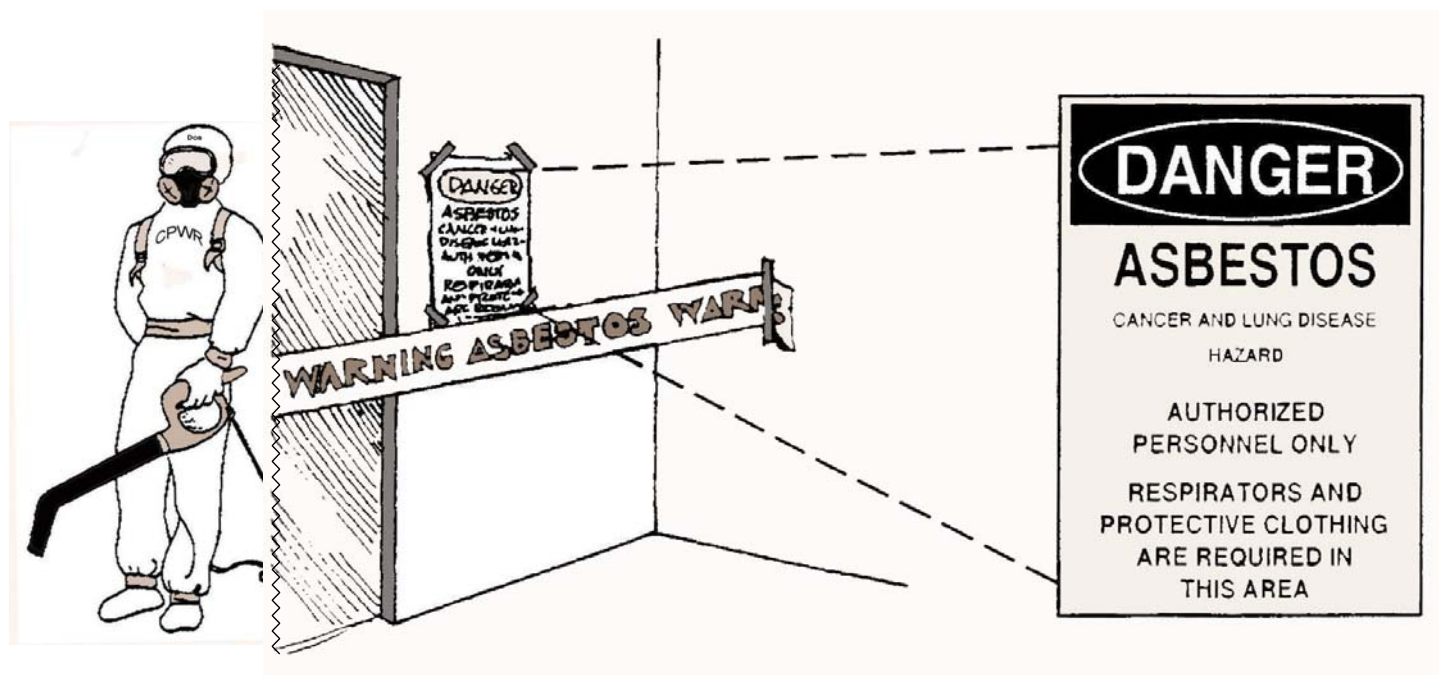


EPA Model Asbestos Worker Training Manual

Seventh Edition 1999
CPWR Revision 2006



The Center to Protect Workers' Rights

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Introduction

Thirty to forty years ago workers weren't told that asbestos is dangerous. They did not know to protect themselves while they were working. Various sources have estimated that upwards of 12,000 workers will die of asbestos-related disease every year. Most of these workers have, or will have, died ten to forty years after they started working with asbestos. Asbestos can cause disease or kill you unless you protect yourself. Asbestos can kill members of your family unless you take steps not to take asbestos fibers home. There are ways you can protect yourself, those who work with you, and your family.

During this class, you will learn how to protect yourself. You will learn how to make your work with asbestos as safe as possible.

Protecting yourself from asbestos overexposure while you work means safe for you, safe for your family, and safe for the environment. As you learn the rules for working with asbestos, you will greatly lower your chances of getting sick years from now. You must work smart and carefully. Follow the asbestos and respirator work practice laws. If you do, then you will also help protect your family and neighbors from asbestos-related diseases.

The goal of this class is to help you learn how to protect yourself – be a decision-maker. You will learn how to keep asbestos fibers out of the air. You will learn how to keep asbestos out of your lungs if it gets in the air. You will learn how to keep asbestos fibers from spreading outside the work area. You will learn how asbestos fibers may affect your health. You will learn about timely and preventative medical exams which are required for you when working around asbestos. You will be able to make better decisions about your quality of work – and life.

Asbestos is a naturally-occurring mineral. It can be found in low levels almost everywhere. Everyone breathes some asbestos just from breathing air. But workers abating asbestos handle large amounts of asbestos. Your employer must give you the proper equipment. You must use this equipment the right way. Such is the stuff of which this class is made.

Contents

Chapter		Page
1	Identifying Asbestos	1
	Key Facts	11
	Training Fact Sheet (review)	12
2	Asbestos Diseases and Medical Exams	19
	Part 1: Asbestos Diseases	19
	Key Facts	34
	Part 2: Medical Exams	37
	Key Facts	45
3	Federal Laws	47
	29 CFR 1926.1101 Construction Asbestos	74
	29 CFR 1910.134 Respiratory Protection	126
	Key Facts	187
4	Control Methods, Setup & Removal	193
	Control Methods	194
	Key Facts	198
	Setup	200
	Key Facts	217
	Class I & II Removal	219
	Key Facts	232
	Class III Removal and Glovebagging	235
	Key Facts	243
5	Personal Protective Equipment	247
	Part 1: Respirator Types	247
	Key Facts	268
	Part 2: Caring For Your Respirator.....	271
	Key Facts	280
	Part 3: Other Safety Equipment	283
	Key Facts	285
6	Cleanup and Disposal	287
	Key Facts	298
7	Other Health and Safety Problems	301
	Key Facts	322

Chapter		Page
8	Additional Resources	327
	Glossary	328
	Acronyms	342
	OSHA 29 CFR 1926.1101 Summary	343
9	State Law	



You will learn how to remove ACM from a pipe using a glovebag...

In addition to the knowledge gained from the classroom activities, the manual, slides, and demonstrations, you will learn from hands-on work practices.



... one way of constructing a decon door panel...



... how to make “hospital corners”
while laying floor poly...



... the joy of taping
with gloves on, and ...



... you will learn about
wearing an APR, goggles,
and a protective suit.

CPWR ASBESTOS ABATEMENT WORKER 32-HOUR TRAINING COURSE SCHEDULE¹

DAY ONE

7:00 - 7:30 a.m.	Welcome and Introduction
7:30 - 8:00	Video Tape
8:00 - 9:30 (w/Break)	Background Information: History, Physical Characteristics, and Uses of Asbestos <i>(Chapter 1: pp 1-11)</i>
9:30 - 11:00	Health Effects of Exposure and Medical Monitoring <i>(Chapter 2: pp 19 - 46)</i>
11:00 - 11:30	Asbestos Regulations <ul style="list-style-type: none">● Federal EPA Regulations: NESHAP, AHERA, ASHARA● Federal OSHA Standards● State Regulations <i>(Chapter 3: all; Chapter 1: pp 12 - 13; Chapter 9, state)</i>
11:30 - 12 noon	Lunch
12:00 - 12:45	Regulations cont'd
12:45 - 1:30 (w/Break)	Pre-work Activities/Control Methods <i>(Chapter 4: 194-199)</i>
1:30 - 3:30	Worksite Preparation/Setup/Decontamination Unit <i>(Chapter 4: 200-218; 225-226)</i>
3:30	End of Day One

¹Course starting and ending times may vary depending on local site requirements. Adjustments in topic sequence and lunch starting time may be required.

CPWR ASBESTOS ABATEMENT WORKER 32-HOUR TRAINING COURSE SCHEDULE

DAY TWO

7:00 - 7:30 a.m.	Day One in Review
7:30 - 9:45 (w/Break)	Work Practices/Engineering Controls (<i>Chapter 4: 219-237, except 225-226</i>)
9:45 - 10:30	Asbestos Bulk Sampling and Air Monitoring (<i>Chapter 1: 7 - 9; Chapter 4: 225-227; Chapter 6: 290-291</i>)
10:30 - 11:30	Respirators – Principles and Types <ul style="list-style-type: none">● Air-purifying Respirators● Powered Air-purifying Respirators● Type C Supplied Air Respirators● Respiratory Protection Program● Other PPE (suits, gloves, eye wear, etc.) (<i>Chapter 5: all; Chapter 1; pages 14-15</i>)
11:30 - 12 noon	Lunch
12 noon - 1:00	Respirators & PPE cont'd
1:00 - 2:15 (w/Break)	Respirator Fit Testing & PPE (Hands-on Workshop)
2:15 - 3:00	Cleanup & Disposal/Lockdown & Sprayback (<i>Chapter 6: all</i>)
3:00 - 3:30	Personal Hygiene and Other Safety and Health Considerations (<i>Chapter 7: all</i>)
3:30	End of Day Two

CPWR ASBESTOS ABATEMENT WORKER 32-HOUR TRAINING COURSE SCHEDULE

DAY THREE

7:00 - 7:30 a.m.

Day Two in Review

7:30 - 9:45
(w/Break)

Glovebag Principles & Procedures
(Chapter 4: 235-243)

9:45 - 11:30

Asbestos Abatement Methods/Cleanup &
Disposal Procedures (Hands-on Workshop)

11:30 - 12 noon

Lunch

12:00 - 2:45
(w/Break)

Asbestos Abatement Methods/Cleanup &
Disposal Procedures (Hands-on Workshop)
Cont'd

2:45 - 3:30

Course Review

3:30

End of Day Three

DAY FOUR

7:00 - 8:30 a.m.

Final Exam (Written)

8:30 - 11:30
(w/Break)

Asbestos Abatement Methods/Cleanup &
Disposal Procedures (Hands-on Workshop)
Cont'd

11:30 - 12 noon

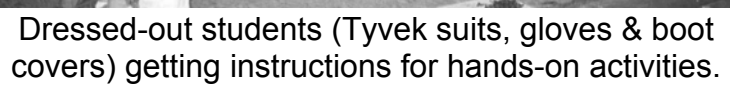
Lunch

12 noon - 3:15
(w/Break)

Final Exam: Hands-on Competency Evaluation

3:15 - 3:30

Course Closing and Evaluation

[illegible]



IDENTIFYING ASBESTOS

1

In this chapter you will learn:

What asbestos is.

That asbestos can be dangerous.

When asbestos is dangerous.

How asbestos gets in the air.

Where you may find asbestos.

How asbestos is identified.

About the different kinds of asbestos fibers.

Recognizing Asbestos...



Will: The asbestos is behind these wall tiles. Let's tear out the tiles before we set up. It will save us some time, and we're behind schedule.

Chris: What's in the tiles?

Will: It's just tile. There's no asbestos in that.

Chris: How do you know?

Will: It doesn't look like it has asbestos in it. And besides, the owner of the building said the asbestos was behind the tiles.

Chris: How does he know where all the asbestos is?

Will: Listen Chris, he owns the building. He should know where all the asbestos is, right? Besides, I know what asbestos looks like. There's nothing in these tiles that can hurt you. Come on, we have a lot of work to do today. Grab a hammer and let's get going.

Chris: Well, ... OK.



Discussion Questions

(Choose 1 or 2 of the following questions to discuss.)



1. How can you tell if something has asbestos in it?
2. How can Will and Chris find out where the asbestos is in the building?
3. Why do you think Will wanted to tear the tiles out before setting up?
4. Why do you think Chris went along with Will?
5. What could Chris have done to find out about the tiles?
6. How could Chris have gotten the information without getting Will angry? (Without risking getting fired or disciplined?)

What is Asbestos?

Asbestos is a mineral. It is a natural rock mined from the ground in places like Vermont, Canada, and South Africa. Asbestos is not a technology-made fiber. (Fiberglass is a technology-made fiber.) Asbestos has been used since Roman times. Most recently, it has been used in building materials.

When asbestos is crushed, it does not make ordinary dust like other rocks. Asbestos breaks into tiny, sharp fibers that are too small to see. You cannot see, feel, or taste asbestos fibers.

When is Asbestos Dangerous?

Asbestos is dangerous when you breathe it. Asbestos fibers are so small they can easily get into your lungs. Asbestos can make you very sick years after you breathe it. Asbestos will not make you cough or sneeze or itch while you breathe it. But if enough asbestos gets into your lungs, it can kill you years later.

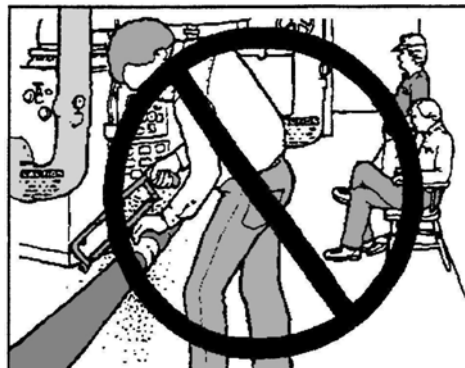
When asbestos gets in the air, you can breathe it. Sometimes plaster has asbestos in it. If the plaster stays on the wall, the asbestos will not hurt you. If you tear down the wall, the asbestos may get in the air. When asbestos is in the air, it is dangerous.



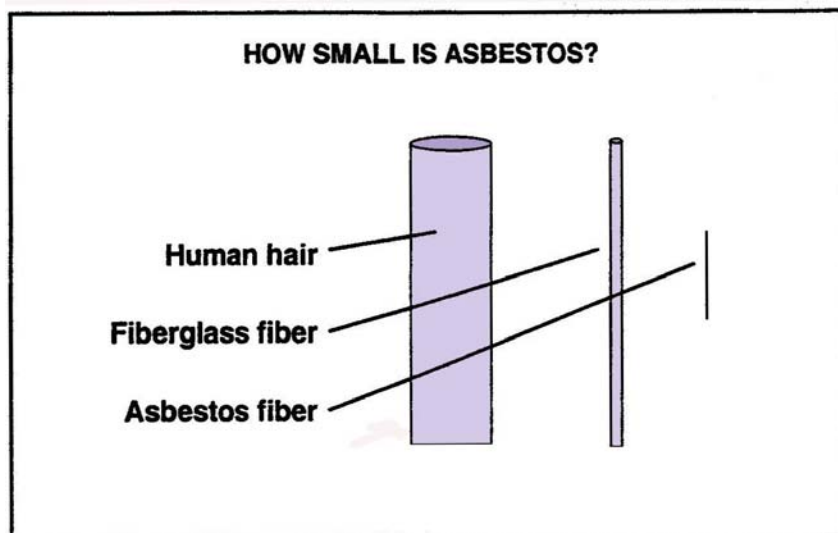
It is easy to get asbestos in the air. If you handle asbestos at all, it can become airborne. If you:

- | | |
|--------|-----------|
| ✓ saw | ✓ drill |
| ✓ nail | ✓ cut |
| ✓ sand | ✓ or tear |

asbestos, it may become airborne. Once asbestos is in the air, it can get in your lungs and make you sick.



Asbestos fibers are so light, they go wherever air goes. If asbestos is in the air in a boiler room, it can travel through the building. It can go through air ducts, under doors, and down halls and stairs. Asbestos is so light it can remain airborne for days. If you step in asbestos dust on the floor, you will push it back into the air.



How Much Asbestos is in the Air?

There are ways to measure how much asbestos is in the air. Air pumps can be used to measure asbestos. Air pumps pull the air through a small filter. The asbestos fibers stick to this filter. The fibers are counted with the use of a microscope. The amount of air that passes through the pump is also



measured. The amount of air is measured in cubic centimeters. A cubic centimeter is about the size of a sugar cube. **Asbestos is measured in fibers per cubic centimeter (f/cc) of air.** This is called **air sampling**. Even though you cannot see asbestos in the air, it can be measured. Remember, asbestos is dangerous when it is in the air.

If asbestos is so dangerous, why is there so much of it?

Asbestos is a very good fire, heat, and sound insulator. It is also very strong. Pound for pound, asbestos is stronger than steel. For example, asbestos is in brake shoes, which need to be strong and resist heat.

Asbestos is in more than 3,000 different products. It is in many building materials. A lot of asbestos is in old buildings. New buildings built in the 1980's don't have as much asbestos in them.

SOME ASBESTOS-CONTAINING MATERIALS (ACM)

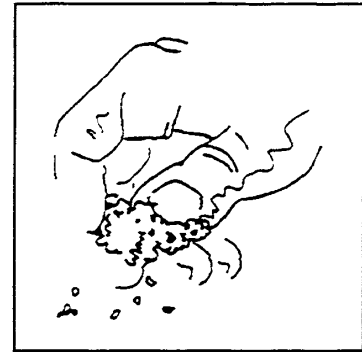
acoustical (sound) plaster	mastic
adhesive backing for floor coverings	paper products
acoustical (sound) tiles	paints and coatings
boiler insulation	pipe gaskets
caulking, putties	pipe insulation
ceiling insulation	plaster/stucco
chemical tanks	roofing felts
decorative plaster	roofing asphalt
dropped ceiling tiles	siding
duct insulation	spackling
electrical insulation	Transite countertops and lab hoods
fire blankets	Transite (cement) sheets
fire curtains	Transite (cement) pipes
fire doors	valves/packing
fireproofing on beams	vinyl-asbestos floor tiles (VATs)

Friable (crumbly) Asbestos

Asbestos that can be crumbled in your hand is called "friable" (FRYable) asbestos. A friable (crumbly) piece of asbestos is more dangerous than a non-friable piece of asbestos. The fibers are more likely to get in the air – **and into your lungs.**



An example of friable asbestos is sprayed-on ceiling insulation. It is a surfacing material. The insulation may fall off the ceiling and get in the air without even being touched. Water damage, vibration, or even air blowing across the ceiling can cause fibers to be released into the air. Other examples of friable asbestos are pipe, boiler, and duct insulation.



FRIABLE (CRUMBLY) ASBESTOS

Non-friable Asbestos

An example of non-friable asbestos is vinyl-asbestos floor tile (VAT). If it is in good condition, the asbestos fibers will probably stay in the tiles. But if you saw, drill, strip, or sand the tile, asbestos may become friable and get into the air. Floor buffers can scrape the tile surface and release fibers into the air.

There are two categories of non-friable asbestos. Category I Non-friable asbestos includes roofings, flooring, packings, and gaskets. Category II Non-friable asbestos includes all other non-friable asbestos materials.

Regulated Asbestos Containing Material (RACM)

This term is used for the materials which are covered by regulations. This list of materials now includes some non-friable materials that were not regulated before. RACMs include:

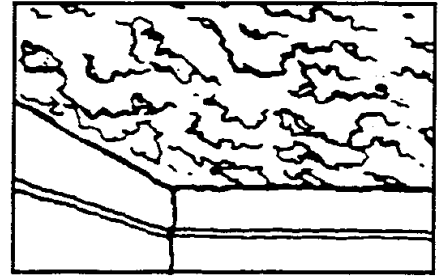
- Friable asbestos containing materials (ACMs)
- Category I non-friable ACMs that have become friable or will be sanded, ground, cut, or abraded
- Category II non-friable ACMs that have become friable or have a high probability of becoming friable during demolition or renovation

Asbestos is common in boiler rooms, on ceilings or above ceilings, and wherever pipes are found. You are likely to find asbestos in:

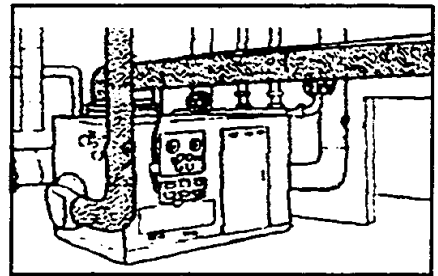
1. **Sprayed-on ceiling insulation**
2. **Pipe and boiler insulation**
3. **Duct insulation**
4. **Floor and ceiling tiles**



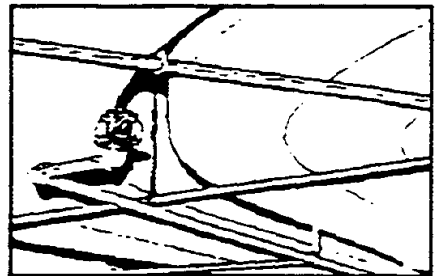
1. Sprayed-on asbestos insulation is usually fluffy material sprayed onto ceilings or beams. Because it covers a surface, sprayed-on insulation is called a "surfacing material." Sometimes you can see the insulation from the floor. Sometimes it is covered by ceiling tiles.



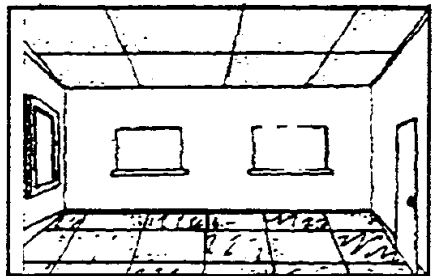
2. Asbestos pipe and boiler insulation may be covered with paper, cloth, or metal. The insulation may be cardboard-like pipe wrap or cement on pipe elbows. It may also be troweled-on insulation on boilers or boiler wrap.



3. Asbestos duct insulation is usually a thin layer of insulation. It is usually painted to match the room. It may be covered with paper, cloth, or metal. When asbestos is put on furnace pipes, boilers, ducts, or tanks it is called thermal system insulation (TSI).



4. Asbestos floor and ceiling tile look exactly like non-asbestos tile. Asbestos floor tile is usually vinyl asbestos tile (VAT). Asbestos floor tile is most often 9 inches square. Asbestos ceiling tile is used for sound insulation or for dropped ceilings.



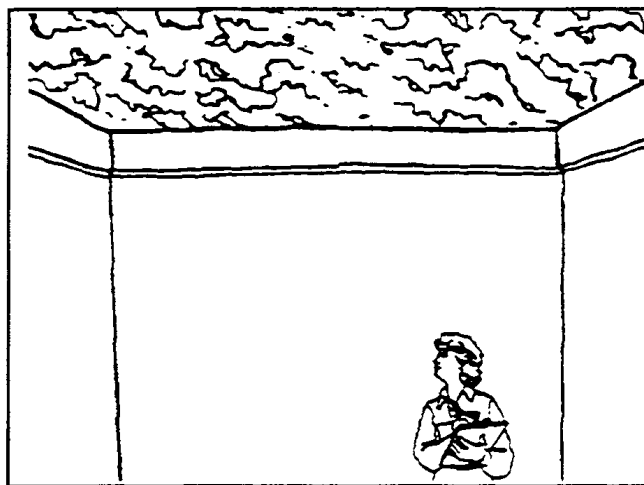
Identifying Asbestos

You can't tell if a product contains asbestos just by looking at it.

If your job is removing asbestos, your supervisor should tell you where the asbestos is when you get on the job. Some maintenance workers also handle asbestos. They may not know where all the asbestos is in their building. If you think something might be asbestos, assume that it is asbestos and treat it as such. Then ask your supervisor to find out for sure by looking at the lab report.



If you work in a school, you can look at your school's Management Plan. The Plan has the lab reports in it. They tell you whether or not the material is asbestos.



IS IT ASBESTOS?

Many things look the same, whether they have asbestos in them or not. Ceiling tiles made by different companies are made to look the same so they can be replaced. A ceiling tile with 10% asbestos may look exactly the same as a ceiling tile with 30% asbestos.

Sometimes asbestos looks white and fluffy. Sometimes it looks like brown mud. Sometimes it is covered with a paper jacket. The jacket may be painted any color.

Some people say they can tell if something is asbestos just by looking at it. This is not true. No one can tell for sure if something is asbestos by looking, feeling, or smelling it. **The only way to tell for sure is to send a piece of material (bulk sample) to a lab and have it looked at under a microscope.**

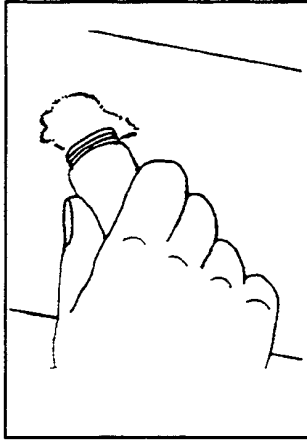
This is the only detection way allowed by law. At the lab, a trained analyst looks at the sample under a microscope.

A few building materials have a standard look. Some contain asbestos, some don't. Papery pipe covering almost always has asbestos in it. Fiberglass, black polyurethane foam, and cork rarely ever contain asbestos.

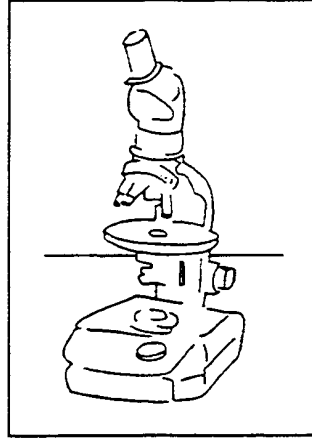
As you can see, asbestos can be in many building materials. You need to work carefully around insulation and other building materials that might be asbestos. Remember that not everything has asbestos in it. Glass, gypsum board, fiberglass, polyurethane foam, cork, and ceramic tiles do not have asbestos in them.



What is Sent to a Lab?



BULK SAMPLE



POLARIZED LIGHT MICROSCOPE

To tell whether something is asbestos, a trained asbestos inspector takes **a sample of the material**. This is called a **bulk sample**. The inspector seals up the hole where the sample was taken. The inspector sends the piece of material to a lab. A sample taken from a school must go to an approved lab. The lab grinds up the **bulk sample** and

stains it with dye. The lab then looks at it under a special microscope. It is called a **Polarized Light Microscope (PLM)**. The lab sends back a report based on the PLM readings.

An Example

A building owner sent a piece of pipe insulation to a lab. Technicians at the lab analyzed the sample for asbestos content with a PLM. The lab found that the pipe insulation had asbestos in it and sent the building owner the following report. **According to the report, what percent of the insulation was asbestos?**

Received: 5/15/94
SAMPLE ID: AH-023

ABC ANALYTICAL LAB, INC. REPORT
NAME: Asbestos Bulk Sample Analysis

DATE ANALYZED: 5/16/94 ANALYST: Sletten VERIFIED BY: KMD

<u>Fiber Type</u>	<u>Result</u>	<u>Other Materials</u>	<u>Result</u>
CHRYSTOTILE	Trace	CELLULOSE FIBER	Trace
AMOSITE	30-35%	FIBROUS GLASS	40-50%
CROCIDOLITE	0%	NANF	10-15%
TREMOLITE	0%		

Definitions:
NANF = Non-Asbestos, Non-Fibrous
Trace = Trace Amounts Noted

BULK SAMPLE REPORT FROM LAB



According to the lab report, the pipe insulation was 30 to 35% amosite asbestos. It also had a trace of chrysotile asbestos in it. It was 40 to 50% fiberglass.

Are There Different Kinds of Asbestos?

There are six kinds of asbestos fibers. They are all dangerous. The three most common kinds of asbestos fibers are:

- **Chrysotile (CRY-so-tile)**
- **Amosite (AM-o-site)**
- **Crocidolite (crow-SID-o-lite)**

Chrysotile asbestos counts for 95% of all asbestos in buildings.

Amosite is less than 5% of all asbestos found in buildings.

Crocidolite is less than 5% of all asbestos found in building materials.

Amosite does not soak up water easily. (Asbestos must be wet before you handle it.) Wetting asbestos helps to keep the fibers out of the air. Therefore, amosite is harder to work with. There are three other kinds of asbestos fibers that are **rarely** used in buildings:

- **Anthophyllite (an-THAW-fill-ite)**
- **Tremolite (TREH-mo-lite)**
- **Actinolite (ack-TIN-o-lite)**

All asbestos fibers are dangerous. Some people say that some kinds of asbestos fibers are less dangerous. Many people (including the government) disagree. You must consider all asbestos to be dangerous.

Protecting Yourself

Asbestos is dangerous if you breathe it. But you can protect yourself and those around you from breathing asbestos fibers. To work safely with asbestos, you have to keep it out of the air. There are lots of good ways to do this. You will learn about them in this class.

You also have to **take asbestos out of the air with special filters.** Most important, you have to filter the air that you breathe through a respirator - a mask that filters the air. You can also wear a respirator that



pumps in clean air from outside the work room. You **must** wear a disposable suit or coveralls (special laundering) when you work. You **must not** take asbestos home with you on your clothes.

The air that leaves the work room also has to be filtered. This protects people outside of the work area.

You cannot tell when asbestos is in the air or is hurting your lungs. **But you can use your knowledge to work more safely and protect yourself.**

It is the responsibility of the building owner to identify any ACMs in their building prior to work which may disturb it. The owner must notify workers of the location of any ACMs before they begin work.

Discussion Questions

1. Is asbestos dangerous if it gets on your clothes ?
2. Sometimes air ducts are insulated with asbestos on the inside. Why is this so bad?
3. Is asbestos floor tile friable? Is this always true?
4. You can't tell whether a product contains asbestos by just looking at it. Why does this make asbestos more dangerous than other workplace problems?
5. Why is it harder to work safely with amosite asbestos than with other kinds of asbestos?



For More Information

List of Asbestos-Containing Materials, Appendix A to EPA, "Guidance For Controlling Asbestos-Containing Materials in Buildings," (the "Purple Book") EPA Publication No. EPA 560/5-85-024.

EPA, "Managing Asbestos in Place" (the "Green Book"), EPA Publication No. 20T-2003.

OSHA Asbestos Standard, 29 CFR 1926.1101 , Appendix H, "Substance Technical Information for Asbestos."



Georgia Tech Research Institute, "Bulk Sampling," Section I in "Model EPA Curriculum for Training Building Inspectors," available from National Technical Information Services at (703) 487-4560.

IDENTIFYING ASBESTOS

Key Facts

Asbestos is a mineral that breaks into fibers that can become airborne.

Asbestos is dangerous when it is in the air and you breathe it.
It is very easy to get asbestos in the air.
Wherever air goes, asbestos can go.

Asbestos can kill you, but you can protect yourself. To work safely with asbestos, you have to:

Keep it out of the air.

Filter the air with special filters.

Protect yourself with special respirators and clothing.

Asbestos is in more than 3,000 different products. In buildings, you will probably find asbestos in:

- * Sprayed-on ceiling insulation
- * Pipe and boiler insulation
- * Duct insulation
- * Floor and ceiling tiles

Friable (crumbly) asbestos is more dangerous than non-friable (hard) asbestos. Damaged non-friable asbestos is also dangerous.

You cannot tell if something contains asbestos just by looking at it. A lab can test a piece of material, called a **bulk sample**. The lab looks at the bulk sample under a **Polarized Light Microscope (PLM)**.

If you do not know whether something contains asbestos, assume that it is asbestos until a bulk sample proves it is not.

There are three common types of asbestos fibers:

- * Chrysotile (CRY-so-tile) (95% of asbestos in buildings)
- * Amosite (AM-o-site) (hard to wet)
- * Crocidolite (crow-SID-o-lite)



TRAINING FACT SHEET

There are a lot of facts that you need to know about asbestos. **This fact sheet has been made to help you. It has information you must remember. All of the information will be covered in the class.** Read this fact sheet over every day. These facts may not make sense when you first start reading them. It will get easier. If you read this every day, it will help you remember the information.

A. Government Agencies involved with asbestos:

There are three federal government agencies that deal with asbestos. You will learn about these agencies throughout this training. Here is a list of the agencies and a brief description of each.

1. Environmental Protection Agency (EPA)

A federal government agency that protects against pollution. The EPA makes and enforces regulations to protect the community and the environment from pollution. The EPA regulations define the different types of ACM and how to protect the community and environment.

AHERA - Asbestos Hazard Emergency Response Act The EPA's "asbestos in schools" regulation.

ASHARA - Asbestos School Hazard Abatement Reauthorization Act The EPA regulation that updates AHERA.

NESHAP - National Emission Standards for Hazardous Air Pollutants The EPA regulation that covers asbestos as an air pollution problem.

2. Occupational Safety and Health Administration (OSHA)

A federal government agency that covers worker safety and health. OSHA makes and enforces regulations (standards) to protect workers. The OSHA regulations define the different types of asbestos work, how you are to be protected while you work, and how you are to work safely. OSHA has regulations about: asbestos, chemical safety, electrical safety, ladders, respirators, scaffolds, fall protection, confined spaces, and many other workplace hazards.



3. National Institute for Occupational Safety and Health (NIOSH)

A federal government agency that researches worker safety and health, and reports its findings to the Occupational Safety and Health Administration (OSHA). NIOSH makes recommendations to OSHA for Health and Safety standards. NIOSH also approves respirators.

4. State governments

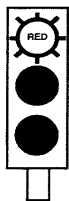
Many individual state governments have their own set of asbestos regulations. These regulations must be at least as strict as the federal regulations.

B. Measurement of Asbestos

Asbestos is measured in fibers per cubic centimeter (f/cc) of air. A cubic centimeter is about the size of a sugar cube. The air is checked for asbestos fibers through air sampling methods.

OSHA sets limits on the amount of asbestos fibers you can be exposed to while you work. There are two limits that you will need to know. They are the Permissible Exposure Limit (**PEL = 0.1 f/cc**), and the Excursion Limit (**EL = 1.0 f/cc**). These limits are found in the OSHA Asbestos Standard.

Permissible Exposure Limit (PEL) = 0.1 f/cc



The **Permissible Exposure Limit** is the number (0.1 f/cc) of fibers in the air over an **8-hour time** weighted average. The PEL is the highest number of fibers in the air (allowed by law) for a worker to be exposed to.

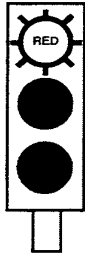
The Permissible Exposure Limit is like a **red light** -it means **stop**. When you are working in an area that reaches the PEL, the OSHA standard states that you must stop until you have:

- Training
- Respirators
- Protective Suits
- Medical exam
- Contained the work area
- Negative air pressure

The OSHA standard states that you must get a medical exam if you wear a negative-pressure respirator or are exposed at or above the PEL for 30 days or more in a year.



Excursion Limit (EL) = 1.0 f/cc



The Excursion Limit is the average number (1.0 f/cc) of fibers in the air over a **30-minute** period of time. It is the highest number of fibers a worker can be exposed to in any **30-minute time period**.

It is like a red light—it means stop. The Excursion Limit protects you from large amounts of asbestos exposure in a short time period.

When you are working in an area that reaches the Excursion Limit the OSHA standard states that you must stop all work and take immediate steps to limit the amount of asbestos dust in the air:

1. Use more amended water.
2. Bag up the asbestos waste more quickly.

C. Respirators

Respirators are used to protect you from breathing asbestos fibers. You need to remember three terms to use the information about respirators. It is important to learn these terms so that you know whether you have the right respirator for your asbestos work. The terms are:

1. **Maximum Use Level (MUL)** = the largest amount of asbestos fibers that a respirator can handle, according to the OSHA law.
2. **Protection Factor (PF)** = the degree of protection a respirator gives you compared to wearing no respirator at all.
3. **Permissible Exposure Limit (PEL)** = the amount of asbestos where respirators become required. **The PEL for asbestos is 0.1 f/cc.**

These three terms combine to give you a **formula** that you can use:



$$\text{Maximum Use Concentration} = \text{Protection Factor} \times \text{Permissible Exposure Limit or } \mathbf{MUC = PF \times PEL}$$

Example on how to use this formula:

A half-mask, air-purifying respirator has a Protection Factor of 10. For every 10 fibers outside the respirator, 1 fiber can leak in. What is the MUL for this respirator?

$$\text{MUC} = \text{PF} \times \text{PEL} \text{ so } \text{MUC} = 10 \times 0.1 \text{ f/cc}$$
$$\mathbf{MUC = 1 \text{ f/cc}}$$

The Maximum Use Concentration is 1 fibers/cc, so:

1. **Below 1 f/cc** in the air, a half-mask, air-purifying respirator is **legal**.
2. **Above 1 f/cc** the respirator is **not allowed**. You need at least a full-face, air-purifying respirator.

D. Classification of Asbestos Work

OSHA classifies asbestos work into one of four categories. Each classification has a specific set of requirements and work practices. The system is based on two factors:

1. what kind of asbestos product you are working with; and
2. the amount of asbestos you may disturb.

The four classes are defined as follows:

Class I asbestos work is when you remove high-risk ACM. High-risk ACM is friable asbestos material. It gets into the air very easily. High-risk ACM is thermal system insulation and sprayed or troweled on surfacing material. Class I work is "full-scale asbestos abatement." It is the most hazardous.

Class II asbestos work is when you remove ACM that is not high-risk. Some examples of Class II materials include wallboard, floor tile and sheeting, ceiling tile, roofing and siding shingles, and construction



mastics. These materials are less friable, or less likely to become friable when removed. There are fewer requirements when working with them. They are less dangerous because less asbestos gets into the air.

Class III asbestos work is repair and maintenance operations where ACM is likely to be disturbed. These operations should involve no more than a single glovebag worth of ACM. These are very small jobs.

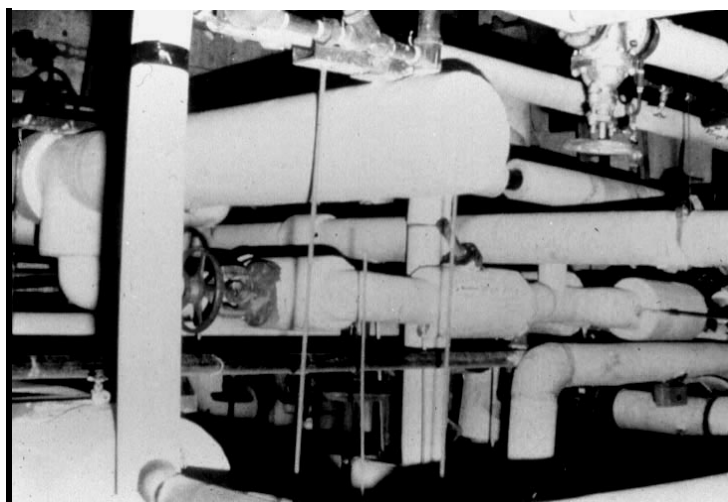
Class IV asbestos work is maintenance and custodial activities in which you come into contact with ACM. Clean up of waste and debris containing ACM is also considered a Class IV operation.

E. Exposure Assessment

Your employer must identify the hazards on the job. Your employer must find out how much asbestos gets into the air while you work. This is called an exposure assessment. An exposure assessment finds out how much asbestos you will be exposed to while you work.

F. Negative Exposure Assessment (NEA)

A negative exposure assessment is when your employer can prove that the asbestos in the air will remain below the PEL and EL. A negative exposure assessment states that you are expected to be exposed to asbestos below the PEL and EL. If the asbestos job has a NEA, then the requirements, procedures, and guidelines for the work may change.



How would you find out if these pipe coverings contain asbestos?



ASBESTOS DISEASES

2

PART 1

In Part 1 you will learn:

About the diseases caused by asbestos.

How asbestos gets into your body.

When asbestos is dangerous.

How much asbestos can make you sick.

How long it takes you to get sick from asbestos.

How your respiratory (breathing) system works.

The connections between asbestos, smoking, and disease.

Asbestos Diseases ...



Pat: One of the waste bags broke. Help me clean up the asbestos that spilled on the floor.

Jesse: OK, let's get our suits and respirators on.

Pat: Don't worry about that. Let's just sweep it up real quick.

Jesse: We shouldn't handle it without some protection. It's dangerous.

Pat: Crossing the street is dangerous, too! Come on. That little bit of asbestos isn't going to hurt you. Let's get it done fast so I can take a cigarette break.





Discussion Questions

(Choose 1 or 2 of the following questions to discuss.)

What would you do if...



1. Do you agree or disagree with the following statements ? Why or why not?

If you only breathe asbestos at levels below the legal limit you cannot get an asbestos disease. **(Yes/No)** _____

Jesse worries too much. **(Yes/No)** _____

Jesse is a better worker than Pat. **(Yes/No)** _____

If you worry about every bit of asbestos, you will never get any work done. **(Yes/No)** _____

Pat is going to get cancer from smoking anyway, so it doesn't matter how careful Pat is with asbestos.
(Yes/No) _____

2. Who would you rather work with, Jesse or Pat?
3. Do you think Jesse decided to help Pat sweep up without a suit and respirator? **Why or why not?**
4. What could Jesse say or do to get Pat to be more careful?

I guess Pat is still on cigarette break.





Breathe

Oxygen lashes
His nostrils
As the black machine
Heaves with the strain.
Stoplight colors flash
As pressure slopes down
Then climbs.

Frail as a dried flower, his steps
Though he only goes to another room.
Mount Everest, he climbs.

A rope of plastic tube
Curves and hangs
As I push this machine
To his chair.

His breath as thick
As stagnant black air.

Breathe my dear father,
Breathe.

Virginia C. Jones

This poem was written about a man who was exposed to asbestos as a seaman in the Navy in World War II. He died of mesothelioma in 1976.



ASBESTOS DISEASES

Asbestos can kill you. When you work with asbestos, you must work carefully. You are in this class to learn how to protect yourself and others from asbestos fibers. Asbestos exposure means breathing or swallowing asbestos fibers. If you are in an area where asbestos is in the air and you are not protected, then you are exposed. **Asbestos exposure can cause:**

- **Asbestosis** - "white lung" – a disease that causes scars on the lungs;
- **Lung cancer** - cancer of the lungs;
- **Mesothelioma** - cancer of the lining of the lungs or of the belly; or
- **Other cancers** - such as cancers of the digestive system.

How do we know that asbestos can make you sick?

We know that asbestos causes asbestosis, mesothelioma, lung cancer, and other cancers because of many studies. One of the most important studies looked at the death certificates of **union insulation workers** who worked with asbestos. All the men had worked with dangerous amounts of asbestos for at least 20 years.

These workers did not know how dangerous their work with asbestos was. **No one told them** that they needed to keep asbestos out of the air. **No one told them** that they had to protect themselves with respirators and disposable suits. **There were no laws** to protect them. **Many of these workers died from asbestos diseases.**

Working with asbestos is a big responsibility

You are in this asbestos class for four days. You will learn that asbestos is dangerous. Asbestos causes diseases that kill. You will learn when asbestos is most dangerous and how to keep the danger level as low as possible. You will learn how to protect yourself and others as you work with asbestos. Use the information from this class. Demand and use the right equipment and protective gear. You can then help reduce the risk of asbestos disease to yourself by up to 90%. (preamble to the OSHA Standards, 29 CFR 1910 and 1926)



When is asbestos dangerous?

Asbestos is dangerous when it is in the air. **When asbestos is in the air, you cannot see it but you breathe it.** Asbestos is dangerous when it gets into your body. Asbestos gets in your body when you breathe or swallow it. Asbestos enters your body through your nose and mouth. Remember that asbestos fibers are so small you can't see them. You cannot see, feel, or taste asbestos. Asbestos will not make you cough or sneeze. It will not make your throat or skin itch. Asbestos does not let you know it is there.

How much asbestos is dangerous?

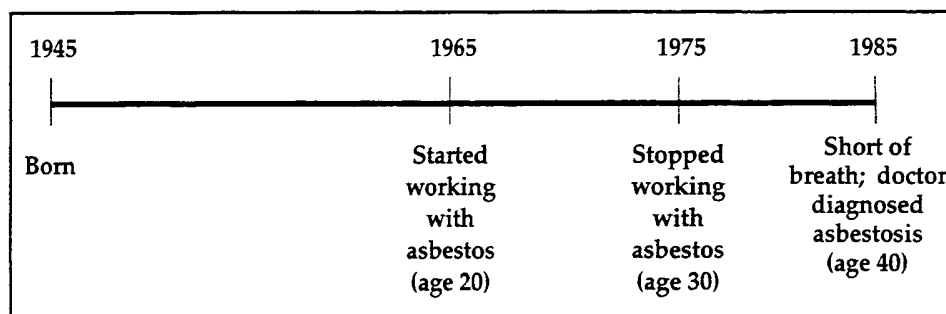
The more asbestos you are exposed to, the more likely you are to get an asbestos-related disease. All of the asbestos diseases except one are **dose-related. Dose-related means the more asbestos you breathe, the more likely you are to get sick. The bigger the dose of asbestos, the more likely you are to get an asbestos-related disease.** You may not get sick until years after you breathe the asbestos.

The more asbestos you breathe, the more likely you are to get asbestosis. The more asbestos you breathe, the more likely you are to get lung cancer. The more asbestos you are exposed to, the more likely you are to get a digestive system cancer. **Asbestosis, lung cancer, and digestive system cancers are dose-related.**

The one asbestos disease that is different is mesothelioma. Very small amounts of asbestos can cause mesothelioma. Asbestos workers' families have gotten mesothelioma from the dust the workers brought home on their clothes. Like other things that cause cancer, **there is no amount of asbestos that has been proven to be safe.**

How long does it take to get sick from asbestos?

All of the asbestos diseases have a **latency period.** The latency period is the gap between the time you are exposed to asbestos and the time you start to feel sick. **The latency period for asbestos diseases is between ten and forty years.** Even if you only worked with asbestos for a year and then stopped, you still might get sick ten to forty years later.



SAMPLE LATENCY PERIOD

If you breathe tear gas, it will make you feel ill right away. It will make your eyes water and throat hurt as soon as you are exposed to it. **If you breathe asbestos, you probably won't even know you are breathing it.** Asbestos does not irritate you while you are being exposed to it. It gives no warning.

You may not feel sick during the latency period of ten to forty years. If you get an asbestos-related disease, you will begin to feel sick **after** the latency period.

Not everyone who is exposed to asbestos gets an asbestos-related disease, but anyone who is exposed to asbestos has a higher risk of getting an asbestos disease. All of the asbestos diseases are difficult to treat. Most are impossible to cure.

Once you get sick, doctors may not be able to stop your disease from getting worse. Except for colon cancer, asbestos diseases - asbestosis, lung cancer, mesothelioma (a cancer) - are very difficult or impossible to treat. The only cure for most asbestos diseases is to prevent them. The best way to avoid getting sick is to not breathe asbestos fibers.



Lung tissue seems to disappear in the x-ray.

When you breathe in asbestos, a few fibers are caught in your throat before they get to your lungs. But many fibers dig into your lungs, and stay there for the rest of your life. It is important to stop these fibers from ever entering your lungs. You can keep many of the fibers out of your lungs by using safer work methods and using personal protection.

They can drain you and your loved ones emotionally and financially for a long time. **The best thing you can do is to prevent them.** When you work safely with asbestos, you help to prevent asbestos related diseases.



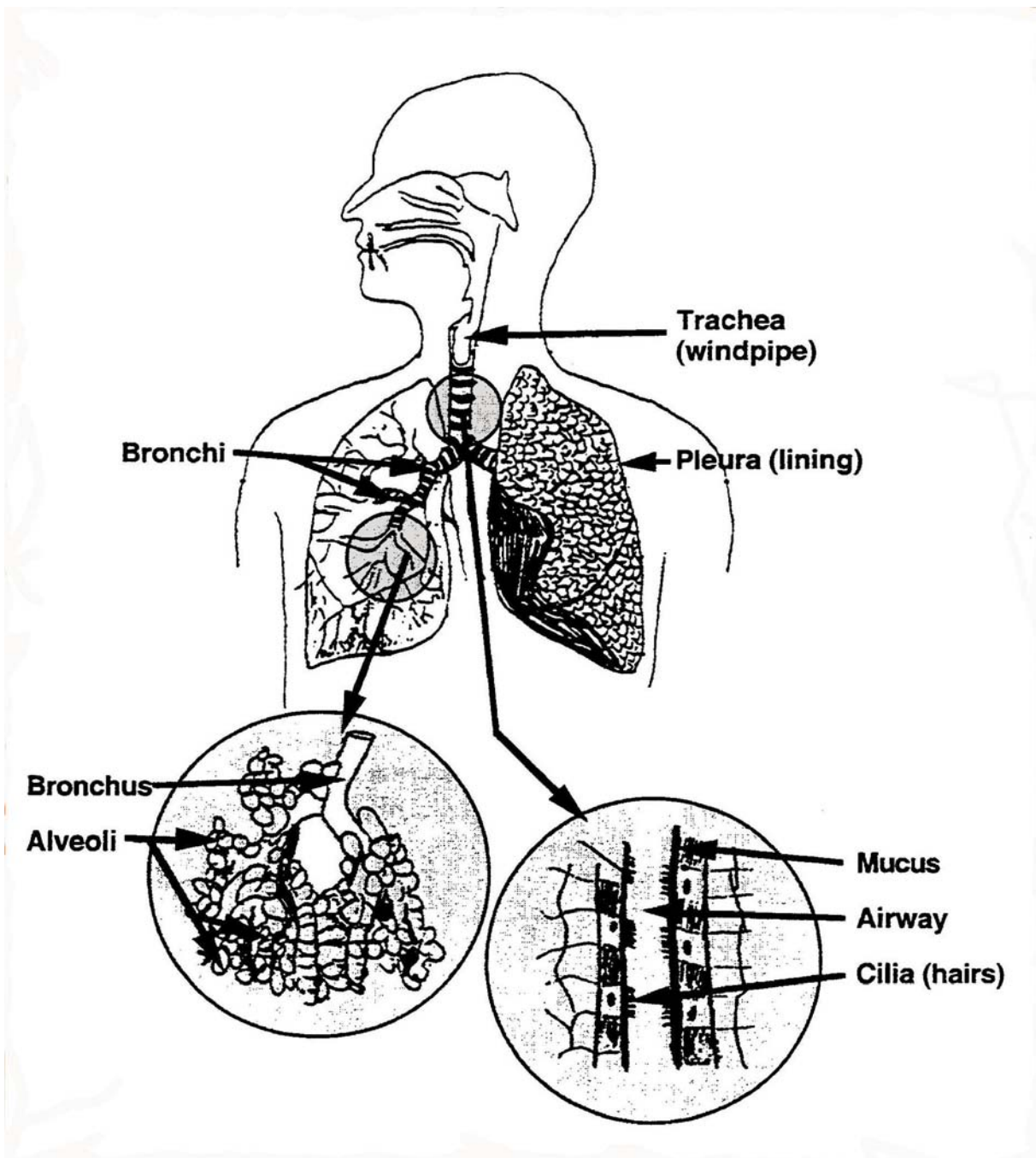
How Your Lungs Work

To understand how asbestos makes you sick, you need to know how your respiratory (breathing) system works.

Your respiratory system brings oxygen (a gas in the air) into your body. You cannot live without oxygen for more than a couple of minutes. When you breathe in, air goes into your lungs. Your lungs are like a giant sponge with a huge surface area for taking in oxygen. **Your lungs take oxygen out of the air into your blood, and get rid of carbon dioxide** (a waste gas in your blood). Then your heart pumps the oxygen-rich blood through your body. Every cell in your body needs the oxygen that comes through your lungs.

Take a deep breath. When you breathe in, air goes through your nose and mouth into your windpipe. The windpipe divides into smaller and smaller tubes and finally ends in tiny sacs called **alveoli (al-VE-o-lie)**. In the alveoli, oxygen from the air goes into your blood, and carbon dioxide from your blood goes through your lungs and out of your body when you breathe out. **The alveoli are like the leaves on a tree. In the alveoli, oxygen passes into the blood and carbon dioxide waste goes out. The walls of your alveoli have to be very thin so that oxygen and carbon dioxide can move through them.** When you breathe, your chest moves in and out. It widens or expands when you breathe in, so that more air can come into your lungs.

When you breathe out your chest narrows or contracts, as your lungs push out the carbon dioxide. **There is a two-layered lining called the pleura. It lines your lungs and your rib cage.** This lining lubricates your chest. It reduces the friction caused by breathing. All of the parts of your respiratory system work together so that you can breathe and live.





Your Body's Defenses Against Asbestos

Your breathing system has some good defenses against breathing in dusts that can hurt you. But the small asbestos fibers can pass through your body's natural defenses and make you sick years later. **Here are some of your body's defenses against asbestos:**

nose - dust gets stuck in hairs and mucus in your nose. **You sneeze to get rid of it.** You can blow out the large asbestos fibers. The smaller fibers travel on to your throat.

throat - smaller dust also gets stuck in hairs and mucus in your throat. **You cough to get rid of it.** The smaller fibers travel down your windpipe.

windpipe - the cells in your windpipe are covered with tiny hairs called **cilia** (SILLY -uh). These tiny hairs quickly beat back and forth. There are other cells in your windpipe that make mucus, a sticky gum-like substance. Some of the asbestos fibers stick to the mucus. The cilia wave back and forth, slowly pushing dust and mucus up your throat. **Then you cough up the mucus and get rid of some of the asbestos fibers. Cigarette smoke paralyzes the cilia. It destroys one of your body's important defenses against asbestos.**

You swallow about a quart of this mucus a day. If the mucus you swallow has asbestos fibers in it, then the fibers lodge in your digestive system. This greatly increases your chance of developing an asbestos-related disease.

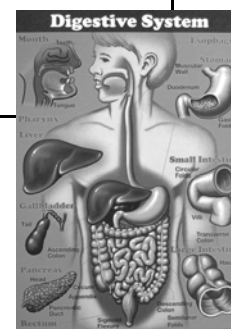
Some of the smaller asbestos fibers travel into the branches of your breathing system. They then lodge in your lungs or the lining of your lungs. They may even enter your blood stream.

white blood cells and scar formation - this part of your immune system **tries to eat up asbestos, just like it would eat up a germ.** But the asbestos fiber kills the white blood cells. The dead cells wrap around the asbestos fiber and your body forms a scar. This scar tissue on your alveoli (air sacs) is called **fibrosis**. The scarring thickens the walls of the alveoli and makes it difficult for oxygen to reach the blood. **This scarring is called asbestosis.**



Diseases Caused by Asbestos

Disease	Signs & Symptoms	Treatment of Symptoms
Asbestosis	Severely short of breath Dry cough Feeling very tired Clubbed fingers	Treatment, but no cure. Stop working with asbestos. Stop smoking Get flu shots. Treat all chest colds quickly with antibiotics.
Lung cancer	Short of breath Constant cough Feeling tired and weak Deep chest pain Cough up blood Weight loss	Surgery, radiation and chemotherapy. 9-13% live for 5+ years Poor cure rate. Smoking multiplies your chances of getting lung cancer. Stop smoking!
Mesothelioma	Pleural Mesothelioma Short of breath Dull chest pain under ribs Swelling in chest Peritoneal Mesothelioma Swollen stomach Belly pain Weight loss	No treatment, some medical procedures for pain reduction. Most people die within 6 months to 2 years after it is discovered. (A few people have died 5 years after their mesothelioma was discovered.)
Digestive system cancer	Change in bowel patterns Blood in bowel movement Feeling tired Weight loss	Surgery, radiation and chemotherapy. Chances of living are good if colon cancer found early. 80% to 90% live for 5+ years.





Asbestosis

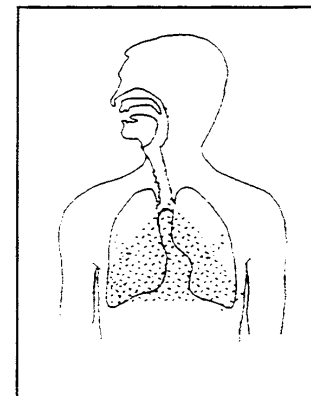
Asbestosis (as-bes- TO-sis) is a scarring of the lungs that can weaken and destroy your lungs ("white lung"). Asbestosis is **not** a cancer. It is a progressive disease. This means that scars keep forming in your lungs even after your exposure to asbestos ends.

Asbestosis is only caused by exposure to asbestos. This is why asbestosis is called a "marker disease." If someone has asbestosis, you know that they have been exposed to asbestos.

When you breathe in asbestos fibers, they go deep into your lungs. Asbestos fibers are thin, sharp and jagged. They dig into your lungs like tiny needles. **Your body forms scars around the fibers.** The scarred lungs cannot get oxygen into your blood any more. The scarred areas of your lungs become useless. You have to breathe more often to get the oxygen you need. You become short of breath.

When you have asbestosis, your heart (your body's pump) has to work much harder to get blood with enough oxygen to all your body cells. Many people with asbestosis die from heart attacks or heart failure because their heart is overworked. Other people with asbestosis die of pneumonia, other infections, and respiratory failure, because asbestosis weakens them.

Asbestosis is dose-related. The more asbestos you breathe, the more likely you are to get asbestosis. The more asbestos you breathe, the more severe the asbestosis will be.



ASBESTOSIS

Asbestos causes cancer. What is cancer?

Several cancers are linked to asbestos exposure. Cancer is a name used for a large group of diseases which affect many different parts of the body.

All cancers are made up of cells which are not normal. These abnormal cancer cells grow rapidly and out of control. They either remain in one area of the body and form a tumor or they spread to other areas of the body.



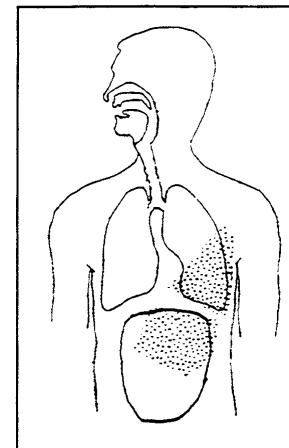
Mesothelioma

Mesothelioma (mes-o-the-lee-O-ma) is a rare but deadly cancer. It is estimated that less than 2% of asbestos worker deaths are caused by mesothelioma. Mesothelioma is a difficult disease to identify or diagnose. It is often not identified and is mislabeled. It is difficult to know how rare this disease really is.

There are two major kinds of mesothelioma. **Pleural mesothelioma** is a cancer that attacks the 2-layered pleural lining of the chest. **Peritoneal mesothelioma** is a cancer that attacks the lining of the stomach or abdomen. Mesothelioma may also be found in the reproductive organs.

Mesothelioma is only caused by asbestos.

It is also considered a "marker disease." Mesothelioma has been directly linked to asbestos exposure in **at least 96%** of the documented cases. There is no cure for mesothelioma. It kills most people 6 months to 2 years after it is detected. There are a few people who have lived more than 5 years after their mesothelioma was discovered.



MESOTHELIOMA

Mesothelioma has the longest latency period of all the asbestos diseases. The latency period for mesothelioma is between 30-40 years. Children are the exception to the long latency period rule. The latency period for a child is much shorter because a child's body grows at a rapid pace.

Mesothelioma is different from other asbestos diseases. **It may only take a very small amount of asbestos to give you mesothelioma.**

Mesothelioma has killed asbestos workers' wives, children, and even pet dogs. This is why you must not take asbestos home with you on your clothes. We say that mesothelioma is **not dose-related** because low levels of asbestos exposure can cause this disease.

There is no amount of asbestos that has been proven to be safe.



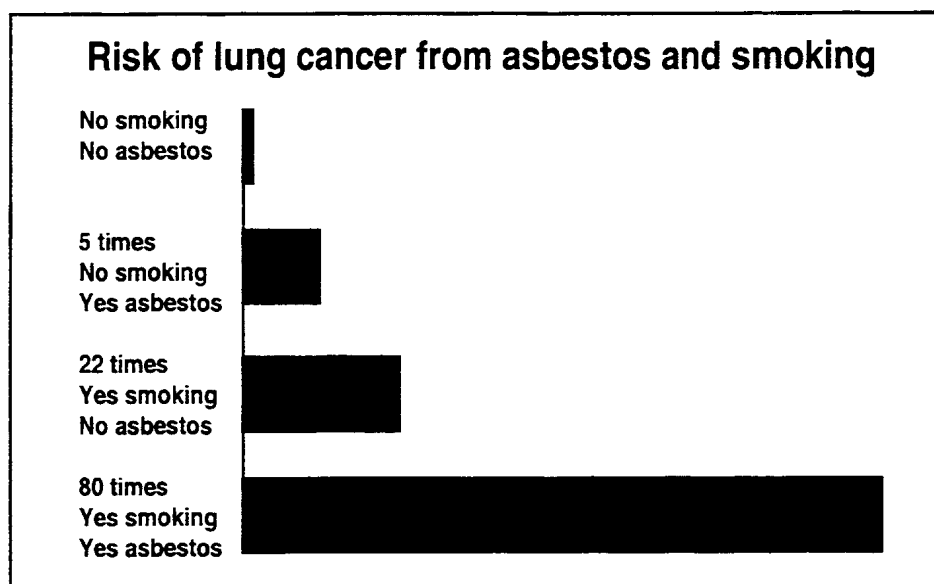
If you are a smoker, get help to quit.

Nicotine addiction and the pleasures of smoking make smoking a very difficult habit to break. How difficult a habit (or addiction) is to break can be measured. It is measured by the percent of relapse. Relapse means that you tried to stop using the substance, but started using it again. Let's say you stopped smoking for 30 days. Then on day 31, you picked up a cigarette and by day 40, you were smoking a pack a day again. You just had a relapse.

About 70% of smokers who quit relapse in the first three months. The rate of relapse is about the same for those who are addicted to heroin and those who have the disease of alcoholism.

There is hope - surveys show that most people who keep trying to quit finally succeed. There are many programs that can help you stop smoking. Your local chapter of the American Lung Association can give you a list of where you can go to get help. Please get help.

In addition to feeling better, breathing easier and smelling better, quitting smoking has many other advantages. Persons who quit smoking before the age of 50 have one-half the risk of dying in the next 15 years compared to continued smokers. **After 10 years of not smoking, the risk of lung cancer is reduced by 30 to 50% compared to continuing smokers.**



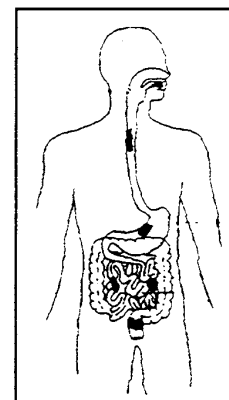


Quitting smoking reduces the risk of many other cancers, including laryngeal, oral, pancreatic, bladder, and cervical cancer. The Surgeon General's report on "The Health Benefits of Smoking Cessation" has over 600 pages of material on the benefits of quitting smoking.

Other Cancers

Many other cancers are more often found in asbestos workers than in people who don't work with asbestos. These cancers include: cancers of the digestive system-that is, cancer in the mouth, the esophagus (the tube from your mouth to your stomach), the stomach, and the lower intestine (colon and rectum), kidneys, pancreas, and reproductive organs.

A doctor may be able to successfully treat colon and rectum cancer **if the doctor finds it early**. Digestive system cancers are **dose - related**.



**DIGESTIVE SYSTEM
CANCER**

Other Diseases

Pleural plaques are found in asbestos workers. They are lesions that grow slowly. They are made of fibrous tissue that can harden. They are found in the lining of the lungs. You may not even know you have pleural plaques until you get an x-ray. If you have these plaques, your risk of lung cancer doubles. You may also develop pleural asbestosis, which is a scarring of the lining of the lungs.

Pleural plaques are not caused by smoking. **Pleural plaques that are found in both the right and left sides of the respiratory system are caused by asbestos exposure and talc exposure only.**

If you protect yourself and keep asbestos out of the air, you lower your odds of getting sick.



Who gets sick from asbestos exposure?

A lot of research has been done to find out who gets sick from asbestos fibers. In June 1990, many new medical study results were presented at the "Third Wave of Asbestos Disease-Asbestos in Place" conference held by Dr. Irving J. Selikoff. Six of those studies are listed on this chart. **School custodians and even school teachers can get asbestos - related diseases.**

Chart Summary of Third Wave Asbestos Studies			
Study	No. in Study	Years on Job	Findings
Wives and children of Union Rubber Asbestos Factory workers, Patterson, NJ by Dr. L. Joubert, American Cancer Society	878	N/A	115 died, cancer rate 2 times higher than expected
NYC Firefighters by Drs. Landrigan and Markowit, Mount Sinai School of Medicine, NY	8,500	20+	15-20% had abnormal X-rays
Sheet Metal Workers (nationwide) by Dr. L. Welch, George Washington Univ. Washington, DC	490	30+ 20 or less	50% had abnormal X-rays 40% had abnormal X-rays
School Maintenance Workers by Dr. H. Anderson, WI Division of Health	457	30	40% had abnormal X-rays
Boston School Custodians by Dr. L. C. Oliver, Harvard Medical School	120	20+	33% had pleural plaques
NYC School Custodians by Dr. S. Levin, Mount Sinai, NY.	660	35+	39% had abnormal X-rays



ASBESTOS DISEASES

Key Facts

Asbestos can kill you or make you sick - unless you protect yourself. Asbestos is silent and deadly. You do not know it is there. You cannot see, hear, feel, taste, smell, or touch the small asbestos fibers that enter your body. When asbestos is in the air, it gets into your body when you breathe and when you swallow.

Asbestos causes four types of disease:

1. Asbestosis, "white lung" - scarring of lungs which makes it hard to breathe.
2. Mesothelioma, the "marker disease" - a cancer of the lining of the lungs or the lining of the belly. It is rare but it always kills. It is not dose-related.
3. Lung Cancer (also caused by smoking) is the biggest killer of all the asbestos diseases. Asbestos workers who smoke are 80 times more likely to get lung cancer than the general public.
4. Other Cancers - cancers of the stomach or colon.

Dose-related

The more asbestos fibers you breathe or swallow, the more likely you are to get sick. This is called a dose relationship. The higher the amount of asbestos, the greater your chances of getting an asbestos disease. Most asbestos-related diseases are dose-related. Mesothelioma is the exception.

Latency period

All of the asbestos diseases have a latency period. The latency period is the time gap between when you take the asbestos into your body and when you become sick. For asbestos diseases, the latency period is between 10 and 40 years long.



Discussion Questions

1. Why is it important to know about the health hazards of asbestos?
2. When is asbestos dangerous?
3. Is there a safe level of asbestos exposure?
4. How do we know that asbestos causes diseases that can kill?



For more information

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Peters, George A., and Barbara J. Peters, Asbestos Disease Update, Garland Publishing, 1989.

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Asbestos Diseases Exercise

This is not a test. It is an exercise. Use it to see for yourself how well you understand the material in the chapter.

1. How do asbestos fibers enter your body?

2. What is a latency period?

3. What does dose-related mean?

4. What are the diseases that asbestos causes?

5. How do asbestos exposure and smoking cigarettes mix?



2

ASBESTOS DISEASES

PART 2: MEDICAL EXAMS

In Part 2 you will learn:

What happens during a medical exam.

Why you need a medical exam.

When to have a medical exam.

About the medical records your employer has keep.

Medical exams



Billy: Do you want to ride with me to the Medical Center to get your asbestos check-up?

Lee: No, I'm not going to get a check-up.

Billy: Why not? You need to get checked to make sure you don't have an asbestos disease.

Lee: I feel fine. Besides, if I am sick, I don't want to know it. I mean, you've got to die from something, right?

Billy: Some cancers can be treated if they find them early enough.

Lee: Yeah. But even if it can be treated, I'd lose my job. I've got a family and a mortgage on the house. What do you think would happen to them if I lost my job?

Billy: What would happen to them if you die?





Discussion Questions

(Choose one or two of the following questions to discuss).

1. Why doesn't Lee want to get a check - up?
2. Do you think Lee would really lose the job if the doctor found an asbestos disease, or is that just an excuse?
3. If Lee doesn't get a check-up and then gets sick later, do you think Lee will be able to get Workers' Compensation?
4. If you were Lee's family, what would you want Lee to do?
5. If you were Lee's employer, what could you do to make Lee less afraid of losing the job?

What would you do if...



MEDICAL EXAMS

If you work with asbestos, you must have a special kind of medical exam called **medical surveillance**. You have to have a medical exam before you start working with asbestos and then **once a year**. The doctor who gives you medical surveillance is a doctor whose specialty is **occupational diseases**. Occupational diseases are caused by your occupation or job. Asbestos causes occupational disease. Medical exams are required by law.

You must have a **baseline** exam before you start to work. The baseline exam documents your health before you do asbestos work. It is the first medical exam that you get with the job. It is a long and complete exam that usually takes 2-3 hours. You may need the records of this exam for legal purposes if you get an asbestos disease.

Each year after that, you will have a medical exam that is shorter than the baseline exam. The doctor looks for any changes in your health since your first exam. With the yearly exam, a disease can be found early. **The earlier an asbestos disease is found, the better your chances for treatment.** Be sure to get these exams. They can save your life. By law, your employer must pay for all of these exams.



When must workers have medical exams?

The OSHA asbestos regulation says your employer must provide medical exams whenever:

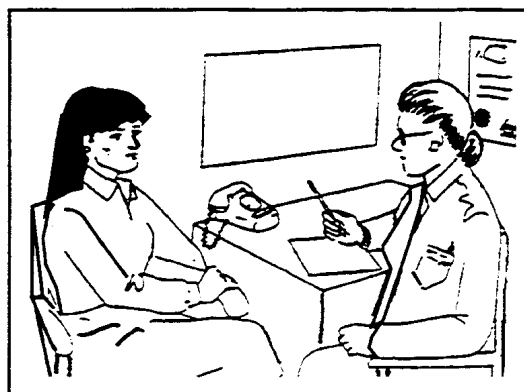
1. **You are issued a negative-pressure respirator.** You will learn about negative-pressure respirators in another section. You must be medically cleared by a doctor before you can wear a respirator. This is to make sure that your heart and lungs can handle the strain of wearing a respirator.
2. **You work on a Class I, II, or III asbestos job below the Permissible Exposure Limit (0.1 f/cc over an 8-hour period) for 30 days or more per year.**
3. **You work on an asbestos job where the amount of asbestos in the air reaches or exceeds the Permissible Exposure Limit or Excursion Limit (1.0 f/cc over a 30 minute period).**

Required Parts of Medical Exams:

1. Work History Questionnaire

The doctor must know if you've ever worked with materials that might have damaged your lungs. These include coal dust, cotton fibers, silica, or asbestos. The questionnaire is a long one - about 9-12 pages. It asks you about your smoking habits and about any lung diseases you have had.

