.

Comments were received regarding the use of a standardized inspection form, and commenters also urged EPA to issue a guidance document for inspectors and management planners. EPA disagrees with comments supporting a mandatory inspection form. The Agency believes LEAs, accredited inspectors, and States should be allowed the flexibility to develop inspection forms to suit their needs. However, EPA is developing a guidance document for LEAs which explains the requirements of this rule, and that document will contain, among other

things, a suggested format for inspection and management plans. In addition, EPA has developed a model course for accreditation of inspectors and management planners which will provide uniform guidance to inspectors and management planners regarding their responsibilities. Further, before any course is offered to accredit inspectors and management planners, it must be reviewed and approved by EPA in accordance with the provisions of the Model Accreditation Plan. This review process will help ensure that inspectors and management planners receive uniform guidance.

The Agency received comments about the requirement for reinspection every 3 years by an accredited inspector. Some commenters supported this requirement, others thought the reinspection should be more frequent, still others felt that the reinspection should be less frequent and that use of an accredited inspector was unnecessary. EPA believes a 3-year reinspection requirement to be conducted by an accredited inspector is necessary. The Agency is concerned that an annual reinspection as suggested by some commenters would prove unduly burdensome to LEAs while providing limited information. The rule provides for periodic surveillance activities at least twice a year to keep track of changes in the ACBM's condition. On the other hand, the Agency believes a reinspection every 5 years is too long a period of time for a school's ACBM not to be checked by an accredited inspector. ACBM could deteriorate substantially over a 5-year period of time. The Agency disagrees with comments suggesting that unaccredited persons should be permitted to perform reinspections. Accredited inspectors will have special training to determine changes in the physical condition of ACBM. The purpose of periodic surveillance, which may be conducted by unaccredited personnel, is to note observable changes in the condition of ACBM. For example, a periodic surveillance check would notice a water leak through an ACBM ceiling. The Agency believes the combination of the semiannual periodic surveillance check and the 3-year reinspection by an accredited inspector provides for adequate scrutiny of ACBM present in schools.

Industry commenters commended the proposed rule for allowing thermal system insulation "that has retained its structural integrity and that has an undamaged protective jacket or wrap that prevents fiber release" to be "deemed" nonfriable for the purposes of this regulation. Others commenters

believed this is a misrepresentation of the true nature of the material, which is still friable under its covering.

The Agency agreed with comments that state friable thermal system insulation cannot properly be "deemed" nonfriable. This constitutes an inaccurate depiction of the true nature of this material. An undamaged jacket on thermal system insulation may be properly seen as an enclosure, which prevents fiber release and reduces hazard, but does not change the characteristics of material friability behind or under the enclosure.

However, while the Agency considers it inappropriate to "deem" or characterize friable thermal system insulation as nonfriable, it is appropriate to "treat" this material as nonfriable. EPA, in its guidance and technical assistance activities, has traditionally treated undamaged friable thermal system insulation as nonfriable, for the purposes of cleaning and other O&M activities.

Accordingly, the regulation at § 763.85(c) has been modified to state that thermal system insulation that has retained its structural integrity and that has an undamaged protective jacket or wrap that prevents fiber release shall be treated as nonfriable.

Ultimately, however, the change in wording does not change the intent of the regulation that thermal insulation that has both an intact protective jacket and has retained structural integrity should be subject to periodic surveillance and preventive measures, and that custodial and maintenance workers must be trained to deal with such material. Furthermore, if the thermal insulation is disturbed or is about to be disturbed such that it would be rendered friable, all applicable O&M and response action provisions will apply. EPA believes that this is consistent with NESHAP, which considers such material to be friable when disturbed or removed.

#### *E. Bulk Asbestos Sample Measurement*

Comments suggested that EPA allow use of electron microscopy and X-ray diffraction (XRD) for the analysis of bulk samples.

For purposes of this rule, PLM will be used for analyzing bulk samples for asbestos. The analytical method to be employed is the EPA "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" (40 CFR 763, Appendix A to Subpart F). EPA feels that the existing EPA PLM protocol is technically sufficient for determining asbestos fiber identity and quantity. Currently, allowance is made in the EPA PLM protocol for additional

determination of a fiber's quantity by XRD. Additionally, validated methods for the use of electron microscopy in bulk asbestos analysis do not exist at this time. New developments in electron microscopy or XRD technology may lead EPA to reconsider the use of these tools for primary analysis at a future time.

A number of comments sought clarification on the laboratory accreditation program. Two laboratory accreditation programs are currently being developed by the NBS for laboratories which analyze bulk and air samples for asbestos. The bulk accreditation program is expected to be operational in early FY89. The air accreditation program is expected to be complete in late FY89.

Until the NBS bulk accreditation program is complete, EPA will establish an interim accreditation program for laboratories which analyze bulk samples by PLM. EPA will provide interim accreditation to laboratories which correctly identify four samples as either asbestos-containing or nonasbestos-containing. EPA announced the availability of this program in the Federal Register of September 3, 1987 (52 FR 33470). The deadline for laboratory participation in the first round was September 30, 1987. A formal listing of the first round of accredited labs will be available in January 1988. Individual laboratories will be informed of their performance by letter in December 1987. Laboratories which did not participate in the first round of accreditation will be considered in the second round of accreditation, which is scheduled for April 1988.

#### *F. Assessment*

One comment regarding assessment of the physical condition of the material by accredited inspectors was that EPA should require accredited inspectors to give reasons for their assessment conclusions. EPA agrees with the comment. This requirement would provide reviewers of management plans at the State level with additional useful information in judging whether the management plan accurately reflects the condition of the school building. The Agency believes the increase in the recordkeeping burden is small. As a result, § 763.80(b) has been changed to require the accredited inspector to give written reasons for the decision to classify ACBM.

Some commenters suggested that management planners should be required to use one assessment method in developing recommendations for LEAs about response actions. These commenters suggested a variety of

algorithms and "decision tree" methods for consideration. Other commenters supported the proposed rule's language to allow various assessment methods. The Agency believes it is not possible to point to one assessment method as most capable of producing an appropriate response action recommendation: there are a number of suitable assessment methods available for use by accredited management planners. EPA's management planner accreditation course will provide instruction about a variety of such methods.

### G. Response Actions

1. *Protection of human health and the environment in response action selection.* Several commenters, particularly several State attorneys general and unions, expressed concern that the structure of the response action subsection allowed costs and other considerations to be granted equal consideration with protecting human health and the environment.

EPA has clarified language in the response action subsection (§ 763.90) to underscore its original intent in the proposed rule that protecting human health and the environment is the prime consideration in selecting an appropriate response action. Comments from the Service Employees International Union were particularly useful in this regard.

The Agency believes its response action approach is consistent with congressional direction to apply the prior and inviolable standard of protecting human health and the environment, and allows the consideration and selection of the least burdensome method only after the overriding health determination is made.

2. *Air monitoring for determining response actions.* Several commenters, primarily from industry, encouraged the establishment of air monitoring standards as the primary basis for hazard assessment. Most commenters, however, supported EPA's position in the proposed rule.

Traditionally, EPA has recommended assessment of asbestos in schools by visual evaluation of qualitative factors such as the material's condition, physical characteristics, and location. A careful examination of physical characteristics of the material, conducted by a trained expert, provides a direct method for determining both the relative degree of hazard and the likelihood of future fiber release.

EPA continues to discourage the use of air monitoring as the primary technique for assessing asbestos hazards, since that method only measures current conditions and

provides no information about potential and future levels of fiber release. Further, when the costs and technical requirements necessary for acquiring truly meaningful air monitoring data are considered, the Agency maintains that assessment of qualitative factors continues to be the appropriate method for assessment of hazards and selection of response actions which protect human health and the environment. However, air monitoring may provide useful supplemental information, when conducted in conjunction with a comprehensive visual inspection.

Several industry commenters proposed that EPA adopt air monitoring standards for damaged and significantly damaged ACM. The levels most often proposed were 0.01 fibers per cubic centimeter ( $f/cm^3$ ) for damaged friable ACM; 0.1  $f/cm^3$  for significantly damaged friable ACM, with fibers longer than 5  $\mu m$  as measured by transmission electron microscopy (TEM) in each case. No commenters, however, provided any substantive rationale for choosing such levels. The Agency believes that such standards used for purposes of assessing asbestos hazards could not ensure protection of human health and the environment as intended by TSCA Title II. As factors to be used in determining whether response actions are necessary, these numerical values provide a false sense of precision regarding the presence and severity of asbestos hazards and the appropriateness of a given response action. For the same reasons cited in the above discussion of the use of air monitoring, the Agency disagrees with the suggestion that a numerical standard is appropriate as the primary criterion for selection of response actions.

3. *Specificity in definitions related to response actions.* Many commenters felt that more objective and definite response action descriptions should be provided by EPA with regard to damage-related definitions and response actions. Some believed that too much discretion was vested in accredited experts, who would be making technical judgments to advise LEA decisions. One comment cited EPA's economic impact analysis of the rule as an illustration of the lack of objectivity of the response action descriptions. In this analysis, EPA's own regional asbestos coordinators varied greatly in their estimates of what percentages of materials in schools in their regions fell into the various damage conditions described in TSCA Title II.

In response to comments, the Agency has added much more illustrative detail to three important definitions—damaged and significantly damaged friable

thermal system insulation ACM; damaged friable miscellaneous ACM; and damaged friable surfacing ACM—which will help accredited experts better identify asbestos hazards in schools. EPA agrees that this language, taken from the preamble of the proposed rule, adds necessary clarification to conditions which may constitute ACM damage and warrant appropriate response actions. These descriptions were not available to Agency regional asbestos coordinators when they gave their estimates of damage in schools. In addition, the extensive training program developed in the rule should achieve much greater consistency in evaluating and assessing asbestos in schools, although perfect consistency will never be achieved.

However, a rigid response action decision structure is not appropriate for this rule, primarily because many asbestos hazard situations are too circumstantial and appropriate response actions are too "hazard specific" to fit neatly into a discrete set of prescriptive categories.

There appears, then, no substitute for the judgment of the accredited management planner, who must recommend appropriate response actions within the general requirements established in § 763.90. That section provides a process by which a range of available choices may be considered by the accredited expert and selected by the LEA to best protect human health and the environment from each particular asbestos hazard in the school.

Under the provisions of the regulation, LEAs may take into account a variety of particular considerations, such as local circumstances, technological feasibility of appropriate response actions, economic considerations, and other relevant factors in selecting the least burdensome method. Such factors, however, may be considered only after the response action has been determined to protect human health and the environment.

Finally, accreditation alone does not imply "expertness." It only assures a suitable and common level of competence and awareness which is necessary for inspection, assessment and response action recommendation. School officials are well-advised to consider a variety of factors, including quality of training, experience, and prior performance of accredited personnel in selecting inspectors, management plan developers, abatement project designers, and contractors for school asbestos projects.

4. *Removal as the "only" appropriate response action for significantly*

*damaged ACM.* Several State attorneys general, among several other commenters, contended that "[I]n cases of significant damage, the only appropriate response is to remove the material, as this is the only action which adequately protects human health and the environment."

EPA disagrees that removal is the only appropriate response in all cases of significantly damaged ACM, particularly thermal system insulation. There may indeed be particular circumstances of significant damage in which removal is both inappropriate and undesirable.

EPA agrees that, particularly with regard to significantly damaged friable miscellaneous and surfacing ACM, isolation of the functional space and removal is often the most appropriate (and possibly, only acceptable) response. Encapsulation, for example, would be an acceptable response action for friable surfacing ACM only under very limited circumstances, given current technology. However, the Agency will not categorically preclude response actions of repair, encapsulation, or enclosure which, under certain circumstances, may also protect human health and the environment.

*5. Implementation of response actions in a timely fashion.* Several commenters asked the Agency to clarify the requirement that appropriate response actions be selected and implemented by LEAs "in a timely fashion," perhaps by establishing time limits for particular actions.

Many of the response action provisions themselves imply timeliness in response. Damaged or significantly damaged thermal system insulation ACM or its covering, for example, must be constantly maintained in an intact state and undamaged condition. In addition, the rule specifies, in the case of significantly damaged friable surfacing or miscellaneous ACM, that LEAs must *immediately* isolate the functional space and restrict access, unless isolation is not necessary to protect human health and the environment.

The Agency does not believe it is able to define "timely fashion" or specify time limits or deadlines in applying such requirements in all cases any better than it is able to prescribe a single response action for every particular damage category. LEAs, in the context of particular asbestos hazards, in consultation with accredited experts and in full view of school-community groups, are responsible for determining appropriate schedules for their asbestos response actions.

However, LEAs should be advised that in providing "a schedule for beginning and completing each preventive measure and response action" as required in § 763.93(e)(6), the LEA is specifying what constitutes implementation of preventive measures and response actions in a timely fashion for that LEA. EPA and State enforcement officials will be monitoring LEA adherence to these schedules to determine whether enforcement actions are warranted against those schools which fail to meet their own deadlines for completing preventive measures and response actions.

*6. Repair for significantly damaged friable thermal system insulation ACM.* Several commenters, State attorneys general and the unions in particular, questioned the efficacy of repair for significantly damaged friable thermal system insulation ACM.

Repair is often successful in preventing fiber release from damaged thermal system insulation and, after assurance that it will protect human health and the environment, an LEA may find repair the least burdensome method of response. Techniques for thermal system insulation ACM repair are well-developed and easily accomplished. Furthermore, the nature of the material makes it especially susceptible to quick remediation with simple techniques.

EPA recognizes that severely damaged friable thermal system ACM may warrant removal to protect human health and the environment, but this is not always the case. If feasible, as determined by the accredited expert, and protective of human health and the environment, repair may be an appropriate response action for this level of damage under particular circumstances. Further, new and emerging repair technologies may offer LEAs new ways to prevent fiber release, protect human health and the environment, and postpone the major disruption often associated with asbestos removal projects until a more appropriate time.

Finally, "feasibility" does *not* imply, as one commenter feared, "repair first, and only if repair is impossible, then remove." There is no predisposition toward repair, but rather a prior consideration of repair feasibility as a check to avoid a major disruption to the material, through removal, if it is not necessary or desirable.

*7. Airborne asbestos fiber measurement for clearance of abatement sites.* EPA has received comments on the use of transmission electron microscopy (TEM), scanning electron microscopy, and phase contrast

microscopy for the analysis of air samples taken for clearance air monitoring. Comments dealt with issues that included the possible uses of each of these analytical methods for clearance air monitoring, as well as issues specific to the use of TEM.

The final rule sets forth TEM as the analytical method to be used for analysis of samples taken for clearance air monitoring although the TEM requirement will be phased-in gradually. EPA convened a committee of leading microscopists from private and Federal laboratories to produce an analytical protocol specific for post-abatement clearance monitoring. Each microscopist had extensive experience in TEM, scanning electron microscopy (SEM), and airborne asbestos analysis. The unanimous conclusion of the microscopists was that, for purposes of clearance air monitoring, TEM was the technique of choice. Consequently, an interim TEM protocol has been formulated for clearance air monitoring of asbestos abatement sites in schools.

EPA chose to require analysis by TEM for four reasons: (1) TEM is capable of measuring the smallest diameter fibers; (2) based on existing, validated methods, a formal protocol has been developed; (3) TEM has been validated by intra- and inter-laboratory comparisons conducted by NBS; and (4) a formal laboratory accreditation program for TEM laboratories is currently under development by the NBS.

Phase Contrast Microscopy (PCM) will be allowed for clearance of small projects (removal of less than 160 ft<sup>2</sup> or 260 linear feet of asbestos) and during a phase-in of the TEM requirement, for clearance of some larger projects. This phase-in period will give laboratories a period of time to acquire and install TEM instruments, and will permit economical clearance of small projects where clearance analysis costs are a significant portion of total abatement costs.

PCM analysis must be made using the latest version of the NIOSH 7400 method. Two other methods of PCM analysis were considered: the OSHA/EPA Reference Method (ORM) and P&CAM 239. The ORM cannot be used for area clearance because it is intended for personal sampling of abatement workers during abatement work clearance following an abatement action. P&CAM 239 will not be allowed since both NIOSH and OSHA have determined that the NIOSH 7400 method is more accurate and reliable.

The PCM method is nonspecific for asbestos and it cannot detect the small

thin fibers found at abatement sites. EPA research data has shown that PCM is often inadequate for post-abatement monitoring of airborne asbestos. These data indicate that sites which were shown to be clean with PCM data were found by TEM data to be still contaminated. Therefore, reoccupancy of sites initially cleared by PCM, and thus, assumed to have been adequately cleaned, may in fact result in exposures to asbestos.

SEM, for purposes of this rulemaking, was determined to be inadequate for building clearance for the following reasons: (1) Currently available methodologies are not validated for the analysis of asbestos fibers; (2) SEM is limited in its ability to identify the crystalline structure of a particular fiber. (SEM analysis is therefore confined to identification of structures by elemental composition and morphology); (3) recent studies conducted by NBS have evaluated several types of scanning electron microscopes and the variability between these instruments. (NBS has found the image contrast of the microscopes is difficult to standardize between individual scanning electron microscopes); and (4) currently no laboratory accreditation program exists for accrediting SEM laboratories. EPA is aware of two methodologies for SEM: a draft method currently in its initial review by the American Society for Testing and Materials (ASTM) and an Asbestos International Association (AIA) protocol. Neither method has been validated. Additionally, NBS has determined that the AIA method has inherent difficulty when examining certain types of asbestos.

Currently, a laboratory accreditation program is in development for TEM by NBS. Additionally, the AIHA PAT Program evaluates laboratories conducting PCM analyses. The NBS has unconditionally stated that it will not formulate a laboratory accreditation program for SEM based on existing methodologies. Until suitable methodologies are developed, EPA will continue to monitor and investigate the progress of SEM methodologies and research for asbestos analysis. New developments in SEM technology may allow SEM to be considered as an acceptable asbestos measurement tool in the future.

Regarding the use of TEM, several commenters suggested that the aspect ratio (length to width) should be extended to 10:1. For the purpose of TEM measurement by the methods in Appendix A, any elongated particle having a minimum length of 0.5  $\mu\text{m}$ , parallel sides, and an aspect ratio

(length to width) of 5:1 or larger is defined as a fiber. This represents a change in the previous EPA proposed TEM methodologies which examine fibers with aspect ratios of 3:1 and above; it follows the direction set by NIOSH in proposing modified counting rules in the 7400 method. It is consistent with the panel of microscopists' observations that asbestos structures have aspect ratios equal to and greater than 5:1 whereas the majority of nonasbestos structures, minerals and particles, for example, gypsum, have aspect ratios of less than 5:1. Analysis of these nonasbestos structures tends to comprise a large portion of the time required for sample analysis. EPA believes that further research is needed to justify the extension of aspect ratio to 10:1. Consequently, for the purpose of TEM building clearance, fibers must have an aspect ratio of at least 5:1.

8. *Phase-in period for TEM.* Several commenters asked that the phase-in period for requiring TEM analysis be lengthened, abbreviated, or eliminated altogether. EPA believes the 3-year phase-in period for requiring TEM for all but the smallest abatement jobs allows commercial laboratories the necessary time to purchase and set up additional TEM instruments. In December 1987, estimates developed by EPA's Office of Research and Development (ORD) indicated that there were approximately 62 commercial laboratories in the country which advertised the ability to perform TEM analysis on airborne asbestos samples. Testimony received during the August 25 and 26 public hearings for this rulemaking as well as information gathered by EPA staff, indicate that many laboratories intended to purchase additional TEM equipment. In addition, several laboratories own more than one transmission electron microscope.

EPA believes that an increased demand for TEM instruments will drive the supply of instruments, and has stipulated the 3-year phase-in to allow commercial laboratories time to react to the increased demand. The Agency believes a shorter phase-in period, or requiring the immediate use of TEM for all jobs would create a substantial burden on schools and laboratories. The delay to clear abatement jobs and the high cost associated with TEM analysis for relatively small jobs would be burdensome. EPA has consequently decided to retain the length and type of phase-in described in the proposed rule.

#### *H. Operations and Maintenance and Worker Protection*

1. *Worker protection and "small-scale-short-duration" activities.* Several

commenters, particularly union groups, advised the Agency to increase worker protection standards and alter the definition and requirements for small-scale, short-duration projects (as defined by Appendix B to Subpart E) prescribed by the Occupational Safety and Health Administration's (OSHA's) and EPA's relevant worker protection regulations. In particular, comments focused on permissible exposure limits (PEL), the allowance of historical air monitoring data, respiratory protection, and the practice of glove bag removal. Other commenters recommended no change, citing OSHA's primacy in this area.

This final regulation, through the provisions of the EPA worker protection rule, extends coverage already in place for O&M workers in private schools under the OSHA construction standard to public sector O&M workers now unprotected in schools. This OSHA standard also includes Appendix B of this rule. LEAs may implement the provisions of Appendix B of the rule instead of the full scope of the EPA/OSHA worker protection regulation when they conduct small-scale, short-duration activities (all of which are presumed to exceed the action level of 0.1 f/cm<sup>3</sup>).

The Agency maintains that OSHA is the most appropriate Federal agency for determining worker protection policy. As noted in the preamble to the proposed rule, EPA believes that OSHA's recently completed worker protection rulemaking, a lengthy and detailed process focused specifically on such issues, is as appropriate to school O&M workers via the EPA worker protection rule as it is to other private sector O&M workers. EPA continues in this belief and no commenters have indicated substantive reasons why the OSHA protections should not be followed.

Therefore, the Agency does not intend to reassess the OSHA determination with respect to issues such as PEL, the use of historical air monitoring data, respiratory protection, and the allowance of glove bag removal. EPA will, however, change the provisions of its worker protection rule (and hence, this regulation) to conform with any modifications subsequently adopted by OSHA.

Finally, with regard to the definition of "small-scale, short-duration" activities, the Agency provides further clarification of the OSHA definition in Appendix B to Subpart E by adding five additional points which may be used to define such projects. EPA believes these additional considerations are instructive



and useful, but will not require their consideration in defining "small-scale, short-duration" activities.

2. *Respiratory protection.* Many organizations, in their comments, advocated the mandatory use of respiratory protection for all operations and maintenance O&M work which might affect asbestos-containing materials ACM.

Once again, the Agency maintains that OSHA is the most appropriate Federal agency for determining worker protection regulations policy, including appropriate respiratory protection, and EPA finds that OSHA's respiratory protection regulations which govern O&M workers in the private sector are equally relevant in schools. EPA does not intend to reassess the OSHA determination in this regard.

However, the regulation does require specific respiratory protection training for all O&M workers who conduct any activities which will result in the disturbance of ACM. Such training must include: (1) Notification of information on the use of respiratory protection as contained in the EPA/National Institute for Occupational Safety and Health (NIOSH) "Guide to Respiratory Protection for the Asbestos Abatement Industry," September 1986 (EPA-560/OPTS-86-001); and (2) hands-on training in the use of respiratory protection.

EPA believes the effect of these training requirements will be to ensure that LEAs determine the appropriate level of protection for its O&M workers and that workers are adequately informed of protection levels and properly trained in respiratory protection practices.

Comments expressed concern that O&M workers could be at risk in situations where peak exposures occur and, thus, may need additional respiratory protection. The comments claim these exposures may exceed OSHA standards and are unpredictable. EPA, however, believes its regulations cover these situations since the regulations provide that respirators shall be supplied in areas where airborne concentrations "can reasonably be expected to exceed permissible limits" 40 CFR 763.121(e) (1) and (4). Since this regulation requires warning labels for asbestos materials (§ 763.95), workers and LEAs should be aware of situations in which asbestos materials will be disturbed to such an extent that respirators may be appropriate.

3. *Right to refuse work.* Several unions provided comments which advanced a proposal to include a right to refuse unsafe or illegal work in the regulation.

EPA believes that the issue of right to refuse work, which is protected under

other labor legislation and worker protection regulations, is more properly addressed by the Department of Labor. This is a general worker protection issue, outside the scope of EPA's expertise. Comments noted that OSHA has promulgated a general regulation affecting an employee's right to refuse work (29 CFR 1977.12(b)(2)) and argue that EPA should extend this safeguard to school workers in the same way the Agency extended other OSHA safeguards to school workers. This point, however, is misplaced. EPA does not believe it should extend general OSHA safeguards to school workers. EPA is not charged with general worker protection, although it is appropriate to extend specific asbestos related standards to school workers.

AHERA section 211(a) does prohibit State or LEA discrimination in any way against someone because that person has provided information relating to a potential violation of the Act or regulation, including a school directive that workers perform unsafe or illegal activities. The Act allows for any employee or representative of employees who believes they have been fired or otherwise discriminated against to apply for review at the Department of Labor under section 11(c) of the Occupational Safety and Health Act.

4. *Routine cleaning.* Several commenters, particularly the State attorneys general and the unions, recommended that the Agency require routine or periodic cleaning in areas with friable ACM, as outlined in the EPA Purple Book.

The Agency has traditionally recommended, as a prudent measure, routine cleaning by wet methods in school areas with asbestos-containing materials, particularly when they are friable. Monthly wet cleaning has been recommended in previous EPA guidance for areas where friable surfacing ACM is present and semiannual wet cleaning is suggested in areas with damaged thermal system insulation ACM.

Other commenters stated the belief that improper cleaning on a regular basis might disturb the material and could actually increase fiber levels in the air. Further, periodic cleaning in limited-access areas, such as pipe tunnels, would not appreciably reduce exposure to school occupants and might actually increase hazard to custodial workers who conduct the cleaning.

EPA is persuaded by the comments that a decision on routine cleaning by the accredited management planner in the context of the particular asbestos hazard is appropriate. The final rule now requires that the accredited management planner shall make a

written recommendation to the LEA regarding the appropriateness and frequency of additional cleaning, which must be included in the management plan.

### *I. Management Plans*

The contents of the management plan were the subject of numerous comments from various parties. In general, commenters urged that the contents of the plan not exceed the items required in the statutory language of Title II. EPA believes that the language of Title II regarding management plans was made very prescriptive to enhance accountability, aid review by States, and improve enforcement of the regulation. The Agency has determined that the additional requirements in the regulation are consistent with the intent of the Act and that the additional information will be useful to parents, employees, accredited persons, State reviewers, and EPA enforcement officials.

The manner in which parents and employees should receive notification about the availability of asbestos management plans was the subject of many comments. In general, LEAs and school administrative groups favored the flexibility provided under the proposed rule, which allowed LEAs to notify parent and employee organizations without specifying the exact form of notification. Other commenters such as educational associations and environmental groups preferred written notification to individual parents and employees as a way of ensuring full awareness of the availability of the plan. EPA has modified this provision of the final rule to require written notification to parent and employee organizations, or, in the absence of such organizations, written public notice regarding plan availability. (Notification in the absence of the organizations could be in the form of a newspaper ad, an article in an LEA newsletter or various other forms.) The change provides a means of notification that should increase awareness of the plan, retain flexibility of LEAs regarding the exact form of the notification, and aid efforts to enforce the notification provisions.

Some commenters suggested that there is no need to notify parents of the availability of the plan. Title II, section 203(i)(5), states that the LEA "shall notify parent, teacher, and employee organizations of the availability of such plan."

Comments were also received regarding the need for an annual notification requirement even though the

plan has not changed since the previous notification. The purpose for the annual notification is to ensure that parents and employees new to the LEA each year have an opportunity to be informed about the availability of the plan. Other commenters suggested that annual notification about the plan should include any asbestos abatement planned for that year, and that the notification requirement be expanded to inform parents whenever actions are taken under the management plans. EPA believes that these ends are achieved in a less burdensome fashion through § 763.84(c), which requires that the LEA inform workers and building occupants, or their legal guardians, at least once each school year about inspections, response actions, and post-response action activities, including periodic surveillance activities that are planned or in progress.

Regarding access to the plan, commenters suggested the plan required to be maintained at the individual school should not be the plan for the entire LEA, but only the plan for that school. The final rule has been clarified to specify that a school needs to have available only that part of the LEA's plan which pertains to that school. Another comment regarding access to the plan came from private school groups interested in limiting access to parents, students, and employees, thereby excluding the general public. EPA believes that this is contrary to Title II, section 203(i)(5), which states that the plan shall be available "for inspection by the public, including teachers, or other school personnel, and parents." Since persons involved with the school are only among those "included" in the public, EPA interprets the statute to preclude limiting access to all other members of the public.

#### *J. State Waivers*

Commenters suggested that the opportunity for a public hearing regarding a State's request for waiver should be granted upon request, rather than in response to a written request which details specific objections, as required in the proposal. EPA believes that by requiring a written statement, it is ensuring that hearings have been requested for a valid reason, thereby discouraging individuals from arbitrarily or capriciously requesting a hearing.

Comments were also received which suggested that documents submitted by States seeking waivers should be made public. State waiver requests will be made available as part of the public record required when EPA issues a notice in the *Federal Register*

announcing receipt of the request and opportunity for public comment.

Commenters suggested that waiver requests from local governments should be permitted. Section 203(m) of Title II is clear in limiting waiver requests to States which have established and are implementing a program of asbestos inspection and management.

Commenters suggested that waivers should be granted to programs which are "substantially equivalent" to the regulation, rather than "at least as stringent." Section 203(m) of Title II clearly states that waivers are to be granted to programs "at least as stringent."

Commenters suggested that States with programs requiring only inspection of friable materials be allowed to seek waivers. The Agency believes that section 203(m) of Title II, which states that EPA "may waive some or all" of the regulatory requirements of Title II allows States which require inspection of friable materials in a manner at least as stringent as section 203 of Title II to be granted a waiver. The LEAs of that State would still be required to comply with the Title II requirements for inspection of nonfriable materials as well as all other Title II requirements for which the State did not have a program at least as stringent.

Other comments on the State waiver provisions will be considered as they are raised in proceedings affecting individual States.

#### *K. Exclusions*

Comments on the proposed exclusion criteria ranged from general support to opposing any exclusions. Some commenters indicated EPA's 1982 rule was frequently not complied with, dealt only with friable ACM, and the inspectors were not required to have accreditation. As a result, these commenters believe few if any exclusions could be granted based on the 1982 rule. Several commenters believe the term "substantial compliance" is vague and unenforceable. In addition, other commenters agreed that the requirement in the proposed rule to assess friable ACM would require inspectors to visually inspect all areas anyway. Lastly, some commenters suggested that requiring an accredited inspector to determine whether the LEA qualifies for an exclusion is too stringent and thus, unreasonable.

TCSA Title II directs the Agency to promulgate regulations which will provide for the exclusion of any area of a school building from the inspection requirements. If LEAs were required to repeat actions conducted properly in the

past, the Agency would place an unnecessary burden on those LEAs and penalize LEAs which made a good faith effort to address asbestos hazards in their building. EPA believes a number of States and localities have developed inspection programs in recent years that are similar to Title II. In addition, LEAs that complied with EPA's 1982 rule could receive an exclusion from part of the final rule's requirements. For example, friable material sampled and found to contain asbestos on the ceiling of the cafeteria would not have to be re-sampled. Although friable ACBM must be assessed even if previously identified, the above example illustrates a savings to the LEA.

"Substantial compliance" allows previous sampling that was done in a random manner with sufficient samples to be adequate to determine no ACBM is present. EPA believes previous adequate inspection and sampling efforts conducted by LEAs should not prove worthless. For example, if a LEA had records that it took three random samples in a 1,500 square foot classroom to comply with EPA's 1982 rule or a State law, and all samples were analyzed negative for asbestos, an accredited inspector may determine that this is sufficient to indicate no asbestos is present even though the current rule would require five samples for the same classroom.

EPA believes only an accredited inspector has the training necessary to determine whether previous inspections and sampling were adequate. EPA has evidence to suggest that many inspections performed under the 1982 rule were conducted by persons with little or no inspection training. If these same individuals were responsible for determining the validity of previous inspections, large areas of schools may not be examined by accredited inspectors. In many respects, this would defeat the purpose of TSCA Title II.

#### *L. Enforcement*

Some commenters stated that the "Compliance and Enforcement" section of the proposed rule (§ 763.97) incorrectly describes the provisions of TSCA Title II and that the final rule should explicitly state the following points. First, LEAs that violate the regulations under Title II are not liable under any enforcement provision of Title I. Second, Title II does not allow EPA to assess penalties against individuals. Third, criminal penalties are not permitted for violation of Title II.

EPA disagrees. The provisions of the "Compliance and Enforcement" section

are in accordance with applicable law, as discussed below.

Section 3 of AHERA, "Technical and Conforming Amendments," amends section 15(1) of TSCA Title I to provide that it is unlawful for any person to fail or refuse to comply with any requirement of TSCA Title II or any rule promulgated or order issued under Title II. Therefore, violations of Title II regulations, published in this document are generally subject to the civil and criminal penalties under section 16 of Title I and to civil injunctive actions under section 17 of Title I. This liability is qualified, however, by section 207 of Title II which describes LEA civil liabilities for violation of regulations and provides that LEAs are not liable for any civil penalty under Title I. Section 207, however, does not alter the criminal liabilities of Title I or the injunctive provisions of section 17 of Title I. Nor does section 207 provide any exemption from Title I provisions for inspectors, management planners or any other person other than an LEA that has responsibilities under TSCA Title II. Finally, regardless of the provisions of TSCA, applicable case law provides that liability for actions of organizations may extend to responsible officials.

Thus the three points noted in the comments are wrong. First, LEAs that violate Title II rules are liable for criminal penalties under section 16 of Title I and are subject to injunctive relief in Federal District Courts under section 17 of Title I. Second, individuals may be liable for violating TSCA Title II regulations. Individuals other than LEAs that violate Title II regulations are subject to any of the penalties under Title I, and responsible LEA officials may be liable for any LEA violation of Title II. Third, the effect of the conforming amendments to TSCA Title I is that criminal penalties may be assessed for violation of Title II.

#### M. Other Issues

##### 1. Cost estimates for inspection.

Several commenters, ranging from school districts to independent consultants, expressed concern that the economic impact analysis of the proposed rule underestimated the cost of inspecting for ACM. Comments claimed that labor rates and time required to conduct inspections were too low.

EPA agreed with these comments. As a result the Agency's estimates for the final rule increased due to an update of unit labor costs and a small increase in the time estimated to perform several inspection activities. As a result the estimated total cost for all inspection activities increased from the proposal to

the final rule from approximately \$58.2 million to approximately \$78.5 million. The cost for the building walkthrough and visual inspection, assessment, and mapping and reporting activities increased, while the cost estimates for bulk sampling and analysis remained the same. The total inspection costs are now estimated to be \$1,144 for public primary schools, \$1,627 for public secondary schools and \$1,587 for private schools.

2. *Cost estimates for management plans.* A number of commenters expressed concern that the proposed rule underestimated the cost of developing management plans due to low assumptions for labor rates and time needed to prepare the plan. EPA also received comments that training and recordkeeping costs were too low. These costs are considered by EPA as part of the cost of the management plan implementation. Several commenters also expressed concern that EPA underestimated the burden associated with the state review of management plans.

EPA agrees that labor costs and time needed to prepare plans were too low in the proposal and has increased these estimates. EPA has also increased the cost for training by raising labor rate estimates and including travel expenses in the cost of training. As a result, the average costs for first year development and implementation of a management plan for a typical school is estimated to be \$3,270 for a public primary school, \$4,521 for a public secondary school and \$4,460 for a private school. The total cost for development and implementation of management plans increased from \$970.8 million in the proposed rule to \$1,272 million in the final rule.

With respect to the cost to States of reviewing management plans, EPA has not substantially changed its estimates. While the proposed rule stated a range of \$63 to \$95 for a State to review a plan, the final rule estimates this cost at approximately \$77. The plan review burden will vary with the different number of schools found in each State. For example, California, with an estimated 10,932 schools, would incur a review cost of roughly \$842,000. Delaware, with an estimated 288 schools, would incur a cost of about \$23,000. States will incur this burden within the 90-day review period specified in the law. The burden for each State, if it must review many plans, may be substantial. However, this burden is imposed by statute.

3. *Costs for operations and maintenance (O&M) programs.* EPA received a comment that it should not

have included a cost for levels of overhead and contingency costs for school O&M programs because schools are not run like a business and would not charge themselves overhead. In addition, the comment argued that EPA's assumed rate of three minor fiber release episodes per school per year was too high. It was also argued that EPA should not have included an opportunity cost associated with O&M work, since schools would not actually spend money on many O&M activities but would redirect their employees' activities. Finally, the commenter identified a mistake in the calculations of the cost of consumable supplies used in O&M programs.

EPA agrees that schools would not incur overhead and contingency costs for O&M work. EPA used these indirect costs to calculate the expenses associated with the incremental utility, payroll, and other expenses attributable to an O&M program. EPA believes that these estimates of indirect rates are reasonable.

EPA slightly modified its assumptions with respect to fiber release episodes. However, this change did not have a significant impact on the total cost of O&M programs.

With respect to using an opportunity cost approach in the calculation of O&M costs, EPA believes that these costs are, indeed, a real cost of conducting O&M. However, the Agency acknowledges that some portion of the O&M cost may not result in actual expenditures by a school if the school chooses to give up some other activity to absorb the additional O&M activity. Regardless of how the school chooses to react, these are costs imposed by the rule. Accordingly, the Agency has included the opportunity costs analysis in the final rule estimates.

EPA acknowledges its mistake in the cost of consumables and has adjusted the O&M costs accordingly. This yields a fairly substantial drop in per school annual expenses for O&M programs. The reason for the decrease in O&M costs noted below is almost entirely due to this decrease in cost of consumables.

The final rule's costs of O&M programs per school on a yearly basis (excluding the cost of special equipment acquisition) are now estimated to be \$3,800 for a public primary school, \$5,100 for a public secondary school and \$3,800 for a private school. The total O&M costs have decreased from \$525.4 million in the proposal to \$292.7 million for the final rule.

4. *Costs for removal, enclosure and encapsulation projects.* Commenters argued that cost estimates in the

proposal for removal projects were incorrect because they assumed replacement costs and post-abatement air monitoring for asbestos materials removed during building demolition. These errors have been corrected in the final cost estimates.

In addition, EPA assumed in the proposal that all post-response action air samples would be analyzed using TEM. Since the rule allows limited PCM, the costs of response actions have decreased accordingly. This cost decrease is approximately \$4,000 in direct expenses per project for those projects using PCM.

Total costs for removal, enclosure and encapsulation projects have decreased from \$1,587.8 million in the proposal to \$1,431 million in the final rule.

5. *Risk related to asbestos in buildings.* Comments argued that EPA did not adequately assess the evidence relating to the harm caused by asbestos in schools. Specifically, they claim that EPA's assessment of risk for this rule (1) did not consider estimates of the toxicological potency of asbestos developed by a number of scientists who disagree with the potency estimates accepted by the Agency; (2) ignored studies showing that prevailing exposure to asbestos in schools has often been measured at levels far below those assumed by the Agency in its assessment (70 to 500 ng/m<sup>3</sup>); and (3) did not consider documentation that asbestos exposures after major abatement, especially removal, may not be reduced at all and may even be elevated. Had such evidence been considered, according to one of these comments (Safe Buildings Alliance), EPA would have come to the conclusion that operations and maintenance programs are, in almost all schools, the appropriate response action to protect health and the environment. This evidence is cited to support the position that protection of health and the environment requires specification of an airborne exposure level of protection.

EPA disagrees that the evidence cited in these comments supports the need for an airborne asbestos standard in buildings. Rather, EPA believes that the data cited by these comments, even if assumed to be correctly interpreted by the commenters, supports the rule as promulgated.

The Agency has noted elsewhere in this preamble the problems with air monitoring as the primary assessment tool for asbestos in schools. Furthermore, no comments have provided any substantive health based justification for choosing any airborne level as an appropriate level to protect public health from asbestos in schools.

Nevertheless, EPA believes that the rule accomplishes the goals of these commenters to ensure that unnecessary removal activities do not occur. Indeed, one of these commenters (Safe Buildings Alliance) specifically stated that it believes removals could typically be the response action if the rules were *incorrectly* applied. The rules, however, are not designated to prefer one response action over another, but to allow schools the flexibility to deal with their particular situations. Certainly, asbestos in many schools may not present significant risks in its current condition, but could cause considerable harm if not dealt with properly. Also, there are plainly schools in which serious measures would be needed immediately. In this context the evidence cited by the comments is supportive of EPA's rule, as discussed below.

With respect to the potency of asbestos, EPA has decided that for purposes of this rule there is no need to resolve the divergence of opinion. See preamble to Proposed Rule, 52 FR 15033. In any event, EPA has considered differing views on asbestos health effects in other proceedings (see, e.g., 51 FR 3728 *et seq.*, January 29, 1986) and commenters have not presented new evidence. The important point for purposes of this rule, is that varying local circumstances will drive the decision on the appropriate response action.

With respect to asbestos exposure, EPA acknowledges that many building air measurements show low prevailing levels. However, peak levels during serious disturbances can be extremely high and may cause very serious risks to individuals involved. Regardless of the actual average measurements in all schools, regardless of whether one accepts the levels used by EPA in its assessment or the levels presented by the commenters, the basic structure of the rule should not be changed. Assessment of all the evidence leads to the conclusion that local educational agencies should at least adopt operations and maintenance programs and institute more serious response actions if local conditions warrant. The levels EPA used in its risk assessment are actual measurements (see, e.g. "Measuring Airborne Asbestos Levels in Buildings," EPA 560/13-80-026; "Airborne Asbestos Levels in Schools," EPA 560/5-83-003) and are reasonable for purposes of decisionmaking in the context of this rule. In any event, the lower airborne asbestos levels cited by the commenters do not make the case for an airborne regulatory level.

Finally, EPA interprets data on airborne levels of asbestos before and after removal actions differently from the commenters. The information available on airborne concentrations before and after asbestos removal is actually limited, dealing with a very small number of abatement actions. Nevertheless, EPA believes that this information indicates that, in the past, some abatement actions were not done properly and led to increased airborne levels. The rule, therefore, was designed to prevent shoddy abatement work. A draft report prepared by Batelle (March 1987) shows significant reduction in airborne asbestos concentrations in the enclosed abatement area in schools immediately after removal operations. Airborne levels measured in the Batelle study did increase back to approximately the same as pre-removal levels after school resumed (based on a statistical analysis of pre- and post-removal levels). However, these levels could only have been the result of reentrainment of asbestos from outside the immediate removal area. Removals, thus, were successful at the removal site but could not guarantee no fiber release from asbestos-containing materials remaining in the building. The Batelle draft, therefore, does not show an increase in exposure from the removal activities as suggested by the comments. At the very least, removal reduced some danger of peak exposures. The data in the Batelle draft may indicate a need for continuing O&M programs following abatement, particularly where all asbestos is not removed.

6. *Model accreditation plan.* EPA received comments about the provisions of the Model Accreditation Plan required under section 206 of TSCA Title II. Under Title II, the Agency was required to submit a final Model Accreditation Plan by April 20, 1987. The final plan was issued by EPA in accordance with that deadline. The final plan appeared in the *Federal Register* of April 30, 1987, entitled "Asbestos-Containing Material in Schools; Model Accreditation Plan."

#### IV. Economic Impact

The economic impact analysis estimates the incremental costs attributable to the proposed regulation, including costs of inspection, sampling, development, and implementation of management plans, training of school employees, periodic surveillance, and the implementation of abatement actions. Estimates of the number of schools affected and square footage of asbestos were developed based on the 1984 EPA survey of asbestos in schools

and data compiled from the Asbestos School Hazard Abatement Act (ASHAA) loan and grant program. Estimates of the percentage of asbestos which falls into each of the hazard categories were based on the results of a survey of the EPA's Regional Asbestos Coordinators (RACs).

