

PLAINTIFF'S  
EXHIBIT  
AL-924

40. Asbestos Workshop for  
Safety/IH Conference 1986



ASBESTOS WORKSHOP FOR  
SAFETY/IA GROUP 1986  
AET 14-17

ASBESTOS WORKSHOP

# DANGER ASBESTOS

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

"Restricted Area" Signs 11" x 14"  
Available from:

Asbestos Control Technology Inc.  
P.O. Box 183  
Maple Shade, NJ 08052

1-800-221-1911

200 paper signs/pack \$ 33/pack

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specify "Danger" or they may sell you  
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# DANGER

CONTAINS ASBESTOS FIBERS  
AVOID CREATING DUST  
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# JOB SAFETY ANALYSIS WORKSHEET

Job Asbestos removal  
 Occupation Bldg. Maint. Mechanic, Mechanical Utility Worker  
 Department Civil Maintenance  
 Prepared By Irene Scheffler, Arkansas Operations  
 Employee Participants \_\_\_\_\_  
 Reviewed \_\_\_\_\_ Date 1986-10-08

Required Personal Protective Equipment:

METHOD: 1) Observe the job 2) Discuss it with operator 3) Draw on your own knowledge

| SEQUENCE OF BASIC JOB STEPS                                                                                                                         | POTENTIAL ACCIDENTS OR HAZARDS                                                                                                                                                                                                         | RECOMMENDED SAFE PROCEDURE                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Describe what is done without detail. Not too broad - not too fine. List the natural steps of the job. Most jobs can be fitted in 12 or less steps. | What can happen at each step?<br>List according to accident type<br>SB Struck By CO Caught On<br>CA Caught Against CB Caught Between<br>SA Struck Against F Fall<br>CW Contact With SO Strain/Overexertion<br>TI Trapped In E Exposure | Describe specific precautions in detail for each step and each hazard. Question the basic job method. Try to develop cost reduction ideas. People? Process? Product?                                                                                                                   |
| 1) Contact IH/Safety to determine type of insulation if it is not known.                                                                            | 1) Exposure to known carcinogen                                                                                                                                                                                                        | 1) If insulation is not marked with asbestos labels, and type of insulation is unknown, bring a small sample of material to the IH/Safety Department for analysis. If analysis can't be made immediately, treat the material like asbestos.                                            |
| 2) If insulation is asbestos, EPA notification procedure must be followed.                                                                          |                                                                                                                                                                                                                                        | 2) Both large and small jobs require the completion of forms by the supervisor (or "competent person" per OSHA definition) of each asbestos removal project. These forms are to be forwarded to IH/Safety upon completion.                                                             |
|                                                                                                                                                     |                                                                                                                                                                                                                                        | a) Large job (per EPA definition) - removal of 260 linear feet or more of pipe covering or 160 square feet or more of other types of asbestos insulation. Large jobs require at least 10 days' advance notification to satisfy EPA rules.                                              |
|                                                                                                                                                     |                                                                                                                                                                                                                                        | b) Small jobs (per EPA definition) - removal of less than 260 linear feet of pipe covering or less than 160 square feet of other types of asbestos insulation. IH/Safety should be notified of small jobs before they begin. (Other states may require prenotification of small jobs.) |

| SEQUENCE OF BASIC JOB STEPS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | POTENTIAL ACCIDENTS OR HAZARDS                              | RECOMMENDED SAFE PROCEDURE                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3) Contact IH/Safety for air monitoring when removing asbestos materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3) E - Ingestion and inhalation.                            | 3) Conduct personal exposure sampling in employee breathing zone. Initial monitoring is required for all jobs. OSHA large jobs may require daily monitoring with tests sufficient to represent each employee's exposure. |
| PPE Requirements:<br>Wherever employee exposures may exceed the OSHA limit of 0.2 fibers/cc, protective clothing is required. This clothing is to include whole-body clothing, head coverings, gloves and foot coverings. Wrist and ankles of coveralls are to be sealed with duct tape to prevent entrance of asbestos contamination. In general rubber boots should be used as the required foot covering. "Boaties" may be used in highly controlled job sites where their tearing would be less likely. Hooded coveralls make acceptable headcoverings. The selection of respiratory protection depends upon the exposure level. The following respirator types are acceptable: |                                                             |                                                                                                                                                                                                                          |
| AIRBORNE ASBESTOS CONCENTRATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | REQUIRED RESPIRATOR                                         |                                                                                                                                                                                                                          |
| ≤ 2 f/cc (10xPEL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | *half-mask air purifying HEPA                               |                                                                                                                                                                                                                          |
| < 10 f/cc (50xPEL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | *full facepiece air purifying HEPA                          |                                                                                                                                                                                                                          |
| < 20 f/cc (100xPEL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | *PAPR with HEPA<br>*full face supplied air, continuous flow |                                                                                                                                                                                                                          |
| < 200 f/cc (1000xPEL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | *Type "C"                                                   |                                                                                                                                                                                                                          |
| > 200 f/cc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | *Type "C" with auxiliary positive pressure SCBA             |                                                                                                                                                                                                                          |

| SEQUENCE OF BASIC JOB STEPS                     | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                 |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| A) Prepare job site.                            |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4.1) CB - Body Burns                            |                                | 4.1) When possible give piping and vessels enough time to cool off before performing work.                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                 |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4.2) F - Exposure of others to a carcinogen.    |                                | 4.2) Set up a restricted area. Post asbestos warning signs at such a distance from the job site that people are aware of the hazard prior to entering the restricted area. Only authorized people with proper protective clothing are allowed inside the restricted area. Restricted area must encompass entire area where airborne asbestos concentration exceeds the PEL. For large scale asbestos abatement jobs (per OSHA definition) a negative pressure enclosure is required whenever feasible. |
|                                                 |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                 |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4.3) F - Slip/fall hazard on visqueen sheeting. |                                | 4.3) Spread 6 mil visqueen sheeting to cover floor in work area to prevent the spread of asbestos material and to aid in cleanup.                                                                                                                                                                                                                                                                                                                                                                      |
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| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS                 | RECOMMENDED SAFE PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                      |
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| 5) Remove insulation.       | 5.1) E - Exposure to asbestos.                 | 5.1) Wet insulation thoroughly with amended water spray wherever this is possible. Be alert for electrical shock hazards and eliminate them before removing asbestos by the wet method. Do not use so much water that streams of contaminated water run away from the job site. If a glove bag or other mini-enclosure is used, put it in place prior to wetting the insulation. Keep asbestos wet at all times during removal. |
|                             | CW - Electrical shock.                         |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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|                             | 5.2) SR - Cuts from knife, saw or sharp metal. | 5.2) To cut asbestos use a sharp knife or a flexible saw. Never knock insulation off with a hammer because this will generate more dust. Be aware of sharp wire or other sharp metal objects associated with the insulation. Wear proper head protection to prevent cuts and abrasions. When cleaning surfaces, use nylon bristled brushes because wire brushes will break asbestos into small fibrils.                         |
|                             | E - Exposure to asbestos.                      |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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|                             | 5.3) F - Trip, slip, stumble                   | 5.3) Be aware of uneven walking surfaces. Be alert when working on top of pipe racks, vessels, scaffolding, and ladders. Tie off whenever possible. Practice good housekeeping to eliminate some tripping hazards.                                                                                                                                                                                                              |
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| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                           |
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| 7. Decontamination.         | 7) E - Exposure to asbestos.   |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                             |                                | 7.1) For small jobs (per OSHA definition) use HEPA vacuum to remove fibers from protective clothing                                                                                                                                                                                                                                                                                                                                  |
|                             |                                | before removing suit. Remove respirator last. Throw away disposable clothing and respirator cartridges with asbestos waste. Rinse gross contamination from respirator with amended water spray. Allow liquid to run into an asbestos disposal container. Finish cleaning respirator with soap and water. Rubber boots can be similarly decontaminated for reuse. Wash hands and face before eating or smoking.                       |
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|                             | 7.2) E - Exposure to asbestos  | 7.2) For large jobs (per OSHA definition) cleanup requires use of decontamination facilities. This consists of a clean room, shower facility and equipment room. When leaving the work area all contaminated clothing must be left in the equipment room. Showers are required. If it's not feasible to have job-site showers, employees may HEPA vacuum clothing or change to clean coveralls before proceeding to the shower area. |
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## CHAPTER 5. ABATEMENT METHODS: CHARACTERISTICS AND RECOMMENDED WORK PRACTICES

This chapter provides more detailed information on the advantages, disadvantages, applicability, and relative costs of alternative abatement methods. Information is also given on recommended work practices for worker protection, work site containment, and project surveillance. This information is provided to help building owners determine which method is most appropriate for their situation and what the abatement effort will involve. It is not intended as an instruction manual for abatement.

### 5.1 Abatement Methods for Sprayed- or Troweled-on Surfacing Material

Each abatement method (removal, enclosure or encapsulation) is a separate and distinct alternative. They share, however, several features. The first is the need to conduct a more detailed inspection of both the ACM to be treated and the underlying surface. Each separate, homogeneous area of ACM, usually a single room, hallway, or central space, should be reinspected. (Remember that seemingly homogeneous areas can be composed of different materials and thus require separate inspections.) It is especially important to inspect for hidden material above a suspended ceiling with lay-in panels (see Figure 9). A second round of material sampling in selected areas may help to confirm the presence of asbestos and better delineate areas needing further corrective action.

The following information should be collected on each area with ACM:

- size of the area, since this affects the cost of abatement;
- type of ceiling construction if the ceiling is coated (for example, concrete joist and beam, concrete waffle slab, steel beam or bar joist, suspended metal lath, suspended lay-in panels, tile, metal, corrugated steel), since different construction types present different control problems;
- ceiling height, which may determine the practicality of enclosing the material;
- type of wall (for example, smooth or rough concrete, block or brick, plasterboard), which may indicate whether an encapsulant is needed if material is removed;
- average thickness of ACM (and variation in thickness), since encapsulants should not be applied to thick material.

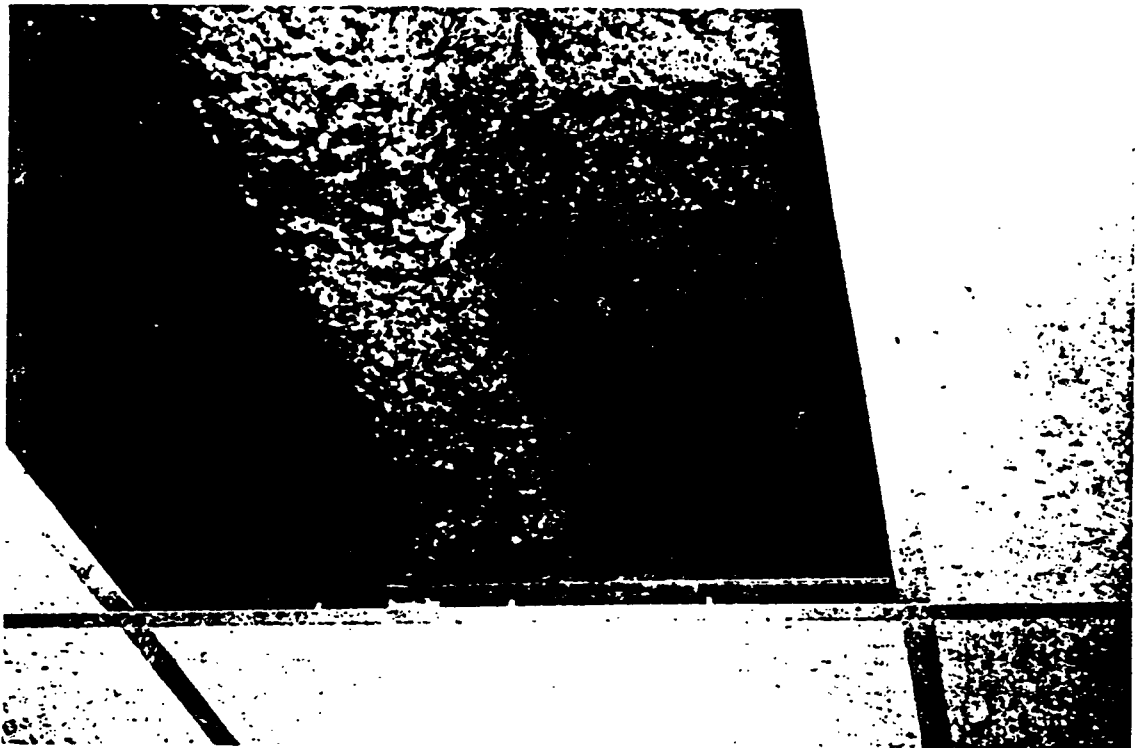
A form for collecting the necessary information was developed by EPA's Region VII Office and is included in Appendix I for illustrative purposes.

The second common feature of the three abatement methods is the need for worker protection during abatement activities. Worker protection entails not only proper training and specified work practices, but also protective equipment (special coveralls and respirators) for the workers. The OSHA standards specify three different respirators depending on the expected concentration of fibers in the work area: (1) a full- or half-face mask with either a single-use or replaceable filter, (2) a full-face mask with replaceable filter and a pump to assist breathing, and (3) a full-face mask with a self-contained or remote air supply.

NIOSH now recommends that the first type of respirator with a single-use filter not be used, because these filters have not been tested for effectiveness specifically against asbestos fibers and because they are difficult to seal properly around the face.<sup>1</sup> Supplied air (type "C") units offer the most protection. Respirators

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<sup>1</sup> A letter setting forth NIOSH's concerns about these respirators was sent to respirator manufacturers on August 25, 1980. A copy of this letter appeared in the December 1980 issue of the *Journal of the American Industrial Hygiene Association*. An industrial hygienist or other appropriately trained professional should assist workers in fitting any type of respirators.



**Figure 9. Asbestos-containing material located above  
a suspended ceiling.**

are required for removal of ACM and are highly recommended for other abatement methods, since enclosure and encapsulation may also elevate fiber levels.

The third common feature is proper work area containment. Containment typically means construction of barriers with 6 mil polyethylene plastic sheets joined with folded seams, and with sealing tape at the seams and boundaries. Some contractors have had problems attaching plastic sheets to walls. Thinner sheets or a better attachment system (for example, stapling and taping sheets to furring strips fastened to walls) may be required. (Figure 10 shows the construction of a typical containment system. Note that respirators should be worn if the ACM will be disturbed during construction.) Air locks and worker decontamination facilities with showers are recommended, as well as negative air pressure systems, described in Section 5.1.1 below.<sup>2</sup> All return air vents should be sealed to prevent asbestos contamination of the air-handling system. Without such containment measures, increased exposure for building occupants is likely. Once abatement begins, everyone not participating in the project should be kept out of the area.

The fourth common feature is the need for a rigorous postabatement cleanup. This includes wet-mopping or HEPA-vacuuming all horizontal and vertical surfaces in the work area. (Wet mopheads and cloths should be discarded in sealed plastic bags and treated as asbestos-contaminated waste.) Cleaning of surfaces outside the work area is highly recommended. Two cleanings—the second after at least 24 hours when suspended fibers have settled—will provide better assurance of fiber reduction than a single cleaning. (Section 6.4 contains additional information on cleaning and inspecting the work site.)