The questionnaire is required by OSHA. **The doctor must use the official questionnaire from Appendix D of the OSHA Asbestos Standard.** The doctor may not use a questionnaire that the employer writes.



DOCTOR TAKING WORK HISTORY



2. General Physical Exam



General Physical Exam

The doctor must give you a physical exam to see if your lungs, heart, and stomach are normal and in good shape. The first physical exam is called a baseline exam. **In your baseline exam, the doctor will document your health and state how healthy you are before you work with asbestos.** It is also to make sure that you don't have any medical problems that asbestos would make worse. After checking your lungs and heart, the doctor will tell you if you can wear a respirator (a mask that protects you from

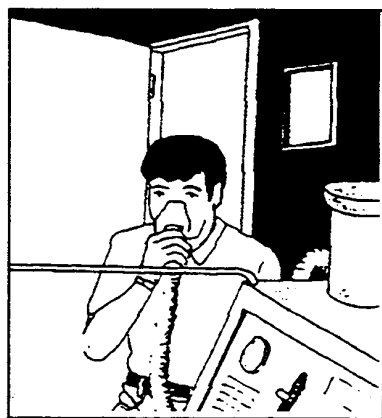
asbestos), and if you can work with asbestos.

You will also need to have a yearly exam. In the yearly exam, the doctor looks for any signs (symptoms) of asbestosis, lung cancer, or other asbestos diseases. For example, the doctor will listen for "rales" or crackling sounds in your lungs, which may be a sign that you have asbestosis.



3. Pulmonary Function Test

A Pulmonary Function Test (PFT) is a special breathing test. A PFT



PULMONARY FUNCTION TEST

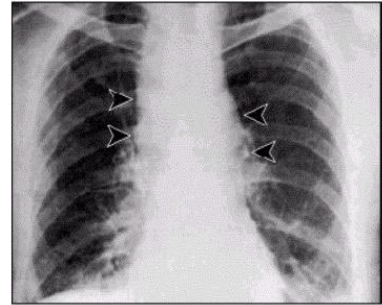
makes sure that your lungs are not damaged before you begin work. It is used as a comparison for later tests. You blow in and out of a tube using your mouth. Your nose is held tight so you cannot breathe from it. All the air that your lungs take in and push out is measured. A meter reads how much air your lungs can hold and how much air you can blow out in one second. This test often gives the first clue that your lungs are being hurt by asbestos. Smokers may also have a poor pulmonary function test result. Your pulmonary function test may also be poor if you have a bad cold.



Recommended Parts of the Medical Exam

1. Chest x-ray

The doctor might take a chest X-ray to make sure that your lungs are not damaged before you begin to work. It is compared to future x-rays to find any changes that take place in your lungs as you work with asbestos over the years. The need for a chest x-ray is your doctor's decision. It is usually a part of the baseline exam.



The x-ray must be checked by a doctor with experience in reading X-rays of work-related lung diseases. Doctors who are trained and certified to read X-rays for asbestos workers are called "**B readers**."

In general, you should have a chest x-ray every 5 years (more often if you're older and/or have worked with asbestos for many years, less often if your doctor says). **You do not need to have a chest x-ray every year.** The table below is a recommended (not required) schedule. Your doctor will determine when you need to have an x-ray.

RECOMMENDED SCHEDULE FOR CHEST X-RAYS			
YEARS SINCE FIRST WORKED WITH ASBESTOS	AGE NOW 18-35	AGE NOW 36-45	AGE NOW OVER 45
0 - TO 10 YRS	EVERY 5 YRS	EVERY 5 YRS	EVERY 5 YRS
MORE THAN 10 YRS	EVERY 5 YRS	EVERY 2 YRS	ONCE A YEAR

2. EKG (electrocardiogram)

The doctor may take an EKG to make sure that your heart is working well. It measures the electrical workings of your heart. If you are 40 years old or over, this test should be included in your exam.

3. Sputum cytology

This is a special test to find abnormal cells that warn of cancer. You cough up some mucus into a cup and it is examined.



4. Hemoccult slide

This test checks for blood in your digestive system by examining your stool for hidden blood.

Why are medical exams required?

Yearly medical exams are the quickest way to tell if asbestos is making you sick. **The exams are for finding asbestos diseases early.** It's important to find these diseases as early as possible.

Medical exams are used as evidence for workers' compensation. Workers' compensation is a no-fault insurance system. You must prove that you got your disease or injury on the job. You will then be financially compensated, to some extent, for your disability. Medical exams also help doctors research asbestos diseases, so they can prevent them in the future.

The first exam shows a baseline - how healthy you were when you started work. **Yearly exams can catch a problem when it first starts.** The yearly exam is a little shorter than the first one. It must include the following:

1. **A short (3-page) questionnaire every year.** This is also an official OSHA questionnaire. It asks about your work experience, smoking habits, and lung diseases over the last year.
2. **A general physical exam** each year, just like the first year.
3. **Pulmonary Function Tests (PFTs)** each year, just like the first year.

Many lives have been saved by these tests. Employers are required by the OSHA law to provide these tests for their workers. The tests are not to punish you for getting sick on the job. They are to keep you from getting sicker if asbestos begins to make you sick. The earlier most asbestos diseases are found, the better your chances for treatment. Medical exams are also very important if you ever have to file for workers' compensation or disability.



Your Medical Exam Results

After these medical exams, the doctor writes a report and gives a copy to your employer. The doctor tells your employer whether you have any medical problems that would make it more dangerous for you to work with asbestos. The doctor writes down any medical limitations on your work. The doctor might say that you have to wear a **powered air-purifying respirator (PAPR)** instead of a negative pressure respirator.

Your employer pays for the doctor. The law requires the employer to inform the doctor of the **required** and recommended tests for the medical exam. A urine test should not be requested. It is not a part of this exam. The employer must also inform the doctor not to report any finding that does not prevent you from working with asbestos. You are the doctor's patient. **By law, the doctor must not tell your employer anything about your health, unless it will keep you from doing asbestos work. Your employer must give you a copy of the doctor's report within 30 days after getting it from the doctor.**



Records

Your employer must keep your medical records for at least 30 years after you leave the job. If your employer goes out of business, your employer has to give your medical records to the person who takes over the business. If the business folds, the records are to be sent to the Director of the National Institute for Occupational Safety and Health (NIOSH). You cannot count on your employer to be in business when you need your medical records.



Even in the best business offices, records can get lost or ruined. The longer the records have to be kept, the more chances that they get lost or misplaced. You have the right to get copies of your medical records from the doctor. You and your family are the people who will care the most about your health. You may need the information from your medical records 20-30 years from now. **YOU SHOULD GET COPIES OF ALL YOUR MEDICAL RECORDS AND KEEP THEM IN A SAFE PLACE.** A safe deposit box is a good place to keep them. Thirty years from now, you may need these records, and they need to be in a place where you can find them.



Beyond Medical Exams

There are some things you can do to lower your risk of getting cancer from working with asbestos:



- 1. Always remember how dangerous asbestos can be.** The law requires your employer to give you the right equipment and protective gear you need to do the work safely. A good abatement job protects you and everyone around. Keep asbestos out of the air. Demand the right equipment. Work safely. Protect yourself with the right respirator and disposable suit.
- 2. Quit smoking.** There are many places you can go for help to quit smoking. Encourage your family, friends, and co-workers to quit smoking.
- 3. Inform any doctor you visit that you have worked with asbestos.** Tell the doctor the year when you started working with asbestos. Tell the doctor how long you worked with it. Asbestos diseases have a latency period of ten to forty years. Tell the doctor about all the diseases that asbestos causes and ask the doctor to look for those diseases.
- 4. Even after you stop working with asbestos, you should have a yearly physical** with a rectal exam. This is even more important if you worked with asbestos ten years ago or more.
- 5. You have the right to know what hazards you are working with** and what hazards and pollutants are in your community. Work with your coworkers, union, and community to lower these hazards.





MEDICAL EXAMS

Key Facts

Asbestos workers must have medical surveillance, a special kind of doctor's check-up:

1. before they start work, and
2. once a year after that.

Medical exams are the quickest way to tell if asbestos is making you sick.

A medical exam includes:

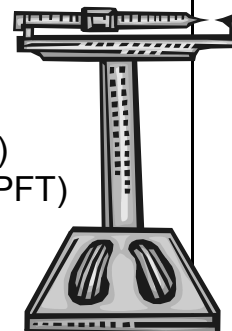
- ✎ First exam
- ✎ Long questionnaire
- ✎ General physical (lungs, heart, stomach)
- ✎ Lung tests (Pulmonary Function Tests (PFT))

Every year

- ✎ Short questionnaire
- ✎ General physical (lungs, heart, stomach)
- ✎ Lung tests (Pulmonary Function Tests (PFT))

Your employer must give you a copy of the doctor's written opinion within 30 days after she or he gets it.

Your employer must keep your medical records for at least 30 years after your last day on the job.





What do you think?



Discussion Questions

1. What good is medical surveillance ?
2. Why is it important to find asbestos diseases early?
3. Why is it important to have an asbestos medical exam before doing any asbestos abatement?
4. When are medical exams required by OSHA ?
5. List the required parts of an asbestos medical exam.
6. What is the baseline exam?
7. How long must the employer keep the medical records?
8. Why keep copies of your medical records?
9. What do I do when I am no longer working with asbestos and do not get yearly medical surveillance?

For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, paragraph (m)(2), "Medical Examinations and Consultations."

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix I, "Medical Surveillance Guidelines."

Stop smoking information:

Call your local chapter of the American Lung Association.

Call your local chapter of the American Cancer Society.

Look in the yellow pages under "Smoking."





LAWS & REGULATIONS

3

In this chapter you will learn about:

Regulations, and how they are enforced.
The difference between federal and state asbestos laws.
The laws that protect you on the job.
The laws that protect the environment on the job.

Laws and Regulations

There are lots of laws and regulations on the books. Laws and regulations give you many rights. They help to protect you and require your employer to protect you. **You can't fight for your rights unless you know what they are.** The law is one tool for a safer and healthier job.

Not everyone follows laws. Think about the speed limit. Lots of people drive above the speed limit and don't get caught. But if you get caught too many times, you can lose your driver's license. If employers are caught violating regulations, they can be fined.

Congress passes **laws**, and EPA and OSHA write and enforce **regulations** or **standards** based on those laws. These regulations tell your employer what specifically has to be done to make the workplace safer. OSHA and EPA can give your employer a fine for breaking their regulations. Regulations are just as strong as laws.

The Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) have regulations that cover asbestos work. EPA enforces regulations which protect the environment. Some of these regulations also protect workers. OSHA enforces regulations which protect workers on the job. OSHA is part of the Department of Labor.



Some states have their own asbestos regulations, which must be followed when you work in those states. State laws must be at least as protective as federal laws.

Environmental Protection Agency

There are a number of EPA asbestos regulations you need to know about. Your teacher must go over these regulations in detail. These notes are only to give you some background to understand the regulations.

Asbestos Hazard Emergency Response Act

In 1987, Congress passed a law that required EPA to develop rules about managing asbestos materials in schools. That law was called the "Asbestos Hazard Emergency Response Act," or **AHERA**.

Under AHERA, schools have to be inspected for asbestos. Schools with asbestos then must develop and follow a special Operations and Maintenance program for managing the asbestos. Anyone who deals with asbestos in schools - workers, supervisors, inspectors, and management planners - must go through special training and get accreditation. As of November, 1992, the "Asbestos School Hazard Abatement Reauthorization Act" (**ASHARA**) extended the training requirement to cover asbestos workers, supervisors, and inspectors in **public and commercial buildings** as well.

How AHERA affects your work:

1. It defines asbestos material as being more than 1% asbestos.
2. It lays out the five control methods: operations and maintenance, enclosure, encapsulation, repair, and removal.
3. It describes clearance air sampling at the end of the job with aggressive air sampling and a Transmission Electron Microscope.
4. It regulates training classes like this one and requires this training for all workers working with asbestos, not just school workers.



Asbestos School Hazard Abatement Act (ASHAA) Public Law 98-377

ASHAA, enacted by Congress in 1984, directed EPA to help schools carry out their asbestos hazard responsibilities. ASHARA required EPA to provide technical assistance to schools on how to identify and abate asbestos health hazards. ASHARA also required EPA to provide funds to state and local agencies. These funds were used for training people involved in asbestos inspections and abatement. They were also used for abating asbestos materials that posed a threat to the health and safety of school children or employees.

Asbestos School Hazard Abatement Reauthorization Act (ASHARA) Public Law 101-637

In 1990, Congress reauthorized ASHAA through ASHARA. In addition to providing more money for school abatement programs, ASHARA also made changes to both AHERA and the EPA's "Model Accreditation Plan."

Under the ASHARA revisions AHERA's training requirements now apply to all persons working with asbestos in public and commercial buildings, not just school buildings. This means that all asbestos inspectors, supervisors, and workers must have EPA-approved AHERA training. Public and commercial buildings are all buildings other than school buildings and apartment buildings with fewer than 10 living units. Single family homes are excluded from this rule.

ASHARA has also increased the number of hours required for asbestos worker and supervisor training to 32 and 40 respectively. The additional eight hours of training provides more hands-on training.

National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 61, Subpart M

The National Emission Standards for Hazardous Air Pollutants is part of the Clean Air Act. NESHAP says that you have to keep asbestos out of the air. There should never be so much asbestos that you can see it in the air. NESHAP is the EPA's law that treats asbestos as a hazardous air pollutant.



How NESHAP affects your work:

1. It defines any job that is at least 160 square feet, 260 linear feet, or 35 cubic feet as a large job.
2. It requires that if the combined work area of a group of small jobs in one facility equals, or exceeds, the measurements for a large job, those jobs must be treated as a large job.
3. It says that **asbestos must be adequately wet** before it can be taken down and when it is sealed in an airtight container.
4. It is illegal to drop asbestos more than 50 feet during demolition or renovation work.
5. Your employer must notify EPA of the job 10 working days before it begins and notify EPA again if the start date changes.
6. **Waste bags must be labeled** with the location of the job. and the name of the waste generator.
7. Buildings must be inspected for asbestos **prior to demolition or renovation work.**

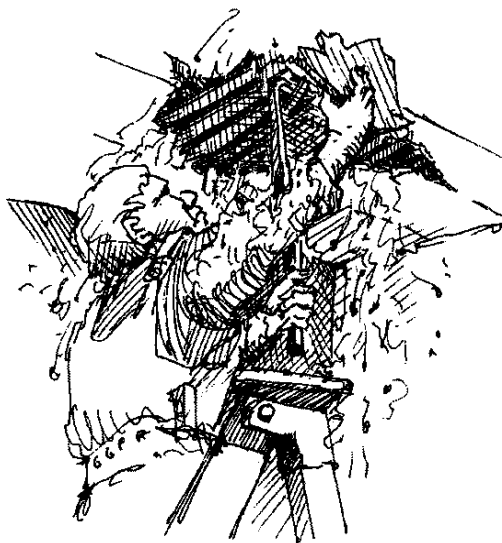
Ban and Phase Out Rule 40 CFR 763.160 to 763.179

Beginning in 1990, the EPA began a 7-year phased ban on 94% of all asbestos products. The ban covered asbestos containing floor tiles, ceiling tiles, brake shoes, clutch facings, and most other uses of asbestos. The Ban was overturned by the 5th U.S. Circuit Court of Appeals. Only products that were discontinued before the overturning of the Ban are still banned and cannot be reintroduced.



Worker Protection Rule 40 CFR 763

Some state and local government workers are not protected by the Occupational Safety and Health Administration's rules. EPA's Worker Protection Rule gives these workers who conduct asbestos abatement the same protection as everyone else.



This is not the way
you remove ceiling
or attic asbestos
insulation.

Occupational Safety and Health Administration

The Occupational Safety and Health Administration (OSHA) has regulations that cover your work. This is the most important thing for you to know: **You have the right to a safe and healthy workplace.** Your employer is required to keep your workplace safe. Only employers can be fined by OSHA. Workers cannot be fined by OSHA.

OSHA has two key regulations that cover the asbestos industry:

- **Construction Industry Asbestos Standard (29 CFR 1926.1101)**
- **Respiratory Standard (29 CFR 1910.134)**



Construction Industry Asbestos Standard 29 CFR 1926.1101

The OSHA Construction Industry Standard has regulations covering asbestos abatement. It covers most of the material in this class. The Standard sets the Permissible Exposure Limit (legal limit) of **0.1 f/cc** of asbestos in air and requires:

- | | |
|--------------------|-------------------------|
| △ work practices | △ air sampling |
| △ protective suits | △ negative air pressure |
| △ medical exams | △ respirators |
| △ record-keeping | △ decons |

See the chart on the next page for more information on your rights under this standard.

The OSHA Respirator Standard 29 CFR 1910.134

The OSHA Respirator Standard covers **everyone who wears a respirator**. It doesn't just cover respirators for asbestos work. This is like a "Worker's Respirator Bill of Rights." Your employer must have a written respirator program.

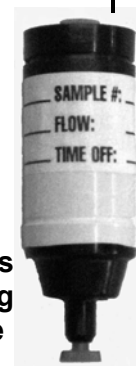
A battery-powered tight-fitting
Powered-air Purifying
Respirator w/HEPA
Filter





Little-known Rights in the OSHA Asbestos Regulations	
Section of 1926.1101	Employee Right:
(f)(1)(iii)	Your employer has to take 30-minute air samples on every shift from a cross-section of workers.
(f)(6)(i)	The employer must allow the workers or their designated representative to observe air sampling.
(h)(2)(ii)	If a doctor says that you may not work with asbestos, your employer has to offer you another job at the same pay, if there is one.
(h)(3)(ii)	You have the right to get a (PAPR) instead of another air-purifying respirator if you ask.
(i)(2)(i)	The employer shall ensure that laundering of contaminated clothing is done to prevent the release of asbestos.
(m)(4)(iii)	The doctor has to write a letter to your employer about the exam. Your employer has to send you a copy within 30 days after getting it.
1910.134 (g)(2)(ii)(B)	You have the right to change your respirator filters every time it gets hard to breathe. (The filters are clogged.)
1910.134 (g)(2)(ii)(4)	You have the right to wash your face and respirator when asbestos or the respirator irritates your face.

Asbestos Sampling Cassette





Other OSHA Rights

Right-to-Know (Hazard Communication Standard)

29 CFR 1910.1200 & 29 CFR 1926.59

OSHA says you have to be trained about the dangers of your work. One danger is chemicals. In this class, we mention methylene chloride (in spray glue) and ammonia (in spray poly). Your employer has to give you training about the chemicals you work with. This is part of the **Right-to-Know law**.

Your employer is also required under this law to make sure all containers holding hazardous substances are properly labeled. There must also be fact sheets about all the chemicals you work with. These fact sheets are called **Material Safety Data Sheets or MSDS**. In required training, you learn how to use the data sheets. MSDSs tell you about how the chemicals can harm your health. They also tell you how to protect yourself from the chemicals.

Non-discrimination

OSHA law says your employer may not fire you for fighting for your health and safety. Your employer may not discipline you or discriminate against you. This is called "11 C" protection. (It comes from section 11(c) of the OSH Act.)

Some people have been fired for fighting for their rights. However, if you win an 11 C case, you can get your job back, get back pay, and your employer can be fined. But 11 C cases often take a long time to settle. Even if you lose your case, you may still be able to get unemployment benefits.

It's important to know your rights and fight for them. It's also important to do your job. It is illegal to fire someone because they are fighting for their rights. It is legal to fire someone because they didn't do their job. If you are fighting for a safer workplace, don't forget to do your job too.

State Laws

Some state laws protect you more than the federal laws. OSHA and EPA regulations do not say exactly how you are supposed to build a work room. They don't tell you how many layers of poly or tape you should use. Many state and even county or city laws do cover these details.



If your state has a law, your instructor will go over the state law in detail. It is important to know the state and local laws. The better you know the laws, the safer you can work.

Most state asbestos laws are licensing laws. Some states make you take a class and pass a test to work with asbestos. Some state laws also cover work practices, waste disposal, and other topics. Many states enforce federal laws for themselves. Your state may have its own OSHA or EPA law.

Many people think that a federal law always overrules a state law. Some people think that a state law always overrules a federal law. This is not true. **The law that holds is the one that protects you more.** Many state asbestos laws protect you more than the federal law.

Many states took the work practices recommended by the EPA and OSHA, and made them required. Many of these state laws are based on the OSHA standard. Many state laws are also based on EPA laws. Some state laws are developed by either the state department of health, department of labor, or environmental protection agency. You will get your license from the agency that is responsible for asbestos licensing in your state.

Excerpt of:

**Colorado Department of Public Health and Environment – Air Pollution Control Division
APPLICATION FOR ASBESTOS ABATEMENT CERTIFICATION**

PART II Type of Certificate Requested

_____ Building Inspector	\$122.50
_____ Management Planner	\$175.00
_____ Worker	\$122.50
_____ Project Designer	\$175.00
_____ Supervisor	\$175.00
_____ Building Inspector/Management Planner	\$175.00
_____ Supervisor/Project Designer	\$175.00

PART III This is an application for a:

- _____ New Certificate (First time applicants)
 _____ Re-certification
 _____ Replacement Identification card/certification
 (\$10.00 fee/1st time, \$25.00 fee/after 1st)

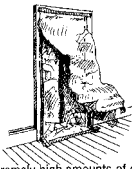
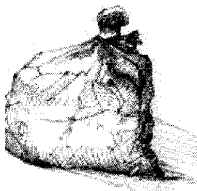
Fee Enclosed \$ _____
 Please make check payable
 to: **Colorado Department of
 Public Health and
 Environment (or CDPHE)**

PART IV Attachments

Attach **originals** of all training certificates. This includes AHERA training certificate and all subsequent AHERA refresher training certificates. Verifiable U.S. Government photo identification required at the time of application. Originals will be returned to you with Colorado certification.



Here are some areas where state laws protect you better than the federal law:

OSHA says ...	Some States say ...
<p>You must wear clothing that covers your whole body. Workers may wear street clothes.</p> <p>Half-mask air-purifying respirators are allowed up to 1.0 f/cc.</p> <p>Provides some direction about how to build a work room for each class of job.</p> <p>Must have plastic flapped doorways in the decon.</p>  <p>Recommends area air samples, but does not require them.</p> <p>Recommends how to clean the work room.</p> <p>Must use sealed, labeled, leakproof containers.</p> 	<p>You must wear a disposable suit.</p> <p>Half-mask air-purifying respirators are only allowed up to 0.1 f/cc.</p> <p>There must be two layers of 4-mil poly on walls. There must be two layers of 6-mil poly on floors.</p> <p>That a 3-foot-long air lock between each decon room is recommended.</p> <p>Must take six area samples per day.</p> <p>Must clean the work room with damp rags, then wait 24 hours. Then clean the work room again with damp rags and HEPA vacs. The workroom must then be inspected by the Department of Labor. The room is clean at .005 f/cc.</p> <p>Bags must have a tag with the asbestos license number and the date the bag was sealed</p>



Solving Problems on the Job

Many employers try to go by the book on an asbestos job. Contract specs are very specific, and the employer can lose money if they aren't followed. But what if you see something done wrong on a job? What if the negative air machine breaks, but your foreman tells you to keep on working? What if you ask for a PAPR instead of a full-face, air-purifying respirator and your boss tells you he's never heard of one? You may see something wrong, and you have to decide whether you're going to do anything about it. What can you do to solve these kinds of problems at work?

Talk to other workers first.

If your company or union has a health and safety committee, go to it first. Talk to other workers. You will get better results if your employer sees that it is a problem for everyone, not just a "personal problem."



Collect Information and Records

When did the problem start? Did anyone try to do anything about it? Talk to the industrial hygienist on the job.

Get copies of your air samples. Get some more information from the people who trained you. Find out what part of the OSHA standard applies. The "For More Information" section at the end of each chapter in the manual lists the sections of the OSHA standards that apply.





Then take the problem to a supervisor.

You may want to go to the contractor right away, but you are much more likely to get results, and keep your job, if you start at the bottom. If you are not satisfied with the supervisor's answer, then take it up the management ladder.



If you go all the way to the top and you still don't think the work is being done right, then you might go outside the company for help.

If you ask OSHA or EPA to inspect the job, you should know what they can and can't do. They will try to come on the job. If the company has broken their rules, they can fine the company or they could shut the job down. Some fines are small. But a contractor can lose his or her asbestos license if fined by EPA or OSHA. You have to be specific and know what you are talking about if you call OSHA or EPA. You must specifically ask for your name to be kept secret if you do not want the company to know you have filed a complaint.

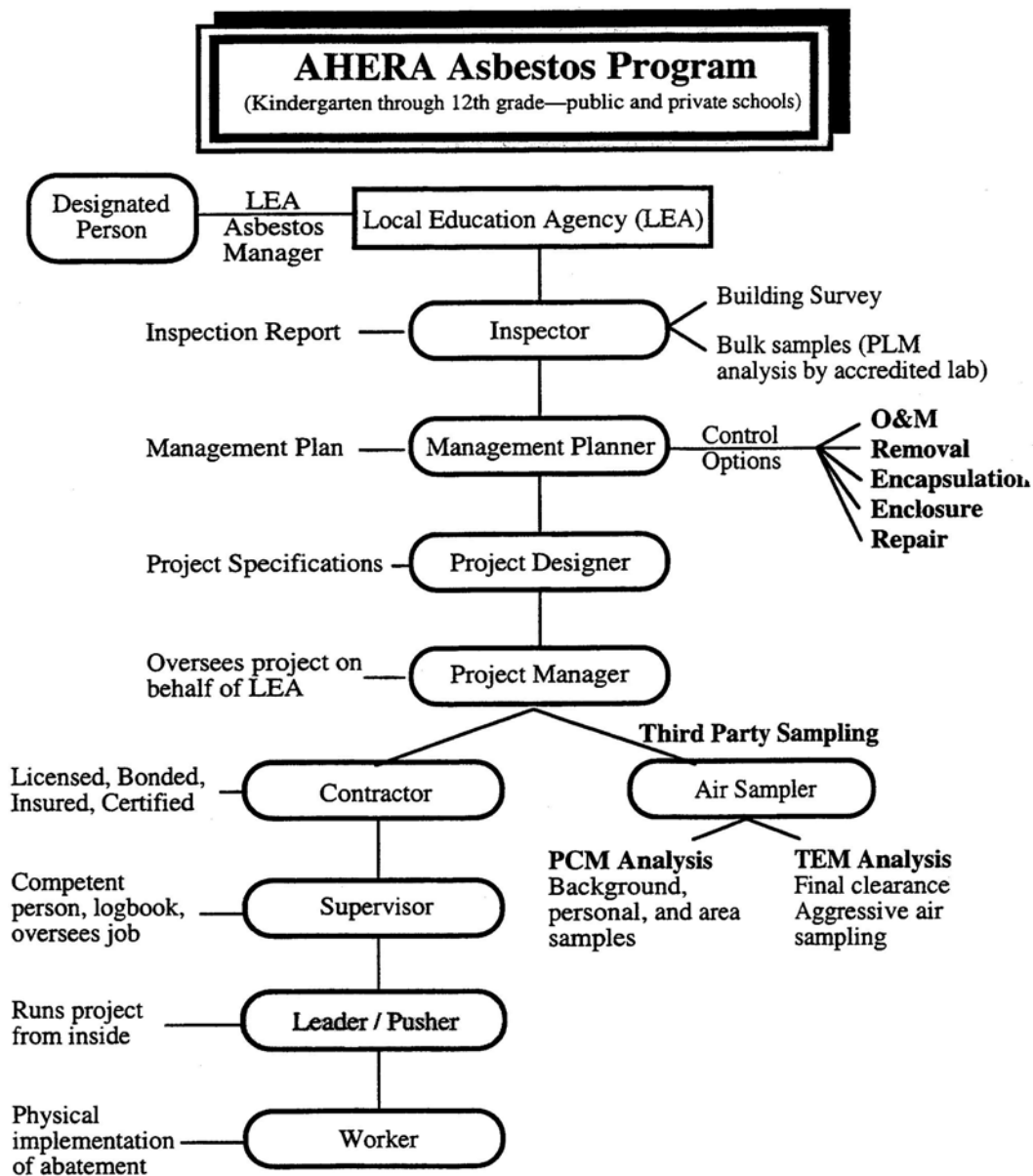
However, jobs are sometimes short. Inspectors can't always get there while the work is still going on. If there is a problem with the job that isn't covered by a regulation, then the agency can't fine the company. For example, heat stress is a big problem on asbestos jobs. OSHA does not have rules about heat. Calling the government is not a quick fix. You may get good results. But if you call the government, it should be one part of an overall strategy.

The number to call to report a life or death situation is **1-800-321-OSHA**. Do not call this joking around. This number is for emergency situations only and is available 24 hours a day. Remember to be specific when you call to report something-know exactly what you want to say. Be patient. Know the specific law being broken, if you can.





EPA Asbestos Hazard Emergency Response Act AHERA





EPA Asbestos Hazard Emergency Response Act AHERA

What is AHERA?

AHERA is a Congressional mandate which President Reagan signed into law in 1986. It addresses the problem asbestos in kindergarten through senior high schools (K - 12). AHERA covers all public and private K - 12 schools. EPA estimates that asbestos was used in nearly 31,000 public schools. EPA implemented AHERA through the EPA Asbestos in Schools rule. We refer to the Asbestos in Schools rule as “AHERA” for simplicity’s sake.

What does AHERA do?

AHERA established **state-of-the-art** management practices for schools with asbestos. **AHERA requires that all school buildings be inspected for asbestos by an accredited inspector.** If the inspector finds asbestos in the school, an **Asbestos Management Plan** must be developed for the building.

The management planner develops the Asbestos Management Plan for the school. The plan outlines where the asbestos is located, the condition of the asbestos, potential for disturbance, and what the school plans to do to minimize asbestos fiber release.

Once the school adopts the management plan, the school should notify all students and/or guardians about the presence of asbestos in the building and how the school plans to handle it. The school will choose an individual – called the **Designated Person** – to be responsible for the school’s asbestos program. The Designated Person is obligated by AHERA law to let the public review the management plan.

Some large corporations have also been following AHERA guidelines. By following AHERA, or exercising due diligence, corporations protect themselves, in part, from future liability.



How can schools control the asbestos?

Under AHERA, schools have five control options to choose from to handle their asbestos issues:

- △ Removal;
- △ Enclosure;
- △ Encapsulation;
- △ Repair; and
- △ Establishing an Operations & Maintenance Program.

All schools which have asbestos in them must be covered by an Operations & Maintenance Program. Following the O&M Plan and training school employees, implementing special cleanup procedures, and using other protective practices covered later in this manual, helps prevent asbestos fibers from getting into the air. Any combination of the options may be used to control the asbestos hazard.

How does the school know if the plan is working?

School building must be inspected by an **accredited asbestos inspector every three years** to check for changes in the condition of asbestos. In addition to the three-year re-inspections, **school staff must conduct a surveillance inspection of contaminated buildings every six months**. If the asbestos is somehow being disturbed, these inspections should catch it before an overexposure happens.

NESHAP (40 CFR Part 61, Subpart M)

EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) was issued under the Clean Air Act of 1970 (Section 112). It has regulations about demolition and renovation of buildings containing asbestos. Major aspects of the law include:

- Notification to EPA of demolition or renovation projects;
- Work practices for asbestos removal, including **no visible emissions to the outside**;
- Waste disposal requirements, including labeling; and
- Inspection prior to demolition or renovation activity.

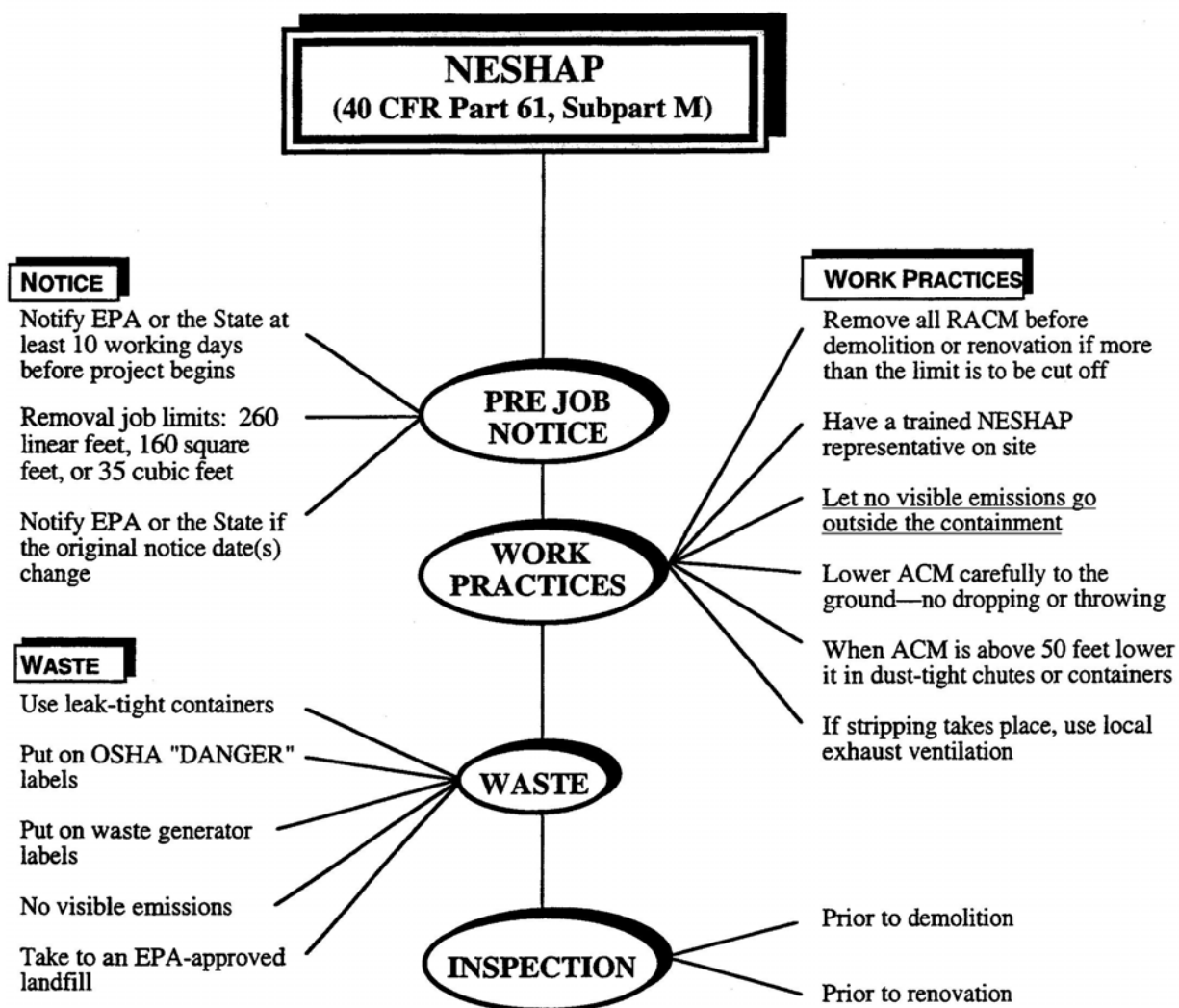


Buildings covered under NESHAP

NESHAP covers all buildings except private homes and apartment buildings with four or less living units. These include:

- Institutional buildings (hospitals, school, etc.);
- Commercial buildings (offices, stores, apartment buildings, etc.); and
- Industrial buildings (factories, warehouses, etc.).

EPA National Emission Standards for Hazardous Air Pollutants – NESHAP Flow Chart





Notification

EPA must be notified before demolition jobs even if there is not asbestos. EPA also needs to be notified before most renovation operations. Notification refers to the notice given to the State Air Pollution Management Agency of which a copy must go to the US EPA Regional Office.

Demolition – More than 160 ft², 260 linear feet, or 35 ft³

When a planned demolition job includes **more than** ...

- 160 ft² of other friable asbestos material, or
- 260 linear feet of friable asbestos pipe insulation, or
- 35 ft³ of friable asbestos material that could not be measured before removal, building owners or contractors must give at least 10 working days notice.

Demolition – Less than 160 ft², 260 linear feet, or 35 ft³

When a planned demolition job includes **less than** ...

- 160 ft² of other friable asbestos material, or
- 260 linear feet of friable asbestos pipe insulation, or
- 35 ft³ of friable asbestos material that could not be measured before removal, building owners or contractors must give at least 10 working days notice.

Renovation – More than 160 ft², 260 linear feet, or 35 ft³

When a planned renovation job includes **more than** ...

- 160 ft² of other friable asbestos material, or
- 260 linear feet of friable asbestos pipe insulation, or
- 35 ft³ of friable asbestos material that could not be measured before removal, building owners or contractors must give at least 10 working days notice.

Emergency Renovation

An emergency renovation which results from a sudden, unexpected event



must be reported as soon as possible, but not more than the following working day after the emergency renovation.

Renovation – Less than 160 ft², 260 linear feet, or 35 ft³

No notification is required.

Planned Renovations

When a number of individually non-scheduled operations are planned which total an amount includes **more than ...**

- 160 ft² of other friable asbestos material, or
- 260 linear feet of friable asbestos pipe insulation, or
- 35 ft³ of friable asbestos material that could not be measured before removal, building owners or contractors must give at least 10 working days notice.

Revisions to Notice

If the planned start date changes after the notice is given, re-notify according to the following schedule:

- **If the new start date is later**, then call in the new date and follow-up with a notice in writing. This action must be done as soon as possible and no later than the original start date.
- **If the new start date is earlier**, then give notice in writing at least 10 days before any work begins.

No work shall start on a date earlier than the date in the written notice or revised written notice.

Removal Before Demolition or Renovation

All RACM must be removed before demolition or renovation of a building if the amount of RACM is greater than 160 ft², 260 linear feet, or 35 ft³.

Trained Representative on Site

There must be a representative on site who is trained in:



- NESHAP regulations;
- Notice requirements;
- Material identification procedures; and
- Control practices for removal including:
 - wetting
 - negative pressure enclosures
 - waste disposal practices
 - asbestos hazards
 - local exhaust ventilation
 - glovebag procedures
 - HEPA filters
 - reporting/recordkeeping
 - worker protection

Exemptions from Removal Requirements

Regulated ACM does not need to be removed before demolition if it is:

- Category I non-friable ACM (such as packing, gaskets, asphalt roofing, and vinyl floor tile) that is in good condition.
- On a component that is packed in concrete (or other similar material) as long as it is adequately wet whenever exposed during demolition.
- Not accessible for testing or was not discovered before demolition, and cannot be safely removed. the exposed material and any asbestos contaminated debris must be treated as ACM waste until final disposal.
- Category II non-friable ACM that is unlikely to become crumbled, pulverized, or reduced to powder during demolition.

Work Practices

NESHAP requires that **there be no visible emissions to the outside air** during removal. Measures must be taken to lessen asbestos emissions during removal including:

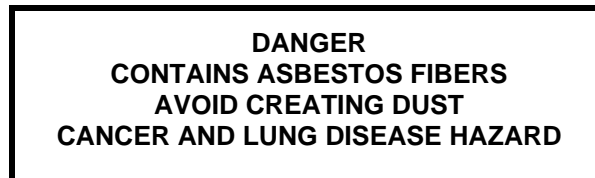
- Adequately wet ACM to ensure that it remains wet during all stages of removal until it is bagged;
- Wetted ACM should be carefully lowered to ground level without dropping or throwing the material. ACM removed from 50 feet above ground level must be transported by dust-tight chutes or container;
- If stripping takes place, local exhaust ventilation must be used; and



- Stripping is not required if the component to be removed:
 - is large (like a reactor vessel, large tank, or steam generator, **not including beams**);
 - can be removed, transported, stored, and reused without damaging the asbestos; and
 - is encased in a properly labeled, leak-tight wrapping during all loading and unloading operations and during storage.

Waste Disposal

All asbestos-containing waste must be sealed in leak-tight containers while wet, including waste bags (minimum 6-mil thick). Bags or containers must be labeled:



All asbestos-containing waste material must be disposed in EPA-approved waste disposal sites. EPA requires that there be **no visible emissions during transport or disposal** of the material at the waste site.

NESHAP Definitions

Adequately Wet: sufficiently mix or penetrate with liquid to prevent the release of particles. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet.

Category I Non-friable Asbestos-containing Material (ACM): asbestos-containing gaskets, resilient floor covering, and asphalt roofing products **containing more than one percent** of asbestos as determined by using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, **Polarized Light Microscopy**.



Category II Non-friable ACM: any material, excluding Category I non-friable ACM containing more than one percent asbestos determined by polarized light microscopy (PLM), that when dry cannot be crumbled, pulverized, or reduced to a powder by pressure.

Demolition: the wrecking or taking out of any load-supporting structural member of a facility together with any relating handling operations or the intentional burning of any facility.

Emergency Renovation Operation: a renovation operation that was not planned but results from a sudden, unexpected event that, if not immediately attended to, presents a safety or public health hazard, is necessary to protect equipment from damage, or is necessary to avoid imposing an unreasonable financial burden. This term includes operations necessitated by non-routine failures of equipment.

Facility Component: any part of a facility including equipment.

Friable Asbestos Material: any material containing **more than one per cent asbestos** as determined by using the method specified in Appendix A ... that, when dry, can be reduced to a powder by hand pressure. If the asbestos content is less than 10 per cent as determined by a method other than point counting **polarized light microscopy (PLM)**, verify the asbestos content by point counting using PLM.

Leak-tight: solids or liquids cannot escape or spill out. It also means **dust-tight**.

Non-friable ACM: any material that contains **more than one percent asbestos** as determined by using the method specified in Appendix A ... **that when dry cannot be crumbled, pulverized, or reduced to a powder by hand pressure.**

Non-scheduled Renovation Operation: a renovation operation necessitated by the routine failure of equipment, which is expected to occur within a given period based on past operating experiences, but for which an exact date cannot be predicted.



Planned Renovation Operation: a renovation operation, or a number of such operations, in which some RACM will be removed or stripped within a given period of time and that can be predicted. Individual non-scheduled operations are included if a number of such operations can be predicted to occur during a given period of time based on operating experience.

Regulated Asbestos Containing Material (RACM):

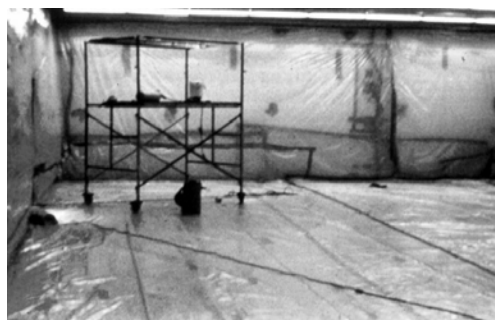
(a) Friable asbestos material, (b) Category I non-friable ACM that will or has been subjected to sanding, grinding, cutting, or abrading, or (c) Category II non-friable ACM that has a high probability of becoming or has become crumbled or pulverized or reduced to a powder by the forces expected to act on the material in the course of demolition or renovation operations regulated by this subpart.

Renovation: altering a facility or one or more facility components in any way, including the stripping or removal of RACM from a facility component. Operations in which load supporting structural members are wrecked or taken out are demolitions.

Visible Emissions: any emissions, which are visually detectable without the aid of instruments, coming from RACM or asbestos-containing waste material, or from any asbestos milling, manufacturing, or fabricating operation. This does not include condensed water vapor.

Waste Generator: any owner or operator of a source covered by this subpart whose act or process produces asbestos-containing waste material.

Working Day: Monday through Friday and includes holidays that fall on any of the days Monday through Friday.



Ceiling renovation requiring poly covered walls and floor.



EPA Ban and Phase Out Rule Fact Sheet

The U.S. Environmental Protection Agency has the authority to prohibit or limit the making and distributing of harmful products (Toxic Substance Control Act – TSCA). To do this, EPA must first prove that a product is in fact dangerous. Then, the Agency must devise the “least burdensome” plan to ban or limit the use of such products.

Presenting the Case

Asbestos causes cancer. There is a lot of data that traces the harmful effects of asbestos on the human body. EPA, in order to prevent future risks to human and environmental health, decided to ban and phase out most uses of asbestos.

On July 12, 1989, EPA came up with a 7-year “Ban and Phase Out” plan to eliminate 94% of all asbestos products still being processed, manufactured, or distributed. This three-stage ban plan would take seven years to complete.

Challenge and Verdict

Several businesses involved in the asbestos industry, as well as the governments of Quebec and Canada, joined together to try to overturn the Asbestos Ban and Phase Out Rule. They brought their case to the 5th U.S. Circuit Court of Appeals in New Orleans, Louisiana.

On October 19, 1991, the Court overturned most of the Ban and Phase Out Rule. It ruled that EPA did not allow proper input in to the decision-making process. Additionally, the Court ruled that a “ban and phase out” of asbestos process was not the “least burdensome” solution EPA could have used.

EPA seeks clarification

EPA asked for a more specific ruling, which the court handed down on November 5, 1991. The court ruled that asbestos products which were off the market when the ban was overturned would remain banned.

Building owners and contractors who are aware of the effects of asbestos and the legal liability of asbestos products will probably not continue to use asbestos because of the Court’s actions.



Asbestos Material Safety Data Sheet

MSDSs can be life savers. They contain information about the chemicals in products with which you work, and the hazards they can cause. Manufacturers are supposed to provide MSDSs to companies when they sell their products.

According to **29 CFR 1926.59 (and 1910.1200)**, an MSDS must contain at least the following completed information sections:

- I. Product Identity;
- II. Hazardous Ingredients;
- III. Physical/Chemical Data;
- IV. Fire and Explosion Hazard Data;
- V. Reactivity Data;
- VI. Health Hazard Data;
- VII. Precautions for Safe Handling and Use; and
- VIII. Control Measures.

On the next page is a standard MSDS. This sheet is for "Asbest-O- Magic Fireproofing." On the job there will also be MSDSs for spray glue, mastic removal solvents, and any other chemicals that can be hazardous to workers.

There are many hazards on project sites in addition to asbestos. Knowing about them can help you work more safely.

If you or a coworker get injured by a chemical at work, take the MSDS with you to the hospital. It will help the doctor figure out the best treatment. It can save valuable time - even a life!



MATERIAL SAFETY DATA SHEET (MSDS)

Material Safety Data Sheet (MSDS)
May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200. Standard must be
consulted for specific requirements.
las normas para obtener los requisitos específicos

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB Num. 1218-0072

IDENTITY (As Used on Label and List)

Asbest-o-Magic Fireproofing

Note: Blank spaces are not permitted. If any item is not applicable, or no

Information is available, the space must be marked to indicate that

Section I

Manufacturers Name Asbesto-Tech, Inc.	Emergency Telephone Number 1-800-555-1212
Address (Number, Street, City, State and ZIP Code) 123 Main St. ,	Telephone Number for Information 1-212-555-1212
Fair Promise, NY 11202	Date prepared: 1/2003
	Signature of preparer (optional): <i>Don Ellenberger, MPH, CIH</i>

Section II - Hazardous Ingredients/identity Information

Hazardous Components (Specific Chemical Identity Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% optional;
Asbestos (chrysotile);	0.1 f/cc	1 f/cc	NIOSH REL	100%
"white asbestos"	8-hr TWA	8-hr TWA	0.1 f/cc	
			8-hr TWA	
	OSHA EL			
	1.0 f/cc			
	30-min TWA			

Section III- Physical/Chemical Characteristics

Boiling Point	Doesn't boil at room temp.	2,300° F	Specific Gravity (H ₂ O=1)	Sinks in Water	5
Vapor Pressure(mm Hg)	Doesn't evaporate at rm temp.	NA	Melting Point		2,300° F
Vapor Density (air=1)	Travels in air currents	1	Evaporation Rate (Butyl Acetate ; 1)		NA
Solubility in Water: Totally insoluble.					
Appearance and Odor: Fine, slender flaxy fibers. No odor					

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Does not burn (TBT)	Flammable Limits	Does not burn	LEL	NA	UEL	NA
Extinguishing Media: NA							
Special Fire Fighting Procedures: Firefighters must thoroughly wet material to prevent contamination.							
Unusual Fire and Explosion Hazards: NA							



Section V – Reactivity Data

Solubility	<u>Unstable</u> Stable	Conditions to avoid	<u>None</u>
Incompatibility (materials to avoid)	<u>None</u>		
Hazardous Decomposition or By-products	<u>None</u>		
Hazardous Polymerization	<u>May Occur</u> Will Not Occur	Conditions to Avoid	<u>None</u> <u>X</u>

Section VI – Health Hazard Data

Route(s) of Entry:	Inhalation? <u>Primary</u>	Skin? <u>No</u>	Ingestion: <u>Secondary</u>
Health Hazards (<i>Acute and Chronic</i>) <u>Acute: eye irritation. Chronic: Asbestos causes asbestosis (a progressive fibrotic lung disease), lung cancer, mesothelioma (a cancer of connective tissue) and digestive system cancers. It is suspected of causing kidney damage.</u>			
Carcinogenicity:	NTP? <u>Yes</u>	ACR Monograph? <u>Yes</u>	OSHA Regulated? <u>Yes</u>
Signs and Symptoms of Exposure	<u>Symptoms appear 10 to 40 years after first exposure: short of breath, change in cough, dull pain in chest, change in bowel patterns</u>		
Medical Conditions Generally Aggravated by Exposure	<u>Any lung or heart disease – asthma, bronchitis, pneumonia, emphysema, fibrosis</u>		
Emergency and First Aid Procedures	<u>Wash eye with clean running water for 15 minutes</u>		

Section VII – Precautions for Safe Handling

Steps to Be Taken in Case Material is Released or Spilled	<u>Wet material immediately to keep its fibers out of the air. Shut down and seal off air handling units. Keep unauthorized workers out. Post OSHA warning signs.</u>
Waste Disposal Method	<u>Dispose of waste while wet. Seal in air-tight, water-tight, impermeable containers of at least 6-mil thickness. Label.</u>
Precautions to be Taken in Handling and Storage	<u>Prevent fibers from becoming airborne. Wet, enclose, or ventilate when pouring materials from dry bags. Inspect containers for tears.</u>
Other Precautions	<u>Always apply materials wet. Do not spray apply.</u>

Section VIII – Control Measures

Respiratory Protection (<i>Specify type</i>)	<u>10-100 f/cc-PD, as 0.1-1.0 f/cc half mask AP, 1-5 f/cc FFAP; 5-10 f/cc PAPR or CF</u>		
Ventilation	<u>Local Exhaust</u> Special	<u>Required on all Power Tools</u> Keep work area under negative air pressure 24hrs a day	<u>Mechanical</u> <u>Negative Air Machine</u>
Protective Gloves	<u>Wear latex gloves because material accumulates under nails</u>		
Eye Protection	<u>Wear OSHA-accepted safety goggles because material gets in the eyes</u>		
Other Protective Clothing or Equipment	<u>Wear full body protective clothing, hood, and boots</u>		
Work/hygienic Practices	<u>Keep asbestos out of the air. Don't drop or throw. Bag waste as soon as possible. Remove waste in whole pieces. Wet material before handling.</u>		



How to Read an OSHA Regulation (Standard)

All OSHA standards are composed of paragraphs. These paragraphs begin with small letters (a), (b), (c), and etc. The construction industry asbestos standard, 29 CFR 1926.1101, contains paragraphs (a) through (q). For example:

(c) Permissible exposure limits (PELS)

Sub-sections to the paragraphs begin with regular (Arabic) numbers (1), (2), (3), and etc. For example:

- (c) Permissible exposure limits (PELS)
 - (1) **Time - weighted average limit (TWA) ...**
 - (2) **Excursion limit....**

Sub-sections of the numbered sub-sections begin with lower case Roman numerals (I), (ii), (iii), (iv), and etc. For example:

- (h) Respiratory Protection...
 - (1) General...
 - (2) Respirator Selection ...
 - (i) **Where respirators are used, the employer shall select and provide....**

When the Roman numeral sub-sections have sub-sections, they begin with capital letters (A), (B), (C), and etc. For example:

- (h) Respiratory Protection
 - (1) ...
 - (2) ...
 - (i) ...
 - (ii) ...
 - (iii) **(A) the employer shall provide a tight-fitting powered air-purifying respirator in lieu of any negative-pressure respirator specified in Table 1**



OSHA Construction Industry Asbestos Standard

29 CFR 1926.1101

(a)	Scope and Application	page 75
(b)	Definitions	page 75
(c)	Permissible Exposure Limits	page 79
(d)	Multi-employer Worksites	page 79
(e)	Regulated Areas	page 80
(f)	Exposure Assessments & Monitoring	page 81
(g)	Methods of Compliance	page 84
(h)	Respiratory Protection	page 99
(i)	Protective Clothing	page 101
(j)	Hygiene Facilities and Practices	page 102
(k)	Communication of Hazards	page 104
(l)	Housekeeping	page 112
(m)	Medical Surveillance	page 113
(n)	Recordkeeping	page 116
(o)	Competent Person	page 118
(p)	Appendices	page 120
(q)	Dates	page 121



1926.1101(a) Scope and Application.

This section regulates asbestos exposure in all work as defined in 29 CFR 1910.12(b), including but not limited to the following:

1926.1101(a)(1)

Demolition or salvage of structures where asbestos is present;

1926.1101(a)(2)

Removal or encapsulation of materials containing asbestos;

1926.1101(a)(3)

Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos;

1926.1101(a)(4)

Installation of products containing asbestos;

1926.1101(a)(5)

Asbestos spill/emergency cleanup; and

1926.1101(a)(6)

Transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

1926.1101(a)(7)

Coverage under this standard shall be based on the nature of the work operation involving asbestos exposure.

1926.1101(a)(8)

This section does not apply to asbestos-containing asphalt roof coatings, cements and mastics.

1926.1101(b) Definitions.

"Aggressive method" means removal or disturbance of building material by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact ACM.

"Amended water" means water to which surfactant (wetting agent) has been added to increase the ability of the liquid to penetrate ACM.

"Asbestos" includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that has been chemically treated and/or altered. For purposes of this standard, "asbestos" includes PACM, as defined below.

"Asbestos-containing material (ACM)", means any material containing more than one percent asbestos.

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

"Authorized person" means any person authorized by the employer and required by work duties to be present in regulated areas. "Building/facility owner" is the legal entity, including a lessee, which exercises



control over management and record keeping functions relating to a building and/or facility in which activities covered by this standard take place.

"Certified Industrial Hygienist (CIH)" means one certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.

"Class I asbestos work" means activities involving the removal of TSI and surfacing ACM and PACM.

"Class II asbestos work" means activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.

"Class III asbestos work" means repair and maintenance operations, where "ACM", including TSI and surfacing ACM and PACM, is likely to be disturbed.

"Class IV asbestos work" means maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste and debris resulting from Class I, II, and III activities.

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

"Closely resemble" means that the major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

"Competent person" means, in addition to the definition in **29 CFR 1926.32 (f)**, one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in **29 CFR 1926.32(f)**: in addition, for Class I and Class II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (**40 CFR 763**) for supervisor, or its equivalent and, for Class III and Class IV work, who is trained in a manner consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at **40 CFR 763.92 (a)(2)**.

"Critical barrier" means one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.

"Decontamination area" means an enclosed area adjacent and connected to the regulated area and consisting of an equipment room,



shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

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

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

"Disturbance" means activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount which can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which shall not exceed 60 inches in length and width.

"Employee exposure" means that exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.

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

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

"Glovebag" means not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

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

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

"Industrial hygienist" means a professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards.

"Intact" means that the ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

"Modification for purposes of paragraph (g)(6)(ii)" means a changed or altered procedure, material or component of a control system, which



replaces a procedure, material or component of a required system. Omitting a procedure or component, or reducing or diminishing the stringency or strength of a material or component of the control system is not a "modification" for purposes of paragraph (g)(6) of this section.

"Negative Initial Exposure Assessment" means a demonstration by the employer, which complies with the criteria in paragraph (f)(2)(iii) of this section, that employee exposure during an operation is expected to be consistently below the PELs.

"PACM" means "presumed asbestos containing material".

"Presumed Asbestos Containing Material" means thermal system insulation and surfacing material found in buildings constructed no later than 1980. The designation of a material as "PACM" may be rebutted pursuant to paragraph (k)(5) of this section.

"Project Designer" means a person who has successfully completed the training requirements for an abatement project designer established by 40 U.S.C. Sec. 763.90(g).

"Regulated area" means an area established by the employer to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit. Requirements for regulated areas are set out in paragraph (e) of this section.

"Removal" means all operations where ACM and/or PACM is taken out or stripped from structures or substrates, and includes demolition operations.

"Renovation" means the modifying of any existing structure, or portion thereof.

"Repair" means overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

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

"Surfacing ACM" means surfacing material which contains more than 1% asbestos.

"Thermal system insulation (TSI)" means ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain.

"Thermal system insulation ACM" is thermal system insulation which contains more than 1% asbestos.

**1926.1101(c) Permissible Exposure Limits (PELS)****1926.1101(c)(1) Time-weighted Average Limit (TWA).**

The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an eight (8) hour time-weighted average (TWA), as determined by the method prescribed in Appendix A to this section, or by an equivalent method.

1926.1101(c)(2) Excursion limit.

The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty (30) minutes, as determined by the method prescribed in Appendix A to this section, or by an equivalent method.

1926.1101(d) Multi-employer Worksites.**1926.1101(d)(1)**

On multi-employer worksites, an employer performing work requiring the establishment of a regulated area shall inform other employers on the site of the nature of the employer's work with asbestos and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other employers are not exposed to asbestos.

1926.1101(d)(2)

Asbestos hazards at a multi-employer work site shall be abated by the contractor who created or controls the source of asbestos contamination. For example, if there is a significant breach of an enclosure containing Class I work, the employer responsible for erecting the enclosure shall repair the breach immediately.

1926.1101(d)(3)

In addition, all employers of employees exposed to asbestos hazards shall comply with applicable protective provisions to protect their employees. For example, if employees working immediately adjacent to a Class I asbestos job are exposed to asbestos due to the inadequate containment of such job, their employer shall either remove the employees from the area until the enclosure breach is repaired; or perform an initial exposure assessment pursuant to (f) of this section.

1926.1101(d)(4)

All employers of employees working adjacent to regulated areas established by another employer on a multi-employer work-site, shall take steps on a daily basis to ascertain the integrity of the enclosure and/or the effectiveness of the control method relied on by the primary asbestos contractor to assure that asbestos fibers do not migrate to such adjacent areas.

**1926.1101(d)(5)**

All general contractors on a construction project which includes work covered by this standard shall be deemed to exercise general supervisory authority over the work covered by this standard, even though the general contractor is not qualified to serve as the asbestos "competent person" as defined by paragraph **(b)** of this section. As supervisor of the entire project, the general contractor shall ascertain whether the asbestos contractor is in compliance with this standard, and shall require such contractor to come into compliance with this standard when necessary.

1926.1101(e) Regulated Areas.**1926.1101(e)(1)**

All Class I, II and III asbestos work shall be conducted within regulated areas. All other operations covered by this standard shall be conducted within a regulated area where airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed a PEL. Regulated areas shall comply with the requirements of paragraphs **(2)**, **(3)**, **(4)**, and **(5)** of this section.

1926.1101(e)(2) Demarcation.

The regulated area shall be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they may demarcate the regulated area. Signs shall be provided and displayed pursuant to the requirements of paragraph **(k)(7)** of this section.

1926.1101(e)(3) Access.

Access to regulated areas shall be limited to authorized persons and to persons authorized by the Act or regulations issued pursuant thereto.

1926.1101(e)(4) Respirators.

All persons entering a regulated area where employees are required pursuant to paragraph **(h)(1)** of this section to wear respirators shall be supplied with a respirator selected in accordance with paragraph **(h)(2)** of this section.

1926.1101(e)(5) Prohibited activities.

The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated area.

1926.1101(e)(6) Competent Persons.

The employer shall ensure that all asbestos work performed within regulated areas is supervised by a competent person, as defined in paragraph **(b)** of this section. The duties of the competent person are set out in paragraph **(o)** of this section.



1926.1101(f) Exposure Assessments and Monitoring.

1926.1101(f)(1) General Monitoring Criteria.

1926.1101(f)(1)(i)

Each employer who has a workplace or work operation where exposure monitoring is required under this section shall perform monitoring to determine accurately the airborne concentrations of asbestos to which employees may be exposed.

1926.1101(f)(1)(ii)

Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee.

1926.1101(f)(1)(iii)

Representative 8-hour TWA employee exposure shall be determined on the basis of one or more samples representing full-shift exposure for employees in each work area. Representative 30-minute short-term employee exposures shall be determined on the basis of one or more samples representing 30 minute exposures associated with operations that are most likely to produce exposures above the excursion limit for employees in each work area.

1926.1101(f)(2) Initial Exposure Assessment.

1926.1101(f)(2)(i)

Each employer who has a workplace or work operation covered by this standard shall ensure that a "competent person" conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with requirements which are triggered by exposure data or the lack of a "negative exposure assessment," and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly.

1926.1101(f)(2)(ii) Basis of Initial Exposure Assessment:

Unless a negative exposure assessment has been made pursuant to paragraph (f)(2)(iii) of this section, the initial exposure assessment shall, if feasible, be based on monitoring conducted pursuant to paragraph (f)(1)(iii) of this section. The assessment shall take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the employer which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of the PELs, or otherwise makes a negative exposure assessment



pursuant to paragraph **(f)(2)(iii)** of this section, the employer shall presume that employees are exposed in excess of the TWA and excursion limit.

1926.1101(f)(2)(iii) Negative Exposure Assessment:

For any one specific asbestos job which will be performed by employees who have been trained in compliance with the standard, the employer may demonstrate that employee exposures will be below the PELs by data which conform to the following criteria;

1926.1101(f)(2)(iii)(A)

Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the TWA and excursion limit under those work conditions having the greatest potential for releasing asbestos; or

1926.1101(f)(2)(iii)(B)

Where the employer has monitored prior asbestos jobs for the PEL and the excursion limit within 12 months of the current or projected job, the monitoring and analysis were performed in compliance with the asbestos standard in effect; and the data were obtained during work operations conducted under workplace conditions "closely resembling" the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job, and these data show that under the conditions prevailing and which will prevail in the current workplace there is a high degree of certainty that employee exposures will not exceed the TWA and excursion limit; or

1926.1101(f)(2)(iii)(C)

The results of initial exposure monitoring of the current job made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee covering operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

1926.1101(f)(3) Periodic Monitoring.

1926.1101(f)(3)(i) Class I and II operations.

The employer shall conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing Class I or II work, unless the employer pursuant to **(f)(2)(iii)** of this section, has made a negative exposure assessment for the entire operation.

1926.1101(f)(3)(ii) All operations under the standard other than Class I and II operations.



The employer shall conduct periodic monitoring of all work where exposures are expected to exceed a PEL, at intervals sufficient to document the validity of the exposure prediction.

1926.1101(f)(3)(iii) Exception:

When all employees required to be monitored daily are equipped with supplied-air respirators operated in the pressure demand mode, or other positive pressure mode respirator, the employer may dispense with the daily monitoring required by this paragraph. However, employees performing Class I work using a control method which is not listed in paragraph (g)(4)(i), (ii), or (iii) of this section or using a modification of a listed control method, shall continue to be monitored daily even if they are equipped with supplied-air respirators.

1926.1101(f)(4) Termination of Monitoring.

1926.1101(f)(4)(i)

If the periodic monitoring required by paragraph (f)(3) of this section reveals that employee exposures, as indicated by statistically reliable measurements, are below the permissible exposure limit and excursion limit the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

1926.1101(f)(4)(ii) Additional Monitoring.

Notwithstanding the provisions of paragraph (f)(2) and (3), and (f)(4) of this section, the employer shall institute the exposure monitoring required under paragraph (f)(3) of this section whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the permissible exposure limit and/or excursion limit or when the employer has any reason to suspect that a change may result in new or additional exposures above the permissible exposure limit and/or excursion limit. Such additional monitoring is required regardless of whether a "negative exposure assessment" was previously produced for a specific job.

1926.1101(f)(5) Employee Notification of Monitoring Results.

1926.1101(f)(5)(i)

The employer shall notify affected employees of the monitoring results that represent that employee's exposure as soon as possible following receipt of monitoring results.

1926.1101(f)(5)(ii)

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



1926.1101(f)(6) Observation of Monitoring.

1926.1101(f)(6)(i)

The employer shall provide affected employees and their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos conducted in accordance with this section.

1926.1101(f)(6)(ii)

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

1926.1101(g) Methods of Compliance.

1926.1101(g)(1) Engineering controls and work practices for all operations covered by this section.

The employer shall use the following engineering controls and work practices in all operations covered by this section, regardless of the levels of exposure:

1926.1101(g)(1)(i)

Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM and PACM, except as provided in paragraph **(g)(8)(ii)** of this section in the case of roofing material.

1926.1101(g)(1)(ii)

Wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where employers demonstrate that the use of wet methods is infeasible due to for example, the creation of electrical hazards, equipment malfunction, and, in roofing, except as provide in paragraph **(g)(8)(ii)** of this section; and

1926.1101(g)(1)(iii)

Prompt clean-up and disposal of wastes and debris contaminated with asbestos in leak-tight containers except in roofing operations, where the procedures specified in paragraph **(g)(8)(ii)** of this section apply.

1926.1101(g)(2)

In addition to the requirements of paragraph **(g)(1)** of this section, the employer shall use the following control methods to achieve compliance with the TWA permissible exposure limit and excursion limit prescribed by paragraph **(c)** of this section;

1926.1101(g)(2)(i)

Local exhaust ventilation equipped with HEPA filter dust collection systems;

1926.1101(g)(2)(ii)

Enclosure or isolation of processes producing asbestos dust;

**1926.1101(g)(2)(iii)**

Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;

1926.1101(g)(2)(iv)

Use of other work practices and engineering controls that the Assistant Secretary can show to be feasible.

1926.1101(g)(2)(v)

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

1926.1101(g)(3) Prohibitions.

The following work practices and engineering controls shall not be used for work related to asbestos or for work which disturbs ACM or PACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:

1926.1101(g)(3)(i)

High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.

1926.1101(g)(3)(ii)

Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

1926.1101(g)(3)(iii)

Dry sweeping, shoveling or other dry clean-up of dust and debris containing ACM and PACM.

1926.1101(g)(3)(iv)

Employee rotation as a means of reducing employee exposure to asbestos.

1926.1101(g)(4) Class I Requirements.

In addition to the provisions of paragraphs (g)(1) and (2) of this section, the following engineering controls and work practices and procedures shall be used.

1926.1101(g)(4)(i)

All Class I work, including the installation and operation of the control system shall be supervised by a competent person as defined in paragraph (b) of this section;



1926.1101(g)(4)(ii)

For all Class I jobs involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs, where the employer cannot produce a negative exposure assessment pursuant to paragraph (f)(2)(iii) of this section, or where employees are working in areas adjacent to the regulated area, while the Class I work is being performed, the employer shall use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area:

1926.1101(g)(4)(ii)(A)

Critical barriers shall be placed over all the openings to the regulated area, except where activities are performed outdoors; or

1926.1101(g)(4)(ii)(B)

The employer shall use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area surveillance during each work shift at each boundary of the regulated area, showing no visible asbestos dust; and perimeter area monitoring showing that clearance levels contained in **40 CFR Part 763, Subpt. E**, of the EPA Asbestos in Schools Rule are met, or that perimeter area levels, measured by Phase Contrast Microscopy (PCM) are no more than background levels representing the same area before the asbestos work began. The results of such monitoring shall be made known to the employer no later than 24 hours from the end of the work shift represented by such monitoring. Exception: For work completed outdoors where employees are not working in areas adjacent to the regulated areas, this paragraph (g)(4)(ii) is satisfied when the specific control methods in paragraph (g)(5) of this section are used.

1926.1101(g)(4)(iii)

For all Class I jobs, HVAC systems shall be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent;

1926.1101(g)(4)(iv)

For all Class I jobs, impermeable dropcloths shall be placed on surfaces beneath all removal activity;

1926.1101(g)(4)(v)

For all Class I jobs, all objects within the regulated area shall be covered with impermeable dropcloths or plastic sheeting which is secured by duct tape or an equivalent.

1926.1101(g)(4)(vi)

For all Class I jobs where the employer cannot produce a negative exposure assessment, or where exposure monitoring shows that a PEL is exceeded, the employer shall ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a



HEPA filtration or collection device.

1926.1101(g)(5) Specific Control Methods for Class I Work.

In addition, Class I asbestos work shall be performed using one or more of the following control methods pursuant to the limitations stated below:

1926.1101(g)(5)(i)

Negative Pressure Enclosure (NPE) systems: NPE systems may be used where the configuration of the work area does not make the erection of the enclosure infeasible, with the following specifications and work practices.

