

CHAPTER 8
ASBESTOS FIBERS

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Chapter 8 ASBESTOS FIBERS

I. Introduction

Asbestos is an inhalation and ingestion hazard which causes chronic lung disease (asbestosis) and certain cancers of the lung (mesothelioma) and digestive tract, as well as other asbestos related diseases. Asbestos occurs naturally in a variety of mineral deposits and is used for thermal and electrical insulation, fire-proofing, and cement products. The physical form of asbestos includes fibers of various sizes, colors, and textures.

A. Definitions

Asbestos - a generic term for several hydrated silicates. When these silicates are crushed or processed, they separate into flexible fibers. The term asbestos, as stated in 30 CFR §§ 56/57.5001(b), is limited to the following mineral fibers: *chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.*

Asbestos is classified as either serpentine or amphibole. About 95% of all commercial asbestos is serpentine. The following table outlines the groups of asbestos and their respective types:

Group	Mineral Name	Type of Asbestos	CAS* No.
Serpentine	Serpentine	Chrysotile	12001-29-5
Amphibole	Grunerite (cummingtonite-grunerite)	Amosite (grunerite asbestos or brown asbestos)	12172-73-5
	Riebeckite	Crocidolite (blue asbestos)	12001-28-4
	Anthophyllite	Anthophyllite asbestos	77536-67-5
	Tremolite	Tremolite asbestos	77536-68-6
	Tremolite-actinolite	Actinolite asbestos	77536-66-4

* CAS - Chemical Abstract Service

Fibers - fibrils with a length greater than five microns.

B. Sources of Asbestos Fibers

Natural Occurrence - Asbestos occurs in asbestos-producing mines (of which there are presently none active in the U.S.), and in association with certain other mineral ores. Therefore, asbestos sampling should be considered at mine properties where the following rock and minerals are found: talc, vermiculite, taconite, serpentinized limestone, and banded ironstone.

Asbestos fibers may be released into the ambient air by the breaking, crushing, grinding, drilling, or general abrasive handling of a solid material having asbestos components.

Introduced Commercial Asbestos - Asbestos exposure can occur from products brought onto the mine property, such as brake linings and pads, asbestos cement boards, asbestos welding blankets, asbestos jointing and packing compounds and asbestos coated wiring. Inspectors should encourage operators to replace these items with asbestos-free materials where miners could be exposed. Removal of asbestos containing materials, such as building insulation, requires the use of special precautions. See section III below.

If asbestos-containing items are used, collect samples in their areas of use. For example, collect fiber samples when a mechanic is fabricating and/or changing brake linings, or in large dragline housings where asbestos brakes are used. Inspectors must use appropriate Personal Protective Equipment when collecting samples.

II. Applicable MSHA Standards for Metal and Nonmetal:

A. Threshold Limit Values (TLVs[®]) per 30 CFR 56/57.5001(b):

The exposure limits for airborne asbestos fiber concentrations are:

- 1. Full-shift** - an exposure limit of 2.0 fibers/mL (same as 2.0 fibers/cc).
- 2. Short-term** - a 15-minute exposure limit of 10.0 fibers/mL (same as 10.0 fibers/cc).

B. Other Standards in 30 CFR That Should Be Evaluated if Asbestos Presence is Known or Suspected:

47.41	Labeling of toxic materials, HazCom
56/57.5002	Exposure monitoring
56/57.5005	Control of exposure to airborne contaminants
56/57.15004	Eye protection
56/57.15006	Protective equipment and clothing for hazards and irritants
56/57.16003	Storage of hazardous materials
56/57.16004	Containers for hazardous materials
56/57.18002	Examination of working places
56/57.18006	New employees
56/57.20011	Barricades and warning signs
56/57.20014	Prohibited areas for food and beverages

III. Handling Materials Containing Asbestos

When asbestos exposure is possible (known or suspected), inspectors should wear appropriate personal protective equipment (PPE). To determine what PPE to use, refer to the *Recommendations for Chemical Protective Clothing, NIOSH Pocket Guide to Chemical Hazards*, or consult with the district health specialist/industrial hygienist. PPE and appropriate sampling equipment can be obtained from the District.

Adhere to the following guidelines when miners are observed mining, installing, stabilizing, or removing materials containing asbestos, or demolishing structures containing asbestos.