### 5.1.1 Removal, Disposal, and Replacement

Figure 11 is a photograph of a typical removal project. When removing ACM, observe the following requirements:

- The material must first be treated with a solution of water and a wetting agent to reduce fiber release. Some types of amosite-containing materials will not absorb either water or water combined with the wetting agent suggested by EPA (50% polyoxyethylene ester and 50% polyoxyethylene ether). Other wetting agents should be tested on the material for absorption. If the material will not absorb the wetting agent, undertake a dry removal using Type C respiratory protection. EPA must approve all dry removal operations. Get in touch with the NESHAPS contact in your region (see Appendix D).
- Friable ACM must be disposed of in "leak-tight containers," typically 6 mil polyethylene bags. Bags can be placed in 55-gallon drums for additional protection. Bags or drums must be labeled, as specified by NESHAPS (see Appendix C) or OSHA (see Appendix F).
- OSHA procedures for worker protection and decontamination, as well as for measurement of airborne asbestos, must be strictly followed (see Appendix F). While not required by law, EPA procedures for work area containment should also be followed to assure safe removal.

Research on asbestos removal plus EPA's experience with removal activities in schools since 1979 have pointed up several other important issues:

- A tear in the containment barrier is a significant exposure hazard for building occupants and should be repaired immediately. The use of negative pressure systems together with HEPA filtration (that is, low speed exhaust fans with HEPA filters) to move air from within the work area

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<sup>2</sup> OSHA decontamination requirements specify worker change rooms as a minimum provision for asbestos removal projects. If negative air systems are used, "air locks" should not be airtight. That is, make-up air should pass through the air lock. See Appendix J for additional information.



**Figure 10. Construction of containment barriers.**

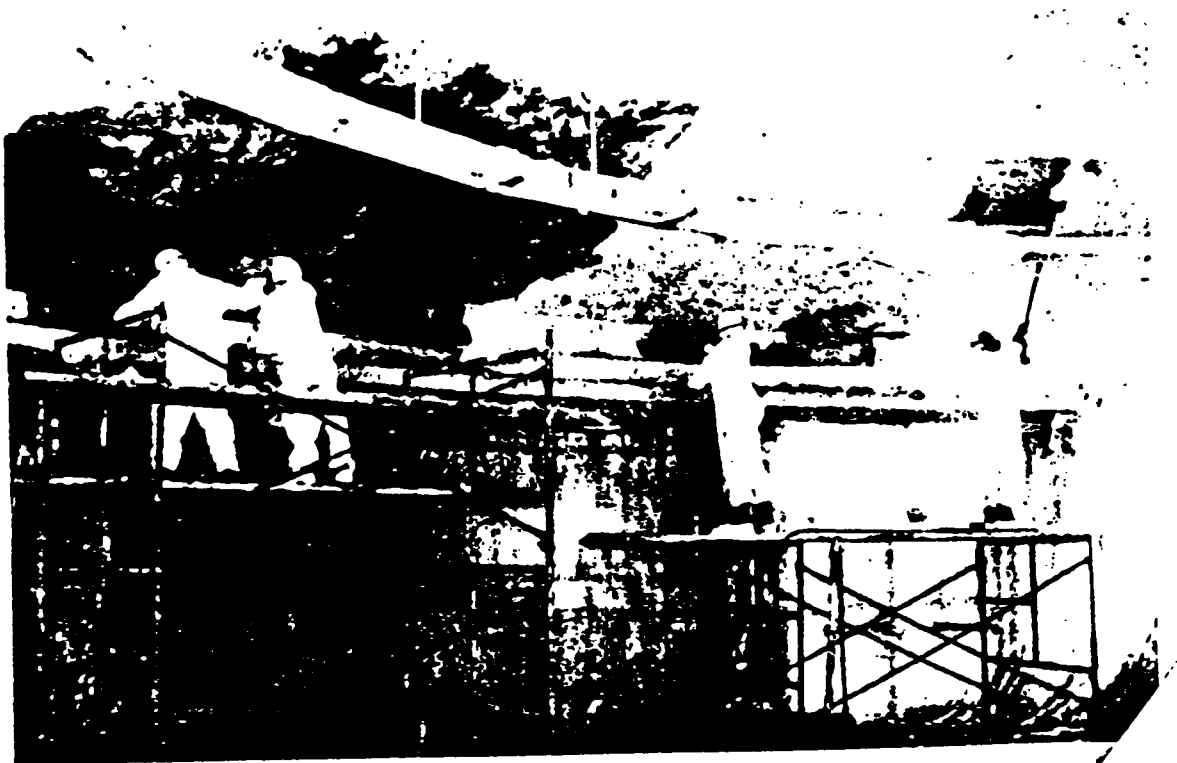


Figure 11. An asbestos removal project.

No er  
across

to outside the building will provide added protection in case of an accident. Appendix J summarizes specifications for negative air systems.

- When containment barriers are dismantled after ACM removal, the sealing tape used to attach the plastic sheets to walls and ceilings frequently removes paint. It is prudent to include the cost of repainting all walls (and ceilings, if appropriate) in estimates of asbestos removal costs.
- Asbestos waste is sometimes spilled both in and outside the work area. Containers full of wet material are very heavy and hard to transport. These containers must be sealed and handled carefully. Workers should continue to wear protective equipment during these operations. Also, disposal sites may be scarce. Some states require a disposal permit before removal begins.
- Amended water (water and wetting agents) from spray operations may leak through the polyethylene sheets and damage floors, especially tile and wood. Sealed double plastic sheets should protect the floors.

When removal and disposal operations are finished, evaluate the need for a sealant on the exposed surface. (The need to reinsulate or resoundproof with asbestos-free materials should be decided before removal begins.) Sealants generally are necessary where the underlying surfaces are porous (for example, concrete blocks or slabs), since a few fibers usually remain after removal.

Cost of asbestos removal varies widely by region and by job. Where the underlying surface must be sealed and the ACM replaced, those costs must be added to removal costs.

#### 5.1.2 Enclosure

Enclosure involves construction of airtight walls and ceilings around the ACM. Figure 12 shows a typical enclosure. These recommendations for constructing enclosures should be followed:

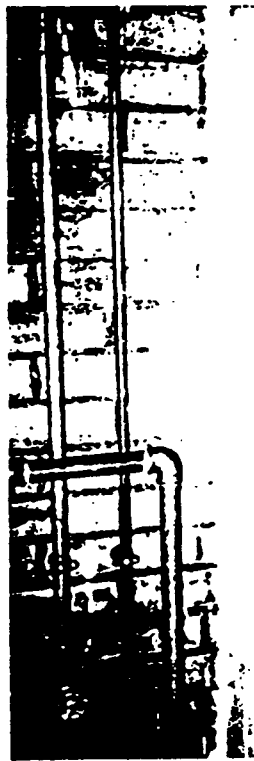
- To reduce fiber release, drills used during installation should be equipped with HEPA-filtered vacuums.
- Underlying structures must be able to support new walls and ceilings.
- New construction material should be impact-resistant and assembled to be airtight.<sup>3</sup> Gypsum panels taped at the seams, tongue-and-groove boards, and boards with spline joints all qualify. Suspended ceilings with lay-in panels are not acceptable. Joints between walls and ceilings should be caulked.
- If lights are recessed into ACM, they must be removed carefully to minimize fiber release. Lights should be reinstalled beneath the new ceiling.
- Relocation of plumbing lines and computer cables may be necessary.
- Building records must note the presence of asbestos behind the enclosure to prevent accidental fiber release during remodeling or building demolition. (The presence of ACM should have been documented as part of the special O&M program.) Signs should be posted, noting that ACM is behind the enclosure.

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<sup>3</sup> No enclosure will be totally airtight. The practices recommended here are designed to greatly reduce air movement across the enclosure boundary.



Before enclosure



After enclosure

Figure 12. An asbestos enclosure project.

### 5.1.3 Encapsulation with Sealants

Encapsulation refers to the spraying of ACM with a sealant. The sealant should bind together the asbestos fibers and other material components and offer some resistance to damage from impact. Figure 13 shows an asbestos encapsulation project.

Encapsulation should be used only on granular, cementitious material—commonly known as acoustical plaster. A sealant should penetrate the ACM and adhere to the substrate (or form a tough skin over the material), withstand moderate impact, be flexible and flame-retardant, resist deterioration over time, and be non-toxic. EPA evaluated over 100 sealants, using five criteria: impact resistance, flame spread, smoke generation, toxic gas release during combustion, and adhesive/cohesive strength (USEPA 1981). The American Society of Testing and Materials (ASTM) also is developing laboratory testing criteria for sealants. Additional information on the EPA sealant study can be obtained from EPA's Office of Toxic Substances, TSCA Assistance Office (see Appendix E for phone numbers).

Although the EPA study can help building owners choose a sealant, its effectiveness on the particular ACM should still be tested on-site over several days. (ASTM is developing criteria and procedures for such on-site tests.) Do not encapsulate material that is delaminated or deteriorated, or that shows extensive damage. If delaminated, the material will be pulled down by the additional weight; if deteriorated, the ACM may be blown off by sealant application; if extensively damaged, the material may be repeatedly abused and the sealant will not hold up. The condition of the sealant on previously encapsulated materials also should be inspected. Reapplication of sealant may be necessary.

Latex paint has been used as a sealant for granular, cementitious materials. Select a brand with a high vehicle content (at least 60 percent by weight) and at least 25 percent by weight vehicle resin.<sup>4</sup> For encapsulating ACM, apply paint considerably thicker than recommended for painting. Coverage should be no more than 100 sq. ft. per gallon, and should create a continuous, unbroken coating.

Apply sealants with airless spray equipment.<sup>5</sup> One recommended method is to apply a light (mist) coat, then a full coat applied at a 90 degree angle to the direction of the first. If latex paint is used, the full coat can also be applied by roller before the mist coat dries.

Record the type of sealant used and the nature of the material and substrate encapsulated. This information is needed to avoid unintentional release of fibers during later remodeling or demolition.

## 5.2 Abatement Methods for Pipe and Boiler Insulation

Abatement methods for ACM used to insulate pipes, boilers, ducts, tanks, and related equipment are somewhat different from methods for asbestos sprayed or troweled on surfaces. When damage to pipe or boiler covering is limited, repair is the recommended abatement approach. Non-asbestos plastering can restore open joints, wrapped or plastered areas that are damaged, and areas around valves and flanges. Encapsulants can also be used as a temporary measure. Do not use duct tape; it becomes brittle after exposure to high temperatures.

Where large portions of pipe and boiler insulation must be removed, erect containment barriers and employ the full range of worker protections (see Section 5.1). Containment bags may be used instead of constructing containment barriers around the work area. These bags are available commercially. As shown in Figure 14, the bags are positioned around the pipe insulation to be removed, and sealed to the pipe with tape.

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<sup>4</sup> Paint constituents appear on the label of the can.

<sup>5</sup> The use of respirators is recommended for applying any sealant. Solvent-based (as compared to water-based) sealants may require the use of a supplied air (Type C) respirator due to hazards from the solvents.

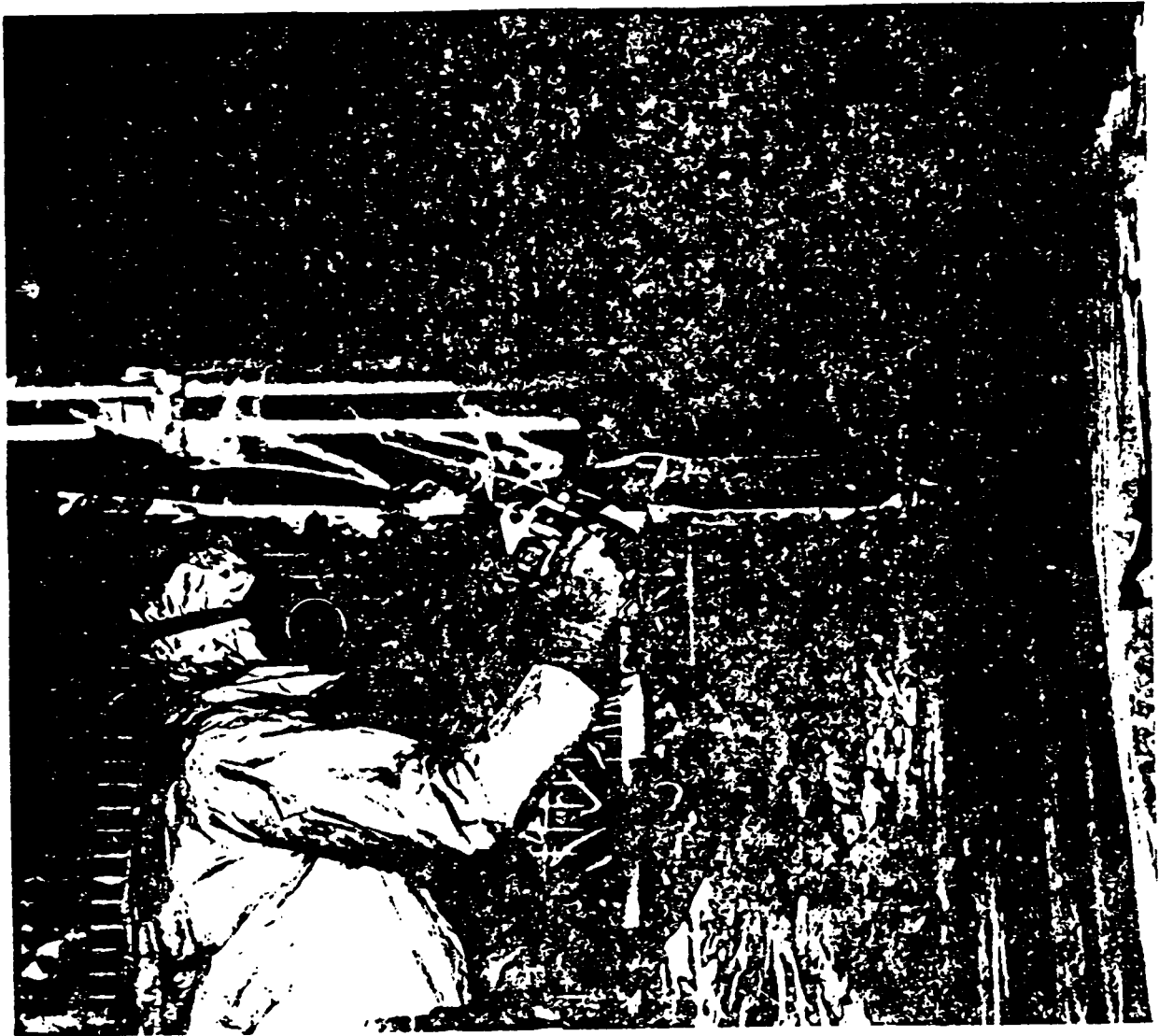


Figure 13. An asbestos encapsulation project.