1926.1101(g)(5)(i)(A) Specifications:

1926.1101(g)(5)(i)(A)(1)

The negative pressure enclosure (NPE) may be of any configuration,

1926.1101(g)(5)(i)(A)(2)

At least 4 air changes per hour shall be maintained in the NPE,

1926.1101(g)(5)(i)(A)(3)

A minimum of -0.02 column inches of water pressure differential, relative to outside pressure, shall be maintained within the NPE as evidenced by manometric measurements,

1926.1101(g)(5)(i)(A)(4)

The NPE shall be kept under negative pressure throughout the period of its use, and

1926.1101(g)(5)(i)(A)(5)

Air movement shall be directed away from employees performing asbestos work within the enclosure, and toward a HEPA filtration or a collection device.

1926.1101(g)(5)(i)(B) Work Practices:

1926.1101(g)(5)(i)(B)(1)

Before beginning work within the enclosure and at the beginning of each shift, the NPE shall be inspected for breaches and smoke-tested for leaks, and any leaks sealed.

1926.1101(g)(5)(i)(B)(2)

Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters.

1926.1101(g)(5)(ii)

Glove bag systems may be used to remove PACM and/or ACM from straight runs of piping and elbows and other connections with the following specifications and work practices:

1926.1101(g)(5)(ii)(A) Specifications:

1926.1101(g)(5)(ii)(A)(1)

Glovebags shall be made of 6 mil thick plastic and shall be seamless at the bottom.



1926.1101(g)(5)(ii)(A)(2)

Glovebags used on elbows and other connections must be designed for that purpose and used without modifications.

1926.1101(g)(5)(ii)(B) Work Practices:

1926.1101(g)(5)(ii)(B)(1)

Each glovebag shall be installed so that it completely covers the circumference of pipe or other structure where the work is to be done.

1926.1101(g)(5)(ii)(B)(2)

Glovebags shall be smoke-tested for leaks and any leaks sealed prior to use.

1926.1101(g)(5)(ii)(B)(3)

Glovebags may be used only once and may not be moved.

1926.1101(g)(5)(ii)(B)(4)

Glovebags shall not be used on surfaces whose temperature exceeds 150 deg. F.

1926.1101(g)(5)(ii)(B)(5)

Prior to disposal, glovebags shall be collapsed by removing air within them using a HEPA vacuum.

1926.1101(g)(5)(ii)(B)(6)

Before beginning the operation, loose and friable material adjacent to the glovebag/box operation shall be wrapped and sealed in two layers of six mil plastic or otherwise rendered intact,

1926.1101(g)(5)(ii)(B)(7)

Where system uses attached waste bag, such bag shall be connected to collection bag using hose or other material which shall withstand pressure of ACM waste and water without losing its integrity:

1926.1101(g)(5)(ii)(B)(8)

Sliding valve or other device shall separate waste bag from hose to ensure no exposure when waste bag is disconnected:

1926.1101(g)(5)(ii)(B)(9)

At least two persons shall perform Class I glovebag removal operations.

1926.1101(g)(5)(iii) Negative Pressure Glove Bag Systems.

Negative pressure glove bag systems may be used to remove ACM or PACM from piping.

1926.1101(g)(5)(iii)(A) Specifications:

In addition to specifications for glove bag systems above, negative pressure glove bag systems shall attach HEPA vacuum systems or other devices to bag to prevent collapse during removal.

1926.1101(g)(5)(iii)(B) Work Practices:

1926.1101(g)(5)(iii)(B)(1)

The employer shall comply with the work practices for glove bag systems in paragraph (g)(5)(ii)(B)(4) of this section.

**1926.1101(g)(5)(iii)(B)(2)**

The HEPA vacuum cleaner or other device used to prevent collapse of bag during removal shall run continually during the operation until it is completed at which time the bag shall be collapsed prior to removal of the bag from the pipe.

1926.1101(g)(5)(iii)(B)(3)

Where a separate waste bag is used along with a collection bag and discarded after one use, the collection bag may be reused if rinsed clean with amended water before reuse.

1926.1101(g)(5)(iv) Negative Pressure Glove Box Systems:

Negative pressure glove boxes may be used to remove ACM or PACM from pipe runs with the following specifications and work practices.

1926.1101(g)(5)(iv)(A) Specifications:**1926.1101(g)(5)(iv)(A)(1)**

Glove boxes shall be constructed with rigid sides and made from metal or other material which can withstand the weight of the ACM and PACM and water used during removal:

1926.1101(g)(5)(iv)(A)(2)

A negative pressure generator shall be used to create negative pressure in the system:

1926.1101(g)(5)(iv)(A)(3)

An air filtration unit shall be attached to the box:

1926.1101(g)(5)(iv)(A)(4)

The box shall be fitted with gloved apertures:

1926.1101(g)(5)(iv)(A)(5)

An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water:

1926.1101(g)(5)(iv)(A)(6)

A back-up generator shall be present on site:

1926.1101(g)(5)(iv)(A)(7)

Waste bags shall consist of 6 mil thick plastic double-bagged before they are filled or plastic thicker than 6 mil.

1926.1101(g)(5)(iv)(B) Work Practices:**1926.1101(g)(5)(iv)(B)(1)**

At least two persons shall perform the removal:

1926.1101(g)(5)(iv)(B)(2)

The box shall be smoke-tested for leaks and any leaks sealed prior to each use:

1926.1101(g)(5)(iv)(B)(3)

Loose or damaged ACM adjacent to the box shall be wrapped and sealed in two layers of 6 mil plastic prior to the job, or otherwise made intact prior to the job.



1926.1101(g)(5)(iv)(B)(4)

A HEPA filtration system shall be used to maintain pressure barrier in box.

1926.1101(g)(5)(v) Water Spray Process System.

A water spray process system may be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. The system shall meet the following specifications and shall be performed by employees using the following work practices.

1926.1101(g)(5)(v)(A) Specifications:

1926.1101(g)(5)(v)(A)(1)

Piping shall be surrounded on 3 sides by rigid framing,

1926.1101(g)(5)(v)(A)(2)

A 360 degree water spray, delivered through nozzles supplied by a high pressure separate water line, shall be formed around the piping.

1926.1101(g)(5)(v)(A)(3)

The spray shall collide to form a fine aerosol which provides a liquid barrier between workers and the ACM and PACM.

1926.1101(g)(5)(v)(B) Work Practices:

1926.1101(g)(5)(v)(B)(1)

The system shall be run for at least 10 minutes before removal begins.

1926.1101(g)(5)(v)(B)(2)

All removal shall take place within the water barrier.

1926.1101(g)(5)(v)(B)(3)

The system shall be operated by at least three persons, one of whom shall not perform removal, but shall check equipment, and ensure proper operation of the system.

1926.1101(g)(5)(v)(B)(4)

After removal, the ACM and PACM shall be bagged while still inside the water barrier.

1926.1101(g)(5)(vi)

A small walk-in enclosure which accommodates no more than two persons (mini-enclosure) may be used if the disturbance or removal can be completely contained by the enclosure with the following specifications and work practices.

1926.1101(g)(5)(vi)(A) Specifications:

1926.1101(g)(5)(vi)(A)(1)

The fabricated or job-made enclosure shall be constructed of 6 mil plastic or equivalent:

1926.1101(g)(5)(vi)(A)(2)

The enclosure shall be placed under negative pressure by means of a HEPA filtered vacuum or similar ventilation unit:



1926.1101(g)(5)(vi) Work Practices:

1926.1101(g)(5)(vi)(B)(1)

Before use, the mini-enclosure shall be inspected for leaks and smoke-tested to detect breaches, and breaches sealed.

1926.1101(g)(5)(vi)(B)(2)

Before reuse, the interior shall be completely washed with amended water and HEPA-vacuumed.

1926.1101(g)(5)(vi)(B)(3)

During use, air movement shall be directed away from the employee's breathing zone within the mini-enclosure.

1926.1101(g)(6) Alternative Control Methods for Class I Work.

Class I work may be performed using a control method which is not referenced in paragraph (g)(5) of this section, or which modifies a control method referenced in paragraph (g)(5) of this section, if the following provisions are complied with:

1926.1101(g)(6)(i)

The control method shall enclose, contain or isolate the processes or source of airborne asbestos dust, or otherwise capture or redirect such dust before it enters the breathing zone of employees.

1926.1101(g)(6)(ii)

A certified industrial hygienist or licensed professional engineer who is also qualified as a project designer as defined in paragraph (b) of this section, shall evaluate the work area, the projected work practices and the engineering controls and shall certify in writing that the planned control method is adequate to reduce direct and indirect employee exposure to below the PELs under worst-case conditions of use, and that the planned control method will prevent asbestos contamination outside the regulated area, as measured by clearance sampling which meets the requirements of EPA's Asbestos in Schools rule issued under AHERA, or perimeter monitoring which meets the criteria in paragraph (g)(4)(ii)(B) of this section.

1926.1101(g)(6)(ii)(A)

Where the TSI or surfacing material to be removed is 25 linear or 10 square feet or less the evaluation required in paragraph (g)(6) of this section may be performed by a "competent person", and may omit consideration of perimeter or clearance monitoring otherwise required.

1926.1101(g)(6)(ii)(B)

The evaluation of employee exposure required in paragraph (g)(6) of this section, shall include and be based on sampling and analytical data representing employee exposure during the use of such method under worst-case conditions and by employees whose training and experience are equivalent to employees who are to perform the current job.



1926.1101(g)(6)(iii)

Before work which involves the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material is begun using an alternative method which has been the subject of a paragraph **(g)(6)** of this section required evaluation and certification, the employer shall send a copy of such evaluation and certification to the national office of **OSHA, Office of Technical Support, Room N3653, 200 Constitution Avenue, NW, Washington, DC 20210**. The submission shall not constitute approval by OSHA.

1926.1101(g)(7) Work Practices and Engineering Controls for Class II Work.

1926.1101(g)(7)(i)

All Class II work shall be supervised by a competent person as defined in paragraph **(b)** of this section.

1926.1101(g)(7)(ii)

For all indoor Class II jobs, where the employer has not produced a negative exposure assessment pursuant to paragraph **(f)(2)(iii)** of this section, or where during the job, changed conditions indicate there may be exposure above the PEL or where the employer does not remove the ACM in a substantially intact state, the employer shall use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area;

1926.1101(g)(7)(ii)(A)

Critical barriers shall be placed over all openings to the regulated area; or,

1926.1101(g)(7)(ii)(B)

The employer shall use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area monitoring or clearance monitoring which meets the criteria set out in paragraph **(g)(4)(ii)(B)** of this section.

1926.1101(g)(7)(ii)(C)

Impermeable drop cloths shall be placed on surfaces beneath all removal activity;

1926.1101(g)(7)(iii) [Reserved]

1926.1101(g)(7)(iv)

All Class II asbestos work shall be performed using the work practices and requirements set out above in paragraph **(g)(1)(i)** through **(g)(1)(iii)** of this section.

1926.1101(g)(8) Additional Controls for Class II Work.

Class II asbestos work shall also be performed by complying with the work practices and controls designated for each type of asbestos work to be performed, set out in this paragraph. Where more than one control method may be used for a type of asbestos work, the employer may choose one or a combination of designated control methods. Class II



work also may be performed using a method allowed for Class I work, except that glove bags and glove boxes are allowed if they fully enclose the Class II material to be removed.

1926.1101(g)(8)(i)

For removing vinyl and asphalt flooring materials which contain ACM or for which in buildings constructed no later than 1980, the employer has not verified the absence of ACM pursuant to paragraph **(g)(8)(i)(I)** of this section. The employer shall ensure that employees comply with the following work practices and that employees are trained in these practices pursuant to paragraph **(k)(9)** of this section:

1926.1101(g)(8)(i)(A)

Flooring or its backing shall not be sanded.

1926.1101(g)(8)(i)(B)

Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) shall be used to clean floors.

1926.1101(g)(8)(i)(C)

Resilient sheeting shall be removed by cutting with wetting of the snip point and wetting during de-lamination. Rip-up of resilient sheet floor material is prohibited.

1926.1101(g)(8)(i)(D)

All scraping of residual adhesive and/or backing shall be performed using wet methods.

1926.1101(g)(8)(i)(E)

Dry sweeping is prohibited.

1926.1101(g)(8)(i)(F)

Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirements of paragraph **(g)(5)(i)** of this section.

1926.1101(g)(8)(i)(G)

Tiles shall be removed intact, unless the employer demonstrates that intact removal is not possible.

1926.1101(g)(8)(i)(H)

When tiles are heated and can be removed intact, wetting may be omitted.

1926.1101(g)(8)(i)(I)

Resilient flooring material including associated mastic and backing shall be assumed to be asbestos-containing unless an industrial hygienist determines that it is asbestos-free using recognized analytical techniques.

1926.1101(g)(8)(ii)

For removing roofing material which contains ACM the employer shall ensure that the following work practices are followed:

**1926.1101(g)(8)(ii)(A)**

Roofing material shall be removed in an intact state to the extent feasible.

1926.1101(g)(8)(ii)(B)

Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards.

1926.1101(g)(8)(ii)(C)

Cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.

1926.1101(g)(8)(ii)(D)

When removing built-up roofs with asbestos-containing roofing felts and an aggregate surface using a power roof cutter, all dust resulting from the cutting operation shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. When removing built-up roofs with asbestos-containing roofing felts and a smooth surface using a power roof cutter, the dust resulting from the cutting operation shall be collected either by a HEPA dust collector or HEPA vacuuming along the cut line, or by gently sweeping and then carefully and completely wiping up the still-wet dust and debris left along the cut line.

1926.1101(g)(8)(ii)(E)

Asbestos-containing material that has been removed from a roof shall not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist:

1926.1101(g)(8)(ii)(E)(1)

Any ACM that is not intact shall be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift.

While the material remains on the roof it shall either be kept wet, placed in an impermeable waste bag, or wrapped in plastic sheeting.

1926.1101(g)(8)(ii)(E)(2)

Intact ACM shall be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift.

1926.1101(g)(8)(ii)(F)

Upon being lowered, unwrapped material shall be transferred to a closed receptacle in such manner so as to preclude the dispersion of dust.

1926.1101(g)(8)(ii)(G)

Roof level heating and ventilation air intake sources shall be isolated or the ventilation system shall be shut down.



1926.1101(g)(8)(ii)(H)

Notwithstanding any other provision of this section, removal or repair of sections of intact roofing less than 25 square feet in area does not require use of wet methods or HEPA vacuuming as long as manual methods which do not render the material non-intact are used to remove the material and no visible dust is created by the removal method used. In determining whether a job involves less than 25 square feet, the employer shall include all removal and repair work performed on the same roof on the same day.

1926.1101(g)(8)(iii)

When removing cementitious asbestos-containing siding and shingles or transite panels containing ACM on building exteriors (other than roofs, where paragraph (g)(8)(ii) of this section applies) the employer shall ensure that the following work practices are followed:

1926.1101(g)(8)(iii)(A)

Cutting, abrading or breaking siding, shingles, or transite panels, shall be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release cannot be used.

1926.1101(g)(8)(iii)(B)

Each panel or shingle shall be sprayed with amended water prior to removal.

1926.1101(g)(8)(iii)(C)

Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

1926.1101(g)(8)(iii)(D)

Nails shall be cut with flat, sharp instruments.

1926.1101(g)(8)(iv)

When removing gaskets containing ACM, the employer shall ensure that the following work practices are followed:

1926.1101(g)(8)(iv)(A)

If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag as described in paragraph (g)(5)(ii) of this section.

1926.1101(g)(8)(iv)(B) [Reserved]

1926.1101(g)(8)(iv)(C)

The gasket shall be immediately placed in a disposal container.

1926.1101(g)(8)(iv)(D)

Any scraping to remove residue must be performed wet.

1926.1101(g)(8)(v)

When performing any other Class II removal of asbestos containing material for which specific controls have not been listed in paragraph



(g)(8)(iv)(A) through (D) of this section, the employer shall ensure that the following work practices are complied with.

1926.1101(g)(8)(v)(A)

The material shall be thoroughly wetted with amended water prior to and during its removal.

1926.1101(g)(8)(v)(B)

The material shall be removed in an intact state unless the employer demonstrates that intact removal is not possible.

1926.1101(g)(8)(v)(C)

Cutting, abrading or breaking the material shall be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.

1926.1101(g)(8)(v)(D)

Asbestos-containing material removed, shall be immediately bagged or wrapped, or kept wetted until transferred to a closed receptacle, no later than the end of the work shift.

1926.1101(g)(8)(vi) Alternative Work Practices and Controls.

Instead of the work practices and controls listed in paragraph (g)(8)(i) through (v) of this section, the employer may use different or modified engineering and work practice controls if the following provisions are complied with.

1926.1101(g)(8)(vi)(A)

The employer shall demonstrate by data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used, that employee exposure will not exceed the PELs under any anticipated circumstances.

1926.1101(g)(8)(vi)(B)

A competent person shall evaluate the work area, the projected work practices and the engineering controls, and shall certify in writing, that the different or modified controls are adequate to reduce direct and indirect employee exposure to below the PELs under all expected conditions of use and that the method meets the requirements of this standard. The evaluation shall include and be based on data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used for the current job, and by employees whose training and experience are equivalent to employees who are to perform the current job.

1926.1101(g)(9) Work Practices and Engineering Controls for Class III Asbestos Work.

Class III asbestos work shall be conducted using engineering and work practice controls which minimize the exposure to employees performing



the asbestos work and to bystander employees.

1926.1101(g)(9)(i)

The work shall be performed using wet methods.

1926.1101(g)(9)(ii)

To the extent feasible, the work shall be performed using local exhaust ventilation.

1926.1101(g)(9)(iii)

Where the disturbance involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of thermal system insulation or surfacing material, the employer shall use impermeable drop cloths, and shall isolate the operation using mini-enclosures or glove bag systems pursuant to paragraph **(g)(5)** of this section or another isolation method.

1926.1101(g)(9)(iv)

Where the employer does not produce a "negative exposure assessment" for a job, or where monitoring results show the PEL has been exceeded, the employer shall contain the area using impermeable drop cloths and plastic barriers or their equivalent, or shall isolate the operation using a control system listed in and in compliance with paragraph **(g)(5)** of this section.

1926.1101(g)(9)(v)

Employees performing Class III jobs, which involve the disturbance of thermal system insulation or surfacing material, or where the employer does not produce a "negative exposure assessment" or where monitoring results show a PEL has been exceeded, shall wear respirators which are selected, used and fitted pursuant to provisions of paragraph **(h)** of this section.

1926.1101(g)(10) Class IV Asbestos Work.

Class IV asbestos jobs shall be conducted by employees trained pursuant to the asbestos awareness training program set out in paragraph **(k)(9)** of this section. In addition, all Class IV jobs shall be conducted in conformity with the requirements set out in paragraph **(g)(1)** of this section, mandating wet methods, HEPA vacuums, and prompt clean up of debris containing ACM or PACM.

1926.1101(g)(10)(i)

Employees cleaning up debris and waste in a regulated area where respirators are required shall wear respirators which are selected, used and fitted pursuant to provisions of paragraph **(h)** of this section.

1926.1101(g)(10)(ii)

Employers of employees who clean up waste and debris in, and employers in control of, areas where friable thermal system insulation or surfacing material is accessible, shall assume that such waste and debris contain asbestos.



1926.1101(g)(11) Alternative Methods of Compliance for Installation, Removal, Repair, and Maintenance of certain Roofing and Pipeline Coating Materials.

Notwithstanding any other provision of this section, an employer who complies with all provisions of this paragraph (g)(11) when installing, removing, repairing, or maintaining intact pipeline asphaltic wrap, or roof flashings which contain asbestos fibers encapsulated or coated by bituminous or resinous compounds shall be deemed to be in compliance with this section. If an employer does not comply with all provisions of this paragraph (g)(11) or if during the course of the job the material does not remain intact, the provisions of paragraph (g)(8) of this section apply instead of this paragraph (g)(11).

1926.1101(g)(11)(i)

Before work begins and as needed during the job, a competent person who is capable of identifying asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate such hazards, shall conduct an inspection of the worksite and determine that the roofing material is intact and will likely remain intact.

1926.1101(g)(11)(ii)

All employees performing work covered by this paragraph (g)(11) shall be trained in a training program that meets the requirements of paragraph (k)(9)(viii) of this section.

1926.1101(g)(11)(iii)

The material shall not be sanded, abraded, or ground. Manual methods which do not render the material non-intact shall be used.

1926.1101(g)(11)(iv)

Material that has been removed from a roof shall not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist. All such material shall be removed from the roof as soon as is practicable, but in any event no later than the end of the work shift.

1926.1101(g)(11)(v)

Where roofing products which have been labeled as containing asbestos pursuant to paragraph (k)(8) of this section are installed on non-residential roofs during operations covered by this paragraph (g)(11), the employer shall notify the building owner of the presence and location of such materials no later than the end of the job.

1926.1101(g)(11)(vi)

All removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

**1926.1101(h) Respiratory Protection.****1926.1101(h)(1) General.**

For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

1926.1101(h)(1)(i)

Class I asbestos work.

1926.1101(h)(1)(ii)

Class II asbestos work when ACM is not removed in a substantially intact state.

1926.1101(h)(1)(iii)

Class II and III asbestos work that is not performed using wet methods, except for removal of ACM from sloped roofs when a negative-exposure assessment has been conducted and ACM is removed in an intact state.

1926.1101(h)(1)(iv)

Class II and III asbestos work for which a negative-exposure assessment has not been conducted.

1926.1101(h)(1)(v)

Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed.

1926.1101(h)(1)(vi)

Class IV asbestos work performed within regulated areas where employees who are performing other work are required to use respirators.

1926.1101(h)(1)(vii)

Work operations covered by this section for which employees are exposed above the TWA or excursion limit.

1926.1101(h)(1)(viii)**1926.1101(h)(2) Respirator Program.****1926.1101(h)(2)(i)**

The employer must implement a respiratory protection program in accordance with **29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).**

1926.1101(h)(2)(ii)

No employee shall be assigned to asbestos work that requires respirator use if, based on their most recent medical examination, the examining physician determines that the employee will be unable to function normally while using a respirator, or that the safety or health of the employee or other employees will be impaired by the employee's respirator use. Such employees must be assigned to another job or given the opportunity to transfer to a different position that they can perform. If such a transfer position is available, it must be with the same employer, in the same geographical area, and with the same seniority,



status, rate of pay, and other job benefits the employee had just prior to such transfer.

1926.1101(h)(3) Respirator Selection.

1926.1101(h)(3)(i)

The employers must:

1926.1101(h)(3)(i)(A)

Select, and provide to employees, the appropriate respirators specified in paragraph (d)(3)(i)(A) of 29 CFR 1910.134; however, employers must not select or use filtering facepiece respirators for use against asbestos fibers.

1926.1101(h)(3)(i)(B)

Provide HEPA filters for powered and non-powered air-purifying respirators.

1926.1101(h)(3)(ii)

The employer must provide an employee with a tight-fitting, powered air-purifying respirator (PAPR) instead of a negative-pressure respirator selected according to paragraph (h)(3)(i)(A) of this standard when the employee chooses to use a PAPR and it provides adequate protection to the employee.

1926.1101(h)(3)(iii)

The employer must provide employees with an air-purifying half-mask respirator, other than a filtering facepiece respirator, whenever the employees performs:

1926.1101(h)(3)(iii)(A)

Class II and III asbestos work for which no negative exposure assessment is available.

1926.1101(h)(3)(iii)(B)

Class III asbestos work involving disturbance of TSI or surfacing ACM or PACM.

1926.1101(h)(3)(iv)

Employers must provide employees with:

1926.1101(h)(3)(iv)(A)

A tight-fitting powered air-purifying respirator or a full facepiece, supplied-air respirator operated in the pressure-demand mode and equipped with either HEPA egress cartridges or an auxiliary positive-pressure, self-contained breathing apparatus (SCBA) whenever the employees are in a regulated area performing Class 1 asbestos work for which a negative exposure assessment is not available and the exposure assessment indicates that the exposure level will be at or below 1 f/cc as an 8-hour time-weighted average (TWA).

1926.1101(h)(3)(iv)(B)

A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive pressure SCBA



whenever the employees are in a regulated area performing Class 1 asbestos work for which a negative exposure assessment is not available and the exposure assessment indicates that the exposure level will be above 1 f/cc as an 8-hour time-weighted average (TWA).

1926.1101(i) Protective Clothing.**1926.1101(i)(1) General.**

The employer shall provide and require the use of protective clothing, such as coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos that exceed the TWA and/or excursion limit prescribed in paragraph (c) of this section, or for which a required negative exposure assessment is not produced, or for any employee performing Class I operations which involve the removal of over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.

1926.1101(i)(2) Laundering.**1926.1101(i)(2)(i)**

The employer shall ensure that laundering of contaminated clothing is done so as to prevent the release of airborne asbestos in excess of the TWA or excursion limit prescribed in paragraph (c) of this section.

1926.1101(i)(2)(ii)

Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in paragraph (i)(2)(i) of this section to effectively prevent the release of airborne asbestos in excess of the TWA and excursion limit prescribed in paragraph (c) of this section.

1926.1101(i)(3) Contaminated Clothing.

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

1926.1101(i)(4) Inspection of Protective Clothing.**1926.1101(i)(4)(i)**

The competent person shall examine worksuits worn by employees at least once per work shift for rips or tears that may occur during performance of work.

1926.1101(i)(4)(ii)

When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the worksuit shall be immediately replaced.



1926.1101(j) Hygiene Facilities and Practices for Employees.

1926.1101(j)(1) Requirements for employees performing Class I asbestos jobs involving over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.

1926.1101(j)(1)(i) Decontamination Areas:

the employer shall establish a decontamination area that is adjacent and connected to the regulated area for the decontamination of such employees. The decontamination area shall consist of an equipment room, shower area, and clean room in series. The employer shall ensure that employees enter and exit the regulated area through the decontamination area.

1926.1101(j)(1)(i)(A) Equipment Room.

The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment.

1926.1101(j)(1)(i)(B) Shower Area.

Shower facilities shall be provided which comply with 29 CFR 1910.141 (d)(3), unless the employer can demonstrate that they are not feasible. The showers shall be adjacent both to the equipment room and the clean room, unless the employer can demonstrate that this location is not feasible. Where the employer can demonstrate that it is not feasible to locate the shower between the equipment room and the clean room, or where the work is performed outdoors, the employers shall ensure that employees:

1926.1101(j)(1)(i)(B)(1)

Remove asbestos contamination from their worksuits in the equipment room using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or

1926.1101(j)(1)(i)(B)(2)

Remove their contaminated worksuits in the equipment room, then don clean work suits, and proceed to a shower that is not adjacent to the work area.

1926.1101(j)(1)(i)(c) Clean Change Room.

The clean room shall be equipped with a locker or appropriate storage container for each employee's use. When the employer can demonstrate that it is not feasible to provide a clean change area adjacent to the work area or where the work is performed outdoors, the employer may permit employees engaged in Class I asbestos jobs to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the regulated area. Following showering, such employees however must then change into street clothing in clean change areas provided by the employer which otherwise meet the requirements of this section.



1926.1101(j)(1)(ii) Decontamination Area Entry Procedures.

The employer shall ensure that employees:

1926.1101(j)(1)(ii)(A)

Enter the decontamination area through the clean room;

1926.1101(j)(1)(ii)(B)

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

1926.1101(j)(1)(ii)(C)

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

1926.1101(j)(1)(ii)(D)

Before entering the regulated area, the employer shall ensure that employees pass through the equipment room.

1926.1101(j)(1)(iii) Decontamination Area Exit Procedures.

The employer shall ensure that:

1926.1101(j)(1)(iii)(A)

Before leaving the regulated area, employees shall remove all gross contamination and debris from their protective clothing.

1926.1101(j)(1)(iii)(B)

Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.

1926.1101(j)(1)(iii)(C)

Employees shall not remove their respirators in the equipment room.

1926.1101(j)(1)(iii)(D)

Employees shall shower prior to entering the clean room.

1926.1101(j)(1)(iii)(E)

After showering, employees shall enter the clean room before changing into street clothes.

1926.1101(j)(1)(iv) Lunch Areas.

Whenever food or beverages are consumed at the worksite where employees are performing Class I asbestos work, the employer shall provide lunch areas in which the airborne concentrations of asbestos are below the permissible exposure limit and/or excursion limit.

1926.1101(j)(2) Requirements for Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM and PACM, and for Class II and Class III asbestos work operations where exposures exceed a PEL or where there is no negative exposure assessment produced before the operation.

1926.1101(j)(2)(i)

The employer shall establish an equipment room or area that is adjacent to the regulated area for the decontamination of employees



and their equipment which is contaminated with asbestos which shall consist of an area covered by a impermeable drop cloth on the floor or horizontal working surface.

1926.1101(j)(2)(ii)

The area must be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area (as determined by visible accumulations).

1926.1101(j)(2)(iii)

Work clothing must be cleaned with a HEPA vacuum before it is removed.

1926.1101(j)(2)(iv)

All equipment and surfaces of containers filled with ACM must be cleaned prior to removing them from the equipment room or area.

1926.1101(j)(2)(v)

The employer shall ensure that employees enter and exit the regulated area through the equipment room or area.

1926.1101(j)(3) Requirements for Class IV Work.

Employers shall ensure that employees performing Class IV work within a regulated area comply with the hygiene practice required of employees performing work which has a higher classification within that regulated area. Otherwise employers of employees cleaning up debris and material which is TSI or surfacing ACM or identified as PACM shall provide decontamination facilities for such employees which are required by paragraph (j)(2) of this section.

1926.1101(j)(4) Smoking in Work Areas.

The employer shall ensure that employees do not smoke in work areas where they are occupationally exposed to asbestos because of activities in that work area.

1926.1101(k) Communication of hazards.

1926.1101(k)(1)

This section applies to the communication of information concerning asbestos hazards in construction activities to facilitate compliance with this standard. Most asbestos-related construction activities involve previously installed building materials. Building owners often are the only and/or best sources of information concerning them. Therefore, they, along with employers of potentially exposed employees, are assigned specific information conveying and retention duties under this section. Installed Asbestos Containing Building Material. Employers and building owners shall identify TSI and sprayed or troweled on surfacing materials in buildings as asbestos-containing, unless they determine in compliance with paragraph (k)(5) of this section that the



material is not asbestos-containing. Asphalt and vinyl flooring material installed no later than 1980 must also be considered as asbestos containing unless the employer, pursuant to paragraph (g)(8)(i)(I) of this section determines that it is not asbestos-containing. If the employer/building owner has actual knowledge, or should have known through the exercise of due diligence, that other materials are asbestos-containing, they too must be treated as such. When communicating information to employees pursuant to this standard, owners and employers shall identify "PACM" as ACM. Additional requirements relating to communication of asbestos work on multi-employer worksites are set out in paragraph (d) of this section.

1926.1101(k)(2) Duties of Building and Facility Owners.

1926.1101(k)(2)(i)

Before work subject to this standard is begun, building and facility owners shall determine the presence, location, and quantity of ACM and/or PACM at the work site pursuant to paragraph (k)(1) of this section

1926.1101(k)(2)(ii)

Building and/or facility owners shall notify the following persons of the presence, location and quantity of ACM or PACM, at the work sites in their buildings and facilities. Notification either shall be in writing, or shall consist of a personal communication between the owner and the person to whom notification must be given or their authorized representatives:

1926.1101(k)(2)(ii)(A)

Prospective employers applying or bidding for work whose employees reasonably can be expected to work in or adjacent to areas containing such material;

1926.1101(k)(2)(ii)(B)

Employees of the owner who will work in or adjacent to areas containing such material:

1926.1101(k)(2)(ii)(C)

On multi-employer worksites, all employers of employees who will be performing work within or adjacent to areas containing such materials;

1926.1101(k)(2)(ii)(D)

Tenants who will occupy areas containing such material.

1926.1101(k)(3) Duties of employers whose employees perform work subject to this standard in or adjacent to areas containing ACM and PACM. Building/facility owners whose employees perform such work shall comply with these provisions to the extent applicable.

1926.1101(k)(3)(i)

Before work in areas containing ACM and PACM is begun; employers shall identify the presence, location, and quantity of ACM,



and/or PACM therein pursuant to paragraph **(k)(1)** of this section.

1926.1101(k)(3)(ii)

Before work under this standard is performed, employers of employees who will perform such work shall inform the following persons of the location and quantity of ACM and/or PACM present in the area and the precautions to be taken to insure that airborne asbestos is confined to the area.

1926.1101(k)(3)(ii)(A)

Owners of the building/facility;

1926.1101(k)(3)(ii)(B)

Employees who will perform such work and employers of employees who work and/or will be working in adjacent areas.

1926.1101(k)(3)(iii)

Within 10 days of the completion of such work, the employer whose employees have performed work subject to this standard, shall inform the building/facility owner and employers of employees who will be working in the area of the current location and quantity of PACM and/or ACM remaining in the area and final monitoring results, if any.

1926.1101(k)(4)

In addition to the above requirements, all employers who discover ACM and/or PACM on a worksite shall convey information concerning the presence, location and quantity of such newly discovered ACM and/or PACM to the owner and to other employers of employees working at the work site, within 24 hours of the discovery.

1926.1101(k)(5) Criteria to rebut the designation of installed material as PACM.

1926.1101(k)(5)(i)

At any time, an employer and/or building owner may demonstrate, for purposes of this standard, that PACM does not contain asbestos. Building owners and/or employers are not required to communicate information about the presence of building material for which such a demonstration pursuant to the requirements of paragraph **(k)(5)(ii)** of this section has been made. However, in all such cases, the information, data and analysis supporting the determination that PACM does not contain asbestos, shall be retained pursuant to paragraph **(n)** of this section.

1926.1101(k)(5)(ii)

An employer or owner may demonstrate that PACM does not contain more than 1 percent asbestos by the following:

1926.1101(k)(5)(ii)(A)

Having a completed inspection conducted pursuant to the requirements of AHERA (40 CFR Part 763, Subpart E) which demonstrates that the material is not ACM; or



1926.1101(k)(5)(ii)(B) Performing tests of the material containing PACM which demonstrate that no ACM is present in the material. Such tests shall include analysis of bulk samples collected in the manner described in 40 CFR 763.86. The tests, evaluation and sample collection shall be conducted by an accredited inspector or by a CIH. Analysis of samples shall be performed by persons or laboratories with proficiency demonstrated by current successful participation in a nationally recognized testing program such as the **National Voluntary Laboratory Accreditation Program (NVLAP)** or the **National Institute for Standards and Technology (NIST)** or the Round Robin for bulk samples administered by the **American Industrial Hygiene Association (AIHA)** or an equivalent nationally-recognized round robin testing program.

1926.1101(k)(5)(iii)

The employer and/or building owner may demonstrate that flooring material including associated mastic and backing does not contain asbestos, by a determination of an industrial hygienist based upon recognized analytical techniques showing that the material is not ACM.

1926.1101(k)(6)

At the entrance to mechanical rooms/areas in which employees reasonably can be expected to enter and which contain ACM and/or PACM, the building owner shall post signs which identify the material which is present, its location, and appropriate work practices which, if followed, will ensure that ACM and/or PACM will not be disturbed. The employer shall ensure, to the extent feasible, that employees who come in contact with these signs can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.

1926.1101(k)(7) Signs.

1926.1101(k)(7)(i)

Warning signs that demarcate the regulated area shall be provided and displayed at each location where a regulated area is required to be established by paragraph (e) of this section. Signs shall be posted at such a distance from such a location that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.

1926.1101(k)(7)(ii)(A)

The warning signs required by paragraph (k)(7) of this section shall bear the following information.

**DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY**



1926.1101(k)(7)(ii)(B)

In addition, where the use of respirators and protective clothing is required in the regulated area under this section, the warning signs shall include the following:

**RESPIRATORS AND PROTECTION CLOTHING
ARE REQUIRED IN THIS AREA**

1926.1101(k)(7)(iii)

The employer shall ensure that employees working in and contiguous to regulated areas comprehend the warning signs required to be posted by paragraph **(k)(7)(i)** of this section. Means to ensure employee comprehension may include the use of foreign languages, pictographs and graphics.

1926.1101(k)(8) Labels.

1926.1101(k)(8)(i)

Labels shall be affixed to all products containing asbestos and to all containers containing such products, including waste containers. Where feasible, installed asbestos products shall contain a visible label.

1926.1101(k)(8)(ii)

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

1926.1101(k)(8)(iii)

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

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

1926.1101(k)(8)(iv) [Reserved]

1926.1101(k)(8)(v)

Labels shall contain a warning statement against breathing asbestos fibers.

1926.1101(k)(8)(vi)

The provisions for labels required by paragraphs **(k)(8)(i)** through **(k)(8)(iii)** of this section do not apply where:

1926.1101(k)(8)(vi)(A)

Asbestos fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that, during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the permissible exposure limit and/or excursion limit will be released, or



1926.1101(k)(8)(vi)(B)

Asbestos is present in a product in concentrations less than 1.0 percent.

1926.1101(k)(8)(vii)

When a building owner or employer identifies previously installed PACM and/or ACM, labels or signs shall be affixed or posted so that employees will be notified of what materials contain PACM and/or ACM. The employer shall attach such labels in areas where they will clearly be noticed by employees who are likely to be exposed, such as at the entrance to mechanical room/areas. Signs required by paragraph **(k)(6)** of this section may be posted in lieu of labels so long as they contain information required for labeling. The employer shall ensure, to the extent feasible, that employees who come in contact with these signs or labels can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.

1926.1101(k)(9) Employee Information and Training.

1926.1101(k)(9)(i)

The employer shall, at no cost to the employee, institute a training program for all employees who are likely to be exposed in excess of a PEL and for all employees who perform Class I through IV asbestos operations, and shall ensure their participation in the program.

1926.1101(k)(9)(ii)

Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

1926.1101(k)(9)(iii)

Training for Class I operations and for Class II operations that require the use of critical barriers (or equivalent isolation methods) and/or negative pressure enclosures under this section shall be the equivalent in curriculum, training method and length to the **EPA Model Accreditation Plan (MAP)** asbestos abatement workers training (**40 CFR Part 763, Subpart E, Appendix C**).

1926.1101(k)(9)(iv) Training for Other Class II Work.

1926.1101(k)(9)(iv)(A)

For work with asbestos containing roofing materials, flooring materials, siding materials, ceiling tiles, or transite panels, training shall include at a minimum all the elements included in paragraph **(k)(9)(viii)** of this section and in addition, the specific work practices and engineering controls set forth in paragraph **(g)** of this section which specifically relate to that category. Such course shall include "hands-on" training and shall take at least 8 hours.

1926.1101(k)(9)(iv)(B)

An employee who works with more than one of the categories of material specified in paragraph **(k)(9)(iv)(A)** of this section shall receive



training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

1926.1101(k)(9)(iv)(C)

For Class II operations not involving the categories of material specified in paragraph **(k)(9)(iv)(A)** of this section, training shall be provided which shall include at a minimum all the elements included in paragraph **(k)(9)(viii)** of this section and in addition, the specific work practices and engineering controls set forth in paragraph **(g)** of this section which specifically relate to the category of material being removed, and shall include "hands-on" training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

1926.1101(k)(9)(v)

Training for Class III employees shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at **40 CFR 763.92(a)(2)**. Such a course shall also include "hands-on" training and shall take at least 16 hours. Exception: For Class III operations for which the competent person determines that the EPA curriculum does not adequately cover the training needed to perform that activity, training shall include as a minimum all the elements included in paragraph **(k)(9)(viii)** of this section and in addition, the specific work practices and engineering controls set forth in paragraph **(g)** of this section which specifically relate to that activity, and shall include "hands-on" training in the work practices applicable to each category of material that the employee disturbs.

1926.1101(k)(9)(vi)

Training for employees performing Class IV operations shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at **40 CFR 763.92(a)(1)**. Such a course shall include available information concerning the locations of thermal system insulation and surfacing ACM/PACM, and asbestos-containing flooring material, or flooring material where the absence of asbestos has not yet been certified; and instruction in recognition of damage, deterioration, and delamination of asbestos containing building materials. Such course shall take at least 2 hours.

1926.1101(k)(9)(vii)

Training for employees who are likely to be exposed in excess of the PEL and who are not otherwise required to be trained under paragraph **(k)(9)(iii)** through **(vi)** of this section, shall meet the requirements of paragraph **(k)(9)(viii)** of this section.



1926.1101(k)(9)(viii)

The training program shall be conducted in a manner that the employee is able to understand. In addition to the content required by provisions in paragraphs **(k)(9)(iii)** through **(vi)** of this section, the employer shall ensure that each such employee is informed of the following:

1926.1101(k)(9)(viii)(A)

Methods of recognizing asbestos, including the requirement in paragraph **(k)(1)** of this section to presume that certain building materials contain asbestos;

1926.1101(k)(9)(viii)(B)

The health effects associated with asbestos exposure;

1926.1101(k)(9)(viii)(C)

The relationship between smoking and asbestos in producing lung cancer;

1926.1101(k)(9)(viii)(D)

The nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures, and any necessary instruction in the use of these controls and procedures; where Class III and IV work will be or is performed, the contents of **EPA 20T-2003, "Managing Asbestos In-Place" July 1990** or its equivalent in content;

1926.1101(k)(9)(viii)(E)

The purpose, proper use, fitting instructions, and limitations of respirators as required by **29 CFR 1910.134**;

1926.1101(k)(9)(viii)(F)

The appropriate work practices for performing the asbestos job;

1926.1101(k)(9)(viii)(G)

Medical surveillance program requirements;

1926.1101(k)(9)(viii)(H)

The content of this standard including appendices;

1926.1101(k)(9)(viii)(I)

The names, addresses and phone numbers of public health organizations which provide information, materials and/or conduct programs concerning smoking cessation. The employer may distribute the list of such organizations contained in **Appendix J** to this section, to comply with this requirement; and

1926.1101(k)(9)(viii)(J)

The requirements for posting signs and affixing labels and the meaning of the required legends for such signs and labels.



1926.1101(k)(10) Access to Training Materials.

1926.1101(k)(10)(i)

The employer shall make readily available to affected employees without cost, written materials relating to the employee training program, including a copy of this regulation.

1926.1101(k)(10)(ii)

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

1926.1101(k)(10)(iii)

The employer shall inform all employees concerning the availability of self-help smoking cessation program material. Upon employee request, the employer shall distribute such material, consisting of **NIH Publication No, 89-1647**, or equivalent self-help material, which is approved or published by a public health organization listed in **Appendix J** to this section.

1926.1101(l) Housekeeping.

1926.1101(l)(1) Vacuuming.

Where vacuuming methods are selected, HEPA filtered vacuuming equipment must be used. The equipment shall be used and emptied in a manner that minimizes the reentry of asbestos into the workplace.

1926.1101(l)(2) Waste Disposal.

Asbestos waste, scrap, debris, bags, containers, equipment, and contaminated clothing consigned for disposal shall be collected and disposed of in sealed, labeled, impermeable bags or other closed, labeled, impermeable containers except in roofing operations where the procedures specified in paragraph **(g)(8)(ii)** of this section apply.

1926.1101(l)(3) Care of Asbestos-containing Flooring Material.

1926.1101(l)(3)(i)

All vinyl and asphalt flooring material shall be maintained in accordance with this paragraph unless the building/facility owner demonstrates, pursuant to paragraph **(g)(8)(i)(I)** of this section that the flooring does not contain asbestos.

1926.1101(l)(3)(ii)

Sanding of flooring material is prohibited.

1926.1101(l)(3)(iii)

Stripping of finishes shall be conducted using low abrasion pads at speeds lower than 300 rpm and wet methods.

1926.1101(l)(3)(iv)

Burnishing or dry buffing may be performed only on flooring which has sufficient finish so that the pad cannot contact the flooring material.



1926.1101(l)(4)

Waste and debris and accompanying dust in an area containing accessible thermal system insulation or surfacing ACM/PACM or visibly deteriorated ACM:

1926.1101(l)(4)(i)

shall not be dusted or swept dry, or vacuumed without using a HEPA filter;

1926.1101(l)(4)(ii)

shall be promptly cleaned up and disposed of in leak tight containers.

1926.1101(m) Medical surveillance.

1926.1101(m)(1) General.

1926.1101(m)(1)(i) Employees covered.

1926.1101(m)(1)(i)(A)

The employer shall institute a medical surveillance program for all employees who for a combined total of 30 or more days per year are engaged in Class I, II and III work or are exposed at or above a permissible exposure limit. For purposes of this paragraph, any day in which a worker engages in Class II or Class III operations or a combination thereof on intact material for one hour or less (taking into account the entire time spent on the removal operation, including cleanup) and, while doing so, adheres fully to the work practices specified in this standard, shall not be counted.

1926.1101(m)(1)(i)(B)

For employees otherwise required by this standard to wear a negative pressure respirator, employers shall ensure employees are physically able to perform the work and use the equipment. This determination shall be made under the supervision of a physician.

1926.1101(m)(1)(ii) Examination.

1926.1101(m)(1)(ii)(A)

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

1926.1101(m)(1)(ii)(B)

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

1926.1101(m)(2) Medical examinations and consultations.

1926.1101(m)(2)(i) Frequency.

The employer shall make available medical examinations and consultations to each employee covered under paragraph (m)(1)(i) of



this section on the following schedules:

1926.1101(m)(2)(i)(A)

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

1926.1101(m)(2)(i)(B)

When the employee is assigned to an area where exposure to asbestos may be at or above the permissible exposure limit for 30 or more days per year, or engage in Class I, II, or III work for a combined total of 30 or more days per year, a medical examination must be given within 10 working days following the thirtieth day of exposure;

1926.1101(m)(2)(i)(C)

And at least annually thereafter.

1926.1101(m)(2)(i)(D)

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

1926.1101(m)(2)(i)(E) Exception:

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

1926.1101(m)(2)(ii) Content.

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

1926.1101(m)(2)(ii)(A)

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

1926.1101(m)(2)(ii)(B)

On initial examination, the standardized questionnaire contained in **Part 1 of Appendix D** to this section, and, on annual examination, the abbreviated standardized questionnaire contained in **Part 2 of Appendix D** to this section.

1926.1101(m)(2)(ii)(C)

A physical examination directed to the pulmonary and gastrointestinal systems, including a chest roentgenogram to be administered at the discretion of the physician, and pulmonary function tests of forced vital capacity (FVC) and forced expiratory volume at one second (FEV(1)). Interpretation and classification of chest shall be conducted in accordance with **Appendix E** to this section.

1926.1101(m)(2)(ii)(D)

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



1926.1101(m)(3) Information provided to the Physician.

The employer shall provide the following information to the examining physician:

1926.1101(m)(3)(i)

A copy of this standard and **Appendices D, E, and I** to this section;

1926.1101(m)(3)(ii)

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

1926.1101(m)(3)(iii)

The employee's representative exposure level or anticipated exposure level;

1926.1101(m)(3)(iv)

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

1926.1101(m)(3)(v)

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

1926.1101(m)(4) Physician's Written Opinion.

1926.1101(m)(4)(i)

The employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

1926.1101(m)(4)(i)(A)

The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos;

1926.1101(m)(4)(i)(B)

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

1926.1101(m)(4)(i)(C)

A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions that may result from asbestos exposure.

1926.1101(m)(4)(i)(D)

A statement that the employee has been informed by the physician of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

1926.1101(m)(4)(ii)

The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos.

1926.1101(m)(4)(iii)

The employer shall provide a copy of the physician's written opinion to



the affected employee within 30 days from its receipt.

1926.1101(n) Recordkeeping.

1926.1101(n)(1) Objective data relied on pursuant to paragraph (f) to this section.

1926.1101(n)(1)(i)

Where the employer has relied on objective data that demonstrates that products made from or containing asbestos or the activity involving such products or material are not capable of releasing fibers of asbestos in concentrations at or above the permissible exposure limit and/or excursion limit under the expected conditions of processing, use, or handling to satisfy the requirements of paragraph (f), the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

1926.1101(n)(1)(ii)

The record shall include at least the following information:

1926.1101(n)(1)(ii)(A)

The product qualifying for exemption;

1926.1101(n)(1)(ii)(B)

The source of the objective data;

1926.1101(n)(1)(ii)(C)

The testing protocol, results of testing, and/or analysis of the material for the release of asbestos;

1926.1101(n)(1)(ii)(D)

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

1926.1101(n)(1)(ii)(E)

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

1926.1101(n)(1)(iii)

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

1926.1101(n)(2) Exposure Measurements.

1926.1101(n)(2)(i)

The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos as prescribed in paragraph (f) of this section. NOTE: The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

1926.1101(n)(2)(ii)

This record shall include at least the following information:

1926.1101(n)(2)(ii)(A)

The date of measurement;



1926.1101(n)(2)(ii)(B)

The operation involving exposure to asbestos that is being monitored;

1926.1101(n)(2)(ii)(C)

Sampling and analytical methods used and evidence of their accuracy;

1926.1101(n)(2)(ii)(D)

Number, duration, and results of samples taken;

1926.1101(n)(2)(ii)(E)

Type of protective devices worn, if any; and

1926.1101(n)(2)(ii)(F)

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

1926.1101(n)(2)(iii)

The employer shall maintain this record for at least thirty (30) years, in accordance with **29 CFR 1910.1020**.

1926.1101(n)(3) Medical Surveillance.

1926.1101(n)(3)(i)

The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (m) of this section, in accordance with **29 CFR 1910.1020**.

1926.1101(n)(3)(ii)

The record shall include at least the following information:

1926.1101(n)(3)(ii)(A)

The name and social security number of the employee;

1926.1101(n)(3)(ii)(B)

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

1926.1101(n)(3)(ii)(C)

Physician's written opinions;

1926.1101(n)(3)(ii)(D)

Any employee medical complaints related to exposure to asbestos; and

1926.1101(n)(3)(ii)(E)

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

1926.1101(n)(3)(iii)

The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with **29 CFR 1910.1020**.

1926.1101(n)(4) Training Records.

The employer shall maintain all employee training records for one (1) year beyond the last date of employment by that employer.



1926.1101(n)(5) Data to Rebut PACM.

Where the building owner and employer have relied on data to demonstrate that PACM is not asbestos-containing, such data shall be maintained for as long as they are relied upon to rebut the presumption.

1926.1101(n)(6) Records of Required Notifications.

Where the building owner has communicated and received information concerning the identification, location and quantity of ACM and PACM, written records of such notifications and their content shall be maintained by the building owner for the duration of ownership and shall be transferred to successive owners of such buildings/facilities.

1926.1101(n)(7) Availability.

1926.1101(n)(7)(i)

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

1926.1101(n)(7)(ii)

The employer, upon request, shall make any exposure records required by paragraphs (f) and (n) of this section available for examination and copying to affected employees, former employees, designated representatives, and the Assistant Secretary, in accordance with **29 CFR 1910.1020(a) through (e) and (g) through (i)**.

1926.1101(n)(7)(iii)

The employer, upon request, shall make employee medical records required by paragraphs (m) and (n) of this section available for examination and copying to the subject employee, anyone having the specific written consent of the subject employee, and the Assistant Secretary, in accordance with **29 CFR 1910.1020**.

1926.1101(n)(8) Transfer of Records.

1926.1101(n)(8)(i)

The employer shall comply with the requirements concerning transfer of records set forth in **29 CFR 1910.1020(h)**.

1926.1101(n)(8)(ii)

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

1926.1101(o) **Competent person.**

1926.1101(o)(1) General.

On all construction worksites covered by this standard, the employer shall designate a **competent person**, having the qualifications and authorities for ensuring worker safety and health required by **Subpart**



C, General Safety and Health Provisions for Construction (29 CFR 1926.20 through 1926.32).

1926.1101(o)(2) Required Inspections by the Competent Person.

Section 1926.20(b)(2) which requires health and safety prevention programs to provide for frequent and regular inspections of the job sites, materials, and equipment to be made by competent persons, is incorporated

1926.1101(o)(3) Additional Inspections.

In addition, the competent person shall make frequent and regular inspections of the job sites, in order to perform the duties set out below in paragraph (o)(3)(i) and (ii) of this section. For Class I jobs, on-site inspections shall be made at least once during each work shift, and at any time at employee request. For Class II, III, and IV jobs, on-site inspections shall be made at intervals sufficient to assess whether conditions have changed, and at any reasonable time at employee request.

1926.1101(o)(3)(i)

On all worksites where employees are engaged in Class I or II asbestos work, the competent person designated in accordance with paragraph (e)(6) of this section shall perform or supervise the following duties, as applicable:

1926.1101(o)(3)(i)(A)

Set up the regulated area, enclosure, or other containment;

1926.1101(o)(3)(i)(B)

Ensure (by on-site inspection) the integrity of the enclosure or containment;

1926.1101(o)(3)(i)(C)

Set up procedures to control entry to and exit from the enclosure and/or area;

1926.1101(o)(3)(i)(D)

Supervise all employee exposure monitoring required by this section and ensure that it is conducted as required by paragraph (f) of this section;

1926.1101(o)(3)(i)(E)

Ensure that employees working within the enclosure and/or using glove bags wear respirators and protective clothing as required by paragraphs (h) and (i) of this section;

1926.1101(o)(3)(i)(F)

Ensure through on-site supervision, that employees set up, use and remove engineering controls, use work practices and personal protective equipment in compliance with all requirements;

1926.1101(o)(3)(i)(G)

Ensure that employees use the hygiene facilities and observe the



decontamination procedures specified in paragraph (j) of this section;
1926.1101(o)(3)(i)(H)

Ensure that through on-site inspection, engineering controls are functioning properly and employees are using proper work practices; and,

1926.1101(o)(3)(i)(I)

Ensure that notification requirement in paragraph (k) of this section are met.

1926.1101(o)(3)(ii) [Reserved]

1926.1101(o)(4) Training for the Competent Person.

1926.1101(o)(4)(i)

For Class I and II asbestos work the competent person shall be trained in all aspects of asbestos removal and handling, including: abatement, installation, removal and handling; the contents of this standard; the identification of asbestos; removal procedures, where appropriate; and other practices for reducing the hazard. Such training shall be obtained in a comprehensive course for supervisors that meets the criteria of **EPA's Model Accredited Plan (40 CFR part 763, subpart E, Appendix C)**, such as a course conducted by an EPA-approved or state-approved training provider, certified by EPA or a state, or a course equivalent in stringency, content, and length.

1926.1101(o)(4)(ii)

For Class III and IV asbestos work, the competent person shall be trained in aspects of asbestos handling appropriate for the nature of the work, to include procedures for setting up glove bags and mini-enclosures, practices for reducing asbestos exposures, use of wet methods, the contents of this standard, and the identification of asbestos. Such training shall include successful completion of a course that is consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at **40 CFR 763.92(a)(2)**, or its equivalent in stringency, content, and length. Competent persons for Class III and IV work, may also be trained pursuant to the requirements of paragraph (o)(4)(i) of this section.

1926.1101(p) Appendices.

1926.1101(p)(1)

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

1926.1101(p)(2)

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



1926.1101(q) Dates.

1926.1101(q)(1)

This standard shall become effective October 11, 1994.

1926.1101(q)(2)

The provisions of **29 CFR 1926.58** remain in effect until the start-up dates of the equivalent provisions of this standard.

1926.1101(q)(3) Start-up dates.

All obligations of this standard commence on the effective date except as follows:

1926.1101(q)(3)(i) Methods of Compliance.

The engineering and work practice controls required by paragraph (g) of this section shall be implemented by October 1, 1995.

1926.1101(q)(3)(ii)

Respiratory protection. Respiratory protection required by paragraph (h) of this section shall be provided by October 1, 1995.

1926.1101(q)(3)(iii)

Hygiene facilities and practices for employees. Hygiene facilities and practices required by paragraph (j) of this section shall be provided by October 1, 1995.

1926.1101(q)(3)(iv) Communication of Hazards.

Identification, notification, labeling and sign posting, and training required by paragraph (k) of this section shall be provided by October 1, 1995.

1926.1101(q)(3)(v) Housekeeping.

Housekeeping practices and controls required by paragraph (l) of this section shall be provided by October 1, 1995.

1926.1101(q)(3)(vi)

Medical surveillance required by paragraph (m) of this section shall be provided by October 1, 1995.

1926.1101(q)(3)(vii)

The designation and training of competent persons required by paragraph (o) of this section shall be completed by October 1, 1995.

[59 FR 40964, Aug. 10, 1994; 60 FR 9624, Feb. 21, 1995; 60 FR 33343, June 28, 1995; 60 FR 33972, June 29, 1995; 60 FR 36043, July 13, 1995; 60 FR 50411, Sept. 29, 1995; 61 FR 5507, Feb. 13, 1996; 61 FR 43454, August 23, 1996; 63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998; 63 FR 35138, June 29, 1998]

Appendices for the Asbestos Standard have not been reproduced in this manual. They can be found in a current copy of the OSHA Construction Standards or by accessing them on the web at www.OSHA.gov.



Notes and Scribbles



Notes and Scribbles



Notes and Scribbles



Notes and Scribbles



OSHA Industrial/Construction Industries Respiratory Protection Standard

29 CFR 1910.134/1926.103
October 5, 1998

(a)	Permissible Practice	page 127
(b)	Definitions	page 127
(c)	Respiratory Protection Program	page 130
(d)	Selection of Respirators	page 132
(e)	Medical Evaluation	page 135
(f)	Fit Testing	page 138
(g)	Use of Respirators	page 140
(h)	Maintenance and Care of Respirators	page 142
(i)	Breathing Air Quality and Use	page 144
(j)	Identification of Filters, Cartridges, and Canisters	page 145
(k)	Training and Information	page 147
(l)	Program Evaluation	page 148
(m)	Recordkeeping	page 149
(n)	Dates	page 150
(o)	Appendices	page 150



This section applies to General Industry (**part 1910**), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (**part 1926**).

1910.134(a) Permissible Practice.

1910.134(a)(1)

In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

1910.134(a)(2)

Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program which shall include the requirements outlined in paragraph (c) of this section.

1910.134(b) Definitions.

The following definitions are important terms used in the respiratory protection standard in this section.

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is



created inside the facepiece by inhalation.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Filtering facepiece dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

Helmet means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Hood means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

Immediately Dangerous to Life or Health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Interior structural firefighting means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)



Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Maximum use concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substances. The MUC can be determined by multiplying the assigned protection factor specified for a respirator by the required OSHA permissible exposure limit, short-term exposure limit, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer must determine a MUC on the basis of relevant available informational judgement.

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

Respiratory inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to



be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

This section means this respiratory protection standard.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

1910.134(c) Respiratory Protection Program.

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The *Small Entity Compliance Guide* contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the *Small Entity Compliance Guide* will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

1910.134(c)(1)

In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

1910.134(c)(1)(i)

Procedures for selecting respirators for use in the workplace;

1910.134(c)(1)(ii)

Medical evaluations of employees required to use respirators;

1910.134(c)(1)(iii)

Fit testing procedures for tight-fitting respirators;

1910.134(c)(1)(iv)

Procedures for proper use of respirators in routine and reasonably



- foreseeable emergency situations;
- 1910.134(c)(1)(v)
 - Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;
- 1910.134(c)(1)(vi)
 - Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
- 1910.134(c)(1)(vii)
 - Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;
- 1910.134(c)(1)(viii)
 - Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and
- 1910.134(c)(1)(ix)
 - Procedures for regularly evaluating the effectiveness of the program.
- 1910.134(c)(1)(2)
 - Where respirator use is not required:
- 1910.134(c)(2)(i)
 - An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section ("Information for Employees Using Respirators When Not Required Under the Standard"); and
- 1910.134(c)(2)(ii)
 - In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).
- 1910.134(c)(3)
 - The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

**1910.134(c)(4)**

The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

1910.134(d) Selection of Respirators.

This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

1910.134(d)(1) General Requirements.**1910.134(d)(1)(i)**

The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

1910.134(d)(1)(ii)

The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

1910.134(d)(1)(iii)

The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

1910.134(d)(1)(iv)

The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

1910.134(d)(2) Respirators for IDLH Atmospheres.**1910.134(d)(2)(i)**

The employer shall provide the following respirators for employee use in IDLH atmospheres:

1910.134(d)(2)(i)(A)

A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

1910.134(d)(2)(i)(B)

A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

1910.134(d)(2)(ii)

Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be



used.

1910.134(d)(2)(iii)

All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

1910.134(d)(3) Respirators for Atmospheres that are not IDLH.

1910.134(d)(3)(i)

The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

1910.134(d)(3)(i)(A) Assigned Protection Factors (APFs)

Employers must use the assigned protection factors listed in the Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Table 1. – Assigned Protection Factors⁵

Type of Respirator ^{1,2}	Quarter Mask	Half Mask	Full Face-piece	Helmet/Hood	Loose-fitting Facepiece
1. Air-Purifying Respirator.....	5	³ 10	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR) .....	.....	50	1,000	⁴ 25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand Mode .....	.....	10	50	.....	.....
• Continuous Flow Mode .....	.....	50	1,000	⁴ 25,1000	25
• Pressure-Demand or other Positive-Pressure Mode .....	.....	50	1,000	.....	.....
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand Mode .....	.....	10	50	50	.....
• Pressure-Demand or other Positive-Pressure Mode (e.g., open/closed circuit) .....	.....	.....	10,000	10,000	.....

Notes:

¹ Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

² The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

³ This APF Category includes filtering facepieces, and half masks with elastomeric facepieces.

⁴ The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of



1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

- ⁵ These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 Subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

1910.134(d)(3)(i)(B) Maximum Use Concentration (MUC)

1910.134(d)(3)(i)(B)(1)

The employer must select a respirator for employee use that maintains the employee's exposure to the hazardous substance, when measured outside the respirator, at or below the MUC.

1910.134(d)(3)(i)(B)(2)

Employers must not apply MUCs to conditions that are immediately dangerous to life or health (IDLH); instead, they must use respirators listed for IDLH conditions in paragraph (d)(2) of this standard.

1910.134(d)(3)(i)(B)(3)

When the calculated MUC exceeds the IDLH level for a hazardous substance, or the performance limits of the cartridge or canister, then employers must set the maximum MUC at that lower limit.

1910.134(d)(3)(ii)

The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

1910.134(d)(3)(iii)

For protection against gases and vapors, the employer shall provide:

1910.134(d)(3)(iii)(A)

An atmosphere-supplying respirator, or

1910.134(d)(3)(iii)(B)

An air-purifying respirator, provided that:

1910.134(d)(3)(iii)(B)(1)

The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

1910.134(d)(3)(iii)(B)(2)

If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

1910.134(d)(3)(iv)

For protection against particulates, the employer shall provide:

1910.134(d)(3)(iv)(A)

An atmosphere-supplying respirator; or



1910.134(d)(3)(iv)(B)

An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

1910.134(d)(3)(iv)(C)

For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

Table II – Altitude and the Oxygen Deficient Atmospheres

Altitude (ft.)	Oxygen Deficient Atmosphere (% O ₂) for which the employer may rely on atmosphere-supplying respirators
less than 3,001	16.0 - 19.5
3,001 - 4,000	16.4 - 19.5
4,001 - 5,000	17.1 - 19.5
5,001 - 6,000	17.8 - 19.5
6,001 - 7,000	18.5 - 19.5
7,001 - 8,000 ¹	19.3 - 19.5
¹ Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.	

(e) Medical Evaluation.

Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

1910.134(e)(1) General.

The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

1910.134(e)(2) Medical Evaluation Procedures.



1910.134(e)(2)(i)

The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

1910.134(e)(2)(ii)

The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

1910.134(e)(3) Follow-up Medical Examination.

1910.134(e)(3)(i)

The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

1910.134(e)(3)(ii)

The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

1910.134(e)(4) Administration of the medical questionnaire and examinations.

1910.134(e)(4)(i)

The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

1910.134(e)(4)(ii)

The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

1910.134(e)(5) Supplemental Information for the PLHCP.

1910.134(e)(5)(i)

The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

1910.134(e)(5)(i)(A)

The type and weight of the respirator to be used by the employee;

1910.134(e)(5)(i)(B)

The duration and frequency of respirator use (including use for rescue and escape);

1910.134(e)(5)(i)(C)

The expected physical work effort;



1910.134(e)(5)(i)(D)

Additional protective clothing and equipment to be worn; and

1910.134(e)(5)(i)(E)

Temperature and humidity extremes that may be encountered.

1910.134(e)(5)(ii)

Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

1910.134(e)(5)(iii)

The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

Note to Paragraph (e)(5)(iii): When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

1910.134(e)(6) Medical Determination.

In determining the employee's ability to use a respirator, the employer shall:

1910.134(e)(6)(i)

Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

1910.134(e)(6)(i)(A)

Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

1910.134(e)(6)(i)(B)

The need, if any, for follow-up medical evaluations; and

1910.134(e)(6)(i)(C)

A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

1910.134(e)(6)(ii)

If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

**1910.134(e)(7) Additional Medical Evaluations.**

At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

1910.134(e)(7)(i)

An employee reports medical signs or symptoms that are related to ability to use a respirator;

1910.134(e)(7)(ii)

A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

1910.134(e)(7)(iii)

Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

1910.134(e)(7)(iv)

A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

1910.134(f) Fit Testing.

This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

1910.134(f)(1)

The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

1910.134(f)(2)

The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

1910.134(f)(3)

The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

1910.134(f)(4)

If after passing a QLFT or QNFT, the employee subsequently notifies



the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

1910.134(f)(5)

The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

1910.134(f)(6)

QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

1910.134(f)(7)

If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

1910.134(f)(8)

Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

1910.134(f)(8)(i)

Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

1910.134(f)(8)(ii)

Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

1910.134(f)(8)(iii)

Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

**1910.134(g) Use of Respirators.**

This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

1910.134(g)(1) Facepiece Seal Protection.**1910.134(g)(1)(i)**

The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

1910.134(g)(1)(i)(A)

Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

1910.134(g)(1)(i)(B)

Any condition that interferes with the face-to-facepiece seal or valve function.

1910.134(g)(1)(ii)

If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

1910.134(g)(1)(iii)

For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

1910.134(g)(2) Continuing Respirator Effectiveness.**1910.134(g)(2)(i)**

Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

1910.134(g)(2)(ii)

The employer shall ensure that employees leave the respirator use area:

1910.134(g)(2)(ii)(A)

To wash their faces and respirator facepieces as necessary to prevent



- eye or skin irritation associated with respirator use; or
- 1910.134(g)(2)(ii)(B)
 - If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or
- 1910.134(g)(2)(ii)(C)
 - To replace the respirator or the filter, cartridge, or canister elements.
- 1910.134(g)(2)(iii)
 - If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.
- 1910.134(g)(3) Procedures for IDLH Atmospheres.
 - For all IDLH atmospheres, the employer shall ensure that:
- 1910.134(g)(3)(i)
 - One employee or, when needed, more than one employee is located outside the IDLH atmosphere;
- 1910.134(g)(3)(ii)
 - Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;
- 1910.134(g)(3)(iii)
 - The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;
- 1910.134(g)(3)(iv)
 - The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;
- 1910.134(g)(3)(v)
 - The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;
- 1910.134(g)(3)(vi)
 - Employee(s) located outside the IDLH atmospheres are equipped with:
- 1910.134(g)(3)(vi)(A)
 - Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- 1910.134(g)(3)(vi)(B)
 - Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- 1910.134(g)(3)(C)
 - Equivalent means for rescue where retrieval equipment is not required



under paragraph (g)(3)(vi)(B).

1910.134(g)(4) Procedures for Interior Structural Firefighting.

In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

1910.134(g)(4)(i)

At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

1910.134(g)(4)(ii)

At least two employees are located outside the IDLH atmosphere; and

1910.134(g)(4)(iii)

All employees engaged in interior structural firefighting use SCBAs.

Note 1 to paragraph (g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

Note 2 to paragraph (g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

1910.134(h) Maintenance and Care of Respirators.

This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

1910.134(1) Cleaning and Disinfecting.

The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

1910.134(h)(1)(i)

Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

1910.134(h)(1)(ii)

Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

1910.134(h)(1)(iii)

Respirators maintained for emergency use shall be cleaned and disinfected after each use; and



1910.134(h)(1)(iv)

Respirators used in fit testing and training shall be cleaned and disinfected after each use.

1910.134(h)(2) Storage.

The employer shall ensure that respirators are stored as follows:

1910.134(h)(2)(i)

All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

1910.134(h)(2)(ii)

In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

1910.134(h)(2)(ii)(A)

Kept accessible to the work area;

1910.134(h)(2)(ii)(B)

Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

1910.134(h)(2)(ii)(C)

Stored in accordance with any applicable manufacturer instructions.

1910.134(h)(3) Inspection.

1910.134(h)(3)(i)

The employer shall ensure that respirators are inspected as follows:

1910.134(h)(3)(i)(A)

All respirators used in routine situations shall be inspected before each use and during cleaning;

1910.134(h)(3)(i)(B)

All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

1910.134(h)(3)(i)(C)

Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

1910.134(h)(3)(ii)

The employer shall ensure that respirator inspections include the following:

1910.134(h)(3)(ii)(A)

A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and



1910.134(h)(3)(ii)(B)

A check of elastomeric parts for pliability and signs of deterioration.

1910.134(h)(3)(iii)

In addition to the requirements of paragraphs **(h)(3)(i)** and **(ii)** of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

1910.134(h)(3)(iv)

For respirators maintained for emergency use, the employer shall:

1910.134(h)(3)(iv)(A)

Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

1910.134(h)(3)(iv)(B)

Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

1910.134(h)(4) Repairs.