Using a model school/model project approach, costs of inspection, sampling, and appropriate response actions were developed for schools with ACM in each of the different hazard categories. For schools with only nonfriable ACM, the only costs estimated were for management plan implementation, nominal plan implementation activities, training of the asbestos program manager, custodial training for proper repair and maintenance of ACM, and the periodic surveillance and reinspection of ACM. For purposes of the economic analysis, EPA assumed that all schools with only nonfriable ACM would choose to forego sampling and instead just treat suspect material as asbestos-containing.

Asbestos abatement-related costs expected to be incurred regardless of the existence of these regulations were subtracted from the total costs to calculate only the incremental cost of the final regulations. For example, data from the ASHAA loan and grant application data base were used to project an average annual rate of removal of asbestos that is assumed would have occurred even if TSCA Title II legislation and these regulations were not promulgated. That average annual rate was estimated to be approximately 3.4 percent for primary schools, 3.3 percent for secondary schools, and 1.8 percent for private schools. The costs associated with this underlying rate of removal were subtracted from the total costs. Also, the costs of removal of friable ACM prior to demolition that is required by the NESHAPs regulations were also netted out of the total costs.

The estimated present value of the costs of these final regulations is approximately \$3,145 million (using a 10 percent discount rate) over 30 years. This includes the cost of initial inspection and sampling—\$78.5 million; development and implementation of management plans—\$1,272 million; periodic surveillance—\$47.7 million; reinspection—\$23.2 million; special operations and maintenance programs—\$292.7 million; and abatement response actions—\$1,431 million.

The total number of primary and secondary schools potentially affected by these regulations is estimated to be 106,983. Approximately 44,600 are estimated to have about 213 million square feet of surfacing or thermal

systems insulation ACM. Of these, an estimated 10,700 have surfacing ACM only. It is likely that every school contains some amount of nonfriable ACM such as floor tile, transite board, and fire doors.

The cost of an asbestos inspection is estimated to range from \$1,144 to \$1,627 per school for schools with both surfacing and thermal systems insulation ACM. This cost varies depending upon the size of the school, the amount and type of ACM contained in the school, and the type of professional doing the work. The costs of sampling and analysis if friable materials are found will depend upon the number of samples taken and analyzed. Costs of analysis are estimated to range from \$25 to \$47 per sample. Assuming the average school has to analyze 20 samples, the cost of analysis will be \$500 to \$940 per school. The cost of mapping ACM is estimated to range from \$110 to over \$270 per school.

The cost of developing a management plan if asbestos-containing surfacing ACM or thermal systems insulation ACM is present is estimated to range from \$1,025 for an average-size public primary school to \$1,420 for an average-size public secondary school. These estimates are weighted averages of the costs of plans developed by trained school personnel and by outside consultants. A less extensive management plan would be required for schools containing only nonfriable materials. The average development cost for a management plan where only nonfriable materials are present is estimated to be about \$500 for both public primary and private schools, and about \$715 for public secondary schools.

The cost of training for school employees involves a variety of factors ranging from course and accreditation exam fees to the possible expenses for any out of town travel required for the training. The estimated course fee for a 2-hour awareness session required of all school maintenance employees in schools with ACM is approximately \$50 per person. The additional 14 hours of training for school maintenance workers who may come in contact with asbestos in doing minor repair and maintenance work that disturbs asbestos is estimated to cost \$250. A fee of \$420 is estimated for the 24 hours of training required for the certification of asbestos abatement workers doing more than just minor repair and small glove-bag removal jobs. The fee for the 40-hour training course and certification required for asbestos abatement contractors is estimated to be \$640.

Response action costs depend primarily on the condition of the asbestos in a school and to a lesser extent on many other factors. In general, for surfacing ACM in all but the significantly damaged category, it is likely that the primary response action undertaken by a school will be special O&M activities. Use of O&M activities would likely continue until or unless the ACBM deteriorates to a "significantly damaged" condition. The annual cost of a special O&M program (excluding acquisition of special equipment) is estimated to range from \$3,800 for a typical public primary school to \$5,100 for a typical public secondary school. Initial cleaning costs are expected to range from \$950 to \$1,400.

The cost of removal depends upon many factors including size of the project. The estimated cost of removal for a 4,000 ft<sup>2</sup> project in which surfacing material is removed would be approximately \$51,300. The cost of removal for a 900 ft<sup>2</sup> boiler wrap project is estimated to be approximately \$30,900. The total discounted costs of response actions were estimated assuming schools undertake a combination of response actions that depend on the condition of the ACM.

## V. Rulemaking Record

EPA has established a record for this rulemaking (docket control number OPTS-62048E). The record is available in the Office of Toxic Substances Public Information Office, from 8 a.m. to 4 p.m. Monday through Friday, except legal holidays. The Public Information Office is located in Rm. NE-G004, 401 M St., SW., Washington, DC.

The record includes information considered by EPA in developing the proposed and final rules. The record now includes the following categories of information:

1. Federal Register notices.
2. Support documents.
3. Reports.
4. Memoranda and letters.
5. Records of the negotiating committee.
6. Public comments received on the proposed rule.
7. Response to comments document.
8. Transcript of the August 25 and 26 Public Meeting.

EPA requests that any person who commented on this rule submit to the Agency in writing any information which such person believes shows there are errors or omissions in the record. EPA will evaluate such submissions and supplement the record as appropriate.

## VI. References

1. USEPA. "Guidance for Controlling Asbestos-Containing Materials in Buildings." EPA 560/5-85-024, June 1985.
2. USEPA. "A Guide to Respiratory Protection for the Asbestos Abatement Industry." EPA 560/OPTS-86-001, September 1986.
3. USEPA. "Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials." EPA 560/5-85-030a, October 1985.
4. USEPA. Friable Asbestos-Containing Materials in Schools. 40 CFR Part 763, Subpart F.
5. USEPA. National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M.
6. USDOL. OSHA. Occupational Exposure to Asbestos, 29 CFR 1926.58.
7. USEPA. Toxic Substances; Asbestos Abatement Projects, 40 CFR Part 763, Subpart G.

## VII. Regulatory Assessment Requirements

### A. Executive Order 12291

Under Executive Order 12291, EPA has determined that this rule is a "major" rule and has developed a Regulatory Impact Analysis. EPA has prepared an economic impact analysis of the TSCA Title II regulations.

### B. Regulatory Flexibility Act

EPA has analyzed the economic impact of this rule on small businesses. EPA's analysis of the economic consequences of this rule appears in Unit IV.

### C. Paperwork Reduction Act

The reporting and recordkeeping provisions in this rule have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, and has been assigned OMB control number 2070-0091.

### List of Subjects in 40 CFR Part 763

Asbestos, Environmental protection, Hazardous substances, Incorporation by reference, Occupational health and safety, Recordkeeping, Schools.

Dated: October 17, 1987.

Lee M. Thomas,  
Administrator.

Therefore, 40 CFR Part 763 is amended as follows:

### PART 763—(AMENDED)

1. The authority citation for Part 763 continues to read as follows:

**Authority:** 15 U.S.C. 2605 and 2607(c). Subpart E also issued under 15 U.S.C. 2641, 2643, 2646, and 2647.

2. By adding §§ 763.80 through 763.99 and Appendices A, B, and D to Subpart E to read as follows:

#### Subpart E—Asbestos-Containing Materials in Schools

Sec.	
763.80	Scope and purpose.
763.83	Definitions.
763.84	General local education agency responsibilities.
763.85	Inspection and reinspections.
763.86	Sampling.
763.87	Analysis.
763.88	Assessment.
763.90	Response actions.
763.91	Operations and maintenance.
763.92	Training and periodic surveillance.
763.93	Management plans.
763.94	Recordkeeping.
763.95	Warning labels.
763.97	Compliance and enforcement.
763.98	Waiver; delegation to State.
763.99	Exclusions.
Appendix A to Subpart E—Interim Transmission Electron Microscopy Analytical Methods—Mandatory and Nonmandatory—and Mandatory Section to Determine Completion of Response Actions	
Appendix B to Subpart E—Work Practices and Engineering Controls for Small-Scale, Short-Duration Operations Maintenance and Repair (O&M) Activities Involving ACM	
* * * * *	
Appendix D to Subpart E—Transport and Disposal of Asbestos Waste	

#### § 763.80 Scope and purpose.

(a) This rule requires local education agencies to identify friable and nonfriable asbestos-containing material (ACM) in public and private elementary and secondary schools by visually inspecting school buildings for such materials, sampling such materials if they are not assumed to be ACM, and having samples analyzed by appropriate techniques referred to in this rule. The rule requires local education agencies to submit management plans to the Governor of their State by October 12, 1988, begin to implement the plans by July 9, 1989, and complete implementation of the plans in a timely fashion. In addition, local education agencies are required to use persons who have been accredited to conduct inspections, reinspections, develop management plans, or perform response actions. The rule also includes recordkeeping requirements. Local education agencies may contractually delegate their duties under this rule, but they remain responsible for the proper performance of those duties. Local education agencies are encouraged to consult with EPA Regional Asbestos Coordinators, or if applicable, a State's lead agency designated by the State

Governor, for assistance in complying with this rule.

(b) Local education agencies must provide for the transportation and disposal of asbestos in accordance with EPA's "Asbestos Waste Management Guidance." For convenience, applicable sections of this guidance are reprinted as Appendix D of this subpart. There are regulations in place, however, that affect transportation and disposal of asbestos waste generated by this rule. The transportation of asbestos waste is covered by the Department of Transportation (49 CFR Part 173, Subpart J) and disposal is covered by the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61, Subpart M).

#### § 763.83. Definitions.

For purposes of this subpart:

"Act" means the Toxic Substances Control Act (TSCA), 15 U.S.C. 2601, *et seq.*

"Accessible" when referring to ACM means that the material is subject to disturbance by school building occupants or custodial or maintenance personnel in the course of their normal activities.

"Accredited" or "accreditation" when referring to a person or laboratory means that such person or laboratory is accredited in accordance with section 206 of Title II of the Act.

"Air erosion" means the passage of air over friable ACBM which may result in the release of asbestos fibers.

"Asbestos" means the asbestiform varieties of: Chrysotile (serpentine); crocidolite (riebeckite); amosite (cummingtonitegrunerite); anthophyllite; tremolite; and actinolite.

"Asbestos-containing material" (ACM) when referring to school buildings means any material or product which contains more than 1 percent asbestos.

"Asbestos-containing building material" (ACBM) means surfacing ACM, thermal system insulation ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a school building.

"Asbestos debris" means pieces of ACBM that can be identified by color, texture, or composition, or means dust, if the dust is determined by an accredited inspector to be ACM.

"Damaged friable miscellaneous ACM" means friable miscellaneous ACM which has deteriorated or sustained physical injury such that the internal structure (cohesion) of the material is inadequate or, if applicable, which has delaminated such that its bond to the substrate (adhesion) is

inadequate or which for any other reason lacks fiber cohesion or adhesion qualities. Such damage or deterioration may be illustrated by the separation of ACM into layers; separation of ACM from the substrate; flaking, blistering, or crumbling of the ACM surface; water damage; significant or repeated water stains, scrapes, gouges, mars or other signs of physical injury on the ACM. Asbestos debris originating from the ACBM in question may also indicate damage.

"Damaged friable surfacing ACM" means friable surfacing ACM which has deteriorated or sustained physical injury such that the internal structure (cohesion) of the material is inadequate or which has delaminated such that its bond to the substrate (adhesion) is inadequate, or which, for any other reason, lacks fiber cohesion or adhesion qualities. Such damage or deterioration may be illustrated by the separation of ACM into layers; separation of ACM from the substrate; flaking, blistering, or crumbling of the ACM surface; water damage; significant or repeated water stains, scrapes, gouges, mars or other signs of physical injury on the ACM. Asbestos debris originating from the ACBM in question may also indicate damage.

"Damaged or significantly damaged thermal system insulation ACM" means thermal system insulation ACM on pipes, boilers, tanks, ducts, and other thermal system insulation equipment where the insulation has lost its structural integrity, or its covering, in whole or in part, is crushed, water-stained, gouged, punctured, missing, or not intact such that it is not able to contain fibers. Damage may be further illustrated by occasional punctures, gouges or other signs of physical injury to ACM; occasional water damage on the protective coverings/jackets; or exposed ACM ends or joints. Asbestos debris originating from the ACBM in question may also indicate damage.

"Encapsulation" means the treatment of ACBM with a material that surrounds or embeds asbestos fibers in an adhesive matrix to prevent the release of fibers, as the encapsulant creates a membrane over the surface (bridging encapsulant) or penetrates the material and binds its components together (penetrating encapsulant).

"Enclosure" means an airtight, impermeable, permanent barrier around ACBM to prevent the release of asbestos fibers into the air.

"Fiber release episode" means any uncontrolled or unintentional disturbance of ACBM resulting in visible emission

"Friable" when referring to material in a school building means that the material, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure, and includes previously nonfriable material after such previously nonfriable material becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure.

"Functional space" means a room, group of rooms, or homogeneous area (including crawl spaces or the space between a dropped ceiling and the floor or roof deck above), such as classroom(s), a cafeteria, gymnasium, hallway(s), designated by a person accredited to prepare management plans, design abatement projects, or conduct response actions.

"High-efficiency particulate air" (HEPA) refers to a filtering system capable of trapping and retaining at least 99.97 percent of all monodispersed particles 0.3  $\mu\text{m}$  in diameter or larger.

"Homogeneous area" means an area of surfacing material, thermal system insulation material, or miscellaneous material that is uniform in color and texture.

"Local education agency" means:

(1) Any local educational agency as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 3381).

(2) The owner of any nonpublic, nonprofit elementary, or secondary school building.

(3) The governing authority of any school operated under the defense dependents' education system provided for under the Defense Dependents' Education Act of 1978 (20 U.S.C. 921, et seq.).

"Miscellaneous ACM" means miscellaneous material that is ACM in a school building.

"Miscellaneous material" means interior building material on structural components, structural members or fixtures, such as floor and ceiling tiles, and does not include surfacing material or thermal system insulation.

"Nonfriable" means material in a school building which when dry may not be crumbled, pulverized, or reduced to powder by hand pressure.

"Operations and maintenance program" means a program of work practices to maintain friable ACBM in good condition, ensure clean up of asbestos fibers previously released, and prevent further release by minimizing and controlling friable ACBM disturbance or damage.

"Potential damage" means circumstances in which:

(1) Friable ACBM is in an area regularly used by building occupants,

including maintenance personnel, in the course of their normal activities.

(2) There are indications that there is a reasonable likelihood that the material or its covering will become damaged, deteriorated, or delaminated due to factors such as changes in building use, changes in operations and maintenance practices, changes in occupancy, or recurrent damage.

"Potential significant damage" means circumstances in which:

(1) Friable ACBM is in an area regularly used by building occupants, including maintenance personnel, in the course of their normal activities.

(2) There are indications that there is a reasonable likelihood that the material or its covering will become significantly damaged, deteriorated, or delaminated due to factors such as changes in building use, changes in operations and maintenance practices, changes in occupancy, or recurrent damage.

(3) The material is subject to major or continuing disturbance, due to factors including, but not limited to, accessibility or, under certain circumstances, vibration or air erosion.

"Preventive measures" means actions taken to reduce disturbance of ACBM or otherwise eliminate the reasonable likelihood of the material's becoming damaged or significantly damaged.

"Removal" means the taking out or the stripping of substantially all ACBM from a damaged area, a functional space, or a homogeneous area in a school building.

"Repair" means returning damaged ACBM to an undamaged condition or to an intact state so as to prevent fiber release.

"Response action" means a method, including removal, encapsulation, enclosure, repair, operations and maintenance, that protects human health and the environment from friable ACBM.

"Routine maintenance area" means an area, such as a boiler room or mechanical room, that is not normally frequented by students and in which maintenance employees or contract workers regularly conduct maintenance activities.

"School" means any elementary or secondary school as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 2854).

"School building" means:

(1) Any structure suitable for use as a classroom, including a school facility such as a laboratory, library, school eating facility, or facility used for the preparation of food.

(2) Any gymnasium or other facility which is specially designed for athletic

or recreational activities for an academic course in physical education.

(3) Any other facility used for the instruction or housing of students or for the administration of educational or research programs.

(4) Any maintenance, storage, or utility facility, including any hallway, essential to the operation of any facility described in this definition of "school building" under paragraphs (1), (2), or (3).

(5) Any portico or covered exterior hallway or walkway.

(6) Any exterior portion of a mechanical system used to condition interior space.

"Significantly damaged friable miscellaneous ACM" means damaged friable miscellaneous ACM where the damage is extensive and severe.

"Significantly damaged friable surfacing ACM" means damaged friable surfacing ACM in a functional space where the damage is extensive and severe.

"State" means a State, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Northern Marianas, the Trust Territory of the Pacific Islands, and the Virgin Islands.

"Surfacing ACM" means surfacing material that is ACM.

"Surfacing material" means material in a school building that is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

"Thermal system insulation" means material in a school building applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain, or water condensation, or for other purposes.

"Thermal system insulation ACM" means thermal system insulation that is ACM.

"Vibration" means the periodic motion of friable ACBM which may result in the release of asbestos fibers.

#### **§ 763.84 General local education agency responsibilities.**

Each local education agency shall:

(a) Ensure that the activities of any persons who perform inspections, reinspections, and periodic surveillance, develop and update management plans, and develop and implement response actions, including operations and maintenance, are carried out in accordance with Subpart E of this part.

(b) Ensure that all custodial and maintenance employees are properly

trained as required by this Subpart E and other applicable Federal and/or State regulations (e.g., the Occupational Safety and Health Administration asbestos standard for construction, the EPA worker protection rule, or applicable State regulations).

(c) Ensure that workers and building occupants, or their legal guardians, are informed at least once each school year about inspections, response actions, and post-response action activities, including periodic reinspection and surveillance activities that are planned or in progress.

(d) Ensure that short-term workers (e.g., telephone repair workers, utility workers, or exterminators) who may come in contact with asbestos in a school are provided information regarding the locations of ACBM and suspected ACBM assumed to be ACM.

(e) Ensure that warning labels are posted in accordance with § 763.95.

(f) Ensure that management plans are available for inspection and notification of such availability has been provided as specified in the management plan under § 763.93(g).

(g)(1) Designate a person to ensure that requirements under this section are properly implemented.

(2) Ensure that the designated person receives adequate training to perform duties assigned under this section. Such training shall provide, as necessary, basic knowledge of:

(i) Health effects of asbestos.

(ii) Detection, identification, and assessment of ACM.

(iii) Options for controlling ACBM.

(iv) Asbestos management programs.

(v) Relevant Federal and State regulations concerning asbestos, including those in this Subpart E and those of the Occupational Safety and Health Administration, U.S. Department of Labor, the U.S. Department of Transportation and the U.S. Environmental Protection Agency.

(h) Consider whether any conflict of interest may arise from the interrelationship among accredited personnel and whether that should influence the selection of accredited personnel to perform activities under this subpart.

#### **§ 763.85 Inspection and reinspections.**

(a) *Inspection.* (1) Except as provided in paragraph (a)(2) of this section, before October 12, 1988, local education agencies shall inspect each school building that they lease, own, or otherwise use as a school building to identify all locations of friable and nonfriable ACBM.

(2) Any building leased or acquired on or after October 12, 1988, that is to be

used as a school building shall be inspected as described under paragraphs (a) (3) and (4) of this section prior to use as a school building. In the event that emergency use of an uninspected building as a school building is necessitated, such buildings shall be inspected within 30 days after commencement of such use.

(3) Each inspection shall be made by an accredited inspector.

(4) For each area of a school building, except as excluded under § 763.99, each person performing an inspection shall:

(i) Visually inspect the area to identify the locations of all suspected ACBM.

(ii) Touch all suspected ACBM to determine whether they are friable.

(iii) Identify all homogeneous areas of friable suspected ACBM and all homogeneous areas of nonfriable suspected ACBM.

(iv) Assume that some or all of the homogeneous areas are ACM, and, for each homogeneous area that is not assumed to be ACM, collect and submit for analysis bulk samples under §§ 763.86 and 763.87.

(v) Assess, under § 763.88, friable material in areas where samples are collected, friable material in areas that are assumed to be ACBM, and friable ACBM identified during a previous inspection.

(vi) Record the following and submit to the person designated under § 763.84 a copy of such record for inclusion in the management plan within 30 days of the inspection:

(A) An inspection report with the date of the inspection signed by each accredited person making the inspection, State of accreditation, and if applicable, his or her accreditation number.

(B) An inventory of the locations of the homogeneous areas where samples are collected, exact location where each bulk sample is collected, dates that samples are collected, homogeneous areas where friable suspected ACBM is assumed to be ACM, and homogeneous areas where nonfriable suspected ACBM is assumed to be ACM.

(C) A description of the manner used to determine sampling locations, the name and signature of each accredited inspector who collected the samples, State of accreditation, and, if applicable, his or her accreditation number.

(D) A list of whether the homogeneous areas identified under paragraph (a)(4)(vi)(B) of this section are surfacing material, thermal system insulation, or miscellaneous material.

(E) Assessments made of friable material, the name and signature of each accredited inspector making the



assessment, State of accreditation, and if applicable, his or her accreditation number.

(b) *Reinspection.* (1) At least once every 3 years after a management plan is in effect, each local education agency shall conduct a reinspection of all friable and nonfriable known or assumed ACBM in each school building that they lease, own, or otherwise use as a school building.

(2) Each inspection shall be made by an accredited inspector.

(3) For each area of a school building, each person performing a reinspection shall:

(i) Visually reinspect, and reassess, under § 763.88, the condition of all friable known or assumed ACBM.

(ii) Visually inspect material that was previously considered nonfriable ACBM and touch the material to determine whether it has become friable since the last inspection or reinspection.

(iii) Identify any homogeneous areas with material that has become friable since the last inspection or reinspection.

(iv) For each homogeneous area of newly friable material that is already assumed to be ACBM, bulk samples may be collected and submitted for analysis in accordance with §§ 763.86 and 763.87.

(v) Assess, under § 763.88, the condition of the newly friable material in areas where samples are collected, and newly friable materials in areas that are assumed to be ACBM.

(vi) Reassess, under § 763.88, the condition of friable known or assumed ACBM previously identified.

(vii) Record the following and submit to the person designated under § 763.84 a copy of such record for inclusion in the management plan within 30 days of the reinspection:

(A) The date of the reinspection, the name and signature of the person making the reinspection, State of accreditation, and if applicable, his or her accreditation number, and any changes in the condition of known or assumed ACBM.

(B) The exact locations where samples are collected during the reinspection, a description of the manner used to determine sampling locations, the name and signature of each accredited inspector who collected the samples, State of accreditation, and, if applicable, his or her accreditation number.

(C) Any assessments or reassessments made of friable material, the name and signature of the accredited inspector making the assessments, State of accreditation, and if applicable, his or her accreditation number.

(c) *General.* Thermal system insulation that has retained its structural

integrity and that has an undamaged protective jacket or wrap that prevents fiber release shall be treated as nonfriable and therefore is subject only to periodic surveillance and preventive measures as necessary.

#### § 763.86 Sampling.

(a) *Surfacing material.* An accredited inspector shall collect, in a statistically random manner that is representative of the homogeneous area, bulk samples from each homogeneous area of friable surfacing material that is not assumed to be ACM, and shall collect the samples as follows:

(1) At least three bulk samples shall be collected from each homogeneous area that is 1,000 ft<sup>2</sup> or less, except as provided in § 763.87(c)(2).

(2) At least five bulk samples shall be collected from each homogeneous area that is greater than 1,000 ft<sup>2</sup> but less than or equal to 5,000 ft<sup>2</sup>, except as provided in § 763.87(c)(2).

(3) At least seven bulk samples shall be collected from each homogeneous area that is greater than 5,000 ft<sup>2</sup>, except as provided in § 763.87(c)(2).

(b) *Thermal system insulation.* (1) Except as provided in paragraphs (b) (2) through (4) of this section and § 763.87(c), an accredited inspector shall collect, in a randomly distributed manner, at least three bulk samples from each homogeneous area of thermal system insulation that is not assumed to be ACM.

(2) Collect at least one bulk sample from each homogeneous area of patched thermal system insulation that is not assumed to be ACM if the patched section is less than 6 linear or square feet.

(3) In a manner sufficient to determine whether the material is ACM or not ACM, collect bulk samples from each insulated mechanical system that is not assumed to be ACM where cement or plaster is used on fittings such as tees, elbows, or valves, except as provided under § 763.87(c)(2).

(4) Bulk samples are not required to be collected from any homogeneous area where the accredited inspector has determined that the thermal system insulation is fiberglass, foam glass, rubber, or other non-ACBM.

(c) *Miscellaneous material.* In a manner sufficient to determine whether material is ACM or not ACM, an accredited inspector shall collect bulk samples from each homogeneous area of friable miscellaneous material that is not assumed to be ACM.

(d) *Nonfriable suspected ACBM.* If any homogeneous area of nonfriable suspected ACBM is not assumed to be ACM, then an accredited inspector shall

collect, in a manner sufficient to determine whether the material is ACM or not ACM, bulk samples from the homogeneous area of nonfriable suspected ACBM that is not assumed to be ACM.

#### § 763.87 Analysis.

(a) Local education agencies shall have bulk samples, collected under § 763.86 and submitted for analysis, analyzed for asbestos using laboratories accredited by the National Bureau of Standards (NBS). Local education agencies shall use laboratories which have received interim accreditation for polarized light microscopy (PLM) analysis under the EPA Interim Asbestos Bulk Sample Analysis Quality Assurance Program until the NBS PLM laboratory accreditation program for PLM is operational.

(b) Bulk samples shall not be composited for analysis and shall be analyzed for asbestos content by PLM, using the "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" found at Appendix A to Subpart F in 40 CFR Part 763.

(c)(1) A homogeneous area is considered not to contain ACM only if the results of all samples required to be collected from the area show asbestos in amounts of 1 percent or less.

(2) A homogeneous area shall be determined to contain ACM based on a finding that the results of at least one sample collected from that area shows that asbestos is present in an amount greater than 1 percent.

(d) The name and address of each laboratory performing an analysis, the date of analysis, and the name and signature of the person performing the analysis shall be submitted to the person designated under § 763.84 for inclusion into the management plan within 30 days of the analysis.

#### § 763.88 Assessment.

(a)(1) For each inspection and reinspection conducted under § 763.85 (a) and (c) and previous inspections specified under § 763.99, the local education agency shall have an accredited inspector provide a written assessment of all friable known or assumed ACBM in the school building.

(2) Each accredited inspector providing a written assessment shall sign and date the assessment, provide his or her State of accreditation, and if applicable, accreditation number, and submit a copy of the assessment to the person designated under § 763.84 for inclusion in the management plan within 30 days of the assessment.

(b) The inspector shall classify and give reasons in the written assessment for classifying the ACBM and suspected ACBM assumed to be ACM in the school building into one of the following categories:

- (1) Damaged or significantly damaged thermal system insulation ACM.
- (2) Damaged friable surfacing ACM.
- (3) Significantly damaged friable surfacing ACM.
- (4) Damaged or significantly damaged friable miscellaneous ACM.
- (5) ACBM with potential for damage.
- (6) ACBM with potential for significant damage.
- (7) Any remaining friable ACBM or friable suspected ACBM.

(c) Assessment may include the following considerations:

- (1) Location and the amount of the material, both in total quantity and as a percentage of the functional space.
- (2) Condition of the material,

specifying:

(i) Type of damage or significant damage (e.g., flaking, blistering, water damage, or other signs of physical damage).

(ii) Severity of damage (e.g., major flaking, severely torn jackets, as opposed to occasional flaking, minor tears to jackets).

(iii) Extent or spread of damage over large areas or large percentages of the homogeneous area.

(3) Whether the material is accessible.

(4) The material's potential for disturbance.

(5) Known or suspected causes of damage or significant damage (e.g., air erosion, vandalism, vibration, water).

(6) Preventive measures which might eliminate the reasonable likelihood of undamaged ACM from becoming significantly damaged.

(d) The local education agency shall select a person accredited to develop management plans to review the results of each inspection, reinspection, and assessment for the school building and to conduct any other necessary activities in order to recommend in writing to the local education agency appropriate response actions. The accredited person shall sign and date the recommendation, provide his or her State of accreditation, and, if applicable, provide his or her accreditation number, and submit a copy of the recommendation to the person designated under § 763.84 for inclusion in the management plan.

#### § 763.90 Response actions.

(a) The local education agency shall select and implement in a timely manner the appropriate response actions in this section consistent with the assessment

conducted in § 763.88. The response actions selected shall be sufficient to protect human health and the environment. The local education agency may then select, from the response actions which protect human health and the environment, that action which is the least burdensome method. Nothing in this section shall be construed to prohibit removal of ACBM from a school building at any time, should removal be the preferred response action of the local education agency.

(b) If damaged or significantly damaged thermal system insulation ACM is present in a building, the local education agency shall:

- (1) At least repair the damaged area.
- (2) Remove the damaged material if it is not feasible, due to technological factors, to repair the damage.
- (3) Maintain all thermal system insulation ACM and its covering in an intact state and undamaged condition.

(c)(1) If damaged friable surfacing ACM or damaged friable miscellaneous ACM is present in a building, the local education agency shall select from among the following response actions: encapsulation, enclosure, removal, or repair of the damaged material.

(2) In selecting the response action from among those which meet the definitional standards in § 763.83, the local education agency shall determine which of these response actions protects human health and the environment. For purposes of determining which of these response actions are the least burdensome, the local education agency may then consider local circumstances, including occupancy and use patterns within the school building, and its economic concerns, including short- and long-term costs.

(d) If significantly damaged friable surfacing ACM or significantly damaged friable miscellaneous ACM is present in a building the local education agency shall:

- (1) Immediately isolate the functional space and restrict access, unless isolation is not necessary to protect human health and the environment.
- (2) Remove the material in the functional space or, depending upon whether enclosure or encapsulation would be sufficient to protect human health and the environment, enclose or encapsulate.

(e) If any friable surfacing ACM, thermal system insulation ACM, or friable miscellaneous ACM that has potential for damage is present in a building, the local education agency shall at least implement an operations and maintenance (O&M) program, as described under § 763.91.

(f) If any friable surfacing ACM, thermal system insulation ACM, or friable miscellaneous ACM that has potential for significant damage is present in a building, the local education agency shall:

(1) Implement an O&M program, as described under § 763.91.

(2) Institute preventive measures appropriate to eliminate the reasonable likelihood that the ACM or its covering will become significantly damaged, deteriorated, or delaminated.

(3) Remove the material as soon as possible if appropriate preventive measures cannot be effectively implemented, or unless other response actions are determined to protect human health and the environment. Immediately isolate the area and restrict access if necessary to avoid an imminent and substantial endangerment to human health or the environment.

(g) Response actions including removal, encapsulation, enclosure, or repair, other than small-scale, short-duration repairs, shall be designed and conducted by persons accredited to design and conduct response actions.

(h) The requirements of this Subpart E in no way supersede the worker protection and work practice requirements under 29 CFR 1926.58 (Occupational Safety and Health Administration (OSHA) asbestos worker protection standards for construction), 40 CFR Part 763, Subpart G (EPA asbestos worker protection standards for public employees), and 40 CFR Part 61, Subpart M (National Emission Standards for Hazardous Air Pollutants—Asbestos).

(i) Completion of response actions. (1) At the conclusion of any action to remove, encapsulate, or enclose ACBM or material assumed to be ACBM, a person designated by the local education agency shall visually inspect each functional space where such action was conducted to determine whether the action has been properly completed.

(2)(i) A person designated by the local education agency shall collect air samples using aggressive sampling as described in Appendix A to this Subpart E to monitor air for clearance after each removal, encapsulation, and enclosure project involving ACBM, except for projects that are of small-scale, short-duration.

(ii) Local education agencies shall have air samples collected under this section analyzed for asbestos using laboratories accredited by the National Bureau of Standards to conduct such analysis using transmission electron microscopy (TEM) or, under circumstances permitted in this section,

laboratories enrolled in the American Industrial Hygiene Association Efficiency Analytical Testing Program phase contrast microscopy (PCM).  
 (iii) Until the National Bureau of Standards TEM laboratory accreditation program is operational, local educational agencies shall use laboratories that use the protocol described in Appendix A to Subpart E of this part.

(3) Except as provided in paragraphs (i) (4), (5), (6), or (7) of this section, an action to remove, encapsulate, or enclose ACBM shall be considered complete when the average concentration of asbestos of five air samples collected within the affected functional space and analyzed by the TEM method in Appendix A of this Subpart E, is not statistically significantly different, as determined by the Z-test calculation found in Appendix A of this Subpart E, from the average asbestos concentration of five air samples collected at the same time outside the affected functional space and analyzed in the same manner, and the average asbestos concentration of the three field blanks described in Appendix A of this Subpart E is below the filter background level, as defined in Appendix A of this Subpart E, of 70 structures per square millimeter (70 s/mm<sup>2</sup>).

(4) An action may also be considered complete if the volume of air drawn for each of the five samples collected within the affected functional space is equal to or greater than 1,199 L of air for a 25 mm filter or equal to or greater than 2,799 L of air for a 37 mm filter, and the average concentration of asbestos as analyzed by the TEM method in Appendix A of this Subpart E, for the five air samples does not exceed the filter background level, as defined in Appendix A, of 70 structures per square millimeter (70 s/mm<sup>2</sup>). If the average concentration of asbestos of the five air samples within the affected functional space exceeds 70 s/mm<sup>2</sup>, or if the volume of air in each of the samples is less than 1,199 L of air for a 25 mm filter or less than 2,799 L of air for a 37 mm filter, the action shall be considered complete only when the requirements of paragraph (i) (3), (5), (6), or (7) of this section are met.

(5) At any time, a local education agency may analyze air monitoring samples collected for clearance purposes by phase contrast microscopy (PCM) to confirm completion of removal, encapsulation, or enclosure of ACBM that is greater than small-scale, short-duration and less than or equal to 160 square feet or 260 linear feet. The action shall be considered complete when the results of samples collected in the

affected functional space and analyzed by phase contrast microscopy using the National Institute for Occupational Safety and Health (NIOSH) Method 7400 entitled "Fibers" published in the NIOSH Manual of Analytical Methods, 3rd Edition, Second Supplement, August 1987, show that the concentration of fibers for each of the five samples is less than or equal to a limit of quantitation for PCM (0.01 fibers per cubic centimeter (0.01 f/cm<sup>3</sup>) of air). The method is available at the Office of the Federal Register Information Center, 11th and L St., NW., Room 8401, Washington, DC, 20408, and the EPA OPTS Reading Room, Rm. G004 Northeast Mall, 401 M St., SW., Washington, DC 20460. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. The method is incorporated as it exists on the effective date of this rule, and a notice of any change to the method will be published in the Federal Register.

(6) Until October 7, 1989, a local education agency may analyze air monitoring samples collected for clearance purposes by PCM to confirm completion of removal, encapsulation, or enclosure of ACBM that is less than or equal to 3,000 square feet or 1,000 linear feet. The action shall be considered complete when the results of samples collected in the affected functional space and analyzed by PCM using the NIOSH Method 7400 entitled "Fibers" published in the NIOSH Manual of Analytical Methods, 3rd Edition, Second Supplement, August 1987, show that the concentration of fibers for each of the five samples is less than or equal to a limit quantitation for PCM (0.01 fibers per cubic centimeter, 0.01 f/cm<sup>3</sup>). The method is available at the Office of the Federal Register, 11th and L St., NW., Room 8301, Washington, DC, 20408, and in the EPA OPTS Reading Room, Rm. G004 Northeast Mall, 401 M St., SW., Washington, DC 20460. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. The method is incorporated as it exists on the effective date of this rule and a notice of any change to the method will be published in the Federal Register.

(7) From October 8, 1989, to October 7, 1990, a local education agency may analyze air monitoring samples collected for clearance purposes by PCM to confirm completion of removal, encapsulation, or enclosure of ACBM that is less than or equal to 1,500 square feet or 500 linear feet. The action shall be considered complete when the results of samples collected in the affected

functional space and analyzed by PCM using the NIOSH Method 7400 entitled "Fibers" published in the NIOSH Manual of Analytical Methods, 3rd Edition, Second Supplement, August 1987, show that the concentration of fibers for each of the five samples is less than or equal to a limit of quantitation for PCM (0.01 fibers per cubic centimeter, 0.01 f/cm<sup>3</sup>). The method is available at the Office of the Federal Register, 11th and L St., NW., Room 8301, Washington, DC, 20408, and in the EPA OPTS Reading Room, Rm. G004 Northeast Mall, 401 M St., SW., Washington, DC 20460. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. The method is incorporated as it exists on the effective date of this rule and a notice of any change to the method will be published in the Federal Register.

(8) To determine the amount of ACBM affected under paragraphs (i) (5), (6), and (7) of this section, the local education agency shall add the total square or linear footage of ACBM within the containment barriers used to isolate the functional space for the action to remove, encapsulate, or enclose the ACBM. Contiguous portions of material subject to such action conducted concurrently or at approximately the same time within the same school building shall not be separated to qualify under paragraphs (i) (5), (6), or (7) of this section.

#### § 763.91 Operations and maintenance.

(a) *Applicability.* The local education agency shall implement an operations, maintenance, and repair (O&M) program under this section whenever any friable ACBM is present or assumed to be present in a building that it leases, owns, or otherwise uses as a school building. Any material identified as nonfriable ACBM or nonfriable assumed ACBM must be treated as friable ACBM for purposes of this section when the material is about to become friable as a result of activities performed in the school building.

(b) *Worker protection.* The protection provided by EPA at 40 CFR 763.121 for worker protection during asbestos abatement projects is extended to employees of local education agencies who perform operations, maintenance, and repair (O&M) activities involving ACM and who are not covered by the OSHA asbestos construction standard at 29 CFR 1926.58 or an asbestos worker approved by OSHA under section 19 of the Occupational Safety and Health Act. Local education agencies may consult

Appendix B of this Subpart if their employees are performing operations, maintenance, and repair activities that are of small-scale, short-duration.

(c) *Cleaning*—(1) *Initial cleaning*. Unless the building has been cleaned using equivalent methods within the previous 6 months, all areas of a school building where friable ACBM, damaged or significantly damaged thermal system insulation ACM, or friable suspected ACBM assumed to be ACM are present shall be cleaned at least once after the completion of the inspection required by § 763.85(a) and before the initiation of any response action, other than O&M activities or repair, according to the following procedures:

(i) HEPA-vacuum or steam-clean all carpets.

(ii) HEPA-vacuum or wet-clean all other floors and all other horizontal surfaces.

(iii) Dispose of all debris, filters, mopheads, and cloths in sealed, leak-tight containers.

(2) *Additional cleaning*. The accredited management planner shall make a written recommendation to the local education agency whether additional cleaning is needed, and if so, the methods and frequency of such cleaning.

(d) *Operations and maintenance activities*. The local education agency shall ensure that the procedures described below to protect building occupants shall be followed for any operations and maintenance activities disturbing friable ACBM:

(1) Restrict entry into the area by persons other than those necessary to perform the maintenance project, either by physically isolating the area or by scheduling.

(2) Post signs to prevent entry by unauthorized persons.

(3) Shut off or temporarily modify the air-handling system and restrict other sources of air movement.

(4) Use work practices or other controls, such as, wet methods, protective clothing, HEPA-vacuums, mini-enclosures, glove bags, as necessary to inhibit the spread of any released fibers.

(5) Clean all fixtures or other components in the immediate work area.

(6) Place the asbestos debris and other cleaning materials in a sealed, leak-tight container.

(e) *Maintenance activities other than small-scale, short-duration*. The response action for any maintenance activities disturbing friable ACBM, other than small-scale, short-duration maintenance activities, shall be designed by persons accredited to design response actions and conducted

by persons accredited to conduct response actions.

(f) *Fiber release episodes*—(1) *Minor fiber release episode*. The local education agency shall ensure that the procedures described below are followed in the event of a minor fiber release episode (i.e., the falling or dislodging of 3 square or linear feet or less of friable ACBM):

(i) Thoroughly saturate the debris using wet methods.

(ii) Clean the area, as described in paragraph (e) of this section.

(iii) Place the asbestos debris in a sealed, leak-tight container.

(iv) Repair the area of damaged ACM with materials such as asbestos-free spackling, plaster, cement, or insulation, or seal with latex paint or an encapsulant, or immediately have the appropriate response action implemented as required by § 763.90.

(2) *Major fiber release episode*. The local education agency shall ensure that the procedures described below are followed in the event of a major fiber release episode (i.e., the falling or dislodging of more than 3 square or linear feet of friable ACBM):

(i) Restrict entry into the area and post signs to prevent entry into the area by persons other than those necessary to perform the response action.

(ii) Shut off or temporarily modify the air-handling system to prevent the distribution of fibers to other areas in the building.

(iii) The response action for any major fiber release episode must be designed by persons accredited to design response actions and conducted by persons accredited to conduct response actions.

#### § 763.92 Training and periodic surveillance.

(a) *Training*. (1) The local education agency shall ensure, prior to the implementation of the O&M provisions of the management plan, that all members of its maintenance and custodial staff (custodians, electricians, heating/air conditioning engineers, plumbers, etc.) who may work in a building that contains ACBM receive awareness training of at least 2 hours, whether or not they are required to work with ACBM. New custodial and maintenance employees shall be trained within 60 days after commencement of employment. Training shall include, but not be limited to:

(i) Information regarding asbestos and its various uses and forms.

(ii) Information on the health effects associated with asbestos exposure.

(iii) Locations of ACBM identified throughout each school building in which they work.

(iv) Recognition of damage, deterioration, and delamination of ACBM.

(v) Name and telephone number of the person designated to carry out general local education agency responsibilities under § 763.84 and the availability and location of the management plan.

(2) The local education agency shall ensure that all members of its maintenance and custodial staff who conduct any activities that will result in the disturbance of ACBM shall receive training described in paragraph (a)(1) of this section and 14 hours of additional training. Additional training shall include, but not be limited to:

(i) Descriptions of the proper methods of handling ACBM.

(ii) Information on the use of respiratory protection as contained in the EPA/NIOSH *Guide to Respiratory Protection for the Asbestos Abatement Industry*, September 1986 (EPA 560/OPTS-86-001), available from TSCA Assistance Office (TS-799), Office of Toxic Substances, Environmental Protection Agency, Rm. E-543, 401 M St. SW., Washington, DC 20460, and other personal protection measures.

(iii) The provisions of this section and § 763.91, Appendices A, B, C, D of this Subpart E of this part, EPA regulations contained in 40 CFR Part 763, Subpart G, and in 40 CFR Part 61, Subpart M, and OSHA regulations contained in 29 CFR 1926.58.

(iv) Hands-on training in the use of respiratory protection, other personal protection measures, and good work practices.

(3) Local education agency maintenance and custodial staff who have attended EPA-approved asbestos training or received equivalent training for O&M and periodic surveillance activities involving asbestos shall be considered trained for the purposes of this section.

(b) *Periodic surveillance*. (1) At least once every 6 months after a management plan is in effect, each local education agency shall conduct periodic surveillance in each building that it leases, owns, or otherwise uses as a school building that contains ACBM or is assumed to contain ACBM.

(2) Each person performing periodic surveillance shall:

(i) Visually inspect all areas that are identified in the management plan as ACBM or assumed ACBM.

(ii) Record the date of the surveillance, his or her name, and any

changes in the condition of the materials.

(iii) Submit to the person designated carry out general local education agency responsibilities under § 763.84 a copy of such record for inclusion in the management plan.

#### § 763.93 Management plans.

(a)(1) On or before October 12, 1988, each local education agency shall develop an asbestos management plan for each school, including all buildings that they lease, own, or otherwise use as school buildings, and submit the plan to an Agency designated by the Governor of the State in which the local education agency is located. The plan may be submitted in stages that cover a portion of the school buildings under the authority of the local education agency.