Armholes and an inside pouch for tools let the worker remove insulation without exposure to asbestos fibers. A sealed side port also can be constructed to allow access for wetting the asbestos and evacuating the bag with a HEPA-filtered vacuum.<sup>6</sup> Workers who use containment bags should still wear respirators in case a bag leaks.

To remove individual pipe sections or an entire pipe network, a small section (about 6 inches wide) of insulation should be removed. The pipe then can be cut into manageable lengths with a saw or torch. Exposed ends of the insulating material should be sealed with plastic and tape. If the remaining insulation is not in good condition, the entire pipe should be wrapped in 6 mil plastic. Disposal of insulation material must follow EPA procedures discussed earlier for ACM disposal (Sections 1.4 and 5.1). More information on pipe and pipe insulation removal will be provided in a future technical bulletin.

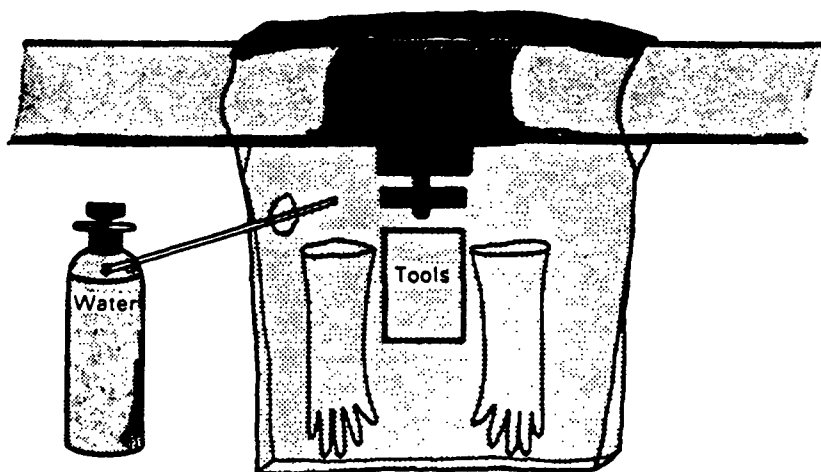


Figure 14. Custom containment bags for repairing or removing pipe insulation.

### 5.3. Abatement Methods for Other Types of ACM

Additional corrective action generally is not needed for other types of ACM. The special O&M program should continue until building renovation or maintenance requires ACM removal. The ACM should then be removed following the guidelines for surfacing materials (i.e., worker protection and work area containment). Removed ACM should be wrapped in 6 mil plastic sheets or placed in plastic bags, labeled as asbestos waste, and transported to a solid waste site. Unless these materials are friable, OSHA and NESHAPS regulations covering removal operations do not apply.

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<sup>6</sup> Seals can be checked with a flashlight and smoke from a smoke tube.

## **CHAPTER 6. CONDUCTING ABATEMENT PROJECTS**

Because efforts to treat ACM may be hazardous to abatement workers and building occupants, careful planning and diligent implementation of the project are essential. Removal, enclosure, or encapsulation of surfacing materials and removal or repair of pipe and boiler insulation may cause large-scale fiber release if proper procedures are not followed. As a result, asbestos levels in the building may increase rather than decrease.

For this reason, key elements of the abatement project include comprehensive and precise contract specifications, workers specially trained in asbestos abatement, rigorously applied worker protection and site containment measures, and the regular monitoring of the work site. When abatement activity is complete, the entire work site should be thoroughly cleaned. The contractor should be released only after the work site has passed visual inspection and a test for airborne asbestos.

### **SUMMARY**

#### **Who Should Do the Work:**

Usually a contractor is hired to conduct abatement work that goes beyond special O&M. Occasionally, a large school district or an owner of many buildings will train and dedicate an in-house asbestos abatement team.

#### **Selecting a Contractor:**

Steps in selecting a contractor include checking references, conducting interviews, reviewing insurance coverage, and writing precise contract specifications. Note that the most cost-effective contractor is not necessarily the lowest bidder.

#### **Managing the Work:**

- Regular on-site inspections will assure conformance with work specifications and avoid costly and hazardous errors.
- Before the contractor is released, the work site should pass both a visual inspection and an air test for asbestos fibers to be sure the site has been adequately cleaned. From a technical point of view, the TEM method is preferred for the air test. Although the PCM method is not as specific for asbestos nor as sensitive to thin fibers as the TEM method, it is frequently more available and easier to implement.

### **6.1 Who Should Do the Abatement Work**

Employees involved in the abatement work must be specially trained and committed to quality work. Training should:

- Familiarize workers with the general problems of airborne asbestos;
- Teach them to handle ACM safely and prevent unnecessary fiber release; and
- Explain how to interpret asbestos abatement work orders.

Either in-house staff or outside contractors can conduct asbestos abatement work. The decision depends primarily on training, equipment, and experience.

In most cases, the in-house maintenance staff will not have enough time to master asbestos abatement methods for surfacing materials—removal, enclosure, and encapsulation. However, some school districts with many buildings containing surfacing ACM have formed asbestos abatement teams whose sole responsibility is control of ACM. These in-house teams can thoroughly learn the requirements and methods of asbestos abatement. With this training and knowledge of the buildings, an in-house team may be the most effective. More typically, however, an outside contractor specializing in asbestos abatement is hired for specific abatement projects.

Building maintenance workers accustomed to repairing equipment with insulation are frequently trained to undertake abatement actions involving pipe and boiler insulation. However, outside contractors are typically hired to remove extensive amounts of insulation or to remove both pipe and insulation.

## **6.2 Selecting a Contractor**

Selecting a competent contractor is the first step toward successful abatement. EPA's experience with asbestos abatement and comments from technical advisors suggest that many contractors cannot properly conduct abatement projects. Several contractors, awarded jobs based on responsive and reasonable cost bids, proved unable or unwilling to follow contract specifications. Suggestions to help building owners avoid these situations are as follows:

- Assign the technical advisor who will monitor the abatement work to assist in writing job specifications and selecting the contractor. The advisor should not be employed by an abatement contractor.
- Require evidence of prospective contractors' experience and/or training in asbestos abatement.
- Check references, including other building owners for whom contractors have worked. (See Appendix K for an example checklist of contractor qualifications.)
- Ask for detailed written descriptions of how bidders will satisfy the project specifications.
- Interview bidders regarding their work, worker protection, and site containment plans. A statement that the contractor will comply with all EPA, OSHA, and state regulations is not sufficient. Ask bidders for copies of their standard operating procedures and employee protection plans, specifically their OSHA medical monitoring and respirator training program. The interview is invaluable for evaluating each contractor's capabilities and understanding of the problem.
- Obtain documentation of each contractor's fiscal qualifications, including financial performance, assets, liabilities, legal judgments, and insurance.
- Be sure that the contractor selected has adequate liability insurance. Some forms of insurance may not provide enough long-term protection against inadequate abatement work. The building owner's attorney and insurance advisor should determine if coverage is adequate.
- Be specific about what constitutes successful job completion. A thorough visual inspection to insure adequate cleaning is an absolute necessity. Air monitoring is also recommended (see Section 6.4). The person carrying out the air monitoring should not be employed by the abatement contractor.
- Require evidence of worker certification or have the contractor conduct an on-site training program for workers.

- Encourage bidding competition, since prices can vary greatly. Multiple bids are desired, but too many can confuse the selection process. Remember that successful abatement, not cost minimization, is the goal.
- If possible, avoid contracting for abatement work during the summer. Many school projects are conducted during that season, taxing the limited number of competent contractors.

Appendix L contains a list of organizations that have prepared model contract specifications for asbestos removal. Together with the above suggestions, these models can serve as the basis for writing specifications tailored to individual projects. Remember that EPA's RAC can provide additional information and suggestions.

### **6.3 Managing the Work**

As in all construction jobs, the program manager or the manager's representative (frequently the technical advisor) should visit the abatement work site often (no less than four times per day) to insure that all plans and procedures are properly implemented. The work site monitor should:

- Be sure the workers follow specifications;
- Confirm compliance with worker protection requirements; and
- Assure that the containment barriers around the work site are properly constructed and maintained.

By carefully monitoring the abatement work, the asbestos program manager can correct errors quickly. Work site inspections are most effective if the manager can refer to a detailed workplan containing specific work practices. Where work does not follow specifications, the project should be stopped immediately. The abatement contractor, the asbestos program manager, and the work site monitor (if different from the program manager) should then identify the problems and take steps to correct them.

The need for worker protection (protective clothing, respirators, and change facilities) was discussed in Section 5.1. Although contractors are responsible for their employees, a building owner's concern for the safety of everyone in the building extends to the abatement workers.

Work area containment is essential for all types of abatement and for both surfacing material and pipe and boiler insulation. Once abatement begins, all persons not directly involved in the work should be barred from the area. The work site monitor should make sure plastic barriers are in place (see Section 5.1) and that warning signs are posted at least 20 ft. in front of the work site entrance.

If abatement activity is limited to repair or minor removal of pipe and boiler insulation, containment bags will probably be used (see Section 5.2). The monitor should inspect the construction and use of the bags. Warning signs should be posted outside the work site.

The monitor should also check the air lock at the entrance to the work site. If a negative pressure system is not used, the air lock (and the entire containment system) should be airtight. If a negative pressure system is used (as recommended), the air lock must allow air from the building to enter the work site to replace the contaminated air that is filtered and exhausted outside. When inspecting the work in progress, the monitor's specific checklist will depend on the type of abatement. Abatement inspection for surfacing materials and pipe and boiler insulation should be based on guidelines and precautions described in Chapter 5 (Sections 5.1 and 5.2, respectively).

Work site inspections greatly increase an abatement project's likelihood of success. The importance of doing the job right the first time cannot be over-emphasized. Tests must be performed when the work is

finished to determine if the project has been conducted properly and the work site adequately cleaned (described in 6.4.) However, if the workers have not been diligent throughout the project, proper cleaning of the work site may not be possible.

#### **6.4 Releasing the Contractor**

An asbestos abatement project is successful when the source of fiber release has been controlled and airborne asbestos generated during abatement has been reduced to an acceptable level. As discussed earlier in this chapter, success can be built into the project with a sound work plan and constant monitoring of the work area to insure proper implementation. All workers must be trained and must follow stipulated work practices. Also, it is important to use negative air pressure ventilation to capture asbestos fibers generated during all types of abatement, and to continually remove debris from the site. When the abatement project is completed, the entire site should be cleaned at least twice.

Success is confirmed with a final evaluation at each work area. The evaluation consists of visual inspection and air testing. Visual inspection is used to determine if the work has been performed properly and to check for debris and other obvious signs of poor cleaning. Air testing helps confirm that the work site has been adequately cleaned. Only then is the contractor released.

##### **6.4.1 Visual Inspection**

The primary test for releasing the contractor is a thorough visual inspection of the work site. The inspection should be conducted before the containment barriers have been taken down but after the plastic sheets have been cleaned with damp mops and cloths or a HEPA vacuum cleaner. Since elevated levels of airborne asbestos may still be present, the inspector should wear a respirator (see Section 5.1).

First, the inspector should confirm job completeness. If ACM has been removed, substrate surfaces should be checked to be sure no ACM remains. Special attention should be given to pipes, beams, and irregular surfaces that may have corners and hard-to-reach areas. If the materials were enclosed, check the area for tight construction (e.g., no stray drill holes or openings at corners). Inspect encapsulated surfaces to insure that the right amount of sealant has been used: there should be no holes, voids, or cracks. Check surfaces behind obstructions (e.g., pipes or ducts) for these signs.

Next, the inspector should determine that the work site has been adequately cleaned. Any activity that disturbs ACM will release fibers. Therefore, work site cleanup after removal, repair, enclosure, or encapsulation is critical.

Examine all surfaces for dust and debris, especially overhead areas like tops of suspended light fixtures. Use a damp cloth to collect dust from these surfaces and then inspect the cloth for evidence of dust. This is a practical way to establish that the "no dust" requirement has been met.

A more sensitive test for dust is to darken the room and shine a flashlight so that the beam just glances any smooth horizontal surface. Run your finger across the illuminated area. If a line is left on the surface, or if airborne particles shine in the light, dust is still present.

If dust is found by either of the two tests, the entire work area should be recleaned and the tests repeated.

##### **6.4.2 Air Testing**

Conduct air monitoring only after the site has passed visual inspection. First, remove all plastic sheets covering floors, walls, and other surfaces. (The plastic barriers separating the site from the rest of the building

and the plastic sheets covering doors, vents, and windows should be left in place until the air test has been passed.) If a negative air pressure ventilation system was used during abatement, it should continue operating while air monitoring is in progress.

As discussed in Section 4.1, measuring airborne asbestos fibers accurately is technically complex and usually expensive. It involves two steps: air sampling to capture fibers on a filter, and laboratory analysis to determine the quantity of asbestos. There are several approaches to air sampling and analysis, varying in technical requirements, cost, and availability. Which approach is more appropriate is a controversial subject. The information presented in the remainder of this chapter is based in part on a 1984 workshop sponsored by EPA and the National Bureau of Standards. A companion EPA guidance document on air monitoring following an abatement action discusses the subject in more detail (USEPA 1985b).

#### **6.4.2.1 Sampling**

Sampling for asbestos consists of collecting fibers by drawing air through a filter at a known rate. Usually, sampling equipment is placed at a fixed location for a certain period of time. But this approach may fail to detect the presence of fibers. For example, if sampling is conducted for a short time during a quiet period (i.e., when air movement is limited), many fibers will settle out of the air onto the floor and other surfaces and may not be captured on the filter. Under these conditions, air measurements could show little or no asbestos.

Previously, EPA recommended sampling for at least eight hours to cover various air circulation conditions and thus increase the likelihood of capturing asbestos fibers if they are present. A quicker and more effective way to accomplish this, however, is to circulate the air artificially so that the fibers remain airborne during sampling.

This "aggressive sampling" is recommended for the post-abatement air test. Recommended methods for conducting aggressive sampling are presented in Appendix M. They use forced-air equipment such as a leaf blower to dislodge free fibers, then slow-speed fans to keep the fibers suspended during sampling.

Persons who conduct the sampling should wear a respirator. Even though the work site has been cleaned and has passed the visual test, levels of airborne asbestos still may be elevated.

#### **6.4.2.2 Analysis of Samples**

Three microscopic methods are currently being used to analyze asbestos: phase contrast microscopy (PCM), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The characteristics and relative merits of each method are summarized in Table 5 and are described in detail in the companion EPA guidance document (USEPA 1985b).

As indicated in Table 5, PCM is the method that is most familiar, available, and frequently used. It is also the least expensive and has a well-established analytical protocol. (As noted in Section 4.1.2, OSHA specifies PCM for monitoring worker exposure in asbestos industries.) However, the NIOSH protocol for PCM does not distinguish between asbestos and other types of fibers and counts only fibers longer than 5 micrometers. Nor is PCM sensitive enough to detect the extremely thin fibers typical of airborne asbestos in buildings. Thus, the interpretation of PCM results assumes that a low concentration of relatively large airborne fibers means that the concentration of asbestos fibers is also low.

The TEM method gives the most complete information on airborne asbestos: it can distinguish asbestos from other fibers and also is able to detect very thin fibers. However, it can be expensive and time-consuming. TEM is not widely available.