The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

1910.134(h)(i)

Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

1910.134(h)(ii)

Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

1910.134(h)(iii)

Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

**1910.134(i) Breathing Air Quality and Use.**

This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

1910.134(i)(1)

The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

1910.134(i)(1)(i)

Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

1910.134(i)(1)(ii)

Compressed breathing air shall meet at least the requirements for Type 1-Grade D breathing air described in *ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989*, to include:

1910.134(i)(1)(ii)(A)

Oxygen content (v/v) of 19.5-23.5%;

1910.134(i)(1)(ii)(B)

Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

1910.134(i)(1)(ii)(C)

Carbon monoxide (CO) content of 10 ppm or less;

1910.134(i)(1)(ii)(D)

Carbon dioxide content of 1,000 ppm or less; and

1910.134(i)(1)(ii)(E)

Lack of noticeable odor.

1910.134(i)(2)

The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

1910.134(i)(3)

The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

1910.134(i)(4)

The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

1910.134(i)(4)(i)

Cylinders are tested and maintained as prescribed in the *Shipping Container Specification Regulations* of the Department of Transportation (49 CFR part 173 and part 178);

1910.134(i)(4)(ii)

Cylinders of purchased breathing air have a certificate of analysis from



the supplier that the breathing air meets the requirements for Type 1 -- Grade D breathing air; and

1910.134(i)(4)(iii)

The moisture content in the cylinder does not exceed a dew point of -50 deg. F (-45.6 deg. C) at 1 atmosphere pressure.

1910.134(i)(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

1910.134(i)(5)(i)

Prevent entry of contaminated air into the air-supply system;

1910.134(i)(5)(ii)

Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg. C) below the ambient temperature;

1910.134(i)(5)(iii)

Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

1910.134(i)(5)(iv)

Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

1910.134(i)(6)

For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

1910.134(i)(7)

For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

1910.134(i)(8)

The employer shall ensure that breathing air couplings are incompatible with outlets for non-respirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

1910.134(i)(9)

The employer shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

1910.134(j) Identification of Filters, Cartridges, and Canisters.

The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

**1910.134(k) Training and Information.**

This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

1910.134(k)(1)

The employer shall ensure that each employee can demonstrate knowledge of at least the following:

1910.134(k)(1)(i)

Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

1910.134(k)(1)(ii)

What the limitations and capabilities of the respirator are;

1910.134(k)(1)(iii)

How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

1910.134(k)(1)(iv)

How to inspect, put on and remove, use, and check the seals of the respirator;

1910.134(k)(1)(v)

What the procedures are for maintenance and storage of the respirator;

1910.134(k)(1)(vi)

How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

1910.134(k)(1)(vii)

The general requirements of this section.

1910.134(k)(2)

The training shall be conducted in a manner that is understandable to the employee.

1910.134(k)(3)

The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

1910.134(k)(4)

An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.



1910.134(k)(5)

Retraining shall be administered annually, and when the following situations occur:

1910.134(k)(5)(i)

Changes in the workplace or the type of respirator render previous training obsolete;

1910.134(k)(5)(ii)

Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

1910.134(k)(5)(iii)

Any other situation arises in which retraining appears necessary to ensure safe respirator use.

1910.134(k)(6)

The basic advisory information on respirators, as presented in **Appendix D** of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

1910.134(l) Program Evaluation.

This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

1910.134(l)(1)

The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

1910.134(l)(2)

The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

1910.134(l)(2)(i)

Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

1910.134(l)(2)(ii)

Appropriate respirator selection for the hazards to which the employee is exposed;

1910.134(l)(2)(iii)

Proper respirator use under the workplace conditions the employee encounters; and



1910.134(l)(2)(iv)

Proper respirator maintenance.

1910.134(m) Recordkeeping.

This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

1910.134(m)(1) Medical Evaluation.

Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.20.

1910.134(m)(2) Fit Testing.

1910.134(m)(2)(i)

The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

1910.134(m)(2)(i)(A)

The name or identification of the employee tested;

1910.134(m)(2)(i)(B)

Type of fit test performed;

1910.134(m)(2)(i)(C)

Specific make, model, style, and size of respirator tested;

1910.134(m)(2)(i)(D)

Date of test; and

1910.134(m)(2)(i)(E)

The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

1910.134(m)(2)(ii)

Fit test records shall be retained for respirator users until the next fit test is administered.

1910.134(m)(3)

A written copy of the current respirator program shall be retained by the employer.

1910.134(m)(4)

Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

**1910.134(n) Dates.****1910.134(1) Effective Date.**

This section is effective April 8, 1998. The obligations imposed by this section commence on the effective date unless otherwise noted in this paragraph. Compliance with obligations that do not commence on the effective date shall occur no later than the applicable start-up date.

Paragraphs (d)(3)(i)(A) and (d)(3)(i)(B) of this section become effective November 22, 2006.

1910.134(2) Compliance Dates.

All obligations of this section commence on the effective date except as follows:

1910.134(2)(i)

The determination that respirator use is required (paragraph (a)) shall be completed no later than September 8, 1998.

1910.134(2)(ii)

Compliance with provisions of this section for all other provisions shall be completed no later than October 5, 1998.

1910.134(3)

The provisions of 29 CFR 1910.134 and 29 CFR 1926.103, contained in the 29 CFR parts 1900 to 1910.99 and the 29 CFR part 1926 editions, revised as of July 1, 1997, are in effect and enforceable until April 8, 1998, or during any administrative or judicial stay of the provisions of this section.

1910.134(4) Existing Respiratory Protection Programs.

If, in the 12 month period preceding April 8, 1998, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of those activities to comply with the corresponding provisions of this section, providing that these activities were conducted in a manner that meets the requirements of this section.

1910.134(o) Appendices.**1910.134(1)**

Compliance with Appendix A, Appendix B-1, Appendix B-2, and Appendix C of this section is mandatory.

1910.134(2)

Appendix D of this section is non-mandatory and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

**Appendix A to Sec. 1910.134: Fit Testing Procedures (Mandatory)****Part I. OSHA-Accepted Fit Test Protocols****A. Fit Testing Procedures -- General Requirements**

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.
3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.
4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.
5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.
6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:
 - (a) Position of the mask on the nose;
 - (b) Room for eye protection;
 - (c) Room to talk; and
 - (d) Position of mask on face and cheeks.



7. The following criteria shall be used to help determine the adequacy of the respirator fit:
 - (a) Chin properly placed;
 - (b) Adequate strap tension, not overly tightened;
 - (c) Fit across nose bridge;
 - (d) Respirator of proper size to span distance from nose to chin;
 - (e) Tendency of respirator to slip; and
 - (f) Self-observation in mirror to evaluate fit and respirator position.
8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.
9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.
10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.
11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.
12. Exercise Regimen.

Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.
13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.
14. Test Exercises.
 - (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP



protocol. The test subject shall perform exercises, in the test environment, in the following manner:

- (1) **Normal Breathing.** In a normal standing position, without talking, the subject shall breathe normally.
- (2) **Deep Breathing.** In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.
- (3) **Turning Head Side to Side.** Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.
- (4) **Moving Head Up and Down.** Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).
- (5) **Talking.** The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

- (6) **Grimace.** The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)
- (7) **Bending Over.** The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.



(8) **Normal Breathing.** Same as exercise (1).

- (b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

B. Qualitative Fit Test (QLFT) Protocols

1. General

- (a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.
- (b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

2. Isoamyl Acetate Protocol

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

(a) Odor Threshold Screening

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

- (1) Three 1 liter glass jars with metal lids are required.
- (2) Odor-free water (e.g., distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the solutions.
- (3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly



- (4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.
 - (5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.
 - (6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.
 - (7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.
 - (8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."
 - (9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.
 - (10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.
 - (11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.
- (b) Isoamyl Acetate Fit Test**
- (1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center



- of the chamber shall have a small hook attached.
- (2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.
 - (3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.
 - (4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.
 - (5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.
 - (6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.
 - (7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.
 - (8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.



- (9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.
- (10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste Threshold Screening.

The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

- (1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.
- (2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.
- (3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.
- (4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.
- (5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It



can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

- (6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.
- (7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.
- (8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.
- (9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.
- (10) The test conductor will take note of the number of squeezes required to solicit a taste response.
- (11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

Note to paragraph 3. (a): If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

- (12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.
- (13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.
- (14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

**(b) Saccharin Solution Aerosol Fit Test Procedure.**

- (1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.
- (2) The fit test uses the same enclosure described in 3(a) above.
- (3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).
- (4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.
- (5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.
- (6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.
- (7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.
- (8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
- (9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).
- (10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.
- (11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).
- (12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.



4. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste Threshold Screening.

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

- (1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #14 and #15 combined, is adequate.
- (2) The test enclosure shall have a 3/4 inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.
- (3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste.
- (4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.
- (5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.
- (6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.
- (7) An initial ten squeezes are repeated rapidly and then the test



subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

- (8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.
 - (9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.
 - (10) The test conductor will take note of the number of squeezes required to solicit a taste response.
 - (11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.
 - (12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.
 - (13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.
 - (14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.
- (b) **Bitrex Solution Aerosol Fit Test Procedure.**
- (1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.
 - (2) The fit test uses the same enclosure as that described in 4. (a) above.
 - (3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).
 - (4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to



- distinguish it from the screening test solution nebulizer.
- (5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.
 - (6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.
 - (7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.
 - (8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
 - (9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).
 - (10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.
 - (11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

5. Irritant Smoke (Stannic Chloride) Protocol

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

(a) General Requirements and Precautions

- (1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).
- (2) Only stannic chloride smoke tubes shall be used for this protocol.
- (3) No form of test enclosure or hood for the test subject shall be used.
- (4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to



minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

- (5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

(b) Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

- (1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.
- (2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.
- (3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

(c) Irritant Smoke Fit Test Procedure

- (1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).
- (2) The test subject shall be instructed to keep his/her eyes closed.
- (3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the faceseal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make



two more passes around the perimeter of the mask, moving to within six inches of the respirator.

- (4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.
- (5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.
- (6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.
- (7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.
- (8) If a response is produced during this second sensitivity check, then the fit test is passed.

C. Quantitative Fit Test (QNFT) Protocols

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

1. General

- (a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.



- (b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

2. Generated Aerosol Quantitative Fit Testing Protocol

(a) Apparatus.

(1) Instrumentation.

Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber.

The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

- (3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.
- (4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.
- (5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.
- (6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is



no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

- (7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.
- (8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.
- (9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.
- (10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.
- (11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate or P100 series filter) before release.
- (12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.
- (13) The limitations of instrument detection shall be taken into account when determining the fit factor.
- (14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements.

- (1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.
- (2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.



- (3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.
- (4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.
- (5) A stable test agent concentration shall be obtained prior to the actual start of testing.
- (6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.
- (7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.
- (8) Calculation of fit factors.
 - (i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.
 - (ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.
 - (iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:
 - (A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer



integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

- (B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.
- (C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.
- (D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{\text{Number of Exercises}}{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_6 + 1/ff_7 + 1/ff_8}$$

Where ff1, ff2, ff3, etc. are the fit factors for exercises 1, 2, 3, etc.

- (9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.
- (10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

3. Ambient Aerosol Condensation Nuclei Counter (CNC) Quantitative Fit Testing Protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit



testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements.

- (1) Check the respirator to make sure the respirator is fitted with a high-efficiency filter and that the sampling probe and line are properly attached to the facepiece.
- (2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.
- (3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.
- (4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.
- (5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.
- (6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
- (7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

**(b) Portacount Test Instrument.**

- (1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.
- (2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.
- (3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Controlled Negative Pressure (CNP) Quantitative Fit Testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With

pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds.



Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

- (1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.
- (2) The CNP system defaults selected for test pressure shall be set at -- 1.5 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

(Note: CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)

- (3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.
- (4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.
- (5) The test subject shall be trained to hold his or her breath for at least 20 seconds.
- (6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.
- (7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

(b) CNP Test Exercises.

(1) Normal breathing.

In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.



- (2) **Deep breathing.** In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.
- (3) **Turning head side to side.** Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.
- (4) **Moving head up and down.** Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.
- (5) **Talking.** The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.
- (6) **Grimace.** The test subject shall grimace by smiling or frowning for 15 seconds.
- (7) **Bending Over.**
The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.
- (8) **Normal Breathing.**
The test subject shall remove and re-don the respirator



within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

(c) CNP Test Instrument.

- (1) The test instrument shall have an effective audio warning device when the test subject fails to hold his or her breath during the test. The test shall be terminated whenever the test subject failed to hold his or her breath. The test subject may be refitted and retested.
- (2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

Part II. New Fit Test Protocols

- A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.
- B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:
 1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or
 2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.
- C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this



section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

Appendix B-1 to Sec. 1910.134: User Seal Check Procedures (Mandatory)

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

I. Facepiece Positive and/or Negative Pressure Checks

A. Positive Pressure Check.

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

B. Negative pressure check.

Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

II. Manufacturer's Recommended User Seal Check Procedures

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the



manufacturer's procedures are equally effective.

Appendix B-2 to Sec. 1910.134: Respirator Cleaning Procedures (Mandatory)

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B-2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

I. Procedures for Cleaning Respirators

- A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
- B. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- C. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.
- D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
 1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,
 2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,
 3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
- E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized.



Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

- F.** Components should be hand-dried with a clean lint-free cloth or air-dried.
- G.** Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.
- H.** Test the respirator to ensure that all components work properly.

Appendix C to Sec. 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:

Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: _____
2. Your name: _____
3. Your age (to nearest year): _____
4. Sex (circle one): Male / Female
5. Your height: ____ ft. ____ in.
6. Your weight: ____ lbs.



7. Your job title: _____
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code): _____
9. The best time to phone you at this number: _____
10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes / No
11. Check the type of respirator you will use (you can check more than one category):
 - ☐ N, R, or P disposable respirator (filter-mask, non-cartridge type only).
 - ☐ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).
12. Have you worn a respirator (circle one): Yes / No

If "yes," what type(s): _____

Part A. Section 2. (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes / No
2. Have you ever had any of the following conditions?
 - a. Seizures (fits): Yes / No
 - b. Diabetes (sugar disease): Yes / No
 - c. Allergic reactions that interfere with your breathing: Yes / No
 - d. Claustrophobia (fear of closed-in places): Yes / No
 - e. Trouble smelling odors: Yes / No
3. Have you ever had any of the following pulmonary or lung problems?
 - a. Asbestosis: Yes / No
 - b. Asthma: Yes / No
 - c. Chronic bronchitis: Yes / No
 - d. Emphysema: Yes / No
 - e. Pneumonia: Yes / No
 - f. Tuberculosis: Yes / No
 - g. Silicosis: Yes / No



- h. Pneumothorax (collapsed lung): Yes / No
- i. Lung cancer: Yes / No
- j. Broken ribs: Yes / No
- k. Any chest injuries or surgeries: Yes / No
- l. Any other lung problem that you've been told about: Yes / No
- 4. Do you currently have any of the following symptoms of pulmonary or lung illness?
 - a. Shortness of breath: Yes / No
 - b. Shortness of breath when walking fast on level ground or walking up a slight chill or incline: Yes / No
 - c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes / No
 - d. Have to stop for breath when walking at your own pace on level ground: Yes / No
 - e. Shortness of breath when washing or dressing yourself: Yes / No
 - f. Shortness of breath that interferes with your job: Yes / No
 - g. Coughing that produces phlegm (thick sputum): Yes / No
 - h. Coughing that wakes you early in the morning: Yes / No
 - i. Coughing that occurs mostly when you are lying down: Yes / No
 - j. Coughing up blood in the last month: Yes / No
 - k. Wheezing: Yes / No
 - l. Wheezing that interferes with your job: Yes / No
 - m. Chest pain when you breathe deeply: Yes / No
 - n. Any other symptoms that you think may be related to lung problems: Yes / No
- 5. Have you ever had any of the following cardiovascular or heart problems?
 - a. Heart attack: Yes / No
 - b. Stroke: Yes / No
 - c. Angina: Yes / No
 - d. Heart failure: Yes / No
 - e. Swelling in your legs or feet (not caused by walking): Yes / No
 - f. Heart arrhythmia (heart beating irregularly): Yes / No
 - g. High blood pressure: Yes / No
 - h. Any other heart problem that you've been told about: Yes / No
- 6. Have you ever had any of the following cardiovascular or heart symptoms?
 - a. Frequent pain or tightness in your chest: Yes / No
 - b. Pain or tightness in your chest during physical activity: Yes / No
 - c. Pain or tightness in your chest that interferes with your job: Yes / No
 - d. In the past two years, have you noticed your heart skipping or missing a beat: Yes / No
 - e. Heartburn or indigestion that is not related to eating: Yes / No
 - f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No



7. Do you currently take medication for any of the following problems?
 - a. Breathing or lung problems: Yes / No
 - b. Heart trouble: Yes / No
 - c. Blood pressure: Yes / No
 - d. Seizures (fits): Yes / No
8. If you've used a respirator, have you ever had any of the following problems? (If you I've never used a respirator, check the following space and go to question 9:.)
 - a. Eye irritation: Yes / No
 - b. Skin allergies or rashes: Yes / No
 - c. Anxiety: Yes / No
 - d. General weakness or fatigue: Yes / No
 - e. Any other problem that interferes with your use of a respirator: Yes/No
9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes / No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you ever lost vision in either eye (temporarily or permanently): Yes / No
11. Do you currently have any of the following vision problems?
 - a. Wear contact lenses: Yes / No
 - b. Wear glasses: Yes / No
 - c. Color blind: Yes / No
 - d. Any other eye or vision problem: Yes / No
12. Have you ever had an injury to your ears, including a broken ear drum: Yes/No
13. Do you currently have any of the following hearing problems?
 - a. Difficulty hearing: Yes / No
 - b. Wear a hearing aid: Yes / No
 - c. Any other hearing or ear problem: Yes / No
14. Have you ever had a back injury: Yes / No
15. Do you currently have any of the following musculoskeletal problems?
 - a. Weakness in any of your arms, hands, legs, or feet: Yes / No
 - b. Back pain: Yes / No
 - c. Difficulty fully moving your arms and legs: Yes / No
 - d. Pain or stiffness when you lean forward or backward at the waist: Yes / No
 - e. Difficulty fully moving your head up or down: Yes / No



- f. Difficulty fully moving your head side to side: Yes / No
- g. Difficulty bending at your knees: Yes / No
- h. Difficulty squatting to the ground: Yes / No
- i. Climbing a flight of stairs or a ladder carrying more than 25 lbs:
Yes / No
- j. Any other muscle or skeletal problem that interferes with using a
respirator: Yes / No

Part B Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes / No

If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes / No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes / No

If "yes," name the chemicals if you know them: _____

3. Have you ever worked with any of the materials, or under any of the conditions, listed below:
- a. Asbestos: Yes / No
 - b. Silica (e.g., in sandblasting): Yes / No
 - c. Tungsten/cobalt (e.g., grinding or welding this material): Yes / No
 - d. Beryllium: Yes / No
 - e. Aluminum: Yes / No
 - f. Coal (for example, mining): Yes / No
 - g. Iron: Yes / No
 - h. Tin: Yes / No
 - i. Dusty environments: Yes / No
 - j. Any other hazardous exposures: Yes / No
- If "yes," describe these exposures: _____



4. List any second jobs or side businesses you have:

5. List your previous occupations:

6. List your current and previous hobbies:

7. Have you been in the military services? Yes / No

If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes / No

8. Have you ever worked on a HAZMAT team? Yes / No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes / No

If "yes," name the medications if you know them: _____

10. Will you be using any of the following items with your respirator(s)?

- a. HEPA Filters: Yes / No
- b. Canisters (for example, gas masks): Yes / No
- c. Cartridges: Yes / No

11. How often are you expected to use the respirator(s) (circle "yes" or "no") for all answers that apply to you)?:

- a. Escape only (no rescue): Yes / No
- b. Emergency rescue only: Yes / No
- c. Less than 5 hours per week: Yes / No
- d. Less than 2 hours per day: Yes / No
- e. 2 to 4 hours per day: Yes / No
- f. Over 4 hours per day: Yes / No

12. During the period you are using the respirator(s), is your work effort:

- a. Light (less than 200 kcal per hour): Yes / No



If "yes," how long does this period last during the average shift:
____hrs. ____ mins.

Examples of a light work effort are sitting while writing, typing, drafting, or performing light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

b. Moderate (200 to 350 kcal per hour): Yes / No

If "yes," how long does this period last during the average shift:
____hrs. ____ mins.

Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. Heavy (above 350 kcal per hour): Yes / No

If "yes," how long does this period last during the average shift:
____hrs. ____ mins.

Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).

- 13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No**

If "yes," describe this protective clothing and/or equipment: _____

- 14. Will you be working under hot conditions (temperature exceeding 77^o F):
Yes / No**

- 15. Will you be working under humid conditions: Yes / No**

- 16. Describe the work you'll be doing while you're using your respirator(s):**

- 17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):**



18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):

Name of the first toxic substance:

Estimated maximum exposure level per shift:

Duration of exposure per shift

Name of the second toxic substance:

Estimated maximum exposure level per shift:

Duration of exposure per shift:

Name of the third toxic substance:

Estimated maximum exposure level per shift:

Duration of exposure per shift:

The name of any other toxic substances that you'll be exposed to while using your respirator:

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):

Appendix D to Sec. 1910.134 (Non-Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:



1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirator's limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.
4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.



LAWS

Key Facts

OSHA stands for the Occupational Safety and Health Administration

EPA stands for the Environmental Protection Agency

There are four Federal asbestos regulations you need to know:

The OSHA Asbestos Standard

OSHA's 10-point Respirator Standard for everyone who wears a respirator

NESHAP-EPA's air pollution regulation for any job bigger than 160 square feet, or 260 linear feet of pipe, and 35 cubic feet.

AHERA-EPA's "asbestos in schools" regulations

ASHARA - extends AHERA training requirements

Many states have licensing laws. You cannot do asbestos work in those states without a license.

If a state and the federal government both have a law, the law that protects you more is the one that applies.



OSHA Exercise

This is not a test. It is an exercise. Use it to see for yourself how well understand the material in the chapter. **(Use 29 CFR 1926.1101 in this chapter)**

1. What is the Permissible Exposure Limit (PEL) for asbestos? [(c)]

2. What is the Excursion Limit for asbestos ? [(c)]

3. What is a "regulated area"? [(e)]

4. List five things a contractor has to do when setting up a "regulated area."[(e)]

6. When does your employer have to take personal air samples? [(f)]
7. Who does your employer have to sample? [(f)]
8. List four things you have to do to keep asbestos out of the air. [(g)]
9. When do you have to wear a respirator? [(h)]



10. When does a Powered Air Purifying Respirator (PAPR) have to be used or provided? [(h)]
11. What happens if you can't wear a respirator? [(h)]
12. What are the three rooms in a decon? [(j)]
13. What are some other features of a decon? [(j)]

17. What are the three different ways that asbestos can be controlled on small scale jobs? [Start on page 236]



Discussion Questions

1. Why do the federal government and states both have laws about asbestos?
2. Is the legal limit for asbestos totally safe?
3. Why do you have to keep asbestos out of the air even though you wear a respirator and a suit?
4. Some laws are good, but they are not enforced. What can anyone do to get the laws enforced better?
5. Some laws are not strong enough. What can anyone do to get better laws passed?



For More Information

OSHA, "Asbestos Standard for Construction Industry," Publication No. OSHA 3096. Call (202) 523-9667 or visit www.osha.gov for OSHA publications, or send a self-addressed return label and the name of the publication you want to:

OSHA Publications Office
Room. N-3101 200 Constitution Avenue, NW
Washington, DC 20210

For EPA publications, visit www.epa.gov, call the TSCA Assistance Office at (202) 554-1404, or send a self-addressed return label and the name of the publication you want to:

TSCA Assistance Office
US EPA (TS-799) 401 M Street, SW
Washington, DC 20460



Notes and Scribbles



Notes and Scribbles



CONTROL METHODS, SETUP & REMOVAL

4

In the Control Methods section you will learn:

- How asbestos can be controlled.
- About the kind of asbestos work you may do.

In the Setup section you will learn:

- How to keep asbestos out of the air.
- About wearing a respirator and disposable suit.
- What an asbestos job looks like.
- How to clean the work room.
- How to set up the work room.

In the Removal section you will learn:

- How to enter the work room.
- How to take asbestos off ceilings, walls, and pipes.
- How to keep asbestos out of the air.
- How to bag asbestos waste.
- How to exit the work room.
- How your employer measures asbestos in the air
- How to work with Class I & II asbestos.
- How to remove asbestos from pipes.
- How to use a mini-enclosure and a glovebag.
- About Class III asbestos work.

Control Methods

When asbestos materials are found in a building, the owner of the building must make a decision about what to do with them. The danger from asbestos materials depends on how likely they are to release fibers into the air. Products which are in good shape and are unlikely to be damaged by accident are not a problem. These products can stay in the building and might not be removed until the building is renovated or demolished.

Products which are in bad shape need to be taken care of to prevent fibers from getting into the building air. There are a number of different ways to do this. These are called “control methods.” They are:

- 1. Encapsulation;**
- 2. Enclosure;**
- 3. Repair;**
- 4. Removal; and**
- 5. Operations and Maintenance Program.**

These Control Methods are sometimes used together on one project. For example, a job may involve the removal of 100 feet of pipe covering and repair of an additional 1000 feet or encapsulating most of the ceiling material in a building, but removing of the material which is in areas where the hallway is low.

Usually, asbestos workers will not decide which method to use. That decision is made by the building owner and a consultant. It is then included in the job specifications (specs) for the project.

1. Encapsulation

Encapsulation is the spraying of a paint-like coating over the material. The coating is put on using a low-pressure spray system. When material is encapsulated, the coating prevents release of fibers into the air. The coating can also prevent some damage to the material from contact.

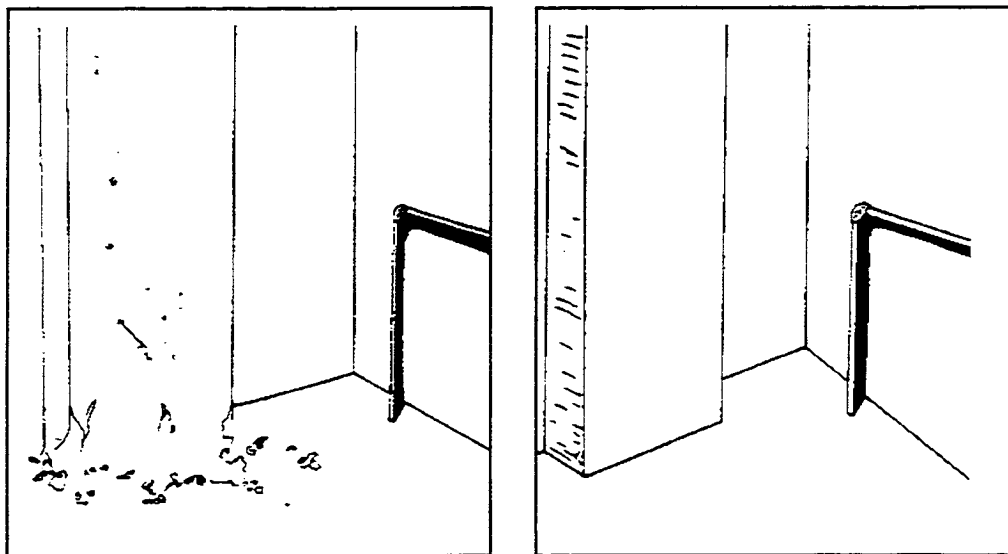
When you work on an encapsulation job you can still be exposed to asbestos fibers. In fact, when the spray of encapsulant hits the material, a small amount of dust is sometimes blown into the air. The material cannot be wetted first, because the encapsulant will not stick. Because of this, an encapsulation job is set up just like a removal job. Workers will also wear respirators and protective clothing while doing encapsulation.

Two kinds of encapsulants are used. One kind is called a **bridging encapsulant**. This kind covers the material with a "tough skin" on the outside. The other kind is called a **penetrating encapsulant**. This kind soaks into the material and binds the material together. The material then becomes hard, like a plaster cast.

When doing encapsulation, workers usually make two passes at the material with the sprayer. This is done to make sure that the asbestos is completely covered. The encapsulant takes some time to dry. Materials contaminated with dust during the job are disposed of as asbestos. This includes plastic barriers, suits, and other items.

2. Enclosure

Enclosure means building an air-tight barrier around the asbestos material. The enclosure is built with non-asbestos building materials. Examples are sheet rock, wood with spline joints, caulked sheet metal, and other materials. **If the barrier is not air-tight, it is not considered an enclosure.** For example, putting in a drop ceiling to control asbestos fireproofing material is not an enclosure.



ENCLOSURE

An enclosure job also requires that a containment be built. Building the enclosure often requires disturbing the material. Workers will also have to wear respirators and protective clothing. If drills or nail guns are used to attach the enclosure, asbestos dust can be released.

Another type of enclosure is sometimes referred to as **encasement**. Encasement means spraying a closed-cell foam directly on an asbestos material or onto a lattice hung below the material. Another example would be to pour concrete onto a dirt floor in a crawl space.

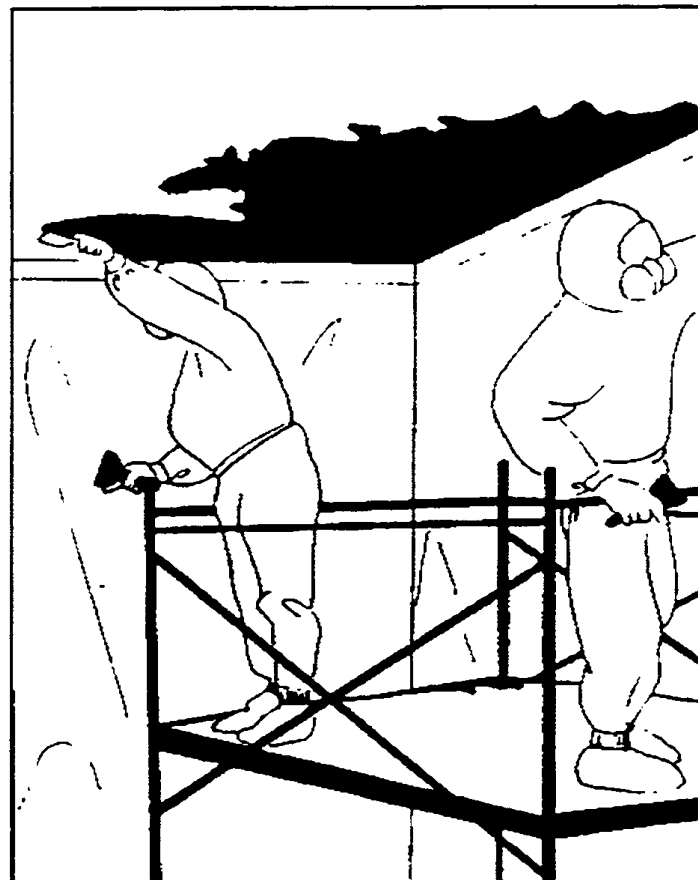
During an enclosure job, disturb the material as little as possible. It is best to use power tools such as drills only if they are attached to a HEPA vacuum. Items from the work area (like plastic sheeting and suits) that get dust on them have to be disposed of as asbestos waste. Other things like power tools must be cleaned before they leave the containment.

3. Repair

Repair is a control method which can be used if there are small amounts of damage to asbestos materials. For example, asbestos pipe insulation might have a canvas covering which is torn. The tear exposes the asbestos fibers and they can be released into the air. By simply wrapping new canvas around the tear and repainting with mastic, the area is repaired.

4. Removal

Removal is the method used most to control fiber release from asbestos materials in buildings. Removal means taking the asbestos off of whatever it is on. It is then bagged and sealed and taken to an asbestos landfill. A removal job must not only remove the material that can be easily seen. Workers will also be doing lots of cleaning. This is because when asbestos is scraped, pulled, or ripped off surfaces or mechanical systems, many fibers are released. These must be cleaned up as a part of the removal job.



REMOVAL



On a removal job you can be exposed to a lot of asbestos dust. This is why strong rules have been made for these jobs. If removal jobs are not done right, workers can be exposed to asbestos. Additionally, a poor removal job can leave more asbestos fibers in the building air than there were before.

5. Operations and Maintenance

An Operations and Maintenance program is a control method used for managing asbestos while it remains in a building. An O&M program should be done in any building which has asbestos building materials in it. The program has a number of different parts. They are listed below.

- A. A list or inventory of all asbestos materials in the building is made. The inventory should include details about the kinds of materials, their location, and their condition.
- B. Asbestos materials in the building should be labeled with stickers to alert workers that they contain asbestos.
- C. Asbestos materials should be inspected on a regular basis (for instance every six months) to see if they stay in good shape.
- D. Training is done for maintenance employees so that they can handle small amounts of asbestos that might be disturbed during their work.
- E. Work procedures are developed for maintenance work. For example: how to safely remove and dispose of a small amount of pipe insulation so that a leaking pipe valve can be repaired.
- F. Proper equipment is provided to maintenance workers so that they can do the work safely.
- G. Procedures are developed for dealing with accidental damage to asbestos materials (fiber release episodes).

The point of the Operations and Maintenance program is to prevent the asbestos materials from releasing fibers into the building. This protects maintenance and service workers, outside contractors (plumbers, electricians, etc.), and other people in the building. All of the parts of the program are important. If some parts are done but others are not, the program won't be successful. An effective O&M program also requires that the building owner have a knowledgeable person on staff to deal with asbestos. The building engineer or someone else should be trained to know about asbestos hazards and how to run the owner's program.

CONTROL METHODS

Key Facts

Asbestos in buildings can be controlled in a number of different ways. The different ways are:

- Encapsulation;
- Enclosure;
- Repair;
- Removal; and
- Operations and Maintenance Program.

Encapsulation means spraying a paint-like coating over the material. This binds the material together.

Enclosure means building an airtight barrier around the asbestos material.

Repair means fixing small areas of damaged asbestos material.

Removal means taking the asbestos material off of whatever it is on, cleaning the material up, and properly disposing of it.

An **Operations and Maintenance Program (O&M)** is a written program. It is needed when asbestos will remain in a building. The program states what training a worker must have. In order to work with asbestos, workers should receive a two-day operations and maintenance training. The written O&M program includes:

- Where asbestos is found. Many asbestos materials should be labeled.
- Worker training requirements.
- Ways to work with asbestos safely. This includes equipment, worker protection, and medical exams.
- Permits which are required before beginning work.
- How to check the condition of asbestos materials and record any changes.



Discussion Questions

1. What kind of material do you think would not be good to encapsulate?
2. Can you see a situation in which more than one control method might be used in an area?

What would you do if...



For More Information

Guidance for Controlling Asbestos Containing Materials in Buildings (“The Purple Book”), U.S. Environmental Protection Agency, June 1985.

Managing Asbestos In Place, A Building Owner's Guide to Operations and Maintenance Programs for Asbestos-Containing Materials, U.S. Environmental Protection Agency, July, 1990.

.....

Notes and Scribbles

SETUP

Setup ...



- Carlos:** We need to set up this room for removal. Let's put on our suits and respirators and start wiping the walls and floors.
- Tom:** I don't need a suit and respirator. It's too hot in here.
- Carlos:** But there's asbestos in this room. You really need to protect yourself.
- Tom:** All the asbestos is in the ceiling. We're not going to disturb it. A respirator and suit in this heat will just slow me down. The supervisor told me that my last setup was too slow.
- Carlos:** I know it's really hot in here, but you need to protect yourself so you don't get sick in a few years.
- Tom:** I don't want to get in trouble for working too slow. This is the first work I've had in 3 months. I need this job.

Discussion Questions

What would
you do if...



1. Do you agree or disagree with the following? Why or why not?
 - Tom and Carlos don't really need to wear a suit and respirator if they are just setting up. **(Yes/No)** _____
 - It's none of Carlos' business if Tom doesn't want to wear a suit and respirator. **(Yes/No)** _____
 - The foreman should put in a fan or air conditioner to cool the room during setup. **(Yes/No)** _____
 - It would be better for Tom to work without a respirator than to risk losing his job. **(Yes/No)** _____
 - If Tom explained things to the foreman, Tom wouldn't get in trouble with him. **(Yes/No)** _____
2. Why is Tom in such a hurry?
3. What could Carlos do to convince Tom to wear his respirator and suit?
4. What could the foreman do to make it easier for Tom to wear his respirator and suit?

KEEP ASBESTOS OUT OF THE AIR

Four basic rules for working with asbestos --

1. Keep the asbestos wet
2. Contain the work area
3. Filter the air
4. Use negative air pressure

No matter how good your respirator is, some asbestos will leak in. So one of the best ways to keep asbestos out of your lungs is to **keep it out of the air**. There are many ways to keep asbestos out of the air. These are called **work practices (or work methods) and engineering controls**.

There are four basic rules for working with asbestos. Follow these rules on all asbestos jobs, whether they are small or large. These rules must be followed from the time you start setting up for an asbestos job to the time you finish one.

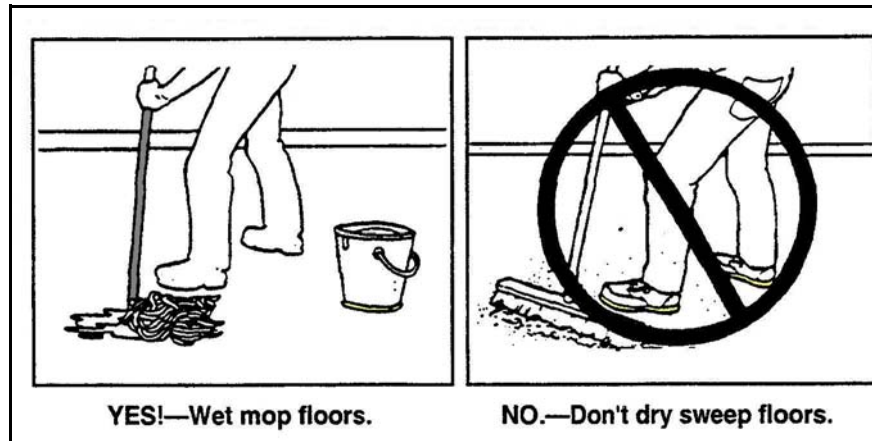
1. Keep the Asbestos Wet

When you work on asbestos, you must keep it wet. Dry, fluffy asbestos can send up a cloud of fibers you can't even see. The fibers are so light they can float in the air for days.

When the asbestos is wet, the fibers stick together. When you spray water into the air, asbestos fibers are trapped by the drops of water. The fibers are pulled down to the ground, out of the air. To make the water soak into the asbestos faster, always add a chemical called **surfactant**. Surfactant makes the water wetter. Water with surfactant in it is called **amended water**.

Get the asbestos wet before you cut it or even touch it. Do this when you are working on a large job or a small one. Do this when you are setting up, removing asbestos, throwing it out, or cleaning up. Wetting asbestos with amended water can reduce asbestos in the air by as much as 90%.





2. Contain the Work Area

Cover the walls and floor of the work room with plastic. Use polyethylene sheet plastic. On the job it is usually called poly (pronounced "polly"). Putting up poly does three things:

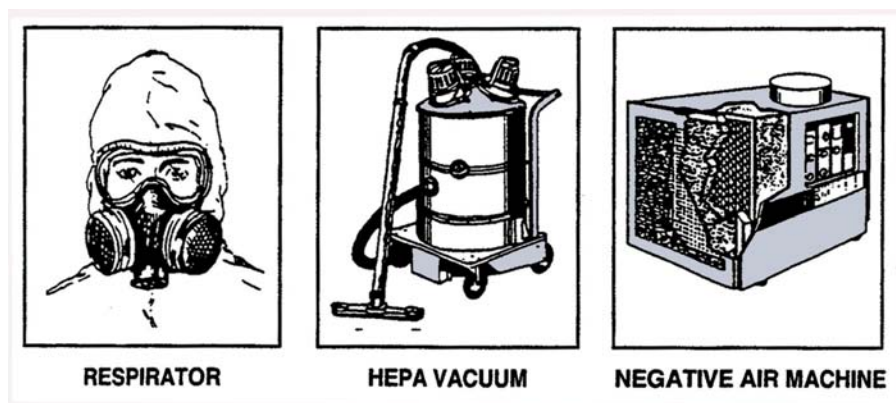
1. It protects the walls and floor from water and asbestos.
2. It keeps asbestos from spreading outside the work area.
3. It keeps everyone but workers away from the asbestos.

The plastic must be nearly air-tight. Put up plastic on large jobs and small jobs. When working on a whole room, use a full containment. When working on a small section of pipe, use a mini-enclosure or a glove bag.

3. Filter the Air

Any air that has asbestos in it must be filtered. You must use a filter that is so fine it can catch the asbestos in the air. It is called a High Efficiency Particulate Air filter (HEPA filter). A HEPA filter takes out 99.97% of all particles .3 microns or larger. (A micron is very small. More than 25,000 microns fit in one inch.) **Air that goes through a HEPA filter is safe to breathe.**

Respirators, vacuum cleaners, and negative air machines (see the next page) **all must have HEPA filters in them** so that the air will be safe to breathe.

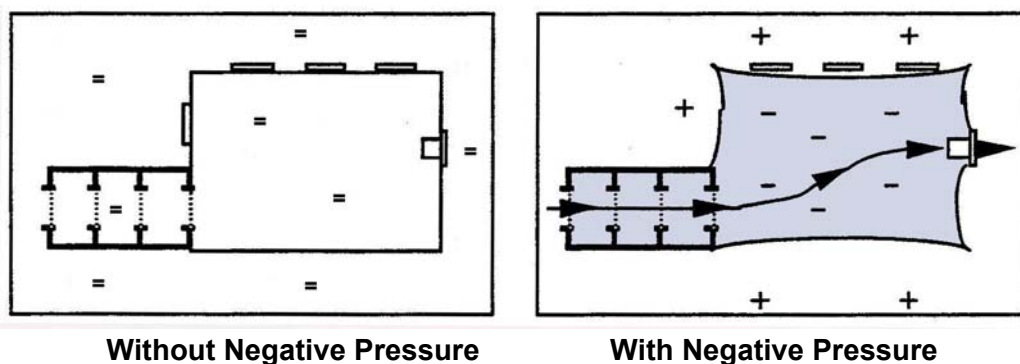


Never use an ordinary shop vacuum for asbestos work. The vacuum has a paper filter that will not trap asbestos. You will blow asbestos into the air. You must use a vacuum with HEPA filters (a HEPA vac) when you work with asbestos.

4. Use Negative Air Pressure

Put a heavy-duty fan with HEPA filters at one end of the work room. This is called a negative air machine. The fan pulls dirty air into the negative air machine. The HEPA filters catch the asbestos. All the air that leaves the room is clean.

The negative air machine also pulls clean air in from across the work room. It makes the work room a little cooler. The negative air machine makes the air pressure inside the room lower than the air pressure outside the room. Inside the room, there is negative air pressure. Asbestos can't leak out of the room, it can only leak in.



Use negative air pressure on both large and small jobs. On a large job, use a negative air machine for negative air pressure. On a small job, use a vacuum with HEPA filters (a HEPA vac) for negative air pressure.

After you follow these four basic rules, there will still be asbestos in the air. You should wear a respirator and a disposable suit every time you work with asbestos.

KEEPING ASBESTOS OUT OF THE AIR

Key Facts

One way to keep asbestos out of your lungs is to keep it out of the air.

Four basic rules for keeping asbestos out of the air --

- 1. Contain the work area with plastic (poly).**
The plastic can be as large as a work room or as small as a glove bag.
- 2. Use negative air pressure.**
Use a negative air machine to clean the air.
- 3. Keep the asbestos wet.**
Wet down the asbestos material before you handle it. To make the water soak into the asbestos faster, add a chemical called surfactant. Water with surfactant in it is called amended water.
- 4. Filter the air with High Efficiency Particulate Air (HEPA) filters.**
 - \ Use a respirator with HEPA filters.
 - \ Use a HEPA vacuum ú ú ú ú ú ú ú
 - \ Use a negative air machine with HEPA filters to clean the air that leaves the room.



Discussion Questions

1. Why not try to spread asbestos fibers around and lower the concentration in the air?
2. Why won't fibers leak out if there is a negative air machine set up?
3. How does surfactant cause water to soak the asbestos?

What would
you do if...



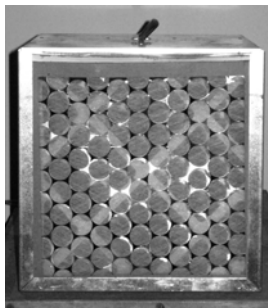
For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, Section g, "Methods of Compliance."

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix F, "Work Practices and Engineering Controls for Major Asbestos Removal...."

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix G, "Work Practices and Engineering Controls for Small-Scale, Short Duration Asbestos Renovation...."

Negative Air Machine – Intake View



First pre-filter



Second pre-filter



HEPA filter

SETUP - OVERVIEW

By now, you know that protecting your lungs with respirators and wearing suits is very important. You also know about some ways to keep asbestos out of the air. One way to do this is to cover the walls and floor with **sheet plastic (poly)**. This keeps the asbestos in the work room. It keeps it out of the rest of the building.

For the rest of this class, you will apply the rules you have learned to a large asbestos removal job. Keep the asbestos wet, contain the work area, filter the air, and use negative air pressure.

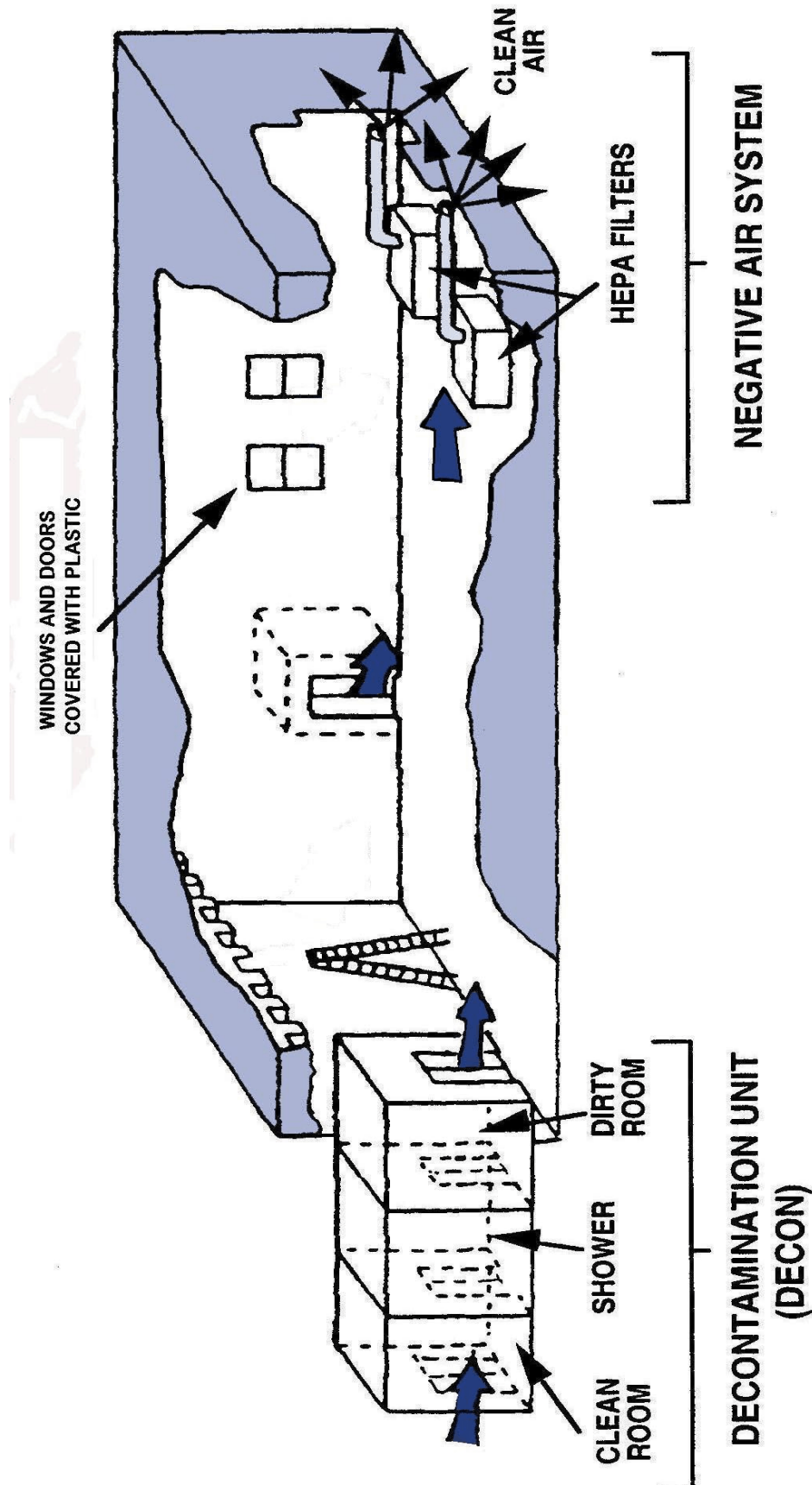
When you take asbestos off a whole ceiling, build a **full containment**. Do this when you take asbestos off a whole run of pipes, or air ducts, or a whole wall or floor. Cover the walls and floor with sheets of plastic (poly). Seal off all the exits except one. Build a **shower unit** (decontamination unit or decon) there. Set up a **negative air machine** at the other end of the room.

Most of this manual is based on what OSHA law says you have to do. In the first part of the class, you learned what kind of respirators **must** be used. You learned that asbestos **must** be wet. This section of the manual is not based on a law. OSHA law does not say how many layers of poly (sheet plastic) **must** be used. It does not tell you how many negative air machines **must** be used. (Some state laws do tell you how many layers of poly, etc., you must use.) This manual describes "**state-of-the-art**" work practices. State-of-the-art work practices are the work practices considered to be the best. OSHA law does not say you have to put **two** layers of poly on the floors. But so many companies do this that you will find it on most jobs. It has become "standard operating procedure."

Some things on your job may be different from what you learn in this section of the manual. Many states have regulations that are more strict than OSHA regulations. You must follow state regulations **in addition to** OSHA regulations.

Class I Setup

Experienced asbestos companies know that a good setup is at least 40% of an asbestos job. When working with thermal system insulation or surfacing materials (Class I), you have to cover the room with sheet plastic. You have to turn off the ventilation system. Class I asbestos work requires more preparation than any of the other classes. You have to clean and protect the



CLASS I WORK ROOM



room. You have to bring in extension cords. Good setup makes the rest of your job much easier. It also prevents many safety problems.

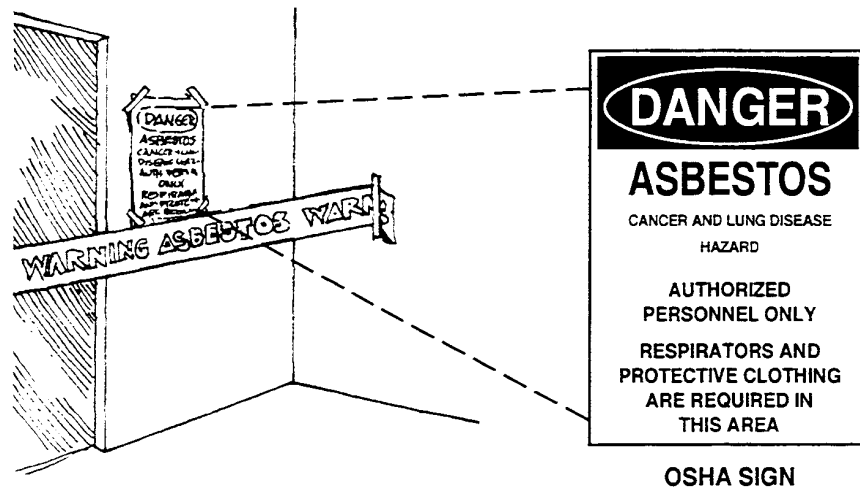
The building owner will probably hire someone to write up contract specifications (specs). The specs should tell you how many layers of poly to use. They should tell you how to set up the work room. Setup must be supervised by a trained supervisor. The supervisor is called the "competent person."

Before you do any work, find out if you need to put on a suit and respirator. Set up the work room in this order:

1. Put up warning signs and barrier tape.
2. Shut off the ventilation system.
3. Shut off the electrical system.
4. Bring in extension cords.
5. Build the decontamination unit (decon).
6. Cover all openings to the room with plastic.
7. Clean everything in the room.
8. Throw out what you can't clean.
9. Take out anything you can move.
10. Wrap anything you can't move in poly.
11. Hook up and test the negative air machine.
12. Put poly on the floor.
13. Put poly on the walls.
14. Bring scaffolds and tools into the room.
15. Position decontamination unit.

1. Put Up Warning Signs & Barrier Tape

Put up a barrier outside the work room. This will keep non-workers out. Hang asbestos warning signs on the barrier. The signs must look exactly like the one on the next page. The signs should be at eye level. They should be in a language that building users can read.



2. Shut Off the Ventilation System

The ventilation system carries air through the building. **It can carry asbestos through the building.** Asbestos goes where air goes. The ventilation system for the work room must be shut off. Shut off the system at the electrical box. Lock the box and label it with a tag. The ventilation system is often called the **HVAC system**. HVAC stands for Heating, Ventilating, and Air Conditioning.

3. Shut Off the Electrical System (Lockout/Tag-out: 29 CFR 1910.147)

Asbestos jobs are wet. Electrical shocks are one of the worst dangers on an asbestos job. Water can leak into an electrical outlet and kill you. The electrical system must be shut off. Shut off the system at the electrical box. Lock the box and label it with a tag. Turning off wall switches is not enough. **Someone who doesn't know about asbestos work could electrocute you by mistake. Never take another worker's lock off of a box.** Machines also have to be shut off. A machine with moving parts could hurt someone. It has to be turned off and locked so that people can work safely around it. Steam pipes have to be shut off, too. Let the pipe cool for at least 12 hours before working on it.





4. Bring in Extension Cords

Negative air machines, safety lights, HEPA vacuums, and hand tools all need power. Bring in extension cords for all equipment. Extension cords are sometimes called **temporary wiring**. **Tape cords onto the walls so that workers won't trip on them. Do not hang cords with metal wire.** This could cause a shock.

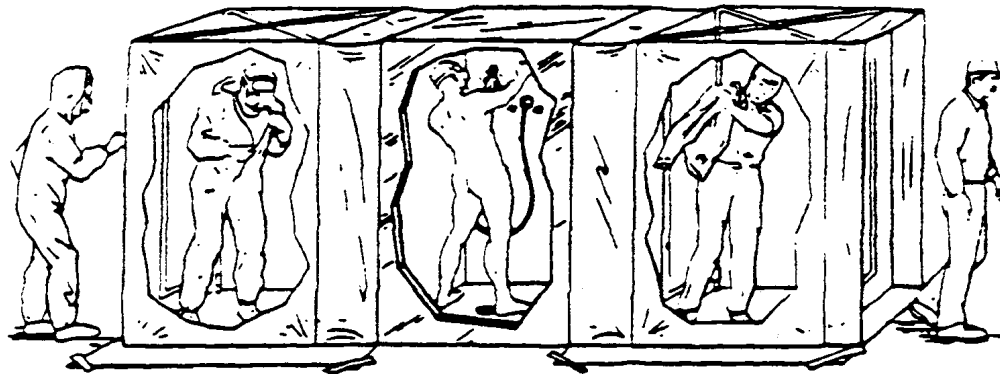
Cords should be hooked up to sensitive circuit breakers. These are called **Ground Fault Interrupters(GFIs)**.

5. Build the Decontamination Unit (decon)

You go into and leave the work room through a special room. It is called the decontamination unit (decon). The decon has a shower. Every time you leave the work room, you must take a shower. Don't take asbestos with you out of the work room on your body.

The decon has three rooms. They have to be in this order (starting from the work room) --

Dirty room — Shower — Clean room



The decon is lined with two layers of poly and duct tape. The rooms have plastic flaps between them. The flaps keep air from moving out, but let air come in. Seal the decon air-tight to the work room.

Some decons have extra empty rooms (air locks). These keep air from moving out through the decon. Some new decons have solid doors with gaskets (rubber strips around the edge). Air comes in through HEPA

filters or flaps built into the walls of the decon or work room.

Some contractors build their own decons. They use wood, pipes, poly, spray glue, and tape. Some contractors use hard plastic decons. Others use decon trailers that go outside the building. An outside decon should be windproof and waterproof. Use plywood and 16-mil reinforced poly on the floor.

Sometimes a separate decon is built for waste bags and tools. This is called a waste load-out.

6. Cover All Windows and Openings to the Room

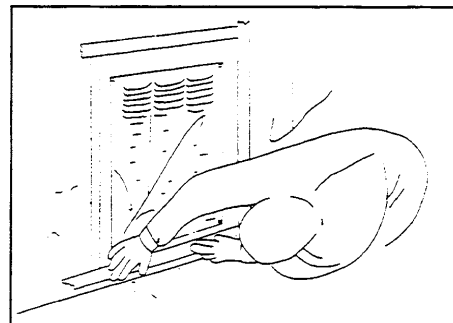
In the work room, air should only come in through the decontamination unit (decon). Air should only go out through the negative air machine. Seal up any other places where air can go into or out of the room. Cover windows and doors with two layers of poly and duct tape. Leave one window prepared for the negative air machine's clean air exhaust.

Cover all these places --

- windows
- electrical outlets
- light wells (where lights were taken out)
- air vents
- doors
- pipe chases (where pipes go through a wall)

Cover air vents with two layers of poly. Seal them with duct tape. Seal the poly so that no water and no air can get in or out. Cover light wells with two layers of poly and duct tape. If you can't take the lights out, seal them up with poly and tape.

Putting poly over windows and their openings forms what are called "**critical barriers.**" (Sometimes they are called "**primary barriers.**")



COVER AIR VENTS WITH POLY

7. Clean Everything in the Room

You might do a great job of scraping the asbestos off a ceiling. But what about the asbestos dust that was on the floor before you started the job? If you can see asbestos dust on surfaces, it must be cleaned up. If you don't clean before you take off the asbestos, the room will still be dirty at the end of the job. **Clean everything in the room before you put up the poly**

(plastic). Use damp rags and HEPA vacuums.

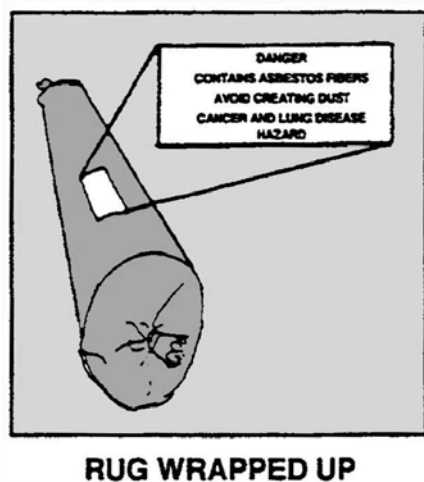
When you clean, you may get asbestos in the air. Even if you can't see it, the asbestos may be there. **As soon as you start to handle asbestos, put on a respirator. Your employer should test the air.** You must have permission from a doctor before you may wear a respirator. You must pass a fit test before you may wear a respirator.

Clean everything in the room --

- walls
- floors
- window sills
- furniture
- air vents
- electrical outlets
- paintings
- posters
- books
- office equipment
- office supplies
- machines
- circuit breakers
- fuse boxes
- lights

Clean air vents with damp rags and HEPA vacuums. Take the grates out of the work room. Wet the filters and throw them out with the asbestos. Clean electrical outlets with HEPA vacs. Clean circuit breakers and fuse boxes. Clean the lights inside and out.

Clean carefully, starting at the top of the walls and working down. Otherwise you will spread asbestos onto places you've already cleaned. The rags have to be thrown out with the asbestos.



8. Throw Out What You Can't Clean

Rugs and fabric on furniture should be steam cleaned. If they can't be cleaned, they should be thrown out. Wrap the rug in two layers of poly. Seal it up with duct tape and put a label on it. The label must look like this one. Send the rug to an asbestos landfill.

9. Take Out Anything You Can Move

Move anything you can out of the room --

- chairs
- desks
- cabinets
- office supplies
- equipment
- paintings
- books
- air grates
- lights

There is no excuse for piling furniture in a corner of the room. Even if you cover it with poly, it will get asbestos or water on it. Lights should always be taken out unless they can be sealed up.

10. Wrap Anything You Can't Move in Poly

If you can't move machines, seal them up. Wrap them in two layers of poly and duct tape. Put tape on all of the seams. Tape the poly to the floor. The poly has to be totally sealed, not just draped over the machine.

Sinks and water fountains also have to be sealed in two layers of poly. Shut them off at the valve. Label them with DO NOT DRINK signs. **You may not use the sinks or electrical boxes in the room during the job.**

Seal up electrical boxes, blackboards, thermostats, alarms, and anything else that must stay in the room.

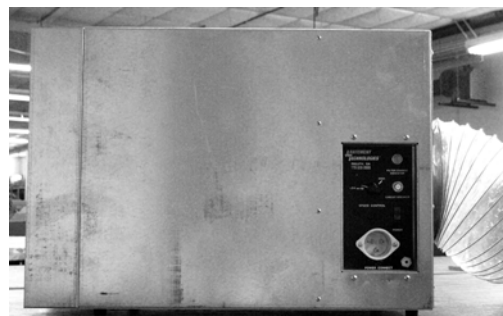
In places like boiler rooms you may have to seal off a working machine. This is hard, since poly will melt and can burn at 150° F. Machines give off heat and may also need air to work. You have to keep asbestos out of the machine without starting a fire. Experienced companies know how to seal off working machines.

11. Hook up and test the negative air machine

The clean air from the negative air machine goes out a window. The seal at the window has to be air-tight. Cut holes in a piece of plywood and tape the hose in. If you are working in a large room, there will be more than one machine.

Put the negative air machine as far away as possible from the decon. Air should be pulled across the longest possible distance from the decon. You may have to use hoses if the only window in the room is right next to the decon. If there is more than one machine, they should all be on the side of the room farthest from the decon.

When the negative air machine is on, air comes into the room through the decon. The negative air machine should be on 24 hours a day. **Air should only leak in, not out.** Sometimes extra holes are cut in the poly so that enough air will come in. This is called **makeup air**. These holes **must** be covered on the inside with plastic flaps or HEPA filters in case the negative air machine shuts down.



Control panel side view of a negative air machine.



12. Put Poly on the Floor

The first layer of poly goes on the floor. **Cut the poly big enough so that it goes up the walls at least one foot.** Tape all the way around the edges of the poly. The idea is to build a water-tight plastic bubble inside the room. The poly on the floor should catch all of the asbestos and water. Air and water should not leak out.

Try to cover the whole floor with one piece of poly. If there are seams in the poly, they have to be sealed. Overlap the pieces of plastic 6 to 12 inches. Use **spray glue** (glue in a spray can) and duct tape. It is a good idea to put a line of blue carpenters chalk under the seams. If water and asbestos leak through, they will make the chalk dark. Then you can clean up the leaks before they damage the floor.

There may be seams in both layers of poly. Put the seams at least six feet apart. Then a leak in the top layer of plastic won't leak through the bottom layer.

There are gases in spray glue that can make you sick. Use a respirator “combo” filter that protects you from both spray glue (vapors) and asbestos (fibers).



13. Put Poly on the Walls

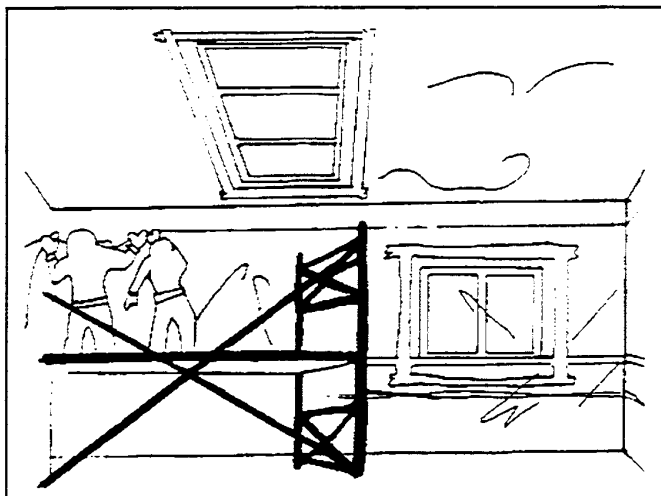
Cut the poly big enough so that it comes down at least one foot onto the floor. There should be at least a two foot overlap between the poly on the floor and on the walls.

Tape the poly to the top of the walls. Tape it two or three inches below the ceiling so that you can clean the corner. Don't tape it one or two feet down from the ceiling. Remember, the poly has to make an air-tight and water-tight bubble inside the room. It protects the walls from asbestos and water. If the top of the wall is not covered, it may get asbestos on it. It will probably be damaged. Tape all the way around the edges of the poly at the bottom.

Poly is heavy, and duct tape can come loose when it's wet. Duct tape and spray glue may not be strong enough to hold the poly on the walls. You may have to nail furring strips (small pieces of wood) to the walls. Staple the poly to the furring strips. Put duct tape over all the staples and the edge of

the poly, Put two layers of poly on the floor and two on the walls. If there is a leak, the asbestos will get on the poly, not on the floor or walls.

Another way to cover the walls and floor is with **spray poly**. This is liquid polyethylene plastic. It is sprayed onto walls and floors with a low-pressure sprayer. You have to put regular poly on the windows and doors first (critical barriers). **Spray poly has ammonia in it.** Use a respirator filter that protects you from both ammonia and asbestos.



PUT POLY ON THE WALLS

Work rooms can be dark and confusing, especially in an emergency. It is a good idea to make some arrows out of bright tape at different heights on the walls that point the way to the decon. In an emergency, the arrows will show you how to get out of the work room.

14. Bring Scaffolds and Tools into the Room

Scaffolds may be too big to bring through the decontamination unit (decon). Bring the scaffolds in before the decon is hooked up. Put tape over the ends of the scaffolds so that asbestos won't fall in. Bring in any large equipment. Be sure that all the tools you need are in the work room before removal begins.

15. Position Decontamination Unit

Now that all of the large, bulky equipment is inside the work area, you may move the decon into position. From this point on everyone and everything that enters the work area will do so through the decon.



Testing the Negative Air Pressure

The negative air machine should pull the plastic doors in the decon toward the machine. You can test the negative air pressure in the room. Use a machine to puff chemical smoke from outside the clean room. The air and

smoke should be pulled in through the decon. The smoke should be sucked in, not drift out through cracks. Test the seals on primary barriers to make sure they are really air-tight. You have now built an air- and water-tight bubble which is under negative air pressure. The negative pressure enclosure must be smoke tested before the job starts and **before each shift**.

Class II Setup

The removal of ACM that is not thermal system insulation or surfacing material is considered to be Class II work. Class II ACM materials include roofing and siding shingles, floor tile and sheeting, wallboard, ceiling tile, and construction mastics. Working with Class II asbestos materials is not considered to be as dangerous as working with Class I materials. Class II asbestos work does not require quite as much setup as Class I work.

You may not have to wear a respirator and protective clothing when doing this kind of work. Your supervisor will make this decision before you begin working. It is important to remember that even when you aren't suited up, you must still be careful to keep asbestos fibers out of the air. The Class II work area should be setup in the following order:

1. Put up warning signs and barrier tape.
2. Shut off the ventilation system.
3. Shut off the electrical system.
4. Bring in extension cords.
5. Cover all openings to the room with plastic (poly).
6. Clean everything in the room.
7. Throw out what you can't clean.
8. Take out anything you can move.
9. Wrap anything you can't move in poly.
10. Bring scaffolds and tools into the room.
11. Put poly on the floor.

In addition, if there is no negative exposure assessment for the job, then



all openings to the room must be covered with plastic (poly). The same is true if the material is not being removed intact. For example, if floor tiles are being removed by breaking and chipping them up off the floor, then all vents, outlets, doors, windows, etc., must be covered with plastic. When working on a roof, all air intake vents must be sealed in plastic.

Decontamination

On Class II jobs, decontamination areas consist of an equipment room large enough to allow the workers space to clean themselves and their equipment. It is positioned directly next to the work area so that all employees must enter and exit through it. The room must have a plastic-lined floor to keep any debris from spreading beyond the established area.

SETUP Key Facts

Always wear a suit and respirator when you work with asbestos.

1. Put up warning signs and barriers at eye level.
2. Shut off the ventilation system.
3. Shut off the electrical system. Lock the electrical box.
4. Bring in extension cords and tape them up off the floor.
5. The decon has three rooms (starting from the work room): Dirty room (Equipment room) - Shower - Clean room.
6. Poly all doors, windows, air vents, pipe chases, and electrical outlets.
7. Clean everything in the room before you put up poly.
8. If you can't clean something, wrap it in poly, label it, and take it to an asbestos landfill.
9. Take out anything you can move.
10. If you can't take something out of the work room, seal it air-tight and watertight with poly and duct tape.
11. Set up the negative air machine at the other end of the room from the decon.
12. Tape one layer of poly on the floor, going up the walls one foot. Tape the edges of the poly to the walls.
13. Put one layer of poly on the walls. Tape the edges of the poly to the floor. Put another layer of poly on the floor and the walls.
14. Bring scaffolds and tools into the room before you build the decon.
15. Position the decontamination unit.