(2) If a building to be used as part of a school is leased or otherwise acquired after October 12, 1988, the local education agency shall include the new building in the management plan for the school prior to its use as a school building. The revised portions of the management plan shall be submitted to the Agency designated by the Governor.

(3) If a local education agency begins to use a building as a school after October 12, 1988, the local education agency shall submit a management plan for the school to the Agency designated by the Governor prior to its use as a school.

(b) On or before October 17, 1987, the Governor of each State shall notify local education agencies in the State regarding where to submit their management plans. States may establish administrative procedures for reviewing management plans. If the Governor does not disapprove a management plan within 90 days after receipt of the plan, the local education agency shall implement the plan.

(c) Each local education agency must begin implementation of its management plan on or before July 9, 1989, and complete implementation in a timely fashion.

(d) Each local education agency shall maintain and update its management plan to keep it current with ongoing operations and maintenance, periodic surveillance, inspection, reinspection, and response action activities. All provisions required to be included in the management plan under this section shall be retained as part of the management plan, as well as any information that has been revised to bring the plan up-to-date.

(e) The management plan shall be developed by an accredited management planner and shall include:

(1) A list of the name and address of each school building and whether the school building contains friable ACBM, nonfriable ACBM, and friable and nonfriable suspected ACBM assumed to be ACM.

(2) For each inspection conducted before the December 14, 1987:

(i) The date of the inspection.

(ii) A blueprint, diagram, or written description of each school building that identifies clearly each location and approximate square or linear footage of any homogeneous or sampling area where material was sampled for ACM, and, if possible, the exact locations where bulk samples were collected, and the dates of collection.

(iii) A copy of the analyses of any bulk samples, dates of analyses, and a copy of any other laboratory reports pertaining to the analyses.

(iv) A description of any response actions or preventive measures taken to reduce asbestos exposure, including if possible, the names and addresses of all contractors involved, start and completion dates of the work, and results of any air samples analyzed during and upon completion of the work.

(v) A description of assessments, required to be made under § 763.88, of material that was identified before December 14, 1987, as friable ACBM or friable suspected ACBM assumed to be ACM, and the name and signature, State of accreditation, and if applicable, accreditation number of each accredited person making the assessments.

(3) For each inspection and reinspection conducted under § 763.85:

(i) The date of the inspection or reinspection and the name and signature, State of accreditation and, if applicable, the accreditation number of each accredited inspector performing the inspection or reinspection.

(ii) A blueprint, diagram, or written description of each school building that identifies clearly each location and approximate square or linear footage of homogeneous areas where material was sampled for ACM, the exact location where each bulk sample was collected, date of collection, homogeneous areas where friable suspected ACBM is assumed to be ACM, and where nonfriable suspected ACBM is assumed to be ACM.

(iii) A description of the manner used to determine sampling locations, and the name and signature of each accredited inspector collecting samples, the State of accreditation, and if applicable, his or her accreditation number.

(iv) A copy of the analyses of any bulk samples collected and analyzed, the name and address of any laboratory that analyzed bulk samples, a statement

that the laboratory meets the applicable requirements of § 763.87(a) the date of analysis, and the name and signature of the person performing the analysis.

(v) A description of assessments, required to be made under § 763.88, of all ACBM and suspected ACBM assumed to be ACM, and the name, signature, State of accreditation, and if applicable, accreditation number of each accredited person making the assessments.

(4) The name, address, and telephone number of the person designated under § 763.84 to ensure that the duties of the local education agency are carried out, and the course name, and dates and hours of training taken by that person to carry out the duties.

(5) The recommendations made to the local education agency regarding response actions, under § 763.88(d), the name, signature, State of accreditation of each person making the recommendations, and if applicable, his or her accreditation number.

(6) A detailed description of preventive measures and response actions to be taken, including methods to be used, for any friable ACBM, the locations where such measures and action will be taken, reasons for selecting the response action or preventive measure, and a schedule for beginning and completing each preventive measure and response action.

(7) With respect to the person or persons who inspected for ACBM and who will design or carry out response actions, except for operations and maintenance, with respect to the ACBM, one of the following statements:

(i) If the State has adopted a contractor accreditation program under section 206(b) of Title II of the Act, a statement that the person(s) is accredited under such plan.

(ii) A statement that the local education agency used (or will use) persons who have been accredited by another State which has adopted a contractor accreditation plan under section 206(b) of Title II of the Act or is accredited by an EPA-approved course under section 206(c) of Title II of the Act.

(8) A detailed description in the form of a blueprint, diagram, or in writing of any ACBM or suspected ACBM assumed to be ACM which remains in the school once response actions are undertaken pursuant to § 763.90. This description shall be updated as response actions are completed.

(9) A plan for reinspection under § 763.85, a plan for operations and maintenance activities under § 763.91,

and a plan for periodic surveillance under § 763.92, a description of the recommendation made by the management planner regarding additional cleaning under § 763.91(c)(2) as part of an operations and maintenance program, and the response of the local education agency to that recommendation.

(10) A description of steps taken to inform workers and building occupants, or their legal guardians, about inspections, reinspections, response actions, and post-response action activities, including periodic reinspection and surveillance activities that are planned or in progress.

(11) An evaluation of the resources needed to complete response actions successfully and carry out reinspection, operations and maintenance activities, periodic surveillance and training.

(12) With respect to each consultant who contributed to the management plan, the name of the consultant and one of the following statements:

(i) If the State has adopted a contractor accreditation plan under section 206(b) of Title II of the Act, a statement that the consultant is accredited under such plan.

(ii) A statement that the contractor is accredited by another State which has adopted a contractor accreditation plan under section 206(b) of Title II of the Act, or is accredited by an EPA-approved course developed under section 206(c) of Title II of the Act.

(f) A local education agency may require each management plan to contain a statement signed by an accredited management plan developer that such person has prepared or assisted in the preparation of such plan or has reviewed such plan, and that such plan is in compliance with this Subpart E. Such statement may not be signed by a person who, in addition to preparing or assisting in preparing the management plan, also implements (or will implement) the management plan.

(g)(1) Upon submission of a management plan to the Governor for review, a local education agency shall keep a copy of the plan in its administrative office. The management plans shall be available, without cost or restriction, for inspection by representatives of EPA and the State, the public, including teachers, other school personnel and their representatives, and parents. The local education agency may charge a reasonable cost to make copies of management plans.

(2) Each local education agency shall maintain in its administrative office a complete, updated copy of a management plan for each school under

its administrative control or direction. The management plans shall be available, during normal business hours, without cost or restriction, for inspection by representatives of EPA and the State, the public, including teachers, other school personnel and their representatives, and parents. The local education agency may charge a reasonable cost to make copies of management plans.

(3) Each school shall maintain in its administrative office a complete, updated copy of the management plan for that school. Management plans shall be available for inspection, without cost or restriction, to workers before work begins in any area of a school building. The school shall make management plans available for inspection to representatives of EPA and the State, the public, including parents, teachers, and other school personnel and their representatives within 5 working days after receiving a request for inspection. The school may charge a reasonable cost to make copies of the management plan.

(4) Upon submission of its management plan to the Governor and at least once each school year, the local education agency shall notify in writing parent, teacher, and employee organizations of the availability of management plans and shall include in the management plan a description of the steps taken to notify such organizations, and a dated copy of the notification. In the absence of any such organizations for parents, teachers, or employees, the local education agency shall provide written notice to that relevant group of the availability of management plans and shall include in the management plan a description of the steps taken to notify such groups, and a dated copy of the notification.

(h) Records required under § 763.94 shall be made by local education agencies and maintained as part of the management plan.

(i) Each management plan must contain a true and correct statement, signed by the individual designated by the local education agency under § 763.84, which certifies that the general, local education agency responsibilities, as stipulated by § 763.84, have been met or will be met.

#### **§ 763.94 Recordkeeping.**

(a) Records required under this section shall be maintained in a centralized location in the administrative office of both the school and the local education agency as part of the management plan. For each homogeneous area where all ACBM has been removed, the local education

agency shall ensure that such records are retained for 3 years after the next reinspection required under § 763.85(b)(1), or for an equivalent period.

(b) For each preventive measure and response action taken for friable and nonfriable ACBM and friable and nonfriable suspected ACBM assumed to be ACM, the local education agency shall provide:

(1) A detailed written description of the measure or action, including methods used, the location where the measure or action was taken, reasons for selecting the measure or action, start and completion dates of the work, names and addresses of all contractors involved, and if applicable, their State of accreditation, and accreditation numbers, and if ACBM is removed, the name and location of storage or disposal site of the ACM.

(2) The name and signature of any person collecting any air sample required to be collected at the completion of certain response actions specified by § 763.90(i), the locations where samples were collected, date of collection, the name and address of the laboratory analyzing the samples, the date of analysis, the results of the analysis, the method of analysis, the name and signature of the person performing the analysis, and a statement that the laboratory meets the applicable requirements of § 763.90(i)(2)(ii).

(c) For each person required to be trained under § 763.92(a) (1) and (2), the local education agency shall provide the person's name and job title, the date that training was completed by that person, the location of the training, and the number of hours completed in such training.

(d) For each time that periodic surveillance under § 763.92(b) is performed, the local education agency shall record the name of each person performing the surveillance, the date of the surveillance, and any changes in the conditions of the materials.

(e) For each time that cleaning under § 763.91(c) is performed, the local education agency shall record the name of each person performing the cleaning, the date of such cleaning, the locations cleaned, and the methods used to perform such cleaning.

(f) For each time that operations and maintenance activities under § 763.91(d) are performed, the local education agency shall record the name of each person performing the activity, the start and completion dates of the activity, the locations where such activity occurred, a description of the activity including preventive measures used, and if ACBM

is removed, the name and location of age or disposal site of the ACM.

(j) For each time that major asbestos activity under § 763.91(e) is performed, the local education agency shall provide the name and signature, State of accreditation, and if applicable, the accreditation number of each person performing the activity, the start and completion dates of the activity, the locations where such activity occurred, a description of the activity including preventive measures used, and if ACBM is removed, the name and location of storage or disposal site of the ACM.

(h) For each fiber release episode under § 763.91(f), the local education agency shall provide the date and location of the episode, the method of repair, preventive measures or response action taken, the name of each person performing the work, and if ACBM is removed, the name and location of storage or disposal site of the ACM.

(Approved by the Office of Management and Budget under control number 2070-0091)

#### § 763.95 Warning labels.

(a) The local education agency shall attach a warning label immediately adjacent to any friable and nonfriable ACBM and suspected ACBM assumed to be ACM located in routine

maintenance areas (such as boiler rooms) at each school building. This shall include:

(1) Friable ACBM that was responded to by a means other than removal.

(2) ACBM for which no response action was carried out.

(b) All labels shall be prominently displayed in readily visible locations and shall remain posted until the ACBM that is labeled is removed.

(c) The warning label shall read, in print which is readily visible because of large size or bright color, as follows: CAUTION: ASBESTOS. HAZARDOUS. DO NOT DISTURB WITHOUT PROPER TRAINING AND EQUIPMENT.

#### § 763.97 Compliance and enforcement.

(a) *Compliance with Title II of the Act.* (1) Section 207(a) of Title II of the Act (15 U.S.C. 2647) makes it unlawful for any local education agency to:

(i) Fail to conduct inspections pursuant to section 203(b) of Title II of the Act, including failure to follow procedures and failure to use accredited personnel and laboratories.

(ii) Knowingly submit false information to the Governor regarding any inspection pursuant to regulations under section 203(i) of Title II of the Act.

(iii) Fail to develop a management plan pursuant to regulations under section 203(i) of Title II of the Act.

(2) Section 207(a) of Title II of the Act (15 U.S.C. 2647) also provides that any local education agency which violates any provision of section 207 shall be liable for a civil penalty of not more than \$5,000 for each day during which the violation continues. For the purposes of this subpart, a "violation" means a failure to comply with respect to a single school building.

(b) *Compliance with Title I of the Act.*

(1) Section 15(1)(D) of Title I of the Act (15 U.S.C. 2614) makes it unlawful for any person to fail or refuse to comply with any requirement of Title II or any rule promulgated or order issued under Title II. Therefore, any person who violates any requirement of this Subpart is in violation of section 15 of Title I of the Act.

(2) Section 15(3) of Title I of the Act (15 U.S.C. 2614) makes it unlawful for any person to fail or refuse to establish or maintain records, submit reports, notices or other information, or permit access to or copying of records, as required by this Act or a rule thereunder.

(3) Section 15(4) (15 U.S.C. 2614) of Title I of the Act makes it unlawful for any person to fail or refuse to permit entry or inspection as required by section 11 of Title I of the Act.

(4) Section 16(a) of Title I of the Act (15 U.S.C. 2615) provides that any person who violates any provision of section 15 of Title I of the Act shall be liable to the United States for a civil penalty in an amount not to exceed \$25,000 for each such violation. Each day such a violation continues shall, for purposes of this paragraph, constitute a separate violation of section 15. A local education agency is not liable for any civil penalty under Title I of the Act for failing or refusing to comply with any rule promulgated or order issued under Title II of the Act.

(c) *Criminal penalties.* If any violation committed by any person (including a local education agency) is knowing or willful, criminal penalties may be assessed under section 16(b) of Title I of the Act.

(d) *Injunctive relief.* The Agency may obtain injunctive relief under section 208(b) of Title II of the Act to respond to a hazard which poses an imminent and substantial endangerment to human health or the environment or section 17 (15 U.S.C. 2616) of Title I of the Act to restrain any violation of section 15 of Title I of the Act or to compel the taking of any action required by or under Title I of the Act.

(e) *Citizen complaints.* Any citizen who wishes to file a complaint pursuant to section 207(d) of Title II of the Act should direct the complaint to the

Governor of the State or the EPA Asbestos Ombudsman, 401 M Street, SW., Washington, DC 20460. The citizen complaint should be in writing and identified as a citizen complaint pursuant to section 207(d) of Title II of TSCA. The EPA Asbestos Ombudsman or the Governor shall investigate and respond to the complaint within a reasonable period of time if the allegations provide a reasonable basis to believe that a violation of the Act has occurred.

(f) *Inspections.* EPA may conduct inspections and review management plans under section 11 of Title I of the Act (15 U.S.C. 2610) to ensure compliance.

#### § 763.98 Waiver; delegation to State.

(a) *General.* (1) Upon request from a State Governor and after notice and comment and an opportunity for a public hearing in accordance with paragraphs (b) and (c) of this section, EPA may waive some or all of the requirements of this Subpart E if the State has established and is implementing or intends to implement a program of asbestos inspection and management that contains requirements that are at least as stringent as the requirements of this Subpart E.

(2) A waiver from any requirement of this Subpart E shall apply only to the specific provision for which a waiver has been granted under this section. All requirements of this Subpart E shall apply until a waiver is granted under this section.

(b) *Request.* Each request by a Governor to waive any requirement of this Subpart E shall be sent with three complete copies of the request to the Regional Administrator for the EPA Region in which the State is located and shall include:

(1) A copy of the State provisions or proposed provisions relating to its program of asbestos inspection and management in schools for which the request is made.

(2)(i) The name of the State agency that is or will be responsible for administering and enforcing the requirements for which a waiver is requested, the names and job titles of responsible officials in that agency, and phone numbers where the officials can be contacted.

(ii) In the event that more than one agency is or will be responsible for administering and enforcing the requirements for which a waiver is requested, a description of the functions to be performed by each agency, how the program will be coordinated by the lead agency to ensure consistency and

effective administration in the asbestos inspection and management program within the State, the names and job titles of responsible officials in the agencies, and phone numbers where the officials can be contacted. The lead agency will serve as the central contact point for the EPA.

(3) Detailed reasons, supporting papers, and the rationale for concluding that the State's asbestos inspection and management program provisions for which the request is made are at least as stringent as the requirements of this Subpart E.

(4) A discussion of any special situations, problems, and needs pertaining to the waiver request accompanied by an explanation of how the State intends to handle them.

(5) A statement of the resources that the State intends to devote to the administration and enforcement of the provisions relating to the waiver request.

(6) Copies of any specific or enabling State laws (enacted and pending enactment) and regulations (promulgated and pending promulgation) relating to the request, including provisions for assessing criminal and/or civil penalties.

(7) Assurance from the Governor, the Attorney General, or the legal counsel of the lead agency that the lead agency or other cooperating agencies have the legal authority necessary to carry out the requirements relating to the request.

(c) *General notice—hearing.* (1) Within 30 days after receipt of a request for a waiver, EPA will determine the completeness of the request. If EPA does not request further information within the 30-day period, the request will be deemed complete.

(2) Within 30 days after EPA determines that a request is complete, EPA will issue for publication in the **Federal Register** a notice that announces receipt of the request, describes the information submitted under paragraph (b) of this section, and solicits written comment from interested members of the public. Comments must be submitted within 60 days.

(3) If, during the comment period, EPA receives a written objection to a Governor's request and a request for a public hearing detailing specific objections to the granting of a waiver, EPA will schedule a public hearing to be held in the affected State after the close of the comment period and will announce the public hearing date in the **Federal Register** before the date of the hearing. Each comment shall include the name and address of the person submitting the comment.

(d) *Criteria.* EPA may waive some or all of the requirements of Subpart E of this part if:

(1) The State's lead agency and other cooperating agencies have the legal authority necessary to carry out the provisions of asbestos inspection and management in schools relating to the waiver request.

(2) The State's program of asbestos inspection and management in schools relating to the waiver request and implementation of the program are or will be at least as stringent as the requirements of this Subpart E.

(3) The State has an enforcement mechanism to allow it to implement the program described in the waiver request.

(4) The lead agency and any cooperating agencies have or will have qualified personnel to carry out the provisions relating to the waiver request.

(5) The State will devote adequate resources to the administration and enforcement of the asbestos inspection and management provisions relating to the waiver request.

(6) When specified by EPA, the State gives satisfactory assurances that necessary steps, including specific actions it proposes to take and a time schedule for their accomplishment, will be taken within a reasonable time to conform with applicable criteria under paragraph (d) (2) through (4) of this section.

(e) *Decision.* EPA will issue for publication in the **Federal Register** a notice announcing its decision to grant or deny, in whole or in part, a Governor's request for a waiver from some or all of the requirements of this Subpart E within 30 days after the close of the comment period or within 30 days following a public hearing, whichever is applicable. The notice will include the Agency's reasons and rationale for granting or denying the Governor's request. The 30-day period may be extended if mutually agreed upon by EPA and the State.

(f) *Modifications.* When any substantial change is made in the administration or enforcement of a State program for which a waiver was granted under this section, a responsible official in the lead agency shall submit such changes to EPA.

(g) *Reports.* The lead agency in each State that has been granted a waiver by EPA from any requirement of Subpart E of this part shall submit a report to the Regional Administrator for the Region in which the State is located at least once every 12 months to include the following information:

(1) A summary of the State's implementation and enforcement activities during the last reporting period relating to provisions waived under this section, including enforcement actions taken.

(2) Any changes in the administration or enforcement of the State program implemented during the last reporting period.

(3) Other reports as may be required by EPA to carry out effective oversight of any requirement of this Subpart E that was waived under this section.

(h) *Oversight.* EPA may periodically evaluate the adequacy of a State's implementation and enforcement of and resources devoted to carrying out requirements relating to the waiver. This evaluation may include, but is not limited to, site visits to local education agencies without prior notice to the State.

(i) *Informal conference.* (1) EPA may request that an informal conference be held between appropriate State and EPA officials when EPA has reason to believe that a State has failed to:

(i) Substantially comply with the terms of any provision that was waived under this section.

(ii) Meet the criteria under paragraph (d) of this section, including the failure to carry out enforcement activities or act on violations of the State program.

(2) EPA will:

(i) Specify to the State those aspects of the State's program believed to be inadequate.

(ii) Specify to the State the facts that underlie the belief of inadequacy.

(3) If EPA finds, on the basis of information submitted by the State at the conference, that deficiencies did not exist or were corrected by the State, no further action is required.

(4) Where EPA finds that deficiencies in the State program exist, a plan to correct the deficiencies shall be negotiated between the State and EPA. The plan shall detail the deficiencies found in the State program, specify the steps the State has taken or will take to remedy the deficiencies, and establish a schedule for each remedial action to be initiated.

(j) *Rescission.* (1) If the State fails to meet with EPA or fails to correct deficiencies raised at the informal conference, EPA will deliver to the Governor of the State and a responsible official in the lead agency a written notice of its intent to rescind, in whole or part, the waiver.

(2) EPA will issue for publication in the **Federal Register** a notice that announces the rescission of the waiver, describes those aspects of the State's



program determined to be inadequate, § 763.85(a) specifies the facts that underlie the reasons of inadequacy.

#### § 763.99 Exclusions.

(a) A local education agency shall not be required to perform an inspection under § 763.85(a) in any sampling area as defined in 40 CFR 763.103 or homogeneous area of a school building where:

(1) An accredited inspector has determined that, based on sampling records, friable ACBM was identified in that homogeneous or sampling area during an inspection conducted before December 14, 1987. The inspector shall sign and date a statement to that effect with his or her State of accreditation and if applicable, accreditation number and, within 30 days after such determination, submit a copy of the statement to the person designated under § 763.84 for inclusion in the management plan. However, an accredited inspector shall assess the friable ACBM under § 763.88.

(2) An accredited inspector has determined that, based on sampling records, nonfriable ACBM was identified in that homogeneous or sampling area during an inspection conducted before December 14, 1987. The inspector shall sign and date a statement to that effect with his or her State of accreditation and if applicable, accreditation number and, within 30 days after such determination, submit a copy of the statement to the person designated under § 763.84 for inclusion in the management plan. However, an accredited inspector shall identify whether material that was nonfriable has become friable since that previous inspection and shall assess the newly-friable ACBM under § 763.88.

(3) Based on sampling records and inspection records, an accredited inspector has determined that no ACBM is present in the homogeneous or sampling area and the records show that the area was sampled, before December 14, 1987 in substantial compliance with § 763.85(a), which for purposes of this section means in a random manner and with a sufficient number of samples to reasonably ensure that the area is not ACBM.

(i) The accredited inspector shall sign and date a statement, with his or her State of accreditation and if applicable, accreditation number that the homogeneous or sampling area determined not to be ACBM was sampled in substantial compliance with § 763.85(a).

Within 30 days after the inspector's determination, the local education agency shall submit a copy of

the inspector's statement to the EPA Regional Office and shall include the statement in the management plan for that school.

(4) The lead agency responsible for asbestos inspection in a State that has been granted a waiver from § 763.85(a) has determined that, based on sampling records and inspection records, no ACBM is present in the homogeneous or sampling area and the records show that the area was sampled before December 14, 1987, in substantial compliance with § 763.85(a). Such determination shall be included in the management plan for that school.

(5) An accredited inspector has determined that, based on records of an inspection conducted before December 14, 1987, suspected ACBM identified in that homogeneous or sampling area is assumed to be ACM. The inspector shall sign and date a statement to that effect, with his or her State of accreditation and if applicable, accreditation number and, within 30 days of such determination, submit a copy of the statement to the person designated under § 763.84 for inclusion in the management plan. However, an accredited inspector shall identify whether material that was nonfriable suspected ACBM assumed to be ACM has become friable since the previous inspection and shall assess the newly friable material and previously identified friable suspected ACBM assumed to be ACM under § 763.88.

(6) Based on inspection records and contractor and clearance records, an accredited inspector has determined that no ACBM is present in the homogeneous or sampling area where asbestos removal operations have been conducted before December 14, 1987, and shall sign and date a statement to that effect and include his or her State of accreditation and, if applicable, accreditation number. The local education agency shall submit a copy of the statement to the EPA Regional Office and shall include the statement in the management plan for that school.

(7) An architect or project engineer responsible for the construction of a new school building built after October 12, 1988, or an accredited inspector signs a statement that no ACBM was specified as a building material in any construction document for the building, or, to the best of his or her knowledge, no ACBM was used as a building material in the building. The local education agency shall submit a copy of the signed statement of the architect, project engineer, or accredited inspector to the EPA Regional Office and shall include the statement in the management plan for that school.

(b) The exclusion, under paragraph (a) (1) through (4) of this section, from conducting the inspection under § 763.85(a) shall apply only to homogeneous or sampling areas of a school building that were inspected and sampled before October 17, 1987. The local education agency shall conduct an inspection under § 763.85(a) of all areas inspected before October 17, 1987, that were not sampled or were not assumed to be ACM.

(c) If ACBM is subsequently found in a homogeneous or sampling area of a local education agency that had been identified as receiving an exclusion by an accredited inspector under paragraphs (a) (3), (4), (5) of this section, or an architect, project engineer or accredited inspector under paragraph (a)(7) of this section, the local education agency shall have 180 days following the date of identification of ACBM to comply with this Subpart E.

### Appendix A to Subpart E—Interim Transmission Electron Microscopy Analytical Methods—Mandatory and Nonmandatory—and Mandatory Section to Determine Completion of Response Actions

#### I. Introduction

The following appendix contains three units. The first unit is the mandatory transmission electron microscopy (TEM) method which all laboratories must follow; it is the minimum requirement for analysis of air samples for asbestos by TEM. The mandatory method contains the essential elements of the TEM method. The second unit contains the complete non-mandatory method. The non-mandatory method supplements the mandatory method by including additional steps to improve the analysis. EPA recommends that the non-mandatory method be employed for analyzing air filters; however, the laboratory may choose to employ the mandatory method. The non-mandatory method contains the same minimum requirements as are outlined in the mandatory method. Hence, laboratories may choose either of the two methods for analyzing air samples by TEM.

The final unit of this Appendix A to Subpart E defines the steps which must be taken to determine completion of response actions. This unit is mandatory.

#### II. Mandatory Transmission Electron Microscopy Method

##### A. Definitions of Terms

1. "Analytical sensitivity"—Airborne asbestos concentration represented by each fiber counted under the electron

microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 structures/cm<sup>3</sup>.

2. "Asbestiform"—A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. "Aspect ratio"—A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. "Bundle"—A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. "Clean area"—A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm<sup>2</sup> in an area of 0.057 mm<sup>2</sup> (nominally 10 200-mesh grid openings) and a maximum of 53 structures/mm<sup>2</sup> for any single preparation for that same area.

6. "Cluster"—A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

7. "ED"—Electron diffraction.

8. "EDXA"—Energy dispersive X-ray analysis.

9. "Fiber"—A structure greater than or equal to 0.5 μm in length with an aspect

ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. "Grid"—An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. "Intersection"—Nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. "Laboratory sample coordinator"—That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. "Filter background level"—The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on a blank (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm<sup>2</sup>.

14. "Matrix"—Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. "NSD"—No structure detected.

16. "Operator"—A person responsible for the TEM instrumental analysis of the sample.

17. "PCM"—Phase contrast microscopy.

18. "SAED"—Selected area electron diffraction.

19. "SEM"—Scanning electron microscope.

20. "STEM"—Scanning transmission electron microscope.

21. "Structure"—a microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. "S/cm<sup>3</sup>"—Structures per cubic centimeter.

23. "S/mm<sup>2</sup>"—Structures per square millimeter.

24. "TEM"—Transmission electron microscope.

## B. Sampling

1. The sampling agency must have written quality control procedures and documents which verify compliance.

2. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (References 1, 2, 3, and 5 of Unit II.J.).

3. Sampling for airborne asbestos following an abatement action must use commercially available cassettes.

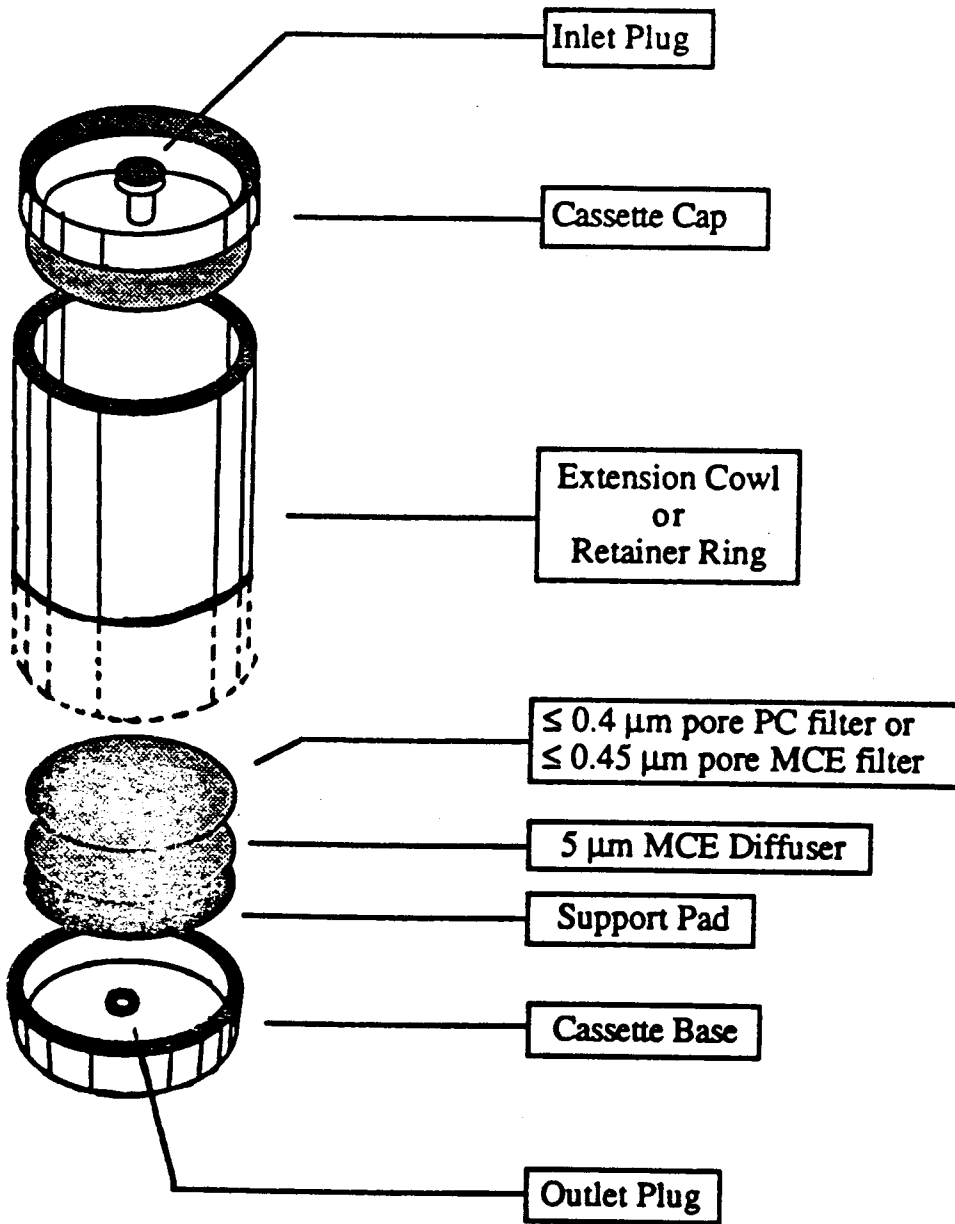
4. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm<sup>2</sup> in an area of 0.057 mm<sup>2</sup> (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm<sup>2</sup> for that same area is acceptable for this method.

5. Use sample collection filters which are either polycarbonate having a pore size less than or equal to 0.4 μm or mixed cellulose ester having a pore size less than or equal to 0.45 μm.

6. Place these filters in series with a 5.0 μm backup filter (to serve as a diffuser) and a support pad. See the following Figure 1:

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FIGURE I--SAMPLING CASSETTE CONFIGURATION



7. Reloading of used cassettes is not permitted.

8. Orient the cassette downward at approximately 45 degrees from the horizontal.

9. Maintain a log of all pertinent sampling information.

10. Calibrate sampling pumps and their flow indicators over the range of their intended use with a recognized standard. Assemble the sampling system with a representative filter (not the filter which will be used in sampling) before and after the sampling operation.

11. Record all calibration information.

12. Ensure that the mechanical vibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

13. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by damping out any pump action fluctuations if necessary.

14. The final plastic barrier around the abatement area remains in place for the sampling period.

15. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust. (See suggested protocol in Unit III.B.7.d.)

16. Select an appropriate flow rate equal to or greater than 1 liter per minute (L/min) or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

17. A minimum of 13 samples are to be collected for each testing site consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 seconds and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each abatement area.

ii. At one of the ambient sites. (DO NOT leave the field blanks open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

18. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

19. The following Table I specifies volume ranges to be used:

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TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS  
(0.0057 MM<sup>2</sup>) THAT NEED TO BE ANALYZED TO  
MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC  
BASED ON VOLUME AND EFFECTIVE FILTER AREA

Effective Filter Area 385 sq mm		Effective Filter Area 855 sq mm	
Volume (liters)	# of grid openings	Volume (liters)	# of grid openings
560	24	1,250	24
600	23	1,300	23
700	19	1,400	21
800	17	1,600	19
900	15	1,800	17
1,000	14	2,000	15
1,100	12	2,200	14
1,200	11	2,400	13
1,300	10	2,600	12
1,400	10	2,800	11
1,500	9	3,000	10
1,600	8	3,200	9
1,700	8	3,400	9
1,800	8	3,600	8
1,900	7	3,800	8
2,000	7	4,000	8
2,100	6	4,200	7
2,200	6	4,400	7
2,300	6	4,600	7
2,400	6	4,800	6
2,500	5	5,000	6
2,600	5	5,200	6
2,700	5	5,400	6
2,800	5	5,600	5
2,900	5	5,800	5
3,000	5	6,000	5
3,100	4	6,200	5
3,200	4	6,400	5
3,300	4	6,600	5
3,400	4	6,800	4
3,500	4	7,000	4
3,600	4	7,200	4
3,700	4	7,400	4
3,800	4	7,600	4

Note minimum volumes required:

25 mm : 560 liters

37 mm : 1250 liters

Filter diameter of 25 mm = effective area of 385 sq mm

Filter diameter of 37 mm = effective area of 855 sq mm

20. Ensure that the sampler is turned upright before interrupting the pump flow.

21. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

22. Ensure that the samples are stored in a secure and representative location.

23. Do not change containers if portions of these filters are taken for other purposes.

24. A summary of Sample Data Quality Objectives is shown in the following Table II:

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TABLE II--SUMMARY OF SAMPLING AGENCY DATA QUALITY OBJECTIVES

This table summarizes the data quality objectives from the performance of this method in terms of precision, accuracy, completeness, representativeness, and comparability. These objectives are assured by the periodic control checks and reference checks listed here and described in the text of the method.

<u>Unit Operation</u>	<u>QC Check</u>	<u>Frequency</u>	<u>Conformance Expectation</u>
Sampling materials	Sealed blank	1 per I/O site	95%
Sample procedures	Field blanks	2 per I/O site	95%
	Pump calibration	Before and after each field series	90%
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample shipment	Review of sending report	Each sample	95% complete

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### C. Sample Shipment

Ship bulk samples to the analytical laboratory in a separate container from air samples.

### D. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

### E. Sample Preparation

1. All sample preparation and analysis shall be performed by a laboratory independent of the abatement contractor.

2. Wet-wipe the exterior of the cassettes to minimize contamination possibilities before taking them into the clean room facility.

3. Perform sample preparation in a well-equipped clean facility.

**Note:** The clean area is required to have the following minimum characteristics. The area or hood must be capable of maintaining a positive pressure with make-up air being HEPA-filtered. The cumulative analytical blank concentration must average less than 18 s/mm<sup>2</sup> in an area of 0.057 mm<sup>2</sup> (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm<sup>2</sup> for that same area.

4. Preparation areas for air samples must not only be separated from preparation areas for bulk samples, but they must be prepared in separate rooms.

5. Direct preparation techniques are required. The object is to produce an intact film containing the particulates of the filter surface which is sufficiently clear for TEM analysis.

a. TEM Grid Opening Area measurement must be done as follows:

i. The filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique.

ii. Measure 20 grid openings on each of 20 random 200-mesh copper grids by placing a grid on a glass and examining it under the PCM. Use a calibrated graticule to measure the average field diameters. From the data, calculate the field area for an average grid opening.

iii. Measurements can also be made on the TEM at a properly calibrated low magnification or on an optical microscope at a magnification of approximately 400X by using an eyepiece fitted with a scale that has been calibrated against a stage micrometer. Optical microscopy utilizing

manual or automated procedures may be used providing instrument calibration can be verified.

b. TEM specimen preparation from polycarbonate (PC) filters. Procedures as described in Unit III.G. or other equivalent methods may be used.

c. TEM specimen preparation from mixed cellulose ester (MCE) filters.

i. Filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique or the Burdette procedure (Ref. 7 of Unit II.J.)

ii. Plasma etching of the collapsed filter is required. The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher. Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the conditions that should be used. Insufficient etching will result in a failure to expose embedded filters, and too much etching may result in loss of particulate from the surface. As an interim measure, it is recommended that the time for ashing of a known weight of a collapsed filter be established and that the etching rate be calculated in terms of micrometers per second. The actual etching time used for the particulate asher and operating conditions will then be set such that a 1–2 μm (10 percent) layer of collapsed surface will be removed.

iii. Procedures as described in Unit III. or other equivalent methods may be used to prepare samples.

### F. TEM Method

1. An 80–120 kV TEM capable of performing electron diffraction with a fluorescent screen inscribed with calibrated gradations is required. If the TEM is equipped with EDXA it must either have a STEM attachment or be capable of producing a spot less than 250 nm in diameter at crossover. The microscope shall be calibrated routinely for magnification and camera constant.

2. Determination of Camera Constant and ED Pattern Analysis. The camera length of the TEM in ED operating mode must be calibrated before ED patterns on unknown samples are observed. This can be achieved by using a carbon-coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thicker gold film would

normally give multiple gold rings, but it will tend to mask weaker diffraction spots from the unknown fibrous particulate. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings are unnecessary on zone-axis ED patterns. An average camera constant using multiple gold rings can be determined. The camera constant is one-half the diameter of the rings times the interplanar spacing of the ring being measured.

3. Magnification Calibration. The magnification calibration must be done at the fluorescent screen. The TEM must be calibrated at the grid opening magnification (if used) and also at the magnification used for fiber counting. This is performed with a cross grating replica (e.g., one containing 2,160 lines/mm). Define a field of view on the fluorescent screen either by markings or physical boundaries. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric). A logbook must be maintained, and the dates of calibration and the values obtained must be recorded. The frequency of calibration depends on the past history of the particular microscope. After any maintenance of the microscope that involved adjustment of the power supplied to the lenses or the high-voltage system or the mechanical disassembly of the electron optical column apart from filament exchange, the magnification must be recalibrated. Before the TEM calibration is performed, the analyst must ensure that the cross grating replica is placed at the same distance from the objective lens as the specimens are. For instruments that incorporate an eucentric tilting specimen stage, all specimens and the cross grating replica must be placed at the eucentric position.

4. While not required on every microscope in the laboratory, the laboratory must have either one microscope equipped with energy dispersive X-ray analysis or access to an equivalent system on a TEM in another laboratory.

5. Microscope settings: 80–120 kV, grid assessment 250–1,000X, then 15,000–20,000X screen magnification for analysis.

6. Approximately one-half (0.5) of the predetermined sample area to be analyzed shall be performed on one sample grid preparation and the remaining half on a second sample grid preparation.

7. Individual grid openings with greater than 5 percent openings (holes)



or covered with greater than 25 percent  
articulate matter or obviously having  
nonuniform loading must not be  
analyzed.

8. Reject the grid if:

a. Less than 50 percent of the grid  
openings covered by the replica are  
intact.

b. The replica is doubled or folded.

c. The replica is too dark because of

incomplete dissolution of the filter.

9. Recording Rules.

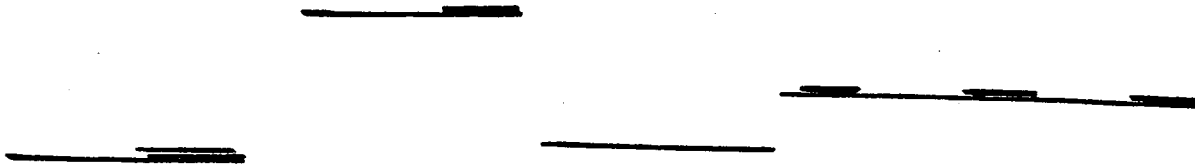
a. Any continuous grouping of  
particles in which an asbestos fiber with  
an aspect ratio greater than or equal to  
5:1 and a length greater than or equal to  
0.5  $\mu\text{m}$  is detected shall be recorded on  
the count sheet. These will be  
designated asbestos structures and will  
be classified as fibers, bundles, clusters,

or matrices. Record as individual fibers  
any contiguous grouping having 0, 1, or 2  
definable intersections. Groupings  
having more than 2 intersections are to  
be described as cluster or matrix. An  
intersection is a nonparallel touching or  
crossing of fibers, with the projection  
having an aspect ratio of 5:1 or greater.  
See the following Figure 2:

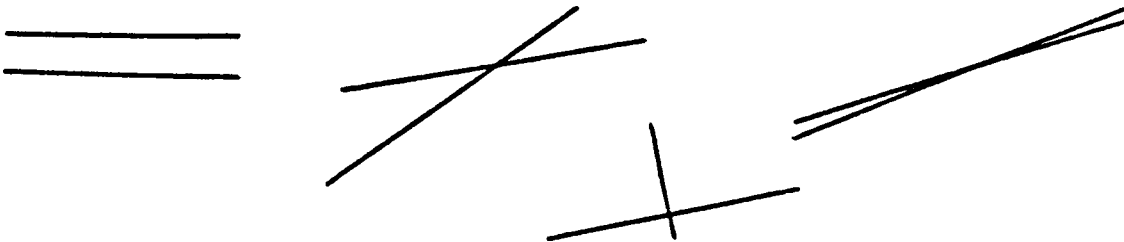
BILLING CODE 6560-50-M

**FIGURE 2--COUNTING GUIDELINES USED IN  
DETERMINING ASBESTOS STRUCTURES**

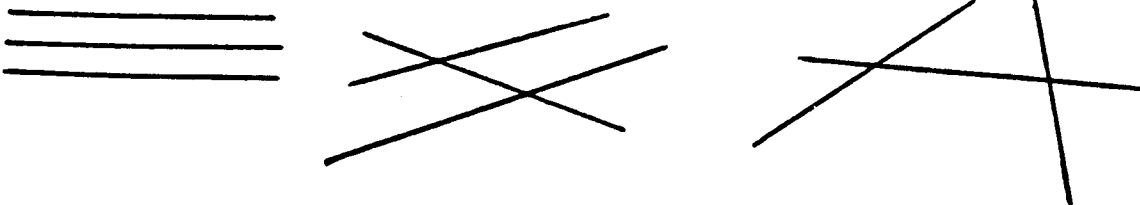
Count as 1 fiber; 1 Structure; no intersections.



Count as 2 fibers if space between fibers is greater than width of 1 fiber diameter or number of intersections is equal to or less than 1.