**TABLE 5. COMPARISON OF METHODS FOR MEASURING AIRBORNE ASBESTOS**

|                                             | <b>PCM</b>                                                                       | <b>SEM</b>                                              | <b>TEM</b>                                                      |
|---------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------|
| <b>Standard Methods</b>                     | NIOSH P&CAM 239 Method. <sup>1</sup>                                             | No standard method.                                     | EPA provisional method & update. <sup>2</sup>                   |
| <b>Quality Assurance</b>                    | Proficiency Analytical Testing Program; no NBS <sup>3</sup> reference materials. | No lab testing, or NBS reference materials.             | Limited lab testing; NBS reference materials available.         |
| <b>Cost</b>                                 | \$25-50                                                                          | \$50-300                                                | \$200-600                                                       |
| <b>Availability</b>                         | Most available.                                                                  | Less available.                                         | Least available.                                                |
| <b>Time Requirements</b>                    | 1 hr. preparation & analysis, < 6 hrs. turnaround.                               | 4 hrs. preparation & analysis, 6-24 hrs. turnaround.    | 4-24 hrs. preparation & analysis, 2-7 days turnaround.          |
| <b>Sensitivity (Thinnest Fiber Visible)</b> | 0.15 $\mu\text{m}$ at best; 0.25 $\mu\text{m}$ typical.                          | 0.05 $\mu\text{m}$ at best; 0.20 $\mu\text{m}$ typical. | 0.0002 $\mu\text{m}$ at best; 0.0025 $\mu\text{m}$ typical.     |
| <b>Specificity</b>                          | Not specific for asbestos.                                                       | More specific than PCM but not definitive for asbestos. | Definitive for asbestos. when used to its fullest capabilities. |

<sup>1</sup> NIOSH 1979. The new NIOSH 7400 method is an alternative.

<sup>2</sup> USEPA 1977, Yamate 1984.

<sup>3</sup> National Bureau of Standards.

Source: Taken with modification from USEPA 1985b.

The SEM method can be somewhat more specific for asbestos and more sensitive to thin fibers than PCM, but less so than TEM. It is also less expensive and time-consuming than TEM. At present, however, no standard measurement protocol is available for SEM. As a result, it has not been systematically evaluated nor has the reliability of SEM measurements been established.

EPA acknowledges that all three methods are used in air testing for the purpose of releasing abatement contractors. However, only PCM and TEM have standard methods and testing programs. A standard method has not yet been developed for SEM. While TEM is technically the method of choice, PCM is the only option in many localities.

#### **6.4.2.3 Recommended Test Specifications**

Regardless of the microscopic method for measuring asbestos, identifying homogeneous work sites is the first important step in the process. A site within the abatement work area is homogeneous if it contains one type of ACM and only one type of abatement was used. For sampling purposes, the air in each

homogeneous site is assumed to be relatively uniform. Guidelines for locating the samplers are included in Appendix M. Several other aspects of the air test are identical, regardless of microscopic method:

- Choose sampling locations within the homogeneous work site to assure representative samples. (See Appendix M).
- Begin sampling when the work site is dry (24 hours after cleaning).
- Conduct aggressive air sampling in all cases.
- Follow sampling and analysis specifications, including procedures for quality control.

The asbestos program manager should be sure the technical advisor in charge of the air test knows the specifications listed below. The advisor should insist that recommended procedures be followed for both air sampling and laboratory analysis.

### **Testing with the TEM Method**

#### **Sampling:**

- Draw at least 3000 liters of air through each filter at a rate of 2 to 12 liters per minute.
- Collect at least five samples in each homogeneous work site.
- At the same time, collect at least five samples just outside the work site but within the building. These samples will be compared with those collected inside the work site to ensure that the work site is at least as clean as the incoming air (see Appendix M for details).<sup>1</sup>

#### **Analysis:**

- Measure the asbestos on each filter with TEM using the EPA provisional procedures and updates (USEPA 1977 and Yamate 1984).
- Use a direct transfer method of sample preparation if possible (see Appendix M).
- Express the results as f/cc, or as ng/m<sup>3</sup> if an indirect sample preparation is used.
- Include at least one field blank <sup>2</sup> and one laboratory blank per abatement job for quality control purposes (see Section 6.4.3). Also, split one work site sample and conduct duplicate analyses.

#### **Release Criterion:**

- Release the contractor if the average fiber concentration of the work site samples is not statistically larger than the average of the outside samples. Each homogeneous site must pass the test before the contractor is released. (Appendix M contains information to determine statistical differences.)
- If the average of the work site samples is statistically larger than the average of the outside samples, clean the entire work site again and repeat the test (collect new work site samples and follow the procedures described above).

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<sup>1</sup> If a negative pressure system has not been used, collect the "outside" samples outdoors.

<sup>2</sup> A blank is a filter that is not used for sampling but is otherwise treated in the same way as other filters.

## Testing with the PCM Method

### Sampling:

- Draw at least 3000 liters of air through each filter at a rate of 2 to 12 liters per minute.
- Collect at least five samples per homogeneous work site, or one per room, whichever is greater.

### Analysis:

- Measure the asbestos on each filter with PCM using the NIOSH P&CAM 239 procedures. (The newer NIOSH 7400 procedures can also be used. See Appendix M.)
- Include at least one field blank and one laboratory blank per abatement project, for quality control purposes. Also, split one work site sample for duplicate analysis.

### Release Criterion:

- Release the contractor if every sample value is below the limit of reliable quantification (approximately 0.01 f/cc when 3000 liters of air are sampled; see Appendix M).
- If any of the sample values is above the prescribed level, clean the entire work site again, collect new samples, and evaluate the samples as described above.

For each method, the recommended number of samples and the prescribed use of the data defining the release criteria are based on a compromise involving practical considerations of cost, time required for the tests, performance characteristics of the methods, and statistical criteria. Details of the sampling and analysis specifications are provided in Appendix M.

### 6.4.3 Quality Assurance

Notwithstanding the advantages of one microscopic method over another, no method will produce reliable results unless both the field sampling and laboratory analysis are properly conducted. To obtain reliable results, a quality assurance (QA) program for the collection and analysis of data is essential.

The objective is to produce measurements with sufficient and documented quality for their intended purpose. In this case, the purpose is to determine satisfactory completion of an abatement project. The components of a QA program range from clerical activities such as labeling samples and documenting results, to performing technically complex tasks in the laboratory. When establishing the quality of data, however, all activities are equally important.

Preparing and implementing a QA program requires the assistance of a technical advisor on asbestos measurement. EPA and OSHA have published guidelines on quality assurance for TEM and PCM (Yamate 1984, and NIOSH 1979). The QA Program Checklist below can be used by the asbestos program manager in reviewing a proposed QA program.

### QA Program Checklist

- **Training and Experience:** Be sure that all persons producing the measurement understand their roles and are trained. Select a laboratory with demonstrated proficiency in asbestos analysis. Request details of the laboratory's quality control program, and get documentation of the lowest level of fibers routinely reported.

- **Quality Control Checks:** Use field and laboratory blanks to check for fiber contamination, coded sample labels to avoid analyst bias, duplicate analyses to confirm precision, and a second laboratory to spot-check the accuracy of results.
- **Chain-of-Custody:** Assign responsibility for security of the samples to specific persons at each stage of the analysis. Document each step in the passage of the sample from the field to the laboratory.
- **Documentation:** Check and document laboratory results as well as their labeling. The building owner should retain all test results and records documenting the testing process.

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## Appendix A. Asbestos-Containing Materials Found in Buildings\*

| Subdivision                           | Generic name                     | Asbestos (%) | Dates of use    | Binder/sizing                                      |
|---------------------------------------|----------------------------------|--------------|-----------------|----------------------------------------------------|
| Surfacing material                    | sprayed- or troweled-on          | 1-95         | 1935-1970       | sodium silicate, portland cement, organic binders. |
| Preformed thermal insulating products | batts, blocks, and pipe covering |              |                 |                                                    |
|                                       | 85% magnesia                     | 15           | 1926-1949       | magnesium carbonate                                |
|                                       | calcium silicate                 | 6-8          | 1949-1971       | calcium silicate                                   |
| Textiles                              | cloth <sup>a</sup>               |              |                 |                                                    |
|                                       | blankets (fire) <sup>a</sup>     | 100          | 1910-present    | none                                               |
|                                       | felts                            | 90-95        | 1920-present    | cotton/wool                                        |
|                                       | blue stripe                      | 80           | 1920-present    | cotton                                             |
|                                       | red stripe                       | 90           | 1920-present    | cotton                                             |
|                                       | green stripe                     | 95           | 1920-present    | cotton                                             |
|                                       | sheets                           | 50-95        | 1920-present    | cotton/wool                                        |
|                                       | cord/rope/yarn <sup>a</sup>      | 80-100       | 1920-present    | cotton/wool                                        |
|                                       | tubing                           | 80-85        | 1920-present    | cotton/wool                                        |
|                                       | tape/strip                       | 90           | 1920-present    | cotton/wool                                        |
|                                       | curtains <sup>a</sup>            |              |                 |                                                    |
|                                       | (theatre, welding)               | 60-65        | 1945-present    | cotton                                             |
| Cementitious concrete-like products   | extrusion panels                 | 8            | 1965-1977       | portland cement                                    |
|                                       | corrugated                       | 20-45        | 1930-present    | portland cement                                    |
|                                       | flat                             | 40-50        | 1930-present    | portland cement                                    |
|                                       | flexible                         | 30-50        | 1930-present    | portland cement                                    |
|                                       | flexible perforated              | 30-50        | 1930-present    | portland cement                                    |
|                                       | laminated                        | 35-50        | 1930-present    | portland cement                                    |
|                                       | (outer surface)                  |              |                 |                                                    |
|                                       | roof tiles                       | 20-30        | 1930-present    | portland cement                                    |
|                                       | clapboard and shingles           |              |                 |                                                    |
|                                       | clapboard                        | 12-15        | 1944-1945       | portland cement                                    |
|                                       | siding shingles                  | 12-14        | unknown-present | portland cement                                    |
|                                       | roofing shingles                 | 20-32        | unknown-present | portland cement                                    |
|                                       | pipe                             | 20-15        | 1935-present    | portland cement                                    |
| Paper products                        | corrugated                       |              |                 |                                                    |
|                                       | high temperature                 | 90           | 1935-present    | sodium silicate                                    |
|                                       | moderate temperature             | 35-70        | 1910-present    | starch                                             |
|                                       | indented                         | 98           | 1935-present    | cotton and organic binder                          |
|                                       | millboard                        | 80-85        | 1925-present    | starch, lime, clay                                 |
| Roofing felts                         | smooth surface                   | 10-15        | 1910-present    | asphalt                                            |
|                                       | mineral surface                  | 10-15        | 1910-present    | asphalt                                            |
|                                       | shingles                         | 1            | 1971-1974       | asphalt                                            |
|                                       | pipeline                         | 10           | 1920-present    | asphalt                                            |

\* The information in this Appendix is taken, with modification, from: Lory EE, Coin DC. February 1981. *Management Procedure for Assessment of Friable Asbestos Insulating Material*. Port Hueneme, CA: Civil Engineering Laboratory Naval Construction Battalion Center. The U.S. Navy prohibits the use of asbestos-containing materials when acceptable nonasbestos substitutes have been identified.

<sup>a</sup>Laboratory aprons, gloves, cord, rope, fire blankets, and curtains may be common in schools.

## Appendix A. Asbestos-Containing Materials Found in Buildings\*

| Subdivision                           | Generic name                                | Asbestos (%) | Dates of use    | Binder/sizing                                      |
|---------------------------------------|---------------------------------------------|--------------|-----------------|----------------------------------------------------|
| Surfacing material                    | sprayed- or troweled-on                     | 1-95         | 1935-1970       | sodium silicate, portland cement, organic binders. |
| Preformed thermal insulating products | batts, blocks, and pipe covering            |              |                 |                                                    |
|                                       | 85% magnesia                                | 15           | 1926-1949       | magnesium carbonate                                |
|                                       | calcium silicate                            | 6-8          | 1949-1971       | calcium silicate                                   |
| Textiles                              | cloth <sup>a</sup>                          |              |                 |                                                    |
|                                       | blankets (fire) <sup>a</sup>                | 100          | 1910-present    | none                                               |
|                                       | felts                                       | 90-95        | 1920-present    | cotton/wool                                        |
|                                       | blue stripe                                 | 80           | 1920-present    | cotton                                             |
|                                       | red stripe                                  | 90           | 1920-present    | cotton                                             |
|                                       | green stripe                                | 95           | 1920-present    | cotton                                             |
|                                       | sheets                                      | 50-95        | 1920-present    | cotton/wool                                        |
|                                       | cord, rope/yarn <sup>a</sup>                | 80-100       | 1920-present    | cotton/wool                                        |
|                                       | tubing                                      | 80-85        | 1920-present    | cotton/wool                                        |
|                                       | tape, strip                                 | 90           | 1920-present    | cotton/wool                                        |
|                                       | curtains <sup>a</sup><br>(theatre, welding) | 60-65        | 1945-present    | cotton                                             |
| Cementitious concrete-like products   | extrusion panels                            | 8            | 1965-1977       | portland cement                                    |
|                                       | corrugated                                  | 20-45        | 1930-present    | portland cement                                    |
|                                       | flat                                        | 40-50        | 1930-present    | portland cement                                    |
|                                       | flexible                                    | 30-50        | 1930-present    | portland cement                                    |
|                                       | flexible perforated                         | 30-50        | 1930-present    | portland cement                                    |
|                                       | laminated<br>(outer surface)                | 35-50        | 1930-present    | portland cement                                    |
|                                       | roof tiles                                  | 20-30        | 1930-present    | portland cement                                    |
|                                       | clapboard and shingles                      |              |                 |                                                    |
|                                       | clapboard                                   | 12-15        | 1944-1945       | portland cement                                    |
|                                       | siding shingles                             | 12-14        | unknown-present | portland cement                                    |
|                                       | roofing shingles                            | 20-32        | unknown-present | portland cement                                    |
| Paper products                        | pipe                                        | 20-15        | 1935-present    | portland cement                                    |
|                                       | corrugated                                  |              |                 |                                                    |
|                                       | high temperature                            | 90           | 1935-present    | sodium silicate                                    |
|                                       | moderate temperature                        | 35-70        | 1910-present    | starch                                             |
|                                       | indented                                    | 98           | 1935-present    | cotton and organic binder                          |
| Roofing felts                         | millboard                                   | 80-85        | 1925-present    | starch, lime, clay                                 |
|                                       | smooth surface                              | 10-15        | 1910-present    | asphalt                                            |
|                                       | mineral surface                             | 10-15        | 1910-present    | asphalt                                            |
|                                       | shingles                                    | 1            | 1971-1974       | asphalt                                            |
|                                       | pipeline                                    | 10           | 1920-present    | asphalt                                            |

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<sup>a</sup>Laboratory aprons, gloves, cord, rope, fire blankets, and curtains may be common in schools.