Discussion Questions

1. Why shouldn't the electricity be turned off at the wall switches?
2. Why are two layers of poly put on the floor?
3. Some state laws say you have to put plywood on the floor if you leave carpets on the floor when you remove asbestos. Why is this done?
4. You have to protect yourself from asbestos when you set up. What other dangers do you need to think about when setting up?
5. You are about to start a project where the material being removed is on the ceiling of a computer room and the computers cannot be shut down. How could you do the preparation of the work area?
6. You are working on an asbestos removal job in a multi-storied building. Several elevators run through the middle of the floor. What kinds of problems does this pose? What could you do to solve them?



For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix F, "Work Practices and Engineering Controls for Major Asbestos Removal."

Georgia Tech Research Institute, Chapter VI, "Pre-Work Activities and Considerations" and "Preparing the Work Area and Establishing the Decontamination Unit" in "Model Curriculum for Training Asbestos Abatement Contractors and Supervisors," available from National Technical Information Services, (703) 487-4650.

EPA, "Guidance For Controlling Asbestos-Containing Materials in Buildings," ("Purple Book") EPA Publication No. EPA 560/5-85-024.

National Institute of Building Sciences, "Temporary Enclosures," in Model Asbestos Abatement Guide Specification, Section 01526.

CLASS I & II ASBESTOS REMOVAL



Work Methods ...



- Ed:** Hey! Slow down up there! You 're scraping that plaster off faster than I can bag it!
- Jeff:** Don't worry. Just bag as fast as you can. I'll help you clean up the rest as soon as I finish the ceiling.
- Ed:** But the longer we leave the asbestos on the floor the more fibers will get into the air.
- Jeff:** No problem. Your respirator will protect you.
- Ed:** Respirators will only protect you so much. You really need to slow down.
- Jeff:** Listen. My job is to do the scraping. If you can't keep up, that's **your** problem. ➡

Discussion Questions

(Choose one or two of the following questions to discuss.)



1. Who is right, Ed or Jeff?
2. Is there anything wrong with leaving asbestos waste on the floor instead of bagging it right away?
3. Why should you be concerned about stirring up fibers if you are wearing a respirator?
4. Do you agree or disagree with the following statements?
Why or Why not?
 - Ed should work faster to keep up with Jeff. **(Yes/No)** _____
 - Jeff should slow down so Ed can keep up. **(Yes/No)** _____
 - Ed should have a partner to help him clean up faster. **(Yes/No)** _____
5. Why do you think Jeff is in a hurry?
6. What could the supervisor do to make sure the asbestos is bagged as soon as it is scraped?

Class I Removal

Four basic rules for working with asbestos:

- ❖ **Keep the asbestos wet;**
- ❖ **Contain the work area ;**
- ❖ **Filter the air; and**
- ❖ **Use negative air pressure.**

Good setup makes the work of taking the asbestos off the ceiling much easier. **Taking off asbestos safely means using the basic rules we've talked about all through this manual.** You have to keep the asbestos wet, contain the work area, filter the air, and use negative air pressure. You also have to use respirators that fit right and disposable suits.

Entering the Work Room

When you go into the work room, start in the clean room of the decon. In the clean room, take your street clothes off. Put them in a locker. Inspect your respirator. Put it on and do the negative and positive pressure seal checks. Make sure your respirator fits.

Inspect your suit and put it on. Use duct tape to make it fit right so you won't trip over it. Pull the hood of the suit over the respirator straps. Tighten the hood around your face.

Walk through the shower room into the dirty room. Put on any gear stored there. You might put on boots, hard hats, or a belt for your respirator hose. Pick up scrapers, squeegees, and other tools. If you are using a Type C respirator, the hookup is usually in the decon.



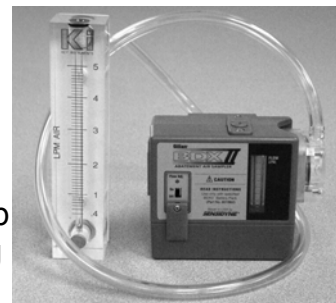
AIR SAMPLING PUMP

Some workers will put on pumps. These are called personal air sampling pumps. At least one worker doing each type of job should wear an air sampling pump. They are small air pumps that you wear on your belt. A hose goes over your shoulder. A small paper filter clips on your collar. The filter faces down. The pump pulls air through the filter. The pump should be on all the time you are working. Asbestos in the air is caught on the filter. Your employer sends the filter to a lab. The lab tells him how many fibers are in the air when you are working.

Never touch the filter when you are working. This will interfere with the air sample. You need good air samples to be sure you are wearing the right respirator.

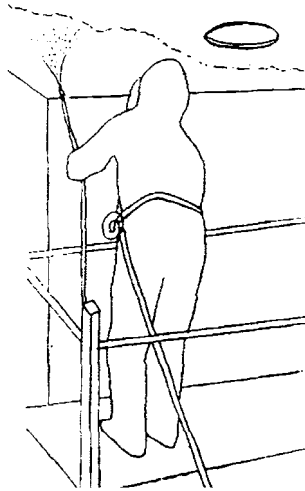
Personal air sampling tells you how much asbestos is in the air. Then your supervisor will decide which respirator you will wear. When there is more asbestos in the air, you have to wear a respirator with a higher Protection Factor.

Personal Air
Sampling Pump
with Calibrating
Rotometer



Keep the Asbestos Wet

The first step in taking off the asbestos is getting it wet. Wet the asbestos before you remove it, while you remove it, and after you remove it.



KEEP THE ASBESTOS WET!

Use a low pressure sprayer or a garden sprayer. Amended water is water that has a surfactant, a detergent, added to it. Amended water soaks the asbestos better than plain water. The asbestos may turn a darker color or swell a bit. Sometimes asbestos is in a paper cover. Make a small hole in the paper and spray water inside it.

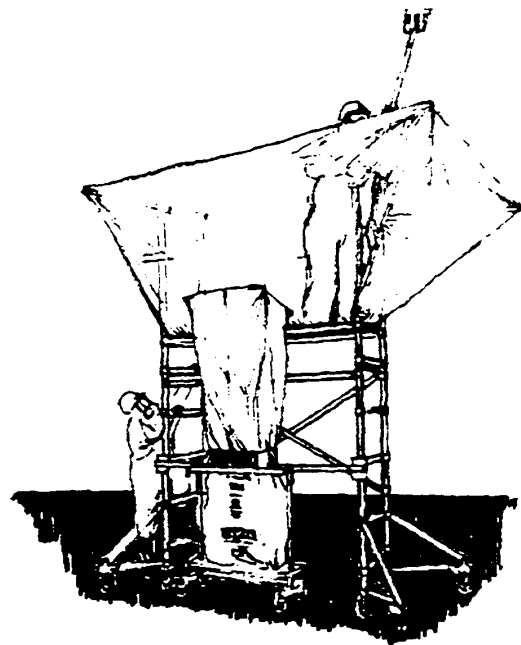
At least one worker should wet the asbestos as the work goes on. He or she should make sure that the asbestos on the ceilings, pipes, etc., is really wet. The worker should mist the air as the work goes on. Drops of water will catch the asbestos in the air and pull it down to the floor. The worker should wet the asbestos on the floor until it is put in bags.

Don't use too much water. The work area should be damp, not flooded. If you use too much water, it will make puddles on the floor. The water could leak through the poly or make someone slip. Remember that water will not soak into amosite asbestos. **Never use water on live electrical lines. You could get a bad shock. Never use water on a hot steam line. The water could boil and burn you.** At least one sprayer on each shift should wear an air sampling pump.

Scraping

Once the asbestos is wet, it is usually the texture of cooked oatmeal. You can easily scrape it off with metal or plastic scrapers. You may have to use ladders, scaffolds, or long-handled scrapers to get to the asbestos. It is safer to use a scraper with a long handle than to stand on a scaffold.

Take asbestos off pipes with scrapers and utility knives. You may need snips to



cut wire or metal bands. Chicken wire can be sharp. Use the right tool to cut the metal. You can burn yourself on a hot pipe. Wear gloves to protect your hands. Asbestos may be in wire lath, which is heavy and sharp. You may need a hard hat or steel-toed boots to protect you from falling material or tools.

As you take asbestos off, don't throw it. Don't drop it more than 10 feet. If you work on a high ceiling, bag the asbestos on the scaffold or lower it to the ground.

Never use an air gun to blow the asbestos off. Scrape it or cut it off. Some contractors now use water guns on high ceilings. Water guns have some problems. Air samples show that they blow a lot of asbestos into the air. High-pressure water or air can force the asbestos into cracks or blow it out of the work room.

After you scrape off the big pieces, there will still be some asbestos on the ceiling. Use a nylon brush to take off all the asbestos. **Wire brushes break the asbestos into smaller, more dangerous fibers.** Be sure to scrub off all the asbestos. Wipe the surface with a damp rag until you can't see any asbestos. At least one scraper on each shift should wear an air sampling pump.



Bagging

A few workers will use **plastic** shovels and squeegees to bag the asbestos as it is taken down. (Metal shovels can rip the poly.) Be sure the asbestos is wet when you put it in the bag. **Bagging asbestos right away is one of the best ways to keep asbestos out of the air.**

Asbestos must be put in sealed containers (bags or drums) with warning labels. The asbestos will dry out if it sits on the floor or piles up. When workers walk through it, a lot of asbestos will get in the air.

When you bag asbestos, use the following process:

1. **Tape the bag**

Use a HEPA vac to pull the air out of the bag. Then twist the top of the bag. Tape around it.

2. **Gooseneck the Bag**

Double the top of the bag back on itself. Tape





around it again. This is called "**goosenecking**" the bag. Tying a knot in the top of the bag will not make a water-tight seal.

3. Use Double-bagging

On the job, workers usually put one bag inside another. If the first bag breaks, asbestos won't leak out. This is called **double-bagging**.

Put sharp metal lath in cardboard drums. Wrap large pieces of waste (like carpets) in two layers of poly and tape them up. Put a label on the poly.

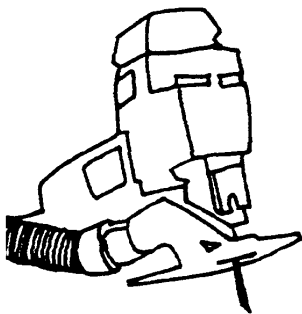
Keep the floor dry so that workers won't slip. Use a wet/dry HEPA vac to pick up small amounts of asbestos and water. (Water will ruin a dry HEPA vac.) At least one worker bagging asbestos on each shift should wear an air sampling pump.



Special Tools

Use plastic or wood tools, such as scrapers, shovels, and squeegees. Metal tools can rip the poly. They can also cause electric shocks.

Use special power tools on an asbestos job. They must have a HEPA vac attached. (This is called local ventilation or local exhaust



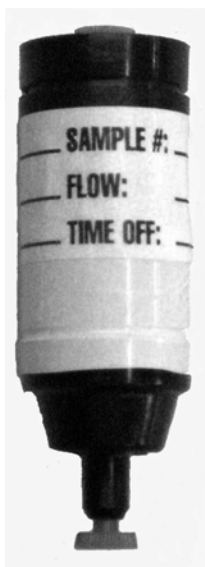
SPECIAL TOOLS

ventilation.) Never use a regular shop vacuum. You should not use a regular drill, saw, or other power tool. All tools should have HEPA vacuums attached to them.

Power tools should be double-insulated. They should also be grounded. This means they won't shock you, even if they are wet.

Filters in the negative air machine need to be changed many times a day. Be sure they are wet before you put them in a waste bag.

Always wear your respirator and suit inside the work room. If your suit tears, fix it with duct tape. If you have to put on a new suit, you must decontaminate first. **You may not eat, drink, chew gum, chew tobacco, or smoke in the work room.** To do that, you would have to take your respirator off. **Don't do it!**



Air Samples

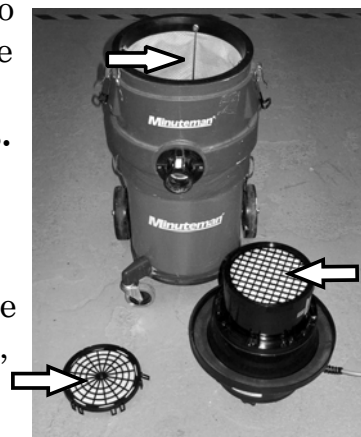
Your employer must take 8-hour air samples from some workers on every shift. (There are a few exceptions.) Your employer has to know how much asbestos is in the air under the worst conditions. Usually, 1/4 of the workers wear sampling pumps each day.

Personal air samples also tell you whether you're doing the work right (keeping asbestos out of the air). If air samples show a lot of asbestos in the air, you should be sure that the asbestos is really wet, that the negative air machine is working, and that asbestos isn't piling up on the floor.

Building owners sometimes take air samples outside the work room. They want to know if asbestos is leaking out of the work room. These are called area air samples. You may see air sampling pumps outside of the clean room. You may also see them outside the negative air machine or outside the building. **Even if your employer takes area air samples, the employer also has to sample workers.**

Clean Up Every Day

Clean all of the asbestos off the floor at the end of every day. Use wet rags and HEPA vacuums to clean the poly. It is easy to rip poly. Shovels, scaffolds, equipment, and tools can all rip the poly on the floor. A supervisor must check the poly at the end of every day and fix any rips or holes right away.



The three filters of a HEPA vacuum.

Decontamination

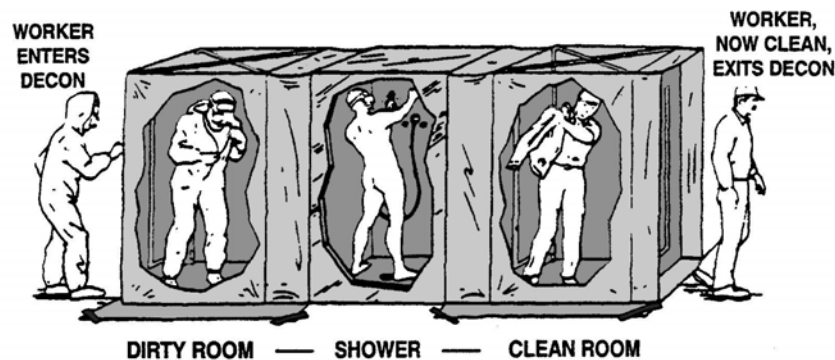
You must go through decontamination every time you leave the work room. When you leave the work room, clean off your suit and respirator. In the decon take off your suit, take a shower, and wash your respirator. Leave the asbestos behind you.

In the work room, clean off your suit with a damp rag. Go into the dirty room (this is also called the **equipment room**). Take off your hard hat, boots, and any other dirty equipment. Take off your air sampling pump and turn it off. Wipe off your equipment and leave it in the dirty room.

Take off your suit carefully and throw it out. Fold it inside out as you take it off. Try to keep the asbestos on the suit and off your skin. Leave

your respirator on, and get into the shower.

Wash off the outside of your respirator. Rinse your face and the rest of your body. Take the dirty, wet filters off your respirator and throw them out. You can also put tape on the outside of the filters and put the filters in a bag. Remember that water destroys HEPA filters. If your filters get wet, you must throw them out. Take off your respirator and wash it with soap and water. Wash your body and your hair with soap and water. In the clean room, put on street clothes or another disposable suit.



The shower must have warm water, towels, and soap. There must be one shower for every ten workers. If men and women both work on the job, they will shower separately.

You must decontaminate every time you leave the work room. Every time you take a break, you must decontaminate. Every time you go to the bathroom, wash your face, eat, drink, or smoke a cigarette, you must decontaminate. You must throw out your suit, wash your respirator, and take a shower. On the way back in, you have to put on another suit. You can't take short cuts with decontamination. You may decontaminate four or more times each day.

At the end of the day, clean the decon. Use wet rags and HEPA vacuums. Clean up any asbestos you can see. Seal up the bag with dirty suits and respirator filters. The clean room should be wet-wiped each day.

Air Sampling

At the end of the day the filters from the air sampling pumps go to a lab. At the lab, the technician cuts a small piece of the filter. The technician dissolves the filter and counts the asbestos fibers under a microscope. The microscope is called a **Phase Contrast Microscope (PCM)**.





The lab sends your employer a report of the results. The report has the number of asbestos fibers per cubic centimeter of air (fibers per cc or f/cc). **Your employer must post the air sampling results as soon as he or she gets them from the lab.** Here's an example of a lab report.

Received: 02/27/94 SAMPLE ID: AH-129				
ABC ANALYTICAL LAB, INC. REPORT				
NAME: Asbestos Air Sample Analysis DATE ANALYZE : 02/28/94 ANALYST: Christopher VERIFIED BY: LAL				
Sample Number	Location	Sample Duration (Minutes)	Sample Volume (Liters)	Total Fiber Concentration (f/cc)
ASD-267	Personal sample, inside enclosure, on W. Mata scraping and bagging.	30	59	2.75
ASD-268	Personal sample, inside enclosure, on P. Moses bagging and wetting.	388	577	1.07
ASD-269	Personal sample, inside enclosure, on L. Lane cleaning and spraying.	365	601	0.32
ASD-270	Personal sample, inside enclosure, on J. Cromley scraping.	379	598	3.50

In this example, an employer sent some air samples to a lab. The lab reported how much asbestos was in the air for each worker. The numbers on the right show the number of fibers per cc. The second column from the left shows who the sample was taken from. The first sample was taken from Mr. W. Mata. His sample had 2.75 fiber of asbestos per cc in it. He was scraping asbestos and bagging it.

Asbestos Cleanup Jobs

Most asbestos jobs are planned ahead of time. But sometimes you may work on a job that wasn't planned. If there is an accident – a fire, or a flood, or a ceiling falls in – you may have to go and clean up the asbestos. The building owner has to shut off the ventilation and electricity as soon as the accident happens. The building owner must also get people out of the area and put up OSHA signs to keep non-workers out.

If you clean up an asbestos spill, you can't just walk in and put up poly.

You have to make sure that the building will stay up while you take out the asbestos. Is the electricity shut off? Is the fire totally out? Once you are sure the building is safe, then you can think about the asbestos. After you set up, the job will look just like any other removal job. You will have to put up plastic, build a decon, and run a negative air machine. You must wear a respirator and a suit. There may be a lot of asbestos in the air. You might wear a Type C respirator.

When you come in, there will probably be dry asbestos all over the floor. Everyone must wear suits and respirators while setting up. Build the decon before you handle any asbestos. The first step is to get the asbestos wet. Bag some of the asbestos to make room to walk around in. Cover the air vents and set up a negative air machine. You may have to build barriers if the room opens up into a hallway. After that, take out the asbestos, just like any other job.

If you are already on the job and a lot of asbestos falls down, get it wet right away. Stop all the other work and bag up the asbestos.

The Competent Person

One of the most important people on an asbestos job is the "competent person." **By law, your employer has to have one person on every shift who makes sure that rules are followed.** The competent person is always a supervisor. This person must be certified as an EPA- or state-approved asbestos contractor/supervisor.

The competent person must make sure that no one but trained workers are on the job. The competent person must make sure that everyone wears respirators and suits. This person must make sure that there are enough suits, duct tape, respirator filters, and other supplies.

The competent person must supervise setup. The competent person must make sure that the negative air machine is working. The competent person must check the work room to make sure that the poly stays up. He or she must make sure that everyone goes through decontamination. This person must make sure that rules about eating, drinking and smoking on the job are followed. If the competent person on your shift is well-trained, he or she will be a good source of information. **You may have questions about how to do the work safely. You should be able to go to the competent person and get the answers.**

What You Can Do To Work Safely

There are many things your employer has to do to make the work safer.



Your employer has to give you the right respirator and tools. He or she has to set up the work room correctly. Your employer has to run the negative air machine.

But **there are also a lot of things you have to do to keep yourself safe.** Always wear your respirator. Keep it in good shape. Do your seal checks. Wear your suit and a hard hat if you need one. Clean yourself off carefully in the decon. Don't take asbestos home with you. You are the only one who can do these things. **The difference between doing a good job and doing a sloppy job could cost you your health.**

Class II Asbestos Removal

Removal of ACM that is not thermal system insulation or surfacing material is considered Class II asbestos work. The OSHA asbestos standard requires specific methods and controls for each type of Class II material. These materials include the following:

- floor tile and sheeting;
- roofing and siding shingles;
- wallboard and ceiling tiles;
- gaskets; and
- construction mastics.

In addition to the specific requirements for each type of material, there are several general requirements for any Class II asbestos work.

1. All work must be supervised by a competent person.
2. ACM must be wetted down before it is worked on.

Listed below are brief descriptions of how to remove each type of Class II material.

1. Removal of Vinyl Asbestos Tile (VAT) and Sheeting

When removing VAT or asbestos sheeting, you should begin by wet mopping the area with amended water. This will help to keep asbestos dust levels down. Tiles should be removed whole whenever possible. (When using heat to remove tiles whole, wetting is not required.) Be careful of damaged tiles. They often chip during removal. Keep all damaged tiles wet until you can dispose of them properly. Asbestos sheeting is removed by cutting while

continuously wetting. Ripping-up of asbestos sheeting is prohibited. Sanding of any asbestos flooring material is also prohibited.

Use heat, dry ice, or a solvent to more easily remove whole tiles. Heat (infrared) equipment melts the mastic. Dry ice cools the glue so the tile pops away from the mastic. Solvents remove the mastic itself. All scraping of residual mastic or backing must be done using amended water. All of these methods keep dust out of the air, but be careful when you use them. They may present other, more immediate hazards than asbestos exposure. Dry ice can produce carbon dioxide, which can be dangerous in an enclosed space. Solvents can be inhaled and absorbed through your skin. Use appropriate protective equipment and avoid solvents with methylene chloride or trichloroethylene.

Although not all flooring was made with asbestos, the law requires **all** resilient flooring material, including its mastic and backing, to be treated as ACM. The exception to this rule is when the material has been tested and shown to be asbestos free.

2. Removal of Asbestos Containing Roofing Material

Most asbestos containing roofing material is non-friable. However, in order to remove it, you may have to cut into the material. This will create asbestos dust. For this reason, precautions must be taken to minimize the amount of dust released into the air.

Remove the Material Intact

The less cutting, chipping, and sawing of roofing materials, the better. As much as is possible, roofing shingles, felt, flashing, and other materials should be removed whole.

Wet the Material

Like other Class II asbestos jobs, the use of amended water is a primary means of reducing dust. On a roof though, water may present a serious fall hazard. Care must be taken to insure the safety of the workers. This may mean less water can be used. Additionally, use of too much water may damage the deck or room below. It is a good idea to install a shut off valve on the hose at the roof level. This way you can turn the water on and off from the roof. Place a misting attachment at the end of the nozzle to break the water into smaller droplets.



Use a Special Roof Cutter

Roofers have roof cutters specially designed for asbestos projects. This is important because roofing felts can contain high levels of asbestos. The cutter should have a skirt over the blade guard to keep the dust inside. The skirt will often rip and will have to be replaced. Before using the cutter, remove all non-asbestos debris from the roof. This includes rock, gravel, and any other debris.

The special cutter must have a mister attachment to spray amended water on the surface of the material and the cutting edge. In addition to keeping most of the dust out of the air, the water also helps the cutter blade last longer. A 5-gallon tank of amended water on top of the cutter will last for half a day.

HEPA vacuums must be used to collect all loose dust. HEPA vacuums attached to roof cutters fill up very quickly due to the large amounts of non-asbestos dust found on roofs. The vacuum has to be emptied every half hour. The filters on the HEPA vac may have to be changed more often than on an inside job.

Contain the Debris

Waste debris should be wrapped in plastic sheeting and lowered to the ground by the end of the shift. If the waste is not wrapped, it must be lowered to the ground in an enclosed chute or crane immediately after removal.

3. Removal of Asbestos-containing Siding, Shingles, and Transite Panels

Before removal, each panel or shingle must be wetted down with amended water. This is the primary way in which fibers are kept out of the air when working with these materials.

These materials should always be removed intact. Cutting, abrading, or breaking of the siding, shingles, or panels is not permitted unless the employer can demonstrate that there is no other way to remove the material.

Use HEPA-equipped Tools ...

If you have to cut, abrade, or break non-friable asbestos materials, it is even more important to keep dust levels down. HEPA-equipped power tools can catch the asbestos fibers as they

are released. Wetting the material prior to cutting or drilling helps keep asbestos out of the air.

Most power tools used to work on asbestos materials can be fitted with a hood or shroud. The hood connects to a HEPA vacuum, which sucks up the asbestos dust created by the tool. These tools include:

- ✓ Jigsaws
- ✓ Drills
- ✓ Circular saws
- ✓ Cast cutters



Contain the Debris

Panels and shingles should be wrapped in plastic sheeting and lowered to the ground by the end of the shift. If the waste is not wrapped, it must be lowered to the ground in an enclosed chute or crane immediately after removal.

REMOVAL

Key Facts

Protection

Use good work methods-keep the asbestos wet, contain the work area, use negative air pressure, and use HEPA filters. Use respirators that fit right and disposable suits. Do negative and positive pressure fit checks before you go in the work room. Never take your respirator off inside the work room.

Removal

Wet the asbestos and keep it wet. Do not use metal scrapers, brushes, or shovels. Do not use vacuum cleaners or power tools unless they are equipped with HEPA-vacuums. Do not drop asbestos. Keep asbestos out of the air by wetting the air.

Waste disposal

Keep asbestos out of the air by bagging it as soon as possible. Use waste bags with warning labels. Pull all the air out of the bag and gooseneck it.

Decontamination

Enter and leave through the decon. You must decontaminate yourself every time you leave the work room.

Class II Removal

Remove the material intact whenever possible.
Wet the material before removal whenever possible.

This is not a test. It is an exercise. Use it to see for yourself how well you understand the material in the chapter.

- ## The Center To Protect Workers' Rights

Discussion Questions

What would
you do if...



1. Why do you put colored chalk under the seams between sheets of poly on the floor?
2. Why do you put tape or wood over poly on stairs in the work area ?
3. There are some jobs where you need to be extra careful. If you know about good work methods, how to wear a respirator, and how to understand air sampling results, you can figure out what to do on an unusual job. Here are a few examples which you can use for discussion:
 - Amosite asbestos;
 - Can't shut off electricity;
 - Working equipment in the work room; or
 - Taking off part of the asbestos in a large room (like taking off half of the ceiling from a whole warehouse).

For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix F, "Work Practices and Engineering Controls for Major Asbestos Removal..."

Georgia Tech Research Institute, Chapter XI, "Confining and Minimizing Airborne Fibers," in "Model Curriculum for Training Asbestos Abatement Contractors and Supervisors," available from National Technical Information Services, (703) 487-4650.

EPA, "Guidance For Controlling Asbestos-Containing Materials in Buildings," (the "Purple Book"), EPA Publication No. EPA 560/5-85-024.

National Institute of Building Sciences, "Removal of Asbestos Containing Materials" (Section 02081), "Building Demolition: Asbestos Abatement" (Section 02051), and "Resilient Floor Removal" (Sections 02085 and 02087), in Model Asbestos Abatement Guide Specifications.



MAINTENANCE-RELATED REMOVAL-- MINI-ENCLOSURES AND GLOVEBAGS

Maintenance-related Removal ...



Supervisor: We need to replace one of the hangers on the sprinkler pipe above the ceiling tiles. Help me set up a mini-enclosure.

Brian: I think we need to enclose the whole room, don't we?

Supervisor: That's not necessary. The mini-enclosure will be big enough for the job. We'll use a HEPA-vacuum to maintain negative air pressure. Make sure you wet the asbestos down well and wear two suits and a respirator. We'll do everything we do in a regular enclosure. It will just be in a smaller area.

Brian: I've never seen that done. I'm not sure it's safe.

Supervisor: I've just explained to you why the mini-enclosure is safe. Come on. I haven't got all day!

Discussions Questions

(Choose one or two of the following questions to discuss.)

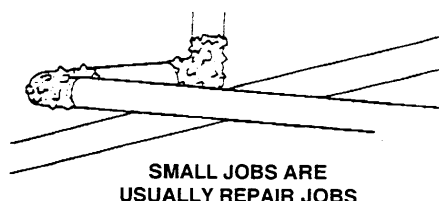
1. Who do you think is right, Brian or the supervisor?
2. When is it OK to use a mini-enclosure?
3. What are the principles you should use when working in a mini-enclosure?
4. Should Brian be trained in how to use a mini-enclosure before being required to do the work?



Class III (small) Asbestos Jobs

When you take asbestos off a whole ceiling, you need to cover the whole room with poly. You also need to do this for a whole run of pipes or air ducts, or a whole wall or floor. You need to put up poly, build a decon, and set up a negative air machine.

But there are lots of jobs where you only need to take off a little asbestos. It would be silly to cover a whole room with plastic just to take asbestos cement off one pipe elbow. **But you still need to protect yourself and others from the asbestos.**



You can use a mini-enclosure (a plastic closet) or a glovebag (a plastic bag with gloves built in) to do a small job. Small jobs are usually repair jobs.

When you do a small job you must **keep the asbestos wet, contain the work area, filter the air, and use negative air pressure. Protect yourself with respirators that fit right and disposable suits.** On a small job, you just apply these work methods in different ways.

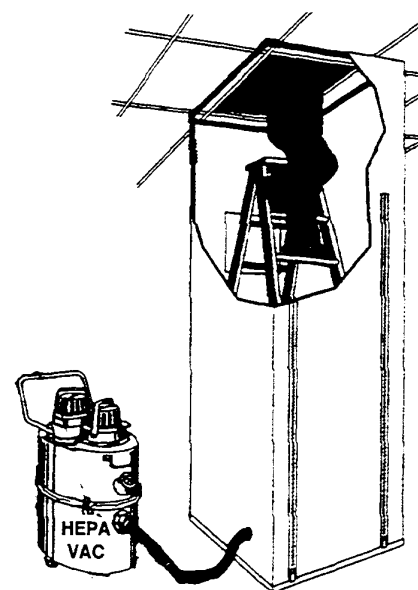
Mini-enclosures

How do you take off a small patch of asbestos to hang a sprinkler pipe? You don't have to build a full room. You can build a tiny work room, a mini-enclosure, without a decon.

A mini-enclosure is also good for --

- ✓ Taking off the insulation around one electrical box.
- ✓ Taking off the insulation around one outlet.
- ✓ Taking off ceiling insulation to put up lights.

A mini-enclosure looks like a plastic closet. Line a wood frame with two layers of plastic or attach the plastic to a part of the ceiling that is not covered with asbestos. There are also mini-enclosures that have metal frames with springs.



When you use a mini-enclosure, follow the same four basic rules as on a large job: keep the asbestos wet; contain the work area; filter the air; and use negative air pressure. With a mini-enclosure, use a HEPA vac for negative air pressure.

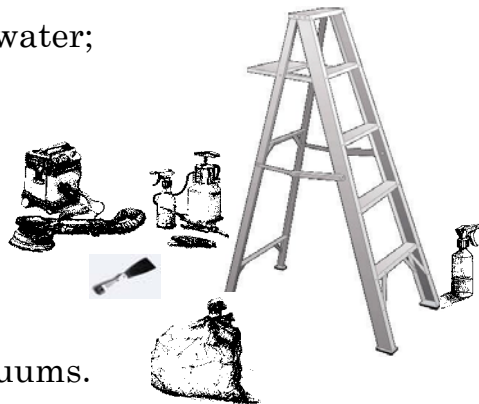
A small job is a lot like a large job. Use two layers of poly on the floor and walls of the mini-enclosure. Just like any other asbestos job, you have to wet the asbestos. You have to put it in asbestos waste bags. You have to scrub the surface clean. You have to lock down the asbestos fibers you can't see with a lockdown sealant.

In a mini-enclosure, you need these tools:

- spray bottle with amended water;
- HEPA vacuum;
- labeled waste bag; and
- scrapers.

You may need these tools:

- ladder; and
- power tools with HEPA vacuums.



Since a mini-enclosure does not have a decon, wear two suits when you do the work. When you finish, clean off the outside suit with a HEPA vac or a damp rag. Stand on a piece of poly. Wipe off your respirator. Take the outside suit off and put it in an asbestos waste bag. Go to a shower wearing the inside suit and your respirator. Some mini-enclosures have a small change room.

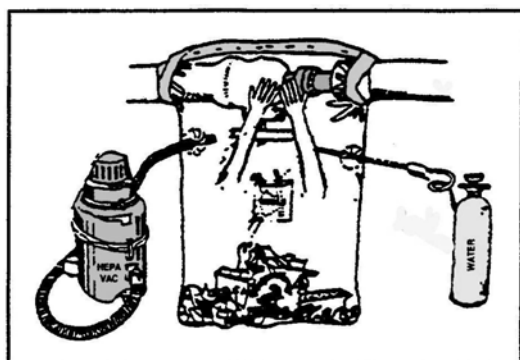
Use one or more HEPA vacs for negative air pressure in a mini-enclosure. The two main differences between a mini-enclosure and a large scale job are: **(1)** there is no decon; and **(2)** negative air pressure comes from a HEPA vac.

In a mini-enclosure:

- You still have to use respirators and protective suits.
- You can't eat or smoke.
- You have to put up warning signs and barriers.
- You have to use electricity safely.

Glovebags

A glovebag is a large plastic bag with gloves built into it. **Glovebags are good for taking off the insulation around a valve, pipe elbow, or pipe.** The asbestos inside the bag is contained. The bag is sealed air-tight to the pipe. Your bare hands never touch the asbestos. You do the work through the gloves. Use a garden sprayer and a HEPA vacuum to keep asbestos out of the air.



This section tells you how to use one glovebag to take off a small amount of asbestos. These small jobs are all maintenance jobs—you take off the asbestos so someone else can fix the pipe. If a contractor wants to use glovebags to take off a lot of asbestos, the contractor has to:

- Set up a negative air machine.
- Set up appropriate decontamination facilities.
- Take clearance air samples (in a school).

Glovebags come in many sizes and shapes. They are usually made of poly with latex gloves. They have a warning label printed on them. Some companies make glovebags from thicker poly. There are special glovebags for work on vertical pipes. There are glovebags for pipe elbows and glovebags with only one glove. **You may only use a glovebag only once and you cannot move or slide it along a pipe.** After you are done, throw it away with the asbestos.

A glovebag can only be used on a cool pipe. Poly burns at 150°F. Glovebags can usually be used on hot water pipes. They are usually about 140°F. **A glovebag cannot be used on pipe that is above 150°F.** Steam pipes are about 300°F. If you take asbestos off a steam pipe, turn the steam off, and let the pipe cool for at least 12 hours.

Glovebag Removal of Class I Material

If you are removing a small amount of thermal system insulation (TSI) using a glovebag, then a minimum of 2 people must do the work. In addition, both people must wear personal protective equipment, including respirators.



Glovebags are primarily used for maintenance-related repairs. A good rule of thumb for maintenance work is: if you have to take off more than 3 feet of insulation at a time, build a mini-enclosure. Many employers use glovebags instead of building a work room. This is illegal, and your employer can be fined for it.

The typical glovebag is open at the top and has a tool pouch inside the bag. Cut the sides of the bag at the top. Attach the top of the bag to the pipe with duct tape. Then put your hands inside the gloves and take off the asbestos. Asbestos doesn't get into the air because it is trapped inside the bag. **When you are done, pull the air out of the glovebag with a HEPA vac. Throw out the glovebag in a sealed asbestos waste bag.**

Just like a large job, 40% of a glovebag job is preparation:

1. Put up barrier tape and warning signs.
2. Put on a respirator. A PAPR is better than a half-mask, air-purifying respirator.
3. Put on a disposable suit.
4. Tape plastic over the heating and ventilating system.
5. Clean the area.
6. Put a piece of poly on the floor.
7. Put all tools and materials inside the glovebag.
8. Apply duct tape to the section of pipe the glovebag will be attached to.
9. Attach the glovebag to the tape on the pipe creating an airtight seal.
10. Attach a HEPA vacuum cleaner to the glovebag (negative air).
11. Attach a low-pressure water sprayer to the glovebag.
12. Smoke-test the bag.

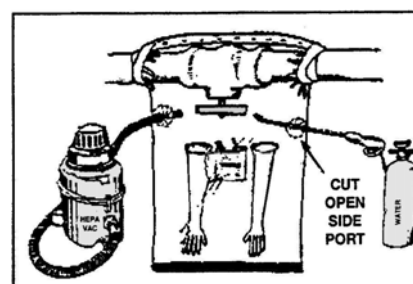
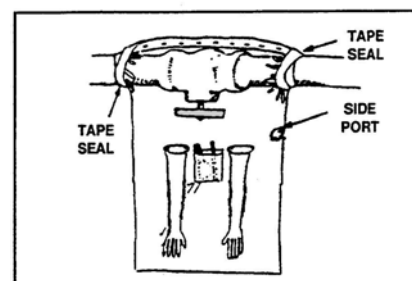
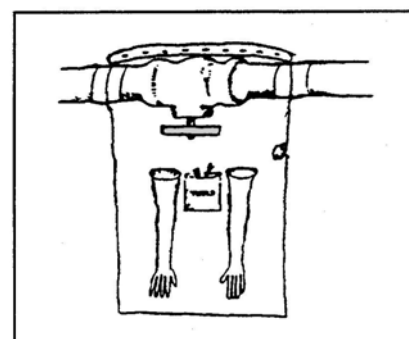
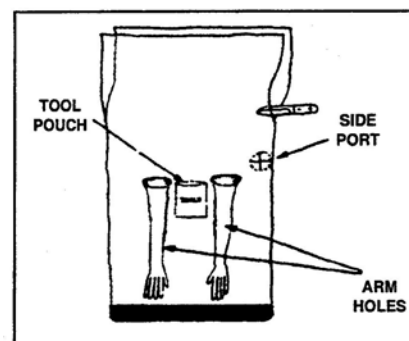
When you use a glovebag, follow the same rules you do on a large job: **keep the asbestos wet, contain the work area, filter the air, and use negative air pressure.** With a glovebag, the bag contains the work and a HEPA vac supplies the negative air pressure.

Just like a large job, you need to clean the pipe until all the asbestos is gone. Wash the area to clean off any asbestos. Spray a lockdown sealant. Cover up the edge of the insulation where you cut it. Put the asbestos in a

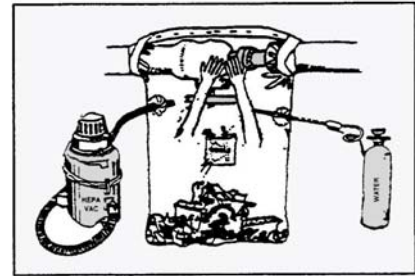
sealed, labeled waste bag.

The following illustrations go through a glovebag job step by step. Use any combination of duct tape, staples, or spray glue to seal up the bag, as long as it is sealed totally air-tight.

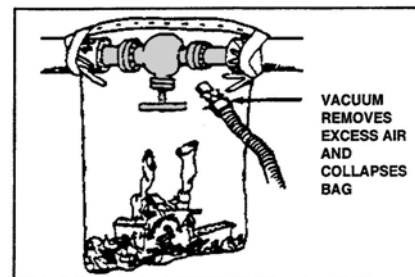
1. Inspect the bag. Tape any holes or tears.
2. Use duct tape to strengthen the bottom of the bag. Cut a slit about 12 inches down each side of the bag.
3. Put a knife, nylon bristle brush, lockdown sealant, encapsulant, and other tools inside the tool pouch.
4. Put tape around the pipe where you will attach the bag.
5. Fold down the top edge of the bag about one inch. Staple or glue it shut. Fold the sealed edge down again. Tape over the seam and all the staples.
6. Fold in the sides of the bag about one inch, and glue or staple. Tape over the side seams and all the staples.
7. Tape the sealed bag onto the tape on the pipe.
8. Tape the nozzle of the garden sprayer into the side of the bag. Tape the nozzle of the HEPA vac into the other side of the bag.
9. Puff chemical smoke into the bag to check for leaks. Squeeze the bag to move the smoke around in the bag. Fix any leaks.



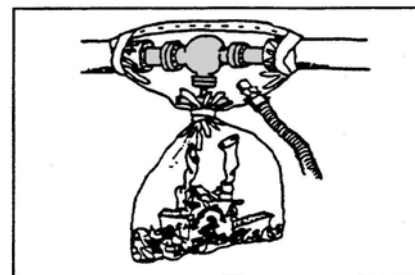
10. Wet the asbestos with amended water. Cut the asbestos off the pipe carefully. Lower it to the bottom of the glovebag.
11. Brush off all the asbestos that's stuck to the pipe.
12. Rinse all the asbestos off the pipe. Rinse the sides of the bag.



13. Spray a lockdown sealant to seal the fibers you can't see onto the pipe.
14. Seal the cut edge of the insulation with encapsulant (paint).
15. Grab the tools in your hands, and pull the gloves inside out. Turn on the HEPA vac and pull the air out of the bag.



16. Twist the gloves (with the tools inside) and tape them shut with two pieces of tape. Cut the gloves off the bag.
17. Turn the vacuum on again. Twist the bottom of the glovebag shut. Put tape around the twist.



18. Cut the tape holding the vacuum hose and sprayer hose onto the bag.
19. Put a waste bag under the glovebag. With the vacuum on, carefully cut the glovebag off the pipe. Lower it into the waste bag.
20. Use the vacuum to pull the air out of the waste bag. Twist the waste bag shut. Remove the HEPA vac and tape the bag shut.
21. Fold over the top of the waste bag, and tape it down (gooseneck the bag).

Open up the gloves in a bucket of soapy water. Clean the tools. Take the poly off the floor and air vents. Seal up the poly, gloves, suit, and respirator filters in a waste bag.

Problems with Glovebags

There are some problems with glovebags. It can be clumsy to use your hands inside the gloves. When the bags get wet, it is hard to see the pipe inside. If the pipe is hot, the bag can fog up. A glovebag can melt on a hot pipe. The seams on the bags can leak. The gloves can tear off. Glovebags work well if the work is done right. But this is often not the case.

Whether you use a mini-enclosure or a glovebag, do all the same things you do on a large job to keep asbestos out of the air. On a small job, you just adapt those methods. Instead of a negative air machine, use a HEPA vac for negative air pressure. Instead of a decon, use a HEPA vac and damp rags to clean yourself off. Then take a shower.

Repairing Asbestos

Another kind of maintenance-related work is repairing asbestos. It is usually the pipe covering or jacket that is repaired, not the friable asbestos itself. (Sprayed-on insulation can't be repaired.) **You must wear a respirator when doing repairs.** You may need to wear a suit, especially if you are working in a dirty boiler room.

Repairs are usually done by putting a canvas or fiberglass patch over the torn jacket or covering. Mastic (glue) is then painted over the patch. You may use fiberglass that has glue already in it. Dipping the patch in water activates the glue. You may also use caulk or plaster to repair hard materials.

It is possible to do repairs inside a glovebag or mini-enclosure. For large repairs (more than 3 feet long or 3 feet square), use negative air pressure, put poly on the walls and floor, and build a decon. **A large-scale repair is just like any large job.** If you have to remove crumbling plaster or other materials to do a small repair, use a mini-enclosure.

Use a HEPA vacuum to clean any dust off the surface. Mist the torn covering with water. Be careful not to tear the asbestos or the covering. Work carefully and make the patch air-tight.



MAINTENANCE-RELATED REMOVAL

Key Facts

To take off small amounts of asbestos, follow the same rules you do on a large job:

- Keep the asbestos wet;
- Contain the work;
- Filter the air with HEPA filters; and
- Use a HEPA vacuum for negative air pressure.

When you work on a small job, you must wear a respirator and you should wear a disposable suit.

A mini-enclosure is the same as a full containment without a full decontamination unit.

Use HEPA vacuums for negative pressure in a mini-enclosure.

In a mini-enclosure, wear two disposable suits. Clean the outside suit off with a damp rag and a HEPA vac. Go to a shower wearing the inside suit.

You can only use a glovebag on a pipe or column.

A glovebag cannot be used on a pipe above 150°F.

With a glovebag, your hands never touch the asbestos inside the bag.

When you are done, pull the air out of the glovebag with a HEPA vacuum.

Throw out the glovebag in a sealed asbestos waste bag.

GLOVE BAG EXERCISE

This is not a test. It is an exercise on the use of the glove bag. Use it to see for yourself how well you understand the procedures for safely doing glove bag removal of asbestos insulation. Read over all of the steps below. Put these steps in order by writing a number in the space before each item to show the order in which each step would be performed.

Setup

- _____ Put tape around the pipe where you will attach the bag. Staple and tape the glove bag closed. Tape the bag to the tape on the pipe.
- _____ Reinforce the bottom of the bag with tape. Cut about a foot down the sides of the glove bag. Place tools in the pouch inside.
- _____ Put on a respirator and disposable suit. Do negative and positive pressure fit checks.
- _____ Put up barrier tape and hang asbestos warning signs.
- _____ Cut two small holes in the bag and insert the nozzles of the HEPA vac and the sprayer. Seal the openings with duct tape. Smoke test the bag to insure that it is sealed air-tight.
- _____ Lay a plastic drop cloth under the area in which the work is to be done.

Removal

- _____ Break the insulation away from the pipe and lower it to the bottom of the bag.
- _____ Spray the inside of the bag with water to wash any asbestos to the bottom of the bag.
- _____ Spray the insulation with amended water, being sure to soak the area to be cut.

- _____ Cut the insulation with a saw at each end of the section to be removed.
Cut it lengthwise along the bottom with a knife.
- _____ Put encapsulant paint on the cut edges of the asbestos on the pipe.
Spray lockdown on the pipe and upper part of the bag.
- _____ Grab the tools in your hands and pull the gloves inside out. Twist the sleeve and tie it off with duct tape. Cut the sleeve in the middle of the tape. Put the sleeve containing the tools in the next glove bag to be used or open it in a pail of water for cleaning.
- _____ Spray, scrub, and wipe the exposed pipe to remove any asbestos on the pipe. Use a brush with nylon or fiber bristles.
- _____ Vacuum the work area and your clothes.
- _____ Remove rope and signs from the work area.
- _____ Remove the air in the bag by turning on the HEPA vacuum.
- _____ Twist the bag below the pipe and tape it closed.
- _____ Slip a large plastic disposal bag around the glove bag.
Remove the glove bag from the pipe and fold it into the disposal bag. Carefully fold up the drop cloth and place it in the disposal bag.
- _____ Wipe your respirator with a damp cloth. Remove your suit inside out - and place it in a disposal bag with contaminated rags and used filters. Seal and label the bag for disposal.



Removing the glovebag after a repair.

Discussion Questions

1. When you use a HEPA vac for negative air pressure in a mini-enclosure, where do you put it? At the top of the mini-enclosure? At the bottom? In the decon room?
2. How do you use a mini-enclosure to string cables above a dropped ceiling? Do you need an enclosure at both ends? How can you set up negative air pressure?
3. What kind of enclosure would you use to take the asbestos off one small boiler in a large basement?



For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix G, "Work Practices and Engineering Controls for Small-Scale, Short-Duration Renovation."

Asbestos Operations and Maintenance Work Practices," National Institute of Building Sciences, Washington, DC. 1992



Using a bone-saw to remove pipe covering ACM – in a glovebag



5

PERSONAL PROTECTIVE EQUIPMENT

PART 1: RESPIRATOR TYPES

In Part 1 you will learn:

What respirators are and how they work.

You must wear a respirator when you work with asbestos.

Respirators are not perfect.

Respirators have to fit.

What respirators are allowed on an asbestos job.

What respirators are not allowed on an asbestos job.

How to figure out if you have the right respirator for the job.

Respirators ...



Nick: I don't think these half-mask respirators will protect us enough for this job.

Bobby: But we were using half-masks last week. And when they tested for asbestos in the air, the level was real low.

Nick: Last week we were just removing floor tiles. Now we're scraping sprayed-on insulation off the ceiling. There's bound to be a lot more asbestos in the air now.

Bobby: I hate using the supplied-air respirators. I always trip over the hoses. These half-masks do the job just fine.

Nick: The half-masks will only protect you if there is a small amount of asbestos in the air. What are the air levels now?

Bobby: I don't know. We don't get to see the report until 4 or 5 days after they take the sample.



Discussion Questions

(Choose one or two of the following questions to discuss.)

1. How do you know what type of mask you need?
2. Do you think half-masks are good enough for this job? Why or why not?
3. Should Nick go ahead and use the half-mask?
4. Why doesn't this contractor post air-monitoring results sooner?
5. Does Bobby have a right to see the air sampling results from the job site?

What would you do if...



What is a Respirator?



Your employer has to prepare the workplace to make it safe. Your employer also has to train you in safe work practices for doing asbestos work.

Asbestos is very hazardous. Making changes in the workplace and using safe work practices are not enough. You must wear protective clothing and respirators to protect yourself from asbestos.

You need to keep asbestos out of your lungs when you work with it. One way to do this is to keep asbestos out of the air. But no matter what you do, some asbestos will still be in the air. This is why you have to wear a respirator.

A respirator is a mask that filters the air in the work room or supplies clean air from outside the work room.

Some respirators have filters that filter out asbestos fibers from the air. Other respirators pump fresh air through a hose.

Paper nuisance dust masks are not respirators! They will not protect anyone from asbestos. **They are illegal on asbestos jobs.**



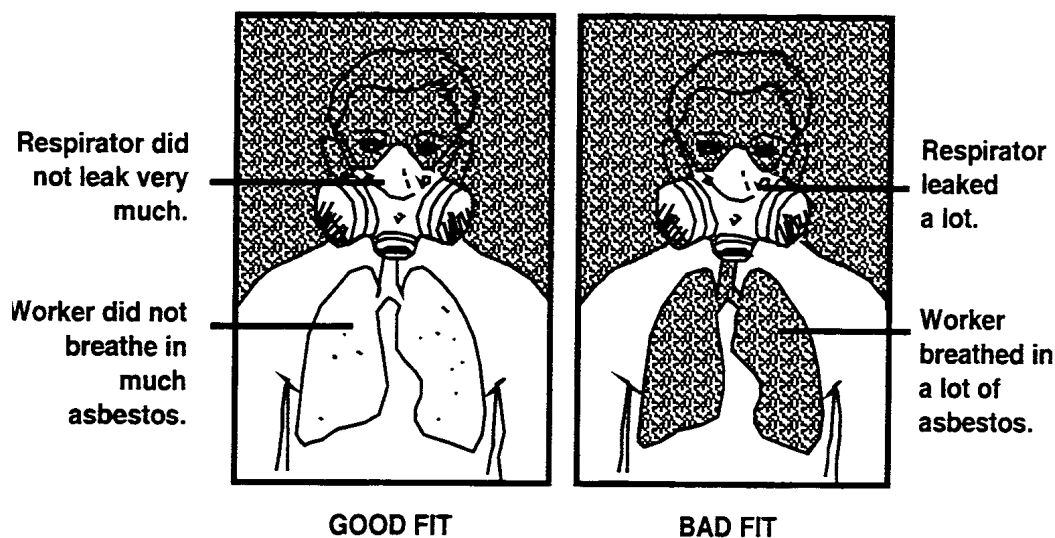
The Last Line of Defense

Respirators are your last line of defense. They are absolutely necessary to protect your lungs from asbestos disease. Workers don't like respirators. Respirators are uncomfortable, hot, and heavy. They block your sight, and they make it hard to breathe. It is important to remember you are protecting yourself from asbestos diseases by wearing them.

Respirators are also not a quick fix, though many people think they are. The OSHA law says that before they can wear a respirator, workers have to have a medical evaluation, a fitting session (called a fit test), and training. Respirators must be maintained and kept in good shape all the time. Employers have to pay for the medical evaluation, fit testing, training, and the respirators. Employers must also have a written respirator program. They must do regular inspections to be sure that respirators actually protect workers.

A Respirator is Only as Good as its Fit

If you wear a respirator that doesn't fit, air and asbestos will leak in around the sides of the mask. Instead of being caught in the filters, asbestos will go into your lungs. This is why the law says you must have a fit test. The test tells you whether the respirator seals around your face. A respirator that does not fit looks the same as one that does. There is no way to tell if a respirator protects you or not just by looking at it.

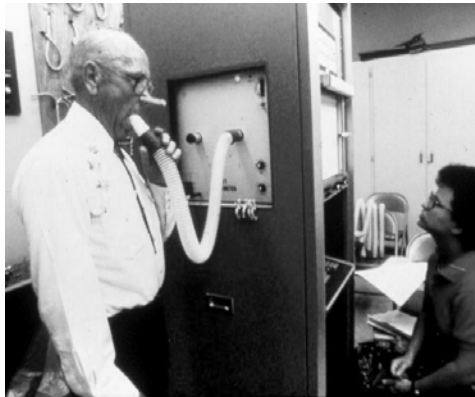




Not Everyone Can Wear a Respirator

Some people cannot find a respirator to fit their face. If you have a beard, you can not wear a tight fitting respirator. If you have any hair on your face where the respirator seals, the respirator will not protect you. Even a large moustache can break the seal of your respirator.

If you have a broken nose you may not be able to wear a respirator. If you have missing teeth, large scars, a very narrow or broad face, or any face with an unusual shape, you may not be able to wear a respirator.



Checking lung capacity

If you feel very anxious, a little faint, or shaky when you first try a respirator on, you may not be able to wear a respirator. You may have a fear of confined spaces, claustrophobia.

Respirators also make it hard to breathe. You need to have a medical checkup to be sure that your lungs and heart are strong enough to take the strain of working with a respirator.

You must have a medical evaluation before you can wear a respirator on the job.

Who Must Wear a Respirator?

Workers who come in contact with high-risk ACM (thermal system insulation, sprayed or troweled on surfacing material) are always required to wear respirators. Other types of ACM are not always considered as dangerous. In some cases respirator use is required, in others it is not.

Whenever you work with asbestos in the air that reaches the PEL, 0.1 fibers per cubic centimeter in an eight hour day (time weighted average), you must wear a respirator.

Factors that affect the need for respirator protection include the type of ACM, abatement methods used, and the amount of airborne fibers. OSHA has put the different job tasks and types of asbestos material into four categories. They are Class I, II, III, and IV. Class I creates the most amount of asbestos in the air.

The chart on the next page describes when respirators are required for each class of asbestos work.



RESPIRATORS MUST BE WORN WHEN:

Class I	Class II	Class III	Class IV
Always	you are exposed above the PEL/EL or wet methods are not used or there is no negative exposure assessment* or ACM is not removed in a substantially intact state	you are exposed above the PEL/EL or wet methods are not used or there is no negative exposure assessment* or when TSI or surfacing material is disturbed	you are exposed above the PEL/EL or working in an area where other employees are required to wear respirators

* A negative exposure assessment is a demonstration by the employer that employee exposure during an operation will be consistently below the PEL/EL.

No Respirator is Perfect

Every kind of respirator has its good and bad points. Every respirator leaks. Some respirators protect you more than others. Each respirator on the following pages has a Protection Factor (PF). This number tells you how much the respirator protects you.

There are five kinds of respirators allowed on asbestos jobs. Which respirator you wear depends on the amount of asbestos in the air. Your employer must test workers' breathing air every day. Then he decides what kind of respirator is needed, based on how much asbestos is in the air.

Protection Factors

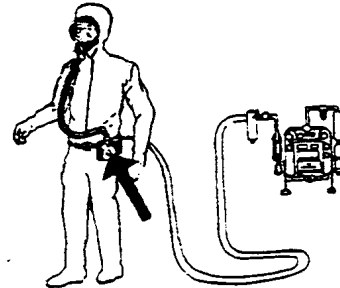
How much asbestos can a respirator handle? Some respirators are better than others at keeping asbestos out of your lungs. A respirator's Protection Factor (PF) is a measure of how well it should protect you from asbestos. OSHA asbestos Protection Factors go from 10 to 10,000. Remember, your respirator must fit right in order to get these Protection Factors.



Respirators Fall into Two Main Groups –



AIR-PURIFYING
respirators use a filter
to clean the air
that's in the workplace.



SUPPLIED-AIR
respirators pump
clean air to you
through a hose.

#1 Half-mask, Air-purifying Respirator

This is the simplest respirator you may use on an asbestos job. It is a half mask, air-purifying respirator. The bottom of the respirator facepiece (the wide part) goes under your chin. The top of the facepiece (the narrow part) goes over your nose.

It is the **least** protective respirator the law allows. The two filters catch the asbestos and filter it out of the air. The filters are called HEPA filters (High Efficiency Particulate Air) or “100” s. This is an air-purifying respirator. It filters, or purifies, the air that's in the room. You must not use it if there is not enough oxygen to breathe. It will not work unless the filters are made for asbestos. HEPA filters are often magenta, purple, or red in color. An asbestos respirator must have filters that say they protect against asbestos dust. Filtering facepieces are not allowed on asbestos abatement jobs.

When you breathe in, your lungs pull air through the filters. This takes a lot of effort. It is called a negative-pressure respirator. When you breathe in, it makes a suction, or negative pressure inside the mask. The facepiece has to fit perfectly on your nose, cheeks, and chin. If it does not form an airtight seal, air and asbestos will leak in around the edges of the mask. The fibers will not be filtered through the magenta filters. Negative-pressure respirators can leak. Remember, a respirator is only as good as its fit. The type of fit test you must have for this mask is called a qualitative fit test. You will learn about this fit test in Part 2 of this chapter. **Note that NIOSH recommends the use of this respirator up to 0.1 f/cc, or up to the PEL.**



#1
HALF-MASK AIR-PURIFYING RESPIRATOR
Protection Factor = 10



#2 Full-face, Air-purifying Respirator

This respirator is legal for five times as much asbestos as respirator #1. It is the same as respirator #1, except the top of the facepiece goes all the way around your face and across your forehead. It is a full-face air-purifying respirator.

Because it is also an air-purifying respirator, you must not use it if there is not enough oxygen to breathe. It is also a negative-pressure respirator. When you breathe in, it makes a suction or negative pressure inside the facepiece. The facepiece has to fit perfectly on your forehead, the sides of your face, and your chin. If it does not form an airtight seal, air and asbestos will leak in around the edges of the mask. It will not be filtered through the HEPA/100 filters.



You must not wear a full-face respirator if you wear regular glasses. The side bars of the glasses break the seal of the mask. The mask will not fit tightly on your face. If you wear glasses, your employer has to pay for special glasses and a frame that holds your lenses in place inside the full face respirator.

You must have a special fit test called a quantitative fit test for a full-face respirator. If you have a quantitative fit test, the maximum use level of the full-face mask is 5 fibers per cubic centimeter. If you get a qualitative fit test on a full-face mask, your maximum use level will be only 1 fiber per cubic centimeter. This is the same maximum use level as the half-face, air-purifying respirator. You will learn more about these two types of fit tests in Part 2 of this chapter.

#2 FULL-FACE AIR-PURIFYING RESPIRATOR Protection Factor = 50





#3 Powered Air-purifying Respirator (PAPR)

This respirator is legal for ten times as much asbestos as respirator #1. It looks like respirator #2, but it has an air pump. It has filters (or cartridges). The air pump and the filters are usually on a belt or on the facepiece. The pump pulls the air through the filters. It blows the air through a hose into the mask.

This respirator only filters the air that's already in the room. It is an air-purifying respirator. Because it has an air pump, this respirator is called a powered air-purifying respirator or PAPR. The OSHA asbestos law states that you have the right to get a PAPR whenever a negative pressure respirator is required on the job.

The air coming through the hose pushes air and asbestos away from the sides of the mask. This is a positive-pressure respirator. The air pump makes a positive pressure inside the mask. One good thing about a positive-pressure respirator is that if it leaks, it leaks out. Asbestos is not supposed to leak in.



Another good thing about a powered air-purifying respirator (PAPR) is that your lungs do not have to work so hard to pull the air through the filters. The air pump does some of the work. But if the batteries are low, this PAPR is no better than a full-face respirator without an air pump.

Another problem with a PAPR is that it only filters the dirty air in the room. It is just like any other air-purifying respirator. If the batteries in the air pump are run down, air and asbestos can leak in around the sides of the mask. This can also happen if the HEPA/100 filters are clogged with dust or if you are breathing very hard.

The air pump on a PAPR blows air at the same rate, no matter how hard you breathe. If you breathe in very hard, it makes a suction, or negative pressure inside the facepiece. The facepiece has to fit perfectly on your forehead, the sides of your face, and your chin. If it does not form an airtight seal, air and asbestos will leak in around the edges of the facepiece. This is called over-breathing the respirator.



#3
POWERED AIR-PURIFYING RESPIRATOR
Protection Factor = 1000



#4 Continuous-flow Supplied-air Respirator

This respirator is also legal for ten times as much asbestos as respirator #1. It looks a lot like respirator #2 and #3. But this respirator is very different from the other three. Fresh air comes in through a hose from outside of the room. It comes from an air tank or a purification unit and compressor. This is a supplied-air respirator or a **"Type C" respirator**. With a Type C respirator, you don't have to worry about whether the air in the room is safe to breathe.

All Type C respirators are positive-pressure respirators. The air coming through the hose pushes asbestos fibers away from the mask. Another good thing about a supplied-air respirator is that your lungs do not have to work so hard to pull in air. The air is pumped in through the hose.

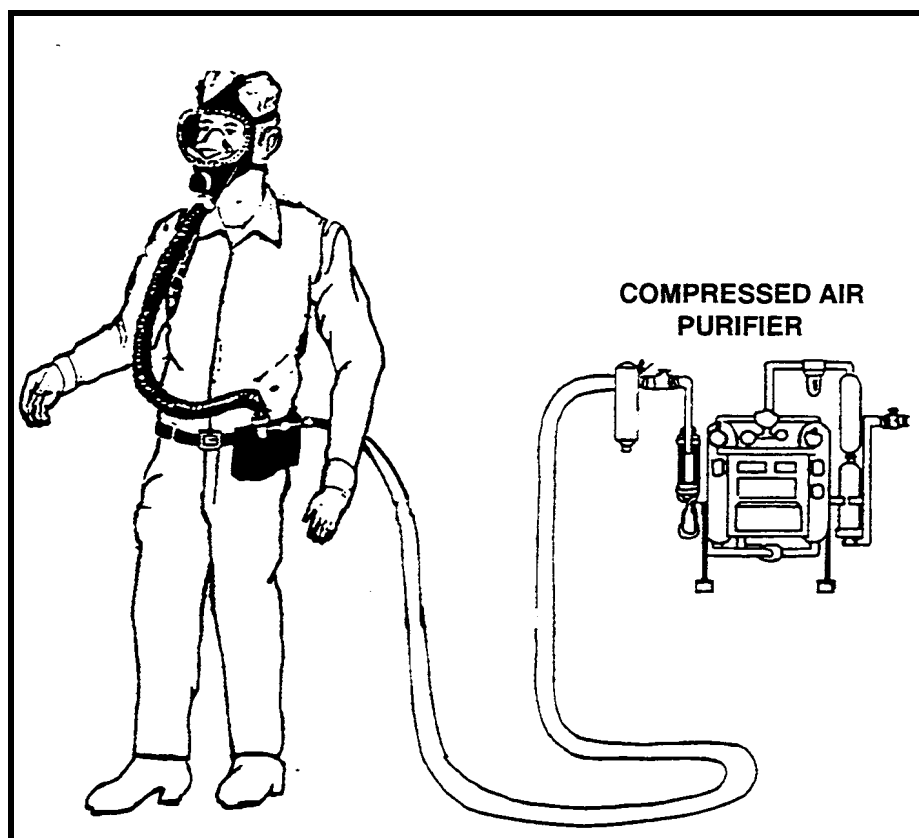
One problem with this respirator is that it pumps air at a constant rate. It is a continuous flow respirator. No matter how hard you breathe, the air



pump blows air at the same rate. So if you breathe in very hard, it makes a suction, or negative pressure inside the facepiece. The facepiece has to fit perfectly on your forehead, the sides of your face, and your chin. If it does not form an airtight seal, air and asbestos will leak in around the edges of the facepiece. If you breathe hard, you will pull air and asbestos in around the edges of the mask just like with an air-purifying respirator. **This is called over-breathing the respirator.**

Another problem with this respirator is that you can trip on the hose, or it can get caught on a scaffold. The respirator needs an extra HEPA/100 filter or a egress bottle of air (reserve air) in case the air supply is cut off.

#4
**TYPE C CONTINUOUS-FLOW SUPPLIED-AIR
RESPIRATOR**
Protection Factor = 1000





5 Pressure-Demand Supplied-Air Respirator

This respirator looks exactly the same as respirator #4. But it is legal for one hundred times as much as respirator #1. Like respirator #4, fresh air comes in through a hose from outside of the room. It is also a supplied-air respirator or Type C respirator. **It is also a positive-pressure respirator.**

The only difference between this respirator and the last one is a tiny valve. It opens to give you more air when you breathe harder. **It is called a pressure-demand respirator.** When you breathe harder, more air comes through the hose. A pressure-demand respirator is the most protective. Most Type C respirators on asbestos jobs are the pressure-demand type.

Even if the facepiece does not fit perfectly (if it does not form an airtight seal), the pump forces air into the mask and pushes asbestos away from the edges of the facepiece.

One problem with this respirator is that you can trip on the hose, or it can get caught on a scaffold. The respirator needs an extra HEPA/100 filter or egress bottle of air (reserve air) in case the air supply is cut off. The bottle of air is called the back-up self-contained breathing apparatus (SCBA). You must wear this type of respirator if you are working in an area where exposure assessments indicate the exposure level is in excess of 1 f/cc as an 8-hour time weighted average and a negative exposure assessment has not been produced (or if you are in a permit-required confined space).



#5
TYPE C PRESSURE-
DEMAND SUPPLIED-
AIR RESPIRATOR
Protection Factor =
1,000



More About Type C respirators

Type C respirators are more complicated than air-purifying respirators. Fresh air goes into a compressor. **It is cleaned in an air-purifying panel. It is pumped into the respirator through a hose.** The air has to be clean, cool, and at low pressure so that it's comfortable to breathe.

The air you breathe in a Type C respirator is called **"Grade D Air" or breathable air.** (You do not breathe pure oxygen in a Type C respirator.) Grade D air is air that has chemicals filtered out and 20.8% - 21% oxygen. (Normal air has about 21% oxygen.) Grade D air has almost all of the carbon monoxide filtered out. Carbon monoxide is a dangerous gas which you can't smell.

Your employer may use a special rig which filters the air to Grade D quality. He may buy bottled air which the manufacturer or distributor certifies to be Grade D or "breathable." An ordinary compressor will pump dirty air into your mask, which can hurt you. If there is a compressor on the job, it must have these features:

- * **A filter to take out odors and some chemicals.** The filters on the air purification panel must be cleaned and maintained.
- * **A carbon monoxide (CO) alarm or a high-temperature alarm.** CO can come from compressors which work at high temperatures or from the outside air because of cars or trucks. A carbon monoxide alarm is better than a high-temperature alarm.
- * **A trap to catch the water in the air.**

If a carbon monoxide alarm goes off, stop work immediately. Leave the work room as soon as possible. Supervisors should make sure all workers are out. They should make sure that all respirators are accounted for and are not in use.

There are low-pressure and high-pressure air systems. Although they are very similar, they differ in a few ways: the pressure of the compressed air, the way the system looks, and the way the air is delivered. On the next page is a chart summarizing the two systems.

You may have up to **300 feet of hose** on a Type C respirator depending on how much air pressure is in your lines and the type of system. Some Type- C systems may only allow 50 feet of hose. You must check the owner's manual or the NIOSH Certified Equipment List to see what your Type C system can



handle. **It is illegal to have more than 300 feet of hose with any Type C respirator.** It is illegal to use a Type C system differently than how the manufacturer specifies to use it. Make sure that the airline connectors do not interchange with compressed-air tool airlines.

You Need Training in How to Use a Type C Respirator

Special training must be given to each worker who is using a Type C respirator. The training should be specific to the exact type of respirator that is issued. Each supplied-air respirator has emergency escape gear. The escape gear provides the air you breathe while you are getting out of the work area. It will either be a small tank of air that hooks to your belt or a filter that is on the respirator. When you use a filter to escape, your respirator only protects you as much as a negative pressure respirator.

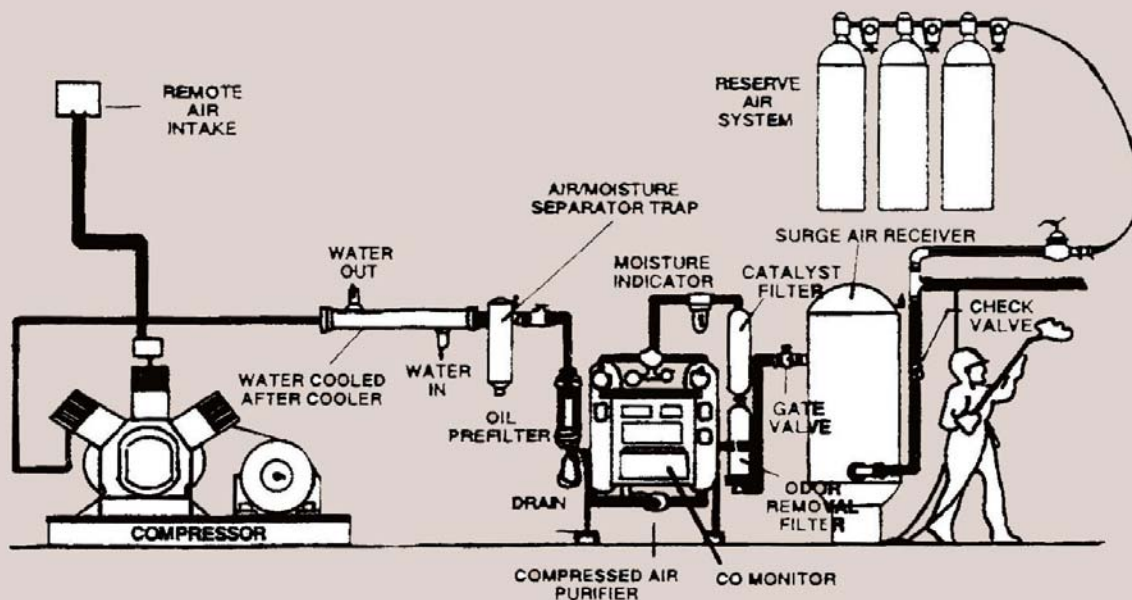
You must know how to use your escape gear. Remember, if the air you are breathing is supplied, anything can happen to that supply. When the source of your air is gone, you may panic. It is very important to practice how to use your escape gear. Practice each day you wear it. Then you will remember how to use your escape air when you need it.