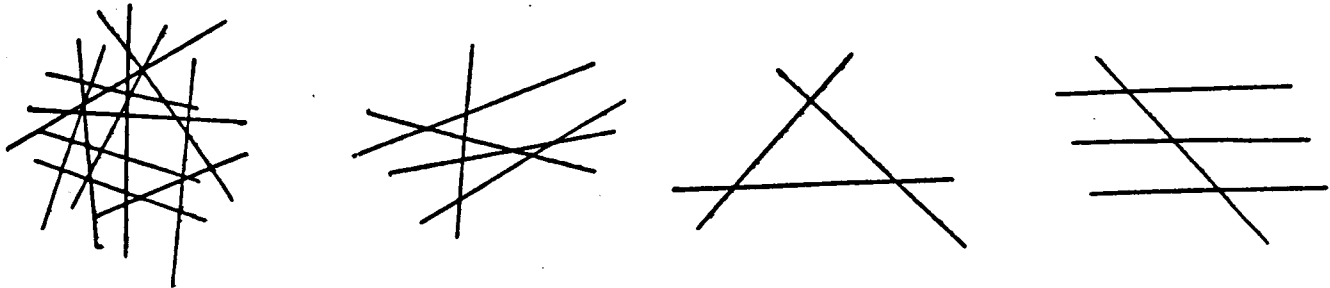
Count as 3 structures if space between fibers is greater than width of 1 fiber diameter or if the number of intersections is equal to or less than 2.



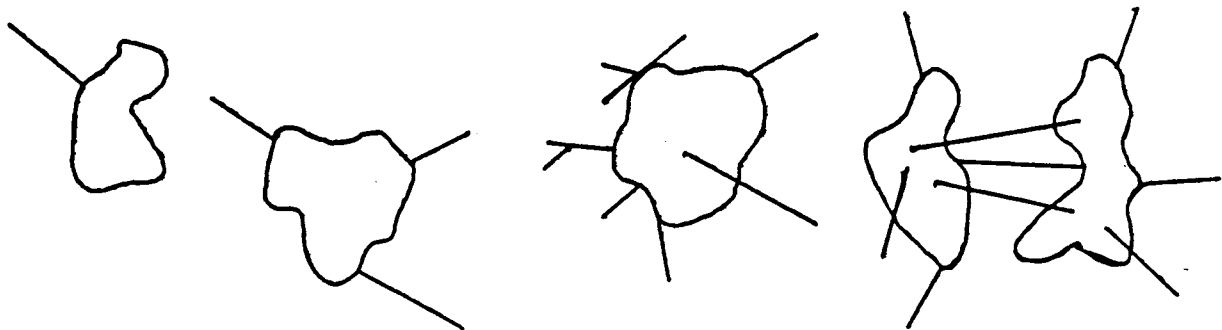
Count bundles as 1 structure; 3 or more parallel fibrils less than 1 fiber diameter separation.



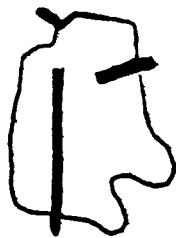
Count clusters as 1 structure; fibers having greater than or equal to 3 intersections.



Count matrix as 1 structure.



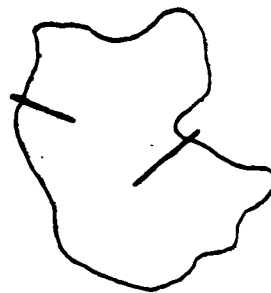
DO NOT COUNT AS STRUCTURES:



Fiber protrusion  
<5:1 Aspect Ratio



No fiber protrusion



Fiber protrusion  
<0.5 micrometer

— <0.5 micrometer in length  
— <5:1 Aspect Ratio

i. *Fiber*. A structure having a minimum length greater than or equal to  $0.5 \mu\text{m}$  and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

ii. *Bundle*. A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

iii. *Cluster*. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

iv. *Matrix*. Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

b. Separate categories will be maintained for fibers less than  $5 \mu\text{m}$  and for fibers equal to or greater than  $5 \mu\text{m}$  in length.

c. Record NSD when no structures are detected in the field.

d. Visual identification of electron diffraction (ED) patterns is required for each asbestos structure counted which would cause the analysis to exceed the  $70 \text{ s/mm}^2$  concentration. (Generally this means the first four fibers identified as asbestos must exhibit an identifiable diffraction pattern for chrysotile or amphibole.)

e. The micrograph number of the recorded diffraction patterns must be reported to the client and maintained in the laboratory's quality assurance records. In the event that examination of the pattern by a qualified individual indicates that the pattern has been misidentified visually, the client shall be contacted.

f. Energy Dispersive X-ray Analysis (EDXA) is required of all amphiboles which would cause the analysis results to exceed the  $70 \text{ s/mm}^2$  concentration. (Generally speaking, the first 4 amphiboles would require EDXA.)

g. If the number of fibers in the nonasbestos class would cause the analysis to exceed the  $70 \text{ s/mm}^2$  concentration, the fact that they are not asbestos must be confirmed by EDXA or measurement of a zone axis diffraction pattern.

h. Fibers classified as chrysotile must be identified by diffraction or X-ray analysis and recorded on a count sheet. X-ray analysis alone can be used only

after  $70 \text{ s/mm}^2$  have been exceeded for a particular sample.

i. Fibers classified as amphiboles must be identified by X-ray analysis and electron diffraction and recorded on the count sheet. (X-ray analysis alone can be used only after  $70 \text{ s/mm}^2$  have been exceeded for a particular sample.)

j. If a diffraction pattern was recorded on film, record the micrograph number on the count sheet.

k. If an electron diffraction was attempted but no pattern was observed, record N on the count sheet.

l. If an EDXA spectrum was attempted but not observed, record N on the count sheet.

m. If an X-ray analysis spectrum is stored, record the file and disk number on the count sheet.

#### 10. Classification Rules.

a. *Fiber*. A structure having a minimum length greater than or equal to  $0.5 \mu\text{m}$  and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

b. *Bundle*. A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

c. *Cluster*. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

d. *Matrix*. Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

11. After finishing with a grid, remove it from the microscope, and replace it in the appropriate grid holder. Sample grids must be stored for a minimum of 1 year from the date of the analysis; the sample cassette must be retained for a minimum of 30 days by the laboratory or returned at the client's request.

#### G. Sample Analytical Sequence

1. Under the present sampling requirements a minimum of 13 samples is to be collected for the clearance testing of an abatement site. These include five abatement area samples, five ambient samples, two field blanks, and one sealed blank.

2. Carry out visual inspection of work site prior to air monitoring.

3. Collect a minimum of 5 air samples inside the work site and 5 samples

outside the work site. The indoor and outdoor samples shall be taken during the same time period.

4. Remaining steps in the analytical sequence are contained in Unit IV of this Appendix.

#### H. Reporting

1. The following information must be reported to the client for each sample analyzed:

a. Concentration in structures per square millimeter and structures per cubic centimeter.

b. Analytical sensitivity used for the analysis.

c. Number of asbestos structures.

d. Area analyzed.

e. Volume of air sampled (which must be initially supplied to lab by client).

f. Copy of the count sheet must be included with the report.

g. Signature of laboratory official to indicate that the laboratory met specifications of the method.

h. Report form must contain official laboratory identification (e.g., letterhead).

i. Type of asbestos.

#### I. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards are to be performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the following Table III:

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TABLE III--SUMMARY OF LABORATORY DATA QUALITY OBJECTIVES

Unit Operation	QC Check	Frequency	Conformance Expectation
Sample receiving	Review of receiving report	Each sample	95% complete
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample preparation	Supplies and reagents	On receipt	Meet specs. or reject
	Grid opening size	20 openings/20 grids/lot of 1000 or 1 opening/sample	100%
	Special clean area monitoring	After cleaning or service	Meet specs or reclean
	Laboratory blank	1 per prep series or 10%	Meet specs. or reanalyze series
	Plasma etch blank	1 per 20 samples	75%
	Multiple preps (3 per sample)	Each sample	One with cover of 15 complete grid sqs.
Sample analysis	System check	Each day	Each day
	Alignment check	Each day	Each day
	Magnification calibration with low and high standards	Each month or after service	95%
	ED calibration by gold standard	Weekly	95%
	EDS calibration by copper line	Daily	95%
Performance check	Laboratory blank (measure of cleanliness)	Prep 1 per series or 10% read 1 per 25 samples	Meet specs or reanalyze series
	Replicate counting (measure of precision)	1 per 100 samples	1.5 x Poisson Std. Dev.
	Duplicate analysis (measure of reproducibility)	1 per 100 samples	2 x Poisson Std. Dev.
	Known samples of typical materials (working standards)	Training and for comparison with unknowns	100%
	Analysis of NBS SRM 1876 and/or RM 8410 (measure of accuracy and comparability)	1 per analyst per year	1.5 x Poisson Std. Dev.
	Data entry review (data validation and measure of completeness)	Each sample	95%
	Record and verify ID electron diffraction pattern of structure	1 per 5 samples	80% accuracy
Calculations and data reduction	Hand calculation of automated data reduction procedure or independent recalculation of hand-calculated data	1 per 100 samples	85%

1. When the samples arrive at the laboratory, check the samples and documentation for completeness and requirements before initiating the analysis.
  2. Check all laboratory reagents and supplies for acceptable asbestos background levels.
  3. Conduct all sample preparation in a clean room environment monitored by laboratory blanks. Testing with blanks must also be done after cleaning or servicing the room.
  4. Prepare multiple grids of each sample.
  5. Provide laboratory blanks with each sample batch. Maintain a cumulative average of these results. If there are more than 53 fibers/mm<sup>2</sup> per 10 200-mesh grid openings, the system must be checked for possible sources of contamination.
  6. Perform a system check on the transmission electron microscope daily.
  7. Make periodic performance checks of magnification, electron diffraction and energy dispersive X-ray systems as set forth in Table III under Unit II.I.
  8. Ensure qualified operator performance by evaluation of replicate analysis and standard sample comparisons as set forth in Table III under Unit II.I.
  9. Validate all data entries.
  10. Recalculate a percentage of all computations and automatic data reduction steps as specified in Table III under Unit II.I.
  11. Record an electron diffraction pattern of one asbestos structure from every five samples that contain asbestos. Verify the identification of the pattern by measurement or comparison of the pattern with patterns collected from standards under the same conditions. The records must also demonstrate that the identification of the pattern has been verified by a qualified individual and that the operator who made the identification is maintaining at least an 80 percent correct visual identification based on his measured patterns.
  12. Appropriate logs or records must be maintained by the analytical laboratory verifying that it is in compliance with the mandatory quality assurance procedures.
- J. References**
- For additional background information on this method, the following references should be consulted.
1. "Guidance for Controlling Asbestos-Containing Materials in Buildings," EPA 560/5-85-024, June 1985.
  2. "Measuring Airborne Asbestos Following an Abatement Action,"

USEPA, Office of Toxic Substances, EPA 600/4-85-049, 1985.

3. Small, John and E. Steel. Asbestos Standards: Materials and Analytical Methods. N.B.S. Special Publication 619, 1982.

4. Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjoberg. Selected Silicate Minerals and Their Asbestiform Varieties. Information Circular 8751, U.S. Bureau of Mines, 1977.

5. Quality Assurance Handbook for Air Pollution Measurement System. Ambient Air Methods, EPA 600/4-77-027a, USEPA, Office of Research and Development, 1977.

6. Method 2A: Direct Measurement of Gas Volume through Pipes and Small Ducts. 40 CFR Part 60 Appendix A.

7. Burdette, G.J., Health & Safety Exec. Research & Lab. Services Div., London, "Proposed Analytical Method for Determination of Asbestos in Air."

8. Chatfield, E.J., Chatfield Tech. Cons., Ltd., Clark, T., PEI Assoc., "Standard Operating Procedure for Determination of Airborne Asbestos Fibers by Transmission Electron Microscopy Using Polycarbonate Membrane Filters," WERL SOP 87-1, March 5, 1987.

9. NIOSH Method 7402 for Asbestos Fibers, 12-11-86 Draft.

10. Yamate, G., Agarwal, S.C., Gibbons, R.D., IIT Research Institute, "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," Draft report, USEPA Contract 68-02-3266, July 1984.

11. "Guidance to the Preparation of Quality Assurance Project Plans," USEPA, Office of Toxic Substances, 1984.

### III. Nonmandatory Transmission Electron Microscopy Method

#### A. Definitions of Terms

1. "Analytical sensitivity"—Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 s/cm<sup>3</sup>.
2. "Asbestiform"—A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.
3. "Aspect ratio"—A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.
4. "Bundle"—A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. "Clean area"—A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm<sup>2</sup> in an area of 0.057 mm<sup>2</sup> (nominally 10 200 mesh grid openings) and a maximum of 53 structures/mm<sup>2</sup> for no more than one single preparation for that same area.

6. "Cluster"—A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

7. "ED"—Electron diffraction.

8. "EDXA"—Energy dispersive X-ray analysis.

9. "Fiber"—A structure greater than or equal to 0.5 μm in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. "Grid"—An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. "Intersection"—Nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. "Laboratory sample coordinator"—That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. "Filter background level"—The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on blanks (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm<sup>2</sup>.

14. "Matrix"—Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. "NSD"—No structure detected.

16. "Operator"—A person responsible for the TEM instrumental analysis of the sample.

17. "PCM"—Phase contrast microscopy.

18. "SAED"—Selected area electron diffraction.

19. "SEM"—Scanning electron microscope.

20. "STEM"—Scanning transmission electron microscope.

21. "Structure"—a microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. "S/cm<sup>3</sup>"—Structures per cubic centimeter.

23. "S/mm<sup>2</sup>"—Structures per square millimeter.

24. "TEM"—Transmission electron microscope.

#### B. Sampling

1. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (See References 1, 2, and 5 of Unit III.L.) Special precautions should be taken to avoid contamination of the sample. For example, materials that have not been prescreened for their asbestos background content should not be used; also, sample handling procedures which do not take cross contamination possibilities into account should not be used.

2. Material and supply checks for asbestos contamination should be made on all critical supplies, reagents, and procedures before their use in a monitoring study.

3. Quality control and quality assurance steps are needed to identify problem areas and isolate the cause of the contamination (see Reference 5 of Unit III.L.). Control checks shall be permanently recorded to document the quality of the information produced. The sampling firm must have written quality control procedures and documents which verify compliance. Independent audits by a qualified consultant or firm should be performed once a year. All documentation of compliance should be retained indefinitely to provide a guarantee of quality. A summary of Sample Data Quality Objectives is shown in Table II of Unit II.B.

#### 4. Sampling materials.

a. Sample for airborne asbestos following an abatement action using commercially available cassettes.

b. Use either a cowl or a filter-retaining middle piece. Conductive material may reduce the potential for particulates to adhere to the walls of the cowl.

c. Cassettes must be verified as "clean" prior to use in the field. If packaged filters are used for loading or preloaded cassettes are purchased from the manufacturer or a distributor, the manufacturer's name and lot number should be entered on all field data sheets provided to the laboratory, and are required to be listed on all reports from the laboratory.

d. Assemble the cassettes in a clean facility (See definition of clean area under Unit III.A.).

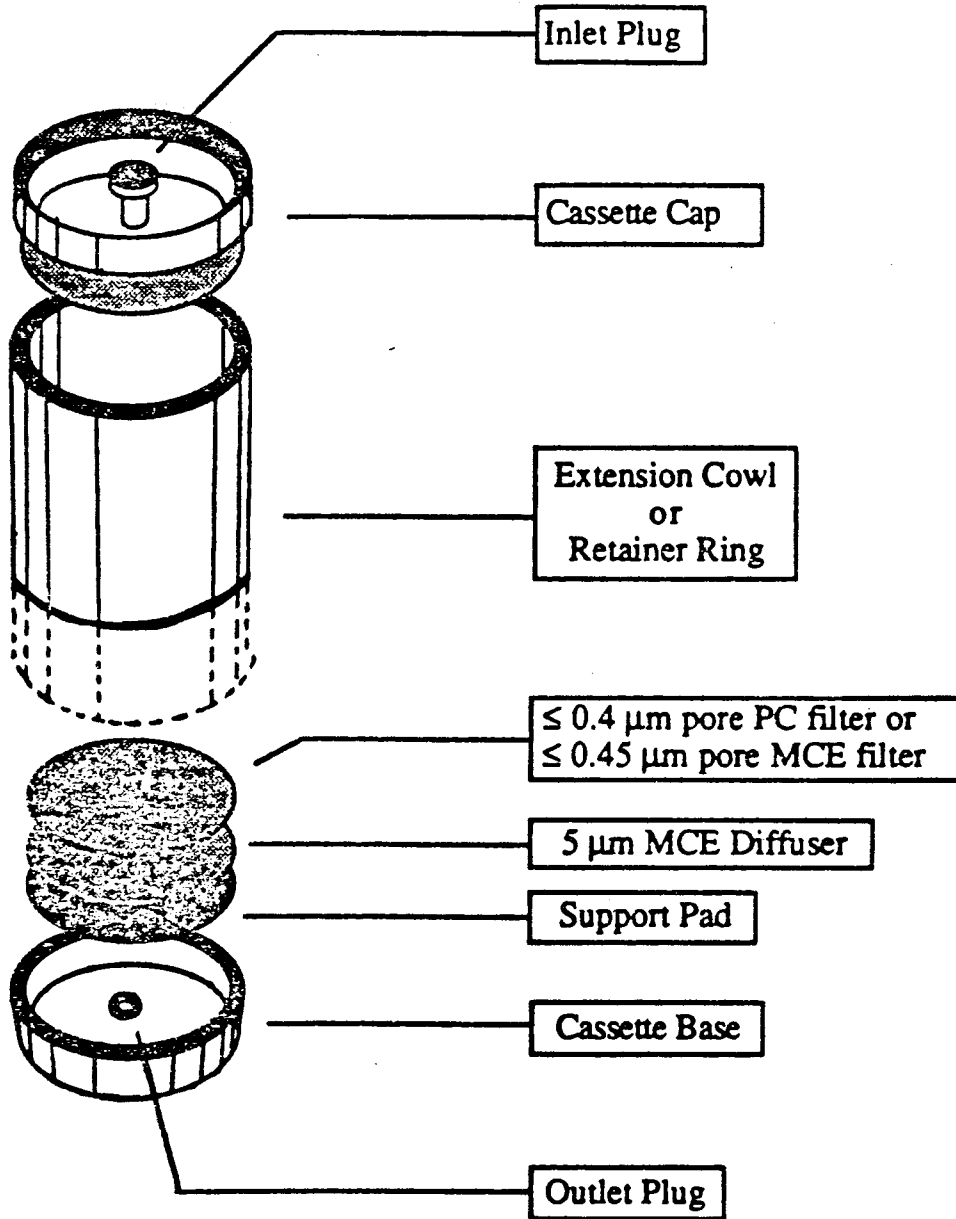
e. Reloading of used cassettes is not permitted.

f. Use sample collection filters which are either polycarbonate having a pore size of less than or equal to 0.4  $\mu\text{m}$  or mixed cellulose ester having a pore size of less than or equal to 0.45  $\mu\text{m}$ .

g. Place these filters in series with a backup filter with a pore size of 5.0  $\mu\text{m}$  (to serve as a diffuser) and a support pad. See the following Figure 1:

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FIGURE I--SAMPLING CASSETTE CONFIGURATION





h. When polycarbonate filters are used, position the highly reflective face such that the incoming particulate is received on this surface.

i. Seal the cassettes to prevent leakage around the filter edges or between cassette part joints. A mechanical press may be useful to achieve a reproducible leak-free seal. Shrink fit gel-bands may be used for this purpose and are available from filter manufacturers and their authorized distributors.

j. Use wrinkle-free loaded cassettes in the sampling operation.

#### 5. Pump setup.

a. Calibrate the sampling pump over the range of flow rates and loads anticipated for the monitoring period with this flow measuring device in

series. Perform this calibration using guidance from EPA Method 2A each time the unit is sent to the field (See Reference 6 of Unit III.L.).

b. Configure the sampling system to preclude pump vibrations from being transmitted to the cassette by using a sampling stand separate from the pump station and making connections with flexible tubing.

c. Maintain continuous smooth flow conditions by damping out any pump action fluctuations if necessary.

d. Check the sampling system for leaks with the end cap still in place and the pump operating before initiating sample collection. Trace and stop the source of any flow indicated by the flowmeter under these conditions.

e. Select an appropriate flow rate equal to or greater than 1 L/min or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

f. Orient the cassette downward at approximately 45 degrees from the horizontal.

g. Maintain a log of all pertinent sampling information, such as pump identification number, calibration data, sample location, date, sample identification number, flow rates at the beginning, middle, and end, start and stop times, and other useful information or comments. Use of a sampling log form is recommended. See the following Figure 2:

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h. Initiate a chain of custody procedure at the start of each sampling, if this is requested by the client.

i. Maintain a close check of all aspects of the sampling operation on a regular basis.

j. Continue sampling until at least the minimum volume is collected, as specified in the following Table I:

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TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS (0.0057 MM<sup>2</sup>) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA

Effective Filter Area 385 sq mm		Effective Filter Area 855 sq mm	
Volume (liters)	# of grid openings	Volume (liters)	# of grid openings
560	24	1,250	24
600	23	1,300	23
700	19	1,400	21
800	17	1,600	19
900	15	1,800	17
1,000	14	2,000	15
1,100	12	2,200	14
1,200	11	2,400	13
1,300	10	2,600	12
1,400	10	2,800	11
1,500	9	3,000	10
1,600	8	3,200	9
1,700	8	3,400	9
1,800	8	3,600	8
1,900	7	3,800	8
2,000	7	4,000	8
2,100	6	4,200	7
2,200	6	4,400	7
2,300	6	4,600	7
2,400	6	4,800	6
2,500	5	5,000	6
2,600	5	5,200	6
2,700	5	5,400	6
2,800	5	5,600	5
2,900	5	5,800	5
3,000	5	6,000	5
3,100	4	6,200	5
3,200	4	6,400	5
3,300	4	6,600	5
3,400	4	6,800	4
3,500	4	7,000	4
3,600	4	7,200	4
3,700	4	7,400	4
3,800	4	7,600	4

Note minimum volumes required:  
 25 mm : 560 liters  
 37 mm : 1250 liters

Filter diameter of 25 mm = effective area of 385 sq mm  
 Filter diameter of 37 mm = effective area of 855 sq mm

k. At the conclusion of sampling, turn cassette upward before stopping the / to minimize possible particle loss. After the sampling is resumed, restart the flow before reorienting the cassette downward. Note the condition of the filter at the conclusion of sampling.

l. Double check to see that all information has been recorded on the data collection forms and that the cassette is securely closed and appropriately identified using a waterproof label. Protect cassettes in individual clean resealed polyethylene bags. Bags are to be used for storing cassette caps when they are removed for sampling purposes. Caps and plugs should only be removed or replaced using clean hands or clean disposable plastic gloves.

m. Do not change containers if portions of these filters are taken for other purposes.

6. Minimum sample number per site. A minimum of 13 samples are to be collected for each testing consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

Two field blanks are to be taken by removing the cap for not more than 30 sec and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each ambient area.

ii. At one of the ambient sites.

(Note: Do not leave the blank open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

#### 7. Abatement area sampling.

a. Conduct final clearance sampling only after the primary containment barriers have been removed; the abatement area has been thoroughly dried; and, it has passed visual inspection tests by qualified personnel. (See Reference 1 of Unit III.L.)

b. Containment barriers over windows, doors, and air passageways must remain in place until the TEM clearance sampling and analysis is completed and results meet clearance test criteria. The final plastic barrier remains in place for the sampling period.

c. Select sampling sites in the abatement area on a random basis to provide unbiased and representative sites.

After the area has passed a thorough visual inspection, use

aggressive sampling conditions to dislodge any remaining dust.

i. Equipment used in aggressive sampling such as a leaf blower and/or fan should be properly cleaned and decontaminated before use.

ii. Air filtration units shall remain on during the air monitoring period.

iii. Prior to air monitoring, floors, ceiling and walls shall be swept with the exhaust of a minimum one (1) horsepower leaf blower.

iv. Stationary fans are placed in locations which will not interfere with air monitoring equipment. Fan air is directed toward the ceiling. One fan shall be used for each 10,000 ft<sup>3</sup> of worksite.

v. Monitoring of an abatement work area with high-volume pumps and the use of circulating fans will require electrical power. Electrical outlets in the abatement area may be used if available. If no such outlets are available, the equipment must be supplied with electricity by the use of extension cords and strip plug units. All electrical power supply equipment of this type must be approved Underwriter Laboratory equipment that has not been modified. All wiring must be grounded. Ground fault interrupters should be used. Extreme care must be taken to clean up any residual water and ensure that electrical equipment does not become wet while operational.

vi. Low volume pumps may be carefully wrapped in 6-mil polyethylene to insulate the pump from the air. High volume pumps cannot be sealed in this manner since the heat of the motor may melt the plastic. The pump exhausts should be kept free.

vii. If recleaning is necessary, removal of this equipment from the work area must be handled with care. It is not possible to completely decontaminate the pump motor and parts since these areas cannot be wetted. To minimize any problems in this area, all equipment such as fans and pumps should be carefully wet wiped prior to removal from the abatement area. Wrapping and sealing low volume pumps in 6-mil polyethylene will provide easier decontamination of this equipment. Use of clean water and disposable wipes should be available for this purpose.

e. Pump flow rate equal to or greater than 1 L/min or less than 10 L/min may be used for 25 mm cassettes. The larger cassette diameters may have comparably increased flow.

f. Sample a volume of air sufficient to ensure the minimum quantitation limits. (See Table I of Unit III.B.5.j.)

#### 8. Ambient sampling.

a. Position ambient samplers at locations representative of the air

entering the abatement site. If makeup air entering the abatement site is drawn from another area of the building which is outside of the abatement area, place the pumps in the building, pumps should be placed out of doors located near the building and away from any obstructions that may influence wind patterns. If construction is in progress immediately outside the enclosure, it may be necessary to select another ambient site. Samples should be representative of any air entering the work site.

b. Locate the ambient samplers at least 3 ft apart and protect them from adverse weather conditions.

c. Sample same volume of air as samples taken inside the abatement site.

#### C. Sample Shipment

1. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

2. Select a rigid shipping container and pack the cassettes upright in a noncontaminating nonfibrous medium such as a bubble pack. The use of resealable polyethylene bags may help to prevent jostling of individual cassettes.

3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.

4. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.

5. Hand-carry samples to the laboratory in an upright position if possible; otherwise choose that mode of transportation least likely to jar the samples in transit.

6. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain of custody and sample tracking procedures. This will also help the laboratory schedule timely analysis for the samples when they are received.

#### D. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of

sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards is performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined, and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the text below.

1. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm<sup>2</sup> in an area of 0.057 mm<sup>2</sup> (nominally 10 200-mesh grid openings) and a maximum of 53 s/mm<sup>2</sup> for that same area for any single preparation is acceptable for this method.

2. Calibrate sampling pumps and their flow indicators over the range of their intended use with a recognized standard. Assemble the sampling system with a representative filter—not the filter which will be used in

sampling—before and after the sampling operation.

3. Record all calibration information with the data to be used on a standard sampling form.

4. Ensure that the samples are stored in a secure and representative location.

5. Ensure that mechanical calibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

6. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by installing a damping chamber if necessary.

7. Open a loaded cassette momentarily at one of the indoor sampling sites when sampling is initiated. This sample will serve as an indoor field blank.

8. Open a loaded cassette momentarily at one of the outdoor sampling sites when sampling is initiated. This sample will serve as an outdoor field blank.

9. Carry a sealed blank into the field with each sample series. Do not open this cassette in the field.

10. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

11. Ensure that the sampler is turned upright before interrupting the pump flow.

12. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

#### E. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Adhere to the following procedures to ensure both the continued chain-of-custody and the accountability of all samples passing through the laboratory:

a. Note the condition of the shipping package and data written on it upon receipt.

b. Retain all bills of lading or shipping slips to document the shipper and delivery time.

c. Examine the chain-of-custody seal, if any, and the package for its integrity.

d. If there has been a break in the seal or substantive damage to the package, the sample coordinator shall immediately notify the shipper and a responsible laboratory manager before any action is taken to unpack the shipment.

e. Packages with significant damage shall be accepted only by the responsible laboratory manager after discussions with the client.

3. Unwrap the shipment in a clean, uncluttered facility. The sample coordinator or his or her designee will record the contents, including a description of each item and all identifying numbers or marks. A Sample Receiving Form to document this information is attached for use when necessary. (See the following Figure 3.)

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FIGURE 3--SAMPLE RECEIVING FORM

Date of package delivery \_\_\_\_\_ Package shipped from \_\_\_\_\_  
 Carrier \_\_\_\_\_ Shipping bill retained \_\_\_\_\_  
 \*Condition of package on receipt \_\_\_\_\_  
 \*Condition of custody seal \_\_\_\_\_  
 Number of samples received \_\_\_\_\_ Shipping manifest attached \_\_\_\_\_  
 Purchase Order No. \_\_\_\_\_ Project I.D. \_\_\_\_\_  
 Comments \_\_\_\_\_

No.	Description	Sampling Medium		Sampled Volume Liters	Receiving ID #	Assigned #
		PC	MCE			
1	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____	_____
11	_____	_____	_____	_____	_____	_____
12	_____	_____	_____	_____	_____	_____
13	_____	_____	_____	_____	_____	_____

(Use as many additional sheets as needed.)

Comments \_\_\_\_\_  
 Date of acceptance into sample bank \_\_\_\_\_  
 Signature of chain-of-custody recipient \_\_\_\_\_  
 Disposition of samples \_\_\_\_\_

\*Note: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.

**Note.**—The person breaking the chain-of-custody seal and itemizing the contents assumes responsibility for the shipment and signs documents accordingly.

4. Assign a laboratory number and schedule an analysis sequence.

5. Manage all chain-of-custody samples within the laboratory such that their integrity can be ensured and documented.

#### F. Sample Preparation

1. Personnel not affiliated with the Abatement Contractor shall be used to prepare samples and conduct TEM analysis. Wet-wipe the exterior of the cassettes to minimize contamination possibilities before taking them to the clean sample preparation facility.

2. Perform sample preparation in a well-equipped clean facility.

**Note.**—The clean area is required to have the following minimum characteristics. The area or hood must be capable of maintaining a positive pressure with make-up air being HEPA filtered. The cumulative analytical blank concentration must average less than 18 s/mm<sup>2</sup> in an area of 0.057 s/mm<sup>2</sup> (nominally 10 200-mesh grid openings) with no more than one single preparation to exceed 53 s/mm<sup>2</sup> for that same area.

3. Preparation areas for air samples must be separated from preparation areas for bulk samples. Personnel must not prepare air samples if they have previously been preparing bulk samples without performing appropriate personal hygiene procedures, i.e., clothing change, showering, etc.

4. Preparation. Direct preparation techniques are required. The objective is to produce an intact carbon film containing the particulates from the filter surface which is sufficiently clear for TEM analysis. Currently recommended direct preparation procedures for polycarbonate (PC) and mixed cellulose ester (MCE) filters are described in Unit III.F.7. and 8. Sample preparation is a subject requiring additional research. Variation on those steps which do not substantively change the procedure, which improve filter clearing or which reduce contamination problems in a laboratory are permitted.

a. Use only TEM grids that have had grid opening areas measured according to directions in Unit III.J.

b. Remove the inlet and outlet plugs prior to opening the cassette to minimize any pressure differential that may be present.

c. Examples of techniques used to prepare polycarbonate filters are described in Unit III.F.7.

d. Examples of techniques used to prepare mixed cellulose ester filters are described in Unit III.F.8.

e. Prepare multiple grids for each sample.

f. Store the three grids to be measured in appropriately labeled grid holders or polyethylene capsules.

#### 5. Equipment.

a. Clean area.

b. Tweezers. Fine-point tweezers for handling of filters and TEM grids.

c. Scalpel Holder and Curved No. 10 Surgical Blades.

d. Microscope slides.

e. Double-coated adhesive tape.

f. Gummed page reinforcements.

g. Micro-pipet with disposal tips 10 to 100  $\mu$ L variable volume.

h. Vacuum coating unit with facilities for evaporation of carbon. Use of a liquid nitrogen cold trap above the diffusion pump will minimize the possibility of contamination of the filter surface by oil from the pumping system. The vacuum-coating unit can also be used for deposition of a thin film of gold.

i. Carbon rod electrodes. Spectrochemically pure carbon rods are required for use in the vacuum evaporator for carbon coating of filters.

j. Carbon rod sharpener. This is used to sharpen carbon rods to a neck. The use of necked carbon rods (or equivalent) allows the carbon to be applied to the filters with a minimum of heating.

k. Low-temperature plasma asher. This is used to etch the surface of collapsed mixed cellulose ester (MCE) filters. The asher should be supplied with oxygen, and should be modified as necessary to provide a throttle or bleed valve to control the speed of the vacuum to minimize disturbance of the filter. Some early models of ashers admit air too rapidly, which may disturb particulates on the surface of the filter during the etching step.

l. Glass petri dishes, 10 cm in diameter, 1 cm high. For prevention of excessive evaporation of solvent when these are in use, a good seal must be provided between the base and the lid. The seal can be improved by grinding the base and lid together with an abrasive grinding material.

m. Stainless steel mesh.

n. Lens tissue.

o. Copper 200-mesh TEM grids, 3 mm in diameter, or equivalent.

p. Gold 200-mesh TEM grids, 3 mm in diameter, or equivalent.

q. Condensation washer.

r. Carbon-coated, 200-mesh TEM grids, or equivalent.

s. Analytical balance, 0.1 mg sensitivity.

t. Filter paper, 9 cm in diameter.

u. Oven or slide warmer. Must be capable of maintaining a temperature of 65–70 °C.

v. Polyurethane foam, 6 mm thickness.

w. Gold wire for evaporation.

#### 6. Reagents.

a. General. A supply of ultra-clean, fiber-free water must be available for washing of all components used in the analysis. Water that has been distilled in glass or filtered or deionized water is satisfactory for this purpose. Reagents must be fiber-free.

b. Polycarbonate preparation method—chloroform.

c. Mixed Cellulose Ester (MCE) preparation method—acetone or the Burdette procedure (Ref. 7 of Unit III.L.).

7. TEM specimen preparation from polycarbonate filters.

a. Specimen preparation laboratory. It is most important to ensure that contamination of TEM specimens by extraneous asbestos fibers is minimized during preparation.

b. Cleaning of sample cassettes. Upon receipt at the analytical laboratory and before they are taken into the clean facility or laminar flow hood, the sample cassettes must be cleaned of any contamination adhering to the outside surfaces.

c. Preparation of the carbon evaporator. If the polycarbonate filter has already been carbon-coated prior to receipt, the carbon coating step will be omitted, unless the analyst believes the carbon film is too thin. If there is a need to apply more carbon, the filter will be treated in the same way as an uncoated filter. Carbon coating must be performed with a high-vacuum coating unit. Units that are based on evaporation of carbon filaments in a vacuum generated only by an oil rotary pump have not been evaluated for this application, and must not be used. The carbon rods should be sharpened by a carbon rod sharpener to necks of about 4 mm long and 1 mm in diameter. The rods are installed in the evaporator in such a manner that the points are approximately 10 to 12 cm from the surface of a microscope slide held in the rotating and tilting device.

d. Selection of filter area for carbon coating. Before preparation of the filters, a 75 mm x 50 mm microscope slide is washed and dried. This slide is used to support strips of filter during the carbon evaporation. Two parallel strips of double-sided adhesive tape are applied along the length of the slide. Polycarbonate filters are easily stretched during handling, and cutting of areas for further preparation must be performed with great care. The filter and the MCE backing filter are removed together from the cassette and placed on a cleaned glass microscope slide. The filter can be cut with a curved scalpel blade by rocking the blade from the



point placed in contact with the filter.

The process can be repeated to cut a strip approximately 3 mm wide across the diameter of the filter. The strip of polycarbonate filter is separated from the corresponding strip of backing filter and carefully placed so that it bridges the gap between the adhesive tape strips on the microscope slide. The filter strip can be held with fine-point tweezers and supported underneath by the scalpel blade during placement on the microscope slide. The analyst can place several such strips on the same microscope slide, taking care to rinse and wet-wipe the scalpel blade and tweezers before handling a new sample. The filter strips should be identified by etching the glass slide or marking the slide using a marker insoluble in water and solvents. After the filter strip has been cut from each filter, the residual parts of the filter must be returned to the cassette and held in position by reassembly of the cassette. The cassette will then be archived for a period of 30 days or returned to the client upon request.

e. Carbon coating of filter strips. The glass slide holding the filter strips is placed on the rotation-tilting device, and the evaporator chamber is evacuated. The evaporation must be performed in very short bursts, separated by some seconds to allow the electrodes to cool. If evaporation is too rapid, the strips of polycarbonate filter will begin to curl, which will lead to cross-linking of the surface material and make it relatively insoluble in chloroform. An experienced analyst can judge the thickness of carbon film to be applied, and some test should be made first on unused filters. If the film is too thin, large particles will be lost from the TEM specimen, and there will be few complete and undamaged grid openings on the specimen. If the coating is too thick, the filter will tend to curl when exposed to chloroform vapor and the carbon film may not adhere to the support mesh. Too thick a carbon film will also lead to a TEM image that is lacking in contrast, and the ability to obtain ED patterns will be compromised. The carbon film should be as thin as possible and remain intact on most of the grid openings of the TEM specimen intact.

f. Preparation of the Jaffe washer. The precise design of the Jaffe washer is not considered important, so any one of the published designs may be used. A washer consisting of a simple stainless steel bridge is recommended. Several pieces of lens tissue approximately 1.0 x 0.5 cm are placed on the stainless steel bridge, and the washer is filled with chloroform to a level where the

meniscus contacts the underside of the mesh, which results in saturation of the lens tissue. See References 8 and 10 of Unit III.L.

g. Placing of specimens into the Jaffe washer. The TEM grids are first placed on a piece of lens tissue so that individual grids can be picked up with tweezers. Using a curved scalpel blade, the analyst excises three 3 mm square pieces of the carbon-coated polycarbonate filter from the filter strip. The three squares are selected from the center of the strip and from two points between the outer periphery of the active surface and the center. The piece of filter is placed on a TEM specimen grid with the shiny side of the TEM grid facing upwards, and the whole assembly is placed boldly onto the saturated lens tissue in the Jaffe washer. If carbon-coated grids are used, the filter should be placed carbon-coated side down. The three excised squares of filters are placed on the same piece of lens tissue. Any number of separate pieces of lens tissue may be placed in the same Jaffe washer. The lid is then placed on the Jaffe washer, and the system is allowed to stand for several hours, preferably overnight.

h. Condensation washing. It has been found that many polycarbonate filters will not dissolve completely in the Jaffe washer, even after being exposed to chloroform for as long as 3 days. This problem becomes more serious if the surface of the filter was overheated during the carbon evaporation. The presence of undissolved filter medium on the TEM preparation leads to partial or complete obscuration of areas of the sample, and fibers that may be present in these areas of the specimen will be overlooked; this will lead to a low result. Undissolved filter medium also compromises the ability to obtain ED patterns. Before they are counted, TEM grids must be examined critically to determine whether they are adequately cleared of residual filter medium. It has been found that condensation washing of the grids after the initial Jaffe washer treatment, with chloroform as the solvent, clears all residual filter medium in a period of approximately 1 hour. In practice, the piece of lens tissue supporting the specimen grids is transferred to the cold finger of the condensation washer, and the washer is operated for about 1 hour. If the specimens are cleared satisfactorily by the Jaffe washer alone, the condensation washer step may be unnecessary.

8. TEM specimen preparation from MCE filters.

a. This method of preparing TEM specimens from MCE filters is similar to

that specified in NIOSH Method 7402. See References 7, 8, and 9 of Unit III.L.

b. Upon receipt at the analytical laboratory, the sample cassettes must be cleaned of any contamination adhering to the outside surfaces before entering the clean sample preparation area.

c. Remove a section from any quadrant of the sample and blank filters.

d. Place the section on a clean microscope slide. Affix the filter section to the slide with a gummed paged reinforcement or other suitable means. Label the slide with a water and solvent-proof marking pen.

e. Place the slide in a petri dish which contains several paper filters soaked with 2 to 3 mL acetone. Cover the dish. Wait 2 to 4 minutes for the sample filter to fuse and clear.

f. Plasma etching of the collapsed filter is required.

i. The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher. Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the conditions that should be used. This is one area of the method that requires further evaluation. Insufficient etching will result in a failure to expose embedded filters, and too much etching may result in loss of particulate from the surface. As an interim measure, it is recommended that the time for ashing of a known weight of a collapsed filter be established and that the etching rate be calculated in terms of micrometers per second. The actual etching time used for a particular asher and operating conditions will then be set such that a 1-2  $\mu\text{m}$  (10 percent) layer of collapsed surface will be removed.

ii. Place the slide containing the collapsed filters into a low-temperature plasma asher, and etch the filter.

g. Transfer the slide to a rotating stage inside the bell jar of a vacuum evaporator. Evaporate a 1 mm x 5 mm section of graphite rod onto the cleared filter. Remove the slide to a clean, dry, covered petri dish.

h. Prepare a second petri dish as a Jaffe washer with the wicking substrate prepared from filter or lens paper placed on top of a 6 mm thick disk of clean spongy polyurethane foam. Cut a V-notch on the edge of the foam and filter paper. Use the V-notch as a reservoir for adding solvent. The wicking substrate should be thin enough to fit into the petri dish without touching the lid.

i. Place carbon-coated TEM grids face up on the filter or lens paper. Label the grids by marking with a pencil on the filter paper or by putting registration

marks on the petri dish lid and marking with a waterproof marker on the dish lid. In a fume hood, fill the dish with acetone until the wicking substrate is saturated. The level of acetone should be just high enough to saturate the filter paper without creating puddles.

j. Remove about a quarter section of the carbon-coated filter samples from the glass slides using a surgical knife and tweezers. Carefully place the section of the filter, carbon side down, on the appropriately labeled grid in the acetone-saturated petri dish. When all filter sections have been transferred, slowly add more solvent to the wedge-shaped trough to bring the acetone level up to the highest possible level without disturbing the sample preparations. Cover the petri dish. Elevate one side of the petri dish by placing a slide under it. This allows drops of condensed solvent vapors to form near the edge rather than

in the center where they would drip onto the grid preparation.

#### G. TEM Method

##### 1. Instrumentation.

a. Use an 80-120 kV TEM capable of performing electron diffraction with a fluorescent screen inscribed with calibrated gradations. If the TEM is equipped with EDXA it must either have a STEM attachment or be capable of producing a spot less than 250 nm in diameter at crossover. The microscope shall be calibrated routinely (see Unit III.J.) for magnification and camera constant.

b. While not required on every microscope in the laboratory, the laboratory must have either one microscope equipped with energy dispersive X-ray analysis or access to an equivalent system on a TEM in another laboratory. This must be an Energy Dispersive X-ray Detector mounted on TEM column and associated

hardware/software to collect, save, and read out spectral information.

Calibration of Multi-Channel Analyzer shall be checked regularly for A1 at 1.48 KeV and Cu at 8.04 KeV, as well as the manufacturer's procedures.

i. Standard replica grating may be used to determine magnification (e.g., 2160 lines/mm).

ii. Gold standard may be used to determine camera constant.

c. Use a specimen holder with single tilt and/or double tilt capabilities.

##### 2. Procedure.

a. Start a new Count Sheet for each sample to be analyzed. Record on count sheet: analyst's initials and date; lab sample number; client sample number microscope identification; magnification for analysis; number of predetermined grid openings to be analyzed; and grid identification. See the following Figure 4:

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b. Check that the microscope is properly aligned and calibrated according to the manufacturer's specifications and instructions.

c. Microscope settings: 80-120 kV, grid assessment 250-1000X, then 15,000-20,000X screen magnification for analysis.

d. Approximately one-half (0.5) of the predetermined sample area to be analyzed shall be performed on one sample grid preparation and the remaining half on a second sample grid preparation.

e. Determine the suitability of the grid.

i. Individual grid openings with greater than 5 percent openings (holes) or covered with greater than 25 percent particulate matter or obviously having nonuniform loading shall not be analyzed.

ii. Examine the grid at low magnification (<1000X) to determine its suitability for detailed study at higher magnifications.

iii. Reject the grid if:

(1) Less than 50 percent of the grid openings covered by the replica are intact.