A. Asbestos Known

When an extraction, insulation, or demolition operation is in progress on mining property, the inspector should inquire whether there is asbestos in the ore, insulation, or structure. If asbestos is known to be present, take personal fiber samples (refer to sections IV, V, and VII below). Be sure the mine operator or contractor understands the hazards of asbestos and how to control or eliminate miner exposure. This includes ensuring that the workplace is examined once each shift, a record is kept, and safety and health hazards are corrected. Ensure that asbestos is properly identified and segregated by barricades. Anyone coming into contact with asbestos must have adequate personal protective equipment. Additionally, when the material is removed, it must be appropriately bagged, labeled, and disposed in accordance with applicable state or Federal asbestos

regulations. Individuals must be trained in the proper use of PPE and safe procedures for working with asbestos.

B. Asbestos Suspected

If the mine operator has not sampled the material and the inspector believes the material could contain asbestos, the inspector should take a bulk sample (refer to sections VI and VII below) and submit it to the MSHA laboratory for analysis. If the inspector strongly suspects the presence of asbestos, personal sampling should be immediately conducted. If the bulk sample results show asbestos is present, the inspector should conduct personal sampling. Alert the mine operator or contractor to the hazards and control of asbestos.

C. Environmental Protection Agency (EPA) Notification

The EPA requires notification when asbestos is present in a building that is to be demolished or renovated and when the asbestos is being removed. However, if all of the asbestos is only being encapsulated and left in place, EPA does not have to be notified. If asbestos is found at a mine site during demolition, renovations, or removal activities, determine if the mine operator or contractor has notified the EPA. If the operator or contractor will not notify EPA, the inspector should notify the nearest EPA Regional Office. EPA will need an estimate of the amount of asbestos-containing material present, in linear feet on pipes or square feet on other facility components. If the phone number of an EPA Regional Office cannot be obtained, contact the District Office.

IV. Personal Exposure Sampling Equipment

A. Filter-Cassette Assembly

Fiber sampling filter-cassette assemblies are factory pre-packaged. Use a 25-millimeter (mm) mixed cellulose ester (MCE) membrane 0.8 micron cassette (SKC or Millipore) mounted inside a black 50-mm electrically conductive plastic extension cowl that has passed quality assurance testing by the manufacturer (refer to Figure 8-1).



Figure 8-1. Filter-Cassette Assembly

B. Personal Sampling Pump

Any personal sampling pump that can maintain the specified flow rate for the sampling period (see discussion below) can be used.

V. Personal Exposure Sampling Procedure

A. Calibrate the Sampling Pump

Calibrate the sampling pumps for fiber sampling in accordance with the procedures contained in Chapter 4. The recommended flow rate for full-shift personal sampling is 1.7 Lpm. Use consecutive samples if necessary to avoid overloading the filter. Do not adjust pump flow rate once sampling has begun.

When sampling for a short term exposure, such as from a task requiring a short amount of time, sample for 15 to 30 minutes at a flow rate of 2.5 Lpm or greater.

B. Prepare Blank Filters

To determine any contamination of the filter in manufacturing or handling, submit at least two field blanks from the same lot (or 10% of the total samples, whichever is greater) for each set of samples.

1. Prepare field blanks at the same time as other cassettes prior to sampling. Remove the inlet cover and outlet plugs, then quickly replace them. Place a new sample seal (MSHA Form 4000-30) over the cassette.
2. Number or uniquely identify the cassette if it is not already marked. This will be the blank sample noted on the Request for Laboratory Analysis form.
3. Treat the blank filter-cassette assemblies the same as the exposed filters. *i.e.*, blank filters are sent along with the air samples to the MSHA laboratory for analysis.

C. Assemble Sampling Train

1. Number or uniquely identify the cassette if it is not already marked. This will be the sample number noted on the Request for Laboratory Analysis (RLA) form.
2. Attach the cassette to the sampling pump.
 - a. Remove the inlet cover and the outlet plug of the cassette. Place them in a clean, convenient location (*e.g.*, in a plastic bag).
 - b. Attach the sampling tube onto the outlet of the cassette. Attach the other end of the tubing to the sampling pump inlet (refer to Figure 8-2). The cassette can be placed in an optional holder (Refer to figure 8-2a).
 - c. Make sure that all fittings are tight and that the cassette is secured to the lapel holder.



Figure 8-2. Asbestos Fiber Sampling Train



Figure 8-2a. Alternate Asbestos Fiber Sampler

D. Attach Sampling Train to Miner

1. Attach the sampling pump and sampling train to the miner so that it will not create a safety hazard to him or her or anyone else while performing normal activities. If the miner is not wearing a shirt or belt, the inspector should provide a belt or vest to facilitate sampling. These are available in various sizes from the District.
2. Attach the open-faced filter-cassette assembly; facing downward, in the miner's breathing zone.