A Trained Supervisor Should Watch the System

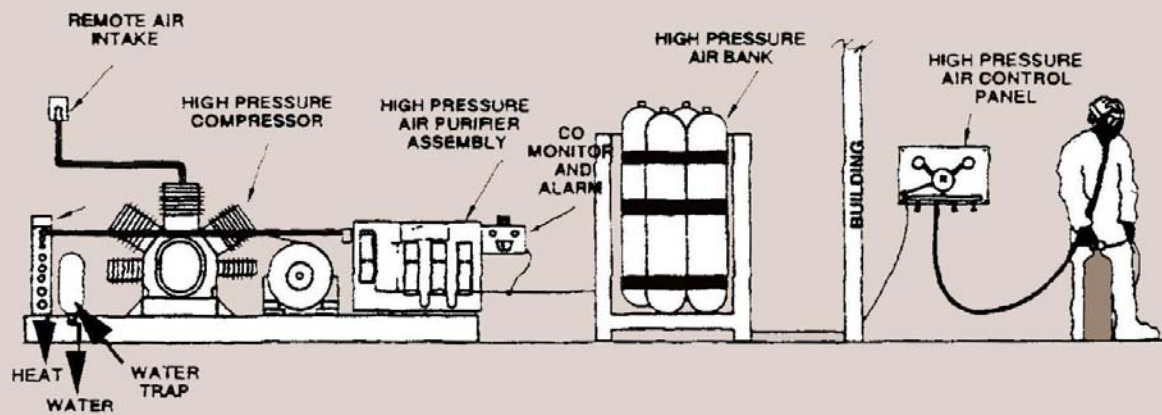
Type C respirator systems protect workers the most. They are also the most complicated respirator systems. There are individual respirators, many long hoses, manifolds, compressors, and alarms.

A supervisor or foreman should be responsible for checking to make sure that the entire Type C system is operating correctly. This person must know the Type C system that is being used. This person must consistently monitor the system, and be alert to the alarms.

This monitoring can save lives by making sure that workers are being supplied breathable air. If you are given a Type C respirator, make sure that you and the foreman really know how the system works. Don't let an amateur be responsible for monitoring the system. Non-breathable air can kill workers immediately.



TYPICAL LOW PRESSURE BREATHING AIR SYSTEM



TYPICAL HIGH PRESSURE BREATHING AIR SYSTEM



How Do You Know It's The Right Respirator?

When you see your air sampling results, how can you tell which respirator will protect you enough? You need to know the respirator's limit or **Maximum Use Concentration (MUC)**. This is how much asbestos the respirator can protect you from.

To figure out the Maximum Use Concentration for a respirator, **take the legal limit (the PEL = 0.1 f/cc) and multiply it by the Protection Factor**. The Protection Factor (PF) tells you how many fibers leak in, compared to the number of fibers outside. You need to keep the number of fibers inside below 0.1 f/cc (the legal limit).

$$\begin{aligned} 0.1 \text{ f/cc (PEL)} \times \text{Protection Factor (PF)} &= \text{Maximum Use Concentration} \\ 0.1 \times \text{PF} &= \text{MUC} \end{aligned}$$

A half-mask, APR has a Protection Factor of 10.

$$0.1 \times 10 = 1 \text{ f/cc}$$

The Maximum Use Concentration is 1 f/cc.

A full-face, APR has a Protection Factor of 50.

$$0.1 \times 50 = 5 \text{ f/cc}$$

The Maximum Use Concentration is 5 f/cc.

A PAPR has a Protection Factor of 1000.

$$0.1 \times 1,000 = 100 \text{ f/cc}$$

The Maximum Use Concentration is 100 f/cc.

A continuous flow SAR has a Protection Factor of 1,000.

$$0.1 \times 1,000 = 100 \text{ f/cc}$$

The Maximum Use Concentration is 100 f/cc.



A pressure-demand SAR has a Protection Factor of 1,000
 $0.1 \times 1,000 = 100 \text{ f/cc}$
The Maximum Use Concentration is 100 f/cc.

A pressure-demand SCBA has a Protection Factor of 10,000
 $0.1 \times 10,000 = 1,000 \text{ f/cc}$
The Maximum Use Concentration is 1,000 f/cc.

How Does NIOSH Determine Its Maximum Use Level?

Use a new equation. Substitute CL for PEL

$$\text{CL} \times \text{PF} = \text{MUL}$$

For a half-mask, air-purifying respirator $0.01 \times 10 = 0.1 \text{ f/cc}$

What Does This Mean?

CL stands for Clearance Level. 0.01 f/cc is a Clearance Level used in the AHERA rule. When the abatement job is complete, air samples are taken. The area is clean when the Clearance Level is reached. The Clearance Level is an acceptable level of exposure. The area can then be opened for the public to use.

NIOSH says that the acceptable level of asbestos exposure for workers should be the same as for the general public. When you use a respirator at the NIOSH recommended MUL, you breathe in one asbestos fiber for each 100 cubic centimeters of air that you breathe.





RESPIRATOR TYPES

Key Facts

- You must wear a respirator when you work with asbestos.
- You must have a doctor's permission before you can wear a respirator on the job.
- Not everyone can wear a respirator.
- Unless respirators fit perfectly, they won't protect you.
- Paper nuisance dust masks are illegal for asbestos work.

Positive pressure (a motor pushes air into the mask and pushes fibers away from the edges of the mask) **is better than negative pressure** (your lungs do all the work to move the air)

Full-face is better than **half-mask**.

Powered Air-Purifying (PAPR) (a motor does some of the work) **is better than non-powered negative pressure** (your lungs do all the work).

Tight-fitting (an airtight seal) **is better than loose-fitting** (no seal).

Supplied-air (pumps in clean air from outside the room) **is better than air-purifying** (filters the air in the room).

Pressure-demand (the motor pumps more air when you breathe harder) **is better than continuous-flow** (a motor always pumps air at the same rate).

- Your employer must give you a PAPR instead of a negative pressure respirator if you want one.
- Your employer chooses your respirator by looking at the air samples.
- Supplied-air respirators use Grade D air.



For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, Section h, "Respiratory Protection."

American Lung Association, "What You Should Know About On- The-Job Respiratory Protection," ALA Item No.0683.

Georgia Tech Research Institute, Chapter VIII, "Establishing a Type C Supplied-Air System," in "Model Curriculum for Training Asbestos Abatement Contractors and Supervisors," available from National Technical Information Services, (703) 487-4650.

EPA/NIOSH, " A Guide to Respiratory Protection for the Asbestos Abatement Industry," Publication No. EPA-560-0PTS-86-001.3.

NIOSH, "Respiratory Protection, A Guide for the Employee," (NIOSH) Publication No.78-1 93B.

NIOSH, "Guide to Industrial Respiratory Protection," DHHS (NIOSH) Publication No. 87 -116.



5 point head strap
for full-face APR



6 point head strap for
a full-face APR





5

PERSONAL PROTECTIVE EQUIPMENT PART 2: CARING FOR YOUR RESPIRATOR

In Part 2 you will learn:

What your employer has to do before giving you a respirator.

How to make sure your respirator fits.

How to take care of your respirator.

How to:

- clean,
- inspect,
- maintain, and
- store your respirator.

A Respirator Program

When OSHA inspects a job for health problems, more than one-third of the problems they find are in the company's respirator program. The law says your employer has to have a very strong respirator program. You can think of this as the "workers' respirator bill of rights."

What Your Employer Has To Do

Before your employer hands you a respirator, he or she has to do a lot of things. The employer has to find out if you can wear a respirator. Who will pick the respirators? Who will maintain them? These things have to be written down in a respirator program. What your employer must do could be called the "Respirator Bill of Rights."

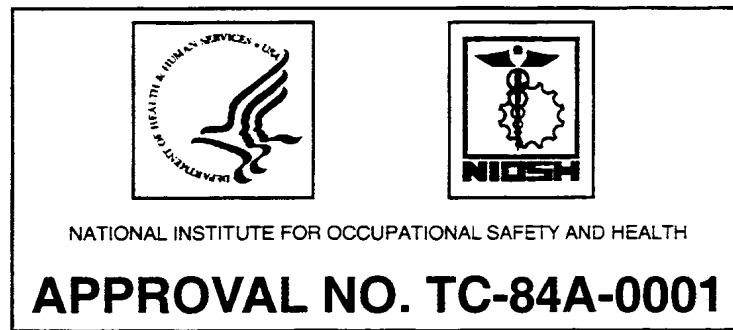


The Respirator Bill of Rights

1. **Your employer must assign one person to be in charge of the respirator program.**
Find out who this person is. He or she can help you if you have a problem with your respirator.
2. **Your employer must have written procedures for choosing and using respirators. Your employer must develop a new plan for each work site.**
Get a copy of this program from the person in charge of the program.
3. **Your employer must check the whole respirator program regularly.**
Is it as good in reality as it is on paper?
4. **Your employer must offer medical exams to everyone who wears a respirator.**
No one is allowed to wear a respirator without a medical evaluation.
5. **Your employer must give you training about respirators.** Before you put on a respirator, you have to be trained. You need training on each respirator you work with. You have to learn about all the parts of your respirator. You have to learn how your respirator works. You need to know what a respirator can do for you. You need to know what a respirator can't do for you. You have to be trained in how to clean, inspect, and store your respirator.
6. **Your employer must use approved respirators.** Respirators must be tested and approved by the National Institute for Occupational Safety and Health (NIOSH). **Make sure your filters are marked either HEPA, N100, R100 or P100 when you are working with Asbestos.** If there is any possibility of exposure to oil in the air, then use P100.



TRAINING



APPROVAL STICKERS

7. **Your employer must choose a respirator based on the hazard.** A gas filter won't protect you from a dust. A dust filter won't protect you from a gas. A filter respirator won't protect if there isn't enough oxygen in the air.
8. **Your employer must be sure your respirator fits you.** When you first get a respirator, and every year after that, the fit must be tested. Remember that a respirator is only as good as its fit. The fit tests are called a qualitative fit test or a quantitative fit test. The tests take from minutes to an hour.

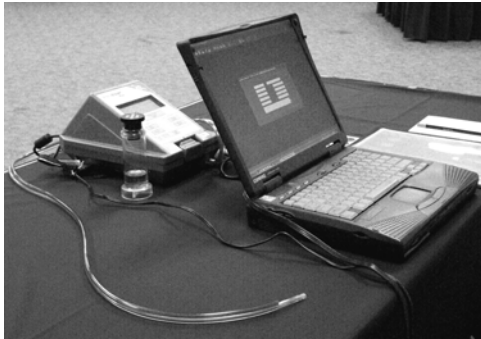
In a qualitative fit test, Bitrex, irritating smoke, banana oil, or saccharine are used. The tester blows irritating smoke around the edges of the respirator. When Bitrex, banana oil, or saccharine are used, you stand with your head in a hood while one of the agents is misted in front of your respirator.



Irritant Smoke QLFT

If the material leaks into the mask, you will smell it or taste it. If you can smell or taste the test material, the mask does not fit well enough to keep asbestos out of your lungs. **A qualitative fit test** tests the quality of the respirator's seal. You use your senses in the qualitative fit test.

In a quantitative fit test, you wear a respirator with a probe inserted into it. The respirator is hooked to a machine by tygon



QNFT machine and computer

tubing. The machine produces an alcohol mist. The machine measures how much mist leaks in compared to how much mist is outside the machine.

In both tests you will be asked to move your head around, bend at the waist, and talk. This makes the test more realistic. You will have one of these fit tests simulated during an EPA-approved Asbestos Worker Training

Class. You must have a fit test on every respirator that is given to you for protection. You must have another fit test every year. You must also have a fit test if the shape of your face changes. This could happen if you ...

- gain or lose more than 10 pounds
- lose teeth or get new dentures
- have surgery on your face
- break your nose
- get pregnant

9. Your employer must check respirators and fix them.

If there is anything wrong with your respirator, your employer has to fix it before you can wear it. Your employer has to check the respirators to make sure they are in perfect shape. Your employer has to have trained people fix your respirator.

10. Your employer must give you a safe place to store your respirator.

Your employer has to give you a clean, dry place to keep your respirator.

What You Have To Do

After your employer gives you the respirator, you have to use it safely. Do you have the right one? Did you get a fit test on your respirator? Does the respirator work? Is it clean?

You are the one who cares the most about whether your respirator works. If it is not in perfect shape, you could breathe asbestos. Learn how to use your respirator and take care of it.



1. Do you have the right respirator?

Does your respirator fit you? You must get a fit test for your respirator.

Do you have an approved respirator? Look for the NIOSH seals on your respirator box and on the filters. Make sure you see N100, R100 or P100 on your filters.

You need to have the right respirator for the job. Look at the air samples. Figure out which respirator you need. Is your respirator good enough? If you can, get a better respirator. By OSHA law, you can ask for a Powered Air-Purifying Respirator (PAPR) and your employer must give you one unless it is not protective enough for the work area. You would then get a supplied-air respirator.

Even if you have an approved respirator, it might not protect you enough from the amount of asbestos in the air. Respirator Protection Factors come from tests in labs. The respirator maker tests an average-size person. The tests are done in a clean, cool lab. Only new respirators are used. But you don't work in a lab. You may not have an average face. You sweat when you work. The respirator may slide on your face. Maybe your respirator isn't as perfect as when it was new. There are many reasons why the respirator may not work as well for you as it did in the lab. Respirators may not protect you as well as they are supposed to. If you can, get a better respirator than the law requires.

2. Know how to use your respirator.

If you don't know how to use your respirator, it will not protect you. If you don't have a clean shaven face, a tight fitting respirator will not protect you. If you don't maintain the respirator, it will not protect you. Get training on the respirator you use. Inspect your respirator. Are all the parts where they belong? Always inspect your respirator before you put it on.

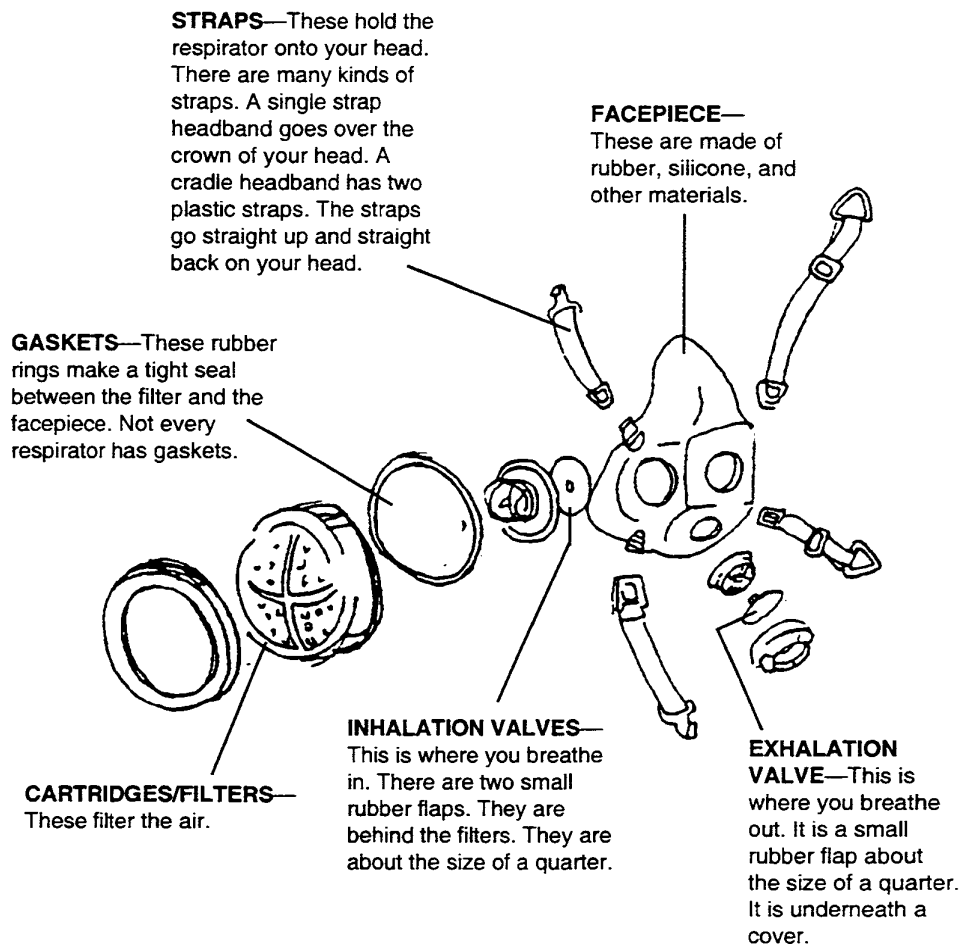
3. Inspect your respirator every time you use it.

A respirator can't help you unless it's in perfect shape. You need to inspect your respirator before you put it on. Make sure all the



parts are there. Make sure all the parts are in good shape. Make sure all the parts are in the right place. **If you find anything wrong with your respirator, do not wear it until it is fixed.**

THE PARTS OF A RESPIRATOR



A PAPR (powered air-purifying respirator) has all of these parts and some more:

hose - If the fan is on your belt, this carries air up to your face.

cord - If the fan is on your facepiece, this carries electricity up to the fan.

battery - Every PAPR has a battery to run the fan.



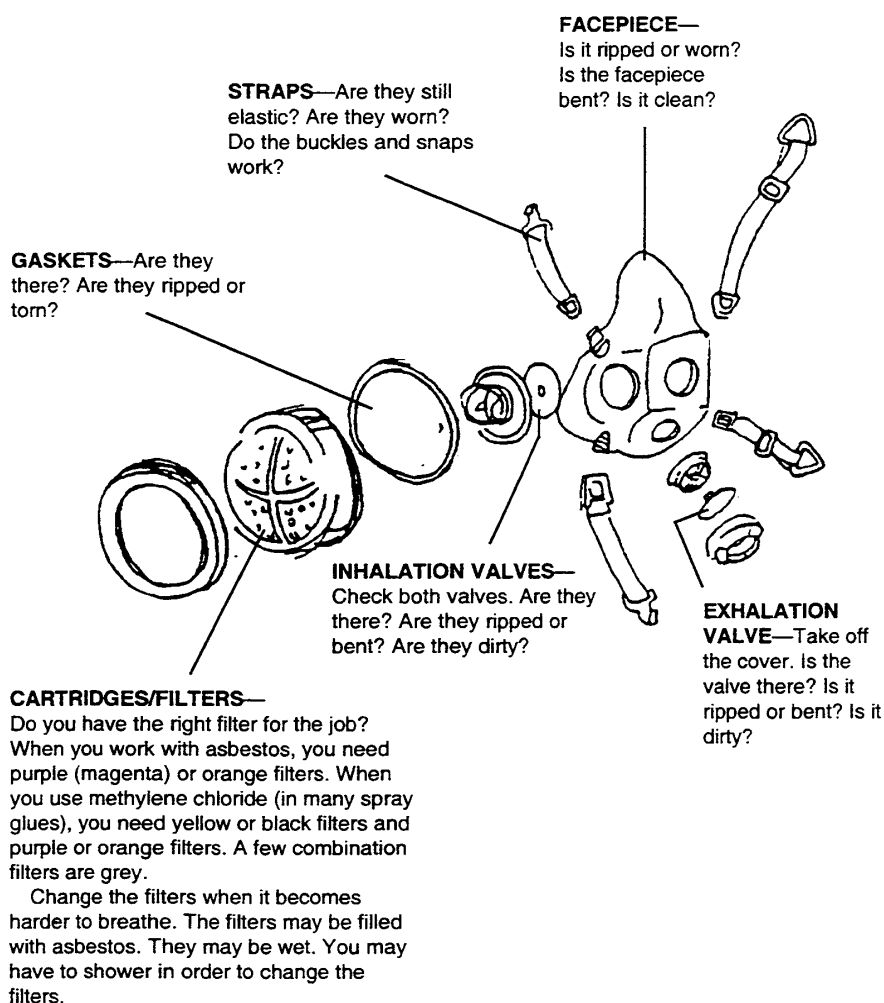
A Type C respirator also has all of the same parts and some different ones:

air regulator - This valve controls how much air comes into the mask. There are continuous flow valves and pressure-demand valves. A pressure-demand valve is better than a continuous flow valve.

escape cartridge - Many Type C respirators have a HEPA filter which is used if air stops coming through the hose. The filter cleans the air while you leave the work area.

escape air bottle - Many Type C respirators have a small bottle of air. If air stops coming through the hose, you can breathe air out of the bottle.

HOW TO INSPECT YOUR RESPIRATOR





If you wear a PAPR, you need to check all of the above and more:

hose - Is it bent or cut?

battery - Is it charged?

flow - Use a tube called a flow meter to see how much air the fan is blowing.

If you wear a Type C respirator, you need to check all of the above and more:

escape cartridge - Is there a HEPA filter? Is it clean?

escape air bottle - Is the bottle full?

Repairs

Respirator parts have to come from the same manufacturer that made the respirator. In other words, you may not use MSA brand filters on a 3M brand respirator. You may not use North brand valves on an AO brand respirator. No one should fix your respirator unless he or she knows how to fix it.

4. Putting on a respirator.

When you put on a respirator for the first time, put the mask up to your face first. Smile and frown and move your face around. Be sure the edges of the mask fit your face. Next, fasten the bottom strap (the one that goes around the back of your neck). Tighten the bottom strap. Pull the top strap over your head. Tighten the top strap. Pull both sides at the same time. The straps need to hold the respirator on your face. Do not make them too tight. The mask will dig into your skin and it will not be comfortable. Then do the two seal (fit) checks.

5. Do seal (fit) checks every time you put a respirator on.

Fit tests every year make sure that you have the right respirator. You also have to check the fit (seal) yourself every time you put a respirator on. The seal checks you do yourself are called a negative-pressure seal check and a positive-pressure seal check. You must do both of these seal checks every time you put on the respirator. Do the two seal checks every time you go into an area where there's asbestos in the air. You can only do these checks



on a tight-fitting respirator. (A tight-fitting respirator makes an air-tight seal around your face.)

The **negative-pressure seal check**. Cover the two filters or the air hose with your hands and suck in gently. Hold for a count of ten. You will feel the respirator pull against your face. You can feel the area of the seal tightening to your face. If there is a leak, air will rush in through the leak instead of pulling the mask against your face. You will feel air move against your cheeks. It may feel like a feather brushing across your face. The air will move toward your mouth. You may hear the air flow. If someone is watching you, they should see the respirator suck in a little at your nose.



The **positive-pressure seal check**. Take the cover off the valve on your chin. Cover the rubber flap with one hand and puff out gently. You should feel the force of your breath balloon the respirator out a tiny bit. This is like the feeling you get when you first blow up a balloon. You have to blow harder to get over the resistance of the balloon. As the mask moves out, you will feel the seal of the respirator tighten on your face. If there is a leak in the mask, air will rush out of the leak instead of making the mask balloon out. If there is a leak, you will feel air rush out against your cheeks. You will not feel the seal tightening to your face. Don't blow too hard, or you can blow out your intake valves and break a good seal.



6. **Keep your respirator clean.** Though respirators are never comfortable, they can become very uncomfortable if you do not clean and disinfect them regularly. It is very easy to clean your respirator, and you must clean it every time you use it.





Take off the filters and wash the respirator in warm water with a mild soap. The water temperature should not be more than 110°F. You may want to use a mild disinfectant. Wash the inside and outside of the facepiece with a soft bristle brush or a clean rag. Rinse the respirator in clean water and let it dry in the air.

7. **Store your respirator in a safe place.**
Don't hang your respirator by its straps to dry. This can stretch out the straps. Keep your respirator in a clean, dry place. It is easy to damage a respirator or get asbestos on it.

CARING FOR YOUR RESPIRATOR

Key Facts

A respirator will not protect you unless it fits.

You must have a fit test before you can wear a negative-pressure respirator at work.

- **Qualitative fit-testing** uses your sense of smell. It doesn't use machines.
- **Quantitative fit-testing** uses a machine. It measures how much air leaks around the edges of your respirator.

You must have another fit test every 12 months.

You must inspect your respirator before you put it on.

You must do fit checks every time you enter an area with asbestos in it.

- Negative pressure seal check: suck in, cover the filters.
- Positive pressure seal check: blow out, cover the valve on your chin.

Clean your respirator with soap and water every time you wear it.

Store your respirator in a clean, safe place.

Use HEPA/100 filters for asbestos. Use black filters for organic vapors like methylene chloride. Use a "combo" filter to protect against multiple atmospheric hazards.

**Discussion Questions**

1. The law gives you the right to go through decontamination and wash your face if asbestos or your respirator irritates it. Why do you have this right?
2. When you first pick up your respirator, what are you going to do?
3. How often do you need a fit test?
4. Why is it important to learn how to do the positive-pressure and negative-pressure seal (fit) checks?

For More Information

OSHA Asbestos Standard, 29 CFR 1926.1101, section (h).

OSHA Respirator Standard, 29 CFR 1910.134.

American Lung Association, "What You Should Know About On- The-Job Respiratory Protection," ALA Item No.0683.

NIOSH, "Respiratory Protection, A Guide for the Employee," DHHS (NIOSH) Publication No.78-193B.

EPA/NIOSH, " A Guide to Respiratory Protection for the Asbestos Abatement Industry," Publication No. EPA-560-0PTS-86-001.



Respirator Exercise

This is not a test. It is an exercise. Use it to see for yourself how well you understand the material in this section of the chapter.

1. What is the difference between a negative-pressure respirator and a positive-pressure respirator?
2. Which one protects you more? Why?
3. If you are working on an abatement project and air samples show 2.5 fibers/cc, which respirator do you have to wear?
4. Can you request a respirator that will protect you more? If so, what type?
5. What is the difference between a qualitative fit test and a quantitative fit test?
6. Some people have a harder time getting a good fit on a respirator. Who are they? Why do they have a hard time?



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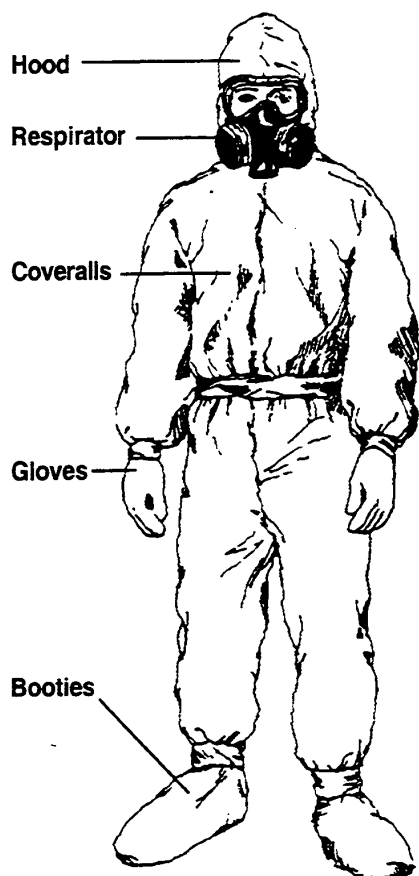
PERSONAL PROTECTIVE EQUIPMENT PART 3: OTHER SAFETY EQUIPMENT

In Part 3 you will learn:

About disposable suits.

About hard hats, boots, and other equipment.

Protective Clothing and Other Safety Equipment



A respirator is the most important piece of equipment for protecting you from asbestos. You also have to wear protective clothing.

Asbestos workers should always wear disposable suits. The suit includes coveralls, booties, and a hood. Sometimes suits are made in one piece, sometimes in two or three. They are usually made of a spun poly material called Tyvek™ or KleenGuard™. Suits come in several sizes. You can shorten a one-piece suit by putting duct tape around the waist, wrists, and ankles. Everyone in the work room must wear a suit. You should also wear gloves to keep asbestos off your hands.

Footwear

Booties are very slippery, especially on the wet plastic in asbestos work rooms. You may wear canvas or rubber shoes outside the booties. You may wear boots or steel-toed safety



Plastic booties are slippery.

shoes. These keep you from slipping or being hurt by falling objects.

You can't take these shoes off the job unless they are clean. Sometimes you can clean all the asbestos off them. (Leather and fabric shoes can not be cleaned; rubber shoes without seams can be cleaned.) If you can't clean them, you have to throw them out or tie them up in a bag. Your employer can take them from job to job in a sealed plastic bag with a warning label on it.

You should not wear street clothes on an asbestos job.

If for some reason you have to wear street clothes, seal them in a plastic bag with a warning label. Do not take them home.

If you use any non-disposable clothing or equipment (such as work boots or a hard hat) on an asbestos job, you must clean it. Do not take it off the job unless it is clean. Your employer can take it from job to job in a sealed, labeled plastic bag.

It is possible to wash clothing with asbestos on it. But disposable suits are much better. If you work in cold weather, you will probably wear long underwear. It should not leave the job. The person who washes the long underwear must be trained about the dangers of asbestos.

If you take asbestos home on your skin or street clothes, dust can come off in your home. Your family could get asbestosis, mesothelioma, or other asbestos diseases if they breathe or swallow asbestos. It is very important to wear a suit and not take your work clothes home.



Tyvek Suit

Goggles, Gloves, and Hard Hats

You need to wear goggles or a full face respirator if you do work overhead. You need to wear latex, cotton, or leather gloves if you work with sharp metal lath or around hot pipes. You need to wear steel-toed safety boots and hard hats if building materials might fall. You must wear rubber gloves, rubber safety boots, and hard hats if you work around live electrical wires.





For example, hard hats are made to protect you if something falls straight down on your head. But they will not protect you if something hits you from the side. OSHA has rules about protective equipment like hard hats, goggles, hearing loss protection, and boots. **Many of the rules for respirators also apply to other equipment.** For example, goggles will not protect you unless they are in perfect shape. They have to be cleaned, stored, and maintained.

For More Information

OTHER PROTECTIVE EQUIPMENT

Key Facts

You must wear protective clothing on an asbestos job.

Asbestos work is just as dangerous as other demolition work.

You may need to wear a hard hat, goggles, or steel-toed boots outside your disposable suit.

You must wear rubber gloves and boots if you are working around live electrical wires.

You need training in how to use safety equipment.

Leave unclean safety equipment on the job site.

Don't bring asbestos home. Leave work clothes at work!



OSHA Personal Protective Equipment Standards, 1910.132, 1910.133, 1910.135, and 1910.136.

OSHA, "Personal Protective Equipment," Publication No. OSHA 3077.











Notes and Scribbles





CLEANUP AND DISPOSAL 6

In this chapter you will learn:

- How to clean up the work area.
- How to take down the poly on the walls and floor.
- What happens to asbestos after it leaves the job.
- How your employer tests the air at the end of the job.
- How to replace the insulation.

Cleanup



- Phil:** There's just a little bit of dust left on the floor. I'll bring in the shop vac and clean it up.
- Pat:** Don't do that. Use the HEPA vacuum.
- Phil:** The HEPA vacuum broke this morning. Besides, the shop vac is OK to use inside the containment. The negative air machine will filter out any dust we kick up.
- Pat:** Why don't we just wet the dust down and sweep it up?
- Phil:** That will take too much time. I've got a date tonight and I want to get out of here before the second shift comes to take down the enclosure. ➞

**Discussion Questions**

(Choose one or two of the following questions to discuss.)

1. Is it OK to use a regular shop vacuum to clean up asbestos as long as you're inside an enclosure? Why or why not?
2. Do you need to worry about kicking up asbestos dust inside the containment? Why or why not?
3. If Phil uses the shop vac, how could it effect the people on the next shift?
4. How could it affect the next person who uses the shop vac?

What would you do if...



Cleanup and Disposal

It is very important to clean up the work room after you remove the asbestos. The work is not finished until the job passes an air sample. This is a very strict test. If all of the asbestos has not been cleaned off of beams, poly, waste bags, tools, and other surfaces, the job will not pass the air sample. Everything will have to be cleaned again until the job passes the air sample. It can be very expensive to clean and take air samples again. If you do a careful job the first time, you will not have to spend time later on cleaning the room again.

1. Clean Up the Asbestos You Can See

It takes a long time to clean up an asbestos job. The first step is to clean up all the asbestos you can see. As you take the asbestos down, bag it up. Clean the ceiling and other surfaces with a nylon-bristle brush. Wipe the surface with a damp rag until you can't see any fibers.

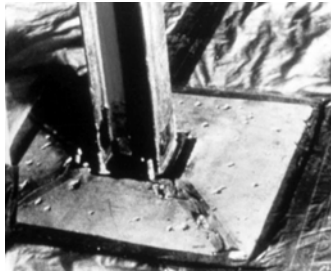
Then clean the poly on the walls and floors with damp rags and HEPA vacs.





Start at the top and work down. After the first cleaning, a supervisor may do an inspection. She makes sure there is no asbestos she can see.

2. Lock Down the Asbestos You Can't See



Then seal up the asbestos fibers you can't see. Use a low-pressure sprayer to spray a sealant called "lockdown." Spray the ceiling and the poly. This glues down any fibers you missed so they can't get in the air. Not all contract specs say you have to use a lockdown spray. But it is hard to pass the air sample at the end of the job without it. You may not use lockdown spray instead of cleaning.

3. Take down the first two layers of poly

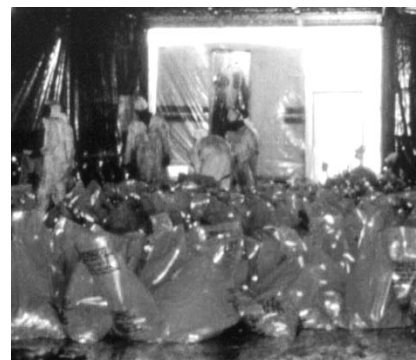
After you clean, you're ready to take down the first layer of poly. Cut the sheets into six-foot-wide strips. Cut through one layer of poly only. Roll the poly onto itself, from the top down. Fold it into bundles that you can handle easily and bag it.

Then take the first layer off the floors. Cut through the first layer of poly and roll it, bundle it, and bag it.

Once you take down the first layer of poly, put lockdown spray on the second layer. Cut, roll, bundle, and bag this second layer of poly. (Sometimes the job is left overnight to let the dust settle.) The critical barriers (on the doors and windows) must stay up until the job passes an air test at the end of the job.

4. Waste disposal

All poly has to be sealed in air-tight bags with labels, just like asbestos. Sometimes there is a waste load-out, which is like a decon for waste bags. It has two rooms – a wash room and a holding room. A worker inside the work room puts the bag into the wash room. A worker in the wash room washes off





the bag and stores it in the holding room. **People don't walk through the waste load-out. Only waste bags go through it.**

Anything with asbestos on it must be taken to an EPA-approved asbestos landfill. It must be sealed in leak-proof, labeled bags or containers. **The waste truck should have closed sides and a top. The truck should be lined with poly. It should be cleaned at the end of the job.** Bladder bags are very large 6-mil poly bags. Bladder bags are used to line a dumpster or truck.



5. Cleaning Tools

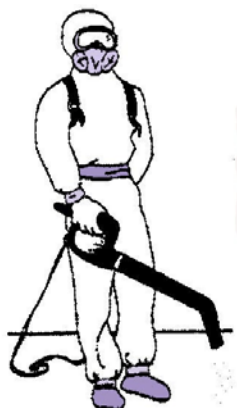
Everything that leaves the job has to be cleaned. This includes:

- | | | |
|------------------|--------------------|-------------------------|
| ● scrapers | ● respirator hoses | ● scaffolds |
| ● squeegees | ● hard hats | ● ladders |
| ● water sprayers | ● boots | ● negative air machines |
| ● tools | ● HEPA vacuums | |

Scrub everything off and rinse it well. Seal it in clear waste bags (with labels) and take it to the next job. You must clean scaffolding very well if it will be used on non-asbestos jobs.

6. Testing the air at the end of the job

A job may look clean, but what about the asbestos you can't see?



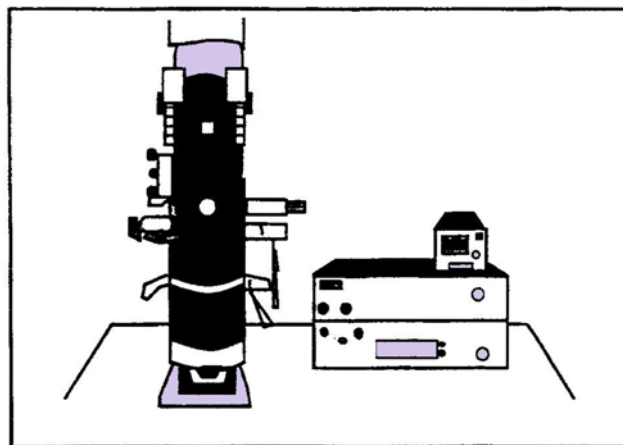
There is no way to know if the room is clean without testing the air. After the poly is taken down, an **industrial hygienist (IH)** will take an air sample. This air sample tells the building owner whether the room is clean enough.

This final air sample is called a clearance air sample. Clearance air samples are different from the air samples taken on workers. The air is stirred up with fans. A pump pulls the air through a filter. The fans stir up any fibers that are on the walls,



floors, or corners. More fibers can be caught on the filter.
Stirring up the air is called aggressive sampling.

The final air sample is sent to a lab, where the fibers are counted. There are several ways to count the fibers. In many specs, the room is clean enough when an air sample is .01 ("point oh one") fibers per cc or less. [.01 is equal to 1/10th of the Permissible Exposure Limit (PEL = 0.1 f/cc).] Sometimes the room is clean enough when it is at least as clean as the air outside the room. (This is how clearance air samples are done in most schools.) For final air samples taken in schools, the lab usually uses a very powerful microscope called a **TEM (Transmission Electron) Microscope**.



TRANSMISSION ELECTRON MICROSCOPE

If the job does not pass the clearance air sample, the room must be cleaned again. This is why critical barriers are left up until the job passes the test.

Take a look at the sample lab report on the next page. A building owner sent a clearance air sample to a lab. The lab looked at

the sample under a microscope. How many fibers per cubic centimeter did they count? Did the job pass the final clearance air test?

The lab counted 0.0036 fibers per cubic centimeter. That amount 0.0036 f/cc - is less than the clearance level - 0.01 f/cc. The job is clean enough to pass!

Sprayback

Contract specs may also ask for new insulation to replace the asbestos.



A.H.E.R.A. LABORATORY ANALYTICAL REPORT TRANSMISSION ELECTRON MICROSCOPY SAMPLE		
ELAP #		NV/LAP #
CLIENT: ADDRESS:		
SITE: N/P DESCRIPTION: AHERA TEM ASBESTOS AIR SAMPLE		
LOCATION: N/P		
PROJECT #: DATE COLLECTED: N/P DATE RECEIVED: 10/27/89 DATE ANALYZED: 10/27/89		
ANALYTICAL SUMMARY		
AVG. GRID SIZE: 0.007255 MM/2	# GRID OPEN	
AREA ANALYZED:		
TOTAL ASBESTOS STRUCTURES: 1		
ASBESTOS TYPE: Chrysotile		
TOTAL NON-ASBESTOS STRUCTURES: 4-(Si, S, Cellulose)		
AMBIGUOUS STRUCTURES: N/A		
TOTAL TIME: N/P Minutes		
FLOW RATE: 10.0 LPM		
TOTAL VOLUME: 1500 Liters		
SAMPLE RESULTS		
ASBESTOS FIBER CONCENTRATION: 13.8408	ZZ Si = 2.11	0.0036 S/cc
ANALYTICAL SENSITIVITY: 0.0036 S/cc		
ASBESTOS FIBERS ≥5 MICRONS IN LENGTH: 1	PERCENT OF TOTAL CONCENTRATION: 100	
ASBESTOS FIBERS <5 MICRONS IN LENGTH: 0	PERCENT OF TOTAL CONCENTRATION: 0	
Transmission Electro Microscopy (TEM) asbestos samples are analyzed by trained microscopists in accordance with EPA AHERA 40 CFR Part 763: ASBESTOS-CONTAINING MATERIALS IN SCHOOLS: FINAL RULE.		
_____ is not responsible for the accuracy of the data received from its clients that is used to calculate s/cc.		
COMMENTS:		
ASBESTOS ANALYST: DATE:	LABORATORY DIRECTOR:	

CLEARANCE AIR SAMPLE REPORT FROM A LAB

This could be fiberglass, mineral wool, or some other non-asbestos insulation. This replacement material is called **sprayback** when it is applied to surfaces where the original material was sprayed on. Don't put up sprayback until the job passes the air test. You may need to wear a respirator when you put up fiberglass or mineral wool. Just because the material isn't asbestos doesn't mean it's safe.

After you put up sprayback, you can take down the critical barriers. You can take the poly off the objects in the room. You can clean the decon and take it down. You can take out the negative air machine.



Re-insulation

After removing pipe insulation, muds, wraps, or any other asbestos material that was not spray applied, you need to re-insulate. Most re-insulation materials are put on in the same way the asbestos materials were applied. Replacement materials can be dangerous to work with so be sure to read the labels and ask questions about them.

Storage, Transportation, and Disposal

Project Design

Asbestos removal is the primary goal of abatement. However, improper storage onsite, transportation offsite, and land fill disposal of waste can create a nightmare if improperly conducted.

Correct disposal begins with good project design. Planning for waste disposal answers the following:

- How will asbestos be securely stored onsite?
- How will it be safely transported offsite?
- What kind of landfill should it be transported to to ensure proper disposal?

These questions must be answered prior to officially removing any amount of asbestos. In fact, project specifications should address each item separately. If specification does not address these issues, each item should **be addressed before project begins**. Even if you remove only one bag of ACM as part of a Class III -- Repair Activity or Class IV -- Maintenance Activity, you must treat your disposable waste the same as Class I or Class II projects. Your project is not complete until all removed ACM is deposited into an EPA-approved and certified landfill and, moreover, a complete waste shipment record must be returned to the Building Owners (Generator). If materials are improperly handled, the building owner, contractor, and transporter can all be fined.

Typically, good waste handling requires good project design. On small jobs, waste load-out is usually conducted by passing it out the decon. This procedure can lead to contamination of the decon unit. For larger more complex abatement jobs, a separate waste load-out area should be considered. This may include a sectioned storage area where bagged material can be thoroughly decontaminated before leaving the job site.



Friable versus Non-Friable

As discussed, pre-job abatement activities should resolve how wastes are to be handled. This should also include how friable and non-friable materials will be handled. All friable materials are regulated when removed. However, non-friable material removal will depend on how it is handled during the removal process. For example, intact non-friable floor tile may be left as is for demolition in some states. However, if this material is likely to become friable (i.e. sanding, grinding, etc.), then it must be removed as required by NESHAPS. A similar situation occurs when removing roofing materials. All dust generated during cutting of roof materials should be controlled at point-of-release. However, disposal of roofing waste will depend on state or local requirements.

Labeling

OSHA labeling regulations, as contained in **29 CFR Part 1926.1101 Section K (8)**, require that each bag, container, or sealed waste material contain the following warning label:

DANGER

CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

Once asbestos waste materials are labeled, little guidance for storage onsite is contained within Federal regulations. However, security of material is extremely important. All waste materials must be securely stored in order to prevent vandalism and release of asbestos fibers. Local and state authorities can provide additional guidance on this matter.

Chain of Custody

All during the removal process, a documented chain of custody must be



maintained. The kind of materials removed, the amount of material, and the amount transported to the landfill must be documented. All Chain of Custody forms must be signed off on as waste changes hands along its route to the landfill.

Transportation



Once demolition or renovation waste materials have been prepared, materials must be properly transported to an EPA-approved landfill. EPA guidance for proper disposal is contained in NESHAPS Regulations 40 CFR Subpart M (Section 61.150).

In summary, asbestos waste transportation and disposal requires:

1. Discard no visible emissions during transportation;
2. Maintain asbestos waste in adequately wet state during transportation;
3. All ACM must be transported to and deposited in an EPA landfill; and
4. Complete and return to building owner (generator), a fully executed signed copy of waste shipment record after deposit in landfill. All chain of custody forms generated should be maintained as part of project file. Project closeout is not complete until waste shipment record is submitted.

DOT regulations 49 CFR 171 and 172 regulate transportation of asbestos-containing waste materials. It also contains requirements for waste containment, shipping papers, and placarding of transport vehicles. Vehicles transporting hazardous waste such as asbestos must contain the following placard symbol **ORM 9**.



SAMPLE QUESTIONS

ADDITIONAL DISCUSSION QUESTIONS:

1. When should waste collected from a job remain onsite?
2. Why do EPA/NESHAPS regulations require "No Visible Emissions?"
3. Who is always responsible for assuring that waste is sent to an EPA approved landfill?
4. How does a generator insure that all waste is properly placed in a landfill?
5. What document(s) are necessary to complete a job?
6. Should Class I, II, III, and IV friable waste be handled differently? If yes, why? Explain



7. When does NESHAPS treat friable and non-friable waste equally?
8. What is the primary concern with NESHAPS?
9. Why should waste remain adequately wet during transportation to a landfill?

For More Information:

U.S. EPA. National Emissions Standards for Hazardous Air Pollutants (NESMPS) Asbestos Regulations (40 CFR 61, SubQart M), 1994.

DOT 49 CFR 171 and 172. Regulates Transportation of Asbestos Containing Waste Material. Requires Waste Containment and Shipping Papers, 1992.

OSHA Asbestos Standard, 29 CFR 1926.1101, Appendix F, "Work Practices and Engineering Controls for Major Asbestos Removal...."

Georgia Tech Research Institute, Chapter XIV, "Sampling and Analytical Methodology Pertaining to Asbestos Abatement," in "Model Curriculum for Training Asbestos Abatement Contractors and Supervisors," available from National Technical Information Services, (703) 487-4650.

EPA, "Asbestos Waste Management Guidance: Generation, Transport, Disposal," Publication No. EP N530-SW-85-007.

National Institute of Building Sciences, "Removal of Asbestos Containing Materials," in Model Asbestos Guide Specification, Section 02084.



CLEANUP AND DISPOSAL

Key Facts

- 1. Use damp rags and HEPA vacuums to clean up the work room.**

First clean all the asbestos you can see.
Then clean all the asbestos you can't see.

- 2. Spray a lockdown spray on the surface and on the poly.**

- 3. Roll up the poly from the top down and bag it as asbestos waste.**

Leave the critical barriers up until the job passes the clearance air sample.

- 4. Take asbestos, poly, dirty suits and other waste to an EPA approved asbestos landfill.**

- 5. Clean all tools with wet rags and HEPA vacs.**

- 6. The clearance air sample tells the building owner whether the room is clean enough.**

Clearance air sampling uses aggressive sampling-stirring up the air with fans.

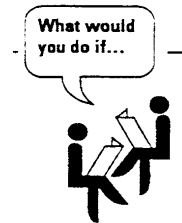
Clearance air samples are sent to a lab, where the fibers are counted. A Transmission Electron Microscope (TEM) is often used.

A job is not clean until the air sample shows 0.01 f/cc or less.

- 7. After the job passes the clearance air sample, put up new insulation (sprayback).**



Discussion Questions



1. Why is it important to clean up the poly if it will be will thrown out anyway?
2. Some people say that lockdown should not be used. They argue that cleanup should be done so well that lockdown is not needed. What do you think?
3. After taking off most of the asbestos, a contractor spray painted the beams instead of cleaning them off. What is the problem with this?
4. Why is the air stirred up before clearance air samples are taken?
5. Why do you wait until the job passes the air test to put up sprayback?
6. In what order would you conduct the following clean-up activities?
 - ___ Wet wipe/HEPA vacuum first (inside) layer of plastic.
 - ___ Conduct visual inspection of the work area.
 - ___ Disassemble the decontamination unit.
 - ___ Wet wipe/HEPA vacuum the second (outside) layer of plastic.
 - ___ Clean primary (critical) barriers.
 - ___ Conduct clearance air monitoring.
 - ___ Take down primary (critical) barriers.
 - ___ Spray a lockdown encapsulant on substrate surface and/or plastic.
 - ___ Remove all bags of waste from the work area.



Notes & Scribbles



Off-loading bagged ACM waste at a
EPA - approved land fill.



7

OTHER HEALTH AND SAFETY PROBLEMS

In this chapter you will learn about these dangers on asbestos jobs:

Problems with heat.

Cuts and bleeding.

Chemicals other than asbestos.

Oxygen-deficient atmospheres.

Slips, trips, and back injuries.

Fires & Explosions.

Noise.

Burns.

Shock.

Tight spaces.

Electrical shocks.

Mold.

Dangers from scaffolds and ladders.

Safety ...



- Supervisor:** Why are you taking your mask off? You know you're supposed to keep it on while you're in the work area.
- Brian:** I'm too hot. And I've got a real bad itch right under my facepiece.
- Supervisor:** You're the third person who's done that today. I'm going to write up the next person who takes their mask off in here!
- Brian:** It's not our fault! These half-mask respirators are just too uncomfortable to wear in the summer. We asked the company for PAPR's last month, but they won't give them to us.
- Supervisor:** Listen, you've just got to be more careful. It's for your own good. ➡



Discussion Questions

(Choose one or two of the following questions to discuss.)



1. Who is right, the foreman or Brian?
2. Why did Brian take his mask off?
3. Is it OK to take your mask off in the containment?
4. What should the workers do if they have to take their masks off?
5. What could the company do to make it easier for workers to keep their masks on?
6. What could the foreman do?
7. What would you do if you were Brian ?
8. What would you do if you were the foreman?

Other Health and Safety Problems

Asbestos is a slow danger on a removal job. But short-term hazards, such as electrocution and fires, can hurt you much more quickly. Asbestos removal is demolition work. Demolition is the most dangerous type of construction work. In this chapter we will discuss some of the short-term dangers on asbestos jobs, such as:

1. Problems with heat
2. Cuts and bleeding
3. Burns
4. Chemicals other than asbestos
5. Oxygen-deficient atmospheres
6. Electrical shocks
7. Noise
8. Fires and explosions
9. Tight spaces
10. Dangers from ladders and scaffolds
11. Slips, trips, and back injuries
12. Shock
13. Mold



Problems with Heat

Your body tries to cool itself by sweating. On the job, you work in a suit that doesn't let your body heat escape. Your lungs have to work harder to pull air through a respirator. The air conditioning must be shut off. You work very hard. If your body overheats, you can get very sick. Overheating can cause heat stroke (a medical emergency) or heat exhaustion.

Heat stroke happens when your body can't control its temperature. You stop sweating. Sweating is your body's way of cooling itself. Your body overheats. Heat stroke can kill you or cause brain damage. Here are some signs of heat stroke.

Signs of Heat Stroke

- | | |
|----------------|-------------|
| ● Hot skin | ● Headache |
| ● Dry skin | ● Dizziness |
| ● Flushed skin | ● Nausea |
| ● Confusion | ● Fainting |

If a worker shows signs of heat stroke, get the person to the hospital right away. Pack ice around the person until the ambulance arrives. Unless the victim is treated quickly, he or she could die. Call 911 and tell the operator there is a medical emergency. There may be a few places in the country where the 911 system is not available. If you are working in one of these areas, memorize the number for emergency help. Until the ambulance comes, you need to cool off the body of a person with heat stroke. The body can't do this by itself.

Get the worker out of the work room. Take off the suit and respirator. Be sure the person is still breathing. Cool the body off with water as soon as possible. You can hold the worker in the shower for a minute. Be sure you don't get water in the nose or mouth. You can wet the skin and fan it. Don't give water to a person who has fainted. You could make the person choke.

Heat exhaustion happens when you lose a lot of water from sweating. Sometimes you lose a lot of salt, too.



Signs of Heat Exhaustion

- Cool skin
- Sweaty skin
- Pale skin
- Headache
- Dizziness
- Nausea

Do these sound familiar? The last three signs of heat stress: headache, dizziness, and nausea are also signs of heat stroke. If a worker has hot, dry, flushed skin, he or she probably has heat stroke. Cool the person down until an ambulance arrives. If the person has cool, clammy, pale skin, he probably has heat exhaustion – cool the body down.

Get the worker out of the work room. Take off the suit and respirator and give the person cool water to drink. If the worker faints, call an ambulance. She may have heat stroke. Don't give water to a person who has fainted. You could make the person choke.

Watch out for these warning signs of heat problems:

- Less alert;
- Gets a headache;
- Less coordinated; and
- Feels sick to stomach

These signs could be the beginning of heat stroke or heat stress. If you start to feel like this, leave the work area. Be sure to take off your booties and wash up. Drink some cool water. If a co-worker shows these signs, get the person out of the work room and have him or her drink cool water.

Heat can make you less coordinated. This can cause other accidents. Heat can also cause muscle cramps or heat rash. These can also be used as warning signals of heat stress or heat stroke. Heat can also make a worker faint. Take a worker who has fainted out of the work area. Be sure that a person who has fainted does not have a more serious problem.



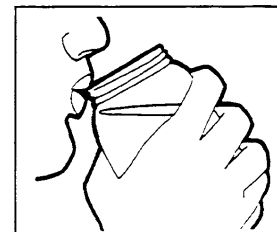


Preventing Heat Problems

Here are some ways to prevent heat problems:

Drink lots of water – Your body loses lots of water when you sweat. It is best to drink every half hour. But you probably won't be able to go through the decon that often. Drink 8 to 16 ounces of water at every break.

Drink some orange juice and eat bananas – or eat potato chips or one salty food once a day. Your body may need a little extra salt. But most Americans already eat too much salt. If you are on a low-salt diet for your heart do not eat extra salt. Salt tablets are very dangerous. Do not take them. You may want to drink a thirst quencher like Gatorade™.



DRINK WATER

Take breaks – Your body will handle heat better if it can cool down sometimes. At least two breaks a day and a lunch break will help your body handle heat better.

Get used to heat gradually – It takes about two weeks for your body to get used to working in the heat. Your body can get unused to heat in about four days. New workers should only work a half day in the heat for the first few days. They should not work a full shift until the end of their first week.

Use cooling vests – There is some new equipment that can help keep you cool. Cooling vests have ice packs in them. The ice melts, and they can be uncomfortable. When you are working in very hot areas, cool vests can prevent heat problems.

Cut down on alcohol – Alcohol dries out your body. Even if you only have two beers the night before work, you are more likely to have problems with heat. If you drink, do it on the weekend when you don't have to work the next morning. Then drink lots of water before going to work.

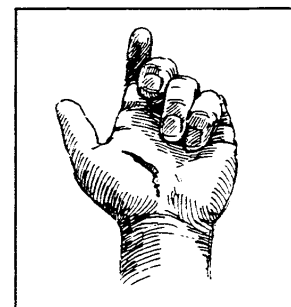


Heat Related Disorders		
Disorder	Symptoms	Remedy
Heat Rash	<ul style="list-style-type: none">• Rash on Skin• Prickly feeling• Tiny red blisters	<ul style="list-style-type: none">• Apply mild drying lotions• Keep skin clean
Heat Cramps	<ul style="list-style-type: none">• Pain in muscles	<ul style="list-style-type: none">• Replenish salt and electrolyte levels
Heat Fainting	<ul style="list-style-type: none">• Fainting after working in a hot area for long time	<ul style="list-style-type: none">• Move worker to cool, dry place• Lie worker down and raise his/her legs
Heat Stress	<ul style="list-style-type: none">• Headache• Nausea• Dizziness• Cool, sweaty, pale skin	<ul style="list-style-type: none">• Move worker to a cool, dry, shady place. Have someone stay with the worker.• Cool the worker with cold water or by fanning.• Replace body liquids.
Heat Stroke	<ul style="list-style-type: none">• Headache• Nausea• Dizziness• Hot, dry, flushed skin• Confusion• Fainting	<ul style="list-style-type: none">• Call 911 for help!!• Move worker to a cool, dry, shady place.• If the worker is conscious, give him/her something to drink.• Cool victim by fanning• Follow doctor's orders.

Cuts and Bleeding

Whenever someone has a cut that is bleeding heavily, you should cover the wound with a clean cloth. Press on the cloth to give direct pressure on the wound. Elevate the wound also. If the wound does not stop bleeding within a few minutes, call 911 for emergency help.

At the same time you are applying direct pressure on the wound and elevating it, you can put direct pressure on the pressure points. You have two pressure points on each side of your body that can be used to stop bleeding. One is



APPLY DIRECT PRESSURE



inside the arm, under your bicep. The other pressure point is at the top of your leg, just inside your hip. Press hard on the wound and the nearest pressure point, while elevating the wound until emergency personnel arrive.

Burns

Do not clean burns or break blisters; remove any clothing that sticks to the burn; apply ointment or medication to severe burns; or use cotton to cover burns.

First Degree Burns -- redness or discoloration of skin; mild swelling and pain. Run water over the burn for at least 15 minutes. Then blot gently and apply a dry sterile pad if necessary. Medical treatment is usually not necessary; however if severe symptoms exist, call for professional medical help. Be alert for signs of shock. Never heat a needle and puncture a blister.

Second Degree Burns - deep burn with red or mottled appearance; blisters; considerable pain and swelling; and skin surface appears wet. If arms and legs are effected, elevate the injury above heart level. Burns may be deep and potentially serious, requiring medical treatment depending on the extent and location. Be alert for signs of shock and infection. Seek treatment for second degree burns.

Third Degree Burns -- deep tissue destruction with a white or charred appearance; no pain. Call for professional medical help immediately. Be alert for signs of shock. See treatment for third degree burns.

Chemicals Other than Asbestos

You have learned about some dangerous chemicals used at work

- » methylene chloride (in spray glue)
- » ammonia (in spray poly)
- » isocyanates (in polyurethane foam)
- » surfactant (in amended water)
- » fiberglass (for replacing)
- » solvents (for taking off floor tile glue)



Willson brand HEPA/
Organic Vapor combo filter



- » lockdown
- » encapsulants
- » carbon monoxide (from motors)

An asbestos filter on your respirator will not protect you from other chemicals. For example, you might need both a **black** filter (for methylene chloride) **and a magenta** filter (for asbestos). You might need both a **green** filter (for ammonia) **and a magenta** filter (for asbestos).

You may also remove asbestos in a chemical plant, lab, or some place where other chemicals are used. You need to know what you are working with. Your employer must have you trained about the chemicals you work with. This is called Right-To-Know training. When you work with harmful gases or vapors, you must protect yourself. Your employer must give you the right respirator and filters. Your employer also must give you a schedule which tells you when to change your gas or vapor filters.

Carbon Monoxide

Carbon monoxide is a dangerous gas. It can poison you. It can cause permanent brain damage and can even kill you. It has no smell, taste, or color. It comes from motors, such as air compressors and portable generators. It can be a real problem if you are using Type C respirators.



Here are some signs of carbon monoxide poisoning.

Suddenly you begin to feel drunk and dizzy and you may start swaying back and forth. Your thinking gets foggy. You may even begin to act crazy and can fall unconscious. You may feel --

- faint
- like throwing up
- sleepy
- headache
- nauseous
- dizzy

Does this sound familiar? Three signs of carbon monoxide poisoning: headache, nausea, and dizziness are also signs of heat stroke and heat stress. If a worker has these signs, get her out of the work room and take off her respirator. If the person faints, call an ambulance. If a person does not respond to you when you call their name and shake their shoulder, they are unconscious. If a worker becomes unconscious because of carbon monoxide, be prepared to give CPR (carpio-pulmonary resuscitation). CPR is a way to get someone's heart and lungs working again. There should always be someone



on your crew who has current CPR certification. You can get certified by taking CPR classes. They are given at your local Red Cross, American Lung Association, and the National Safety Council.

If you begin to have signs of carbon monoxide poisoning and you are wearing a Type C respirator, turn on your escape gear and disconnect your air line. Alert your co-workers and get out of the work area. Help your co-workers to get out and have the air purification system checked.

Oxygen-Deficient and Enriched Atmospheres

Oxygen is a gas in the air you breathe. There must be between 19.5% and 23.5% oxygen in the air when you are working. If the oxygen level goes below 19.5% in a work area, that area has an oxygen-deficient atmosphere.

Oxygen deficient atmospheres may be caused by chemical reactions, work being done, or replacement of oxygen by carbon monoxide or another gas. Air should be tested to see if there is enough oxygen in any confined space.

If you are in an area that has an oxygen-deficient atmosphere, you may feel light headed, anxious, or start to act silly. If you think you are in an oxygen-deficient atmosphere, get out. If the oxygen levels are low enough, you could die in minutes. Only enter an oxygen-deficient atmosphere wearing a self-contained breathing apparatus, or supplied air respirator with bottle escape. If the oxygen content is above 23.5%, it is enriched and is a explosive hazard. Do not enter or remain in an oxygen-enriched area unless you are trained and properly equipped.

Electrical Shocks

Electricity is measured in volts. Even a few volts can kill you if the electricity goes through your heart. Electricity follows the easiest path to the earth. It is very easy for electricity to travel through water. If you are wet and you touch electricity, it may travel through your body.

A wire with electricity going through it is called a "live" wire. If a tool or an extension cord is broken, it may have a short. This means that the electricity doesn't flow through the right wires. It may flow through the tool and into your body. Electricity is a problem on asbestos jobs because:

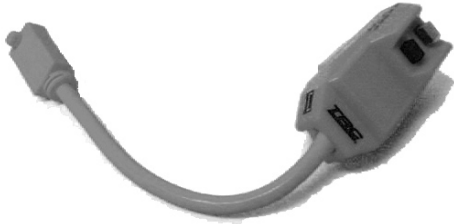
- A lot of water is used.
- Power tools are used.
- Metal tools may be used.
- Power may not be shut off.
- Extension cords are used.
- Exposed wires.



Preventing Electrical Shocks

The best way to protect workers from shocks is to prevent shocks. OSHA says your employer has to prevent shocks. Your employer can use a sensitive **circuit breaker or a written program.**

A Ground Fault Interrupter (GFI) is a very sensitive circuit breaker. If there is a short, the GFI should shut off the power before it can hurt your



heart. A Ground Fault Interrupter is a very good way to prevent shocks. Each extension cord should have its own GFI. Your employer can also use a **written program.** With a written program, you count on a person (instead of a piece of equipment) to keep you safe. You can do the following to prevent electric shocks on the job --

Don't use too much water -- Don't use so much water that there are pools on the floor. Clean up small amounts of water with a wet/dry HEPA vac. Never use water around live wires.

Shut off the power -- Lock the electrical box. Your employer should have an electrician come in and test the wires. You might think that all the power is shut off, but it may not be. You could be in for a big surprise.

Cover electrical outlets -- Be sure that electrical outlets and boxes are covered water-tight.

Use safe power tools -- Power tools should be **double insulated.** This means the outside of the tool doesn't touch the wires in the cord. Tools should also be **grounded.** This means there is an extra wire in the cord. If there is a short, electricity will travel through the extra wire. Electricity should not go into your body. A **grounded** tool has three prongs on the plug (instead of two). **Never cut the third prong off a grounded plug.** Use an adapter. Attach the wire on the adapter to the plate on the outlet.

Keep power tools in perfect shape-- It is much easier to get a shock from a broken tool. Broken tools should be taken off the job. They should have a DO NOT USE tag on them. Do not try to fix a broken tool unless you have been trained. Always unplug a tool before trying to fix



it. Some companies cut the cord of a broken tool so no one can use it.

Here are some ways to keep tools in perfect shape:

- Inspect the tool before you use it.
- Give broken tools to your supervisor.
- Be sure the tool is sharp-the motor has to work harder if it is dull.
- Don't carry a tool by its cord.
- Don't unplug a tool by pulling on the cord.
- Store tools where they won't be damaged.

Use safe extension cords -- Heavy-duty wire is **not meant** for temporary wiring. Your employer must give you extension cords with plugs for power tools. Your employer should give you grounded extension cords.

Keep extension cords in perfect shape -- There may be a lot of extension cords on the job. The negative air machine needs one. So do power tools and lights. Extension cords need to be taped up off the floor. If a scaffold runs over the cords, it could cut them. **Never hang extension cords with wire.** This could cause a shock. When you attach a tool to an extension cord, put electrical tape around the joint. Also do this when you attach two extension cords together.

Never use metal hand tools or ladders- Electricity travels through metal. If you touch a live wire with a metal shovel, you could get a bad shock. Your employer should give you plastic or wood tools. Metal tools with plastic handles are safer. Metal ladders are also dangerous. Your employer should give you wood or fiberglass ladders.

Wires in walls and ceilings -- When you scrape asbestos off a ceiling, you might uncover wires. It is very important to shut off the electricity and have an electrician test it.

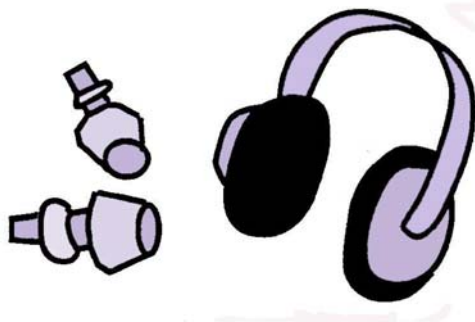
If a worker has been shocked, do not touch him -- You might get a shock yourself. Shut off the power first. Then use dry wood pole to move him away from anything metal. **Someone on the job should be trained to do CPR.**



Use protective equipment – Preventing shocks is the best way to protect workers. But if you must work around live wires, you need to protect yourself. You may need rubber gloves, a hard hat, and rubber boots. The equipment must be made for working with electricity. Only some hard hats are made for working with electricity.

Noise

Working in a noisy place can make it more difficult to work. Too much loud noise can also damage your health. Hearing loud noises for short periods of time can make it hard for you to hear normal noises temporarily. If you hear loud noises often for a long time, your hearing can be damaged forever. Noise can also cause you to have high blood pressure, be irritable or, may upset your sleep temporarily.



Noise is measured in units called decibels (dB). If a noise is increased by 3 dB, it sounds twice as loud. A very soft whisper is 30 dB. A loud rock band may play at 120 dB. OSHA has a law that says your employer must make hearing protection available to you if you work for 8 hours when the noise level is above 85 dB. But studies have many scientists recommending that everyone exposed above 80 dB wears hearing protection. The law requires that you have tests every year to measure your hearing if you work at noise levels above 85 dB. Some HEPA vacuums can cause a noise level of 80 dB. You will be more comfortable if you wear ear plugs or ear muffs while working with a HEPA vacuum. Your employer should help you make sure that your plugs or muffs fit properly.

Fires and Explosions

A fire on an asbestos job is very dangerous. **Poly, duct tape, and disposable suits burn fast. Poly will melt and can burn at about 150 degrees. The negative air machine makes the fire spread fast. The work room is dark and there is only one exit.**

The best way to deal with fires is to prevent them. Any fire needs three things: fuel (something that burns); heat (the heat, flame or spark that starts the fire); and oxygen (in the air). **Preventing fires means keeping fuel, heat and oxygen from coming together.**

**FUEL**

- » poly
- » duct tape
- » spray glue
- » encapsulant
- » disposable suits
- » wood

HEAT

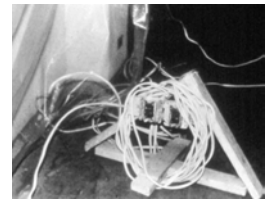
- » welding
- » cutting torches
- » electrical wires
- » lights
- » broken tools
- » operating machines
- » cigarettes

OXYGEN

- » air
- » negative air machine

Welding and cutting – These are often used in demolition. A worker must stand by with a fire extinguisher in case any sparks fly.

Electrical wires and lights – An ordinary lamp on the floor can start a fire. Never wrap lights in poly. Heat will build up and can set the poly on fire. Your employer must use safety lights. The lights have cages that keep the hot bulb from starting a fire. They are also safe in water.



A fire or a trip waiting to happen

Tools – If tools are kept in perfect shape, they are not likely to start a fire.

Operating machines – These need extra protection during setup.

Cigarettes are not allowed on asbestos jobs. Do not smoke during setup. Poly and spray glue both catch fire very easily. There are some new products which can help prevent fires. Fire-resistant poly doesn't burn as easily. New spray glues use chemicals that don't burn as easily.

Flammable Vapors

Some chemicals can give off vapors that can ignite and burn. Many glues and mastics used on work sites produce flammable vapors.



Flammable gases may also be present at the work site. These include those that the workers bring on site, like acetylene for use in torches or methane gas, a naturally occurring flammable gas. Serious injury or death can result from fires due to flammable vapors. For this reason, OSHA has established standards to prevent workers from being in



flammable atmospheres. If you suspect a flammable atmosphere exists, air monitoring must be conducted to determine if the area is safe.

In case of fire

If there is a fire in the work room, get out. The fire will spread very quickly. You may have to cut through the poly to get out of the work room. Your employer must have **fire extinguishers** and an **escape plan**. Fire extinguishers need to be able to put out wood, chemical, and electrical fires. These are called **ABC-rated fire extinguishers**. If there are sprinklers, your employer should try to leave them in service as long as possible.