(2) It is doubled or folded.

(3) It is too dark because of incomplete dissolution of the filter.

iv. If the grid is rejected, load the next sample grid.

v. If the grid is acceptable, continue on to Step 6 if mapping is to be used; otherwise proceed to Step 7.

f. Grid Map (Optional).

i. Set the TEM to the low magnification mode.

ii. Use flat edge or finder grids for mapping.

iii. Index the grid openings (fields) to be counted by marking the acceptable fields for one-half (0.5) of the area needed for analysis on each of the two grids to be analyzed. These may be marked just before examining each grid opening (field), if desired.

iv. Draw in any details which will allow the grid to be properly oriented if it is reloaded into the microscope and a particular field is to be reliably identified.

g. Scan the grid.

i. Select a field to start the examination.

ii. Choose the appropriate magnification (15,000 to 20,000X screen magnification).

iii. Scan the grid as follows.

(1) At the selected magnification, make a series of parallel traverses across the field. On reaching the end of one traverse, move the image one window and reverse the traverse.

*Note.*—A slight overlap should be used so as not to miss any part of the grid opening (field).

(2) Make parallel traverses until the entire grid opening (field) has been scanned.

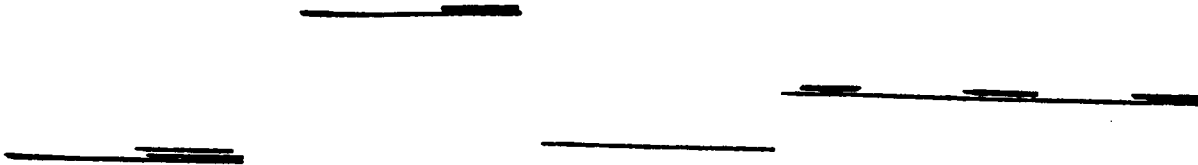
h. Identify each structure for appearance and size.

i. Appearance and size: Any continuous grouping of particles in which an asbestos fiber within aspect ratio greater than or equal to 5:1 and a length greater than or equal to 0.5  $\mu\text{m}$  is detected shall be recorded on the count sheet. These will be designated asbestos structures and will be classified as fibers, bundles, clusters, or matrices. Record as individual fibers any contiguous grouping having 0, 1, or 2 definable intersections. Groupings having more than 2 intersections are to be described as cluster or matrix. See the following Figure 5:

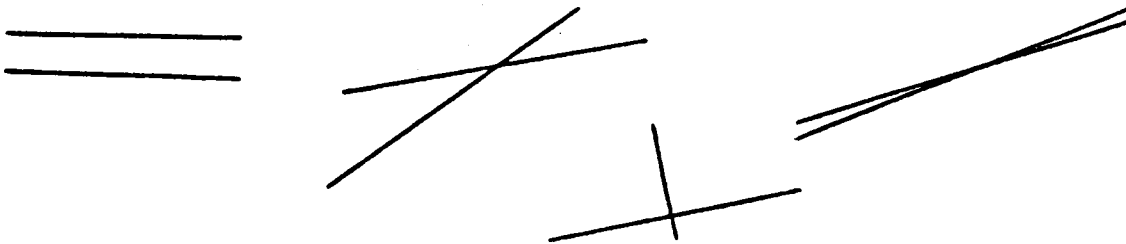
BILLING CODE 6560-50-M

FIGURE 5--COUNTING GUIDELINES USED IN DETERMINING ASBESTOS STRUCTURES

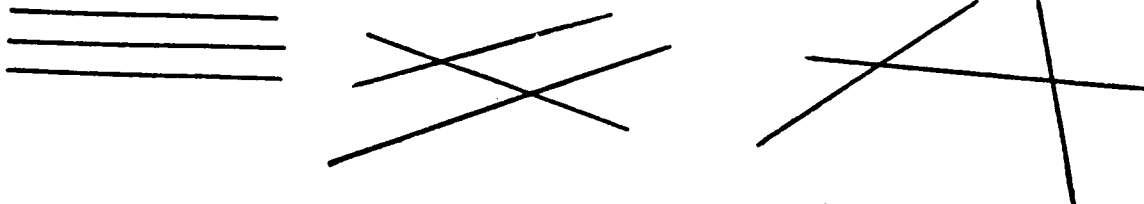
Count as 1 fiber; 1 Structure; no intersections.



Count as 2 fibers if space between fibers is greater than width of 1 fiber diameter or number of intersections is equal to or less than 1.



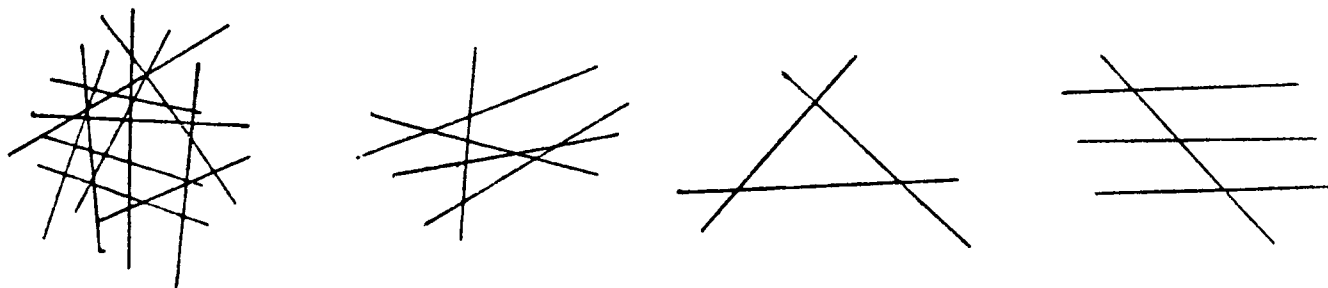
Count as 3 structures if space between fibers is greater than width of 1 fiber diameter or if the number of intersections is equal to or less than 2.



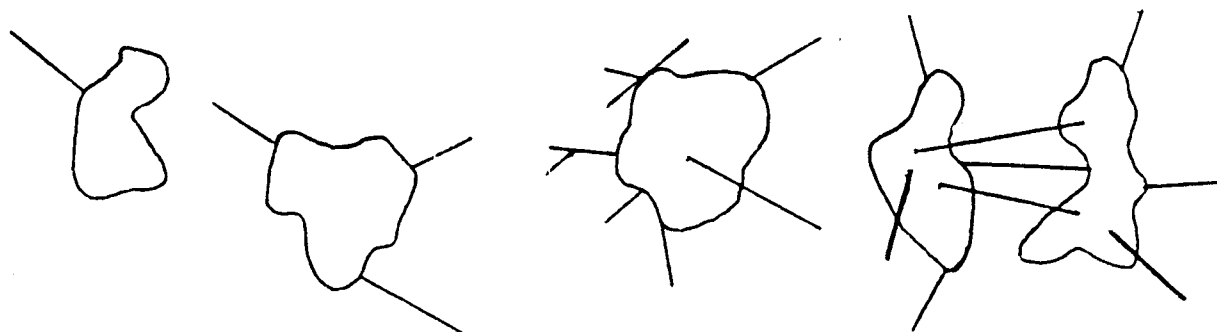
Count bundles as 1 structure; 3 or more parallel fibrils less than 1 fiber diameter separation.



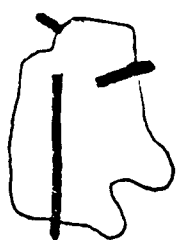
Count clusters as 1 structure; fibers having greater than or equal to 3 intersections.



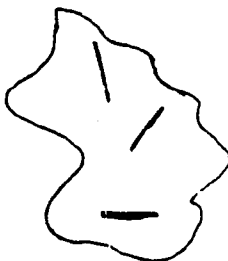
Count matrix as 1 structure.



DO NOT COUNT AS STRUCTURES:



Fiber protrusion  
<5:1 Aspect Ratio



No fiber protrusion



Fiber protrusion  
<0.5 micrometer

— <0.5 micrometer in length  
— <5:1 Aspect Ratio

An intersection is a non-parallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater. Combinations such as a matrix and cluster, matrix and bundle, or bundle and cluster are categorized by the dominant fiber quality—cluster, bundle, and matrix, respectively. Separate categories will be maintained for fibers less than 5  $\mu\text{m}$  and for fibers greater than or equal to 5  $\mu\text{m}$  in length. Not required, but useful, may be to record the fiber length in 1  $\mu\text{m}$  intervals. (Identify each structure morphologically and analyze it as it enters the "window".)

(1) *Fiber*. A structure having a minimum length greater than 0.5  $\mu\text{m}$  and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed, no intersections.

(2) *Bundle*. A structure composed of 3 or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

(3) *Cluster*. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group; groupings must have more than 2 intersections.

(4) *Matrix*. Fiber or fibers with one end free and the other end embedded in hidden by a particulate. The exposed fiber must meet the fiber definition.

(5) *NSD*. Record NSD when no structures are detected in the field.

(6) *Intersection*. Non-parallel touching or crossing of fibers, with the projection having an aspect ratio 5:1 or greater.

ii. Structure Measurement.

(1) Recognize the structure that is to be sized.

(2) Memorize its location in the "window" relative to the sides, inscribed square and to other particulates in the field so this exact location can be found again when scanning is resumed.

(3) Measure the structure using the scale on the screen.

(4) Record the length category and structure type classification on the count sheet after the field number and fiber number.

(5) Return the fiber to its original location in the window and scan the rest of the field for other fibers; if the direction of travel is not remembered, return to the right side of the field and begin the traverse again.

i. Visual identification of Electron Diffraction (ED) patterns is required for each asbestos structure counted which would cause the analysis to exceed the 70 s/mm<sup>2</sup> concentration. (Generally this means the first four fibers identified as asbestos must exhibit an identifiable

diffraction pattern for chrysotile or amphibole.)

i. Center the structure, focus, and obtain an ED pattern. (See Microscope Instruction Manual for more detailed instructions.)

ii. From a visual examination of the ED pattern, obtained with a short camera length, classify the observed structure as belonging to one of the following classifications: chrysotile, amphibole, or nonasbestos.

(1) *Chrysotile*: The chrysotile asbestos pattern has characteristic streaks on the layer lines other than the central line and some streaking also on the central line. There will be spots of normal sharpness on the central layer line and on alternate lines (2nd, 4th, etc.). The repeat distance between layer lines is 0.53 nm and the center doublet is at 0.73 nm. The pattern should display (002), (110), (130) diffraction maxima; distances and geometry should match a chrysotile pattern and be measured semiquantitatively.

(2) *Amphibole Group* [includes grunerite (amosite), crocidolite, anthophyllite, tremolite, and actinolite]: Amphibole asbestos fiber patterns show layer lines formed by very closely spaced dots, and the repeat distance between layer lines is also about 0.53 nm. Streaking in layer lines is occasionally present due to crystal structure defects.

(3) *Nonasbestos*: Incomplete or unobtainable ED patterns, a nonasbestos EDXA, or a nonasbestos morphology.

iii. The micrograph number of the recorded diffraction patterns must be reported to the client and maintained in the laboratory's quality assurance records. The records must also demonstrate that the identification of the pattern has been verified by a qualified individual and that the operator who made the identification is maintaining at least an 80 percent correct visual identification based on his measured patterns. In the event that examination of the pattern by the qualified individual indicates that the pattern had been misidentified visually, the client shall be contacted. If the pattern is a suspected chrysotile, take a photograph of the diffraction pattern at 0 degrees tilt. If the structure is suspected to be amphibole, the sample may have to be tilted to obtain a simple geometric array of spots.

j. *Energy Dispersive X-Ray Analysis (EDXA)*.

i. Required of all amphiboles which would cause the analysis results to exceed the 70 s/mm<sup>2</sup> concentration. (Generally speaking, the first 4 amphiboles would require EDXA.)

ii. Can be used alone to confirm chrysotile after the 70 s/mm<sup>2</sup> concentration has been exceeded.

iii. Can be used alone to confirm all nonasbestos.

iv. Compare spectrum profiles with profiles obtained from asbestos standards. The closest match identifies and categorizes the structure.

v. If the EDXA is used for confirmation, record the properly labeled spectrum on a computer disk, or if a hard copy, file with analysis data.

vi. If the number of fibers in the nonasbestos class would cause the analysis to exceed the 70 s/mm<sup>2</sup> concentration, their identities must be confirmed by EDXA or measurement of a zone axis diffraction pattern to establish that the particles are nonasbestos.

k. *Stopping Rules*.

i. If more than 50 asbestiform structures are counted in a particular grid opening, the analysis may be terminated.

ii. After having counted 50 asbestiform structures in a minimum of 4 grid openings, the analysis may be terminated. The grid opening in which the 50th fiber was counted must be completed.

iii. For blank samples, the analysis is always continued until 10 grid openings have been analyzed.

iv. In all other samples the analysis shall be continued until an analytical sensitivity of 0.005 s/cm<sup>3</sup> is reached.

l. *Recording Rules*. The count sheet should contain the following information:

i. *Field (grid opening)*: List field number.

ii. Record "NSD" if no structures are detected.

iii. *Structure information*.

(1) If fibers, bundles, clusters, and/or matrices are found, list them in consecutive numerical order, starting over with each field.

(2) *Length*. Record length category of asbestos fibers examined. Indicate if less than 5  $\mu\text{m}$  or greater than or equal to 5  $\mu\text{m}$ .

(3) *Structure Type*. Positive identification of asbestos fibers is required by the method. At least one diffraction pattern of each fiber type from every five samples must be recorded and compared with a standard diffraction pattern. For each asbestos fiber reported, both a morphological descriptor and an identification descriptor shall be specified on the count sheet.

(4) *Fibers classified as chrysotile* must be identified by diffraction and/or X-ray analysis and recorded on the count

sheet. X-ray analysis alone can be used as sole identification only after 70s/mm<sup>2</sup> have been exceeded for a particular sample.

(5) Fibers classified as amphiboles must be identified by X-ray analysis and electron diffraction and recorded on the count sheet. (X-ray analysis alone can be used as sole identification only after 70s/mm<sup>2</sup> have been exceeded for a particular sample.)

(6) If a diffraction pattern was recorded on film, the micrograph number must be indicated on the count sheet.

(7) If an electron diffraction was attempted and an appropriate spectra is not observed, N should be recorded on the count sheet.

(8) If an X-ray analysis is attempted but not observed, N should be recorded on the count sheet.

(9) If an X-ray analysis spectrum is stored, the file and disk number must be recorded on the count sheet.

**m. Classification Rules.**

i. *Fiber*. A structure having a minimum length greater than or equal to 0.5 μm and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of

the fiber, i.e., whether it is flat, rounded or dovetailed.

ii. *Bundle*. A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

iii. *Cluster*. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

iv. *Matrix*. Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

v. *NSD*. Record NSD when no structures are detected in the field.

n. After all necessary analyses of a particle structure have been completed, return the goniometer stage to 0 degrees, and return the structure to its original location by recall of the original location.

o. Continue scanning until all the structures are identified, classified and sized in the field.

p. Select additional fields (grid openings) at low magnification; scan at a chosen magnification (15,000 to 20,000X screen magnification); and analyze until the stopping rule becomes applicable.

q. Carefully record all data as they are being collected, and check for accuracy.

r. After finishing with a grid, remove it from the microscope, and replace it in the appropriate grid hold. Sample grids must be stored for a minimum of 1 year from the date of the analysis; the sample cassette must be retained for a minimum of 30 days by the laboratory or returned at the client's request.

**H. Sample Analytical Sequence**

1. Carry out visual inspection of work site prior to air monitoring.

2. Collect a minimum of five air samples inside the work site and five samples outside the work site. The indoor and outdoor samples shall be taken during the same time period.

3. Analyze the abatement area samples according to this protocol. The analysis must meet the 0.005 s/cm<sup>3</sup> analytical sensitivity.

4. Remaining steps in the analytical sequence are contained in Unit IV. of this Appendix.

**I. Reporting**

The following information must be reported to the client. See the following Table II:

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1. Concentration in structures per square millimeter and structures per cubic centimeter.
2. Analytical sensitivity used for the analysis.
3. Number of asbestos structures.
4. Area analyzed.
5. Volume of air samples (which was initially provided by client).
6. Average grid size opening.
7. Number of grids analyzed.
8. Copy of the count sheet must be included with the report.
9. Signature of laboratory official to indicate that the laboratory met specifications of the AHERA method.
10. Report form must contain official laboratory identification (e.g., letterhead).
11. Type of asbestos.

#### J. Calibration Methodology

Note: Appropriate implementation of the method requires a person knowledgeable in electron diffraction and mineral identification by ED and EDXA. Those inexperienced laboratories wishing to develop capabilities may acquire necessary knowledge through analysis of appropriate standards and by following detailed methods as described in References 8 and 10 of Unit III.L.

1. Equipment Calibration. In this method, calibration is required for the air-sampling equipment and the transmission electron microscope (TEM).

a. TEM Magnification. The magnification at the fluorescent screen of the TEM must be calibrated at the grid opening magnification (if used) and also at the magnification used for fiber counting. This is performed with a cross grating replica. A logbook must be maintained, and the dates of calibration depend on the past history of the particular microscope; no frequency is specified. After any maintenance of the microscope that involved adjustment of the power supplied to the lenses or the high-voltage system or the mechanical disassembly of the electron optical column apart from filament exchange, the magnification must be recalibrated. Before the TEM calibration is performed, the analyst must ensure that the cross grating replica is placed at the same distance from the objective lens as the specimens are. For instruments that incorporate an eucentric tilting specimen stage, all specimens and the cross grating replica must be placed at the eucentric position.

b. Determination of the TEM magnification on the fluorescent screen.

i. Define a field of view on the fluorescent screen either by markings or physical boundaries. The field of view

must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric).

ii. Insert a diffraction grating replica (for example a grating containing 2,160 lines/mm) into the specimen holder and place into the microscope. Orient the replica so that the grating lines fall perpendicular to the scale on the TEM fluorescent screen. Ensure that the goniometer stage tilt is 0 degrees.

iii. Adjust microscope magnification to 10,000X or 20,000X. Measure the distance (mm) between two widely separated lines on the grating replica. Note the number of spaces between the lines. Take care to measure between the same relative positions on the lines (e.g., between left edges of lines).

Note.—The more spaces included in the measurement, the more accurate the final calculation. On most microscopes, however, the magnification is substantially constant only within the central 8–10 cm diameter region of the fluorescent screen.

iv. Calculate the true magnification (M) on the fluorescent screen:

$$M = XG/Y$$

where:

X = total distance (mm) between the designated grating lines;

G = calibration constant of the grating replica (lines/mm);

Y = number of grating replica spaces counted along X.

c. Calibration of the EDXA System. Initially, the EDXA system must be calibrated by using two reference elements to calibrate the energy scale of the instrument. When this has been completed in accordance with the manufacturer's instructions, calibration in terms of the different types of asbestos can proceed. The EDXA detectors vary in both solid angle of detection and in window thickness. Therefore, at a particular accelerating voltage in use on the TEM, the count rate obtained from specific dimensions of fiber will vary both in absolute X-ray count rate and in the relative X-ray peak heights for different elements. Only a few minerals are relevant for asbestos abatement work, and in this procedure the calibration is specified in terms of a "fingerprint" technique. The EDXA spectra must be recorded from individual fibers of the relevant minerals, and identifications are made on the basis of semiquantitative comparisons with these reference spectra.

d. Calibration of Grid Openings.

i. Measure 20 grid openings on each of 20 random 200-mesh copper grids by placing a grid on a glass slide and examining it under the PCM. Use a calibrated graticule to measure the

average field diameter and use this number to calculate the field area for an average grid opening. Grids are to be randomly selected from batches up to 1,000.

Note.—A grid opening is considered as one field.

ii. The mean grid opening area must be measured for the type of specimen grids in use. This can be accomplished on the TEM at a properly calibrated low magnification or on an optical microscope at a magnification of approximately 400X by using an eyepiece fitted with a scale that has been calibrated against a stage micrometer. Optical microscopy utilizing manual or automated procedures may be used providing instrument calibration can be verified.

e. Determination of Camera Constant and ED Pattern Analysis.

i. The camera length of the TEM in ED operating mode must be calibrated before ED patterns on unknown samples are observed. This can be achieved by using a carbon-coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film.

ii. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thicker gold film would normally give multiple gold rings, but it will tend to mask weaker diffraction spots from the unknown fibrous particulates. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings are unnecessary on zone-axis ED patterns. An average camera constant using multiple gold rings can be determined. The camera constant is one-half the diameter, D, of the rings times the interplanar spacing, d, of the ring being measured.

#### K. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of

defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards is performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the following Table III:

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TABLE III--SUMMARY OF LABORATORY  
DATA QUALITY OBJECTIVES

<u>Unit Operation</u>	<u>QC Check</u>	<u>Frequency</u>	<u>Conformance Expectation</u>
Sample receiving	Review of receiving report	Each sample	95% complete
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample preparation	Supplies and reagents	On receipt	Meet specs. or reject
	Grid opening size	20 openings/20 grids/lot of 1000 or 1 opening/sample	100%
	Special clean area monitoring	After cleaning or service	Meet specs or reclean
	Laboratory blank	1 per prep series or 10%	Meet specs. or reanalyze series
	Plasma etch blank	1 per 20 samples	75%
	Multiple preps (3 per sample)	Each sample	One with cover of 15 complete grid sqs.
Sample analysis	System check	Each day	Each day
	Alignment check	Each day	Each day
	Magnification calibration with low and high standards	Each month or after service	95%
	ED calibration by gold standard	Weekly	95%
	EDS calibration by copper line	Daily	95%
Performance check	Laboratory blank (measure of cleanliness)	Prep 1 per series or 10% read 1 per 25 samples	Meet specs or reanalyze series
	Replicate counting (measure of precision)	1 per 100 samples	1.5 x Poisson Std. Dev.
	Duplicate analysis (measure of reproducibility)	1 per 100 samples	2 x Poisson Std. Dev.
	Known samples of typical materials (working standards)	Training and for comparison with unknowns	100%
	Analysis of NBS SRM 1876 and/or RM 8410 (measure of accuracy and comparability)	1 per analyst per year	1.5 x Poisson Std. Dev.
	Data entry review (data validation and measure of completeness)	Each sample	95%
	Record and verify ID electron diffraction pattern of structure	1 per 5 samples	80% accuracy
Calculations and data reduction	Hand calculation of automated data reduction procedure or independent recalculation of hand-calculated data	1 per 100 samples	85%

1. When the samples arrive at the laboratory, check the samples and documentation for completeness and requirements before initiating the analysis.
2. Check all laboratory reagents and supplies for acceptable asbestos background levels.
3. Conduct all sample preparation in a clean room environment monitored by laboratory blanks and special testing after cleaning or servicing the room.
4. Prepare multiple grids of each sample.
5. Provide laboratory blanks with each sample batch. Maintain a cumulative average of these results. If this average is greater than  $53 \text{ f/mm}^2$  per 10 200-mesh grid openings, check the system for possible sources of contamination.
6. Check for recovery of asbestos from cellulose ester filters submitted to plasma asher.
7. Check for asbestos carryover in the plasma asher by including a blank alongside the positive control sample.
8. Perform a systems check on the transmission electron microscope daily.
9. Make periodic performance checks of magnification, electron diffraction and energy dispersive X-ray systems as set forth in Table III of Unit III.K.
10. Ensure qualified operator performance by evaluation of replicate counting, duplicate analysis, and standard sample comparisons as set forth in Table III of Unit III.K.
11. Validate all data entries.
12. Recalculate a percentage of all computations and automatic data reduction steps as specified in Table III.
13. Record an electron diffraction pattern of one asbestos structure from every five samples that contain asbestos. Verify the identification of the pattern by measurement or comparison of the pattern with patterns collected from standards under the same conditions.

The outline of quality control procedures presented above is viewed as the minimum required to assure that quality data is produced for clearance testing of an asbestos abated area. Additional information may be gained by other control tests. Specifics on those control procedures and options available for environmental testing can be obtained by consulting References 6, 7, and 11 of Unit III.L.

#### L. References

For additional background information on this method the following references should be consulted.

1. "Guidelines for Controlling Asbestos-Containing Materials in Buildings," EPA 560/5-85-024, June 1985.

2. "Measuring Airborne Asbestos Following an Abatement Action." USEPA/ Office of Toxic Substances, EPA 600/4-85-049, 1985.
3. Small, John and E. Steel. Asbestos Standards: Materials and Analytical Methods. N.B.S. Special Publication 619, 1982.
4. Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjöberg. Selected Silicate Minerals and Their Asbestiform Varieties. Information Circular 8751, U.S. Bureau of Mines, 1977.
5. Quality Assurance Handbook for Air Pollution Measurement System. Ambient Air Methods, EPA 600/4-77-027a, USEPA, Office of Research and Development, 1977.
6. Method 2A: Direct Measurement of Gas Volume Through Pipes and Small Ducts. 40 CFR Part 60 Appendix A.
7. Burdette, G.J. Health & Safety Exec., Research & Lab. Services Div., London, "Proposed Analytical Method for Determination of Asbestos in Air."
8. Chatfield, E.J., Chatfield Tech. Cons., Ltd., Clark, T., PEI Assoc. "Standard Operating Procedure for Determination of Airborne Asbestos Fibers by Transmission Electron Microscopy Using Polycarbonate Membrane Filters." WERL SOP 87-1, March 5, 1987.
9. NIOSH. Method 7402 for Asbestos Fibers, December 11, 1986 Draft.
10. Yamate, G., S.C. Agarwall, R.D. Gibbons, IIT Research Institute, "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy." Draft report, USEPA Contract 68-02-3266, July 1984.
11. Guidance to the Preparation of Quality Assurance Project Plans. USEPA, Office of Toxic Substances, 1984.

#### IV. Mandatory Interpretation of Transmission Electron Microscopy Results to Determine Completion of Response Actions

##### A. Introduction

A response action is determined to be completed by TEM when the abatement area has been cleaned and the airborne asbestos concentration inside the abatement area is no higher than concentrations at locations outside the abatement area. "Outside" means outside the abatement area, but not necessarily outside the building. EPA reasons that an asbestos removal contractor cannot be expected to clean an abatement area to an airborne asbestos concentration that is lower than the concentration of air entering the abatement area from outdoors or from other parts of the building. After

the abatement area has passed a thorough visual inspection, and before the outer containment barrier is removed, a minimum of five air samples inside the abatement area and a minimum of five air samples outside the abatement area must be collected. Hence, the response action is determined to be completed when the average airborne asbestos concentration measured inside the abatement area is not statistically different from the average airborne asbestos concentration measured outside the abatement area.

The inside and outside concentrations are compared by the Z-test, a statistical test that takes into account the variability in the measurement process. A minimum of five samples inside the abatement area and five samples outside the abatement area are required to control the false negative error rate, i.e., the probability of declaring the removal complete when, in fact, the air concentration inside the abatement area is significantly higher than outside the abatement area. Additional quality control is provided by requiring three blanks (filters through which no air has been drawn) to be analyzed to check for unusually high filter contamination that would distort the test results.

When volumes greater than or equal to 1,199 L for a 25 mm filter and 2,799 L for a 37 mm filter have been collected and the average number of asbestos structures on samples inside the abatement area is no greater than  $70 \text{ s/mm}^2$  of filter, the response action may be considered complete without comparing the inside samples to the outside samples. EPA is permitting this initial screening test to save analysis costs in situations where the airborne asbestos concentration is sufficiently low so that it cannot be distinguished from the filter contamination/background level (fibers deposited on the filter that are unrelated to the air being sampled). The screening test cannot be used when volumes of less than 1,199 L for 25 mm filter or 2,799 L for a 37 mm filter are collected because the ability to distinguish levels significantly different from filter background is reduced at low volumes.

The initial screening test is expressed in structures per square millimeter of filter because filter background levels come from sources other than the air being sampled and cannot be meaningfully expressed as a concentration per cubic centimeter of air. The value of  $70 \text{ s/mm}^2$  is based on the experience of the panel of microscopists who consider one structure in 10 grid openings (each grid opening with an area of  $0.0057 \text{ mm}^2$ ) to

be comparable with contamination/background levels of blank filters. The decision is based, in part, on Poisson statistics which indicate that four structures must be counted on a filter before the fiber count is statistically distinguishable from the count for one structure. As more information on the performance of the method is collected, this criterion may be modified. Since different combinations of the number and size of grid openings are permitted under the TEM protocol, the criterion is expressed in structures per square millimeter of filter to be consistent across all combinations. Four structures per 10 grid openings corresponds to approximately 70 s/mm<sup>2</sup>.

#### B. Sample Collection and Analysis

1. A minimum of 13 samples is required: five samples collected inside the abatement area, five samples collected outside the abatement area, two field blanks, and one sealed blank.

2. Sampling and TEM analysis must be done according to either the mandatory or nonmandatory protocols in Appendix A. At least 0.057 mm<sup>2</sup> of filter must be examined on blank filters.

#### C. Interpretation of Results

1. The response action shall be considered complete if either:

a. Each sample collected inside the abatement area consists of at least 1,199 L of air for a 25 mm filter, or 2,799 L of air for a 37 mm filter, and the arithmetic mean of their asbestos structure concentrations per square millimeter of filter is less than or equal to 70 s/mm<sup>2</sup>; or

b. The three blank samples have an arithmetic mean of the asbestos structure concentration on the blank filters that is less than or equal to 70 s/mm<sup>2</sup> and the average airborne asbestos concentration measured inside the abatement area is not statistically higher than the average airborne asbestos concentration measured outside the abatement area as determined by the Z-test. The Z-test is carried out by calculating

$$Z = \frac{\bar{Y}_I - \bar{Y}_O}{0.8(1/n_I + 1/n_O)^{1/2}}$$

where  $\bar{Y}_I$  is the average of the natural logarithms of the inside samples and  $\bar{Y}_O$  is the average of the natural logarithms of the outside samples,  $n_I$  is the number of inside samples and  $n_O$  is the number of outside samples. The response action

is considered complete if Z is less than or equal to 1.65.

(Note.—When no fibers are counted, the calculated detection limit for that analysis is inserted for the concentration.)

2. If the abatement site does not satisfy either (1) or (2) above, the site must be recleaned and a new set of samples collected.

#### D. Sequence for Analyzing Samples

It is possible to determine completion of the response action without analyzing all samples. Also, at any point in the process, a decision may be made to terminate the analysis of existing samples, reclean the abatement site, and collect a new set of samples. The following sequence is outlined to minimize the number of analyses needed to reach a decision.

1. Analyze the inside samples.

2. If at least 1,199 L of air for a 25 mm filter or 2,799 L of air for a 37 mm filter is collected for each inside sample and the arithmetic mean concentration of structures per square millimeter of filter is less than or equal to 70 s/mm<sup>2</sup>, the response action is complete and no further analysis is needed.

3. If less than 1,199 L of air for a 25 mm filter or 2,799 L of air for a 37 mm filter is collected for any of the inside samples, or the arithmetic mean concentration of structures per square millimeter of filter is greater than 70 s/mm<sup>2</sup>, analyze the three blanks.

4. If the arithmetic mean concentration of structures per square millimeter on the blank filters is greater than 70 s/mm<sup>2</sup>, terminate the analysis, identify and correct the source of blank contamination, and collect a new set of samples.

5. If the arithmetic mean concentration of structures per square millimeter on the blank filters is less than or equal to 70 s/mm<sup>2</sup>, analyze the outside samples and perform the Z-test.

6. If the Z-statistic is less than or equal to 1.65, the response action is complete. If the Z-statistic is greater than 1.65, reclean the abatement site and collect a new set of samples.

#### Appendix B to Subpart E—Work Practices and Engineering Controls for Small-Scale, Short-Duration Operations Maintenance and Repair (O&M) Activities Involving ACM

This appendix is not mandatory, in that LEAs may choose to comply with all the requirements of 40 CFR 763.121. Section 763.91(b) extends the protection provided by EPA in its 40 CFR 763.121 for worker protection during asbestos abatement projects to employees of local education agencies who perform

small-scale, short-duration operations, maintenance and repair (O&M) activities involving asbestos-containing materials and are not covered by the OSHA asbestos construction standard at 29 CFR 1926.58 or an asbestos worker protection standard adopted by a State as part of a State plan approved by OSHA under section 18 of the Occupational Safety and Health Act. Employers wishing to be exempt from the requirements of § 763.121 (e)(6) and (f)(2)(i) may instead comply with the provisions of this appendix when performing small-scale, short-duration O&M activities.

#### Definition of Small-Scale, Short Duration Activities

For the purposes of this appendix, small-scale, short-duration maintenance activities are tasks such as, but not limited to:

1. Removal of asbestos-containing insulation on pipes.
2. Removal of small quantities of asbestos-containing insulation on beams or above ceilings.
3. Replacement of an asbestos-containing gasket on a valve.
4. Installation or removal of a small section of drywall.
5. Installation of electrical conduits through or proximate to asbestos-containing materials.

Small-scale, short-duration maintenance activities can be further defined, for the purposes of this subject, by the following considerations:

1. Removal of small quantities of asbestos-containing materials (ACM) only if required in the performance of another maintenance activity not intended as asbestos abatement.
2. Removal of asbestos-containing thermal system insulation not to exceed amounts greater than those which can be contained in a single glove bag.
3. Minor repairs to damaged thermal system insulation which do not require removal.
4. Repairs to a piece of asbestos-containing wallboard.
5. Repairs, involving encapsulation, enclosure or removal, to small amounts of friable asbestos-containing material only if required in the performance of emergency or routine maintenance activity and not intended solely as asbestos abatement. Such work may not exceed amounts greater than those which can be contained in a single prefabricated minienclosure. Such an enclosure shall conform spatially and geometrically to the localized work area, in order to perform its intended containment function.

OSHA concluded 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/cm<sup>3</sup>). (See 51 FR 22714, June 20, 1986.) 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:

1. Wet methods.
2. Removal methods.
  - i. Use of glove bags.
  - ii. Removal of entire asbestos insulated pipes or structures.
  - iii. Use of minienclosures.
3. Enclosure of asbestos materials.
4. 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 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. 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 material 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 minienclosures. The procedures that employers must use for each of these operations if they wish to avail themselves of the rule's exemptions are described in the following sections.

**Glove bags.** OSHA found that the use of glove bags to enclose the work area during small-scale, short-duration maintenance or renovation activities will result in employee exposure to asbestos that are below the rule's action level of 0.1 f/cm<sup>3</sup>. This appendix provides requirements for glove-bag procedures to be followed by employers wishing to avail themselves of the rule's exemption for each activity. OSHA has determined that the use of these procedures will reduce the 8-hour time weighted average (TWA) exposure 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 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. 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. 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 areas of Tyvek<sup>1</sup> material (the same material

<sup>1</sup> Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

used to make the disposal 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-labelled 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 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.
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 wires, 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.
7. HEPA-equipped dual-cartridge or more protective 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.
2. The employee who is performing the asbestos removal with the glove bag must don at least 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 precut port provided in most glove bags or applied through a small hole in the bag).

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 resprayed 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.

*Minienclosures.* 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 minienclosure can be built around the area where small-scale, short-duration asbestos maintenance or renovation work is to be performed. Such enclosures 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 minienclosure 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.
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 minienclosure, and is necessary to allow the worker to vacuum off his protective coveralls and remove them before leaving the work area. While inside minienclosure, the worker should wear Tyvek<sup>1</sup> disposable coveralls and use the appropriate HEPA-filtered dual-cartridge or more protective respiratory protection.

The advantages of minienclosures 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 minienclosures 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 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 friable asbestos-containing materials. Such a program should include:

1. Development of an inventory of all asbestos-containing materials in the facility.
2. Periodic examination of all asbestos-containing materials to detect deterioration.
3. Written procedures for handling asbestos materials during the performance of small-scale, short-duration maintenance and renovation activities.
4. Written procedures for asbestos disposal.
5. 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:

1. Information regarding types of ACM and its various uses and forms.
2. Information on the health effects associated with asbestos exposure.
3. Descriptions of the proper methods of handling asbestos-containing materials.
4. Information on the use of HEPA-equipped dual-cartridge respirators 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:

1. *Not* to drill holes in asbestos-containing materials.
2. *Not* to hang plants or pictures on structures covered with asbestos-containing materials.
3. *Not* to sand asbestos-containing floor tile.
4. *Not* to damage asbestos-containing materials while moving furniture or other objects.
5. *Not* to install curtains, drapes, or dividers in such a way that they damage asbestos-containing materials.
6. *Not* to dust floors, ceilings, moldings or other surfaces in asbestos-contaminated environments with a dry brush or sweep with a dry broom.

7. *Not* to use an ordinary vacuum to clean up asbestos-containing debris.

8. *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.

9. *Not* to remove ventilation system filters dry.

10. *Not* to shake ventilation system filters.

#### Appendix D to Subpart E—Transport and Disposal of Asbestos Waste

For the purposes of this appendix, transport is defined as all activities from receipt of the containerized asbestos waste at the generation site until it has been unloaded at the disposal site. Current EPA regulations state that there must be no visible emissions to the outside air during waste transport. However, recognizing the potential hazards and subsequent liabilities associated with exposure, the following additional precautions are recommended.

**Recordkeeping.** Before accepting wastes, a transporter should determine if the waste is properly wetted and containerized. The transporter should then require a chain-of-custody form signed by the generator. A chain-of-custody form may include the name and address of the generator, the name and address of the pickup site, the estimated quantity of asbestos waste, types of containers used, and the destination of the waste. The chain-of-custody form should then be signed over to a disposal site operator to transfer responsibility for the asbestos waste. A copy of the form signed by the disposal site operator should be maintained by the transporter as evidence of receipt at the disposal site.

**Waste handling.** A transporter should ensure that the asbestos waste is properly contained in leak-tight containers with appropriate labels, and that the outside surfaces of the containers are not contaminated with asbestos debris adhering to the containers. If there is reason to believe that the condition of the asbestos waste may allow significant fiber release, the transporter should not accept the waste. Improper containerization of wastes is a violation of the NESHAPs regulation and should be reported to the appropriate EPA Regional Asbestos NESHAPs contact below:

#### Region I

Asbestos NESHAPs Contact, Air Management Division, USEPA, Region I, JFK Federal Building, Boston, MA 02203, (617) 223-3266.

#### Region II

Asbestos NESHAPs Contact, Air & Waste Management Division, USEPA, Region II, 26 Federal Plaza, New York, NY 10007, (212) 264-6770.

#### Region III

Asbestos NESHAPs Contact, Air Management Division, USEPA, Region III, 841 Chestnut Street, Philadelphia, PA 19107, (215) 597-9325.

#### Region IV

Asbestos NESHAPs Contact, Air, Pesticide & Toxic Management, USEPA, Region IV, 345 Courtland Street, NE., Atlanta, GA 30365, (404) 347-4298.

#### Region V

Asbestos NESHAPs Contact, Air Management Division, USEPA, Region V, 230 S. Dearborn Street, Chicago, IL 60604, (312) 353-6793.

#### Region VI

Asbestos NESHAPs Contact, Air & Waste Management Division, USEPA, Region VI, 1445 Ross Avenue, Dallas, TX 75202, (214) 655-7229.

#### Region VII

Asbestos NESHAPs Contact, Air & Waste Management Division, USEPA, Region VII, 726 Minnesota Avenue, Kansas City, KS 66101, (913) 236-2896.

#### Region VIII

Asbestos NESHAPs Contact, Air & Waste Management Division, USEPA, Region VIII, 999 18th Street, Suite 500, Denver, CO 80202, (303) 293-1814.

#### Region IX

Asbestos NESHAPs Contact, Air Management Division, USEPA, Region IX, 215 Fremont Street, San Francisco, CA 94105, (415) 974-7633.

#### Region X

Asbestos NESHAPs Contact, Air & Toxics Management Division, USEPA, Region X, 1200 Sixth Avenue, Seattle, WA 98101, (206) 442-2724.

Once the transporter is satisfied with the condition of the asbestos waste and agrees to handle it, the containers should be loaded into the transport vehicle in a careful manner to prevent breaking of the containers. Similarly, at the disposal site, the asbestos waste containers should be transferred carefully to avoid fiber release.

**Waste transport.** Although there are no regulatory specifications regarding the transport vehicle, it is recommended that vehicles used for transport of containerized asbestos waste have an enclosed carrying compartment or

utilize a canvas covering sufficient to contain the transported waste, prevent damage to containers, and prevent fiber release. Transport of large quantities of asbestos waste is commonly conducted in a 20-cubic-yard "roll off" box, which should also be covered. Vehicles that use compactors to reduce waste volume should not be used because these will cause the waste containers to rupture. Vacuum trucks used to transport waste slurry must be inspected to ensure that water is not leaking from the truck.

Disposal involves the isolation of asbestos waste material in order to prevent fiber release to air or water. Landfilling is recommended as an environmentally sound isolation method because asbestos fibers are virtually immobile in soil. Other disposal techniques such as incineration or chemical treatment are not feasible due to the unique properties of asbestos. EPA has established asbestos disposal requirements for active and inactive disposal sites under NESHAPs (40 CFR Part 61, Subpart M) and specifies general requirements for solid waste disposal under RCRA (40 CFR Part 257). Advance EPA notification of the intended disposal site is required by NESHAPs.

*Selecting a disposal facility.* An acceptable disposal facility for asbestos wastes must adhere to EPA's requirements of no visible emissions to the air during disposal, or minimizing emissions by covering the waste within 24 hours. The minimum required cover is 6 inches of nonasbestos material, normally soil, or a dust-suppressing chemical. In addition to these federal requirements, many state or local government agencies require more stringent handling procedures. These agencies usually supply a list of "approved" or licensed asbestos disposal sites upon request. Solid waste control agencies are listed in local telephone directories under state, county, or city headings. A list of state solid waste agencies may be obtained by calling the RCRA hotline: 1-800-424-9346 (382-3000 in Washington, DC). Some landfill owners or operators place special requirements on asbestos waste, such as placing all bagged waste into 55-gallon metal drums. Therefore, asbestos removal contractors should contact the intended landfill before arriving with the waste.

*Receiving asbestos waste.* A landfill approved for receipt of asbestos waste should require notification by the waste hauler that the load contains asbestos. The landfill operator should inspect the loads to verify that asbestos waste is

properly contained in leak-tight containers and labeled appropriately. The appropriate EPA Regional Asbestos NESHAPs Contact should be notified if the landfill operator believes that the asbestos waste is in a condition that may cause significant fiber release during disposal. In situations when the wastes are not properly containerized, the landfill operator should thoroughly soak the asbestos with a water spray prior to unloading, rinse out the truck, and immediately cover the wastes with nonasbestos material prior to compacting the waste in the landfill.

*Waste deposition and covering.* Recognizing the health dangers associated with asbestos exposure, the following procedures are recommended to augment current federal requirements:

- Designate a separate area for asbestos waste disposal. Provide a record for future landowners that asbestos waste has been buried there and that it would be hazardous to attempt to excavate that area. (Future regulations may require property deeds to identify the location of any asbestos wastes and warn against excavation.)

- Prepare a separate trench to receive asbestos wastes. The size of the trench will depend upon the quantity and frequency of asbestos waste delivered to the disposal site. The trenching technique allows application of soil cover without disturbing the asbestos waste containers. The trench should be ramped to allow the transport vehicle to back into it, and the trench should be as narrow as possible to reduce the amount of cover required. If possible, the trench should be aligned perpendicular to prevailing winds.

- Place the asbestos waste containers into the trench carefully to avoid breaking them. Be particularly careful with plastic bags because when they break under pressure asbestos particles can be emitted.

- Completely cover the containerized waste within 24 hours with a minimum of 6 inches of nonasbestos material. Improperly containerized waste is a violation of the NESHAPs and EPA should be notified.