## Appendix A. Asbestos-Containing Materials Found in Buildings\*

| Subdivision                           | Generic name                     | Asbestos (%) | Dates of use    | Binder/sizing                                      |
|---------------------------------------|----------------------------------|--------------|-----------------|----------------------------------------------------|
| Surfacing material                    | sprayed- or troweled-on          | 1-95         | 1935-1970       | sodium silicate, portland cement, organic binders. |
| Preformed thermal insulating products | batts, blocks, and pipe covering |              |                 |                                                    |
|                                       | 85% magnesia                     | 15           | 1926-1949       | magnesium carbonate                                |
|                                       | calcium silicate                 | 6-8          | 1949-1971       | calcium silicate                                   |
| Textiles                              | cloth <sup>a</sup>               |              |                 |                                                    |
|                                       | blankets (fire) <sup>a</sup>     | 100          | 1910-present    | none                                               |
|                                       | felts                            | 90-95        | 1920-present    | cotton/wool                                        |
|                                       | blue stripe                      | 80           | 1920-present    | cotton                                             |
|                                       | red stripe                       | 90           | 1920-present    | cotton                                             |
|                                       | green stripe                     | 95           | 1920-present    | cotton                                             |
|                                       | sheets                           | 50-95        | 1920-present    | cotton/wool                                        |
|                                       | cord/rope/yarn <sup>a</sup>      | 80-100       | 1920-present    | cotton/wool                                        |
|                                       | tubing                           | 80-85        | 1920-present    | cotton/wool                                        |
|                                       | tape/strip                       | 90           | 1920-present    | cotton/wool                                        |
|                                       | curtains <sup>a</sup>            |              |                 |                                                    |
| Cementitious concrete-like products   | (theatre, welding)               | 60-65        | 1945-present    | cotton                                             |
|                                       | extrusion panels                 | 8            | 1965-1977       | portland cement                                    |
|                                       | corrugated                       | 20-45        | 1930-present    | portland cement                                    |
|                                       | flat                             | 40-50        | 1930-present    | portland cement                                    |
|                                       | flexible                         | 30-50        | 1930-present    | portland cement                                    |
|                                       | flexible perforated              | 30-50        | 1930-present    | portland cement                                    |
|                                       | laminated                        | 35-50        | 1930-present    | portland cement                                    |
|                                       | (outer surface)                  |              |                 |                                                    |
|                                       | roof tiles                       | 20-30        | 1930-present    | portland cement                                    |
|                                       | clapboard and shingles           |              |                 |                                                    |
|                                       | clapboard                        | 12-15        | 1944-1945       | portland cement                                    |
|                                       | siding shingles                  | 12-14        | unknown-present | portland cement                                    |
|                                       | roofing shingles                 | 20-32        | unknown-present | portland cement                                    |
| Paper products                        | pipe                             | 20-15        | 1935-present    | portland cement                                    |
|                                       | corrugated                       |              |                 |                                                    |
|                                       | high temperature                 | 90           | 1935-present    | sodium silicate                                    |
|                                       | moderate temperature             | 35-70        | 1910-present    | starch                                             |
|                                       | indented                         | 98           | 1935-present    | cotton and organic binder                          |
| Roofing felts                         | millboard                        | 80-85        | 1925-present    | starch, lime, clay                                 |
|                                       | smooth surface                   | 10-15        | 1910-present    | asphalt                                            |
|                                       | mineral surface                  | 10-15        | 1910-present    | asphalt                                            |
|                                       | shingles                         | 1            | 1971-1974       | asphalt                                            |
|                                       | pipeline                         | 10           | 1920-present    | asphalt                                            |

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<sup>a</sup>Laboratory aprons, gloves, cord, rope, fire blankets, and curtains may be common in schools.

# Appendix A. (continued)

| Subdivision                   | Generic name            | Asbestos (%) | Dates of use    | Binder/sizing                    |
|-------------------------------|-------------------------|--------------|-----------------|----------------------------------|
| Asbestos-containing compounds | caulking putties        | 30           | 1930-present    | linseed oil                      |
|                               | adhesive (cold applied) | 5-25         | 1945-present    | asphalt                          |
|                               | joint compound          |              | 1945-1975       | asphalt                          |
|                               | roofing asphalt         | 5            | unknown-present | asphalt                          |
|                               | mastics                 | 5-25         | 1920-present    | asphalt                          |
|                               | asphalt tile cement     | 13-25        | 1959-present    | asphalt                          |
|                               | roof putty              | 10-25        | unknown-present | asphalt                          |
|                               | plaster/stucco          | 2-10         | unknown-present | portland cement                  |
|                               | spackles                | 3-5          | 1930-1975       | starch, casein, synthetic resins |
|                               | sealants fire/water     | 50-55        | 1935-present    | castor oil or polyisobutylene    |
|                               | cement, insulation      | 20-100       | 1900-1973       | clay                             |
|                               | cement, finishing       | 55           | 1920-1973       | clay                             |
|                               | cement, magnesia        | 15           | 1926-1950       | magnesium carbonate              |
| Asbestos ebony products       |                         | 50           | 1930-present    | portland cement                  |
| Flooring tile and Sheet Goods | vinyl/asbestos tile     | 21           | 1950-present    | poly(vinyl)chloride              |
|                               | asphalt/asbestos tile   | 26-33        | 1920-present    | asphalt                          |
|                               | sheet goods/resilient   | 30           | 1950-present    | dry oils                         |
| Wallcovering                  | vinyl wallpaper         | 6-8          | unknown-present | —                                |
| Paints and coatings           | roof coating            | 4-7          | 1900-present    | asphalt                          |
|                               | air tight               | 15           | 1940-present    | asphalt                          |

## Appendix B. Common Units Used in Measuring Airborne Asbestos Concentrations

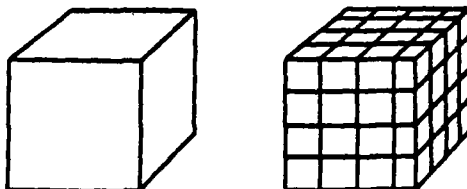
### Length

1 meter (m) = 39.37 inches or 3.28 feet

100 centimeters (cm) = 1 meter

1,000,000 micrometers ( $\mu\text{m}$ ) = 1 meter

### Volume



1 cubic m ( $\text{m}^3$ ) = 35.3 cubic feet

1,000,000  $\text{cm}^3$  = 1  $\text{m}^3$

1,000  $\text{cm}^3$  = 1 liter

### Weight (mass)

454 grams (g) = 1 pound

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

### Concentration (mass contained in a stated volume)

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

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

Mass =  $\pi/4$  (diameter)<sup>2</sup> (length) (density)

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

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

Since the fibers in the above example are the smallest (shortest and thinnest) counted by the NIOSH procedure, fibers actually measured using this protocol are typically larger and thus weigh more. Comparison of fibers in this example with those actually measured is further complicated since nonasbestos as well as asbestos fibers are counted by the NIOSH protocol. As noted in the footnote to Figure 1, comparisons of total fibers counted with the mass of

asbestos measured in air samples indicate that, on an average, about 30 fibers counted by the NIOSH procedures equal one nanogram of asbestos. This relationship applies to samples collected during the spray application of asbestos insulation. For these samples, each fiber counted weighs an average of 0.033 ng, or about 37 times more than those in the example, and 2,000,000 of them would weigh about 67,000 ng.

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

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

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

**§ 61.140 Applicability.**

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

**§ 61.141 Definitions.**

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

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

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

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

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

*Asbestos material* means asbestos or any material containing asbestos.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Outside air** means the air outside buildings and structures.

**Particulate asbestos material** means finely divided particles of asbestos material.

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

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

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

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

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

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

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

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

#### § 61.142 Standard for asbestos mills.

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

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

#### § 61.143 Standard for roadways.

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

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

#### § 61.144 Standard for manufacturing.

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

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

(2) The manufacture of cement products.

(3) The manufacture of fireproofing and insulating materials.

(4) The manufacture of friction products.

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

(6) The manufacture of floor tile.

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

(8) The manufacture of plastics and rubber materials.

(9) The manufacture of chlorine.

(10) The manufacture of shotgun shell wads.

(11) The manufacture of asphalt concrete.

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

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

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

#### § 61.145 Standard for demolition and renovation: Applicability.

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

of a demolition or renovation operation as follows:

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

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

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

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

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

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

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

[49 FR 13681, Apr. 5, 1984; 49 FR 25453, June 21, 1984]

#### § 61.146 Standard for demolition and renovation: Notification requirements.

Each owner or operator to which this section applies shall:

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

(b) Postmark or deliver the notice as follows:

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

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

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

(4) As early as possible before renovation begins.

(c) Include the following information in the notice:

(1) Name and address of owner or operator.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**§ 61.148 Standard for spraying.**

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

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

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

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

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

(i) Name and address of owner or operator.

(ii) Location of spraying operation.

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

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

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

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

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

**§ 61.149 Standard for fabricating.**

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

(1) The fabrication of cement building products.

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

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

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

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

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

**§ 61.150 Standard for insulating materials.**

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

**§ 61.151 Standard for waste disposal for asbestos mills.**

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

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

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

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

(1) Use a wetting agent as follows:

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

particular dust by the manufacturer of the agent.

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

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

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

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

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

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

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

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

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

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

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

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

#### CAUTION

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

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

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

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

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

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

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

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

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

(a) Comply with one of the following:

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

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

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

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

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

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

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

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

(ii) Conform to the requirements for 51 cm x 36 cm (20" x 14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

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

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

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

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

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

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

#### § 61.154 Air-cleaning.

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

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

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

(ii) Ensuring that the airflow permeability, as determined by ASTM Method D737-75, does not exceed 9 m<sup>3</sup>/min/m<sup>2</sup> (30 ft<sup>3</sup>/min/ft<sup>2</sup>) for woven fabrics or 11 m<sup>3</sup>/min/m<sup>2</sup> (35 ft<sup>3</sup>/min/ft<sup>2</sup>) for felted fabrics, except that 12 m<sup>3</sup>/min/m<sup>2</sup> (40 ft<sup>3</sup>/min/ft<sup>2</sup>) for woven and 14 m<sup>3</sup>/min/m<sup>2</sup> (45 ft<sup>3</sup>/min/ft<sup>2</sup>) for felted fabrics is allowed for filtering air from asbestos ore dryers; and

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

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

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

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

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

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

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

#### § 61.155 Reporting.

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

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

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

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

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

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

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

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

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

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

(4) For sources subject to § 61.153:

(i) A brief description of the site; and

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

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

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

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

#### § 61.156 Active waste disposal sites.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Appendix D. (continued)

### Regional Asbestos Coordinators

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*(For information on asbestos identification, health effects, abatement options, analytic techniques, asbestos in schools, and contract documents)*

#### **Region 1**

Regional Asbestos Coordinator  
USEPA  
JFK Federal Building  
Boston, MA 02203  
(617) 223-0585

#### **Region 2**

Regional Asbestos Coordinator  
USEPA  
Woodbridge Avenue  
Edison, NJ 08837  
(201) 321-6668

#### **Region 3**

Regional Asbestos Coordinator  
USEPA  
841 Chestnut Street  
Philadelphia, PA 19107  
(215) 597-9859

#### **Region 4**

Regional Asbestos Coordinator  
USEPA  
345 Courtland Street N.E.  
Atlanta, GA 30365  
(404) 881-3864

#### **Region 5**

Regional Asbestos Coordinator  
USEPA  
230 S. Dearborn Street  
Chicago, IL 60604  
(312) 886-6879

#### **Region 6**

Regional Asbestos Coordinator  
USEPA  
First International Building  
1201 Elm Street  
Dallas, TX 75270  
(214) 767-5314

#### **Region 7**

Regional Asbestos Coordinator  
USEPA  
726 Minnesota Avenue  
Kansas City, KS 66101  
(913) 236-2838

#### **Region 8**

Regional Asbestos Coordinator  
USEPA  
999 18th Street  
Denver, CO 80202  
(303) 293-1730

#### **Region 9**

Regional Asbestos Coordinator  
USEPA  
215 Fremont Street  
San Francisco, CA 94105  
(415) 974-8588

#### **Region 10**

Regional Asbestos Coordinator  
USEPA  
1200 Sixth Avenue  
Seattle, WA 98101  
(206) 442-2632

## **Appendix E. Phone Numbers for Obtaining Information and EPA Publications**

### **Information**

**800/334-8571**

- Sampling and analysis of ACM (bulk materials)
- EPA Sealant Study

### **Publications**

**800/424-9065 (554-1404 — In Washington, DC)**

- Friable Asbestos-Containing Materials in Schools: Identification and Notification Rule (40 CFR Part 763).
- Evaluation of the EPA Asbestos-in-Schools Identification and Notification Rule. EPA 560/5-84-005.
- Asbestos in Buildings: National Survey of Asbestos-Containing Friable Materials. EPA 560/5-84-006.
- Asbestos in Buildings: Guidance for Service and Maintenance Personnel. EPA 560/5-85-018.
- Asbestos Waste Management Guidance. EPA 530-SW-85-007.
- Asbestos Fact Book. EPA Office of Public Affairs.

# NON-HAZARDOUS WASTE BY RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) REGULATIONS

Please print or type (Form designed for use on elite (12-pitch) typewriter)

| <b>NON-HAZARDOUS<br/>WASTE MANIFEST</b>                                                                                                                                                                                                                                                                                                                   |  | 1. Generator's US EPA ID No.                  | Manifest<br>Document No. | 2. Page 1<br>of        | Information in the shaded areas<br>is not required by Federal law |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------|--------------------------|------------------------|-------------------------------------------------------------------|
| 3 Generator's Name and Mailing Address                                                                                                                                                                                                                                                                                                                    |  |                                               |                          |                        |                                                                   |
| 4 Generator's Phone ( )                                                                                                                                                                                                                                                                                                                                   |  |                                               |                          |                        |                                                                   |
| 5. Transporter 1 Company Name                                                                                                                                                                                                                                                                                                                             |  | 6. US EPA ID Number                           |                          |                        |                                                                   |
| 7. Transporter 2 Company Name                                                                                                                                                                                                                                                                                                                             |  | 8. US EPA ID Number                           |                          |                        |                                                                   |
| 9 Designated Facility Name and Site Address                                                                                                                                                                                                                                                                                                               |  | 10. US EPA ID Number                          |                          |                        |                                                                   |
| 11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)                                                                                                                                                                                                                                                                      |  | 12. Containers<br>No.                         | Type                     | 13. Total<br>Quantity  | 14. Unit<br>Wt/Vol                                                |
| a                                                                                                                                                                                                                                                                                                                                                         |  |                                               |                          |                        |                                                                   |
| b                                                                                                                                                                                                                                                                                                                                                         |  |                                               |                          |                        |                                                                   |
| c                                                                                                                                                                                                                                                                                                                                                         |  |                                               |                          |                        |                                                                   |
| d                                                                                                                                                                                                                                                                                                                                                         |  |                                               |                          |                        |                                                                   |
| 13. Additional Descriptions for Materials Listed Above                                                                                                                                                                                                                                                                                                    |  | 14. Shipping Codes for Materials Listed Above |                          |                        |                                                                   |
| 15. Special Handling Instructions and Additional Information                                                                                                                                                                                                                                                                                              |  |                                               |                          |                        |                                                                   |
| 16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national governmental regulations. |  |                                               |                          |                        |                                                                   |
| Printed/Typed Name                                                                                                                                                                                                                                                                                                                                        |  | Signature                                     |                          | Date<br>Month Day Year |                                                                   |
| 17. Transporter 1 Acknowledgement of receipt of Materials                                                                                                                                                                                                                                                                                                 |  | Signature                                     |                          | Date<br>Month Day Year |                                                                   |
| 18. Transporter 2 Acknowledgement of Receipt of Materials                                                                                                                                                                                                                                                                                                 |  | Signature                                     |                          | Date<br>Month Day Year |                                                                   |
| 19. Discrepancy Indication Space                                                                                                                                                                                                                                                                                                                          |  |                                               |                          |                        |                                                                   |
| 20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19                                                                                                                                                                                                                       |  |                                               |                          |                        |                                                                   |
| Printed/Typed Name                                                                                                                                                                                                                                                                                                                                        |  | Signature                                     |                          | Date<br>Month Day Year |                                                                   |

HS-8702

ORIGINAL—RETURN TO GENERATOR

RCRA NON-HAZARDOUS WASTE

GENERATOR

TRANSPORTER

FACILITY

RCRA NON-HAZARDOUS WASTE

## ASBESTOS DEMOLITION/RENOVATION NOTIFICATION

Check appropriate block(s).