The escape plan includes a map and emergency phone numbers. The plan should be hung in the decon. When you start a job, look at the map. Figure out how you would get out in an emergency. Do you have to dial "9" to make a phone call outside of the building? Is there an emergency exit from the work room? Are there arrows made out of tape on the walls to show you how to get out? If the fire started near the decon, you will not be able to get out that way. Where is the fire extinguisher? Do you know how to use it?

Confined Spaces (29 CFR 1910.146.)

There are some cases where you may work in a small area that is hard to get out of. This might happen if you are taking asbestos off the inside of a steam tunnel, a factory oven, or a storage tank. It may be hard to get out of these **confined spaces**.

A "confined space" is an area that has limited opening to get in and out, has poor natural air flow, and is not designed to be worked in continuously. Confined space work can be very dangerous. You need to be trained in special procedures and safety practices.

The air quality inside a confined space may be very different than the air outside of the area. Deadly gases may be trapped inside, or there might not be enough oxygen. The air should be tested inside a confined space before you go in to make sure it is safe. A ventilating system may be hooked up, and air monitoring should continue throughout the entire project.

If you work inside a confined space, you should wear a rescue harness.



CONFINED SPACE ENTRY PERMIT

This permit must be filled out before any entry can occur
and returned to the Safety Officer for filling when work is completed.

1. Name/Location of Area _____
2. Time and Date of Entry _____
3. Personnel who will enter _____
4. Have all valves/electrical equipment been locked? Yes ____ No ____
5. Have all lines been broken, blanked off, or isolated? Yes ____ No ____
6. Combustible gas meter test results _____
7. Oxygen meter test results _____
8. Hydrogen sulfide test results _____
9. Other air monitoring test results _____
10. Warning signs posted? Yes ____ No ____
11. Respirators worn? (list type) _____
12. Lifeline and safety winch? Yes ____ No ____
13. Other safety equipment used? _____
14. Intrinsically safe equipment used? _____

Sign after checking personally:

- | | |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |

There should be another worker outside (attendant) who checks on you at least every few minutes. He can pull you out if something happens to you.

Other safety measures include:

- Preparing a written rescue plan;
- Locking and tagging-out all energy sources;



- Using an entry permit system;
- Using proper entry and rescue equipment; and
- Making sure all team members understand their roles.

People can die in confined spaces. This happens when safety procedures aren't followed. Using an entry permit – a kind of check off list – helps to avoid such deaths and accidents.

No one should go into a confined space to rescue a worker unless he or she is trained and protected. Many people die trying to rescue workers in confined spaces. Hurrying to help out, rescuers often forget to follow safety procedures.

Ladders (29 CFR 1926. Sub Part X)

Never use metal ladders. Electricity passes through them, and it can shock you. Also be sure that ladders are in perfect shape. Ladders can be dangerous if they are not used properly and kept in good condition. **Every time you use a ladder, check for these things:**

- » broken steps;
- » broken hinges;
- » broken feet;
- » wobbly ladder;
- » no rubber safety feet; and
- » water on the ladder.

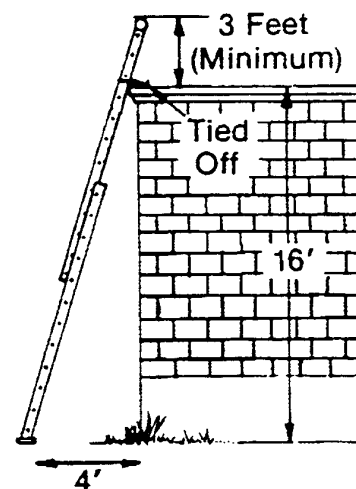
Here are some ways to use ladders safely –

Don't lean a step ladder against a wall. Use a ladder that's made to lean against a wall.

If you lean a ladder against a wall, set it up so that the top of the ladder is four times higher than the distance from the wall to the base of the ladder.

Only use one side of a step ladder. The other side isn't made to hold a person.

Face the ladder. Don't stand on it backwards.



USE LADDERS SAFELY



Don't stand higher than two steps from the top of a step ladder. Get a taller ladder.

Don't use a ladder as a platform. Use a piece of wood.

Scaffolds (29 CFR 1926 Sub Part L)

Scaffolds on wheels are common on asbestos jobs. Metal scaffolds are not safe. Electricity travels through metal. If you touch a live wire with a metal scaffold, you can get a bad shock.

You can't tell whether a scaffold is safe by looking at it. Scaffolds must be put together by someone with experience. All the parts must fit perfectly. They should be inspected by someone other than the person who built them. **Here are some rules about scaffolds on wheels –**

All scaffolds should have railings. These keep you from falling over the side.

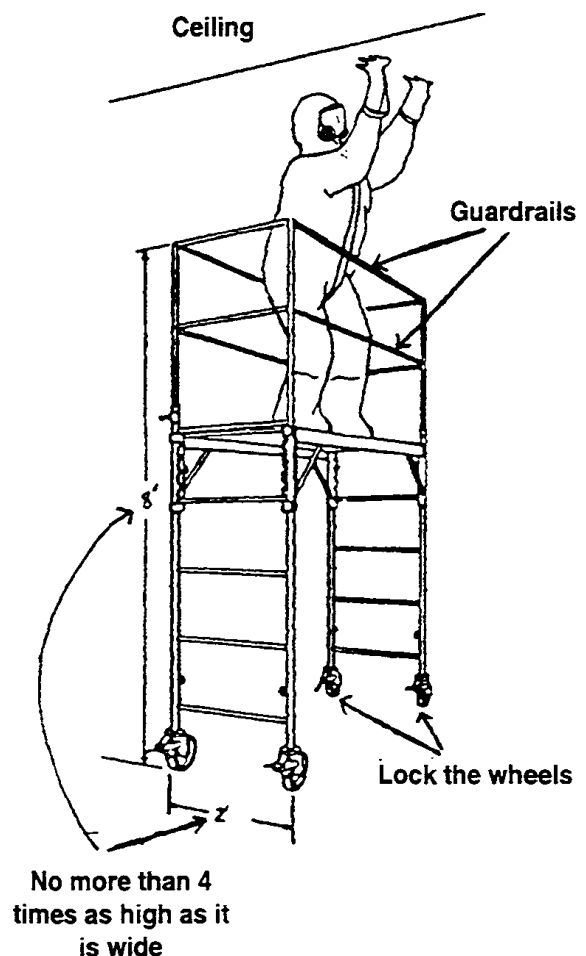
Fall Protection is required if scaffolds are more than 10 feet high.

The scaffold parts must be locked together with pins.

The wheels must be locked when people are on the scaffold.

Generally: Scaffolds may not be more than 4 times higher than they are wide. A scaffold 6' wide may not be more than 24' high; otherwise, they must be secured.

Boards may not overlap the ends of the scaffold more than 1 foot or less than 6 inches. If you step on





the end of the board, the board could tip over and you would fall.

It is safer to use scrapers with long handles than to work on a scaffold.

If you are using air-supplied respirators, it is easy for the hose to be caught on the scaffold. Be sure that there is enough hose for you to move around. It is even more important not to fall off scaffolding. If you fall, you may be trapped by the hose. It can pull the respirator off your face. The hose could pull other people off the scaffold.

Slips, Trips, and Falls

When you work, you wear slippery booties on your feet. The floor has plastic on it. There is water on the floor. You may drag a 300-foot-long air hose behind you. It is easy to slip or trip. You can reduce your risk of falling. **Here are some ways to prevent falls on the job –**

- Keep the floor dry
- Don't use too much water
- Use a wet/dry HEPA vac to pick up small amounts of water
- Wear boots outside of your booties. You cannot wear these boots outside an asbestos job.
- Tape extension cords up on the walls.
- Keep boxes, bags, and other junk out of the way.
- Keep air lines from getting tangled.

Back injuries

Back injuries are very common and very painful. Back injuries are one of the most common injuries to workers in America. They are hard to treat. It is much easier to prevent back problems than to treat them. **Here are some ways to prevent back problems –**

- Figure out how much you can lift comfortably.
- Figure out a way to lift that's comfortable for you. Lift close to your body.
- Try to keep your back straight when you lift. Use your legs to lift.
- Don't lift, twist, and turn at the same time. This is when most back injuries occur.
- Get help to lift heavy bags.



Shock

Whenever anyone has suffered a serious injury, they can go into shock. People who have been cut badly or have a serious burn may go into shock. Shock happens when some parts of the body have a sudden need for a lot of extra blood. Because blood is flowing to other parts of the body, there is less blood going to the brain and the person goes into shock. Symptoms of shock are --

- Cold, wet skin
- Pale
- Rapid heartbeat
- Thready pulse (When someone has a thready pulse, you may not be able to feel a regular beat at their wrist. You may feel the blood running under the skin, but no regular rhythm.)

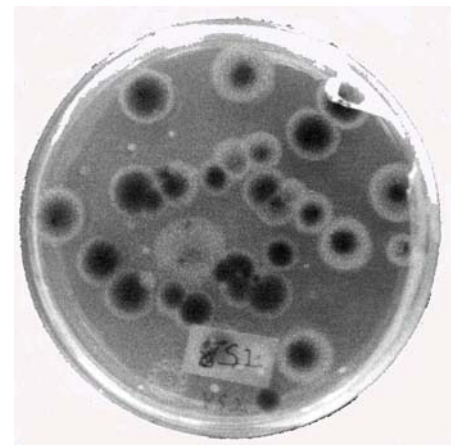
Shock can be very serious. People can die from shock. **Whenever someone goes into shock, you should call 911 or the local emergency number for emergency help.**

To treat a person in shock, the person should lie down. Lift their feet up about 6 inches, unless the person has an injury to their legs. Cover the person with a light blanket, unless they are sweating heavily. Do not give them anything to eat or drink. It is sometimes hard for people to swallow if they are in shock. Treat the person as best as you can until the emergency personnel arrive.

Mold

All molds have potential health effects. Molds can produce allergens that can trigger allergic reactions or even asthma attacks in people allergic (as determined by a physician) to mold. Others are known to produce potent toxins and/or irritants. Unfortunately, medical studies seeking to establish direct health effect results to mold exposure are a mixed bag of results.

Currently there are not any OSHA PELs, NIOSH RELs, nor ACGIH TLVs for exposure to mold. EPA has produced a set of remediation guidelines, as has the city of New York. The term



Mold growth after one week in lab conditions



“professional judgment” can be found in “legally enforceable work practices”. OSHA Class 1 asbestos abatement required regulated area setup, disposal, and worker PPE exceeds EPA mold remediation recommended practices. Work practices are necessarily different and personal decontamination for mold exposure is less stringent. If mold is found during an Class 1 asbestos abatement job, the property’s owner will decide whether or not to remediate the mold contamination while removing asbestos. Since both removal processes make use of poly wall and room barriers, HEPA vacuums, and negative air machines (depending on the level of mold contamination), an owner might decide to have an Class 1 asbestos abatement crew remove mold damaged building parts. Workers performing Class 2 or 3 asbestos abatement work may find changes in PPE, work setup, and remediation.

Non-Regulatory Mold Remediation Guidelines

Containment **Limited:** Use poly sheeting ceiling to floor around affected area with slit entry and covering flap; maintain area under negative air pressure with HEPA filtered fan unit. Block supply and return air vents within the containment area.

Full: Use two layers of fire-retardant poly with one airlock chamber. Maintain area under negative air pressure with HEPA filtered air fan exhausted outside of building. Block supply and return air vents within contaminated area.

Cleanup Methods **Method 1:** Wet vacuum (in case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried.) Steam cleaning may be an alternative for carpets and some upholstered furniture.

Method 2: Damp-wipe surfaces with plain water or water and detergent solution (except wood – use wood floor cleaner); scrub as needed.

Method 3: HEPA vacuum after the material has



been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.

Method 4: Remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

PPE **Minimum:** Gloves, N95 filtering facepiece respirator, goggles/eye protection

Limited: Gloves, N95 filtering facepiece respirator or half-face respirator with HEPA filters, disposable overalls, goggles/eye protection

Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filters

Sources: "Bioaerosols: Assessment and Control" (ACGIH, 1999) and "IICRC S500, Standard and Reference for Professional Water Damage Restoration" (Institute of Inspection, Cleaning and Restoration, 1999).

Medical Evaluation

Individuals with persistent health problems that appear to be related to fungi or other bioaerosols should see their physicians for a referral to practitioners who are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures. Clinical tests that can determine the source, place, or time of exposure to fungi or their products are not currently available. Antibodies developed by exposed persons to fungal agents can only document that exposure has occurred.

Persons recovering from surgery, or people with immune suppression, asthma, hypersensitivity pneumonitis, severe allergies, sinusitis, or other chronic inflammatory lung diseases may be at greater risk for developing health problems associated with certain fungi.



OTHER SAFETY AND HEALTH PROBLEMS

Key Facts

Heat stroke

A medical emergency: call an ambulance

Symptoms: hot skin, dry skin, flushed skin

Get the person out of the work room. Take off the suit and respirator. Get the skin wet to cool off the body.

Heat stress

A medical alert

Symptoms: cold skin, clammy skin, pale skin

Get the person out of the work room. Take off the suit and respirator. Give the victim a cool drink.

To prevent heat problems:

Drink lots of water. Get used to heat gradually over 2 weeks. Take breaks.

Other chemicals:

An asbestos filter on your respirator will not protect you from other chemicals. Use a combination filter or an air-supplied respirator.

Never use metal hand tools or ladders.

Use Ground Fault Interrupters (GFI) on all power sources.

Wear rubber gloves, a hard hat, and rubber boots if you work with live wires.

If a worker has been shocked, shut off the power and use a dry wood pole to move the worker.

To prevent fires:

Have a worker stand by with a fire extinguisher when welding or cutting torches are used. Have an ABC-rated fire extinguisher on the job.

Key Facts continued on next page



Key Facts (continued)

To prevent falls:

Inspect ladders every time you use them.

Make sure all scaffolds have railings. Lock the wheels when people are on the scaffold. Scaffolds may not be more than four times higher than they are wide.

Carbon monoxide is a dangerous gas.

Signs of carbon monoxide poisoning: headache, nausea, dizziness, sleepiness, faint, throw up. Get the worker out of the work room and take off the respirator.

Electrical hazards

An electric shock can stop your heart. If you are wet and you touch electricity, it will travel through your body.

To prevent electric shocks:

Never use water around live wires.

Shut off the power and lock the electrical box.

Use tools that are double-insulated and grounded.



Can you find at least 5 things wrong with this?



Safety and Health Exercise

This is not a test. It is an exercise. Use it to see for yourself how well you understand the material in the chapter.

1. Why is electricity a hazard on asbestos jobs?
2. Why do you need Ground Fault Interrupters (GFIs) for extension cords?
3. How do GFIs protect against electrical shocks?
4. What other protection can you use against electrical shocks?
5. Why shouldn't you use metal ladders?
6. Why are scaffolds on wheels dangerous?



7. How do you protect yourself from these dangers?
8. Name two common tripping hazards on asbestos jobs.
9. Why is fire safety a problem on removal jobs?
10. What type of fire extinguishers should be used on an asbestos job?
11. Why is heat stress a problem on asbestos jobs?
12. What are the symptoms of heat stress?



For More Information

USDOL, "Protecting Workers in Hot Environments," USDOL Fact Sheet #84-16.

NIOSH, "Work in Hot Environments," Publication Ko. DHHS (NIOSH) 86-112.

NIOSH, "A guide to Safety in Confined Spaces," Publication No.87-113.

Federal Register, "Permit Required Confined Spaces; Notice of Proposed Rulemaking," Vol. 54, No.106, p. 24080.

OSHA Electrical Standards, 29 CFR 1926.400 to 449.

OSHA, "Controlling Electrical Hazards," Publication No. OSHA 3075.

OSHA, "Ground Fault Protection on Construction Sites," Publication No. OSHA 3007.

OSHA Ladder Standard, 29 CFR 1926. Sub Part X.

OSHA Scaffold Standard, 29 CFR 1926. Sub Part L.

OSHA Permit Required Confined Space Standard for General Industry, 29 CFR 1910.146

NIOSH, "General Safety Considerations," Appendix E to EPA/NIOSH, " A Guide To Respiratory Protection in the Asbestos Abatement Industry," Publication No. EPA-560-0PTS-86-001.

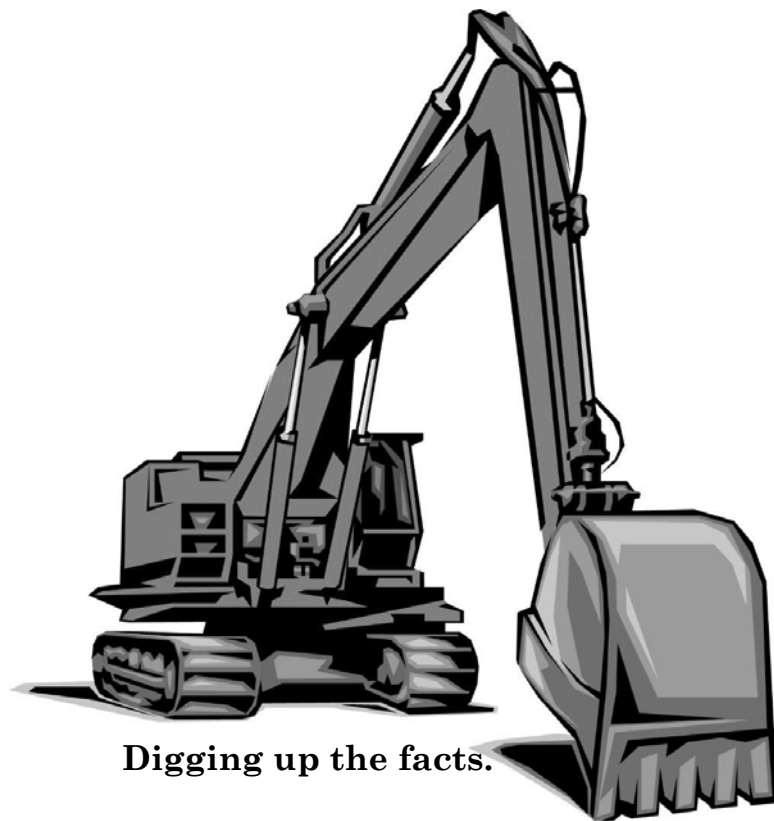
EPA, "Mold Remediation in Schools and Public Buildings," March 20001, EPA Publication No. 402-K-01-001 (epa.gov/iaq/molds/), 800-438-4318.

New York Department of Health, Bureau of Environmental and Occupational Disease Epidemiology, "Guidelines on Assessment and Remediation of Fungi in Indoor Environments," (ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html), 212-788-4290.



Additional Resources

8



Glossary	328
Acronyms	342
OSHA 29 CFR 1926.1101 Summary	343



Terms in **CAPITALS** are defined in the glossary.

ABATEMENT	Lessening the HAZARD of ASBESTOS. Includes ENCAPSULATE, ENCLOSE, REPAIR, and remove ASBESTOS.
ACM	Asbestos-Containing Material.
ADEQUATELY WET	ASBESTOS is "adequately wet" when it is wet enough so that no particles are released. Surfactant is used to adequately wet asbestos. One indication of this (but not the only one) is no visible emissions.
AGGRESSIVE SAMPLING	A way of taking AIR SAMPLES where the air is stirred up using fans and leaf blowers. Aggressive sampling is used for CLEARANCE AIR SAMPLES.
AHERA	The Asbestos Hazard Emergency Response Act- The EPA law covering ASBESTOS in schools.
AIRLOCK	An empty room in some DECONs. Workers pass through the flapped doors one at a time. Air cannot move through the airlock.
AIR - PURIFYING RESPIRATOR	Protective equipment. A face mask with filters that you wear. It filters or purifies the air in the work area.
AIR SAMPLES	Measuring the amount of ASBESTOS in the air using a pump.
AIR-SUPPLIED RESPIRATOR	Protective equipment. A face mask with a hose. It supplies clean air to you from outside the work area.
ALVEOLI	Tiny air sacs found in your lungs. They are important areas where oxygen enters your body.



AMENDED WATER	Water plus a chemical called SURFACTANT. Amended water soaks into ASBESTOS faster than plain water.
AREA AIR SAMPLE	An AIR SAMPLE taken from one spot in a room.
ASBESTOS	A natural mineral used for insulation in many buildings. Asbestos breaks into FIBERs. It causes lung cancer and other diseases.
ASBESTOSIS	A disease caused by ASBESTOS. It is the scarring of the lungs, also known as white lung.
ATTENDANT	A worker stationed outside a CONFINED SPACE to monitor what's going on inside.
B READER	A doctor who has had special training and has been certified to identify signs of occupational diseases on X-rays.
BRONCHI	A branch off the windpipe where air travels to your lungs.
BULK SAMPLE	A chunk of material which is sent to a lab to test for ASBESTOS.
CANCER	A large group of diseases where cells grow abnormally, rapidly, and out of control.
CARBON MONOXIDE	A colorless, odorless, and tasteless poisonous gas.
CARTRIDGE	A filter used on an AIR-PURIFYING RESPIRATOR.
CATEGORY I NON-FRIABLE ACM	ASBESTOS – containing gaskets, resilient floor covering, and asphalt roofing products containing more than one percent of asbestos as determined by using a PLM.



CATEGORY II NON-FRIABLE ACM	All NON-FRIABLE materials that are not Category I non-friable ACM.
CILIA	Very tiny hairs that line the walls of your windpipe and BRONCHI. They beat rapidly and move mucus up your windpipe to remove objects from your respiratory system.
CLEAN ROOM	The last room in the DECON (going out). Clean suits, sanitized respirators, and street clothes are stored here.
CLEARANCE AIR SAMPLE	An AREA AIR SAMPLE taken at the end of the job. It tells the building owner whether the room is clean enough.
COMPETENT PERSON	In the OSHA regulations, a trained supervisor who makes sure that rules are followed and equipment works on the job.
CONFINED SPACE	A space that has the following characteristics: 1) limited openings for entry and exit, 2) inadequate natural air flow, and 3) not designed to be worked in continuously.
CONTAINMENT	Isolating the work area from the rest of the building. Usually done by putting POLY on the walls and floors and using a NEGATIVE AIR MACHINE. This keeps ASBESTOS FIBERS inside the work area.
CONTINUOUS-FLOW AIR -SUPPLIED RESPIRATOR	An AIR-SUPPLIED RESPIRATOR that has a constant amount of air which is supplied to you. It will not give you more air if you need it.
CONTRACT SPECIFICATIONS	See SPECS.
CONTROL METHODS	Ways of controlling ASBESTOS. Includes: ENCAPSULATE, ENCLOSE, REPAIR, remove, and O&M.



COSH	Committee on Occupational Safety and Health-A community based group which helps workers with health and safety problems on the job.
CUBIC CENTIMETER	A space about the size of a sugar cube. Asbestos in the air is measured in FIBERs per cc.
DECON	Decontamination unit or area – A shower unit. The decon has three rooms: DIRTY ROOM, shower and CLEAN ROOM. Everyone must enter and leave the work room through the decon.
DEMAND-ONLY RESPIRATOR	AIR-SUPPLIED RESPIRATOR which always goes into a NEGATIVE PRESSURE before it supplies you the air that you need. This is not a respirator used for ASBESTOS ABATEMENT work.
DEMOLITION	The wrecking or taking out of a load-supporting building part and any related handling operations or the intentional burning of a facility.
DIRTY ROOM	The first room in the DECON (going out). Workers take their suits off in the dirty room on their way to the shower. Dirty hard hats and tools are also stored here.
DOSE	The amount of a substance that you take, or are exposed to, at a specific time.
DOSE-RELATED	A relationship between the amount of a substance you are exposed to and the reaction you have to that exposure.
DUCT TAPE	Sticky, often silver tape. Used to attach POLY.
DUST MASK	A face mask that has no seal to your face. It is not legal for ASBESTOS work. It does not protect you.



ELECTRON MICROSCOPE	A microscope which beams electrons (instead of light) at a sample. Electron microscopes can blow up images much larger than LIGHT MICROSCOPEs.
ENCAPSULANT	A sticky paint used to ENCAPSULATE ASBESTOS
ENCAPSULATE	To cover ASBESTOS with a sticky paint. A way to control ASBESTOS without removing it.
ENCLOSE	To build an air-tight box around ASBESTOS. A way to control ASBESTOS without removing it.
ENGINEERING CONTROLS	Ways of controlling workplace hazards by building barriers, ventilation, etc. Must be done before RESPIRATORS may be used.
ENVIRONMENTAL PROTECTION AGENCY	See EPA.
EPA	Environmental Protection Agency – A U .S. government agency that protects against pollution.
EQUIPMENT ROOM	See DIRTY ROOM.
EXPOSURE	Not protected. If you are in a work area with ASBESTOS fibers in the air and you do not have on the right RESPIRATOR, you are exposed to ASBESTOS.
F/CC	FIBERs per CUBIC CENTIMETER of air – ASBESTOS is measured this way. Air is pumped across a filter. The number of FIBERs are counted. The amount of air is measured in CUBIC CENTIMETERS.
FIBER	A single strand of ASBESTOS. ASBESTOS fibers are so small they are invisible.
FIBROSIS	A disease where scar tissue is formed in the



connective tissue of the lungs.

FRIABLE

Crumbly – Friable ASBESTOS can be crumbled by hand pressure.

**FULL-FACE
RESPIRATOR**

A face mask that covers the full area of your face, from the hair line of your forehead to your chin.

GLOVE BAG

A 3-foot by 4-foot plastic bag with gloves built into it. The top of the bag is sealed around a pipe. The work is done inside the bag. Used for maintenance work only.

GRADE D AIR

Air for an AIR-SUPPLIED RESPIRATOR. Grade D air has chemicals, oil, and water filtered out so that it is safe to breathe.

GFI

Ground Fault Interrupter – A sensitive circuit breaker for tools and extension cords. A GFI will stop a current before it can stop a worker's heart.

**HALF-MASK
RESPIRATOR**

A face mask that covers half of your face. It covers your nose and mouth from the bridge of your nose to your chin. These are difficult masks to fit.

HAZARD

A danger or a risk.

HEAT EXHAUSTION

An illness caused by working in a hot area. A medical alert.

HEATSTROKE

An illness caused by working in a hot area. A medical emergency – the worker's body cannot cool itself.

HEPA FILTER

High Efficiency Particulate Air filter – A filter that is fine enough to trap ASBESTOS FIBERS in the air. HEPA filters are used in RESPIRATORS, HEPA VACUUMs, and NEGATIVE AIR MACHINES.



HEPAVAC	HEPA – equipped vacuum cleaner – A vacuum cleaner which filters air through a HEPA filter.
HVAC SYSTEM	Heating, Ventilating, and Air Conditioning system- The system that heats or cools a building. Usually a central heating and cooling system that blows air through ducts.
IH	See INDUSTRIAL HYGIENIST.
INDUSTRIAL HYGIENIST	A scientist who knows how to control workplace health and safety HAZARDS. An industrial hygienist usually takes air samples and inspects ASBESTOS jobs.
LATENCY PERIOD	A time gap between when you are exposed to a HAZARD and when you have signs and symptoms of disease. For example, if you breathe ASBESTOS today you may get ASBESTOSIS in 20 years. The latency period for most asbestos diseases is 10 – 40 years long.
LEAK- TIGHT	Sealed so that solids or liquids cannot escape or spill out. It also means dust-tight. Six mil poly waste bags or sealed drums are examples of items that could be considered leak tight.
LIGHT MICROSCOPE	A microscope which shines light on a sample. Light microscopes cannot blow up images as large as ELECTRON MICROSCOPES. POLARIZED LIGHT MICROSCOPES (PLMs) and PHASE CONTRAST MICROSCOPES (PCMs) are light microscopes.
LOCAL EXHAUST VENTILATION	Hooking up a vacuum or air duct right at the place where work is being done (for example, on a power tool). This is different from general ventilation – bringing fresh air into a room.
LOCKDOWN	A sticky sealant which is sprayed on beams, decks, ceilings, etc. after ASBESTOS is cleaned off. Lockdown seals in any invisible FIBERs



LOCKDOWN	A sticky sealant which is sprayed on beams, decks, ceilings, etc. after ASBESTOS is cleaned off. Lockdown seals in any invisible FIBERs that weren't cleaned up.
LOCKOUT/TAGOUT	LOCKOUT is putting a lock on the electrical box during ASBESTOS work or CONFINED SPACE work so that no one will turn the power on by accident. TAGOUT is putting up a warning sign explaining why the power box is locked.
LUNG CANCER	A disease which is a CANCER of the lung. It is an abnormal growth of cells in the lung tissue, usually growing in the BRONCHI.
MATERIAL SAFETY DATA SHEET	MSDS – A chemical fact sheet. Your employer must train you how to use Material Safety Data Sheets.
MAXIMUM USE LEVEL	The highest amount of asbestos a respirator can handle and protect you against.
MEDICAL EXAM	An exam given by a doctor to check your health.
MESOTHELIOMA	A disease caused by ASBESTOS. It is a CANCER of the lining of the lungs or the lining of the stomach and digestive system.
MSDS	See MATERIAL SAFETY DATA SHEET.
NEGATIVE AIR MACHINE	A heavy-duty fan with HEPA filters in it. All the air that leaves the work room is pulled through the negative air machine.
NEGATIVE AIR PRESSURE	When a NEGATIVE AIR MACHINE is running, the air pressure inside the work room is less than the air pressure outside the work room. ASBESTOS cannot leak out of the work room.



NEGATIVE PRESSURE SEAL CHECK

A test to check the seal of your RESPIRATOR to make sure that it is fitted to your face so that there are no leaks for fibers to get in. You use NEGATIVE PRESSURE for this check. It is a

check you must do each and every time that you put on your RESPIRATOR.

NEGATIVE PRESSURE RESPIRATOR

A face mask (RESPIRATOR) that works by using NEGATIVE PRESSURE to seal the face piece to the face. NEGATIVE PRESSURE means that there is less air pressure inside the face mask than outside the face piece.

NESHAP

The National Emission Standards for Hazardous Air Pollutants. An EPA regulation for ASBESTOS.

NIOSH

The National Institute for Occupational Safety and Health – A U.S. government agency that researches worker safety and health. NIOSH recommends changes in the regulations to OSHA. NIOSH also approves respirators.

NON-FRIABLE

ASBESTOS that **cannot** be crumbled by hand pressure.

O&M PLAN

Operations and Maintenance Plan – A plan for controlling the ASBESTOS that remains in a building. This plan includes:

- 1) Where the asbestos is found in the building. Many asbestos materials should be labeled.
- 2) The amount of training that workers must receive to work with the material.
- 3) The permits which must be obtained before working with asbestos.
- 4) Accepted ways to work with asbestos safely. This includes equipment, worker protection, and medical exams.
- 5) When and how to check the condition of asbestos materials and record any changes.



OSHA	The Occupational Safety and Health Administration – A U.S. government agency that covers worker safety and health on the job.
OSHA STANDARD	An OSHA regulation, for example, the OSHA Asbestos Standard.
OXYGEN-DEFICIENT ATMOSPHERE	An atmosphere containing an oxygen level less than 19.5 percent.
PAPR	Powered Air Purifying Respirator – An AIR – PURIFYING RESPIRATOR (a face mask with a filter) that has a pump. This pumps air through the filter to the face piece. It is a POSITIVE PRESSURE RESPIRATOR You can request a PAPR whenever a NEGATIVE PRESSURE RESPIRATOR is required by law.
PCM	Phase Contrast Microscope – The microscope used to count ASBESTOS FIBERS from PERSONAL AIR SAMPLES. PCM is sometimes used for AREA AIR SAMPLES.
PEL	Permissible Exposure Limit – The PEL is 0.1 fibers per cubic centimeter over an 8-hour day. This is OSHA's legal limit on how much ASBESTOS you may be exposed to.
PERMISSIBLE EXPOSURE LIMIT	See PEL.
PERSONAL AIR SAMPLE	An AIR SAMPLE taken in a worker's breathing area. This is an accurate measure of how much asbestos the worker was EXPOSED to. Personal air samples are taken on a few workers every day.
PFT	See PULMONARY FUNCTION TEST.
PHASE CONTRAST MICROSCOPE	See PCM.



PLEURA	A two-layered lining of the chest area. It wraps around the lungs and the inside of the rib cage.
PLM	Polarized Light Microscope – The microscope used to look at BULK SAMPLES.
POLARIZED LIGHT MICROSCOPE	See PLM.
POLY	Polyethylene sheet plastic – Sheet plastic that is taped to walls and floors to protect them from ASBESTOS while work is going on.
POSITIVE-PRESSURE Seal CHECK	A test to check the seal of your RESPIRATOR to your face. You check for leaks by testing the fit with POSITIVE PRESSURE. You make the POSITIVE PRESSURE by blowing into the mask.
POSITIVE-PRESSURE RESPIRATOR	A face mask that has more air pressure inside the mask than outside the mask. These RESPIRATORS are more protective than the NEGATIVE PRESSURE RESPIRATORS. With POSITIVE PRESSURE the air leaks from the inside to the outside.
POWERED AIR PURIFYING RESPIRATOR	See PAPR.
PRESSURE-DEMAND AIR-SUPPLIED RESPIRATOR	A face mask with air supplied to the mask through a hose. The amount of air that is supplied to you is exactly what you "demand." There is a regulator that senses the amount of air that you need to breathe.
PROTECTION FACTOR	PF – The degree of protection of a RESPIRATOR. The Protection Factor is determined in a laboratory.
PULMONARY FUNCTION TEST	A breathing test to see how well your lungs are working. It measures how much air you can



breathe in and out. It can tell you if there is a problem with your lungs.

QUALITATIVE FIT TEST

A test that tells you if you have any leaks in your RESPIRATOR. You are tested by someone who follows the OSHA procedure. The test uses smoke, oil or sugar. If you smell or taste the testing substance, you have a leak and the respirator does not fit. You must have a qualitative fit test for any NEGATIVE PRESSURE RESPIRATOR that is issued to you.

QUANTITATIVE FIT TEST

A test that tells you if you have any leaks in your RESPIRATOR. It is a very accurate test. It uses a probe to determine the amount of testing agent outside the mask and the amount inside the mask. It gives you the personal PROTECTION FACTOR which that mask has for you.

RACM

Materials covered by the NESHAP regulations: 1) FRIABLE ASBESTOS material, 2) CATEGORY I NON-FRIABLE ACM that will or has become FRIABLE, or 3) CATEGORY II NON-FRIABLE ACM that has a high probability of becoming or has become FRIABLE during demolition or renovation.

REGULATED ASBESTOS CONTAINING MATERIAL

See RACM.

RENOVATION

Changing a building or one or more building parts in any way, including the stripping or removal of RACM. (Operations whereby load-supporting building parts are wrecked or taken out are DEMOLITIONS.)

REPAIR

Putting a patch on ASBESTOS pipe insulation. A way to control ASBESTOS without removing



it.

RESPIRATOR

A face mask used to protect you. It either filters your breathing air or supplies you with clean breathing air.

SCBA

Self-Contained Breathing Apparatus – A positive pressure, pressure demand AIR-SUPPLIED RESPIRATOR for which you carry the air supply in a tank.

SPECS

Contract specifications – A written plan for the job that the building owner writes. The contractor must follow the specs.

SPRAYBACK

New insulation put up **after** ASBESTOS is removed and the job passes the CLEARANCE AIR SAMPLE.

SURFACTANT

A chemical added to water to make it soak into ASBESTOS faster. Surfactant makes water wetter.

TAGOUT/
LOCKOUT

LOCKOUT is putting a lock on the electrical box during ASBESTOS work or CONFINED SPACE work so that no one will turn on the power source by accident. TAGOUT is putting a tag on the box explaining why the power box is locked.

TEM

Transmission Electron Microscope -- The microscope used to count ASBESTOS from CLEARANCE AIR SAMPLES.

TRANSMISSION
ELECTRON
MICROSCOPE

See TEM.

TIME WEIGHTED
AVERAGE (TWA)

A method of determining fiber counts for an eight hour work period by averaging shorter sampling periods together.



TYPE C RESPIRATOR

An AIR-SUPPLIED RESPIRATOR.

VISIBLE EMISSIONS

A substance given off by RACM, asbestos-containing waste material, or any asbestos milling, manufacturing, or production which can be seen without the aid of instruments.

WHITE BLOOD CELLS

A part of the body's defense system against outside substances. They attack foreign objects like bacteria or ASBESTOS.

WORK HISTORY

A part of your medical exam. You list what you have worked with, when and where. This helps the doctor look for job-related diseases that you might have.

WORK PRACTICES

Ways of doing work that affect how safe it is. For example, keeping ASBESTOS wet is a good work practice. It keeps ASBESTOS out of the air.



“Hands-on” practice at putting down the first floor layer of poly.

This was adapted, in part, from a glossary developed by the Maine Labor Group on Health, Inc. and the Maine Division of Asbestos Management Activities. The information was compiled from many sources, including material supplied by the U.S. Environmental Protection Agency.



Acronyms used in the manual...

ACM	Asbestos-containing Material
ACBM	Asbestos-containing Building Material
AHERA	Asbestos Hazard Emergency Response Act
ASHARA	Asbestos School Hazard Abatement Reauthorization Act
CFR	Code of Federal Regulations
CL	Clearance Level
EL	Excursion Level
EPA	Environmental Protection Agency
f/cc	Fibers per Cubic centimeter
GFI	Ground Fault Interrupter
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilating, and Air Conditioning
MSDS	Material Safety Data Sheet
MUL	Maximum Use Level
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
O&M	Operations & Maintenance
PAPR	Powered Air-Purifying Respirator
PCM	Phase Contrast Microscope
PEL	Permissible Exposure Limit
PF	Protection Factor
PLM	Polarized Light Microscope
SAR	Supplied Air Respirator
TEM	Transmission Electron Microscope
TSI	Thermal System Insulation
VAT	Vinyl-Asbestos Tile



Summary of OSHA Asbestos Standard 29 CFR 1926.1101

Contents

(a)	Scope and Application	page 344
(b)	Definitions	page 344
(c)	Permissible Exposure Limits	page 344
(d)	Multi-employer Worksites	page 345
(e)	Regulated Areas	page 345
(f)	Exposure Assessment and Monitoring	page 345
(g)	Methods of Compliance	page 347
(h)	Respiratory Protection	page 352
(i)	Protective Clothing	page 353
(j)	Hygiene Facilities and Practices	page 353
(k)	Communication of Hazards	page 355
(l)	Housekeeping	page 359
(m)	Medical Surveillance	page 360
(n)	Recordkeeping	page 361
(o)	Competent Person	page 363



(a) Scope and Application

(b) Definitions

Asbestos is defined as including chrysotile, amosite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos. In addition, **presumed asbestos containing material (PACM)** is also treated as asbestos. PACMs include **thermal system insulation (TSI)** and surfacing material found in buildings constructed no later than 1980.

Negative Exposure Assessment is defined as a demonstration by the employer that employee exposure during an operation is or will be consistently below the PELs.

Activities involving exposure to ACMs and PACMs have been divided into four classifications. They are as follows:

Class I asbestos work means activities involving the removal of TSI and surfacing ACM and PACM.

Class II asbestos work means activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos containing wallboard, floor tile and sheeting, roofing and side shingles, and construction mastics.

Class III asbestos work means repair and maintenance operations, where ACM is likely to be disturbed.

Class IV asbestos work means maintenance and custodial activities during which employees contact but do not disturb ACM or PACM, and activities to clean up dust, waste, and debris result from Class I, II, and III activities.

(c) Permissible Exposure Limits

Permissible Exposure Limit (PEL) – The employer must ensure that no employee is exposed to airborne concentrations of asbestos greater than **0.1 f/cc** as measured over an eight hour time period.



Excursion Limit (EL) – The employer shall ensure that no employee is exposed to an airborne concentration of asbestos greater than **1.0 f/cc** as measured over a 30 minute period.

(d) Multi-employer Worksites

On multi-employer worksites, **an employer performing work requiring the establishment of a regulated area shall appropriately inform all other employers.** Employers of employees working adjacent to regulated areas must take measures on a daily basis to ensure that their employees are not being exposed to asbestos fibers. All general contractors are responsible for ensuring that the asbestos contractor is in compliance with the standard.

(e) Regulated Areas

All Class I, II, and III work must be conducted within regulated areas. Other operations must be conducted within regulated areas whenever airborne concentrations of asbestos exceed the PEL. Regulated areas must comply with the following requirements:

Demarcation – Critical barriers, negative-pressure enclosures, and signs may all serve to demarcate the regulated area.

Access – Only authorized persons shall enter regulated areas.

Respirators – When respirators are required, all persons entering a regulated area must be supplied appropriate respirators.

Prohibited Activities – The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated area.

Competent Persons – The employer shall ensure that all asbestos work performed within regulated areas is supervised by a competent person.

(f) Exposure Assessments and Monitoring

1. General Monitoring

Employee exposure shall be determined from breathing zone air



samples that are representative of the 8-hour and 30-minute exposures of each employee.

2. Initial Exposure Assessment

- i. A competent person shall conduct all exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures.
- ii. Unless a negative exposure assessment has been made, the initial exposure assessment shall be based on monitoring results.
For Class I work, the employer shall presume that employees are exposed in excess of the TWA and excursion limit until monitoring results or a negative exposure assessment document that the employees on the job will not be exposed in excess of the PEL.
- iii. **Negative exposure assessment can be determined by:**
 - A. objective data demonstrating that exposures cannot exceed the PEL/EL;
 - B. data obtained from previous similar jobs within the last 12 months; or
 - C. results of initial exposure monitoring.

3. Periodic Monitoring...

- i. **Class I and II work – daily monitoring** is required unless negative exposure assessment.
- ii. **Non-Class I and II work – periodic monitoring** where exposures are expected to exceed the PEL/EL.
- iii. **Exception to monitoring** – when all employees are wearing supplied air respirators operated in the pressure-demand mode.

4. Termination of Monitoring...

- i. allowed if statistically reliable results of monitoring show exposure levels to be below the PEL/EL.
- ii. disallowed whenever there has been a change in process, control equipment, personnel, or work practices that may result in increased levels of exposure.

5. Employee Notification of Monitoring Results...

- i. employees shall be notified as soon as possible as to monitoring results.
- ii. notification shall be done in writing either individually or by posting at a centrally located place that is accessible to affected employees.

6. Observation of Monitoring...

- i. employees and their representatives have the right to observe any monitoring.



- ii. observers shall be provided with and required to wear any protective clothing and equipment applicable.

(g) Methods of Compliance

1. The following **engineering controls** and work practices are required for all ACM work, regardless of levels of exposure.
 - i. HEPA-vacuums.
 - ii. use of **wet methods** except where such methods create a greater hazard.
 - iii. prompt clean-up and disposal of waste in leak-tight containers except in some roofing operations.
2. In order to meet the PEL/EL, the following **control methods** are also required.
 - i. HEPA equipped local exhaust ventilation.
 - ii. enclosure/isolation of the work area.
 - iii. ventilation of the regulated area.
 - iv. other feasible work practices and engineering controls.
 - v. respirators to be used as supplemental measure.
3. **Prohibitions...**
 - i. high-speed abrasive disc saws not equipped with ventilator, or enclosures without HEPA filtered air.
 - ii. compressed air, unless used in conjunction with an enclosed ventilation system designed to capture the dust cloud created.
 - iii. dry sweeping, shoveling, or other dry clean-up methods.
 - iv. employee rotation as a means of reducing employee exposure.
4. **Class I Requirements...**
 - i. all work must be supervised by a competent person.
 - ii. One of the following methods must be used to assure airborne fibers do not migrate from the regulated area.
 - A. **critical barriers** placed over all openings to the regulated area except in outdoor situations.
 - B. other verifiable barrier or isolation methods.
 - iii. HVAC systems shall be isolated in the regulated area by sealing with a **double layer of 6 mil plastic**.
 - iv. impermeable dropcloths shall be placed beneath all removal activity.
5. **Specific Control methods for Class I Work...**
 - i. **Negative Pressure Enclosure (NPE) systems** shall be used whenever feasible.
 - A. **Specifications...**



1. NPE may be of any configuration.
2. **minimum of 4 air exchanges per hour.**
3. minimum of -0.02 column inches of water pressure differential must be maintained.
4. NPE shall be kept under negative pressure at all times.
5. air shall be ventilated away from employees toward HEPA device.

B. Work Practices...

1. NPE shall be inspected for breaches and smoke-tested for leaks before beginning work and at the beginning of each shift.
2. electrical circuits in the enclosure shall be deactivated, uncles equipped with **ground-fault circuit interrupters.**

- ii. **Glovebag Systems** shall be used for removal from straight runs of piping and elbows and other connections.

A. Specifications...

1. glovebags shall be made of 6 mil plastic and shall be seamless at the bottom.
2. glovebags used on elbow and other connections must be designed for that purpose.

B. Work Practices...

1. glovebag shall completely cover the circumference of the pipe.
2. smoke-testing for leaks is required prior to use.
3. glovebag may only be used once and cannot be moved.
4. glovebag shall not be used on surfaces over **150°F.**
5. prior to disposal, removal of air from glovebag using HEPA-vac is required.
6. before beginning, loose and friable material adjacent to the work area shall be wrapped and sealed in two layers of 6 mil plastic.
7. when using an attached waste bag, such a bag shall be connected to a collection bag using hose or other material which can withstand the weight of all waste.
8. a sliding valve or other device shall separate waste bag from hose to ensure no exposure during disconnection.
9. minimum of two persons shall perform Class I work
Other systems specified include: negative pressure glovebag; negative pressure glove box; water spray



process; and mini-enclosure.

6. Alternative control methods for Class I work are allowed providing they are certified by a qualified individual.

7. Work practices and engineering controls for Class II work

- i. All work shall be supervised by a competent person.
- ii. For all indoor Class II jobs without a negative exposure assessment, or where conditions changed during the job in such a way that the PEL/EL may be exceeded, or where the material is not removed in a substantially intact state, the employer shall use one of the following methods:
 - A. critical barriers shall be used.**
 - B.** alternative barrier or isolation methods are allowed as verified by perimeter area monitoring or clearance monitoring.
 - C.** impermeable dropcloths shall be placed beneath all removal activity.
- iii. reserved
- iv. applicable work practices and requirements shall be followed.

8. Additional controls for Class II work

- i. For removing **vinyl and asphalt flooring materials** containing ACM/PACM, the following practices apply...
 - A.** flooring or its backing shall not be sanded.
 - B.** vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) shall be used to clean floors.
 - C.** resilient sheeting shall be removed by cutting with wet methods, rip-up methods are prohibited.
 - D.** all scraping of residual adhesive and/or backing shall be done using wet methods.
 - E.** dry sweeping is prohibited.
 - F.** mechanical chipping is prohibited unless done in a negative pressure enclosure.
 - G.** tiles shall be removed intact, unless employer demonstrates that intact removal is not possible.
 - H.** when tiles are heated and can be removed intact, wetting may be omitted.
 - I.** resilient flooring material including its mastic and backing shall be assumed to be an ACM unless proven otherwise by an industrial hygienist.
- ii. For **removing roofing material** that are ACM, the following work practices apply...
 - A.** roofing material shall be removed intact to the extent feasible.



- B. wet methods shall be used to remove materials that are not intact, or will be rendered not intact, unless not feasible or will create safety hazards.
 - C. cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.
 - D. all loose dust left by sawing must be HEPA-vacuumed and bagged or placed in covered containers immediately.
 - E. ACM from a roof shall not be dropped or thrown to the ground:
 - 1. ACM not intact shall be lowered to the ground as soon as practicable, no later than the end of the work shift. While on roof it shall either be kept wet or covered in plastic.
 - 2. intact ACM shall be lowered to the ground as soon as practicable, no later than the end of the work shift.
 - F. after being lowered, unwrapped material shall be transferred to a closed receptacle
 - G. roof level heating and ventilation air intake sources shall be isolated or the ventilation system shall be shut down.
 - H. removal or repair of intact roofing less than 25 square feet in area (per day) does not require use of wet methods or HEPA vacuuming as long as material is not rendered non-intact. and no visible dust is created
- iii. For **removal of cementitious asbestos-containing siding, shingles, or panels** on building exteriors other than roofs, the following work practices apply...
- A. cutting, abrading, or breaking of siding, shingles, or **transite panels** shall be prohibited unless employer can demonstrate that other methods cannot be used.
 - B. each panel or shingle shall be sprayed with amended water prior to removal.
 - C. unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered, dust-tight chute, crane or hoist, or placed in an impermeable waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.
 - D. nails shall be cut with flat, sharp instruments.
- iv. For removal of **gaskets** containing ACM, the following work practices apply...
- A. if a gasket is visibly deteriorated and unlikely to be removed



- intact, removal shall be done with a glovebag.
- B. reserved
- C. the wet gasket shall be immediately placed in a disposal container.
- D. scraping to remove residue must be performed using wet methods.
- v. For **removal of any other Class II material**, the following work practices apply...
 - A. material shall be thoroughly wetted prior to and during removal.
 - B. material shall be removed intact unless the employer demonstrates that intact removal is impossible.
 - C. cutting, abrading, or breaking the material shall be prohibited unless the employer can demonstrate that other methods are not feasible.
 - D. material removed shall be immediately bagged, wrapped, or kept wetted until transferred to a closed receptacle no later than the end of the work shift.
- vi. Use of **alternative work practices** and controls are allowed if the following provisions are complied with...
 - A. employer shall demonstrate with representative data that employee exposure will not exceed the PEL/EL under any anticipated circumstances.
 - B. a competent person shall evaluate and certify in writing that the method meets necessary standards of operation.
- 9. **Work practices and engineering controls for Class III work...**
 - i. wet methods shall be used.
 - ii. whenever feasible, local exhaust ventilation shall be used.
 - iii. use of impermeable dropcloths and either min-enclosures or glovebags is required whenever drilling, cutting, abrading, sanding, chipping, breaking, or sawing TSI or surfacing materials.
 - iv. containment of work area is required when there is no negative exposure assessment or monitoring results show the PEL has been exceeded.
 - v. respirators are required if TSI or surfacing material is being disturbed, or if there is no negative exposure assessment, or if the PEL has been exceeded.
- 10. **Class IV work shall be conducted by employees who have completed an asbestos awareness training program.** In addition, Class IV work must be done using wet methods, HEPA-vac, and prompt



- clean-up of debris...
- i. employees shall wear respirators when working in areas that require them.
- ii. TSI and surfacing material waste and debris shall be assumed to be asbestos containing.

(h) Respiratory Protection

1. The employer **shall provide respirators** and ensure that they are used under the following circumstances...

- i. all Class I work
- ii. Class II work where the ACM is not removed in a substantially intact state
- iii. Class II and III work performed without using wet methods
- iv. Class II and III work where the employer does not produce a negative exposure assessment
- v. Class III work where TSI or surfacing ACM/PACM is disturbed
- vi. Class IV work performed in regulated areas where other employees are required to wear respirators
- vii. when employees are exposed above the PEL/EL
- viii. in emergencies

2. Respirator Selection

- i. When used, appropriately selected **respirators are to be provided at no cost to the employee.** The employer shall ensure that the employee uses the respirator provided.
- ii. **Respirators must be approved** by the National Institute for Occupational Health and Safety (NIOSH).
- iii. **The employer shall provide a tight-fitting PAPR** in lieu of any negative-fitting respirator whenever:
 - A. an employee chooses to use this type of respirator;
 - B. the respirator will provide adequate protection; and
 - C. the employer shall inform any employee required to wear a respirator of this right
- iv. **The employer shall provide a non-disposable, half-mask, air-purifying respirator** for Class II and III work where there is no negative pressure assessment has been produced, and for Class III work where TSI or surfacing ACM/PACM is disturbed.
- v. **The employer shall provide a tight-fitting PAPR or supplied-air, pressure-demand respirator for Class I work without a NEA in which exposure assessment indicates exposure level will not exceed 1 f/cc. A supplied-air,**



pressure-demand respirator is required if the exposure assessment indicates exposure levels above 1 f/cc.

3. Respiratory Program

- i. The employer shall institute a respiratory program whenever respirators are used.
- ii. Employees are permitted to change filters whenever an **increase in breathing resistance** is detected.
- iii. Employees are **permitted to leave work areas** to wash their faces and respirator facepieces whenever necessary to prevent skin irritation.
- iv. If an employee's most recent physical examination indicates that respirator use would be unsafe, then the employee shall be assigned to another job of equal pay if such a position is available.

4. Respirator Fit Testing

- i. Employer ensures that the respirator issued to the employee fits properly.

5. Either quantitative (QNFT) or qualitative (QLFT) fit tests are required at the time of initial fitting and at least annually thereafter for each employee wearing a respirator. The qualitative fit tests may only be used for fitting half-mask respirators or full-face respirators where they are worn at levels at which half-face respirators are permitted.

(i) Protective Clothing

- 1. Protective clothing is required for employees exposed to airborne asbestos in excess of the PEL/EL, or where negative exposure assessment is not produced, and for Class I work involving the removal of over 25 linear or 10 square feet of TSI or surfacing ACM/PACM.**
- 2. Laundering shall be done by an informed individual in a manner that prevents the release of fibers in excess of the PEL/EL.**
- 3. Contaminated clothing shall be transported in sealed, impermeable bags or containers and labeled appropriately.**
- 4. Inspection of Protective Clothing...**
 - i. a competent person shall examine worksuits at least once per workshift.
 - ii. rips and tears shall be immediately mended or the worksuit shall be immediately replaced.

(j) Hygiene Facilities and Practices

- 1. Requirements for Class I work involving over 25 linear or 10 square feet of TSI or surfacing ACM/PACM...**



- i. A decontamination area shall be established adjacent and connected to the regulated area. The employer shall ensure that employees enter and exit the regulated area through the decon.
 - A. Equipment (Dirty) Room**
 - B. Shower area** shall be located adjacent to the equipment room and the clean room. If the employer can demonstrate that it is not feasible to locate a shower there, then the employer must ensure that employees do not carry asbestos contamination outside the equipment room.
 - C. Clean change room** shall be equipped with separate storage containers for each employee.
- ii. **Decontamination Entry Procedures...**
 - A.** enter through the clean room.
 - B.** remove and deposit street clothing in lockers
 - C.** put on protective clothing and respirator before leaving clean room.
 - D.** before entering regulated area, employees must pass through the equipment room.
- iii. **Decontamination Exit Procedures...**
 - A.** before leaving the regulated area, remove all gross contamination and debris from protective clothing.
 - B.** remove protective clothing in the equipment room.
 - C.** respirators shall not be removed in the equipment room.
 - D.** employees shall shower prior to entering the clean room.
 - E.** after showering, employees shall enter the clean room before changing into street clothes.
- iv. **Lunch Areas...**

Whenever food or beverages are consumed at a Class I worksite, the employer shall provide a lunch area in which airborne concentrations of asbestos are below the PEL/EL.
- 2. Requirements for Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM/PACM, and for Class II and Class III work where exposures exceed the PEL or EL or where there is no negative exposure assessment prior to operation.
 - i. **Equipment room** shall be established adjacent to the regulated area. It shall consist of an area covered by an impermeable drop cloth.
 - ii. The area must be large enough to accommodate cleaning of equipment and removing of personal protective equipment



- without spreading contamination.
 - iii. **Work clothing must be cleaned with a HEPA-vacuum before it is removed.**
 - iv. All equipment and surfaces of containers filled with ACM must be cleaned prior to removal from the area.
 - v. Employer shall ensure that employees enter and exit regulated area through the equipment (dirty) room.
3. Requirements for Class IV work are the same as those for Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM/PACM unless the area in which the work is being done is part of a Class I operation involving greater than 25 linear or 10 square feet of TSI or surfacing ACM/PACM, in which case the more stringent requirements must be met.
4. **No smoking is allowed in the work area.**

(k) Communication of Hazards

1. For the purposes of this standard, employers and building owners are required to treat TSI and sprayed or troweled-on surfacing materials in buildings as ACM, with the exception noted in this section. Asphalt and vinyl flooring material installed no later than 1980 must also be considered to be ACM, unless proven otherwise. PACM is to be identified as ACM.
2. **Duties of Building/Facility Owners...**
- i. determine the presence, location, and quantity of ACM/PACM prior to work.
 - ii. written or direct verbal notification as to the presence, location, and quantity of ACM/PACM must be made to:
 - A. prospective employers applying or bidding for work whose employees reasonably can be expected to work in or adjacent to areas containing such material;
 - B. employees of the owner who will work in or adjacent to areas containing such material;
 - C. on multi-employer worksites, all employers of employees who will be working within or adjacent to areas containing such material; and
 - D. tenants who will occupy areas containing such material.
3. **Duties of employers** whose employees perform work in or adjacent to areas containing ACM/PACM and duties of building/facility owners whose employees perform such work as follows:
- i. employers shall identify the presence, location, and quantity of



- ACM/ PACM prior to work;
 - ii. prior to work, employers shall inform the following persons of the location and quantity of ACM/PACM and the precautions to be taken –
 - A. owners of the building/facility
 - B. employees who will perform such work and employers of employees who work and/or will be working in adjacent areas – and
 - iii. employers shall, within 10 days of the completion of work, inform the building/facility owner and employers of employees who will be working in the area of the current location and quantity of ACM/PACM remaining in the area and final monitoring results, if any.
- 4. Employers who discover ACM/PACM on a worksite shall inform owners and other employees working at the site within 24 hours.
- 5. Criteria to rebut designation of PACM
 - i. At any time an employer or building owner may demonstrate that PACM does not contain asbestos. This information does not have to be communicated; however, the information, data, and analysis supporting the determination on non-PACM shall be retained.
 - ii. Means of demonstrating that PACM does not contain more than 1% asbestos are as follows:
 - A. having a complete inspection conducted that demonstrates that the material is not ACM.
 - B. testing of PACM includes analysis of bulk samples by an accredited inspector or CIH.
- 6. Signs shall be posted at the entrance to mechanical rooms/areas containing TSI, and surfacing ACM/PACM. Signs shall identify the material, its location, and appropriate work practices to avoid disturbing the material. The employer shall ensure that signs can be understood by employees.
- 7. Signs...
 - i. warning signs shall be posted at an appropriate distance from regulated areas.
 - ii. warning signs shall read –

**DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY**



when necessary, signs shall include –

**RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA**

- iii. employer shall ensure that employees comprehend the warning signs.

8. Labels...

- i. labels shall be attached to all products containing asbestos and to all containers holding such products.
- ii. labels shall be printed in large, bold letters on a contrasting background.
- iii. labels shall read –

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

- iv. **reserved**
- vi. labels are not required where –
 - A. asbestos fibers have been modified by a bonding agent, coating, binder, or other material that will ensure that the PEL/EL will not be exceeded.
 - B. asbestos content is less than 1.0 % by weight.
- vii. Labels shall be placed where they will clearly be noticed by employees. Appropriately placed may be posted instead of labels as long as they contain all the necessary labeling information. the employer shall ensure that labels can be understood by employee.

9. Employee Information and Training

- i. The employer shall institute, **at no cost to the employee, a training program for all employees** who are likely to be exposed in excess of a PEL and for all employees who install asbestos materials or perform **Class I** through asbestos operations. The employer shall ensure employees' participation.
- ii. Training shall be provided prior to or at the time of initial assignment and annually thereafter.
- iii. Training for Class I operations and for Class II operations that require the use of critical barriers and/or negative pressure



enclosures shall be equivalent to the EPA Model Accreditation Plan (MAP) asbestos abatement worker training.

- iv. **Training for other Class II work...**
 - A. Training for work involving ACM such as **roofing, flooring, siding, or transite panels** should include all of the elements listed in section (k)(9)(viii) and in addition, the work practices and engineering controls set forth in part (g) specific to that generic category. **This training shall include a “hands-on” section and shall take at least 8 hours.**
 - B. Employees working with more than one category of material shall receive training applicable to each category of material.
 - C. Employees working with materials not listed in section (k)(9)(iv)(A) shall be trained on the applicable work methods.
- v. **Training for Class III employees** shall be consistent with EPA requirements for training local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(2). **This training shall include a “hands-on” section and take at least 16 hours.** At the discretion of the competent person, greater training requirements may apply.
- vi. **Training for employees performing Class IV operations** shall be consistent with EPA requirements for training local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(1). This course shall include information as to the location of TSI and ACM/PACM, and instruction in recognition of damage, deterioration, and delamination of ACM. **This course shall take at least 2 hours.**
- vii. Training for employees who are likely to be exposed in excess of the PEL and are not otherwise required to be trained under paragraph (k)(9)(iii) through (vi) of this section, shall meet the requirements of paragraph (k)(9)(iii).
- viii. Training programs shall be conducted in a manner that the employee is able to understand. In addition to EPA MAP curriculum, the course shall include the following information.
 - A. methods of recognizing asbestos.
 - B. health effects associated with asbestos exposure.
 - C. relationship between smoking and asbestos in producing lung cancer.
 - D. nature of operations that could result in exposure to asbestos,



and the importance of necessary protective controls to minimize exposure.

- E. purpose, proper use, fitting instructions, and limitations of respirators.
- F. appropriate work practices.
- G. medical surveillance program requirements.
- H. content of this standard, including appendices.
- I. names, addresses, and phone numbers of public health organizations which provide information concerning smoking cessation.
- J. requirements for posting signs and affixing labels.

10. Access to Training Materials...

- i. free, written materials relating to the employee training program.
- ii. employer shall provide to the Assistant Secretary and the Director, upon request, all information and training materials relating to the employee information and training program.
- iii. self-help smoking cessation programs shall be made readily available.

(1) Housekeeping

1. Vacuuming

Vacuums must be HEPA filtered.

2. Waste Disposal

All asbestos wasted and contaminated materials shall be disposed of in sealed, labeled, impermeable containers except in roofing operations where the procedures specified in (g)(8)(ii) of this section apply.

3. Care of Asbestos-containing Flooring Material...

- i. all vinyl and asphalt flooring shall be maintained in accordance with this paragraph unless the owner demonstrates that the material is not asbestos containing.
- ii. **sanding is prohibited.**
- iii. stripping of finishes shall be done using low abrasion pads at speeds lower than 300 rpm and wet methods.
- iv. burnishing or dry buffing may be performed only on flooring which has sufficient so that the pad cannot contact the flooring material.

4. Waste and debris and accompanying dust in an area with TSI or surfacing material or visibly deteriorated ACM:

- i. shall not be dusted or swept dry, or vacuumed without using a HEPA filter; and



- ii. shall be promptly cleaned up and disposed of in leak-tight containers.

(m) Medical Surveillance

1. General

i. Employees covered...

- A. Employers shall institute programs that cover all employees who spend 30 or more days per year doing Class I, II, or III work; or are exposed at or above the permissible exposure limit for a combined 30 days or more per year. Any day in which a worker engages in Class II or Class III work for one hour or less, in accordance with work practices, shall not be counted.
- B. For employees required to a negative pressure respirator, employers must, under the supervision of a physician, shall ensure employees are physically able to perform the work and use the equipment.

ii. Examination...

- A. must be performed by a licensed physician at no cost to the employee.
- B. anyone other than a licensed physician who administers the pulmonary function test shall complete a training course in spirometry.

2. Medical Examinations...

i. Examinations are to be conducted:

- A. **prior to beginning of work with a negative pressure respirator.**
- B. **within 10 working days following the 30th day of exposure** at or above the permissible exposure in one year, or when engaging in Class I, II, or III work for a combined total of 30 or more days per year.
- C. **annually after initial exam**
- D. if the examining physician determines that more frequent examinations are needed, employer shall provide such examinations.
- E. no examination is required if employee records show that last examination was within the past 1-year period.

ii. Medical examinations shall include:

- A. medical and work history **with special emphasis on pulmonary, cardiovascular, and gastrointestinal**



- systems.
 - B. on initial exam**, the standardized questionnaire contained in Part 1 of Appendix D; **on the annual examination**, the abbreviated standardized questionnaire contained in Part 2 of Appendix D.
 - C.** physical examination directed at the pulmonary and gastrointestinal systems, and a pulmonary test.
 - D.** any other examinations or tests deemed necessary by the physician.
3. The employer shall provide the following information to the examining physician...
- i. copy of this standard and Appendices D, E, G, and I.
 - ii. description of the employee's duties as the relate to his/her exposure.
 - iii. employee's representative exposure level or anticipated exposure level.
 - iv. description of any personal protective and respiratory equipment used.
 - v. information from employee's previous medical exams.
4. **Physician's Written Opinion...**
- i. Physician shall provide the employer with a written opinion containing the following information:
 - A.** any medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos.
 - B.** any recommended limitations on the employee or on the use of personal protective equipment.
 - C.** statement that the employee has been informed by the physician of the results of the examination and of any medical conditions that may result from asbestos exposure.
 - D.** statement that the employee has been informed by the physician of the increased risk of lung cancer due to the combined effect of smoking and asbestos exposure.
 - ii. **The employer shall instruct the physician not to reveal i the written opinion specific findings or diagnoses unrelated to the occupational exposure to asbestos.**
 - iii. **The employer shall provide a copy of the physician's written opinion tot he employee within 30 days of receipt.**

(n) Recordkeeping

1. Objective data for negative exposure assessment...



- i. When the employer has relied on objective data to demonstrate that a material and operation are not capable of releasing fibers of asbestos in concentration greater than the PEL/EL, then such records shall be maintained for the duration of the employer's reliance upon such objective data.
- ii. records shall include the following information:
 - A. product qualifying for exemption;
 - B. source of the objective data;
 - C. testing protocol, test results;
 - D. description of the operation exempted; and
 - E. other relevant data.
- iii. records shall be maintained for the duration of the employer's reliance upon such objective data.

2. Exposure Assessments

Employer shall keep an accurate record of all measurements taken to monitor employee exposure. **These records shall be maintained for the duration of employment plus 30 years.**

3. Medical Surveillance

Employer shall maintain an accurate record of each employee's medical surveillance for the duration of employment plus 30 years.

4. Training records shall be maintained for **1 year** beyond the last date of employment.

5. When the employer has relied on data to demonstrate that PACM is not asbestos-containing material, such data shall be maintained for as long as they are relied upon.

6. When the building owner has communicated and received information concerning identification, location, and quantity of ACM/PACM, written records of such notifications shall be maintained by the building owner for the duration of ownership and shall be transferred to successive owners.

7. Availability of Records...

- i. upon written request, the employer shall make all records available to OSHA.
 - ii. **exposure records shall be made available to affected employees, former employees, and OSHA.**
 - iii. **medical records shall be made available to the affected employees** and anyone with written consent from the employee, and OSHA.
- 8.** When employer ceases to do business and there is no successor to receive and retain the records for the prescribed period, the employer



shall notify OSHA at least 90 days prior to disposal and, upon request, transmit them to NIOSH.

(o) Competent Person

1. On all construction sites covered by this standard, the employer shall designate a competent person.
2. **Competent person is required to conduct frequent and regular inspections of job sites, material, and equipment.**
3. **Class I jobs require on-site inspections at least once during each work shift, and at any time at employee request.** Class II, II, and IV jobs require on-site inspections at sufficient intervals to assess whether conditions have changed, and at any reasonable time at employee request.
 - i. **Class I and II worksites** require a competent person to supervise the following duties...
 - A. set up the regulated area, enclosure, or other containment.
 - B. ensure the integrity of the enclosure or containment.
 - C. set up procedures to control entry and exit from the enclosure and/or area.
 - D. supervise all employee exposure monitoring.
 - E. ensure that employees wear respirators and protective clothing as required.
 - F. ensure that employees set up and remove engineering controls, use work practices and personal protective equipment in compliance with all requirements.
 - G. ensure that employees use the hygiene facilities and observe the decontamination procedures.
 - H. ensure that engineering controls are functioning properly.
 - I. ensure that notification requirements are met.
4. **Training for the Competent Person...**
 - i. For Class I and II work, training shall meet the criteria of EPA's MAP (40 CFR 763, Subpart E, Appendix C).
 - ii. For Class III and IV work, training shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth in 40 CFR 763.92(a)(2).





Notes and Scribbles



California Code of Regulations

Title 8, Section 1529. Asbestos. Subchapter 4.