However, if improperly containerized waste is received at the disposal site, it should be covered immediately after unloading. Only after the wastes, including properly containerized wastes, are completely covered, can the wastes be compacted or other heavy equipment run over it. During compacting, avoid exposing wastes to the air or tracking asbestos material away from the trench.

- For final closure of an area containing asbestos waste, cover with at

least an additional 30 inches of compacted nonasbestos material to provide a 36-inch final cover. To control erosion of the final cover, it should be properly graded and vegetated. In areas of the United States where excessive soil erosion may occur or the frost line exceeds 3 feet, additional final cover is recommended. In desert areas where vegetation would be difficult to maintain, 3-6 inches of well graded crushed rock is recommended for placement on top of the final cover.

*Controlling public access.* Under the current NESHAPs regulation, EPA does not require that a landfill used for asbestos disposal use warning signs or fencing if it meets the requirement to cover asbestos wastes. However, under RCRA, EPA requires that access be controlled to prevent exposure of the public to potential health and safety hazards at the disposal site. Therefore, for liability protection of operators of landfills that handle asbestos, fencing and warning signs are recommended to control public access when natural barriers do not exist. Access to a landfill should be limited to one or two entrances with gates that can be locked when left unattended. Fencing should be installed around the perimeter of the disposal site in a manner adequate to deter access by the general public. Chain-link fencing, 6-ft high and topped with a barbed wire guard, should be used. More specific fencing requirements may be specified by local regulations. Warning signs should be displayed at all entrances and at intervals of 330 feet or less along the property line of the landfill or perimeter of the sections where asbestos waste is deposited. The sign should read as follows:

**ASBESTOS WASTE DISPOSAL SITE  
BREATHING ASBESTOS DUST MAY  
CAUSE LUNG DISEASE AND CANCER**

*Recordkeeping.* For protection from liability, and considering possible future requirements for notification on disposal site deeds, a landfill owner should maintain documentation of the specific location and quantity of the buried asbestos wastes. In addition, the estimated depth of the waste below the surface should be recorded whenever a landfill section is closed. As mentioned previously, such information should be recorded in the land deed or other record along with a notice warning against excavation of the area.

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**ENVIRONMENTAL PROTECTION AGENCY**

(OPTS-62055; FRL-3269-8)

**Asbestos-Containing Materials in Schools; EPA Approved Courses Under the Asbestos Hazard Emergency Response Act (AHERA)****AGENCY:** Environmental Protection Agency (EPA).**ACTION:** Notice.

**SUMMARY:** In section 206(c)(3) of Title II, the Administrator, in consultation with affected organizations, was directed to publish (and revise as necessary) a list of asbestos courses and tests in effect before the date of enactment of this title which qualify for equivalency treatment for interim accreditation purposes and a list of asbestos courses and tests which the Administrator determines are consistent with the Model Plan and which will qualify a contractor for accreditation. This Federal Register notice includes the initial list of course approvals. In addition, the list includes State accreditation programs that EPA has approved as meeting the requirements of the Model Plan.

**FOR FURTHER INFORMATION CONTACT:** Edward A. Klein, Director, TSCA Assistance Office (TS-799), Office of Toxic Substances, Environmental Protection Agency, Rm. E-543, 401 M St., SW., Washington, DC 20460, Telephone: (202) 554-1404.

**SUPPLEMENTARY INFORMATION:** Section 206 of Title II of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2646, required EPA to develop by April 20, 1987 a Model Contractor Accreditation Plan. The Plan was issued on April 20, and was published in the Federal Register of April 30, 1987, as Appendix C to Subpart E, 40 CFR Part 763.

To conduct asbestos-related work in schools, persons must receive accreditation in order to inspect school buildings for asbestos, develop management plans, and design or conduct response actions. Such persons can be accredited by States, which are required to adopt contractor accreditation plans at least as stringent as the EPA Model Plan, or by completing an EPA-approved training course and passing an examination for such course. The EPA Model Contractor Accreditation Plan establishes those areas of knowledge of asbestos inspection, management plan development, and response action technology that persons seeking accreditation must demonstrate and States must include in their accreditation programs.

Elsewhere in this issue of the Federal Register EPA is promulgating a final "Asbestos-Containing Materials In Schools" rule (40 CFR Part 763, Subpart E) which requires all local education agencies (LEAs) to identify asbestos-containing materials (ACM) in their school buildings and take appropriate actions to control the release of asbestos fibers. The LEAs are also required to describe their activities in management plans, which must be made available to the public and submitted to State governors. Under Title II, LEAs are required to use specially-trained persons to conduct inspections for asbestos, develop the management plans, and design or conduct major actions to control asbestos.

The length of initial training courses for accreditation under the Model Plan varies by discipline. Briefly, inspectors must take a 3-day training course; management planners must take the inspection course plus an additional 2 days devoted to management planning; and abatement project designers are required to have at least 3 days of training. In addition, asbestos abatement contractors and supervisors must take a 4-day training course and asbestos abatement workers are required to take a 3-day training course. For all disciplines, persons seeking accreditation must also pass an examination and participate in annual re-training courses. A complete description of accreditation requirements can be found in the Model Accreditation Plan at 40 CFR Part 763, Subpart E, Appendix C.I.1.A. through E.

In section 206(c)(3) of Title II, the Administrator, in consultation with affected organizations, was directed to publish (and revise as necessary) a list of asbestos courses and tests in effect before the date of enactment of this title which qualify for equivalency treatment for interim accreditation purposes and a list of asbestos courses and tests which the Administrator determines are consistent with the Model Plan and which will qualify a contractor for accreditation. This Federal Register notice includes the initial list of course approvals. In addition, the list includes State accreditation programs that EPA has approved as meeting the requirements of the Model Plan.

Three types of EPA approvals are included in this Federal Register notice. Unit I discusses EPA approval of State accreditation programs. Unit II covers EPA approval of training courses. Unit III discusses EPA approval of training courses for interim accreditation. Lastly, Unit IV provides the list of State accreditation programs and training courses approved by EPA as of October

1987. Subsequent Federal Register notices will add other State programs and training courses to this initial list.

**I. EPA Approval of State Accreditation Programs**

As discussed in the Model Plan, EPA will approve State accreditation programs that the Agency determines are at least as stringent as the Model Plan. In addition, the Agency is able to approve individual disciplines within a State's accreditation program. For example, a State that currently only has an accreditation requirement for inspectors can receive EPA approval for that discipline immediately rather than waiting to develop accreditation requirements for all disciplines in the Model Plan before seeking EPA approval.

As listed in Unit IV, New Jersey has received EPA approval for two accreditation disciplines. Any training courses in these two disciplines approved by New Jersey are EPA-approved courses for purposes of accreditation. These training courses are EPA-approved courses for purposes of TSCA Title II in New Jersey and in all States without an EPA-approved accreditation program for that discipline. For a current list of courses approved by New Jersey, interested parties should contact the State agency listed under Unit IV. EPA plans to include the training courses approved by New Jersey in the next Federal Register notice listing EPA-approved courses.

The State of Kansas currently has a training program for asbestos abatement contractors and supervisors that does not meet all of the Model Plan's requirements for this discipline. However, the Kansas program's training course requirements do meet the requirements for EPA approval of training courses for interim accreditation (see Unit III). As a result, persons who have met the training and exam requirements of the Kansas abatement contractor and supervisor program are accredited as listed under Unit IV on an interim basis. The Kansas contractor and supervisor accreditation program still must be upgraded within the time period specified in TSCA Title II to be at least as stringent as the Model Plan.

**II. EPA Approval of Training Courses**

Training courses approved by EPA are listed under Unit IV. The examinations for these approved courses under Unit IV have also been approved by EPA. EPA has three categories of course approval: full, contingent, and approved for interim accreditation. Courses

approved for interim accreditation will be discussed in Unit III.

Full approval means EPA has reviewed and found acceptable the course's written submission seeking EPA approval and has conducted an on-site audit and determined that the training course meets or exceeds the Model Plan's training requirements for the relevant discipline.

Contingent approval means the Agency has reviewed the course's written submission seeking EPA approval and found the materials to be acceptable (i.e. the written course materials meet the Model Plan's training course requirements). However, EPA has not yet conducted an on-site audit.

Successful completion of either a fully approved course or a contingently approved course provides full accreditation for course attendees. If EPA subsequently audits a contingently approved course and withdraws approval due to deficiencies discovered during the audit, future course offerings would no longer have EPA approval. However, withdrawal of EPA approval would not effect the accreditation of persons who took previously offered training courses including the course audited by EPA.

EPA-approved training courses listed under Unit IV are approved on a national basis. EPA has organized Unit IV by EPA Region to assist the public in locating those training courses that are offered nearby.

EPA-approved State accreditation programs have the authority to have more stringent accreditation requirements than the Model Plan. As a result, some EPA-approved training courses listed under Unit IV may not meet the requirements of a particular State's accreditation program. Sponsors of training courses and persons who have received accreditation or are seeking accreditation should contact individual States to check on accreditation requirements.

A number of training courses offered by several universities before EPA issued the Model Plan equaled or exceeded the subsequently issued Model Plan's training course requirements. These courses are listed under Unit IV as being fully approved. It should be noted that persons who successfully completed these courses are fully accredited; they are not limited only to being interinly accredited.

### III. EPA Approval of Training Courses for Interim Accreditation

TSCA Title II enables EPA to permit persons to be accredited on an interim basis if they have attended previous EPA-approved asbestos training and

have passed (or pass) an asbestos exam. As a result, the Agency is approving training courses offered previously for purposes of accrediting persons on an interim basis. Only those persons who have taken training courses since January 1, 1985 will be considered under these interim accreditation provisions. In addition, EPA will not grant interim accreditation to any person who takes an equivalent training course after the date the asbestos-in-schools rule takes effect. This accreditation is interim since the person shall be considered accredited for only 1 year after the date on which the State where the person is employed establishes an accreditation program at least as stringent as the EPA Model Plan. If the State does not adopt an accreditation program within the time period required by Title II, persons with interim accreditation must become fully accredited within 1 year after the date the State was required to have established a program.

For purposes of the Model Plan, an equivalent training course is one that is essentially similar in length and content to the curriculum found in the Model Plan. In addition, an equivalent examination must be essentially similar to the examination requirements found in the Model Plan.

Persons who have taken equivalent courses in their discipline for purposes of interim accreditation, and can produce evidence that they have successfully completed the course by passing an examination, are accredited on an interim basis under TSCA Title II. Evidence of successful completion of a course would include a certificate or photo identification card that showed the person completed the training course on a certain date and passed the examination.

For persons who took one of the EPA-approved courses for interim accreditation listed under Unit IV, but did not take the course's examination, these persons may become interinly accredited by passing an examination at an EPA-funded training center. These EPA funded training centers are listed under Unit IV. Before taking the exam, persons must provide evidence to the EPA-funded center that they previously had taken one of the training courses listed under Unit IV that is approved by EPA for interim accreditation.

Courses approved by EPA as of October 17 for interim accreditation are listed under Unit IV. Examinations offered by these courses also are approved for purposes of interim accreditation. EPA expects to approve additional courses for interim accreditation purposes, and will list these courses in subsequent Federal

Register notices. Training course vendors that believe their courses offered since January 1, 1985 are suitable sources for interim accreditation should contact their EPA Regional asbestos coordinator (See addresses in Unit IV).

### IV. List of EPA-Approved State Accreditation Programs and Training Courses

Below is the first listing of EPA-approved State accreditation programs and training courses. As discussed above, periodic notifications of EPA approval of State accreditations programs and EPA approval of training courses will be published in subsequent Federal Register notices. The closing date for the acceptance of submissions to EPA for inclusion in this first notice was early October. Omission from this list does not imply disapproval by EPA, nor does the order of the courses reflect priority or quality. The format of the notification lists first the State accreditation programs approved by EPA, followed by EPA-approved training courses listed by Region. The name, address, phone number, and contact person is provided for each training provider followed by the courses and type of course approval (i.e. full, contingent, or for interim purposes). Unless otherwise specified by an alternative date, interim approvals are issued from January 1, 1985.

All five of the EPA-funded asbestos information centers and the three EPA-funded satellite training centers will use the EPA model inspector and management planner course recently developed with EPA funds. As a result, EPA anticipates that all of the EPA-funded training facilities will receive approvals for inspection and management planning courses offered, beginning in October. Currently, the EPA-funded centers at the Georgia Institute of Technology and the University of Illinois at Chicago have inspection and management planning courses that EPA has fully approved. The five centers are: The Georgia Institute of Technology in Atlanta, Georgia; the University of Kansas in Overland Park, Kansas; Tufts University in Medford, Massachusetts; the University of Illinois at Chicago, and the University of California, Berkeley. The three satellite centers are: The University of Texas at Arlington; the Robert Wood Johnson Medical School in Piscataway, New Jersey, and Temple University in Philadelphia, Pennsylvania. The University of Texas at Arlington has received contingent

approval of its inspector and management planner course.

The recently developed EPA-funded model course for inspectors and management planners, and an earlier course developed with EPA funding for asbestos abatement contractors and supervisors are available for interested parties that plan to offer training courses. Interested parties should contact the following firm to receive copies of the training courses: Sterling Federal Systems, Incorporated, Suite 600, 6011 Executive Blvd., Rockville, MD 20852.

A fee for each course will be charged to cover the reproduction costs for the written and visual aid materials.

The following is the initial list of EPA-approved State accreditation programs and training courses:

#### *Approved State Accreditation Programs*

(1)(a) *State: Kansas*—State Agency: Kansas Department of Health and Environment, Forbes Field, Topeka, KS 66620. Attn: John C. Irwin (913) 296-1500.

(b) *Approved Accreditation Program Discipline*—Contractor/Supervisor (training and exam requirements) (approved for interim accreditation).

Abatement worker<sup>1</sup> approved for interim accreditation).

Effective date of regulation: 1/6/1986.

(2)(a) *State: New Jersey*—State Agency: New Jersey Department of Health, CN 360, Trenton, New Jersey 08625-0360. Attn: James Brownlee (609) 984-2193.

(b) *Approved Accreditation Program Discipline*—Contractor/Supervisor. Abatement worker. Effective date of regulation: June 18, 1985.

#### *EPA-Approved Training Courses*

##### *Region I—Boston, MA*

*Regional asbestos coordinator.* Alison Roberts, EPA, Region I, Air and Management Division (APT-231), JFK Federal Building, Boston, MA 02203. (617) 565-3273 (FTS) 835-3275.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region I training courses and contact points for each, are as follows:

(1)(a) *Training provider.* Abatement Technology Corp., One Boston Place, Suite 1025, Boston, MA 02108. Attn: Scott Keyes (617) 723-3100.

(b) *Approved courses.* Contractor/Supervisor (contingent).

(2)(a) *Training provider.* Con-Test, P.O. Box 591, East Longmeadow, MA 01028. Attn: Brenda Bolduc (413) 525-1198.

(b) *Approved courses.* Contractor/Supervisor (contingent). Abatement Worker (contingent). Inspector/Management Planner (contingent). Refresher course (for each of the above disciplines) (contingent).

(3)(a) *Training provider.* Hygientics, Inc., 150 Causeway St., Boston, MA 02114. Attn: John W. Cowdery (617) 723-4664.

(b) *Approved courses.* Inspector (contingent).

(4)(a) *Training provider.* Institute for Environmental Education, 208 West Cummings Park, Woburn, MA 01801. Attn: Janet Oppenheim-McMullen (617) 935-7370.

(b) *Approved courses.* Contractor/Supervisor (full from 9/18/87). Inspector/Management planner (contingent).

(5)(a) *Training provider.* Maine Labor Group on Health Inc., P.O. Box 5, Augusta, Maine 04330. Attn: Dianna White (207) 289-2770.

(b) *Approved courses.* Contractor/Supervisor (contingent). Abatement Worker (contingent).

(6)(a) *Training provider.* New England Laborers' Training Trust Fund, 37 East Street, Hopkinton, MA 01748. Attn: Jim Merloni, Jr. (617) 435-6316.

(b) *Approved courses.* Abatement Workers (contingent).

(7)(a) *Training provider.* Tufts University, 474 Boston Ave., Medford, MA 02155. Attn: Brenda Cole (617) 381-3531.

(b) *Approved courses.* Contractor/Supervisor Course (Interim from 9/85-5/31/87). Contractor/Supervisor Course (Full from 6/22/87).

##### *Region II—Edison, NJ*

*Regional asbestos coordinator.* Arnold Freiberger, EPA, Region II, Woodbridge Ave., Raritan Depot, Bldg. 10, Edison, NJ 08837. (201) 321-6668, (FTS) 340-6671.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region II training courses and contact points for each, are as follows:

(1)(a) *Training provider.* UMDNJ Robert Wood Johnson Medical School, 675 Hoes Lane, Piscataway, NJ 08854-5635. Attn: Lee Laustsen (201) 463-4500.

(b) *Approved courses.* Abatement Worker (full from beginning). Contractor/Supervisor (full from beginning).

##### *Region III—Philadelphia, PA*

*Regional asbestos coordinator.* Pauline Levin, EPA, Region III (3HW-40), 841 Chestnut Bldg., Philadelphia, PA 19107. (215) 597-9859, (FTS) 597-9859.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region III training courses and contact points for each, are as follows:

(1)(a) *Training provider.* Alice Hamilton Center for Occupational Health, 410 7th Street SE., Second Floor, Washington, DC 20003. Attn: Brian Christopher (202) 543-0005.

(b) *Approved courses.* Abatement Workers (contingent).

(2)(a) *Training provider.* The Association of Wall and Ceiling Industries, 24 K Street, NE., Suite 300, Washington, DC 20002. Attn: Chris Hullinger (202) 783-2924.

(b) *Approved courses.* Abatement Worker (full 5/19/87). Contractor/Supervisor (full 5/19/87).

(3)(a) *Training provider.* Biospherics, Inc., 12051 Indian Creek Court, Beltsville, MD 20705. Attn: Marian F. Meiselman (301) 369-3900.

(b) *Approved courses.* Contractor/Supervisor (full from 10/1/87). Abatement worker (full from 10/1/87).

(4)(a) *Training provider.* Drexel University, Environmental Studies Institute, Building 29, 32nd and Chestnut Streets, #216, Philadelphia, PA 19104. Attn: Robert Ross (215) 895-2269.

(b) *Approved courses.* Contractor/Supervisor (full from beginning). Abatement Worker (full from beginning).

(5)(a) *Training provider.* South East Michigan Committee on Occupational Safety and Health (SEMCOHS), 1550 Howard Street, Detroit, MI 48216. Attn: Barbara Boylan (313) 961-3345.

(b) *Approved courses.* Abatement Worker (contingent).

(6)(a) *Training provider.* The National Training Fund for the Sheet Metal and Air Conditioning Industry (in conjunction with the Workers' Institute for Safety and Health), 1126 Sixteenth Street NW., Washington, DC 20036. Attn: Scott Schneider (202) 887-1980.

(b) *Approved courses.* Abatement Worker (contingent).

<sup>1</sup> Applies only to workers who have taken the Kansas Contractor/Supervisor course and passed the State's worker exam.

(7)(a) *Training provider.* Temple University, College of Engineering, 12th and Norris Streets, Philadelphia, PA 19122. Attn: Lester Levin (215) 787-6479.

(b) *Approved courses.* Contractor/Supervisor (full from beginning). Workers (full from beginning).

(8)(a) *Training provider.* Medical College of Virginia, Virginia Commonwealth University, Department of Preventive Medicine, P.O. Box 212, Richmond, VA 23298. Attn: Leonard Vance (804) 786-9785.

(b) *Approved courses.* Contractor/Supervisor (contingent).

(9)(a) *Training provider.* WACO, Inc., P.O. Box 836, 5450 Lewis Road, Sandston, VA 23150. Attn: William Belanich (804) 222-8440.

(b) *Approved courses.* Contractor/Supervisor (contingent). Abatement Workers (contingent).

#### Region IV—Atlanta, GA

*Regional asbestos coordinator.* Jim Littell, EPA Region IV, 345 Courtland St. NE., Atlanta, GA 30365. (404) 347-3864, (FTS) 257-3864.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region IV training courses and contact points for each, are as follows:

(1)(a) *Training provider.* University of Florida, TREEO Center, 3900 SW 63rd Blvd., Gainesville, FL 32608. Attn: Sandra Scaggs (904) 392-9570.

(b) *Approved courses.* Contractor/Supervisor (full from 5/87).

(2)(a) *Training provider.* Georgia Tech Research Institute, Environmental Health and Safety Division, Room 029, O'Keefe Building, Atlanta, GA 30332. Attn: William Ewing (404) 894-3806.

(b) *Approved courses.* Contractor/Supervisor (full from 5/11/87). Contractor/Supervisor (Interim from 6/85—5/10/87). Refresher Course for Contractor/Supervisor (contingent). Inspector/Management Planner (full from 10/87).

(3)(a) *Training provider.* National Asbestos Council, Training Department, 2786 North Decatur Road, Decatur, GA 30033. Attn: Eva Clay (404) 292-0629.

(b) *Approved courses.* Abatement Workers (2 day) (interim from beginning). Abatement Workers (3 day) (full from 7/87).

#### Region V—Chicago, IL

*Regional asbestos coordinator.* Anthony Restaino, EPA Region V, 536 S.

Clark St., Chicago, IL 60604. (312) 886-6879, (FTS) 886-6879.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region V training courses and contact points for each, are as follows:

(1)(a) *Training provider.* AHP Research, Inc., 1501 Johnsons Ferry Rd., Suite 230, P.O. Box 71926, Marietta, GA 30007. Attn: Dwight Brown (404) 565-0061.

(b) *Approved courses.* Inspector/Management Planner (interim from beginning).

(2)(a) *Training provider.* BDN Industrial Hygiene Consultants, 8105 Valleywood Lane, Portage, MI 49002. Attn: Keith Nichols (616) 329-1237.

(b) *Approved courses.* Contractor/Supervisor (contingent).

(3)(a) *Training provider.* DeLisle Consulting and Laboratories, Inc., 2401 East Milham Ave., Kalamazoo, MI 49002. Attn: Mark DeLisle (616) 343-9698.

(b) *Approved courses.* Contractor/Supervisor (contingent).

(4)(a) *Training provider.* Heat & Frost Insulators Local 17, Apprentice Training Center, 3850 South Racine Ave., Chicago, IL 60609. Attn: John P. Shine (312) 247-1007

(b) *Approved courses.* Abatement Workers (contingent).

(5)(a) *Training provider.* I.P.C. Chicago, 4309 West Henderson, Chicago, IL 60641. Attn: Robert G. Cooley (312) 975-3495.

(b) *Approved courses.* Abatement Workers (contingent).

(6)(a) *Training provider.* University of Illinois at Chicago, Midwest Asbestos Information Center, 2035 Taylor, School of Public Health, Chicago, IL 60612. Attn: Tony Billotti (312) 996-5782.

(b) *Approved courses.* Contractor/Supervisor (full from beginning). Inspector/Management Planner (full). Abatement Worker (2 day) (interim from beginning to 10/1/87). Abatement Worker (3 day) (contingent).

#### Region VI—Dallas, TX

*Regional asbestos coordinator.* John West, 6t-Pt. EPA, Region VI, 1445 Ross Avenue, Dallas, TX 75202-2733. (214) 655-7244, (FTS) 255-7235.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a

prioritization. Approvals for Region VI training courses and contact points for each, are as follows:

(1)(a) *Training provider.* GEBCO Associates, Inc., 805-A, Elizabeth Drive, Bedford, TX 76022. Attn: Ed Kirch (817) 268-4006.

(b) *Approved courses.* Asbestos Workers (full from 8/20/87). Asbestos Workers (interim prior to 8/19/87).

(2)(a) *Training provider.* The International Association of Heat and Frost Insulators and Asbestos Workers Union, Local 22, 3219 Pasadena Blvd., Pasadena, TX 77503. Attn: Owen Tilley (713) 473-0888.

(b) *Approved courses.* Asbestos Worker (3 day course) (contingent). Asbestos Worker (2 day course) (interim prior to 10/87). Worker refresher course (contingent).

(3)(a) *Training provider.* Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA 70803-1520. Attn: George Smith (504) 388-6621.

(b) *Approved courses.* Contractor/Supervisor (contingent).

(4)(a) *Training provider.* The Texas A&M University System, The Texas Engineering Extension Service, Building Codes Inspection Training Division, College Station, TX 77843-8000. Attn: Charles Flanders (409) 345-6682.

(b) *Approved courses.* Contractor/Supervisor (full from 9/14/87). Contractor/Supervisor (interim prior to 9/14/87). Abatement Worker (contingent). Inspector/Management Planner (contingent).

(5)(a) *Training provider.* The University of Texas at Arlington Satellite Center, Bureau of Engineering Research, P.O. Box 19020, Arlington, TX 76019. Attn: Ernest Crosby (817) 273-2557.

(b) *Approved courses.* Contractor/Supervisor (full from beginning). Inspector/Management Planner (contingent).

(6)(a) *Training provider.* Tulane University, School of Public Health and Tropical Medicine, Department of Environmental Health Sciences, 1430 Tulane Avenue, New Orleans, LA 70112. Attn: Shau-Wong Chang (504) 588-5374.

(b) *Approved courses.* Contractor/Supervisor (full from 9/15/87). Contractor/Supervisor (interim prior 9/14/87).

#### Region VII—Kansas City, KS

*Regional asbestos coordinator.* Wolfgang Brandner, EPA Region VII, 728 Minnesota Ave., Kansas City, KS 66101. (913) 236-2834, (FTS) 757-2834.

*List of approved courses.* The following training courses have been

approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region VII training courses and contact points for each, are as follows:

(1)(a) *Training provider.* Hall-Kimbrell Environmental Services, 4840 West 15th St., Lawrence, KS 66046. Attn: Alice Hart (913) 749-2381.

(b) *Approved courses.* Contractor/Supervisor (full from 8/17/87). Abatement Worker (full from 8/17/87). Project Designer (full from 8/17/87). Inspector/Management Planner (full from 8/17/87).

(2)(a) *Training provider.* Mahew Environmental Training Assoc., Inc. (META), P.O. Box 1961, Lawrence, KS 66044. Attn: Brad Mayhew (913) 842-6382.

(b) *Approved courses.* Contractor/Supervisor (contingent). Abatement Worker (contingent).

(3)(a) *Training provider.* The University of Kansas National Asbestos Training Center, 6600 College Blvd., Suite 315, Overland Park, KS 66211. Attn: Lani Himegarner (913) 491-0181.

(b) *Approved courses.* Contractor/Supervisor (contingent). Contractor/Supervisor (interim from 6/85-9/9/87). Abatement Worker (contingent).

Region VIII—Denver, CO

*Regional asbestos coordinator.* David Combs, [8AT-TS], EPA, Region VIII. 1

Denver Place, 999-18th St., Suite 1300, Denver, CO 80202-2413. (303) 564-1730, (FTS) 564-1742.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region VIII training courses and contact points for each, are as follows:

(1)(a) *Training provider.* Northern Engineering and Testing, Inc. 600 South 25th Street, P.O. Box 30615, Billings, MT 59107. Attn: Kathleen Smit (406) 248-9161.

(b) *Approved courses.* Asbestos worker (contingent).

(2)(a) *Training provider.* Rocky Mountain Center for Occupational and Environmental Health, Building 512, University of Utah, Salt Lake City, UT 84112. Attn: Jeffery Lee (801) 581-5710.

(b) *Approved courses.* Contractor/Supervisor (contingent).

Region IX—San Francisco, CA

*Regional asbestos coordinator.* Joanne Semones, [T-52], EPA, Region IX, 215 Fremont St., San Francisco, CA 94105. (415) 974-7290, (FTS) 454-7290.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in

alphabetical order and do not reflect a prioritization. Approvals for Region IX training courses and contact points for each, are as follows:

(1)(a) *Training provider.* Environmental Sciences, 375 S. Meyer, Tucson, AZ 85701. Attn: Dale Keyes (602) 577-1764.

(b) *Approved courses.* Inspector/Management Planner (full).

(2)(a) *Training provider.* University of California at Berkeley Pacific Asbestos Information Center. U.C. Extension, 2223 Fulton St., Berkeley, CA 94720. Attn: Debra Dobin (415) 643-7143.

(b) *Approved courses.* Contractor/Supervisor (full from beginning).

Region X—Seattle, WA

*Regional asbestos coordinator.* Walter Jasper, EPA, Region X, 1200 Sixth Ave., Seattle, WA 98101. (206) 442-2870, (FTS) 399-2870.

*List of approved courses.* The following training courses have been approved by EPA. The courses are listed under (b). This approval is subject to the level of certification indicated after the course name. Courses are listed in alphabetical order and do not reflect a prioritization. Approvals for Region X training courses and contact points for each, are as follows:

No approvals for Region X.

Dated: October 17, 1987.

Lee M. Thomas,

Administrator.

[FR Doc. 87-24939 Filed 10-29-87; 8:45 am]

BILLING CODE 6560-50-M









# **Federal Register**

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**Wednesday  
February 25, 1987**

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**Part II**

## **Environmental Protection Agency**

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**40 CFR Part 763**

**Asbestos Abatement Projects; Worker  
Protection; Final Rule**

**ENVIRONMENTAL PROTECTION AGENCY****40 CFR Part 763**

IOPTS-62050; FRL 3104-11

**Asbestos Abatement Projects; Worker Protection**

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

**SUMMARY:** This rule, under section 6(a) of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2605(a), extends additional protections to State and local government employees covered by the EPA asbestos abatement worker protection rule published in the Federal Register of April 25, 1986. This additional protection is provided by incorporating in the EPA rule the new asbestos workplace standard issued by the Occupational Safety and Health Administration (OSHA) in June 1986. EPA's worker protection rule of April 1986 had extended the protection of OSHA's previous asbestos workplace standard to employees in States that do not have either worker protection plans approved by OSHA or asbestos abatement regulations which EPA decided were comparable to or more stringent than EPA's worker protection rule.

**DATES:** In accordance with 40 CFR 23.5 (50 FR 7271), this rule shall be promulgated for purposes of judicial review at 1 p.m. eastern time on March 11, 1987. This rule is effective on March 27, 1987.

**FOR FURTHER INFORMATION CONTACT:** Edward A. Klein, Director, TSCA Assistance Office (TS-789), Office of Toxic Substances, Environmental Protection Agency, Rm. E-343, 401 M St. SW., Washington, DC 20460. (202-554-1404).

**SUPPLEMENTARY INFORMATION:****I. Authority**

Section 6(a) of TSCA authorizes EPA to impose a number of specific regulatory requirements concerning a chemical substance or mixture if the Agency finds that the manufacturing, processing, distribution in commerce, use, or disposal of the substance or mixture, or any combination of these activities presents or will present an unreasonable risk of injury to health or the environment. Among the requirements that EPA may impose are those in section 6(a) (5) and (6). Section 6(a)(5) of TSCA authorizes EPA to prohibit or otherwise regulate any manner or method of commercial use of

a chemical substance or mixture. Section 6(a)(6) of TSCA authorizes EPA to prohibit or otherwise regulate any manner or method of disposal of a chemical substance or mixture, or any article containing that substance or mixture, by any person who uses or disposes of it for commercial purposes.

These subsections provide authority for EPA to issue this rule, which establishes requirements to protect State and local public employees engaged in abating the hazards of asbestos in public buildings. The asbestos present in such buildings has been sold as a commercial product, and therefore abatement activities affecting the use of asbestos in these buildings is commercial activity, subject to section 6(a)(5) of TSCA. The removal of asbestos, a disposal activity, will affect commercial activities occurring in the public buildings, and, therefore, is considered disposal for commercial purposes subject to section 6(a)(6).

**II. Background**

This rule replaces a final rule published in the Federal Register of April 25, 1986 (51 FR 15722). That rule was promulgated after EPA received and considered public comments on an immediately effective proposed rule published in the Federal Register of July 12, 1985 (50 FR 28530). In the previous final rule, EPA extended provisions of the then existing Asbestos Standard of the Occupational Safety and Health Administration (OSHA) to State and local government employees who were not covered by asbestos standards issued under State plans approved by OSHA, or other State regulations in Idaho, Kansas, Oklahoma, and Wisconsin that EPA had determined are comparable to or more stringent than the EPA rule. In that rule EPA announced that it would issue a revised rule when the OSHA standard was revised to ensure that all public and private sector employees who participate in asbestos abatement projects enjoy similar levels of protection. OSHA issued such a revised rule with detailed requirements for construction activities, including asbestos abatement projects, in the Federal Register of June 20, 1986 (51 FR 22812).

EPA also announced in the previous rule that it would issue the revised rule as a final rule with no additional comment period because EPA and OSHA had already received extensive comments on the topic of protection of workers engaged in abatement work (51 FR 15723). EPA is incorporating changes in this rule which have been suggested in comments to both agencies. In this

rule, EPA is lowering the permissible exposure limit (PEL) to asbestos to 0.2 fiber per cubic centimeter of air (f/cc) and is instituting new requirements for engineering and work practice controls, and new requirements to train workers engaged in asbestos abatement.

**III. The Relationship of This Rule to the OSHA Asbestos Standard**

In general, this rule applies the major provisions of OSHA's new Asbestos Standard for construction work to asbestos abatement projects. This rule, however, differs from OSHA's because it retains certain features of EPA's previous final rule. It applies solely to activities involved in asbestos abatement projects, in contrast to the standard promulgated by OSHA, which applies generally to any construction activity involving exposure to asbestos. This rule also retains the definition of asbestos EPA has used in the previous final rule and, unlike OSHA's standard, does not cover non-asbestiform fibers.

This rule also differs from OSHA in retaining the reporting requirements published in the previous final EPA rule. EPA considers these requirements necessary to monitor compliance with the general provisions of the rule. Under § 763.124, employers, with certain exceptions, must notify EPA that they intend to undertake an abatement project covered by the rule at least 10 days before they begin abatement. The exceptions include all asbestos abatement projects involving less than 3 linear feet or 3 square feet of friable asbestos material, which employers need not report to EPA, and emergency projects which need not be reported in advance, but, instead, "as soon as possible but in no case more than 48 hours after the project begins."

Employers engaged in small-scale abatement projects should note that this rule imposes requirements which differ from those in the previous final rule. These requirements differ because EPA is incorporating OSHA's new provisions for small-scale, short-duration projects. Thus, under the new rule, employers whose workers are engaged in sampling or repair projects of less than 3 linear feet or 3 square feet are no longer excluded from all requirements as they were in EPA's previous final rule. Instead, consistent with OSHA, the new rule defines "small-scale", "short duration" projects in a qualitative way and generally imposes requirements different from, and less burdensome than, projects characterized as large-scale and long-duration (see Units V, C and G). Examples of typical small-scale

short-duration projects are listed in Unit V.C.

EPA also wishes to clarify the reasons why it defines the term "fiber" in the same way as OSHA, i.e., as a "particulate form of asbestos 5 micrometers or longer, with a length to diameter ratio of at least 3 to 1." This definition is consistent with OSHA and avoids technical difficulties in measuring concentrations of smaller fibers. The definition does not result from a finding that small fibers are less harmful than other fibers. EPA refers readers to its previous discussion of fiber length in the preamble to the notice published in the Federal Register of January 29, 1986 entitled "Asbestos: Proposed Mining and Import Restrictions and Proposed Manufacturing, Importation and Processing Prohibitions" (51 FR 3742) for an analysis of this issue.

#### IV. Provisions

EPA has retained in §§ 763.120, 763.124, 763.125, and 763.128 the same language concerning the scope of the rule, reporting requirements, enforcement and inspections as in the rule published in April 1986. Those sections are republished in this rule for the convenience of the reader. Section 763.121 of this rule establishes new regulatory requirements for the protection of State and local asbestos abatement workers. These requirements replace the requirements of the rule published in April 1986. The major new provisions are discussed below. Section 763.122 of this rule establishes the criteria for States to be excluded from this rule and the procedures for the submission and review of the regulations adopted by States which request exclusion. These criteria and procedures are summarized in Unit V. This document also corrects the authority citation for 40 CFR Part 763.

This rule is effective March 27, 1987. EPA is making this rule effective at this relatively early date so that protections for asbestos abatement workers in the public sector will be introduced at the same time as, or soon after, the lower permissible exposure level, work practices and engineering controls required by OSHA's standard for the construction industry.

#### A. Exposure Limits

In this rule, EPA establishes a new Permissible Exposure Limit (PEL) for workers exposed to airborne asbestos. In § 763.121(c), it sets the PEL as 0.2 fiber per cubic centimeter of air (f/cc), averaged over an 8-hour day. Employers (defined in this rule as the public department, agency or entity which

hires an employee) must determine the PEL by means of the methods prescribed in Appendix A, the "EPA/OSHA Reference Method," or by an equivalent method, as described in Appendix B, "Detailed Procedures for Asbestos Sampling Analyses, Non-Mandatory." EPA will treat Transmission Electron Microscopy as an equivalent method for the purposes of this rule.

In § 763.121(b) the rule establishes the action level as 0.1 f/cc averaged over 8 hours. The action level is that level at which employers must begin activities such as air monitoring, employee training, and medical surveillance.

#### B. Air Monitoring

This rule establishes new requirements for initial and periodic air monitoring of workplaces where asbestos abatement projects take place. Section 763.121(f) requires that employers who have a workplace or work operation covered by this standard must generally perform initial monitoring to determine the airborne concentrations of asbestos to which employees may be exposed. If employers can demonstrate that employee exposures are below the action level by means of objective data, then initial monitoring is not required. If initial monitoring indicates that employee exposures are below the PEL, daily monitoring is not required. In certain areas designated as regulated areas (discussed in Unit V.C) the employer must conduct daily monitoring unless all workers are equipped with supplied-air respirators operated in the positive pressure mode. If daily monitoring within the regulated area indicates by statistically reliable measurements that employee exposures are below the action level, no further monitoring is required for those employees whose exposures are represented by such monitoring. Employees must be given the chance to observe monitoring, and affected employees must be notified as soon as possible following the employers' receipt of the results.

#### C. Regulated Areas

Where airborne concentrations of asbestos exceed the PEL, the employer must establish special areas, called regulated areas, to demarcate those places. Only authorized personnel may enter regulated areas. All persons entering a regulated area must be supplied with an approved respirator, and employers must ensure that these respirators are worn. No smoking, eating, drinking, or applying cosmetics is permitted in regulated areas. Warning signs stipulated in § 763.121(k) must be

displayed at each regulated area and must be posted at all approaches to regulated areas.

Wherever feasible (i.e., wherever permitted by the physical characteristics of the space where asbestos abatement takes place), § 763.121(e)(6) requires that the employer establish negative-pressure enclosures before commencing asbestos removal, demolition, and renovation operations. In these enclosures, a competent person (described in Section H) must be designated to set up the enclosure and ensure its integrity and supervise employee activity within the enclosure. In addition, the employer must conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area unless all employees are equipped with supplied-air respirators.

Section 763.121(e)(6)(iv) establishes an exemption from the requirement to maintain negative-pressure enclosures in regulated areas for small-scale, short-duration operations, such as pipe repair, valve replacement, installing drywall and other general building maintenance and repair activities.

#### D. Methods of Compliance

EPA stipulates in § 763.121(g)(1) the engineering and work practice controls which must be used to reduce employee exposure to within the PEL. The employer must use one or any combination of the following control methods to achieve compliance: (1) Local exhaust ventilation equipped with High Efficiency Particulate Air (HEPA) filter dust collection systems; (2) general ventilation systems; (3) asbestos vacuum cleaners equipped with HEPA filters; (4) enclosure or isolation of asbestos dust-producing processes; (5) wet methods, wetting agents, or removal encapsulants used during asbestos handling, mixing, removal, cutting, application, and clean-up; and (6) prompt disposal of asbestos-containing wastes in leak-tight containers. Respiratory protection must be used where engineering and work practice controls have been instituted but are insufficient to reduce employee exposure to or below the PEL.

Section 763.121(g)(2) states that certain work practices are prohibited. These include: (1) The use of high speed abrasive disc saws that are not equipped with appropriate engineering controls; (2) the use of compressed air to remove asbestos-containing materials, unless the compressed air is used in conjunction with an enclosed ventilation system; and (3) the spray application of asbestos-containing materials.

### *E. Respiratory Protection*

EPA requires in § 763.121(h) that employers provide respirators and have their employees use them in the following circumstances: (1) While feasible engineering and work practice controls are being installed or implemented; (2) during activities where engineering and work practice controls are not feasible; (3) if feasible engineering and work practice controls are insufficient to reduce employee exposure to or below the exposure limit; and (4) in emergencies. Respirators must be selected according to the provisions of 30 CFR Part 11. The employers must develop a respirator program, and EPA suggests that they develop one that follows the OSHA General Industry Standards (29 CFR 1910.134). Based on available data, EPA believes that this rule would require the wearing of respirators during many asbestos abatement projects.

The rule also requires in § 763.121(h)(3) that employees who use a filter respirator must change filters whenever an increase in breathing resistance is detected. Employees who wear respirators must be allowed to wash their faces and respirator facemasks whenever necessary to prevent skin irritation associated with respirator use. An employee must not be assigned to tasks requiring the use of respirators if a physician determines that the employee is unable to function normally wearing a respirator or that the employee's safety and health or that of others would be affected by the employee's use of a respirator. In this case, the employer must assign the employee to another job which does not require the use of a respirator. The job should be with the same employer in the same geographical area, and with the same seniority, status, and rate of pay, if such a position is available.

Section 763.121(h)(4) requires that the employer must assure that a respirator issued to an employee fits properly and exhibits minimum facepiece leakage. Employers must perform quantitative or qualitative fit tests at the time of initial fitting and at least every 6 months for each employee wearing negative-pressure respirators. Appendix C describes mandatory quantitative and qualitative procedures for testing respirators.

### *F. Protective Clothing*

Section 763.121(i) of this rule establishes the general requirement that employers must provide and require the use of protective clothing such as coveralls or similar full body clothing, head coverings, gloves, and foot

coverings for any employee exposed to airborne concentrations of asbestos that exceed the PEL.

The section also stipulates that asbestos-contaminated work clothing must be removed in change rooms and placed and stored in closed, labeled containers which prevent dispersion of the asbestos into the ambient environment. Protective clothing and equipment must be cleaned, laundered, repaired, or replaced to maintain their effectiveness. EPA recommends the use of disposable protective clothing, but if nondisposable clothing is worn, the employer must inform any person who launders or cleans such asbestos-contaminated clothing of the potentially harmful effects of exposure to asbestos. Contaminated clothing and equipment taken out of change rooms or the workplace for cleaning, maintenance, or disposal must be transported in sealed impermeable bags, or other closed impermeable containers and be appropriately labeled.

### *G. Hygiene Facilities and Practices*

In § 763.121(j), EPA requires that the employer provide clean change areas for employees required to work in regulated areas who wear respirators and protective clothing. Change areas are to be equipped with separate storage facilities for protective clothing and street clothing. Section 763.121(j)(2) requires that for asbestos removal, demolition, and renovation operations, the employer must establish a decontamination area for the decontamination of asbestos-contaminated employees. This area must be adjacent and connected to the regulated area. The section describes in detail the requirements for the decontamination area which must consist of an equipment room, shower area, and clean room in series.

Section 763.121(j) also provides an exclusion for employers of workers engaged in small-scale, short-duration projects. In lieu of the clean change area requirement, the employer may permit employees engaged in the operations to clean their protective clothing with a portable HEPA-equipped vacuum before employees leave the area where maintenance was performed.