- ☐ Demolition/renovation greater than or equal to 260 linear ft. or 160 square ft. (10 day notification required before demolition, if planned).
- ☐ Demolition/renovation less than 260 linear ft. or 160 square ft. (20 day notification required before demolition). Complete items (1) thru (5) only.
- ☐ Demolition ☐ Renovation

1. Name of owner:  
Address:

Name of operator (contractor):  
Address:

2. Description of facility (include size, age and prior use).

3. Estimate of amount of friable asbestos \_\_\_\_\_ linear ft. \_\_\_\_\_ square ft.  
Explain techniques of estimation if less than 260 linear ft. or 160 square ft.

4. Location of facility.

5. Scheduled starting date \_\_\_\_\_ Completion date \_\_\_\_\_

6. Nature of planned demolition or renovation and methods to be used.

7. Procedures to be used to insure compliance with 40 CFR §61.22(d).

8. Name and Location of waste site where asbestos will be dumped.

Solid Waste Permit No. \_\_\_\_\_

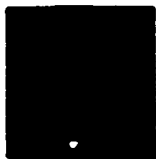
9. If ordered demolition, the name, title and authority of State or local governmental representative who has ordered the demolition.

Number of days to demolish \_\_\_\_\_

Delivered (date stamp)



NILFISK  
OF AMERICA, INC.



*Dust Collection Specialists Since 1910*

SPECIALIZED INDUSTRIAL VACUUMS  
DUST COLLECTION SYSTEMS  
— HEPA —

*General Offices*

300 TECHNOLOGY DRIVE  
MALVERN, PA 19355  
(215) 647-6420

20566 WHITE BARK DR.  
STRONGSVILLE, OH 44136  
(216) 234-1051

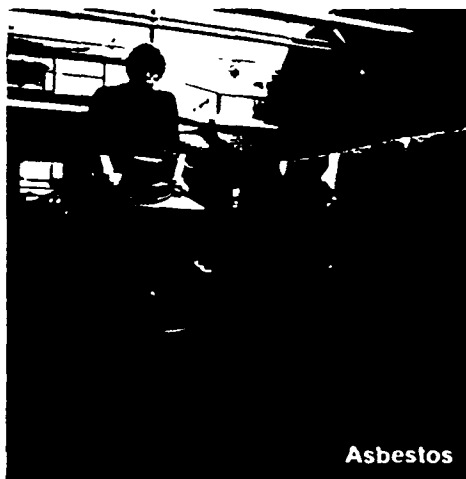
GEORGE C. ERMIL  
DISTRICT MANAGER

**Nilfisk simplifies  
the safe collection  
and disposal of  
toxic, hazardous, and  
nuisance waste  
materials.**

Unique absolute filtering  
system meets or exceeds  
OSHA safety standards  
for control of such toxic  
materials as... lead,  
asbestos, silica, mercury,  
beryllium alloy, insecticides,  
cotton dust, and other  
health endangering dusts.



**Lead**



**Asbestos**



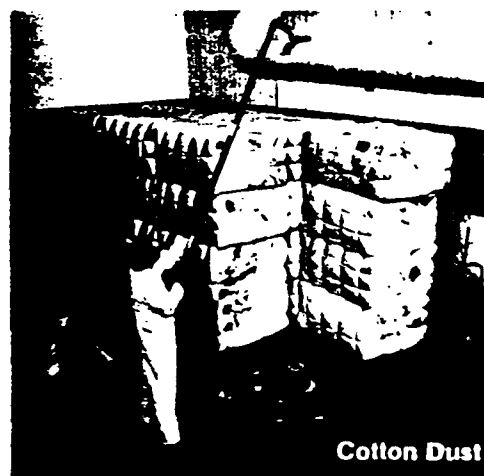
**Silica**



**Mercury**

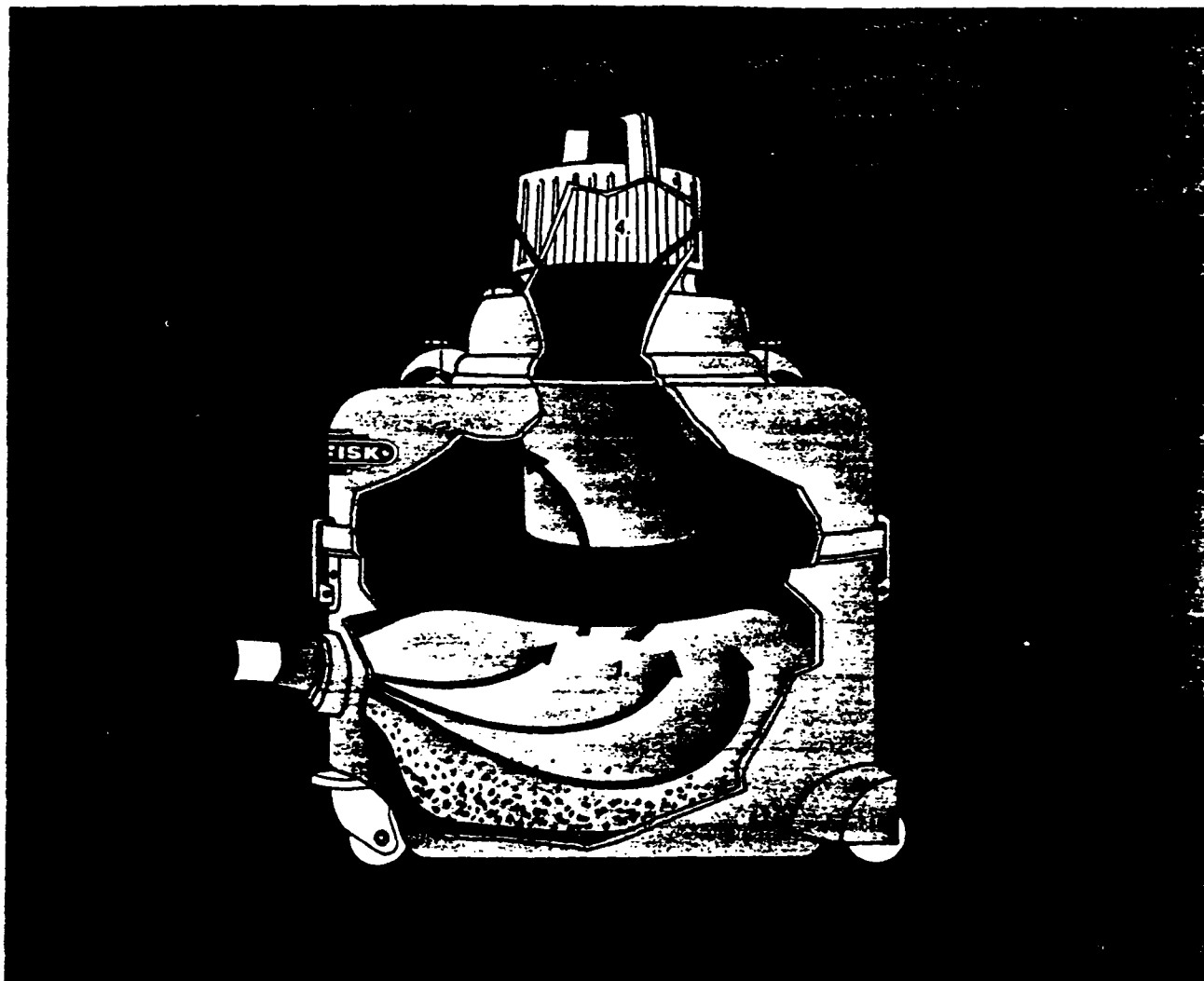


**Beryllium Alloy**



**Cotton Dust**

# **Nilfisk HEPA\* Filtering System traps toxic and hazardous dusts with a 99.97% retention efficiency down to 0.3 microns.**



Nilfisk portable dust collectors / industrial vacuums deliver this absolute filtration with minimal loss of suction and without the risk of motor burn-out. They trap even ultra-fine dusts and return "absolutely" clean air to the work environment. Here's how the absolute filtering system works:

**1. First Stage Separation** — The centrifugal or "cyclonic" airflow pattern of the cleaner aerodynamically separates heavier dust from collected fines

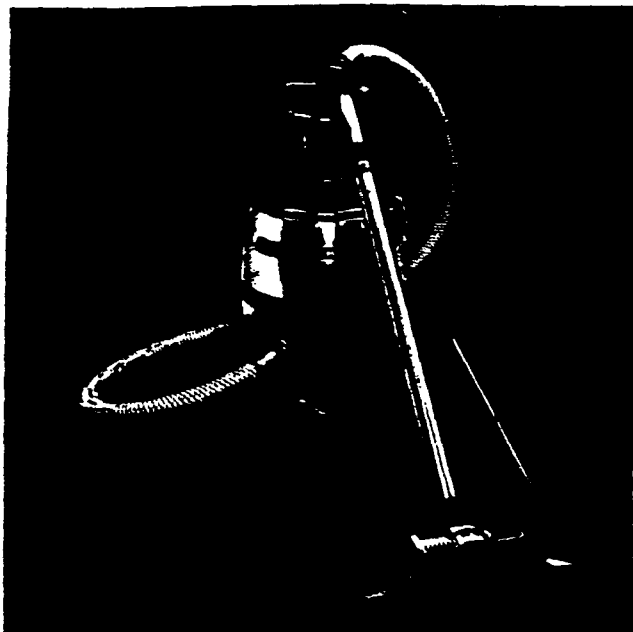
**2. Main Filter** — Powerful suction coupled with extra-large filtering surfaces ensures a steady, even airflow which prolongs filter life and eliminates premature clogging. Optional manometer on larger models detects build-up of dust and alerts the operator to shake the main filter. Exclusive external handle allows the operator to purge the filter without the danger of secondary exposure to collected dust since the cleaner remains sealed.

**3. Microfilter** — Final pre-filtering protection for the motor is provided by a microfilter with a retention efficiency of 99.5% at 2 microns.

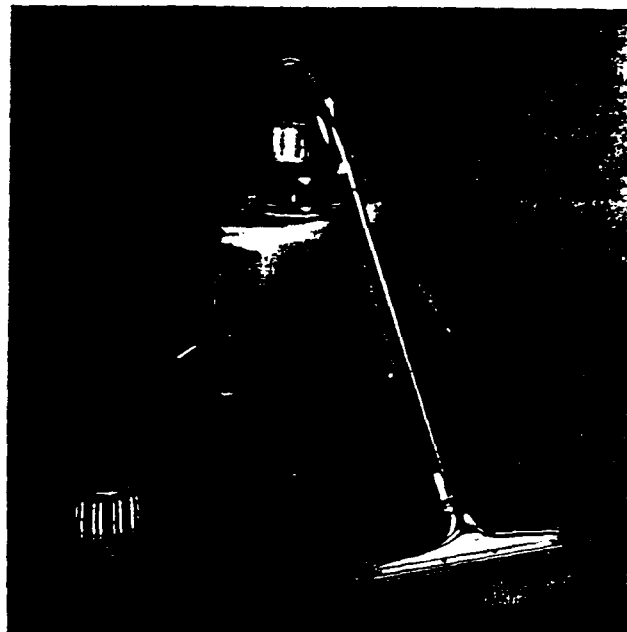
**4. "Absolute" Exhaust Filter** — Nilfisk High Efficiency Particulate Air (HEPA) filter further increases retention efficiency to absolute standards of 99.97% at 0.3 microns. The dust is collected in sealable bags for safe disposal.

Nilfisk portable dust collectors have design advantages that make them ideal for the safe collection and disposal of toxic, hazardous, and nuisance waste materials in any work environment — from laboratories and clean rooms to manufacturing and processing facilities. These design advantages include:

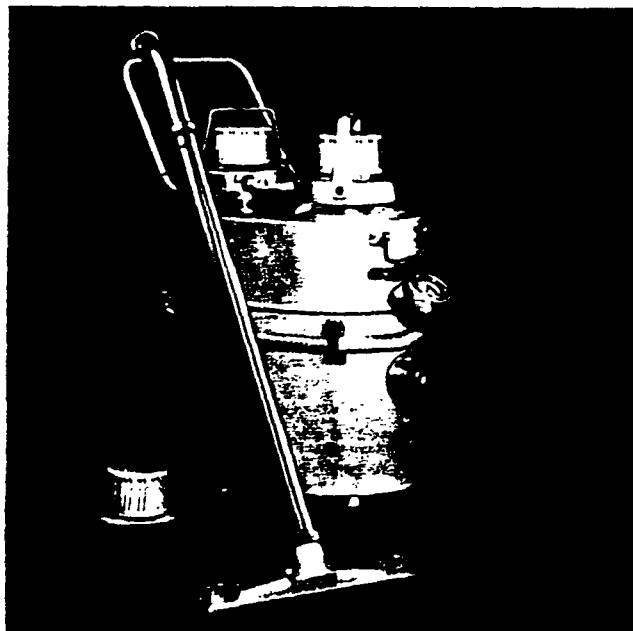
- clog resistance
- absolute filtering
- dust-free disposal
- powerful suction
- large recovery capacity
- low noise level



**Handy small-sized unit with big-power cleanup.** The GS 80 goes anywhere for fast, safe cleanup. Ideal for use at individual work stations. Has a disposable bag capacity of 2¼ gallons dry-bulk.



**Greater capacity with greater durability.** The GS 81 is a larger, heavy-duty unit that is easily maneuvered even where space is restricted. Has a disposable bag capacity of 4 gallons dry-bulk.