E. Instructions to the Miner

1. Explain to the miner what you are doing, what the sampling device does, and the reason for the sampling (i.e., the hazard). If available, issue a Miner Health Hazard Information Sheet or Card.
2. Instruct the miner not to remove the sampling pump or sampling train at any time or cover the filter-cassette assembly with a coat or other garment. If the miner must leave the mine property during the shift, the inspector should remove the sampling train and turn the sampling pump off. Sampling should continue once the miner returns.
3. Instruct the miner not to bump, drop, abuse, or tamper with the sampling pump or sampling train.
4. Emphasize the need for the miner to continue to work in a routine manner and report to you any unusual occurrences during the sampling period.
5. Inform the miner when and where you will remove the sampler and that you will be checking the equipment throughout the shift.

F. Collect Sample

1. Start the sampling pump and replace the security cover.
2. Record the following information in the Health Field Notes (refer to Chapter 21, Section V):
 - Time the sampling pump was started;
 - Pump and cassette identification numbers;
 - Miner's name, job title, and work location(s);
 - Shift hours per day and days per week worked;
 - Any respirator worn or expected to be worn (brand, model, type of filters); and
 - Whether an acceptable respiratory protection program exists (see Chapter 16 for criteria for evaluating respiratory protection program).
3. During each full-shift sample, the inspector must observe the miner being sampled as frequently as is necessary to determine that a representative sample is being conducted of the normal activities. Check the sampling pump and sampling train to make sure that the sampling pump is operating properly, and to make sure the tubing and connections are not leaking. Do not adjust the flow rate at any time while sampling. Record what tasks the miner has performed in the time between subsequent checks so that the completed Health Field Notes (Form 4000-31) will describe the miner's full work shift. This requirement does not necessarily preclude the inspector from doing other inspection work while sampling.
4. Accurate fiber counting depends on optimal fiber loading on the sampling filter. That is, the sampling duration must be sufficient to accumulate at least a density of 100 fibers per square millimeter on the filter. However, dusty atmospheres may cause excessive background dust on the filter and the sample may not be able to be analyzed due to overloading. Observe the dust conditions in the workplace and check the collecting filter surface for excessive accumulation. The filter may need to be changed out

periodically during the shift. Any visible dust accumulation on the filter necessitates a complete filter-cassette assembly replacement.

5. Throughout the shift, include the following pertinent information in the Health Field Notes:
 - Times that the sampling train was checked and condition of sampling equipment; record the times involved if the sampling pump needs to be changed out, stopped, or restarted for any reason;
 - If consecutive samples were taken, record the number of additional cassettes used during sampling period; group consecutive samples taken on a miner onto one RLA; do not mix individuals on the same form;
 - Activity of miner, equipment operating in the area, and approximate time spent at each activity;
 - General description of controls in use and whether or not they seem adequate;
 - Potential sources of exposure, a general description of these sources, number of persons affected, and possible additional control measures;
 - Any other samples taken and the results, if available (such as noise, detector tubes, organic vapor badges); and
 - Environmental conditions (such as wind conditions, temperature, humidity, etc.).

G. Remove Sampler

Collect the sampling train from the miner.

1. Turn off the sampling pump and immediately record the time.
2. Carefully remove the sampling apparatus, replace the inlet cover and the outlet plug, and apply a sample seal end over end to seal to the cassette.

3. Send the samples to the MSHA laboratory in a rigid container with packing material to prevent jostling or damage. (Do not use polystyrene foam for packing.)

VI. Bulk Sampling Procedures

Use caution when taking a bulk sample of a material that is suspected or known to contain asbestos because it can damage the material and cause significant release of fibers. The following guidelines are designed to minimize fiber release and potential exposures to asbestos fiber:

- As a minimum, wear a NIOSH-approved half-face respirator with high efficiency filters (N, P, or R-100), disposable gloves, and safety glasses or goggles (unvented or indirectly vented).
- Wet the surface of the material to be sampled with water (to which a few drops of liquid dish detergent have been added) from a spray bottle, or place a plastic bag around the sampler.
- Label each rigid container with a unique identifier and apply the sample seal.
- For pipe and boiler insulation, use a non-asbestos mastic (binding material). For other material, use latex paint, tape, or a sealant to cover the sample area.
- Do not submit bulk samples in plastic bags; see Sections A. - C. below for proper containers.
- Submit all bulk samples separate from the air sampling cassettes.

A. Settled Dust

Collect settled dust bulk samples (several grams or a sample about the size and thickness of a quarter) in areas where asbestos is suspected or where personal samples (for asbestos) are being collected. Collection areas can be on top surfaces of equipment and tops of beams and supports. Collect the samples in a clean vial (plastic or glass), jar, or other rigid container. (Note: Do not “vacuum” a sample of the surface contamination using a sampling pump and cassette. This collection method could separate fibers from bundles and skew the results.) Label

the sample appropriately and submit it to the MSHA laboratory to determine the percentage and type of asbestos.