### *H. Information and Training*

Section 763.121(k)(3) requires that the employer develop a training program for all employees who are exposed to airborne concentrations of asbestos at or above the action level. Training must be provided prior to the time of initial assignment and at least yearly thereafter. The training program must inform employees about the methods of

recognizing asbestos and the health hazards of asbestos exposure; the relationship between asbestos and smoking in producing lung cancer; operations which could result in asbestos exposure; 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; the purpose, proper use, and limitations of respirators; and the medical surveillance program. All training materials must be available to the employees without cost and, upon request, to the EPA. The competent person who supervises activities in the regulated area must attend a comprehensive course on asbestos hazards and proper methods of abatement, such as the courses offered by EPA-approved Information Centers and Satellite Centers, or courses of similar length and content.

### *I. Housekeeping*

Section 763.121(1) requires that vacuuming equipment, when used, must have HEPA filters. It also stipulates that asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing consigned for disposal must be collected and disposed of in sealed, labeled, impermeable bags or other closed, labeled, impermeable containers.

### *J. Medical Surveillance*

Section 763.121(m) requires that the employer establish a medical surveillance program, prior to assignment, for all employees who will be required to wear respirators or who will be exposed to airborne concentrations of asbestos at or above the action level for 30 or more days per year. All examinations must be performed under the supervision of a licensed physician and shall be provided without cost to the employee and at a reasonable time and place. Examinations must include: A medical and work history and physical examination with special emphasis directed to the respiratory, cardiovascular, and gastrointestinal systems; completion of a respiratory disease questionnaire; a chest X-ray administered at the discretion of the physician; and pulmonary function tests. These examinations must be made available annually, and Appendix E, a mandatory "Medical Questionnaire," must be used.

The employer must give the examining physician: A copy of this rule and its Appendix E; a description of the employee's duties relating to the employee's asbestos exposure; the exposure level or anticipated exposure level; a description of any personal protective and respiratory equipment used or to be used; and information from previous medical examinations. The employer must obtain a written signed opinion from the physician as to whether the employee has any detected medical condition that would place the employee at an increased risk from exposure to asbestos, any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators, and a statement that the employee has been informed by the physician of the results of the medical examination. The physician is not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos. The employer must provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.

#### **K. Recordkeeping**

According to § 763.122(n), the employer must keep an accurate record of all measurements taken to monitor employee exposure to asbestos. This record should include: The date of measurement; operation involving exposure; sampling and analytical methods used, and evidence of their accuracy; number, duration and results of samples taken; type of respiratory protective devices worn; and name, social security number, and the results of all employee exposure measurements. This record must be kept for 30 years.

The employer must also maintain an accurate record for each employee subject to medical surveillance. The record must include: The name and social security number of the employee; a copy of the employee's medical complaints related to exposure to asbestos; and information provided to the examining physician as described under medical surveillance. This record must be maintained for the duration of employment plus 30 years. The employer must maintain all employee training records for 1 year beyond the last date of employment by that employee.

All records must be made available on request to the EPA, as well as to affected employees, former employees, and designated representatives. When the employer ceases to operate (e.g., because of consolidation of a school district or abolition of a special purpose district) and there is no successor

employer to receive the records for the prescribed period, the employer must notify the Administrator of EPA at least 90 days prior to disposal of records.

#### **V. Future Revisions and Exclusions for States**

EPA realizes that it may be necessary to revise this rule in the future. Several parties have brought suit against OSHA challenging provisions of its Asbestos Standard. Should that litigation cause the need to revise the OSHA rule, EPA would revise the present rule to be consistent with any such revisions to the OSHA rule.

In § 763.122 EPA gives the four States which were exempt from the previous final rule 6 months, or such other reasonable time as suggested by the particular State and approved by EPA's Director of the Office of Toxic Substances, to revise their regulations to conform to the new standard. These States must submit any new regulations to the Agency for review. The Agency will review each submission to decide whether to continue excluding the State from coverage under the rule, or to amend the rule to cover the public employees in the State who are engaged in abatement work. Section 763.122(a)(1) of the rule establishes procedures for this review process.

If any other State now has or in the future adopts a regulation which is comparable to or more stringent than this rule and wishes to be excluded from this rule, that State should send a copy of the regulation to EPA's Office of Toxic Substances and request to be excluded from the rule. EPA will review the regulation, and, if it finds the regulation to be comparable to or more stringent than this rule, will propose an amendment excluding that State from coverage. Interested persons may then comment on the proposed exclusion during a period for public comment. After considering any comments, EPA could then promulgate a final amendment to the rule. These procedures are outlined in § 763.122(b) of the rule.

#### **VI. Regulatory Assessment**

EPA, in developing this final rule, has considered the requirements imposed by section 6(c)(1) of TSCA in order to determine whether asbestos or mixtures containing asbestos present an unreasonable risk. Specifically, it has considered the effects of the substance, or mixtures containing the substance, on health and the environment, and the magnitude of human and environmental exposure to the substance or mixture. It has also considered the benefits of the substance and the availability of

substitutes and the reasonably ascertainable economic consequences of the rule. EPA incorporates the regulatory assessment made for the previous final rule (51 FR 15724), and assesses in this document only the incremental changes introduced by this rule.

#### **A. Health Effects and Magnitude of Exposure to Asbestos**

In the rule published in April, EPA reviewed the serious adverse human health effects associated with the use of asbestos. No additional analysis is needed for this rule. EPA's conclusions as to the health effects of asbestos were supported by the "Report to the United States Consumer Product Safety Commission (CPSC) by the Chronic Hazard Advisory Panel on Asbestos," (CHAP) (Ref. 1), "Health Effects and Magnitude of Exposure" in EPA's "Support Document for Final Rule of Friable Asbestos-Containing Materials in School Buildings" (Ref. 2), and the "Report of the (National Research Council) Committee on Nonoccupational Health Risks of Asbestiform Fibers" (Ref. 3), and were summarized more recently in the preambles to EPA's proposal entitled "Asbestos: Proposed Mining and Import Restrictions and Proposed Manufacturing, Importation and Processing Prohibitions" (51 FR 3738) and OSHA's final rule, "Occupational Exposure to Asbestos, Tremolite, Anthophyllite and Actinolite" (51 FR 22812).

The final rule published in April 1986 considered the nature of exposures to asbestos which occur in the course of abatement work, and this rule incorporates that analysis. This rule will lower the exposures due to asbestos abatement experienced by State and local public employees who take part in asbestos abatement work, State and local public employees, and building occupants, such as school children, hospital patients and visitors. It will do so because the rule lowers the PEL from 2.0 f/cc, the level set by the final rule published in August, to 0.2 f/cc, and it requires employers to provide respirators, and to establish engineering and work practice controls to reduce exposures to asbestos to this level.

#### **B. Environmental Effects**

Section 6(c) of TSCA requires that EPA state the relevant environmental factors and key considerations which form the basis for regulatory action under section 6(e). The unreasonable risk finding of this rule is based solely on risks to human health since these risks are by far the most serious consequence of unregulated removal.

enclosure, or encapsulations of friable asbestos material and are sufficient to support this rule.

**C. Benefits of Asbestos Products and Availability of Substitutes**

As in the previous final rule, EPA finds that the benefits of the asbestos-containing products affected by this rule are minimal. This rule applies only when persons have already decided to remove, enclose, or encapsulate friable asbestos material. These people presumably will have already determined that there are no benefits in using the asbestos-containing material in its present condition. In addition, there are adequate substitutes for the asbestos products that are being removed from buildings.

**D. Economic Effects of the Rule**

This portion of the preamble presents EPA's determination of the "reasonably ascertainable economic consequences of the rule, after consideration of the effect on the national economy, small business, technological innovation, the environment, and public health" as required by section 6(c)(1)(D) of TSCA.

EPA estimates that this rule will increase the cost of asbestos abatement to some extent beyond the costs stated in the preamble to the rule published in April (51 FR 15727). In its analysis of the costs of this rule (Ref. 5), EPA estimates that the rule would increase the cost of asbestos removal projects as follows:

	Cost/ project under old rule	Incre- mental increase in cost/ project under new rule	Projects/ year	Incre- mental increase in cost/ year	No. of years	Present value (r = 10%)
Schools	18,000	513,000	48	2,462,400	4	22,201,400
Offices	21,000	17,700	3	82,100	15	624,247
Maintenance	61,000	48,100	3	20,300	15	755,070
Stores	5,000	5,237	2	47,130	15	304,383
Stores/Pipes	3,000	1,000	0	17,000	15	134,613
Total						4,020,244

This analysis assumes the removal of all friable asbestos materials by the end of 15 years, with an accelerated schedule for asbestos removal in schools. EPA acknowledges that the estimate of asbestos abatement projects may be low, because it only considers removal, and thus may miss some maintenance and repair operations. However, even if the total number of asbestos abatement projects is higher than estimated by EPA, both the costs and the benefits of the rule will have been underestimated in roughly the same proportion.

This rule will not have a direct impact on small business, since it applies only to those public employees not covered by OSHA's Asbestos Standard. However, it may have indirect effects similar to those discussed in the rule published in April (51 FR 15727), and EPA incorporates that analysis here.

EPA does not believe that this rule will restrict technological innovation. The rule allows sufficient flexibility for the development of new technology concerning asbestos abatement.

**E. Evaluation of Other Statutes**

Section 6(c) of TSCA requires that if EPA determines that a risk of injury to health or the environment could be eliminated or reduced to a sufficient extent by actions taken under another

statute administered by EPA, EPA may not promulgate a rule under section 6(a) of TSCA unless EPA finds it is in the public interest to protect against the risk by action under TSCA. EPA finds that no other law administered by EPA will eliminate or reduce the risks to the workers associated with the removal, encapsulation, or enclosure of asbestos to a sufficient level.

The Agency has analyzed the Clean Air Act and the Resource Conservation and Recovery Act, and has come to the following conclusions. Although EPA does list asbestos as a hazardous air pollutant under the Clean Air Act, it does not have authority under that Act to issue regulations protecting workers exposed to indoor air containing asbestos fibers. The other law administered by EPA which regulates asbestos, the Resource Conservation and Recovery Act, does not give EPA authority to protect abatement workers, since it allows the Agency to regulate the substance only when it is ultimately placed in a disposal site.

Under section 9(a) of TSCA, EPA is required to review other Federal authorities not administered by EPA to determine whether action under those authorities may prevent or reduce a given risk. EPA cannot determine that there is a statute administered by another Federal agency that can prevent

or reduce the risk presented to persons not covered by the OSHA Asbestos Standard during the removal, enclosure or encapsulation of friable asbestos. EPA's analysis of this issue is in the preamble to the previous final rule (51 FR 15728) and is hereby adopted for this rule.

**VII. Finding of Unreasonable Risk**

EPA has weighed the health risks from asbestos abatement, as presently regulated, against the costs attributable to this regulation. In evaluating risks, it incorporates into its finding the determination made by OSHA in its notice published in the Federal Register of June 20, 1986 (51 FR 22612) that workers exposed to asbestos at the PEL of 2.0 f/cc face a significant risk to their health, and that the new final standard will reduce that risk. OSHA developed this finding after a lengthy rulemaking process and extended public hearings, and EPA believes that the safe finding applies to workers engaged in asbestos abatement in the public sector.

EPA estimates that the rule would increase the costs of asbestos abatement by a total of \$4.0 million. This figure represents the present value of costs incurred over the next 15 years, assuming that all friable asbestos is abated. Although this rule may double the costs of some projects, the costs nonetheless are low, compared to benefits. If a State or local government has decided it can afford a project under the original final rule, the incremental cost under this amended rule should not be substantial. EPA believes that the possibility of reducing releases of asbestos during abatement under the new requirements justifies the increased costs.

EPA has concluded that the additional protection provided by this new rule outweighs the incremental costs of the control measures required, and that public employees engaged in asbestos abatement work should receive the same standard of protection as that set by OSHA for workers in the private sector. Therefore, EPA finds it is necessary to require that certain measures be taken to reduce the risk faced by asbestos abatement workers and persons using and visiting buildings during and after asbestos abatement activities.

**VIII. Enforcement**

Section 15 of TSCA makes it unlawful to fail or refuse to comply with any provision of a rule promulgated under section 6 of TSCA. Therefore, failure to comply with this rule would be a violation of section 15 of TSCA. In



addition, section 15 of TSCA makes it unlawful for any person to: (1) Fail or refuse to establish and maintain records as required by this rule; (2) fail or refuse to permit access to or copying of records, as required by TSCA; or (3) fail or refuse to permit entry or inspection as required by section 11 of TSCA.

Violators may be subject to both civil and criminal liability. Under the penalty provision of section 16 of TSCA, any person who violates section 15 could be subject to a civil penalty of up to \$25,000 for each violation. Each day of operation in violation of this rule could constitute a separate violation. Knowing or willful violations of this rule could lead to the imposition of criminal penalties of up to \$25,000 for each day of violation and imprisonment for up to 1 year. In addition, other remedies are available to EPA under sections 7 and 17 of TSCA, such as seeking an injunction to restrain violations of this rule.

#### IX. Rulemaking Record

EPA has established a record for this rulemaking under document control number OPTS-62030. A public version of the record and an index of documents in the record are available to the public in the Office of Toxic Substances Public Information Office from 8 a.m. to 4 p.m., Monday through Friday, except legal holidays. The Public Information Office is located in Rm. NE-004, 401 M St., SW., Washington, DC.

The record includes information considered by EPA in developing this rule. The record now includes the following categories of information: (1) Federal Register notices, (2) support documents, (3) reports, and (4) memoranda and letters.

The record also includes by reference the rulemaking record compiled by OSHA as part of the revision of the OSHA Asbestos Standard and the rulemaking record for EPA's final rule published in April 1986.

#### X. References

- (1) USCPSC. Reports to the U.S. Consumer Product Safety Commission by the Chronic Hazard Advisory on Asbestos, July 1983.
- (2) USEPA. OPTS, OTS, Support Document for Final Rule on Friable Asbestos-Containing Materials in School Buildings—Health Effects and Magnitude of Exposure, January 1982.
- (3) National Research Council. "Nonoccupational Health Risks of Asbestosiform Fibers". National Academy Press, Washington, DC, 1984.
- (4) USDOL, OSHA. "Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite." [June 20, 1986: 51 FR 22912].
- (5) USEPA, OPTS, OTS. Revision to Asbestos Abatement Worker Protection Rule: Summary of Cost-Effectiveness Analysis, December 1986.

#### XI. Regulatory Assessment Requirements

##### A. Executive Order 12291

Under Executive Order 12291, EPA prepared a Regulatory Impact Analysis. The Analysis estimated that this rule would cost about \$4.2 over 15 years. EPA believes that these costs are reasonable. Under Executive Order 12291, EPA must judge whether a regulation is "major" and therefore requires a Regulatory Impact Analysis. EPA has determined that this rule is not a "Major Rule" because it will not have an effect on the economy of \$100 million or more and it will not have a significant effect on competition, costs, or prices.

This rule was submitted to the Office of Management and Budget (OMB) for review as required by Executive Order 12291.

##### B. Regulatory Flexibility Act

EPA has analyzed the economic impact of this rule on small businesses. Reference to EPA's analysis appears in Unit VLD.

##### C. Paperwork Reduction Act

The information collection requirements contained in this rule have been approved by OMB under the provisions of the Paperwork Reduction Act of 1980, 44 U.S.C 3501 *et seq.*, and have been assigned OMB control number 2070-0072.

##### List of Subjects in 40 CFR Part 763

Asbestos. Environmental protection. Hazardous substances. Reporting and recordkeeping requirements.

Dated: February 6, 1987.

Lee M. Thomas,  
Administrator.

#### PART 763—(AMENDED)

Therefore, 40 CFR Part 763 is amended as follows:

1. The authority citation for Part 763 is revised to read as follows, and all of the section or subpart authorities are removed:

Authority: 15 U.S.C. 2606 and 2607(a).

2. Subpart G consisting of §§ 763.120 through 763.126 is revised to read as follows:

##### Subpart G—Asbestos Abatement Projects

Sec.	Scope.
763.120	Scope.
763.121	Regulatory requirements.
763.122	Exclusions for States.
763.124	Reporting.
763.125	Enforcement.
763.126	Inspections.

##### Subpart G—Asbestos Abatement Projects

###### § 763.120 Scope.

(a) This part establishes requirements which must be followed during asbestos abatement projects by employers of State and local government employees not covered by the Asbestos Standard of the Occupational Safety and Health Administration (OSHA), 29 CFR 1926.58, an Asbestos Standard adopted by a State as part of a State plan approved by OSHA under section 18 of the Occupational Safety and Health Act, or a State asbestos regulation which EPA has determined to be comparable to or more stringent than this part. The rule covers those employees who take part in asbestos abatement work.

(b) [Reserved]

###### § 763.121 Regulatory requirements.

(a) [Reserved]

(b) *Definitions.* "Action level" means an airborne concentration of asbestos of 0.1 fiber per cubic centimeter (f/cc) of air calculated as an 8-hour time-weighted average.

"Administrator" means the Administrator, U.S. Environmental Protection Agency, or designee.

"Asbestos" means the asbestiform varieties of chrysotile (serpentine); crocidolite (riebeckite); amosite (cummingtonite—grunerite); tremolite; anthophyllite, and actinolite.

"Asbestos abatement project" means any activity involving the removal, enclosure, or encapsulation of friable asbestos material.

"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 hazards in the workplace and who has the authority to take prompt corrective measures to eliminate them. 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 this subpart, 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 this subpart; 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.

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

"Emergency project" means a project involving the removal, enclosure, or encapsulation of friable asbestos-containing material that was not planned but results from a sudden unexpected event.

"Employee exposure" means that exposure to airborne asbestos would occur if the employee were not using respiratory protective equipment.

"Employer" means the public department, agency, or entity which hires an employee. The term includes, but is not limited to, any State, County, City, or other local governmental entity which operates or administers schools, a department of health or human services, a library, a police department, a fire department, or similar public service agencies or offices.

"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, 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

"Friable asbestos material" means any material containing more than 1 percent asbestos by weight which, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure.

"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 micrometer in diameter or larger.

"Regulated area" means an area established by the employer to demarcate areas where airborne concentrations of asbestos 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.

"Removal" means the taking out or stripping of asbestos or materials containing asbestos.

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

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

(c) *Permissible exposure limit (PEL).* The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.2 fiber per cubic centimeter of air as an 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 workites, an employer performing asbestos work requiring the establishment of a regulated area shall inform other employers (as defined by this subpart and by 29 U.S.C. section 652(5)) on the site of the nature of the employer's work with asbestos 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 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 in excess of the permissible exposure limit.

(3) *Access.* Access to regulated areas shall be limited to authorized persons.

(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 respirators and protective clothing as required by paragraphs (h) and (i) of this section.

(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.

(H) Ensure that engineering controls are functioning properly.

(iii)(A) In addition to the qualifications specified in paragraph (b) of this section, the competent person shall be trained in all aspects of asbestos abatement, the contents of this subpart, the identification of asbestos and its 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.

(B) 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 subpart shall perform monitoring to determine accurately the airborne concentrations of asbestos 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 fullshift exposure for employees in each work area.

(2) *Initial monitoring.* (i) Each employer who has a workplace or work operation covered by this subpart, except as provided for in paragraphs (f)(2)(ii) and (iii) of this section, shall perform initial monitoring at the initiation of each asbestos job to determine accurately the airborne concentrations of asbestos 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 cannot release airborne fibers in concentrations exceeding the action level under those work conditions having the greatest potential for releasing asbestos.

(iii) Where the employer has monitored each asbestos 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.* (i) The employer shall conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area.

(ii) 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)(i) 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 of this section.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (f) of this section shall be evaluated using the EPA/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.

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

(iv) To satisfy the monitoring requirements of paragraph (f) of this section, 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 of this section.

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

(ii) The employer shall notify affected employees of the results of monitoring representing the employees' 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 conducted in accordance with this section

(ii) When observation of the monitoring of employee exposure to asbestos 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 dust.

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

(F) Prompt disposal of wastes contaminated with asbestos in leak-tight containers.

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

(ii) Wherever the feasible engineering and work practice controls described in this paragraph are not sufficient to reduce employee exposure to or below the limit prescribed in paragraph (c) of this section, 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.

(ii) Compressed air shall not be used to remove asbestos materials containing asbestos 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 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.

(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 1 in paragraph (iv), 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 1 whenever:

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

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

(iv) Table 1—Respiratory Protection for Asbestos Fibers.

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos	Required respirator
Not in excess of 2 1/100 (10 x PEL)	1. Half-mask air-purifying respirator equipped with high-efficiency filters.
Not in excess of 10 1/100 (50 x PEL)	1. Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 20 1/100 (100 x PEL)	1. Any powered air-purifying respirator equipped with high-efficiency filters. 2. Any supplied-air respirator operated in constant flow mode.
Not in excess of 200 1/100 (1,000 x PEL)	1. Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 200 1/100 (> 1,000 x PEL) or unknown airborne concentration.	1. Full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus.

Note.—e. Respirators designed 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. This should include all information and guidance necessary for their proper selection, use, and care. Possible emergency uses of respirators should be anticipated and planned for.

(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 of this section. 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 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 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 effectively to prevent the release of airborne asbestos 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)(A) The employer shall provide clean change areas for

employees required to work in regulated areas or required by paragraph (i)(1)(c) of this section to wear protective clothing.

(B) In lieu of the change area requirement specified in paragraph (i)(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.

(iii) Whenever food or beverages are consumed at the worksite and employees are exposed to airborne concentrations of asbestos in excess of the permissible exposure limit, the employer shall provide lunch areas in which the airborne concentrations of asbestos 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. 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. 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 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.

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

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

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

(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 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**

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

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

(iii) Labels shall be used and shall contain the following information:

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

(iv) [Reserved]

(v) Labels shall contain a warning statement against breathing airborne asbestos fibers.

(vi) The provisions for labels required by paragraph (k)(2)(i) of this section do not apply where:

(A) Asbestos 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 fibers in excess of the action level will be released or

(B) Asbestos 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 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 employee is informed of the following:

(A) Methods of recognizing asbestos.

(B) The health effects associated with asbestos exposure.

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

(D) The nature of operations that could result in exposure to asbestos, 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.

(F) The appropriate work practices for performing the asbestos job; and  
(G) Medical surveillance program requirements.

(H) A review of this subpart, 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 Administrator upon request, all information and training materials relating to the employee information and training program.

(1) *Housekeeping—(1) Vacuuming.* 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 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 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 consultation—(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 schedule:

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

(B)(1) When the employee is assigned to an area where exposure to asbestos 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.

(2) 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.

(C) 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.

(ii) *Content.* Medical examinations made available pursuant to paragraphs (m)(2)(i) (A), (B), and (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 of this section and, on annual examination, the abbreviated standardized questionnaire contained in Appendix D, Part 2 of this section.

(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 (FEV<sub>1</sub>). Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E of this section.

(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 rule and Appendices D, E, and I of this section.

(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.

(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.

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

(C) A statement that the employee has been informed by the physician of the results of the medical examinations and of any medical conditions that may result from asbestos 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.

(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 are not capable of releasing fibers of asbestos 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.

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

(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)(A) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos as prescribed in paragraph (f) of this section.

(B) The employer may utilize the services of competent organizations such as 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 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.

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

(iii) The employer shall maintain this record for at least 30 years.

(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.

(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.

(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 30 years.

(4) *Training records.* The employer shall maintain all employee training records for 1 year beyond the last date of employment by that employer.

(5) *Availability.* (i) The employer, upon request, shall make all records required to be maintained by this section available to the Administrator 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 Administrator.

(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 Administrator.

(6) *Transfer of records.* Whenever the employer ceases to operate and there is no successor employer to receive and

retain the records for the prescribed period, the employer shall notify the Administrator at least 90 days prior to disposal and, upon request, transmit them to the Administrator.

(o) *Effective date.* This section shall become effective March 27, 1987.

(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) Appendix B to this section is informational and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

#### Appendix A To § 763.123—EPA/OSHA Reference Method—Mandatory

This mandatory appendix specifies the procedure for analyzing air samples for asbestos 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 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 § 763.123(f) 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 counting. See below for rejection of blanks.

2. The preferred collection device shall be the 25-mm diameter cassette with an open-faced 30-mm extension cover. 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 device.

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 ( $\pm 2$  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 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 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 fiber equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.

b. Count all particles as asbestos 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 ( $\frac{1}{2}$ ). 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 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 recount and comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In 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 samples for compliance determination shall implement 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 work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

3. All individuals performing asbestos analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos 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 § 763.123—Detailed Procedure for Asbestos Sampling and Analysis—Non-Mandatory

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

*Technique:* Microscopy, Phase Contrast.

*Analyte:* Fibers (manual count).

*Sample Preparation:* Acetone/triacetin method.

*Calibration:* Phase-shift detection limit about 3 degrees.

*Range:* 100 to 1,300 fibers/mm<sup>2</sup> filter area.

*Estimated Limit of Detection:* 7 fibers/mm<sup>2</sup> filter area.

*Sampler:* Filter (0.5-1.5 µm 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 1,300 fibers/mm<sup>2</sup>.

**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 sample). The method gives an index of airborne asbestos 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 and other fibers. Asbestos fibers less than ca. 0.25 μm 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 μm 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 eyepieces, and 40 to 45X phase objective (total magnification ca. 400X); numerical aperture = 0.85 to 0.73.

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-boled rubber stopper and elbow-jointed glass tubing, 18 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 μm diameter circular field at the specimen plane (area = 0.00785 mm<sup>2</sup>), (Type G-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 lap 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 percent 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/mm<sup>2</sup>), of 100 to 1,300 fibers/m<sup>2</sup> [ $3.85 \times 10^6$  to  $5 \times 10^6$  fibers per 25-mm filter with effective collection area ( $A_c = 385 \text{ mm}^2$ )] for optimum counting precision (see step 21 below). Calculate the minimum sampling time, "minimum (min) at the action level (one-half of the current standard), L (f/cc) of the fibrous aerosol being sampled:

$$t_{\text{min}} = \frac{(A_c)(E)}{(Q)(L)(10^3)}$$

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 (nongrainy) 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 238.

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 8 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. 56 °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 side 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,  $d$ , (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,  $L_1$  (mm), using the stage micrometer.

f. Remove the graticule from the microscope and measure its actual grid length,  $L_2$  (mm). This can best be accomplished by using a stage fitted with verniers.

g. Calculate the circle diameter,  $d$ , (mm), for the Walton-Beckett graticule:

$$d = \frac{L_1 \times D}{L_2}$$



Example: If  $L_1 = 108 \mu\text{m}$ ,  $L_2 = 2.93 \text{ mm}$  and  $D = 100 \mu\text{m}$ , then  $d_1 = 2.71 \text{ mm}$ .

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 ( $\text{mm}^2$ ).

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 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.—The identity of the blank filters should be unknown to the counter until all counts have been completed.

Note.—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 percent confidence level. Discard the sample if the difference between the two counts exceeds  $2.77 \sqrt{F_1}$ , where  $F_1$  = average of the two fiber counts and  $s_1$  = 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 counting are required to participate in the Proficiency Analytical Testing (PAT) Program and should routinely participate with other asbestos 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  $5 \mu\text{m}$ . 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  $5 \mu\text{m}$  that lies entirely within the graticule area.

(2) Count as  $\frac{1}{2}$  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.  $\frac{1}{4}$  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/ $\text{mm}^2$ ); by dividing the total fiber count,  $F$ ; minus the mean field blank count,  $B$ , by the number of fields,  $a$ ; and the field area,  $A_f$  ( $0.00785 \text{ mm}^2$  for a properly calibrated Walton-Beckett graticule):

$$E = \frac{F - B}{n(A_f)} \text{ fibers/mm}^2$$

22. Calculate the concentration,  $C$  (effect of fibers in the air volume sampled,  $V$  (L), using the effective collection area of the filter,  $A_c$  ( $385 \text{ mm}^2$  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 § 763.121—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  $25^\circ\text{C}$  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 300 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 300 cc of odor-free water.

7. The odor test and test blank jars shall be labeled 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. 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 identify correctly 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 fitted 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 facepieces 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 of #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 (e.g. see ANSI Z89.3-1980). Before

conducting the negative- or positive-pressure test, the subject shall be told to "seal" 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 85 gallon 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 selection, 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 3 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 facepiece 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 QLFT 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 interferes 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 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 mouth open 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 0.69 gram 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 expand fully.

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 assistance from any person.

2. The fit test uses the same enclosure described in IB 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 69 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 B.6 through B.10 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 C.8.

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 interferes 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 facemask 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 #5845, 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 facial area of the test subject. The person conducting the test shall begin with the tube at least 12 inches from the facemask 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, B6, 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 facemasks 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 facemask 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:

- (1) Weight change of 20 pounds or more.
- (2) Significant facial scarring in the area of the facemask 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 facemask 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. Definitions

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 facemask when the normal air purifying element has been replaced by an essentially perfect purifying element.

b. "Challenge Agent" means the air-borne 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 (facemask 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 perform freely 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 particulate 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.

g. 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 loudly 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. *Grinace (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. Termination of Test

The test shall be terminated whenever any single peak penetration exceeds 5 percent for halfmasks 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.b.).

#### 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 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 halfmask 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. Retesting

In addition, because the sealing of the respirator may be affected, quantitative fit testing shall be repeated immediately when the test subject has a:

- a. Weight change of 20 pounds or more.
- b. Significant facial scarring in the area of the facepiece seal.
- c. Significant dental changes: i.e., multiple extractions without prosthesis, or acquiring dentures.
- d. Reconstructive or cosmetic surgery, or
- e. 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:

- a. Name of test subject.
- b. Date of testing.
- c. Name of the test conductor.
- d. Fit factors obtained from every respirator tested (indicate manufacturer, model, size and approval number).

#### Appendix D to § 763.121—Medical Questionnaires—Mandatory

This mandatory appendix contains the medical questionnaires that must be administered to all employees who are exposed to asbestos 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.

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- Specify job/industry \_\_\_\_\_ Total Years Worked \_\_\_\_\_
- Was dust exposure: 1. Mild \_\_\_\_\_ 2. Moderate \_\_\_\_\_ 3. Severe \_\_\_\_\_
- C. Have you even 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, tremolite, anthophyllite, or actinolite?.....	<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?.....    
 If "YES" state nature of defect \_\_\_\_\_

C. Have you any hearing defect?.....    
 If "YES" state nature of defect \_\_\_\_\_

D. Are you suffering from or have you ever suffered from:

a. Epilepsy (or fits, seizures, convulsions)?	<input type="checkbox"/>	<input type="checkbox"/>
b. Rheumatic fever?	<input type="checkbox"/>	<input type="checkbox"/>
c. Kidney disease?	<input type="checkbox"/>	<input type="checkbox"/>
d. Bladder disease?	<input type="checkbox"/>	<input type="checkbox"/>
e. Diabetes?	<input type="checkbox"/>	<input type="checkbox"/>
f. Jaundice?	<input type="checkbox"/>	<input type="checkbox"/>

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 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 (including 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 \_\_\_



	Father			Mother		
	1. Yes	2. No	3. Don't Know	1. Yes	2. No	3. Don't Know
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 at Death	___
	___	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? (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) 1. Yes \_\_\_ 2. No \_\_\_
- 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 COUGH AND PHLEGM

- 34A. Have you had periods of episodes of (increased\*) cough and phlegm lasting for 3 weeks or more each year? 1. Yes \_\_\_ 2. No \_\_\_  
\*(For persons who usually have cough and/or phlegm)

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. Yes \_\_\_ 2. No \_\_\_  
1. When you have a cold? 1. Yes \_\_\_ 2. No \_\_\_  
2. Occasionally apart from colds? 1. Yes \_\_\_ 2. No \_\_\_  
3. Most days or nights? 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 38 A

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 \_\_\_\_\_

**IF YES TO 40A:  
FOR PERSONS WHO HAVE EVER SMOKED A PIPE**

- B. 1. How old were you when you started to smoke a pipe regularly? Age \_\_\_\_\_
2. If you have stopped smoking a pipe completely, how old were you when you stopped? Age stopped \_\_\_\_\_  
Check if still smoking a pipe \_\_\_\_\_  
Does not apply \_\_\_\_\_

- C. On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week? \_\_\_\_\_ oz. per week (a standard pouch of tobacco contains 1 1/2 oz.)  
Does not apply \_\_\_\_\_

- D. How much pipe tobacco are you smoking now? \_\_\_\_\_ oz. per week  
Not currently smoking a pipe \_\_\_\_\_

- E. Do you or did you inhale the pipe smoke?
1. Never smoked \_\_\_\_\_
  2. Not at all \_\_\_\_\_
  3. Slightly \_\_\_\_\_
  4. Moderately \_\_\_\_\_
  5. Deeply \_\_\_\_\_

- 41A. Have you ever smoked cigars regularly?  
(Yes means more than 1 cigar a week for a year)
1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

**IF YES TO 41A  
FOR PERSONS WHO HAVE EVER SMOKED CIGARS**

- B. 1. How old were you when you started smoking cigars regularly? Age \_\_\_\_\_
2. If you have stopped smoking cigars completely, how old were you when you stopped? Age stopped \_\_\_\_\_  
Check if still smoking cigars \_\_\_\_\_  
Does not apply \_\_\_\_\_

- C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week? \_\_\_\_\_ Cigars per week  
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 \_\_\_\_\_
402. Have you ever smoked a pipe regularly?  
(Yes means more than 12 oz. of tobacco in a lifetime.)
1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

**IF YES TO 40A:  
FOR PERSONS WHO HAVE EVER SMOKED A PIPE**

- B. 1. How old were you when you started to smoke a pipe regularly? Age \_\_\_\_\_
2. If you have stopped smoking a pipe completely, how old were you when you stopped? Age stopped \_\_\_\_\_  
Check if still smoking a pipe \_\_\_\_\_  
Does not apply \_\_\_\_\_
- C. On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week? \_\_\_\_\_ oz. per week (a standard pouch of tobacco contains 1 1/2 oz.)  
Does not apply \_\_\_\_\_
- D. How much pipe tobacco are you smoking now? \_\_\_\_\_ oz. per week  
Not currently smoking a pipe \_\_\_\_\_
- E. Do you or did you inhale the pipe smoke?
1. Never smoked \_\_\_\_\_
  2. Not at all \_\_\_\_\_
  3. Slightly \_\_\_\_\_
  4. Moderately \_\_\_\_\_
  5. Deeply \_\_\_\_\_
- 41A. Have you ever smoked cigars regularly?  
(Yes means more than 1 cigar a week for a year)
1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

**IF YES TO 41A  
FOR PERSONS WHO HAVE EVER SMOKED CIGARS**

- B. 1. How old were you when you started smoking cigars regularly? Age \_\_\_\_\_
2. If you have stopped smoking cigars completely, how old were you when you stopped? Age stopped \_\_\_\_\_  
Check if still smoking cigars \_\_\_\_\_  
Does not apply \_\_\_\_\_
- C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week? \_\_\_\_\_ Cigars per week  
Does not apply \_\_\_\_\_





**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 \_\_\_\_\_ 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	_____	

	<u>Yes or No</u>	<u>Further Comment on Positive Answers</u>
Pneumonia	_____	
Tuberculosis	_____	
Chest Surgery	_____	
Other Lung Problems	_____	
Heart Disease	_____	
Do you have:		
Frequent colds	_____	
Chronic cough	_____	
Shortness of breath when walking or climbing one flight of stairs	_____	
Do you:		
Wheeze	_____	
Cough up phlegm	_____	
Smoke cigarettes	_____	Packs per day _____ How many years _____

Date \_\_\_\_\_

Signature \_\_\_\_\_

BILLING CODE 4910-01-C

**Appendix E to § 763.121—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) 2a.

(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.

**§ 763.122 Exclusions for States.**

(a) The States of Idaho, Kansas, Oklahoma, and Wisconsin have 6 months or such other reasonable time as suggested by the particular State and approved by the Director of the Office of Toxic Substances to make their regulations comparable to or more stringent than this part, and to submit their regulations to EPA's Office of Toxic Substances for review. If in such reasonable time after March 27, 1987, any of these States have not so revised their regulations and submitted them to EPA, State and local government employees in such States shall be covered by the requirements of this part.

(b) Any other State that wishes to be excluded from this rule shall send a copy of a regulation which it considers to be comparable to or more stringent than this part to EPA's Office of Toxic Substances for review. EPA will review the regulation and tentatively determine whether the regulation is comparable to

or more stringent than this part. If EPA makes a positive tentative determination, EPA will propose an amendment to this rule excluding that State from coverage. Interested persons may comment on the proposed exclusion during the period for public comment. After considering any comments, EPA may promulgate the final amendment to the rule.

**§ 763.124 Reporting.**

(a) Employers subject to this rule must report to the Regional Asbestos Coordinator for the EPA Region in which the asbestos abatement project is located at least 10 days before they begin any asbestos abatement project, except one that involves less than either 3 linear feet or 3 square feet of friable asbestos material, and an emergency project. Employers must report any emergency project covered by this rule as soon as possible but in no case more than 48 hours after the project begins. A list of the EPA Regional Offices is given under § 1.7(b) of this chapter.

(b) The report must include:

- (1) The employer's name and address.
- (2) The location, including street address, of the asbestos abatement project.
- (3) The scheduled starting and completion dates for the asbestos abatement project.

(c) If a report is mailed to EPA, the report must be postmarked at least 10 days before the asbestos abatement project begins unless the report is for an emergency project. In such a case, the report must be postmarked as soon as possible but in no case more than 48 hours after the project begins.

(d) Employers do not have to report under this section if they submit a notice to EPA under the National Emission Standard for Asbestos, § 61.146 of this chapter, at least 10 days before they begin the asbestos abatement project and that notice clearly indicates that employees covered by this rule will perform some or all of the asbestos abatement work.

(Approved by the Office of Management and Budget under control number 2070-0072)

**§ 763.126 Enforcement.**

(a) Failure to comply with any provision of this part is a violation of section 15 of the Act (15 U.S.C. 2614).

(b) Failure or refusal to establish and maintain records or to permit access to or copying of records, as required by the Act, is a violation of section 15 of the Act (15 U.S.C. 2614).

(c) Failure or refusal to permit entry or inspection as required by section 11 of the Act (15 U.S.C. 2610) is a violation of section 15 of the Act (15 U.S.C. 2614).

(d) Violators may be subject to the civil and criminal penalties in section 16 of the Act (15 U.S.C. 2615) for each violation.

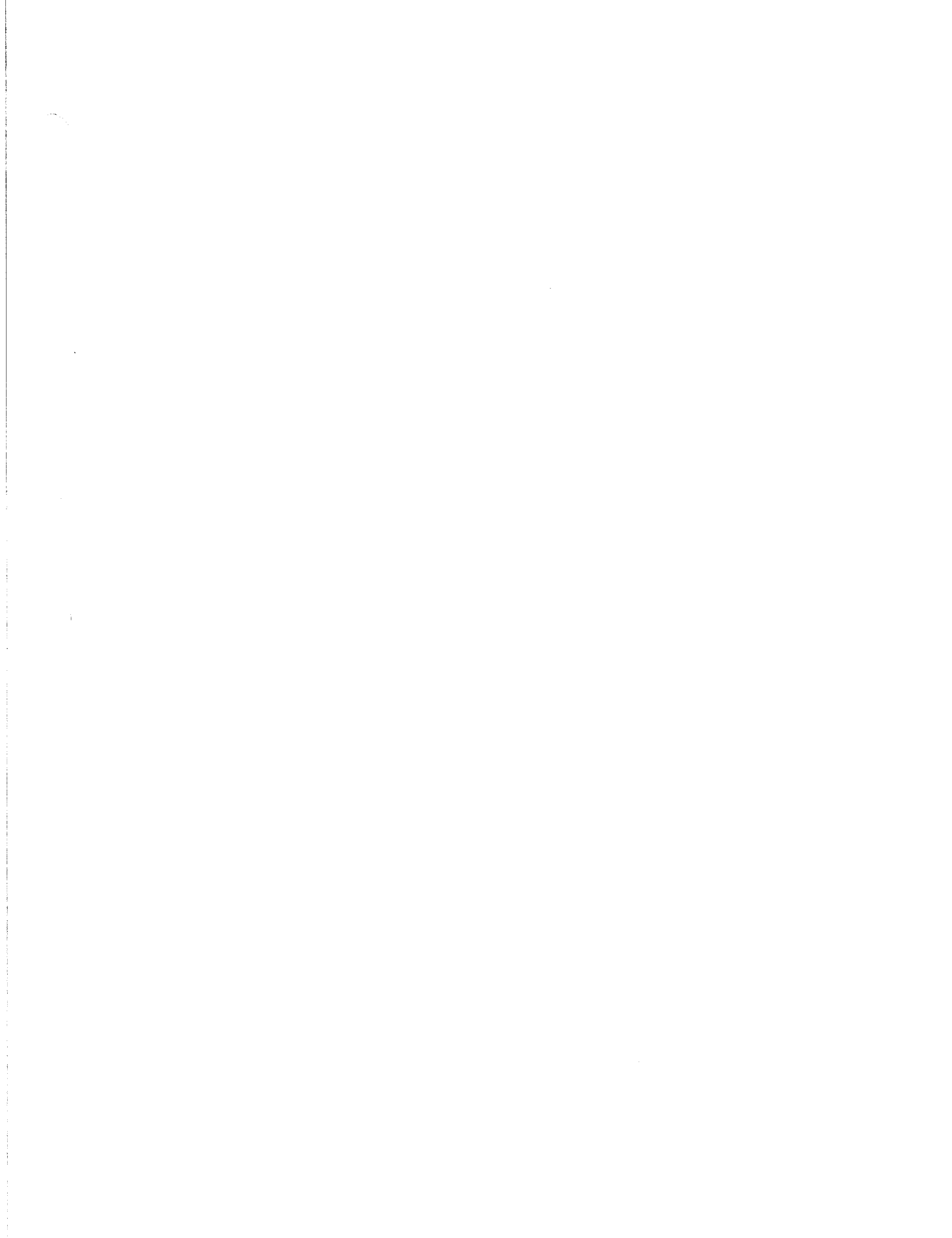
(e) EPA may seek to enjoin an asbestos abatement project in violation of this part, or take other actions under the authority of section 7 or 17 of the Act (15 U.S.C. 2606 or 2616).

**§ 763.128 Inspections.**

EPA will conduct inspections under section 11 of the Act (15 U.S.C. 2610) to ensure compliance with this part.

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## Appendix A2. Occupational Safety and Health Administration (OSHA) Asbestos Regulations for General Industry (29 CFR 1910.1001)

### § 1910.1001 Asbestos, tremolite, anthophyllite, and actinolite.

(a) *Scope and application.* (1) This section applies to all occupational exposures to asbestos, tremolite, anthophyllite, and actinolite, in all industries covered by the Occupational Safety and Health Act, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to construction work as defined in 29 CFR 1910.12(b). [Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58.]

(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 have 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.

"Director" means the Director of the 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.

"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 0.3 micrometer diameter mono-disperse particles.

"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.

"Tremolite, anthophyllite, or 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) *Exposure monitoring.*—(1) *General.* (i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA of each employee.

(ii) Representative 8-hour TWA employee exposures shall be determined on the basis of one or more samples representing full-shift exposures for each shift for each employee in each job classification 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 (d)(2)(ii) and (d)(2)(iii) of this section, shall perform initial monitoring of employees who are, or may reasonably be expected to be exposed to airborne concentrations at or above the action level.

(ii) Where the employer has monitored after December 20, 1985, and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(2)(i) of this section.

(iii) Where the employer has relied upon objective data that demonstrates that asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is not capable of being released in airborne concentrations at or above the action level under the expected conditions of processing, use, or handling, then no initial monitoring is required.

(3) *Monitoring frequency (periodic monitoring) and patterns.* After the initial determinations required by

paragraph (d)(2)(i) of this section, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than six months for employees whose exposures may reasonably be foreseen to exceed the action level.