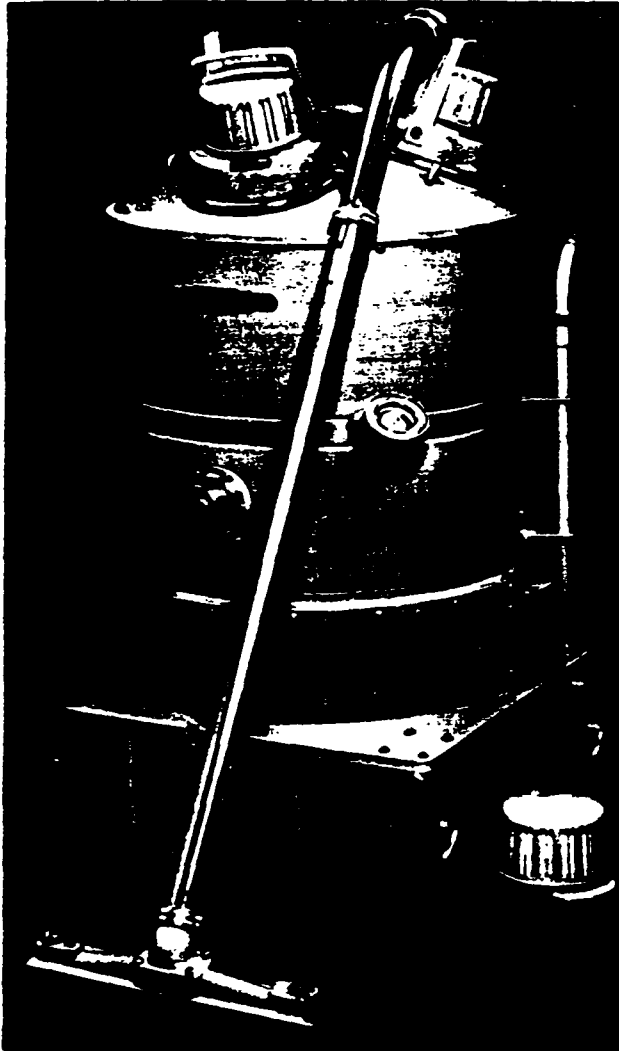


**Ruggedness and versatility in a medium-sized unit.** The GS 82 has the suction capacity to handle a wide range of tough cleanup assignments. Delivers a capacity of 12 gallons dry-bulk.



**Heavy-duty, performance.** The GB 733 has the power and capacity to handle any cleanup assignment. Three-phase induction motor permits continuous recovery of dusts in either built-in or mobile applications. Disposable bag capacity of 18 gallons dry-bulk.

# NILFISK GS 83

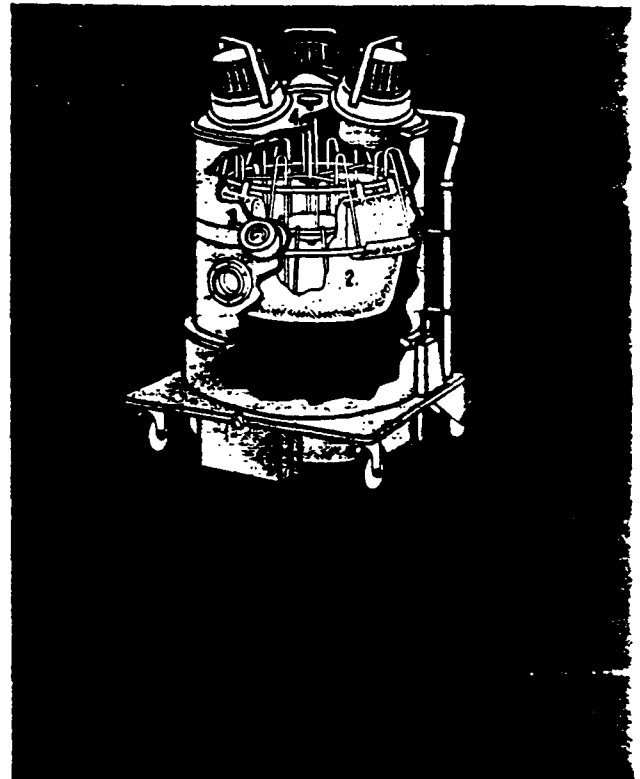


**Big performance and capacity with ease of handling.** The GS 83 brings big performance and capacity to toxic waste cleanup. Practical design ensures ease of handling. Powerful centrifugal airflow maintains optimum suction for continuous operating efficiency — either as a portable cleaning system or as a fixed dust collector. Has a disposable bag capacity of 18 gallons dry-bulk.

## Optional Manometer



(On models GS82 & GS83)  
Alerts operator when filter needs to be shaken. Cleaning the filter regularly maintains high suction and filtration efficiency and extends filter service life.



## Easy, dust-free disposal of debris



1 Use external agitator handle to shake all debris off filter into sealed container

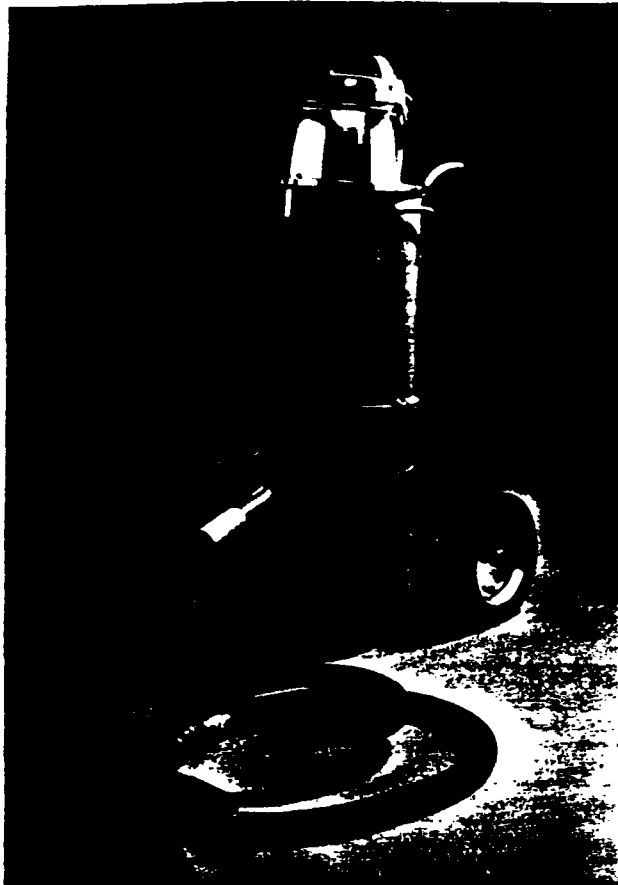


2 Lower the container (bottom of vacuum) to floor. Disposable polyliners are available to fit container.



3 Debris is now captured in the easily sealed heavy-gauge polyliner.

# Nilfisk Mercury Vacuum Cleaner



Nilfisk has developed a completely portable mercury recovery system to eliminate the hazards of mercury spills in laboratories and manufacturing facilities.

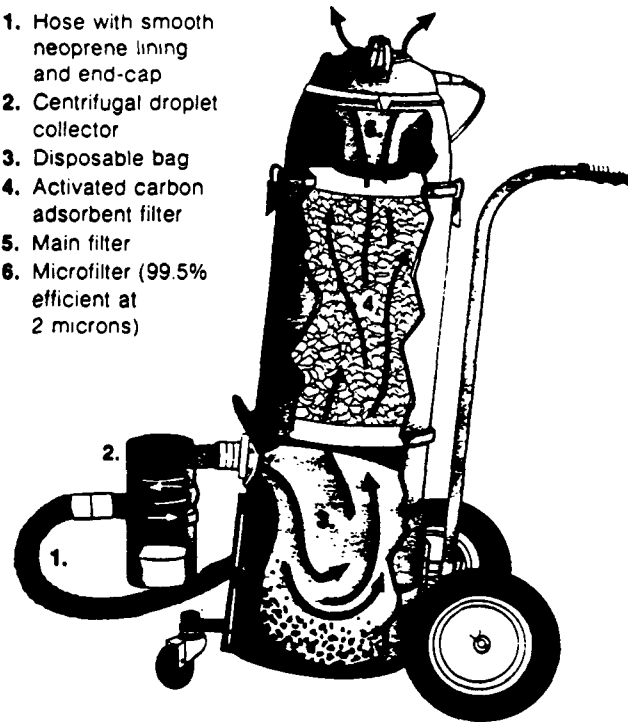
The system handles both liquid mercury and mercury compounds. Powerful suction capacity and well engineered cleaning tools ensure quick cleanup of spills even in hard-to-reach places. The centrifugal droplet separator has been designed to collect liquid mercury in an unbreak-

able plastic bottle for future re-use or disposal. An airtight cover for sealing a filled recovery bottle is also supplied. Smooth neoprene hose-lining reduces droplet residue in the hose.

Large five-gallon stainless steel container with disposable bag provides additional recovery capacity for large spills dust and debris. A thirty-pound charge of specially activated carbon effectively eliminates harmful mercury vapor from the vacuum exhaust. Generally, a carbon cartridge charge will last for two years before needing replacement.

The Nilfisk mercury recovery system meets or exceeds OSHA standards for inorganic mercury. Optional high efficiency particulate air (HEPA) filters ensure "absolute" retention of mercury compound dusts and other contaminants. All particulate and vapor filters are easily replaced.

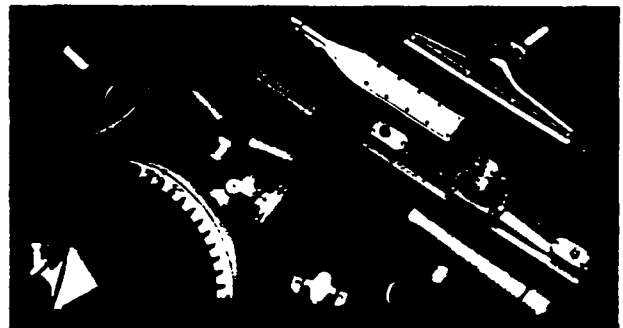
1. Hose with smooth neoprene lining and end-cap
2. Centrifugal droplet collector
3. Disposable bag
4. Activated carbon adsorbent filter
5. Main filter
6. Microfilter (99.5% efficient at 2 microns)



## Complete line of accessories

Nilfisk portable dust collectors can be fitted with a complete line of accessories to handle practically any kind of cleaning situation. Special accessories include attachments for floors, machinery, equipment, overhead pipes, walls, shelving, and just about anything or anyplace where dust collects.

All Nilfisk nozzles are engineered to deliver optimum suction power at the pickup point. All hose-ends have swiveling ball-joint couplings to permit full freedom of movement. The couplings also help to prolong hose life by reducing knots and kinks that can develop during heavy use.



# Nilfisk Asbestos Removal Systems

Nilfisk asbestos removal systems meet or exceed OSHA safety standards for the collection of asbestos dust.

Our HEPA filtering system ensures 99.97% retention efficiency down to 0.3 microns. It traps ultrafine asbestos dust and returns "absolutely" clean air to the work environment. Nilfisk has applied this HEPA filtering system to a number of specific asbestos cleanup problems as indicated below.

**Removing sprayed-on asbestos insulation.** Nilfisk has developed a complete system for the quick, safe removal of sprayed-on asbestos insulation. Oversize main filters eliminate premature clogging. HEPA FILTERS meet OSHA 29 CFR



1910.1001. Separator top fits standard 30- or 55-gallon drums lined with heavy-gauge polyliners to trap the bulk of the loosened asbestos insulation in sealable bags. Unique scraping nozzle loosens wetted asbestos in most cases and sucks it directly into the enclosed system. This reduces the amount of

asbestos that falls to the floor. Lightweight extension wands can eliminate the need for scaffolding, allow the operator to get to hard-to-reach areas. Fixed floor nozzle permits fast cleanup of large open spaces.



**Fabricating asbestos/cement sheets.** Nilfisk offers a wide range of shielded hand-tool systems to control toxic dust created in the fabrication of asbestos/cement sheeting. All systems consistently meet or exceed OSHA asbestos

dust control standards. Each system consists of a HEPA-filtered vacuum dust collector and a safely enclosed hand-tool — such as a saber saw, drill and separate circular saws for flat and corrugated sheet. Static pressure and airflow have been skillfully combined to overcome the unusually high escape velocity of asbestos fibers. Nilfisk portable dust collectors have been in regular use for years in asbestos processing facilities.

**Collecting automotive brake lining dust.** Nilfisk Asbestos-Clene® Systems have been totally engineered to contain and collect asbestos dust which is liberated when automotive brake linings are replaced. Each system consists of a HEPA-filtered dust collector and a brake encapsulation cylinder. When the cylinder is in position, the entire



brake assembly is enclosed by a segmented diaphragm which forms a dust seal. Clear, shatterproof windows permit continuous viewing of the cleaning process. Compressed air directed by the mechanic dislodges even inaccessible asbestos dust from the exposed brake mechanism. The

loosened dust within the cylinder is sucked directly into the Nilfisk collector and trapped in disposable bags. During the entire operation, the mechanic is safe from asbestos dust exposure. The systems require little maintenance. All steel construction resists abuse. Available in three models: System 400 for vehicles with drum brakes in the 7" to 12" diameter range; System 500 is a System 400 fitted to a highlift jack; and 600 for commercial vehicles with drums in the 12" to 19" diameter range. System 600 will accommodate double wheel assemblies.

**National representatives.** Nilfisk has a nationwide network of regional representatives to help you manage your toxic waste cleanup problems. They are thoroughly familiar with governmental codes and regulations dealing with the safe cleanup of toxic and hazardous waste materials. The Nilfisk representative in your area will gladly survey your workplace and make recommendations at no cost.

**For more information.** If you would like more information on Nilfisk portable dust collectors, call or write Customer Service Department, Nilfisk of America, Inc., 300 Technology Drive, Malvern, PA 19355. 1 (800) NIL-FISK.

**NILFISK**   
Dust Collection Specialists Since 1910.



606 Island Avenue, McKees Rocks, PA. 15136



412/331-5337

October 3, 1986

**Aluminum Company of America**

1501 Alcoa Building  
Pittsburgh, PA 15219

Attn: Ms. Laura L. Rippey

**RE: OCTOBER CONFERENCE**

Dear Ms. Rippey:

The following is an outline of topics to be discussed at the October 14, 1986 meeting, 15 minute talk in reference to "Discussion of large scale asbestos removal project".

1. Determine scope of work.
2. Special conditions.
3. Developing specifications.
4. Preparing bid documents.
5. Selecting a contractor.
6. Bid process.
7. Starting the project.
8. Duties during the project.
9. Closing out the contract.

On the following day we will conduct a one hour and 15 minute workshop.

We will go into greater detail on the topics discussed the previous day and review the check list that asks start to finish questions on how to conduct a major asbestos removal project.

The group will be divided into several smaller groups. These smaller groups will be asked to answer the question addressed on the checklist. These answers will then be reviewed and corrected if necessary.

asbestos abatement • consulting • energy retrofit • industrial cleaning

**Checklist to follow on an asbestos abatement project.**

1. Determine Scope of work:

- A. Is material asbestos?
- B. Decide action to be taken, removal or encapsulation etc.
- C. Extent of work.