B. Bulk Pieces

Bulk samples can also be simply taken from raw ore, final products, and other materials (e.g., broken floor tiles) where asbestos may be suspected. If the material is being removed, take a piece of the removed material. Submit samples in a rigid container (jar, vial, etc.) to the MSHA laboratory to determine the type and percentage of asbestos.

C. Bulk Samples Using Sampler/Container

Bulk/core samples can also be taken from wallboard, boiler wrap, gaskets, pipe insulation, or other friable (flaky, crumbly, etc.) materials suspected to contain asbestos. These materials can be sampled with a sampler/container (see Figure 8-3) which is available from the District. Note: Do not take a sample if there is potential for significant substrate damage or a fiber release, especially if the substrate material is in otherwise good condition. Contact the District Health Specialist or Industrial Hygienist for assistance.

To use these samplers, hold the “T” handle provided and slowly push and twist the sampler into the material. Be sure to penetrate any paint or protective coating and all the layers of the material. Each sampler comes with a clear, plastic, shatter-proof container and protective cap. After sampling, insert the sampler in the plastic container and cap it as a unit. Then seal it in a larger container for shipment. **Note:** For your safety, never remove the sample from the sampler. The MSHA laboratory will eject the sample under controlled conditions (hood) prior to analysis. Mail the samplers in a strong container (cardboard box, etc.) to the MSHA laboratory to determine the percentage and type of asbestos.



Figure 8-3. Bulk/Core Asbestos Sampler/Container

VII. Post-Inspection Procedures

- A. **Review Health Field Notes (MSHA Form 4000-31).** Check that all necessary information has been recorded on the form.
- B. **Post-Calibration.** Check sampling pump calibration in accordance with Chapter 4.
- C. **Submit Samples for Analyses**

Complete Request for Laboratory Analysis (RLA) forms for air samples and bulk samples (refer to Chapter 21, Section VII). Send RLA forms in container with sample cassettes to the MSHA laboratory for counting and analysis. To prevent possible cross contamination, do not ship mixtures of air cassettes and bulk samples in the same package.

- Item No. 5 (sample type) - designate “F” for asbestos fiber sample, “B” for bulk sample (for asbestos determination), and “CB” for blank cassettes.
- Item No. 16 (analysis desired) - designate Asbestos Fiber.

- D. **Compliance Determination**

- 1. The MSHA laboratory will calculate personal exposure results in an “Analytical Report” mailed back to the sample collector. The “Report” will present fiber concentrations as determined by the Phase Contrast Microscopy (PCM) analytical method. The PCM method is non-specific and reports unidentified total fiber concentrations. Any PCM fiber concentrations greater than 0.1 fibers/cc will be re-analyzed by the Transmission Electron Microscopy (TEM) method to confirm the identity and concentration of the asbestos fiber proportion of the sample. In these cases two concentration values will be reported, *i.e.*, the PCM value and the TEM value. Determine compliance by comparing the TEM asbestos fiber exposure concentrations with the respective exposure limit:
 - a. **Full-shift** - an 8 hour time-weighted average exposure limit of 2.0 asbestos fibers/mL (cc is same as mL).

- b. Short-term** - a 15-minute exposure limit of 10.0 asbestos fibers/mL (cc is same as mL).
2. If consecutive samples were taken over the length of the shift, and the results are reported as the TWA for each sample, the calculation of the 8-hour equivalent shift-weighted average (SWA) is determined by the following formula:

$$\text{SWA} = (\text{TWA}_1 \times t_1 + \text{TWA}_2 \times t_2 + \dots + \text{TWA}_n \times t_n) / 480 \text{ min.}$$

where: TWA = Contaminant concentration measured by actual sampling time;

t = Time period of each sample in minutes; and

$t_1 + t_2 + \dots + t_n$ is the total time of the full workshift.

Note: Both the SWA for unidentified fiber concentrations determined by PCM, and asbestos fiber concentrations determined by TEM, are calculated the same way.

3. The error factor for asbestos sampling and analysis will be supplied by the MSHA laboratory.

E. Report Writing

1. Complete the Personal Exposure Data Summary (refer to Chapter 21, Section VIII). Record full-shift SWA and short-term STEL personal exposure results for samples collected and analyzed for: unidentified fiber concentration by PCM as code 505, and asbestos fiber concentration by TEM as code 501; even if the results are zero. Note: Code 505 has no TLV.
2. Submit a copy of the Field Notes and Health Field Notes, the Request for Laboratory Analysis, citations/orders, and the Personal Exposure Data Summary with the inspection report.