(4) *Changes in monitoring frequency.* If either the initial or the periodic monitoring required by paragraphs (d)(2) and (d)(3) of this section statistically indicates that employee exposures are below the action level, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(5) *Additional monitoring.* Notwithstanding the provisions of paragraphs (d)(2)(ii) and (d)(4) of this section, the employer shall institute the exposure monitoring required under paragraphs (d)(2)(i) and (d)(3) of this section whenever there has been a change in the production, process, control equipment, personnel or work practices that may result in new or additional exposures above the action level or when the employer has any reason to suspect that a change may result in new or additional exposures above the action level.

(6) *Method of monitoring.* (i) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be personal samples collected following the procedures specified in Appendix A.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be evaluated using the OSHA Reference Method (ORM) specified in Appendix A of this section, 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; and

(B) The comparison indicates that 90% 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% 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 (d) of this section, employers must use the results of monitoring analysis performed by laboratories which have instituted quality assurance programs that include the elements as prescribed in Appendix A.

(7) *Employee notification of monitoring results.* (i) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under the standard, notify the affected employees of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) The written notification required by paragraph (d)(7)(i) of this section shall contain the corrective action being taken by the employer to reduce employee exposure to or below the PEL, wherever monitoring results indicated that the PEL had been exceeded.

(e) *Regulated Areas.*—(1) *Establishment.* The employer shall establish regulated areas wherever airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals are in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(2) *Demarcation.* Regulated areas shall be demarcated from the rest of the workplace in any manner that minimizes the number of persons who will be exposed to asbestos, tremolite, anthophyllite, or actinolite.

(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) *Provision of respirators.* Each person entering a regulated area shall be supplied with and required to use a respirator, selected in accordance with paragraph (g)(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 areas.

(f) *Methods of compliance.*—(1) *Engineering controls and work practices.* (i) The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to or below the exposure limit prescribed in paragraph (c) of this section, except to the extent that such controls are not feasible.

(ii) Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce

employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (g) of this section.

(iii) For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to or below 0.5 fiber per cubic centimeter of air (as an eight-hour time-weighted average) and shall supplement them by the use of any combination of respiratory protection that complies with the requirements of paragraph (g) of this section, work practices and feasible engineering controls that will reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section: Coupling cutoff in primary asbestos cement pipe manufacturing; sanding in primary and secondary asbestos cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.

(iv) *Local exhaust ventilation.* Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with good practices such as those found in the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1979.

(v) *Particular tools.* All hand-operated and power-operated tools which would produce or release fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems which comply with paragraph (f)(1)(iv) of this section.

(vi) *Wet methods.* Insofar as practicable, asbestos, tremolite, anthophyllite, or actinolite shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet

state sufficient to prevent the emission of airborne fibers so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, unless the usefulness of the product would be diminished thereby.

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

(viii) Particular products and operations. No asbestos cement, mortar, coating, grout, piaster, or similar material containing asbestos, tremolite, anthophyllite, or actinolite shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the limit prescribed in paragraph (c) of this section.

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

(2) *Compliance program.* (i) Where the PEL is exceeded, the employer shall establish and implement a written program to reduce employee exposure to or below the limit by means of engineering and work practice controls as required by paragraph (f)(1) of this section, and by the use of respiratory protection where required or permitted under this section.

(ii) Such programs shall be reviewed and updated as necessary to reflect significant changes in the status of the employer's compliance program.

(iii) Written programs shall be submitted upon request for examination and copying to the Assistant Secretary, the Director, affected employees and designated employee representatives.

(iv) The employer shall not use employee rotation as a means of compliance with the PEL.

(g) *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 required under this section, the employer shall select and provide, at no cost to the employee, the appropriate respirator as specified in Table 1. The employer shall select respirators from among those jointly approved as being acceptable for protection by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(ii) The employer shall provide a powered, air-purifying respirator in lieu of any negative pressure respirator specified in Table 1 whenever:

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

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

TABLE 1.—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 or larger

(3) *Respirator program.* (i) Where respiratory protection is required, 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 the regulated area 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 upon 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 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 whose duties 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 the employee 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) For each employee wearing negative pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every six months thereafter. 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 I.

(h) *Protective work clothing and equipment—(1) Provision and use.* If an employee is exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the PEL, or where the possibility of eye irritation exists, the employer shall provide at no cost to the employee and ensure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, head coverings, and foot coverings; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with § 1910.133 of this Part.

(2) *Removal and storage.* (i) The

employer shall ensure that employees remove work clothing contaminated with asbestos, tremolite, anthophyllite, or actinolite only in change rooms provided in accordance with paragraph (i)(1) of this section.

(ii) The employer shall ensure that no employee takes contaminated work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(iii) Contaminated work clothing shall be placed and stored in closed containers which prevent dispersion of the asbestos, tremolite, anthophyllite, and actinolite outside the container.

(iv) Containers of contaminated protective devices or work clothing which are to be taken out of change rooms or the workplace for cleaning, maintenance or disposal, shall bear labels in accordance with paragraph (j)(2) of this section.

(3) *Cleaning and replacement.* (i) The employer shall clean, launder, repair, or replace protective clothing and equipment required by this paragraph to maintain their effectiveness. The employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall prohibit the removal of asbestos, tremolite, anthophyllite, and actinolite from protective clothing and equipment by blowing or shaking.

(iii) Laundering of contaminated clothing shall be done so as to prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(iv) Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in paragraph (h)(3)(iii) of this section to effectively prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit.

(v) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with asbestos, tremolite, anthophyllite, or actinolite, of the potentially harmful effects of exposure to asbestos, tremolite, anthophyllite, or actinolite.

(vi) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled in accordance with

paragraph (j) of this section.

(i) *Hygiene facilities and practices—*  
(1) *Change rooms.* (i) The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is above the permissible exposure limit.

(ii) The employer shall ensure that change rooms are in accordance with § 1910.141(e) of this part, and are equipped with two separate lockers or storage facilities, so separated as to prevent contamination of the employee's street clothes from his protective work clothing and equipment.

(2) *Showers.* (i) The employer shall ensure that employees who work in areas where their airborne exposure is above the permissible exposure limit shower at the end of the work shift.

(ii) The employer shall provide shower facilities which comply with § 1910.141(d)(3) of this part.

(iii) The employer shall ensure that employees who are required to shower pursuant to paragraph (i)(2)(i) of this section do not leave the workplace wearing any clothing or equipment worn during the work shift.

(3) *Lunchrooms.* (i) The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure is above the permissible exposure limit.

(ii) The employer shall ensure that lunchroom facilities have a positive pressure, filtered air supply, and are readily accessible to employees.

(iii) The employer shall ensure that employees who work in areas where their airborne exposure is above the permissible exposure limit wash their hands and faces prior to eating, drinking or smoking.

(iv) The employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface asbestos, tremolite, anthophyllite, and actinolite fibers have been removed from the clothing or equipment by vacuuming or other method that removes dust without causing the asbestos, tremolite, anthophyllite, or actinolite to become airborne.

(j) *Communication of hazards to employees—*(1) *Warning signs.* (i) *Posting.* Warning signs shall be provided and displayed at each regulated area. In addition, warning signs shall be posted at all approaches to regulated areas so that an employee may read the signs and take necessary protective steps before entering the area.

(ii) Sign specifications. The warning signs required by paragraph (j)(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) *Warning labels.* (i) *Labeling.* Warning labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos, tremolite, anthophyllite, or actinolite fibers, or to their containers.

(ii) *Label specifications.* The labels shall comply with the requirements of 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard, and shall include the following information:

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

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

(3) *Material safety data sheets.* Employers who are manufacturers or importers of asbestos, tremolite, anthophyllite, or actinolite or asbestos, tremolite, anthophyllite, or actinolite products shall comply with the requirements regarding development of material safety data sheets as specified in 29 CFR 1910.1200(g) of OSHA's Hazard Communication standard, except as provided by paragraph (j)(4) of this section.

(4) The provisions for labels required by paragraph (j)(2) or for material safety data sheets required by paragraph (j)(3) do not apply where:

(i) 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 fibers of asbestos, tremolite, anthophyllite, actinolite, or a

combination of these minerals in excess of the action level will be released or

(ii) Asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is present in a product in concentrations less than 0.1%.

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

(ii) Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

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

(A) The health effect associated with asbestos, tremolite, anthophyllite, or actinolite exposure;

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

(C) The quantity, location, manner of use, release, and storage of asbestos, tremolite, anthophyllite, or actinolite, and the specific nature of operations which could result in exposure to asbestos, tremolite, anthophyllite, or actinolite;

(D) The engineering controls and work practices associated with the employee's job assignment;

(E) The specific procedures implemented to protect employees from exposure to asbestos, tremolite, anthophyllite, or actinolite, such as appropriate work practices, emergency and clean-up procedures, and personal protective equipment to be used;

(F) The purpose, proper use, and limitations of respirators and protective clothing;

(G) The purpose and a description of the medical surveillance program required by paragraph (1) of this section;

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

(iv) Access to information and training materials.

(A) The employer shall make a copy of this standard and its appendices readily available without cost to all affected employees.

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

Secretary and the Director.

(k) *Housekeeping.* (1) All surfaces shall be maintained as free as practicable of accumulations of dusts and waste containing asbestos, tremolite, anthophyllite, or actinolite.

(2) All spills and sudden releases of material containing asbestos, tremolite, anthophyllite, or actinolite shall be cleaned up as soon as possible.

(3) Surfaces contaminated with asbestos, tremolite, anthophyllite, or actinolite may not be cleaned by the use of compressed air.

(4) *Vacuumping.* HEPA-filtered vacuumping equipment shall be used for vacuumping. The equipment shall be used and emptied in a manner which minimizes the reentry of asbestos, tremolite, anthophyllite, or actinolite into the workplace.

(5) *Shoveling, dry sweeping and dry clean-up of asbestos, tremolite, anthophyllite, or actinolite may be used only where vacuumping and/or wet cleaning are not feasible.*

(6) *Waste disposal.* Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with asbestos, tremolite, anthophyllite, or actinolite consigned for disposal, shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(l) *Medical surveillance—(1)*

*General.—(i) Employees covered.* The employer shall institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(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 shall be provided without cost to the employee and at a reasonable time and place.

(B) Persons other than 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) *Preplacement examinations.* (i) Before an employee is assigned to an occupation exposed to airborne concentrations of asbestos, tremolite, anthophyllite, or actinolite fibers, a preplacement medical examination shall be provided or made available by the employer.

(ii) Such examination shall include, as a minimum, a medical and work history; A complete physical examination of all systems with emphasis on the respiratory system, the cardiovascular system and digestive tract; completion of the respiratory disease standardized questionnaire in Appendix D, Part 1; a chest roentgenogram (posterior-anterior 14x17 inches); pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV<sub>1.0</sub>); and any additional tests deemed appropriate by the examining physician. Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E.

(3) *Periodic examinations.* (i) Periodic medical examinations shall be made available annually.

(ii) The scope of the medical examination shall be in conformance with the protocol established in paragraph (1)(2)(ii), except that the frequency of chest roentgenograms shall be conducted in accordance with Table 2, and the abbreviated standardized questionnaire contained in Appendix D, Part 2, shall be administered to the employee.

(4) *Termination of employment examinations.* (i) The employer shall provide, or make available, a termination of employment medical examination for any employee who has been exposed to airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(ii) The medical examination shall be in accordance with the requirements of the periodic examinations stipulated in paragraph (1)(3) of this section, and shall be given within 30 calendar days before or after the date of termination of employment.

(5) *Recent examinations.* No medical examination is required of any

employee, if adequate records show that the employee has been examined in accordance with any of the preceding paragraphs [(1)(2)-(1)(4)] within the past 1 year period.

(6) *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 and E.

(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.

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

(7) *Physician's written opinion.* (i) The employer shall obtain a written signed 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 upon the use of personal protective equipment such as clothing or 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 resulting from asbestos, tremolite, anthophyllite, or actinolite exposure that require further explanation or treatment.

(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.

(m) *Recordkeeping.—(1) 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 (d) of this

TABLE 2.—FREQUENCY OF CHEST ROENTGENOGRAMS

Years since first exposure	Age of employee		
	15 to 35	35+ to 45	45+
0 to 10	Every 5 years	Every 5 years	Every 5 years
10+	Every 5 years	Every 2 years	Every 1 year

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 which 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 respiratory protective devices worn, if any; and
- (F) Name, social security number and exposure of the employees whose exposure are represented.

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

(2) *Objective data for exempted operations.* (i) Where the processing, use, or handling of products made from or containing asbestos, tremolite, anthophyllite, or actinolite is exempted from other requirements of this section under paragraph (d)(2)(iii) 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:

- (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.

**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.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (l)(1)(i) 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) Physician's written opinions;
- (C) Any employee medical complaints

related to exposure to asbestos, tremolite, anthophyllite, or actinolite; and

(D) A copy of the information provided to the physician as required by paragraph (l)(6) 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.* The employer shall maintain all employee training records for one (1) year beyond the last date of employment of that employee.

(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 paragraph (m)(1) 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 paragraph (m)(2) of this section available for examination and copying to the subject employee, to 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(h).

(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 of records and, upon request, transmit them to the Director.

(n) *Observation of monitoring*—(1) *Employee observation.* 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 paragraph (d) of this section.

(2) *Observation procedures.* 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.

(o) *Dates*—(1) *Effective date.* This standard shall become effective July 21, 1986. 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.* All obligations of this standard commence on the effective date except as follows:

(i) *Exposure monitoring.* Initial monitoring required by paragraph (d)(2) of this section shall be completed as soon as possible but no later than October 20, 1986.

(ii) *Regulated areas.* Regulated areas required to be established by paragraph (e) of this section as a result of initial monitoring shall be set up as soon as possible after the results of that monitoring are known and not later than November 17, 1986.

(iii) *Respiratory protection.* Respiratory protection required by paragraph (g) of this section shall be provided as soon as possible but no later than the following schedule:

(A) Employees whose 8-hour TWA exposure exceeds 2 fibers/cc—July 21, 1986.

(B) Employees whose 8-hour TWA exposure exceeds the PEL but is less than 2 fibers/cc—November 17, 1986.

(C) Powered air-purifying respirators provided under paragraph (g)(2)(ii)—January 16, 1987.

(iv) *Hygiene and lunchroom facilities.* Construction plans for changerooms, showers, lavatories, and lunchroom facilities shall be completed no later than January 16, 1987; and these facilities shall be constructed and in use no later than July 20, 1987. However, if as part of the compliance plan it is predicted by an independent engineering firm that engineering controls and work practices will reduce exposures below the permissible exposure limit by July 20, 1988, for affected employees, then such facilities need not be completed until 1 year after the engineering controls are completed, if such controls have not in fact succeeded in reducing exposure to below the permissible exposure limit.

(v) *Employee information and training.* Employee information and training required by paragraph (j)(5) of

this section shall be provided as soon as possible but no later than October 20, 1986.

(vi) *Medical surveillance.* Medical examinations required by paragraph (1) of this section shall be provided as soon as possible but no later than November 17, 1986.

(vii) *Compliance program.* Written compliance programs required by paragraph (f)(2) of this section as a

result of initial monitoring shall be completed and available for inspection and copying as soon as possible but no later than July 20, 1987.

(viii) *Methods of compliance.* The engineering and work practice controls as required by paragraph (f)(1) shall be implemented as soon as possible but no later than July 20, 1988.

(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 and H to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

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NOTE: The Appendices to 29 CFR 1910.1001 have not been reproduced since they are largely identical to the appendices to 29 CFR 1926.58 which are reproduced on pages 51 to 73. Appendices A-E are identical for both standards. Appendix F of 1910.1001 deals with automotive brake repair, and was omitted as irrelevant to the scope of this guide. Appendices G and H to 29 CFR 1910.1001 are identical to appendices H and I of 29 CFR 1926.58.

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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. 653, 655, 657; 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 (38 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 1/cc (10 X PEL).	1. Half-mask air-purifying respirator equipped with high-efficiency filters.
Not in excess of 10 1/cc (50 X PEL).	1. Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 20 1/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 1/cc (1000 X PEL).	1. Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 200 1/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 (i)(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) *Vacuuming*. 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 (FEV<sub>1</sub>). 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 (h).

(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 0.85 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 (1/2). 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 § 1926.56—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/mm<sup>2</sup> filter area.

Estimated Limit of Detection: 7 fibers/mm<sup>2</sup> 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/mm<sup>2</sup>.

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, 25×75 mm.

5. Cover slips, 25×25 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 mm<sup>2</sup>), (Type G-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 extension 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/mm<sup>2</sup>), of 100 to 1300 fibers/mm<sup>2</sup> [3.85×10<sup>4</sup> to 5×10<sup>5</sup> fibers per 25-mm filter with effective collection area (A<sub>c</sub>=385 mm<sup>2</sup>)] for optimum counting precision (see step 21 below). Calculate the minimum sampling time, t<sub>minimum</sub> (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. 56°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,  $L_s$  (μm), using the stage micrometer.

f. Remove the graticule from the microscope and measure its actual grid length,  $L_a$  (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:

$$d_c = \frac{L_s \times D}{L_a}$$

Example: If  $L_s = 108 \mu\text{m}$ ,  $L_a = 2.93 \text{ mm}$  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 ( $\text{mm}^2$ ).

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  $\frac{1}{2}$  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.  $\frac{1}{4}$  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/mm<sup>2</sup>), by dividing the total fiber count,  $F$ , minus the mean field blank count,  $B$ , by the number of fields,  $n$ ; and the field area,  $A_s$  (0.60785mm<sup>2</sup> for a properly calibrated Walton-Beckett graticule):

$$E = \frac{F - B}{n(A_s)} \text{ fibers/mm}^2$$

22. Calculate the concentration,  $C$  (f/cc), of fibers in the air volume sampled,  $V$  (L), using the effective collection area of the filter,  $A_e$  (385 mm<sup>2</sup> for a 25-mm filter):

$$C = \frac{E(A_e)}{V(10^3)}$$

**Note.**—Periodically check and adjust the value of  $A_e$  if necessary.

**Appendix C to § 1926.55—Qualitative and Quantitative FR 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 QLFT 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 interferes 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 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 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 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 Z89.2 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 facepiece 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 prothesis, 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, when 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, anthophylli 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 4810-26-M

Part 1  
INITIAL MEDICAL QUESTIONNAIRE

1. NAME \_\_\_\_\_

2. SOCIAL SECURITY # 1 2 3 4 5 6 7 8 9

3. CLOCK NUMBER 10 11 12 13 14 15

4. PRESENT OCCUPATION \_\_\_\_\_

5. PLANT \_\_\_\_\_

6. ADDRESS \_\_\_\_\_  
(Zip Code) \_\_\_\_\_

8. TELEPHONE NUMBER \_\_\_\_\_

9. INTERVIEWER \_\_\_\_\_

10. DATE 16 17 18 19 20 21

11. Date of Birth Month Day Year 22 23 24 25 26 27

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 even been exposed to gas of 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:

E. In a mine? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

F. In a quarry? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

G. In a foundry? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

H. In a pottery? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

I. In a cotton, flax or hemp mill? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

J. With asbestos? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_

18. PAST MEDICAL HISTORY

A. Do you consider yourself to be in good health? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_  
If "NO" state reason \_\_\_\_\_

B. Have you any defect of vision? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_  
If "YES" state nature of defect \_\_\_\_\_

C. Have you any hearing defect? \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_  
If "YES" state nature of defect \_\_\_\_\_

D. Are you suffering from or have you ever suffered from:

a. Epilepsy (or fits, seizures, convulsions)?  1. Yes  2. No

b. Rheumatic fever?  1. Yes  2. No

c. Kidney disease?  1. Yes  2. No

d. Bladder disease?  1. Yes  2. No

e. Diabetes?  1. Yes  2. No

f. Jaundice?  1. Yes  2. No

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

Mo 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

Age in Years

Does Not Apply

C. At what age was your first attack? 1. Yes  2. No

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

Age in Years

Does Not Apply

C. At what age did you first have it? 1. Yes  2. No

3. 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

Age in Years

Does Not Apply

C. At what age did it start? 1. Yes  2. No

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? 1. Yes  2. No

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? 1. Yes  2. No

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

Age in Years

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? 1. Yes  2. No

E. If you no longer have it, at what age did it stop? 1. Yes  2. No

26. Have you ever had: 1. Yes  2. No

A. Any other chest illness? 1. Yes  2. No

If yes, please specify



H. Please specify cause of death

COUGH

J2A. 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.)

B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week?

C. Do you usually cough at all on getting up or first thing in the morning?

D. Do you usually cough at all during the rest of the day or at night?

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?

F. For how many years have you had the cough?

31A. Do you usually bring up phlegm from your chest? (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?

C. Do you usually bring up phlegm at all on getting up or first thing in the morning?

D. Do you usually bring up phlegm at all during the rest of the day or at night?

IF YES TO ANY OF THE ABOVE (31A, 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?

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

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:

FATHER 1. Yes 2. No 3. Don't Know MOTHER 1. Yes 2. No 3. Don't Know

A. Chronic Bronchitis? 1. Yes 2. No 3. Don't Know

B. Emphysema? 1. Yes 2. No 3. Don't Know

C. Asthma? 1. Yes 2. No 3. Don't Know

D. Lung cancer? 1. Yes 2. No 3. Don't Know

E. Other chest conditions? 1. Yes 2. No 3. Don't Know

F. Is parent currently alive? 1. Yes 2. No 3. Don't Know

G. Please Specify Age if Living Age at Death Don't Know

Number of Years Does not apply

1. Yes 2. No

1. Yes 2. No

1. Yes 2. No

1. Yes 2. No

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 COUGH AND PHLEGM**

34A. Have you had periods or episodes of (increased) cough and phlegm lasting for 1 week or more each year? (For persons who usually have cough and/or phlegm)

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. Yes
2. No
3. Occasionally apart from colds?
3. Most days or nights?

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?

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(e) 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

Part 2  
PERIODIC MEDICAL QUESTIONNAIRE

IF YES TO 40A:  
FOR PERSONS WHO HAVE EVER SMOKED A PIPE

- B. 1. How old were you when you started to smoke a pipe regularly?
- 2. If you have stopped smoking a pipe completely, how old were you when you stopped?
- C. On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week?
- D. How much pipe tobacco are you smoking now?
- E. Do you or did you inhale the pipe smoke?

41A. Have you ever smoked cigars regularly? (Yes means more than 1 cigar a week for a year)

IF YES TO 41A  
FOR PERSONS WHO HAVE EVER SMOKED CIGARS

- B. 1. How old were you when you started smoking cigars regularly?
- 2. If you have stopped smoking cigars completely, how old were you when you stopped.
- C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week?
- D. How many cigars are you smoking per week now?
- E. Do or did you inhale the cigar smoke?

Age \_\_\_\_\_

1. NAME \_\_\_\_\_

2. SOCIAL SECURITY # 1 2 3 4 5 6 7 8 9 \_\_\_\_\_

3. CLOCK NUMBER 10 11 12 13 14 15 \_\_\_\_\_

4. PRESENT OCCUPATION \_\_\_\_\_

5. PLANT \_\_\_\_\_

6. ADDRESS \_\_\_\_\_

7. \_\_\_\_\_ (Zip Code) \_\_\_\_\_

8. TELEPHONE NUMBER \_\_\_\_\_

9. INTERVIEWER \_\_\_\_\_

10. DATE 16 17 18 19 20 21 \_\_\_\_\_

11. What is your marital status?  
 1. Single \_\_\_\_\_ 4. Separated/Divorced \_\_\_\_\_  
 2. Married \_\_\_\_\_  
 3. Widowed \_\_\_\_\_

12. OCCUPATIONAL HISTORY

12A. In the past year, did you work full time (30 hours per week or more) for 6 months or more?  
 IF YES TO 12A:  
 1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

12B. In the past year, did you work in a dusty job?  
 1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_  
 3. Does Not Apply \_\_\_\_\_

12C. Was dust exposure:  
 1. Mild \_\_\_\_\_ 2. Moderate \_\_\_\_\_ 3. Severe \_\_\_\_\_

12D. In the past year, were you exposed to gas or chemical fumes in your work?  
 1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

12E. Was exposure:  
 1. Mild \_\_\_\_\_ 2. Moderate \_\_\_\_\_ 3. Severe \_\_\_\_\_

12F. In the past year, what was your:  
 1. Job/occupation? \_\_\_\_\_  
 2. Position/job title? \_\_\_\_\_

Age stopped  
 Check if still smoking pipe  
 Does not apply

— oz. per week (a standard pouch or tobacco contains 1 1/2 oz.)  
 — Does not apply

oz. per week  
 Not currently smoking a pipe

1. Never smoked  
 2. Not at all  
 3. Slightly  
 4. Moderately  
 5. Deeply

1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

Age \_\_\_\_\_

Age stopped  
 Check if still smoking cigars  
 Does not apply

Cigars per week  
 Does not apply

Cigars per week  
 Check if not smoking cigars currently

1. Never smoked  
 2. Not at all  
 3. Slightly  
 4. Moderately  
 5. Deeply

Signature \_\_\_\_\_ Date \_\_\_\_\_

**13. RECENT MEDICAL HISTORY**

13A. Do you consider yourself to be in good health? Yes \_\_\_ No \_\_\_

13B. In the past year, have you developed: If NO, state reason \_\_\_

- |                  |         |        |
|------------------|---------|--------|
| Epilepsy?        | Yes ___ | No ___ |
| 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: YES \_\_\_ NO \_\_\_

- Asthma \_\_\_
- Bronchitis \_\_\_
- Hay Fever \_\_\_
- Other Allergies \_\_\_

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ISSUE NO. FEDERAL REGISTER VOL. 51, NO. 119

- Pneumonia \_\_\_
- Tuberculosis \_\_\_
- Chest Surgery \_\_\_
- Other Lung Problems \_\_\_
- Heart Disease \_\_\_

Do you have: \_\_\_

YES OF NO FURTHER COMMENT ON POSITIVE ANSWERS

- Frequent colds \_\_\_
- Chronic cough \_\_\_
- Shortness of breath when walking or climbing one flight of stairs \_\_\_

Do you: \_\_\_

- Wheeze \_\_\_
- Cough up phlegm \_\_\_
- Smoke cigarettes \_\_\_

Packs per day \_\_\_ How many years \_\_\_

Date \_\_\_ Signature \_\_\_

FURTHER COMMENT ON POSITIVE ANSWERS

### 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.a.

(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

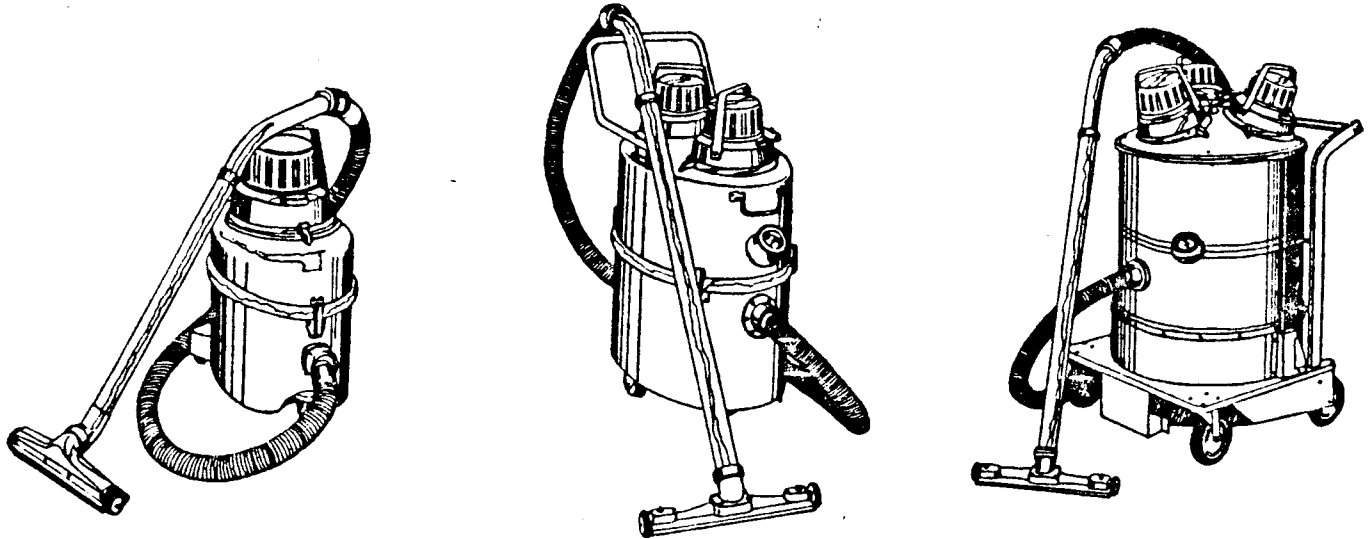
Although individual asbestos removal projects vary in terms of the equipment required to accomplish the removal of the material, some equipment and materials are common to most asbestos removal operations. Equipment and materials that should be available at the beginning of each project are: (1) rolls 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.

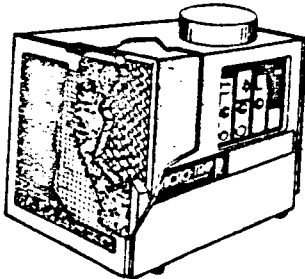
**Exhaust Air Filtration System.** A portable ventilation system is necessary to create a negative pressure within the asbestos removal enclosure. Such units are equipped with a HEPA filter and are designed to exhaust and clean the air inside the enclosure before exhausting it to the outside of the enclosure (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.<sup>1</sup> 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

<sup>1</sup> 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 or 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

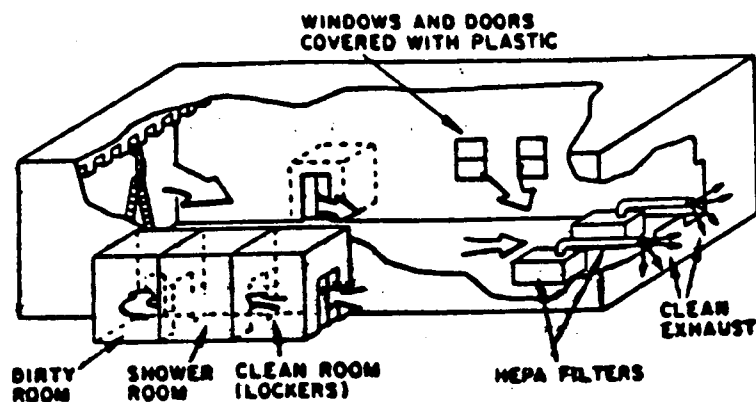
Paragraph (j) of the final standard mandates that employers involved in asbestos removal, demolition, or renovation operations provide their employees with hygiene facilities to be used to decontaminate asbestos-exposed workers, equipment, and clothing before such employees leave the work area. These 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).

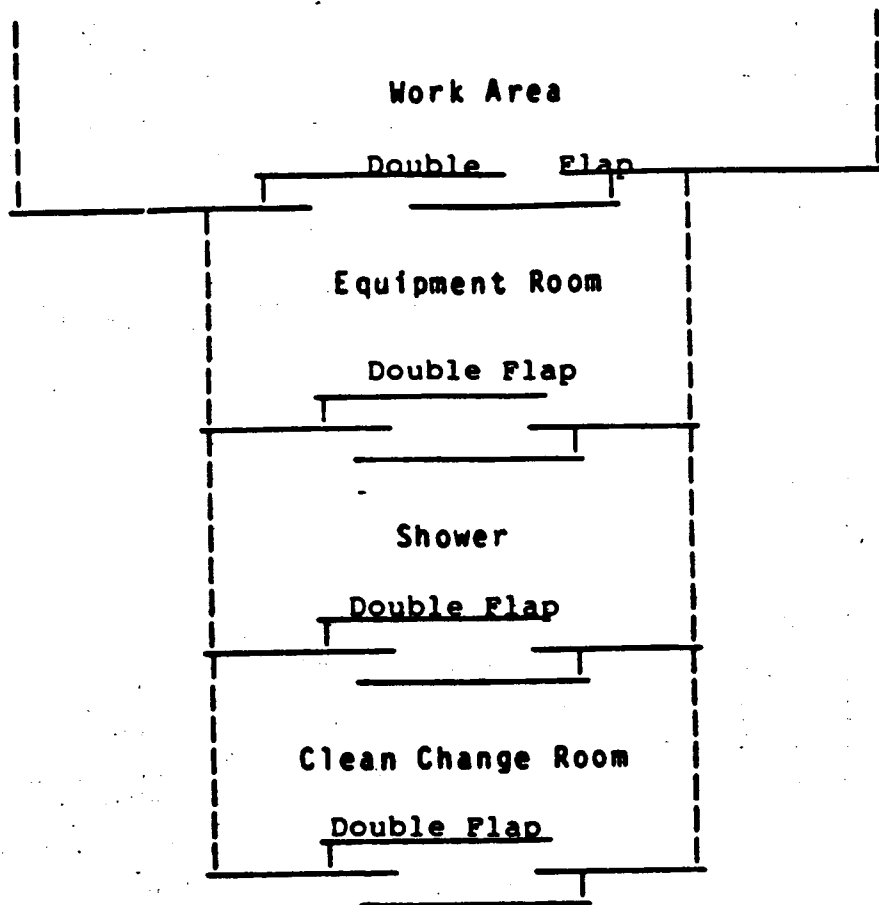


Figure F-4. Typical Hygiene Facility Layout

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 work suit 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.

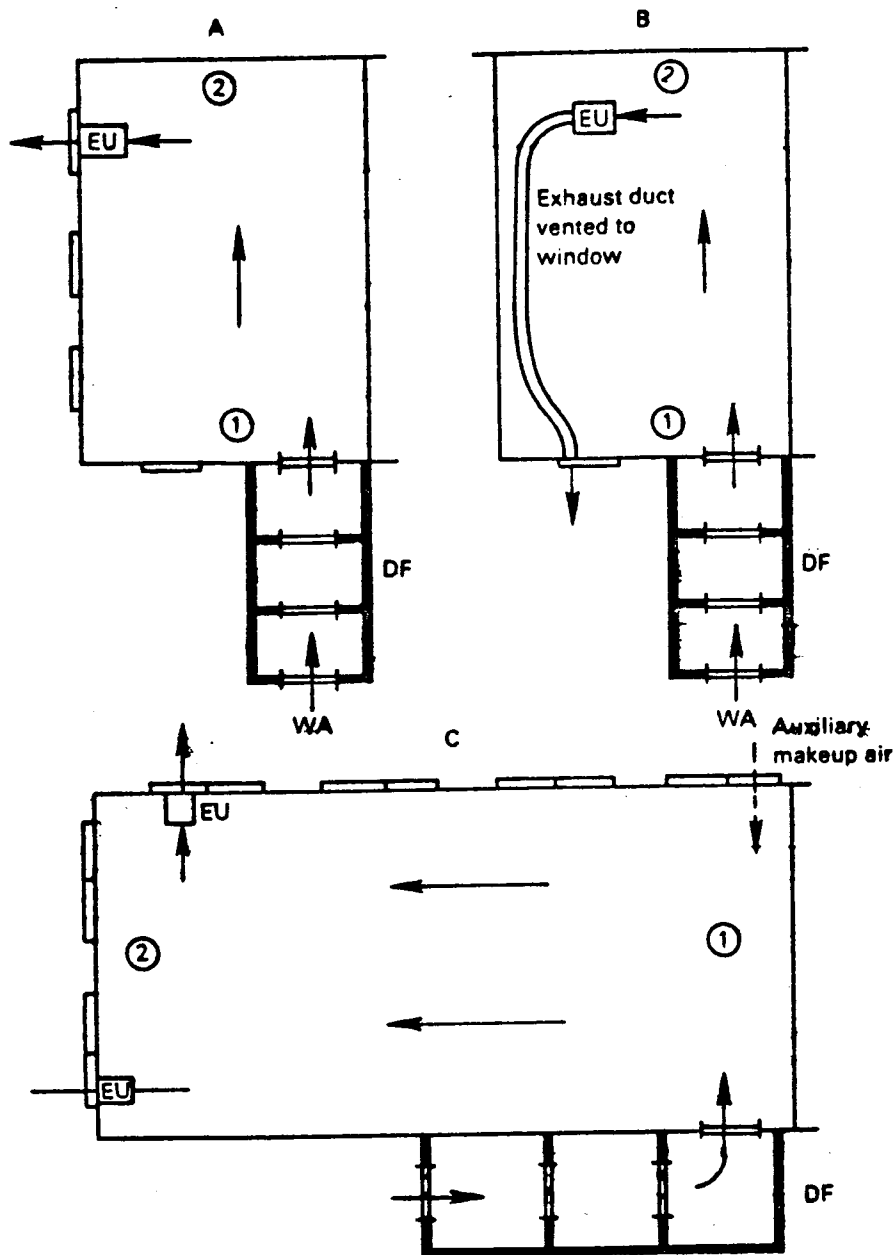
The clean room, shower, and equipment room must be sealed completely to ensure that the sole source of air flow through these areas originates from uncontaminated areas outside the asbestos removal, demolition, or renovation enclosure. The shower must be drained properly after each use to ensure that 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-3. 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.

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

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)(ii) 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

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-8. 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
<b>I. Work site barrier</b>		
Floor covered	_____	_____
Walls covered	_____	_____
Area ventilation off	_____	_____
All edges sealed	_____	_____
Penetrations sealed	_____	_____
Entry curtains	_____	_____
<b>II. Negative Air Pressure</b>		
HEPA Vac _____ Ventilation system _____		
Constant operation	_____	_____
Negative pressure achieved	_____	_____
<b>III. Signs</b>		
Work area entrance	_____	_____
Bags labeled	_____	_____
<b>IV. Work Practices</b>		
Removed material promptly bagged	_____	_____
Material worked wet	_____	_____
HEPA vacuum used	_____	_____
No smoking	_____	_____
No eating, drinking	_____	_____
Work area cleaned after completion	_____	_____
Personnel decontaminated each departure	_____	_____
<b>V. Protective Equipment</b>		
Disposable clothing used one time	_____	_____
Proper NIOSH-approved respirators	_____	_____
<b>VII. Showers</b>		
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 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.

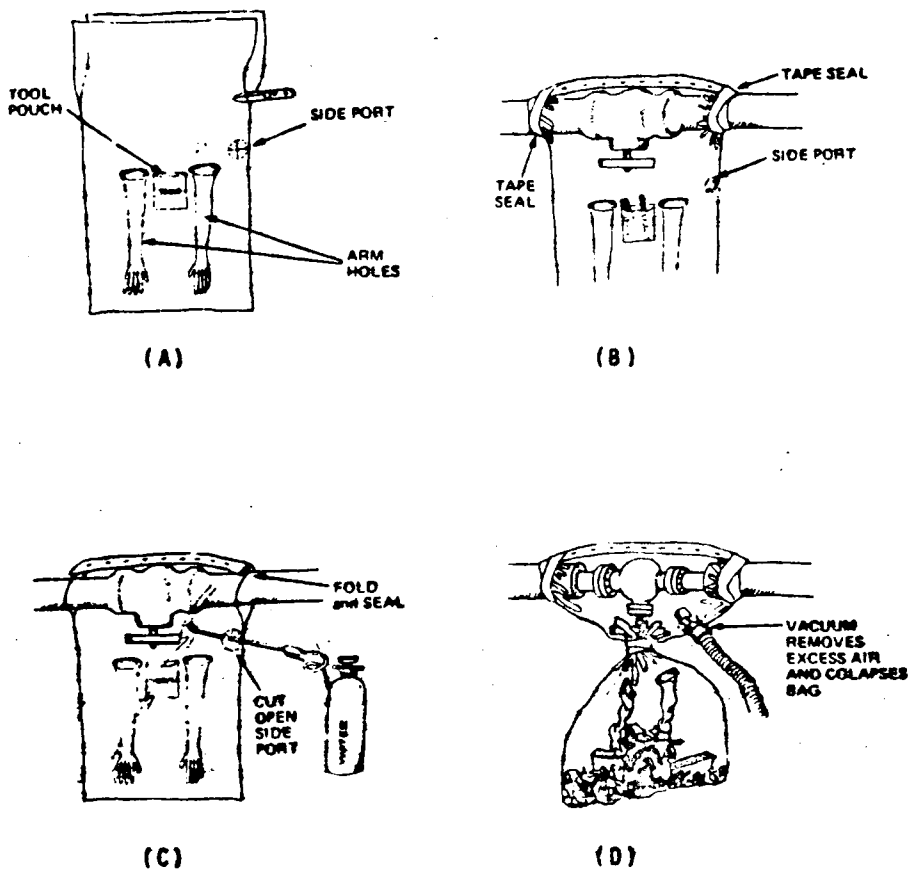


Figure G-1. Diagrams Showing Proper Use of Glove Bags in Small-Scale, Short-Duration Maintenance and Renovation Operations.

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<sup>®</sup> 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.

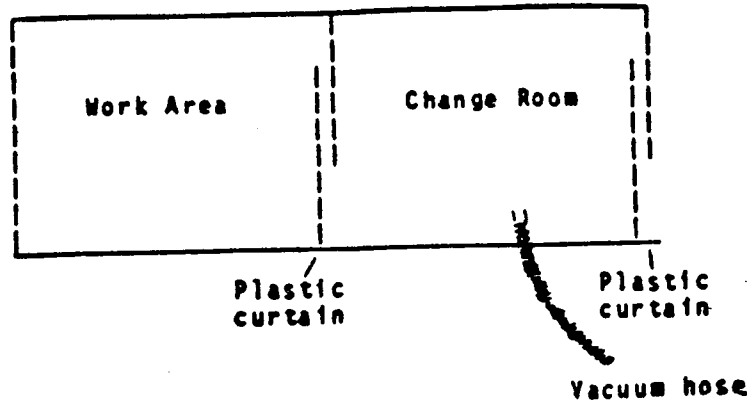
(6) Any asbestos containing insulation edges that have been exposed as a result of the removal or maintenance activity must be encapsulated with bridging encapsulant to ensure that the edges do not release asbestos fibers to the atmosphere after the glove bag has been removed.

(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

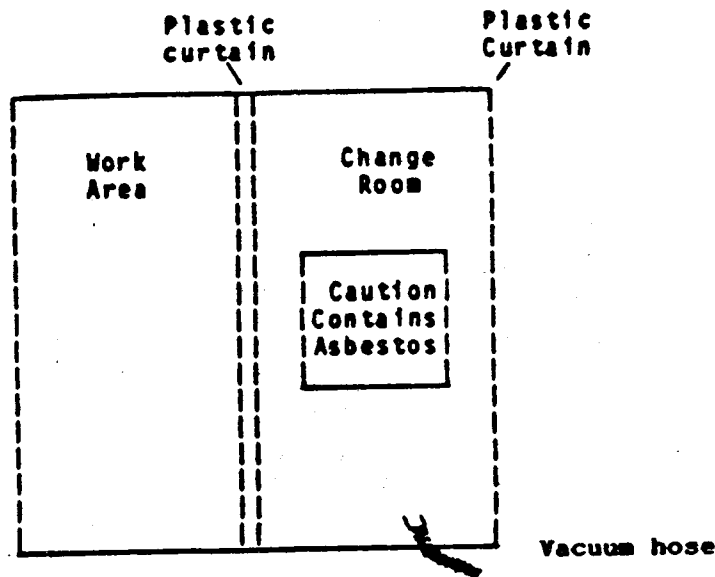


Figure G-2. Schematic of Mini-enclosure

#### 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 Tyvek<sup>1</sup> 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

<sup>1</sup> 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 up 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 disturbed. 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 § 1926.58—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 characteristic 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 (FEV<sub>1</sub>).

(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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