2. Special Conditions:

- A. Unit or equipment unable to shutdown.
- B. Occupied or unoccupied area.
- C. Accessibility.
- D. Schedule best working hours.

3. Developing Specifications:

- A. Choose containment method
  - 1. Glove bags
  - 2. Construct an airtight enclosure around the area.
- B. Rope off around area, post warning signs, conduct air monitoring.
- C. Other\_\_\_\_\_

**4. Prepare Bid Document:**

- A. Outline scope of work (Include drawing if possible).**
- B. List special conditions.**
- C. Specify type of containment method to be utilized.**
- D. Include plant regulations that outside contractors must follow**

**5. Select a Contractor:**

- A. Develop a list of potential bidders**
- B. Initial screening over the phone**
- C. Submittal Information**
  - 1. References on at least five asbestos abatement projects of similar scope. Include dollar value and contact names and phone numbers.**
  - 2. Credit references or financial statement. Is contractor financially capable of performing the project.**
  - 3. Resumes of key people in the organization.**
  - 4. Resumes of superintendent and foreman that will run the project.**
  - 5. Copy of the worker training and respirator program.**
  - 6. List of any violations or fines from the EPA, DER, OSHA or local regulatory agency.**
  - 7. Copy of general liability insurance policy for asbestos exposure. Copy of workmans compensation and vehicle insurance policy. Review with legal department; is coverage adequate and correct for this type of work.**

6. Bid Process:

- A. Select bid date (Day bids are due).
- B. Review contractor submittal into, mail bid packages to prequalified contractors.
- C. Arrange a pre bid meeting, invite all qualified bidders, discuss job, outline all special requirements and tour jobsite.
- D. Ask contractor to submit with these proposals a detailed outline of the scope of work, procedures to be utilized and quantities of asbestos to be removed or encapsulated.
- E. Choose the contractor, not only on price, but on procedures, qualifications, scope and quantity of work they will perform.

7. Starting the Project:

- A. Hold a pre-construction meeting with contractor, safety and health and/or industrial hygienist and operations personnel.
- B. Items to be addressed in pre- construction meeting:
  - 1. Scope of work and effects on Alcoa workers.
  - 2. Work area protection procedures.
  - 3. Schedule
  - 4. List of employees to be utilized and proof of physical ability, asbestos training and respirator training.
  - 5. Does contractor use any hazardous chemicals?

**8. Duties During the Project:**

**A. Safety and health and/or industrial hygienist should oversee project daily and:**

- 1. Assure specifications and procedures are followed.**
- 2. Conduct a visual inspection of all critical barriers and complete set up before allowing work to begin.**
- 3. Perform air monitoring inside and outside the work area.**
  - a. If the contractor is responsible for air monitoring, Alcoa should still perform spot check air monitoring.**
- 4. Review the time weighted averages(TWA's) for the contractors personnel monitoring on a day to day basis.**
- 5. Monitor waste removal from work area and verify containers are sealed. Sign the waste manifest. Receive manifests daily from previous day, duly signed by an authorized representative of the landfill.**
- 6. Conduct a final visual inspection and perform final air sampling. If final inspection or air sampling is unacceptable, make contractor reclean.**
- 7. Remove critical barriers only after final test result is received and acceptable.**

**9. Contract Close Out**

**A. Prior to final payment, have contractor submit the following:**

- 1. Copies of ALL air sample reports, both area and personal.**
- 2. Copies of ALL landfill manifests.**
- 3. A complete copy of the contractors log book which at a minimum should contain:**
  - a. Daily sign in sheets for workers and visitors.**
  - b. Notes of daily activities which specify unusual events, and asbestos exposure, and visitors.**
  - c. Proof of employee training, signed by employee, doctor and trainer.**
  - d. Copy of EPA notification.**
  - e. Copies of any citations received.**

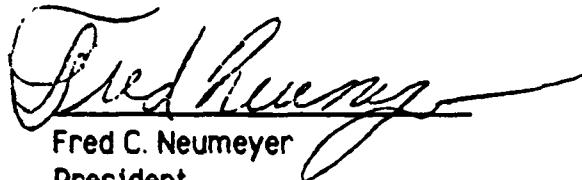
Aluminum Company of America  
October 3, 1986  
Page 2

Slides and visual aids will be utilized to show personal protection equipment and worker decontamination procedures on a typical removal project.

Attached please find the checklist to be included with the conference manuals.

If you have any questions, please advise.

Very truly yours,

  
Fred C. Neumeyer  
President

FCN;lmb  
Enclosure

7.6

FROM: L.L.RIPPEY

TO: IH/SAFETY CONFERENCE  
COMMITTEE

1986-10-10

RE: THE NEW ASBESTOS STANDARD - ITS MEANING TO ALCOA

This session will consist of discussion centered around three aspects of OSHA's new Asbestos Standard. Speakers will address the regulations themselves, large scale asbestos abatement projects, as well as asbestos sampling. Speakers and topic titles are as follows:

Overview of new asbestos regulations - Laura Rippey  
Discussion of large scale asbestos removal project- David Brogan,  
Amaral & Neumeyer Corp.  
Asbestos Sampling and analysis - Rich Milito

Following the three presentations, time will be allowed for a panel discussion so that the speakers can entertain questions from the floor.

"Overview of new Asbestos Regulations" -

Highlights of the new asbestos standards will be reviewed with emphasis on changes from the old OSHA Standard. The decision making process for the selection of the appropriate standard (General Industry or Construction Standard) will also be reviewed. There will also be an examination of the outlook for additional asbestos legislation.

"Large Scale Asbestos Removal Project" -

An asbestos abatement contractor has been invited to discuss large scale asbestos removal jobs. This speaker is prepared to show slides illustrating various aspects of a well managed asbestos removal job. These sorts of construction jobs have new mandatory engineering controls - negative pressure enclosures. There is also a new requirement for "decontamination facilities" which involve pre-job planning and specific work practices.

""Asbestos Sampling and Analysis" -

The new NIOSH 7400 asbestos sampling method will be reviewed and illustrated through use of photomicrographs. Common pitfalls in asbestos sampling will be described along with strategies which may be used to avoid them. New laboratory quality assurance requirements for asbestos analysis will also be briefly reviewed.

Laura

cc. R.M. James

R.A. Milito

Asbest-D.LLR



# JOB SAFETY ANALYSIS WORKSHEET

Job \_\_\_\_\_

Occupation \_\_\_\_\_

Department \_\_\_\_\_

Prepared By \_\_\_\_\_

Employee Participants \_\_\_\_\_

Reviewed \_\_\_\_\_ Date \_\_\_\_\_

Required Personal Protective Equipment:

METHOD:

1) Observe the job

2) Discuss it with operator

3) Draw on your own knowledge

## SEQUENCE OF BASIC JOB STEPS

Describe what is done without detail. Not too broad - not too fine. List the natural steps of the job. Most jobs can be fitted in 12 or less steps.

## POTENTIAL ACCIDENTS OR HAZARDS

What can happen at each step?  
List according to accident type

SB Struck By CO Caught On  
 CA Contacted By CB Caught Between  
 SA Struck Against F Fall  
 CW Contact With SO Strain/Overexertion  
 TI Trapped In E Exposure

## RECOMMENDED SAFE PROCEDURE

Describe specific precautions in detail for each step and each hazard. Question the basic job method. Try to develop cost reduction ideas. People? Process? Product?

[illegible]

Loretta

I've written this JSA for my workshop next week  
 Can you adjust the column widths so it will fit  
 in the attached form? It will probably be impossible  
 to get the printer to print between the lines so cutting  
 and pasting unlined paper over the columns is  
fine with me. When you are ready to do this give me my "draft"  
 disk & I'll copy this. Laura

# JOB SAFETY ANALYSIS WORKSHEET

JOB - Asbestos removal  
 OCCUPATION - Building Maintenance Mechanic, Mechanical Utility Worker  
 DEPARTMENT - Civil Maintenance  
 PREPARER - Irene Scheffler, Arkansas Operations  
 DATE - 1986-10-08

PERSONAL PROTECTIVE EQUIPMENT: see job step 4

## SEQUENCE OF BASIC JOB STEPS (col. 1)

1. Contact IH/Safety to determine type of insulation if it is not known.

## POTENTIAL ACCIDENTS OR HAZARDS: (col. 2)

1. E Exposure to known carcinogen

## RECOMMENDED SAFE PROCEDURE (col. 3)

1. If insulation is not marked with asbestos labels, and the type of insulation is unknown, bring a small sample of the material to the IH/Safety Department for analysis. If analysis can't be made immediately, treat the material like asbestos.

(col. 1)

2. If insulation is asbestos, EPA notification procedures must be followed.

(col. 2)

2. N/A

(col. 3)

2. Both large and small jobs require the completion of forms by the supervisor (or "competant person" per OSHA definition) of each asbestos removal project. These forms are to be forwarded to IH/Safety upon completion.

a. Large job (per EPA definition) - removal of 260 linear feet or more of

of pipe covering or 160 square feet or more of other types of asbestos insulation. Large jobs require at least 10 days advance notification to satisfy EPA rules.

b. Small jobs (per EPA definition) - removal of less than 260 linear feet of pipe covering or less than 160 square feet of other types of asbestos insulation. IH/Safety should be notified of small jobs before they begin. (Other States may require prenotification of small jobs)

(col. 1)

### 3. Contact IH/Safety for air monitoring when removing asbestos materials.

(col. 2)

### 3. E Ingestion and inhalation

(col. 3)

3. Conduct personal exposure sampling in employees breathing zone. Initial monitoring is required for all jobs. OSHA large jobs may require daily monitoring with tests sufficient to represent each employees exposure.

(col. 1)

*(use whatever space is required. Its OK if it extends over more than one column)*

#### PPE Requirements

Wherever employee exposures may exceed the OSHA limit of 0.2 fibers/cc, protective clothing is required. This clothing is to include whole-body clothing, head coverings, gloves and foot coverings. Wrists and ankles of coveralls are to be sealed with duct tape to prevent entrance of asbestos contamination. In general rubber boots should be used as the required foot covering. "Booties" may be used in highly controlled job sites where their tearing would be less likely. Hooded coveralls make acceptable headcoverings. The selection of respiratory protection depends upon the exposure level. The following respirator types are acceptable:

#### Airborne asbestos concentration

#### Required respirator

≤ 2 f/cc  
(10xPEL)

\* half-mask air purifying HEPA

≤ 10 f/cc  
(50xPEL)

\* full facepiece air purifying HEPA

≤ 20 f/cc  
(100xPEL)

\* PAPR w/ HEPA  
\* full face supplied air, continuous flow

≤ 200 f/cc  
(1000xPEL)

\* type "C"

> 200 f/cc

\* type "C" w/ auxiliary positive pressure  
SCBA

(col. 1)

### 4. Prepare job site

(col. 2)

#### 4.1 CB - Body burns

(col. 3)

### 4.1 When possible give piping and vessels enough time to cool off before performing work.

(col. 2)

4.2 E - Exposure of others to a carcinogen

(col. 3)

- 4.2 Set up a restricted area. Post Asbestos Warning Signs at such a distance from the job site that people are aware of the hazard prior to entering the restricted area. Only authorized people with proper protective clothing are allowed inside the restricted area. Restricted area must encompass entire area where airborne asbestos concentration exceeds the PEL. For large scale asbestos abatement jobs (per the OSHA definition) a negative pressure enclosure is required whenever feasible.

(col. 2)

4.3 F- Slip/ fall hazard on visqueen sheeting

(col. 3)

- 4.3 Spread 6 mil visqueen sheeting to cover floor in work area to prevent the spread of asbestos material and to aid in cleanup.

(col. 1)

5 Remove insulation

(col. 2)

5.1 E- Exposure to asbestos  
CW-Electrical Shock

(col. 3)

- 5.1 Wet insulation thoroughly with amended water spray wherever this is possible. Be alert for electrical shock hazards and eliminate them before removing asbestos by the wet method. Do not use so much water that streams of contaminated water run away from the job site. If a glove bag or other mini-enclosure is used, put it in place prior to wetting the insulation. Keep asbestos wet at all times during removal.

(col. 2)

5.2 SB - Cuts from knife, saw or sharp metal  
E - Exposure to asbestos

(col. 3)

- 5.2 To cut asbestos use a sharp knife or a flexible saw. Never knock insulation off with a hammer because this will generate more dust. Be aware of sharp wire or other sharp metal objects associated with the insulation. Wear proper hand protection to prevent cuts and abrasions. When cleaning surfaces, use nylon bristled brushes because wire brushes will break asbestos into smaller fibrils.

(col. 2)

5.3 F - Trip, slip, stumble

(col. 3)

- 5.3 Be aware of uneven walking surfaces. Be alert when working on top of pipe racks, vessels, scaffolding, and ladders. Tie off whenever possible. Practice good housekeeping to eliminate some tripping hazards.

(col.1)

## 6 Disposal of insulation

(col.2)

6.1 SD - Wet insulation will be heavy

(col. 3)

6.1 Do not overload waste containers with wet insulation

(col.2)

6.2 E - Exposure to asbestos

(col. 3)

6.2 Work carefully to avoid generation of dust. Keep insulation wet while filling disposal containers. Lower insulation carefully into containers. do not drop or throw insulation. Do not use compressed air to blow insulation off of surfaces. Use methods that generate less airborne dust (squeegees, shovels and HEPA vacuums are suggested). Clean asbestos containing material from the site before removing the "restricted area".

(col.2)

6.3 E - Exposure to asbestos

(col. 3)

6.3 Package asbestos in 6 mil. bags unless there are sharp metal objects mixed with the insulation. In that case use weatherproof drums. If waste is to be stored temporarily on-site, metal drums make superior waste containers because they are able to withstand the elements. All waste containers must be labeled. Clean exteriors of containers by wet wiping. Cloths used for cleanup must be disposed with asbestos waste. Comply with local regulations on the disposal of asbestos. When disposing of asbestos waste in a landfill, carefully lower containers into the trench to avoid breaking them open. Protective clothing consisting of disposable coveralls, gloves and a half face respirator (HEPA filters) are recommended for this task.

(col. 1)

## 7 ~~Cleanup~~ Decontamination

(col. 2)

7 E - Exposure to asbestos

(col.3)

7.1 For small jobs (per OSHA definition) use HEPA vacuum to remove fibers from protective clothing before removing suit. Remove respirator last. Throw away disposable clothing and respirator cartridges with asbestos waste. Rinse gross contamination from respirator with amended water spray. Allow liquid to run into an asbestos disposal container. Finish cleaning respirator with soap and water. Rubber boots can be similarly decontaminated for reuse.

Wash hands and face before eating or smoking.

(col.2)

7.2 E - Exposure to asbestos

(col. 3)

7.2 For large jobs (per OSHA definition) Cleanup requires use of decontamination facilities. This consists of a clean room, shower facility and equipment room. When leaving the work area all contaminated clothing must be left in the equipment room. Showers are required. If its not feasible to have ~~on the~~ job-site showers, employees may HEPA vacuum clothing or change to clean coveralls before proceeding to the shower area.