Contents

(a)	Scope	Page 2
(b)	Definitions	Page 2
(c)	Permissible Exposure Limits	Page 7
(d)	Multi-Employer Worksites	Page 7
(e)	Regulated Areas	Page 8
(f)	Exposure Assessment and Monitoring	Page 8
(g)	Methods of Compliance	Page 11
(h)	Respiratory Protection	Page 23
(i)	Protective Clothing	Page 25
(j)	Hygiene Facilities and Practices for Employees	Page 26
(k)	Communication of Hazards	Page 28
(l)	Housekeeping	Page 34
(m)	Medical Surveillance	Page 35
(n)	Recordkeeping	Page 38
(o)	Competent Person	Page 40
(p)	Appendices	Page 41
(q)	Certified Asbestos Consultants and Certified Site Survey Technicians	Page 41
(r)	Report of Use and Asbestos-related Work Registration	Page 44
Appendix A	OSHA Reference Method	Page 46
Appendix B	Sampling and Analysis	Page 49
Appendix C	Repealed	Page 64
Appendix D	Medical Questionnaires	Page 65
Appendix E	Interpretation and Classification of Chest Roentgenograms	Page 74
Appendix F	Work Practices and Engineering Controls for Class I Asbestos Operations	Page 75
Appendix G	Repealed	Page 82
Appendix H	Substance Technical Information for Asbestos	Page 83
Appendix I	Medical Surveillance Guidelines for Asbestos	Page 86
Appendix J	Smoking Cessation Program for Asbestos	Page 89
Appendix K	Polarized Light Microscopy of Asbestos	Page 90



**California Code of Regulations,
Title 8, Section 1529. Asbestos. Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and
Gases
1529. Asbestos.**

- (a) **Scope and Application.**
- (a)(1) This section regulates asbestos exposure in all construction work as defined in Section 1502 including but not limited to the following:
- (a)(1)(A) Demolition or salvage of structures where asbestos is present;
- (a)(1)(B) Removal or encapsulation of materials containing asbestos;
- (a)(1)(C) Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos;
- (a)(1)(D) Installation of products containing asbestos;
- (a)(1)(E) Asbestos spill/emergency cleanup;
- (a)(1)(F) Transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed;
- (a)(1)(G) Excavation which may involve exposure to asbestos as a natural constituent which is not related to asbestos mining and milling activities;
- (a)(1)(H) Routine facility maintenance; and
- (a)(1)(I) Erection of new electric transmission and distribution lines and equipment, and alteration, conversion and improvement of the existing transmission and distribution lines and equipment.
- (a)(2) Whenever employee exposures to asbestos, as defined in subsection (b) of this section consist only of exposure to tremolite, anthophyllite, and actinolite in the nonasbestiform mineral habit, the provisions of Section 5208.1 shall apply.
- (a)(3) The provisions of this section are subject to the requirements of the Occupational Carcinogen Control Act of 1976 (Labor Code, Division 5, Part 10).
- (a)(4) Coverage under this Section shall be based on the nature of the work operation involving asbestos exposure.
- (b) **Definitions.**
- Aggressive-method** means removal or disturbance of building material by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact ACM.



Amended Water means water to which surfactant (wetting agent) has been added to increase the ability of the liquid to penetrate ACM.

Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that has been chemically treated and/or altered. For purposes of this standard, asbestos includes PACM, as defined below.

Asbestos-containing Material (ACM) means any material containing more than one percent asbestos.

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

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

Building/Facility Owner is the legal entity, including a lessee, which exercises control over management and record keeping functions relating to a building and/or facility in which activities covered by this standard take place.

Certified Industrial Hygienist (CIH) means one certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.

Chief means the Chief of the Division of Occupational Safety and Health, P.O. Box 420603, San Francisco, CA 94142.

Class I Asbestos Work means activities involving the removal of TSI and surfacing ACM and PACM

Class II Asbestos Work means activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.

Class III Asbestos Work means repair and maintenance operations, where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

Class IV Asbestos Work means maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and



activities to clean up dust, waste and debris resulting from Class I, II, and III activities.

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

Closely Resemble means that the major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent Person means, in addition to one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them, one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them: in addition, for Class I and Class II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR part 763) for supervisor, or its equivalent and, for Class III and Class IV work, who is trained in a manner consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92 (a)(2).

Note: For operations involving more than 100 square feet of asbestos containing construction material as defined in subsection (r) of this section the competent person may fulfill the requirement contained in Section 341.9 to specify a certified supervisor for asbestos related work.

Critical Barrier means one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.

Decontamination Area means an enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

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



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

Disturbance means activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount which can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which shall not exceed 60 inches in length and width.

Employee Exposure means that exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.

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

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

Glovebag means an impervious plastic bag-like enclosure affixed around not more than a 60 x 60 inch asbestos-containing material, with glove-like appendages through which material and tools may be handled.

High-efficiency Particulate Air (HEPA) Filter means a filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

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

Industrial Hygienist means a professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards.

Intact means that the ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.



Modification for purposes of subsection (g)(6), means a changed or altered procedure, material or component of a control system, which replaces a procedure, material or component of a required system. Omitting a procedure or component, or reducing or diminishing the stringency or strength of a material or component of the control system is not a modification for purposes of subsection (g)(6) of this section.

Negative Initial Exposure Assessment means a demonstration by the employer, which complies with the criteria in **subsection (f)(2)(C)** of this section, that employee exposure during an operation is expected to be consistently below the PELs.

PACM means presumed asbestos-containing material.

Presumed Asbestos Containing Material means thermal system insulation and surfacing material found in buildings constructed no later than 1980. The designation of a material as PACM may be rebutted pursuant to subsection (k)(5) of this section.

Project Designer means a person who has successfully completed the training requirements for an abatement project designer established by 40 U.S.C. Sec. 763.90(g).

Regulated Area means: an area established by the employer to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit. Requirements for regulated areas are set out in subsection (e) of this section.

Removal means all operations where ACM and/or PACM is taken out or stripped from structures or substrates, and includes demolition operations.

Renovation means the modifying of any existing structure, or portion thereof.

Repair means overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Surfacing Material means material that is sprayed, troweled-on or otherwise applied to surfaces (such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials



on surfaces for acoustical, fireproofing, and other purposes).

Surfacing ACM means surfacing material which contains more than 1% asbestos.

Thermal System Insulation (TSI) means ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain. Thermal system insulation ACM is thermal system insulation which contains more than 1% asbestos.

(c) Permissible Exposure Limits (PELS).

(c)(1) Time-weighted Average Limit (TWA). The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an eight (8) hour time-weighted average (TWA), as determined by the method prescribed in Appendix A to this section, or by an equivalent method.

(c)(2) Excursion limit. The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty (30) minutes, as determined by the method prescribed in Appendix A to this section, or by an equivalent method.

(d) Multi-employer Worksites.

(d)(1) On multi-employer worksites, an employer performing work requiring the establishment of a regulated area shall inform other employers on the site of the nature of the employer's work with asbestos and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other employers are not exposed to asbestos.

(d)(2) Asbestos hazards at a multi-employer work site shall be abated by the contractor who created or controls the source of asbestos contamination. For example, if there is a significant breach of an enclosure containing Class I work, the employer responsible for erecting the enclosure shall repair the breach immediately.

(d)(3) In addition, all employers of employees exposed to asbestos hazards shall comply with applicable protective provisions to protect their employees. For example, if employees working immediately adjacent to a Class I asbestos job are exposed to asbestos due to the inadequate containment of such job, their employer shall either remove the employees from the area until the enclosure breach is repaired; or perform an initial exposure assessment pursuant to subsection (f) of this section.

(d)(4) All employers of employees working adjacent to regulated areas established by another employer on a multi-employer work-site, shall



take steps on a daily basis to ascertain the integrity of the enclosure and/or the effectiveness of the control method relied on by the primary asbestos contractor to assure that asbestos fibers do not migrate to such adjacent areas.

- (d)(5) All general contractors on a construction project which includes work covered by this standard shall be deemed to exercise general supervisory authority over the work covered by this standard, even though the general contractor is not qualified to serve as the asbestos competent person as defined by subsection (b) of this section. As supervisor of the entire project, the general contractor shall ascertain whether the asbestos contractor is in compliance with this standard, and shall require such contractor to come into compliance with this standard when necessary.

(e) **Regulated Areas.**

- (e)(1) All Class I, II and III asbestos work shall be conducted within regulated areas. All other operations covered by this standard shall be conducted within a regulated area where airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed a PEL. Regulated areas shall comply with the requirements of subsections (2), (3), (4), and (5) of this subsection.

- (e)(2) **Demarcation.** The regulated area shall be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they may demarcate the regulated area. Signs shall be provided and displayed pursuant to the requirements of subsection (k)(7) of this section.

- (e)(3) **Access.** Access to regulated areas shall be limited to authorized persons and to persons authorized by the Chief or Director.

- (e)(4) **Respirators.** All persons entering a regulated area where employees are required pursuant to subsection (h)(1) of this section to wear respirators shall be supplied with a respirator selected in accordance with subsection (h)(2) of this section.

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

- (e)(6) **Competent Persons.** The employer shall ensure that all asbestos work performed within regulated areas is supervised by a competent person, as defined in subsection (b) of this section. The duties of the competent person are set out in subsection (o) of this section.

(f) **Exposure Assessments and Monitoring.**

- (f)(1) **General Monitoring Criteria.**



- (f)(1)(A) Each employer who has a workplace or work operation where exposure monitoring is required under this section shall perform monitoring to determine accurately the airborne concentrations of asbestos to which employees may be exposed.
- (f)(1)(B) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee.
- (f)(1)(C) Representative 8-hour TWA employee exposure shall be determined on the basis of one or more samples representing full-shift exposure for employees in each work area. Representative 30-minute short-term employee exposures shall be determined on the basis of one or more samples representing 30 minute exposures associated with operations that are most likely to produce exposures above the excursion limit for employees in each work area.
- (f)(2) **Initial Exposure Assessment.**
- (f)(2)(A) Each employer who has a workplace or work operation covered by this standard shall ensure that a competent person conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with requirements which are triggered by exposure data or the lack of a negative exposure assessment, and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly.
- (f)(2)(B) **Basis of Initial Exposure Assessment:** Unless a negative exposure assessment has been made pursuant to subsection (f)(2)(C) of this section, the initial exposure assessment shall, if feasible, be based on monitoring conducted pursuant to subsection (f)(1)(C) of this section. The assessment shall take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the employer which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of the PELs, or otherwise makes a negative exposure assessment pursuant to subsection (f)(2)(C) of this section, the employer shall presume that employees are exposed in excess of the TWA and excursion limit.
- (f)(2)(C) **Negative Exposure Assessment:** For any one specific asbestos job which will be performed by employees who have been trained in compliance with the standard, the employer may demonstrate that employee exposures will be below the PELs by data which conform to the following criteria;
- (f)(2)(C)1. Objective data demonstrating that the product or material containing



asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the TWA and excursion limit under those work conditions having the greatest potential for releasing asbestos; or

- (f)(2)(C)2. Where the employer has monitored prior asbestos jobs for the PEL and the excursion limit within 12 months of the current or projected job, the monitoring and analysis were performed in compliance with the asbestos standard in effect; and the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job, and these data show that under the conditions prevailing and which will prevail in the current workplace there is a high degree of certainty that employee exposures will not exceed the TWA and excursion limit; or
- (f)(2)(C)3. The results of initial exposure monitoring of the current job made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee covering operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.
- (f)(3) **Periodic Monitoring.**
- (f)(3)(A) **Class I and II Operations.** The employer shall conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing Class I or II work, unless the employer pursuant to subsection (f)(2)(C) of this section, has made a negative exposure assessment for the entire operation.
- (f)(3)(B) All operations under the standard other than Class I and II operations. The employer shall conduct periodic monitoring of all work where exposures are expected to exceed a PEL, at intervals sufficient to document the validity of the exposure prediction.
- (f)(3)(C) **Exception:** When all employees required to be monitored daily are equipped with supplied-air respirators operated in the pressure demand mode, or other positive pressure mode respirator, the employer may dispense with the daily monitoring required by this subsection. However, employees performing class I work using a control method which is not listed in subsection (g)(4)(A), (B), or (C) of this section or using a modification of a listed control method, shall continue to be monitored daily even if they are equipped with supplied-air respirators.
- (f)(4) **Termination of Monitoring.**
- (f)(4)(A) If the periodic monitoring required by **subsection (f)(3)** of this section reveals that employee exposures, as indicated by statistically reliable



measurements, are below the permissible exposure limit and excursion limit the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

- (f)(4)(B) Additional Monitoring.** Notwithstanding the provisions of subsections (f)(2), (f)(3), and (f)(4) of this section, the employer shall institute the exposure monitoring required under subsection (f)(3) of this section whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the permissible exposure limit and/or excursion limit or when the employer has any reason to suspect that a change may result in new or additional exposures above the permissible exposure limit and/or excursion limit. Such additional monitoring is required regardless of whether a negative exposure assessment was previously produced for a specific job.

(f)(5) Employee Notification of Monitoring Results.

- (f)(5)(A)** As soon as possible following receipt of monitoring results required by this section, the employer shall notify affected employees of the monitoring results.

- (f)(5)(B)** The employer shall notify affected employees of the results of monitoring representing the employee's exposure in writing either individually or by posting at a centrally located place that is accessible to affected employees.

- (f)(5)(C)** The written notification required by subsection (f)(5)(A) of this section shall include the corrective action being taken by the employer to reduce employee exposure to or below the PEL and/or excursion limit wherever monitoring results have indicated that the PEL and/or excursion limit has been exceeded.

(f)(6) Observation of Monitoring.

- (f)(6)(A)** The employer shall provide affected employees and their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos conducted in accordance with this section.

- (f)(6)(B)** When observation of the monitoring of employee exposure to asbestos requires entry into an area where the use of protective clothing or equipment is required, the observer shall be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

(g) Methods of Compliance

- (g)(1)** Engineering controls and work practices for all operations covered by this section. The employer shall use the following engineering controls and work practices in all operations covered by this section, regardless of the levels of exposure:

- (g)(1)(A)** Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM and PACM, except as provided in subsection (g)(8)(B) of this section in the case of roofing material.



- (g)(1)(B) Wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where employers demonstrate that the use of wet methods is infeasible due to for example, the creation of electrical hazards, equipment malfunction, and, in roofing, except as provided in subsection (g)(8)(B) of this section; and
- (g)(1)(C) Prompt clean-up and disposal of wastes and debris contaminated with asbestos in leak-tight containers except in roofing operations, where the procedures specified in subsection (g)(8)(B) of this section apply.
- (g)(2) In addition to the requirements of subsection (g)(1) of this section, the employer shall use the following control methods to achieve compliance with the TWA permissible exposure limit and excursion limit prescribed by subsection (c) of this section;
 - (g)(2)(A) Local exhaust ventilation equipped with HEPA filter dust collection systems;
 - (g)(2)(B) Enclosure or isolation of processes producing asbestos dust;
 - (g)(2)(C) Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;
 - (g)(2)(D) Use of other work practices and engineering controls that the Assistant Secretary can show to be feasible.
 - (g)(2)(E) Wherever the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the permissible exposure limit and/or excursion limit prescribed in subsection (c) of this section, the employer shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of subsection (h) of this section.
- (g)(3) **Prohibitions.** The following work practices and engineering controls shall not be used for work related to asbestos or for work which disturbs ACM or PACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:
 - (g)(3)(A) High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.
 - (g)(3)(B) Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.
 - (g)(3)(C) Dry sweeping, shoveling or other dry clean-up of dust and debris containing ACM and PACM.
 - (g)(3)(D) Employee rotation as a means of reducing employee exposure to asbestos.
- (g)(4) **Class I Requirements.** In addition to the provisions of subsections (g)(1) and (2) of this section, the following engineering controls and work practices and procedures shall be used.



- (g)(4)(A) All Class I work, including the installation and operation of the control system shall be supervised by a competent person as defined in subsection (b) of this section;
- (g)(4)(B) For all Class I jobs involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs, where the employer cannot produce a negative exposure assessment pursuant to subsection (f)(2)(C) of this section, or where employees are working in areas adjacent to the regulated area, while the Class I work is or being performed, the employer shall use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area:
- (g)(4)(B)1. Critical barriers shall be placed over all the openings to the regulated area, except where activities are performed outdoors; or
- (g)(4)(B)2. The employer shall use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area surveillance during each work shift at each boundary of the regulated area, showing no visible asbestos dust; and perimeter area monitoring showing that clearance levels contained in 40 CFR Part 763, Subpart E, of the EPA Asbestos in Schools Rule are met, or that perimeter area levels, measured by Phase Contrast Microscopy (PCM) are no more than background levels representing the same area before the asbestos work began. The results of such monitoring shall be made known to the employer no later than 24 hours from the end of the work shift represented by such monitoring. **Exception:** For work completed outdoors where employees are not working in areas adjacent to the regulated areas, this subsection (g)(4)(B) is satisfied when the specific control methods in subsection (g)(5) of this section are used.
- (g)(4)(C) For all Class I jobs, HVAC systems shall be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent;
- (g)(4)(D) For all Class I jobs, impermeable dropcloths shall be placed on surfaces beneath all removal activity;
- (g)(4)(E) For all Class I jobs, all objects within the regulated area shall be covered with impermeable dropcloths or plastic sheeting which is secured by duct tape or an equivalent.
- (g)(4)(F) For all Class I jobs where the employer cannot produce a negative exposure assessment, or where exposure monitoring shows that a PEL is exceeded, the employer shall ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration or collection device.
- (g)(5) **Specific Control Methods for Class I Work.** In addition, Class I asbestos work may be performed using one or more of the following control methods pursuant to the limitations stated below:
- (g)(5)(A) **Negative Pressure Enclosure (NPE) Systems:** NPE systems may be used where the configuration of the work area does not make the



- erection of the enclosure infeasible, with the following specifications and work practices.
- (g)(5)(A)1. **Specifications:**
- (g)(5)(A)1.a. The negative pressure enclosure (NPE) may be of any configuration,
- (g)(5)(A)1.b. **At least 4 air changes per hour** shall be maintained in the NPE,
- (g)(5)(A)1.c. A minimum of -0.02 column inches of water pressure differential, relative to outside pressure, shall be maintained within the NPE as evidenced by manometric measurements,
- (g)(5)(A)1.d. The NPE shall be kept under negative pressure throughout the period of its use, and
- (g)(5)(A)1.e. Air movement shall be directed away from employees performing asbestos work within the enclosure, and toward a HEPA filtration or a collection device.
- (g)(5)(A)2. **Work Practices:**
- (g)(5)(A)2. a. Before beginning work within the enclosure and at the beginning of each shift, the NPE shall be inspected for breaches and smoke- tested for leaks, and any leaks sealed.
- (g)(5)(A)2. b. Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters.
- (g)(5)(B) **Glove bag systems may be used** to remove PACM and/or ACM from straight runs of piping and elbows and other connections with the following specifications and work practices:
- (g)(5)(B)1. **Specifications:**
- (g)(5)(B)1. a. Glovebags shall be made of 6 mil thick plastic and shall be seamless at the bottom.
- (g)(5)(B)1. b. Glovebags used on elbows and other connections must be designed for that purpose and used without modifications.
- (g)(5)(B)2. **Work Practices:**
- (g)(5)(B)2.a. Each glovebag shall be installed so that it completely covers the circumference of pipe or other structure where the work is to be done.
- (g)(5)(B)2.b. Glovebags shall be smoke-tested for leaks and any leaks sealed prior to use.
- (g)(5)(B)2.c. Glovebags may be used only once and may not be moved.
- (g)(5)(B)2.d. **Glovebags shall not be used on surfaces whose temperature exceeds 150°F.**
- (g)(5)(B)2.e. Prior to disposal, glovebags shall be collapsed by removing air within them using a HEPA vacuum.
- (g)(5)(B)2.f. Before beginning the operation, loose and friable material adjacent to the glovebag/box operation shall be wrapped and sealed in two layers of six mil plastic or otherwise rendered intact,
- (g)(5)(B)2.g. Where system uses attached waste bag, such bag shall be



- connected to collection bag using hose or other material which shall withstand pressure of ACM waste and water without losing its integrity:
- (g)(5)(B)2.h. Sliding valve or other device shall separate waste bag from hose to ensure no exposure when waste bag is disconnected:
 - (g)(5)(B)2.i. At least two persons shall perform Class I glovebag removal operations.
 - (g)(5)(C) **Negative Pressure Glove Bag Systems.** Negative pressure glove bag systems may be used to remove ACM or PACM from piping.
 - (g)(5)(C)1. **Specifications:** In addition to specifications for glove bag systems above, negative pressure glove bag systems shall attach HEPA vacuum systems or other devices to bag to prevent collapse during removal.
 - (g)(5)(C)2. **Work Practices:**
 - (g)(5)(C)2.a. The employer shall comply with the work practices for glove bag systems in subsection (g)(5)(B)2.d. of this section.
 - (g)(5)(C)2.b. The HEPA vacuum cleaner or other device used to prevent collapse of bag during removal shall run continually during the operation until it is completed at which time the bag shall be collapsed prior to removal of the bag from the pipe.
 - (g)(5)(C)2.c. Where a separate waste bag is used along with a collection bag and discarded after one use, the collection bag may be reused if rinsed clean with amended water before reuse.
 - (g)(5)(D) **Negative Pressure Glove Box Systems:** Negative pressure glove boxes may be used to remove ACM or PACM from pipe runs with the following specifications and work practices.
 - (g)(5)(D)1. **Specifications:**
 - (g)(5)(D)1.a. Glove boxes shall be constructed with rigid sides and made from metal or other material which can withstand the weight of the ACM and PACM and water used during removal:
 - (g)(5)(D)1.b. A negative pressure generator shall be used to create negative pressure in the system:
 - (g)(5)(D)1.c. An air filtration unit shall be attached to the box:
 - (g)(5)(D)1.d. The box shall be fitted with gloved apertures:
 - (g)(5)(D)1.e. An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water:
 - (g)(5)(D)1.f. A back-up generator shall be present on site:
 - (g)(5)(D)1.g. Waste bags shall consist of 6 mil thick plastic double-bagged before they are filled or plastic thicker than 6 mil.
 - (g)(5)(D)2. **Work practices:**
 - (g)(5)(D)2.a. At least two persons shall perform the removal:
 - (g)(5)(D)2.b. The box shall be smoke-tested for leaks and any leaks sealed prior to each use.
 - (g)(5)(D)2.c. Loose or damaged ACM adjacent to the box shall be wrapped



- and sealed in two layers of 6 mil plastic prior to the job, or otherwise made intact prior to the job.
- (g)(5)(D)2.d. A HEPA filtration system shall be used to maintain pressure barrier in box.
- (g)(5)(E) **Water Spray Process System.** A water spray process system may be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. The system shall meet the following specifications and shall be performed by employees using the following work practices.
- (g)(5)(E)1. **Specifications:**
- (g)(5)(E)1.a. Piping shall be surrounded on 3 sides by rigid framing,
- (g)(5)(E)1.b. A 360 degree water spray, delivered through nozzles supplied by a high pressure separate water line, shall be formed around the piping.
- (g)(5)(E)1.c. The spray shall collide to form a fine aerosol which provides a liquid barrier between workers and the ACM and PACM.
- (g)(5)(E)2. **Work Practices:**
- (g)(5)(E)2.a. The system shall be run for at least 10 minutes before removal begins.
- (g)(5)(E)2.b. All removal shall take place within the water barrier.
- (g)(5)(E)2.c. The system shall be operated by at least three persons, one of whom shall not perform removal, but shall check equipment, and ensure proper operation of the system.
- (g)(5)(E)2.d. After removal, the ACM and PACM shall be bagged while still inside the water barrier.
- (g)(5)(F) A small walk-in enclosure which accommodates no more than two persons (mini-enclosure) may be used if the disturbance or removal can be completely contained by the enclosure with the following specifications and work practices.
- (g)(5)(F)1. **Specifications:**
- (g)(5)(F)1.a. The fabricated or job-made enclosure shall be constructed of 6 mil plastic or equivalent:
- (g)(5)(F)1.b. The enclosure shall be placed under negative pressure by means of a HEPA filtered vacuum or similar ventilation unit:
- (g)(5)(F)2. **Work Practices:**
- (g)(5)(F)2.a. Before use, the mini-enclosure shall be inspected for leaks and smoke tested to detect breaches, and any breaches sealed.
- (g)(5)(F)2.b. Before reuse, the interior shall be completely washed with amended water and HEPA-vacuumed.
- (g)(5)(F)2.c. During use, air movement shall be directed away from the employee's breathing zone within the mini-enclosure.
- (g)(6) **Alternative control methods for Class I work.** Class I work may be performed using a control method which is not



- referenced in subsection (g)(5) of this section, or which modifies a control method referenced in subsection (g)(5) of this section, if the following provisions are complied with:
- (g)(6)(A)** The control method shall enclose, contain or isolate the processes or source of airborne asbestos dust, or otherwise capture or redirect such dust before it enters the breathing zone of employees.
- (g)(5)(F)2.** A certified industrial hygienist or licensed professional engineer who is also qualified as a project designer as defined in subsection (b) of this section, shall evaluate the work area, the projected work practices and the engineering controls and shall certify in writing that the planned control method is adequate to reduce direct and indirect employee exposure to below the PELs under worst-case conditions of use, and that the planned control method will prevent asbestos contamination outside the regulated area, as measured by clearance sampling which meets the requirements of EPA's Asbestos in Schools rule issued under AHERA, or perimeter monitoring which meets the criteria in subsection (g)(4)(B)2. of this section.
- (g)(5)(F)2.1.** Where the TSI or surfacing material to be removed is 25 linear or 10 square feet or less, the evaluation required in subsection (g)(6) of this section may be performed by a competent person, and may omit consideration of perimeter or clearance monitoring otherwise required.
- (g)(5)(F)2.2.** The evaluation of employee exposure required in subsection (g)(6) of this section, shall include and be based on sampling and analytical data representing employee exposure during the use of such method under worst-case conditions and by employees whose training and experience are equivalent to employees who are to perform the current job.
- (g)(6)(C)** Before work which involves the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material is begun using an alternative method which has been the subject of a subsection (g)(6) of this section required evaluation and certification, the employer shall send a copy of such evaluation and certification to the national office of OSHA, Office of Technical Support, Room N3653, 200 Constitution Avenue, NW, Washington, DC 20210. The submission shall not constitute approval by OSHA.
- (g)(7)** **Work Practices and Engineering Controls for Class II Work.**
- (g)(7)(A)** All Class II work, shall be supervised by a competent person as defined in subsection (b) of this section.
- (g)(7)(B)** For all indoor Class II jobs, where the employer has not produced a negative exposure assessment pursuant to



subsection (f)(2)(C) of this section, or where during the job, changed conditions indicate there may be exposure above the PEL or where the employer does not remove the ACM in a substantially intact state, the employer shall use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area;

- (g)(7)(B)1. Critical barriers shall be placed over all openings to the regulated area; or,
- (g)(7)(B)2. The employer shall use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area monitoring or clearance monitoring which meets the criteria set out in subsection (g)(4)(B)2. of this section.
- (g)(7)(C) Impermeable dropcloths shall be placed on surfaces beneath all removal activity;
- (g)(7)(D) All Class II asbestos work shall be performed using the work practices and requirements set out above in subsection (g)(1)(A) through (C) of this section.
- (g)(8) **Additional Controls for Class II Work.** Class II asbestos work shall also be performed by complying with the work practices and controls designated for each type of asbestos work to be performed, set out in this subsection. Where more than one control method may be used for a type of asbestos work, the employer may choose one or a combination of designated control methods. Class II work also may be performed using a method allowed for Class I work, except that glove bags and glove boxes are allowed if they fully enclose the Class II material to be removed.
- (g)(8)(A) For removing vinyl and asphalt flooring materials which contain ACM or for which, in buildings constructed no later than 1980, the employer has not verified the absence of ACM pursuant to subsection (g)(8)(A)9. of this section. The employer shall ensure that employees comply with the following work practices and that employees are trained in these practices pursuant to subsection (k)(9) of this section:
 - (g)(8)(A)1. Flooring or its backing shall not be sanded.
 - (g)(8)(A)2. Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) shall be used to clean floors.
 - (g)(8)(A)3. Resilient sheeting shall be removed by cutting with wetting of the snip point and wetting during delamination. Rip-up of resilient sheet floor material is prohibited.
 - (g)(8)(A)4. All scraping of residual adhesive and/or backing shall be performed using wet methods.
 - (g)(8)(A)5. **Dry sweeping is prohibited.**
 - (g)(8)(A)6. Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirements of subsection (g)(5)(A) of this section.
 - (g)(8)(A)7. Tiles shall be removed intact, unless the employer demonstrates that intact removal is not possible.



- (g)(8)(A)8.** When tiles are heated and can be removed intact, wetting may be omitted.
- (g)(8)(A)9.** Resilient flooring material including associated mastic and backing shall be assumed to be asbestos-containing unless an industrial hygienist determines that it is asbestos-free using recognized analytical techniques.
- (g)(8)(B)** For removing roofing material which contains ACM the employer shall ensure that the following work practices are followed:
- (g)(8)(B)1.** Roofing material shall be removed in an intact state to the extent feasible.
- (g)(8)(B)2.** Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards.
- (g)(8)(B)3.** Cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.
- (g)(8)(B)4.** When removing built-up roofs with asbestos-containing roofing felts and an aggregate surface using a power roof cutter, all dust resulting from the cutting operation shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. When removing built-up roofs with asbestos containing roofing felts and a smooth surface using a power roof cutter, the dust resulting from the cutting operation shall be collected either by a HEPA dust collector or HEPA vacuuming along the cut line, or by gently sweeping and then carefully and completely wiping up the still-wet dust and debris left along the cut line. The dust and debris shall be immediately bagged or placed in covered containers.
- (g)(8)(B)5.** Asbestos-containing material that has been removed from a roof shall not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist:
- (g)(8)(B)5.a.** Any ACM that is not intact shall be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift. While the material remains on the roof it shall either be kept wet, placed in an impermeable waste bag, or wrapped in plastic sheeting.
- (g)(8)(B)5.b.** Intact ACM shall be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift.
- (g)(8)(B)6.** Upon being lowered, unwrapped material shall be transferred to



a closed receptacle in such manner so as to preclude the dispersion of dust.

- (g)(8)(B)7.** Roof level heating and ventilation air intake sources shall be isolated or the ventilation system shall be shut down.
- (g)(8)(B)8.** Notwithstanding any other provision of this section, removal or repair of sections of intact roofing less than 25 square feet in area does not require use of wet methods or HEPA vacuuming as long as manual methods which do not render the material non-intact are used to remove the material and no visible dust is created by the removal method used. In determining whether a job involves less than 25 square feet, the employer shall include all removal and repair work performed on the same roof on the same day.
- (g)(8)(C)** When removing cementitious asbestos-containing siding and shingles or transite panels containing ACM on building exteriors (other than roofs, where subsection (g)(8)(B) of this section applies) the employer shall ensure that the following work practices are followed:

 - (g)(8)(C)1.** Cutting, abrading, or breaking siding, shingles, or transite panels, shall be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release cannot be used.
 - (g)(8)(C)2.** Each panel or shingle shall be sprayed with amended water prior to removal.
 - (g)(8)(C)3.** Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.
 - (g)(8)(C)4.** Nails shall be cut with flat, sharp instruments.
- (g)(8)(D)** When removing gaskets containing ACM, the employer shall ensure that the following work practices are followed:

 - (g)(8)(D)1.** If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag as described in subsection (g)(5)(B) of this section.
 - (g)(8)(D)2.** The gasket shall be immediately placed in a disposal container.
 - (g)(8)(D)3.** Any scraping to remove residue must be performed wet.
- (g)(8)(E)** When performing any other Class II removal of asbestos containing material for which specific controls have not been listed in subsections (g)(8)(A) through (D) of this section, the employer shall ensure that the following work practices are complied with.

 - (g)(8)(E)1.** The material shall be thoroughly wetted with amended water prior to and during its removal.
 - (g)(8)(E)2.** The material shall be removed in an intact state unless the employer demonstrates that intact removal is not possible.
 - (g)(8)(E)3.** Cutting, abrading or breaking the material shall be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.
 - (g)(8)(E)4.** Asbestos-containing material removed, shall be immediately bagged or



wrapped, or kept wetted until transferred to a closed receptacle, no later than the end of the work shift.

- (g)(8)(F) Alternative Work Practices and Controls.** Instead of the work practices and controls listed in subsection (g)(8)(A) through (E) of this section, the employer may use different or modified engineering and work practice controls if the following provisions are complied with.
- (g)(8)(F)1.** The employer shall demonstrate by data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used, that employee exposure will not exceed the PELs under any anticipated circumstances.
- (g)(8)(F)2.** A competent person shall evaluate the work area, the projected work practices and the engineering controls, and shall certify in writing, that the different or modified controls are adequate to reduce direct and indirect employee exposure to below the PELs under all expected conditions of use and that the method meets the requirements of this standard. The evaluation shall include and be based on data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used for the current job, and by employees whose training and experience are equivalent to employees who are to perform the current job.
- (g)(9) Work Practices and Engineering Controls for Class III Asbestos Work.** Class III asbestos work shall be conducted using engineering and work practice controls which minimize the exposure to employees performing the asbestos work and to bystander employees.
- (g)(9)(A)** The work shall be performed using wet methods.
- (g)(9)(B)** To the extent feasible, the work shall be performed using local exhaust ventilation.
- (g)(9)(C)** Where the disturbance involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of thermal system insulation or surfacing material, the employer shall use impermeable dropcloths, and shall isolate the operation using mini-enclosures or glove bag systems pursuant to subsection (g)(5) of this section or another isolation method.
- (g)(9)(D)** Where the employer does not produce a negative exposure assessment for a job, or where monitoring results show the PEL has been exceeded, the employer shall contain the area using impermeable dropcloths and plastic barriers or their equivalent, or shall isolate the operation using a control system listed in and in compliance with subsection (g)(5) of this section.
- (g)(9)(E)** Employees performing Class III jobs, which involve the disturbance of thermal system insulation or surfacing material, or where the employer does not produce a negative exposure assessment or where monitoring results show a PEL has been exceeded, shall wear



respirators which are selected, used and fitted pursuant to provisions of subsection (h) of this section.

- (g)(10)** **Class IV Asbestos Work.** Class IV asbestos jobs shall be conducted by employees trained pursuant to the asbestos awareness training program set out in subsection (k)(9) of this section. In addition, all Class IV jobs shall be conducted in conformity with the requirements set out in subsection (g)(1) of this section, mandating wet methods, HEPA vacuums, and prompt clean up of debris containing ACM or PACM.
- (g)(10)(A)** Employees cleaning up debris and waste in a regulated area where respirators are required shall wear respirators which are selected, used and fitted pursuant to provisions of subsection (h) of this section.
- (g)(10)(B)** Employers of employees who clean up waste and debris in, and employers in control of, areas where friable thermal system insulation or surfacing material is accessible, shall assume that such waste and debris contain asbestos.
- (g)(11)** Alternative methods of compliance for installation, removal, repair, and maintenance of certain roofing and pipeline coating materials. Notwithstanding any other provision of this section, an employer who complies with all provisions of this subsection (g)(11) when installing, removing, repairing, or maintaining intact pipeline asphaltic wrap, or roof cements, mastics, coatings, or flashings which contain asbestos fibers encapsulated or coated by bituminous or resinous compounds shall be deemed to be in compliance with this section. If an employer does not comply with all provisions of this subsection (g)(11), or if during the course of the job the material does not remain intact, the provisions of subsection (g)(8) of this section apply instead of this subsection (g)(11).
- (g)(11)(A)** Before work begins and as needed during the job, a competent person who is capable of identifying asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate such hazards, shall conduct an inspection of the worksite and determine that the roofing material is intact and will likely remain intact.
- (g)(11)(B)** All employees performing work covered by this subsection (g)(11) shall be trained in a training program that meets the requirements of subsection (k)(9)(H).
- (g)(11)(C)** The material shall not be sanded, abraded, or ground. Manual methods which do not render the material non-intact shall be used.
- (g)(11)(D)** Material that has been removed from a roof shall not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist. All such material shall be removed from the roof as soon as is practicable, but in any event no later than the end of



the work shift.

(g)(11)(E) Where roofing products which have been labeled as containing asbestos pursuant to subsection (k)(8) of this section are installed on non-residential roofs during operations covered by this subsection (g)(11), the employer shall notify the building owner of the presence and location of such materials no later than the end of the job.

(g)(11)(F) All removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

(h) Respiratory Protection.

(h)(1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(h)(1)(A) Class I asbestos work.

(h)(1)(B) Class II asbestos work where the ACM is not removed in a substantially intact state,

(h)(1)(C) Class II and III asbestos work which is not performed using wet methods, except for removal of ACM from sloped roofs when a negative exposure assessment has been made and the ACM is removed in an intact state.

(h)(1)(D) Class II and III asbestos work for which a negative exposure assessment has not been conducted.

(h)(1)(E) Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed.

(h)(1)(F) Class IV asbestos work performed within regulated areas where employees performing other work are required to use respirators.

(h)(1)(G) Work operations covered by this section where employees are exposed above the TWA or excursion limit.

(h)(1)(H) Emergencies.

(h)(2) Respirator Program.

(h)(2)(A) The employer must implement a respiratory protection program in accordance with section 5144(b) through (d) (except (d)(1)(C)), and (f) through (m).

(h)(2)(B) No employee shall be assigned to asbestos work that requires respirator use if, based on their most recent medical examination, the examining physician determines that the employee will be unable to function normally while using a respirator, or that the safety or health of the employee or other employees will be impaired by the employee's respirator use. Such employees must be assigned to another job or given the opportunity to transfer to a different position that they can perform. If such a transfer position is available, it must be with the same employer, in the same geographic area, and with the same seniority, status, rate of pay, and other job benefits the employee had just prior to such transfer.

(h)(3) Respirator selection.



(h)(3)(A) The employer shall select the appropriate respirator as specified in **Table 1.**

TABLE 1
RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos or conditions of use	Required respirator
Not in excess of 1 f/cc (10 X PEL), or otherwise as required independent of exposure pursuant to(h)(2)(D)of this section.	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.
Not in excess of 5 f/cc (50 X PEL).	Full facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 X PEL).	Any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 X PEL).	Full facepiece supplied air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 X PEL) or unknown concentration.	Full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.

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

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

(h)(3)(B) The employer shall provide a tight fitting powered, air- purifying respirator in lieu of any negative-pressure respirator specified in Table 1 whenever:

(h)(3)(B)1. An employee chooses to use this type of respirator; and

(h)(3)(B)2. This respirator will provide adequate protection to the employee.

(h)(3)(C) The employer shall provide a half-mask air purifying respirator, other than a disposable respirator, equipped with high efficiency filters whenever the employee performs:

(h)(3)(C)1. Class II and III asbestos work and a negative exposure assessment has



- not been conducted by the employer;
- (h)(3)(C)2.** Class III jobs where TSI or surfacing ACM or PACM is being disturbed.
- (h)(3)(D)** In addition to the above selection criteria, when employees are in a regulated area where Class I work is being performed, a negative exposure assessment of the area has not been produced, and the exposure assessment of the area indicates the exposure level will not exceed 1 f/cc as an 8-hour time weighted average, employers must provide the employees with one of the following respirators:
- (h)(3)(D)1.** A tight-fitting powered air-purifying respirator equipped with high efficiency filters;
- (h)(3)(D)2.** A full facepiece supplied air-respirator operated in the pressure-demand mode equipped with HEPA egress cartridges; or
- (h)(3)(D)3.** A full facepiece supplied-air respirator operated in the pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus. A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus must be provided under such conditions when the exposure, assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.
- (i)** **Protective Clothing.**
- (i)(1)** **General.** The employer shall provide or require the use of protective clothing, such as coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos that exceed the TWA and/or excursion limit prescribed in subsection (c) of this section, or for which a required negative exposure assessment is not produced, and for any employee performing Class I operations which involve the removal of over 25 linear or 10 square feet of TSI or surfacing ACM and PACM. The employer shall prohibit the removal of asbestos from protective clothing and equipment by blowing, shaking, or brushing.
- (i)(2)** **Laundering.**
- (i)(2)(A)** The employer shall ensure that laundering of contaminated clothing is done so as to prevent the release of airborne asbestos in excess of the TWA or excursion limit prescribed in subsection (c) of this section.
- (i)(2)(B)** Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in subsection (i)(2)(A) of this section to effectively prevent the release of airborne asbestos in excess of the TWA and excursion limit prescribed in subsection (c) of this section.
- (i)(3)** **Contaminated Clothing.** Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and be labeled in accordance with subsection (k) of this section.
- (i)(4)** **Inspection of Protective Clothing.**



- (i)(4)(A) The competent person shall examine worksuits worn by employees at least once per workshift for rips or tears that may occur during performance of work.
- (i)(4)(B) When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the worksuit shall be immediately replaced.
- (j) **Hygiene Facilities and Practices for Employees.**
- (j)(1) Requirements for employees performing Class I asbestos jobs involving over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.
- (j)(1)(A) **Decontamination Areas:** the employer shall establish a decontamination area that is adjacent and connected to the regulated area for the decontamination of such employees. The decontamination area shall consist of an equipment room, shower area, and clean room in series. The employer shall ensure that employees enter and exit the regulated area through the decontamination area.
- (j)(1)(A)1. **Equipment Room.** The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment.
- (j)(1)(A)2. **Shower Area.** Shower facilities shall be provided which comply with Section 3366(f) of the General Industry Safety Orders, unless the employer can demonstrate that they are not feasible. The showers shall be adjacent both to the equipment room and the clean room, unless the employer can demonstrate that this location is not feasible. Where the employer can demonstrate that it is not feasible to locate the shower between the equipment room and the clean room, or where the work is performed outdoors, the employers shall ensure that employees:
 - (j)(1)(A)2. A. Remove asbestos contamination from their worksuits in the equipment room using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or
 - (j)(1)(A)2. B. Remove their contaminated worksuits in the equipment room, then don clean worksuits, and proceed to a shower that is not adjacent to the work area.
- (j)(1)(A)3. **Clean Change Room.** The clean room shall be equipped with a locker or appropriate storage container for each employee's use. When the employer can demonstrate that it is not feasible to provide a clean change area adjacent to the work area or where the work is performed outdoors, the employer may permit employees engaged in Class I asbestos jobs to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the regulated area. Following showering, such employees however must then change into



street clothing in clean change areas provided by the employer which otherwise meet the requirements of this section.

- (j)(1)(B) **Decontamination Area Entry Procedures.** The employer shall ensure that employees:

 - (j)(1)(B)1. Enter the decontamination area through the clean room;
 - (j)(1)(B)2. Remove and deposit street clothing within a locker provided for their use; and
 - (j)(1)(B)3. Put on protective clothing and respiratory protection before leaving the clean room.
 - (j)(1)(B)4. Before entering the regulated area, the employer shall ensure that employees pass through the equipment room.
- (j)(1)(C) **Decontamination Area Exit Procedures.** The employer shall ensure that:

 - (j)(1)(C)1. Before leaving the regulated area, employees shall remove all gross contamination and debris from their protective clothing.
 - (j)(1)(C)2. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.
 - (j)(1)(C)3. Employees shall not remove their respirators in the equipment room.
 - (j)(1)(C)4. Employees shall shower prior to entering the clean room.
 - (j)(1)(C)5. After showering, employees shall enter the clean room before changing into street clothes.
- (j)(1)(D) **Lunch Areas.** Whenever food or beverages are consumed at the worksite where employees are performing Class I asbestos work, the employer shall provide lunch areas in which the airborne concentrations of asbestos are below the permissible exposure limit and/or excursion limit.
- (j)(2) Requirements for Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM and PACM, and for Class II and Class III asbestos work operations where exposures exceed a PEL or where there is no negative exposure assessment produced before the operation.

 - (j)(2)(A) The employer shall establish an equipment room or area that is adjacent to the regulated area for the decontamination of employees and their equipment which is contaminated with asbestos which shall consist of an area covered by a impermeable drop cloth on the floor or horizontal working surface.
 - (j)(2)(B) The area must be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area (as determined by visible accumulations).
 - (j)(2)(C) Work clothing must be cleared with a HEPA vacuum before it is removed.
 - (j)(2)(D) All equipment and surfaces of containers filled with ACM must be cleaned prior to removing them from the equipment room or area.



- (j)(2)(E) The employer shall ensure that employees enter and exit the regulated area through the equipment room or area.
- (j)(3) **Requirements for Class IV Work.** Employers shall ensure that employees performing Class IV work within a regulated area comply with the hygiene practice required of employees performing work which has a higher classification within that regulated area. Otherwise employers of employees cleaning up debris and material which is TSI or surfacing ACM or identified as PACM shall provide decontamination facilities for such employees which are required by subsection (j)(2) of this section.
- (j)(4) **Smoking in Work Areas.** The employer shall ensure that **employees do not smoke in work areas** where they are occupationally exposed to asbestos because of activities in that work area.
- (k) **Communication of Hazards.**
- (k)(1) This section applies to the communication of information concerning asbestos hazards in construction activities to facilitate compliance with this standard. Most asbestos-related construction activities involve previously installed building materials. Building owners often are the only and/or best sources of information concerning them. Therefore, they, along with employers of potentially exposed employees, are assigned specific information conveying and retention duties under this section.
- Installed Asbestos Containing Building Material.**
Employers and building owners shall identify TSI and sprayed or troweled on surfacing materials in buildings as asbestos-containing, unless they determine in compliance with subsection (k)(5) of this section that the material is not asbestos-containing. Asphalt and vinyl flooring material installed no later than 1980 must also be considered as asbestos containing unless the employer, pursuant to subsection (g)(8)(A)9. of this section determines that it is not asbestos-containing. If the employer/building owner has actual knowledge, or should have known through the exercise of due diligence, that other materials are asbestos-containing, they too must be treated as such. When communicating information to employees pursuant to this standard, owners and employers shall identify PACM as ACM. Additional requirements relating to communication of asbestos work on multi-employer worksites are set out in subsection (d) of this section.
- (k)(2) **Duties of Building and Facility Owners.**
- (k)(2)(A) Before work subject to this standard is begun, building and facility owners shall determine the presence, location, and quantity of ACM and/or PACM at the work site pursuant to subsection (k)(1) of this section.
- (k)(2)(B) Building and/or facility owners shall notify the following persons of the presence, location and quantity of ACM or PACM, at the work sites in



their buildings and facilities. Notification either shall be in writing, or shall consist of a personal communication between the owner and the person to whom notification must be given or their authorized representatives:

- (k)(2)(B)1.** Prospective employers applying or bidding for work whose employees reasonably can be expected to work in or adjacent to areas containing such material;
- (k)(2)(B)2.** Employees of the owner who will work in or adjacent to areas containing such material;
- (k)(2)(B)3.** On multi-employer worksites, all employers of employees who will be performing work within or adjacent to areas containing such materials;
- (k)(2)(B)4.** Tenants who will occupy areas containing such material.
- (k)(3)** Duties of employers whose employees perform work subject to this standard in or adjacent to areas containing ACM and PACM. Building/facility owners whose employees perform such work shall comply with these provisions to the extent applicable.
- (k)(3)(A)** Before work in areas containing ACM and PACM is begun; employers shall identify the presence, location, and quantity of ACM, and/or PACM therein pursuant to subsection (k)(1) of this section.
- (k)(3)(B)** Before work under this standard is performed employers of employees who will perform such work shall inform the following persons of the location and quantity of ACM and/or PACM present in the area and the precautions to be taken to insure that airborne asbestos is confined to the area.
 - (k)(3)(B)1.** Owners of the building/facility;
 - (k)(3)(B)2.** Employees who will perform such work and employers of employees who work and/or will be working in adjacent areas.
- (k)(3)(C)** Within 10 days of the completion of such work, the employer whose employees have performed work subject to this standard, shall inform the building/facility owner and employers of employees who will be working in the area of the current location and quantity of PACM and/or ACM remaining in the area and final monitoring results, if any.
- (k)(4)** In addition to the above requirements, all employers who discover ACM and/or PACM on a worksite shall convey information concerning the presence, location and quantity of such newly discovered ACM and/or PACM to the owner and to other employers of employees working at the work site, within 24 hours of the discovery.
- (k)(5)** **Criteria to rebut the designation of installed material as PACM.**
- (k)(5)(A)** At any time, an employer and/or building owner may demonstrate, for purposes of this standard, that PACM does not contain asbestos. Building owners and/or employers are not required to communicate information about the presence of building material for which such a demonstration pursuant to the requirements of subsection (k)(5)(B) of



this section has been made. However, in all such cases, the information, data and analysis supporting the determination that PACM does not contain asbestos, shall be retained pursuant to subsection (n) of this section.

- (k)(5)(B)** An employer or owner may demonstrate that PACM does not contain more than 1% asbestos by the following:

 - (k)(5)(B)1.** Having completed an inspection conducted pursuant to the requirements of AHERA (40 CFR Part 763, Subpart E) which demonstrates that the material is not ACM or;
 - (k)(5)(B)2.** Performing tests of the material containing PACM which demonstrate that no ACM is present in the material. Such tests shall include analysis of bulk samples collected in the manner described in 40 CFR 763.86. The tests, evaluation and sample collection shall be conducted by an accredited inspector or by a CIH. Analysis of samples shall be performed by persons or laboratories with proficiency demonstrated by current successful participation in a nationally recognized testing program such as the National Voluntary Laboratory Accreditation Program (NVLAP) or the National Institute for Standards and Technology (NIST) or the Round Robin for bulk samples administered by the American Industrial Hygiene Association (AIHA) or an equivalent nationally-recognized round robin testing program.
- (k)(5)(C)** The employer and/or building owner may demonstrate that flooring material including associated mastic and backing does not contain asbestos, by a determination of an industrial hygienist based upon recognized analytical techniques showing that the material is not ACM.
- (k)(6)** At the entrance to mechanical rooms/areas in which employees reasonably can be expected to enter and which contain thermal system insulation and surfacing ACM and/or PACM, the building owner shall post signs which identify the material which is present, its location, and appropriate work practices which, if followed, will ensure that ACM and/or PACM will not be disturbed. The employer shall ensure, to the extent feasible, that employees who come in contact with these signs can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.
- (k)(7)** **Signs.**

 - (k)(7)(A)** Warning signs that demarcate the regulated area shall be provided and displayed at each location where a regulated area is required to be established by subsection (e) of this section. Signs shall be posted at such a distance from such a location that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.
 - (k)(7)(B)1.** The warning signs required by **subsection (k)(7)** of this section shall bear the following information:



**DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY**

- (k)(7)(B)2.** In addition, where the use of respirators and protective clothing is required in the regulated area under this section, the warning signs shall include the following:

**RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA**

- (k)(7)(C)** The employer shall ensure that employees working in and contiguous to regulated areas comprehend the warning signs required to be posted by subsection (k)(7)(A) of this section. Means to ensure employee comprehension may include the use of foreign languages, pictographs and graphics.
- (k)(8) Labels.**
- (k)(8)(A)** Labels shall be affixed to all products containing asbestos and to all containers containing such products, including waste containers. Where feasible, installed asbestos products shall contain a visible label.
- (k)(8)(B)** Labels shall be printed in large, bold letters on a contrasting background.
- (k)(8)(C)** Labels shall be used in accordance with the requirements of Section 5194 (f) of the General Industry Safety Orders, and shall contain the following information:

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

- (k)(8)(D)** Labels shall contain a warning statement against breathing asbestos fibers.
- (k)(8)(E)** The provisions for labels required by subsections (k)(8)(A) through (k)(8)(C) do not apply where:
- (k)(8)(E)1.** Asbestos fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that, during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the permissible exposure limit and/or excursion limit will be released, or
- (k)(8)(E)2.** Asbestos is present in a waste product in concentrations less than 1.0 percent.



Note: Section 5194 of the General Industry Safety Orders requires that manufactured and imported products containing more than 0.1% asbestos by weight be labeled with an appropriate warning. The exemptions specified in subsection (k)(7)(E) only apply to waste products or waste containers.

- (k)(8)(F)** When a building owner/or employer identifies previously installed PACM and/or ACM, labels or signs shall be affixed or posted so that employees will be notified of what materials contain PACM and/or ACM. The employer shall attach such labels in areas where they will clearly be noticed by employees who are likely to be exposed, such as at the entrance to mechanical room/areas. Signs required by subsection (k)(6) of this section may be posted in lieu of labels so long as they contain information required for labeling. The employer shall ensure, to the extent feasible, that employees who come in contact with these signs or labels can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.
- (k)(9)** **Employee Information and Training.**
- (k)(9)(A)** The employer shall, at no cost to the employee, institute a training program for all employees who are likely to be exposed in excess of a PEL and for all employees who perform Class I through IV asbestos operations, and shall ensure their participation in the program.
- (k)(9)(B)** Training shall be provided prior to or at the time of initial assignment and at least annually thereafter. Employees engaged in asbestos-related work that requires employer registration under Section 341.6 or engaged in asbestos cement pipe operations as defined in subsection (r), shall be trained and certified by a Division approved training provider. To be approved by the Division, training providers shall:
- (k)(9)(B)(1)** apply to the Division for course approval and
- (k)(9)(B)(2)** pay fees covering the cost of the approval process to the Division as specified in regulations promulgated by the Division pursuant to the provisions of Chapter 3.5 (beginning with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code.
- (k)(9)(C)** Training for Class I operations and for Class II operations that require the use of critical barriers (or equivalent isolation methods) and/or negative pressure enclosures under this section shall be the equivalent in curriculum training method and length to the EPA Model Accreditation Plan (MAP) asbestos abatement workers training (40 CFR Part 763, Subpart E, Appendix C).
- (k)(9)(D)** **Training for Other Class II Work.**
- (k)(9)(D)1.** For work with asbestos containing material involving roofing materials, flooring materials, siding materials, ceiling tiles, or transite panels, training shall include at a minimum all the elements included in subsection (k)(9)(H) of this section and in addition, the specific work practices and engineering controls set forth in subsection (g) of this



section which specifically relate to that category. Such course shall include hands-on training and shall take at least 8 hours.

(k)(9)(D)2. An employee who works with more than one of the categories of material specified in subsection (k)(9)(D)1. of this section shall receive training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

(k)(9)(D)3. For Class II operations not involving the categories of material specified in subsection (k)(9)(D)1. of this section, training shall be provided which shall include at a minimum all the elements included in subsection (k)(9)(H) of this section and in addition, the specific work practices and engineering controls set forth in subsection (g) of this section which specifically relate to the category of material being removed, and shall include hands-on training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

(k)(9)(E) Training for Class III employees shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(2). Such a course shall also include hands-on training and shall take at least 16 hours.

Exception: For Class III operations for which the competent person determines that the EPA curriculum does not adequately cover the training needed to perform that activity, training shall include as a minimum all the elements included in subsection (k)(9)(H) of this section and in addition, the specific work practices and engineering controls set forth in subsection (g) of this section which specifically relate to that activity, and shall include hands-on training in the work practices applicable to each category of material that the employee disturbs.

(k)(9)(F) Training for employees performing Class IV operations shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(1). Such a course shall include available information concerning the locations of thermal system insulation and surfacing ACM/PACM, and asbestos-containing flooring material, or flooring material where the absence of asbestos has not yet been certified; and instruction in recognition of damage, deterioration, and delamination of asbestos containing building materials. Such course shall take at least 2 hours.

(k)(9)(G) Training for employees who are likely to be exposed in excess of the PEL and who are not otherwise required to be trained under subsections (k)(9)(C) through (F) of this section, shall meet the requirements of subsection (k)(9)(H) of this section.

(k)(9)(H) The training program shall be conducted in a manner that the employee is able to understand. In addition to the content required by



provisions in subsections (k)(9)(C) through (F) of this section, the employer shall ensure that each such employee is informed of the following:

- (k)(9)(H)1.** Methods of recognizing asbestos, including the requirement in subsection (k)(1) of this section to presume that certain building materials contain asbestos;
- (k)(9)(H)2.** The health effects associated with asbestos exposure;
- (k)(9)(H)3.** The relationship between smoking and asbestos in producing lung cancer;
- (k)(9)(H)4.** The nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures, and any necessary instruction in the use of these controls and procedures where Class III and IV work will be or is performed, the contents of EPA 20T-2003, "Managing Asbestos In-Place" July 1990 or its equivalent in content;
- (k)(9)(H)5.** The purpose, proper use, fitting instructions, and limitations of respirators as required by Section 5144;
- (k)(9)(H)6.** The appropriate work practices for performing the asbestos job;
- (k)(9)(H)7.** Medical surveillance program requirements;
- (k)(9)(H)8.** The content of this standard including appendices;
- (k)(9)(H)9.** The names, addresses and phone numbers of public health organizations which provide information, materials and/or conduct programs concerning smoking cessation. The employer may distribute the list of such organizations contained in Appendix J to this section, to comply with this requirement; and,
- (k)(9)(H)10.** The requirements for posting signs and affixing labels and the meaning of the required legends for such signs and labels.
- (k)(10) Access to Training Materials.**
- (k)(10)(A)** The employer shall make readily available to affected employees without cost, written materials relating to the employee training program, including a copy of this regulation.
- (k)(10)(B)** The employer shall provide to the Chief and the Director, upon request, all information and training materials relating to the employee information and training program.
- (k)(10)(C)** The employer shall inform all employees concerning the availability of self-help smoking cessation program material. Upon employee request, the employer shall distribute such material, consisting of NIH Publication No. 89-1647, or equivalent self-help material, which is approved or published by a public health organization listed in Appendix J to this section.

(l) Housekeeping.



- (l)(1) Vacuuming.** Where vacuuming methods are selected, HEPA filtered vacuuming equipment must be used. The equipment shall be used and emptied in a manner that minimizes the reentry of asbestos into the workplace.
- (l)(2) Waste Disposal.** Asbestos waste, scrap, debris, bags, containers, equipment, and contaminated clothing consigned for disposal shall be collected and disposed of in sealed, labeled, impermeable bags or other closed, labeled, impermeable containers except in roofing operations, where the procedures specified in subsection (g)(8)(B) of this section apply.
- (l)(3) Care of Asbestos-containing Flooring Material.**
- (l)(3)(A)** All vinyl and asphalt flooring material shall be maintained in accordance with this subsection unless the building/facility owner demonstrates, pursuant to subsection (g)(8)(A)9. of this section that the flooring does not contain asbestos.
- (l)(3)(B)** Sanding of flooring material is prohibited.
- (l)(3)(C)** Stripping of finishes shall be conducted using low abrasion pads at speeds lower than 300 rpm and wet methods.
- (l)(3)(D)** Burnishing or dry buffing may be performed only on flooring which has sufficient finish so that the pad cannot contact the flooring material.
- (l)(4)** Waste and debris and accompanying dust in an area containing accessible thermal system insulation or surfacing ACM/PACM or visibly deteriorated ACM:
- (l)(4)(A)** shall not be dusted or swept dry, or vacuumed without using a HEPA filter;
- (l)(4)(B)** shall be promptly cleaned up and disposed of in leak tight containers.
- (m) Medical Surveillance.**
- (m)(1) General**
- (m)(1)(A) Employees Covered.**
- (m)(1)(A)1.** The employer shall institute a medical surveillance program for all employees who, for a combined total of 30 or more days per year, are engaged in Class I, II and III work or are exposed at or above the permissible exposure limit. For purposes of this paragraph, any day in which a worker engages in Class II or Class III operations or a combination thereof on intact material for one hour or less (taking into account the entire time spent on the removal operation, including cleanup) and, while doing so, adheres fully to the work practices specified in this standard, shall not be counted.
- (m)(1)(A)2.** For employees otherwise required by this standard to wear a negative pressure respirator, employers shall ensure employees are physically able to perform the work and use the equipment. This determination shall be made under the supervision of a physician.
- (m)(1)(B) Examination.**
- (m)(1)(B)1.** The employer shall ensure that all medical examinations and



procedures are performed by or under the supervision of a licensed physician, and are provided at no cost to the employee and at a reasonable time and place.

- (m)(1)(B)2. Persons other than such licensed physicians who administer the pulmonary function testing required by this section shall complete a training course in spirometry sponsored by an appropriate academic or professional institution.

(m)(2) Medical Examinations and Consultations.

- (m)(2)(A) Frequency.** The employer shall make available medical examinations and consultations to each employee covered under subsection (m)(1)(A) of this section on the following schedules:

- (m)(2)(A)1. Prior to assignment of the employee to an area where negative pressure respirators are worn;

- (m)(2)(A)2. When the employee is assigned to an area where exposure to asbestos may be at or above the permissible exposure limit for 30 or more days per year, or engage in Class I, II, or III work for a combined total of 30 or more days per year, a medical examination must be given within 10 working days following the thirtieth day of exposure;

- (m)(2)(A)3. And at least annually thereafter.

- (m)(2)(A)4. If the examining physician determines that any of the examinations should be provided more frequently than specified, the employer shall provide such examinations to affected employees at the frequencies specified by the physician.

- (m)(2)(A)5. **Exception:** No medical examination is required of any employee if adequate records show that the employee has been examined in accordance with this subsection within the past 1 year period.

- (m)(2)(A)6. Employers shall provide a medical examination at the termination of employment for any employee who has been exposed to airborne concentrations of asbestos at or above the permissible exposure limit and/or excursion limit. The medical examination shall be given within 30 calendar days before or after the date of termination of employment.

- (m)(2)(B) Content.** Medical examinations made available pursuant to subsections (m)(2)(A)1. through (m)(2)(A)3. of this section shall include:

- (m)(2)(B)1. A medical and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems.

- (m)(2)(B)2. On initial examination, the standardized questionnaire contained in Part 1 of Appendix D to this section, and, on annual examination, the abbreviated standardized questionnaire contained in Part 2 of Appendix D to this section.

- (m)(2)(B)3. A physical examination directed to the pulmonary and gastrointestinal systems, including a chest roentgenogram to be administered in accordance with Table 2 below, and pulmonary function tests of forced



vital capacity (FVC) and forced expiratory volume at one second [FEV(1)]. Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E to this section.

**TABLE 2
FREQUENCY OF CHEST X-RAYS**

YEARS SINCE FIRST EXPOSURE	AGE OF EMPLOYEE	
	LESS THAN 40	40 AND OLDER
0-10	EVERY 3 YEARS	ANNUALLY*
10+	ANNUALLY*	ANNUALLY*

*Oblique x-rays need only be performed every 3 years.

- (m)(2)(B)4. Any other examinations or tests deemed necessary by the examining physician.
- (m)(3) **Information Provided to the Physician.** The employer shall provide the following information to the examining physician:
 - (m)(3)(A) A copy of this standard and Appendices D, E, and I to this section;
 - (m)(3)(B) A description of the affected employee's duties as they relate to the employee's exposure;
 - (m)(3)(C) The employee's representative exposure level or anticipated exposure level;
 - (m)(3)(D) A description of any personal protective and respiratory equipment used or to be used; and
 - (m)(3)(E) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.
- (m)(4) **Physician's Written Opinion.**
 - (m)(4)(A) The employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:
 - (m)(4)(A)1. The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos;
 - (m)(4)(A)2. Any recommended limitations on the employee or on the use of personal protective equipment such as respirators; and
 - (m)(4)(A)3. A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions that may result from asbestos exposure.
 - (m)(4)(A)4. A statement that the employee has been informed by the physician of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.
 - (m)(4)(B) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated



- to occupational exposure to asbestos.
- (m)(4)(C) The employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.
- (n) **Recordkeeping.**
- (n)(1) Objective data relied on pursuant to subsection (f) to this section.
- (n)(1)(A) Where the employer has relied on objective data that demonstrates that products made from or containing asbestos or the activity involving such products or material are not capable of releasing fibers of asbestos in concentrations at or above the permissible exposure limit and/or excursion limit under the expected conditions of processing, use, or handling to satisfy the requirements of subsection (f), the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.
- (n)(1)(B) The record shall include at least the following information:
- (n)(1)(B)1. The product qualifying for exemption;
- (n)(1)(B)2. The source of the objective data;
- (n)(1)(B)3. The testing protocol, results of testing, and/or analysis of the material for the release of asbestos;
- (n)(1)(B)4. A description of the operation exempted and how the data support the exemption; and
- (n)(1)(B)5. Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.
- (n)(1)(C) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.
- (n)(2) **Exposure Measurements.**
- (n)(2)(A) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos as prescribed in subsection (f) of this section.
- Note:** The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.
- (n)(2)(B) This record shall include at least the following information:
- (n)(2)(B)1. The date of measurement;
- (n)(2)(B)2. The operation involving exposure to asbestos that is being monitored;
- (n)(2)(B)3. Sampling and analytical methods used and evidence of their accuracy;
- (n)(2)(B)4. Number, duration, and results of samples taken;
- (n)(2)(B)5. Type of protective devices worn, if any; and
- (n)(2)(B)6. Name, social security number, and exposure of the employees whose exposures are represented.
- (n)(2)(C) The employer shall maintain this record for at least thirty (30) years, in accordance with Section 3204 of the General Industry Safety Orders.
- (n)(3) **Medical Surveillance.**
- (n)(3)(A) The employer shall establish and maintain an accurate record for each



employee subject to medical surveillance by subsection (m) of this section, in accordance with Section 3204 of the General Industry Safety Orders.

- (n)(3)(B) The record shall include at least the following information:

 - (n)(3)(B)1. The name and social security number of the employee;
 - (n)(3)(B)2. A copy of the employee's medical examination results, including the medical history, questionnaire responses, results of any tests, and physician's recommendations.
 - (n)(3)(B)3. Physician's written opinions;
 - (n)(3)(B)4. Any employee medical complaints related to exposure to asbestos; and
 - (n)(3)(B)5. A copy of the information provided to the physician as required by of this section.
- (n)(3)(C) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with Section 3204 of the General Industry Safety Orders.
- (n)(4) **Training Records.** The employer shall maintain all employee training records for one (1) year beyond the last date of employment by that employer.
- (n)(5) **Data to Rebut PACM.** Where the building owner and employer have relied on data to demonstrate that PACM is not asbestos-containing, such data shall be maintained for as long as they are relied upon to rebut the presumption.
- (n)(6) **Records of Required Notifications.** Where the building owner has communicated and received information concerning the identification, location and quantity of ACM and PACM, written records of such notifications and their content shall be maintained by the building owner for the duration of ownership and shall be transferred to successive owners of such buildings/facilities.
- (n)(7) **Availability.**

 - (n)(7)(A) The employer, upon written request, shall make all records required to be maintained by this section available to the Chief and the Director for examination and copying.
 - (n)(7)(B) The employer, upon request, shall make any exposure records required by subsections (f) and (n) of this section available for examination and copying to affected employees, former employees, designated representatives, and the Chief, in accordance with Section 3204 of the General Industry Safety Orders.
 - (n)(7)(C) The employer, upon request, shall make employee medical records required by subsections (m) and (n) of this section available for examination and copying to the subject employee, anyone having the specific written consent of the subject employee, and the Chief, in accordance with Section 3204 of the General Industry Safety Orders.
- (n)(8) **Transfer of Records.**

 - (n)(8)(A) The employer shall comply with the requirements concerning transfer of records set forth in Section 3204 of the General Industry Safety



Orders.

- (n)(8)(B)** Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the Director at least 90 days prior to disposal and, upon request, transmit them to the Director.

(o) Competent Person.

- (o)(1) General.** On all construction worksites covered by this standard, the employer shall designate a competent person, having the qualifications and authorities for ensuring worker safety and health required by Sections 1509, 1510, 1512, 1513, 1514, 1523, and 1920 of these orders.

- (o)(2) Required Inspections by the Competent Person.** Section 1509(a) of these orders, which requires health and safety prevention programs to provide for frequent and regular inspections of the job sites, materials, and equipment to be made by competent persons, is incorporated.

- (o)(3) Additional Inspections.** In addition, the competent person shall make frequent and regular inspections of the job sites, in order to perform the duties set out below in subsection (o)(3)(A). For Class I jobs, on-site inspections shall be made at least once during each work shift, and at any time at employee request. For Class II, III, and IV jobs, on-site inspections shall be made at intervals sufficient to assess whether conditions have changed, and at any reasonable time at employee request.

- (o)(3)(A)** On all worksites where employees are engaged in Class I or II asbestos work, the competent person designated in accordance with subsection (e)(6) of this section shall perform or supervise the following duties, as applicable:

- (o)(3)(A)1.** Set up the regulated area, enclosure, or other containment;
- (o)(3)(A)2.** Ensure (by on-site inspection) the integrity of the enclosure or containment;
- (o)(3)(A)3.** Set up procedures to control entry to and exit from the enclosure and/or area;
- (o)(3)(A)4.** Supervise all employee exposure monitoring required by this section and ensure that it is conducted as required by subsection (f) of this section;
- (o)(3)(A)5.** Ensure that employees working within the enclosure and/or using glove bags wear respirators and protective clothing as required by subsections (h) and (i) of this section;
- (o)(3)(A)6.** Ensure through on-site supervision, that employees set up, use, and remove engineering controls, use work practices and personal protective equipment in compliance with all requirements;
- (o)(3)(A)7.** Ensure that employees use the hygiene facilities and observe the decontamination procedures specified in subsection (j) of this section;
- (o)(3)(A)8.** Ensure that, through on-site inspection, engineering controls are functioning properly and employees are using proper work practices;



and,

(o)(3)(A)9. Ensure that notification requirement in subsection (k) of this section are met.

(o)(4) Training for the Competent Person.

(o)(4)(A) For Class I and II asbestos work the competent person shall be trained in all aspects of asbestos removal and handling, including: abatement, installation, removal and handling; the contents of this standard; the identification of asbestos; removal procedures, where appropriate; and other practices for reducing the hazard. Such training shall be obtained in a comprehensive course for supervisors, that meets the criteria of EPA's Model Accredited Plan (40 CFR Part 763, Subpart E. Appendix C), such as a course conducted by an EPA-approved or state approved training provider, certified by EPA or a state, or a course equivalent in stringency, content and length.

(o)(4)(B) For Class III and IV asbestos work, the competent person shall be trained in aspects of asbestos handling appropriate for the nature of the work, to include procedures for setting up glove bags and mini-enclosures, practices for reducing asbestos exposures, use of wet methods, the contents of this standard, and the identification of asbestos. Such training shall include successful completion of a course that is consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(2), or its equivalent in stringency, content, and length. Competent persons for Class III and IV work, may also be trained pursuant to the requirements of subsection (o)(4)(A) of this section.

(p) Appendices.

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

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

(q) Certified Asbestos Consultants and Certified Site Surveillance Technicians.

(q)(1) The following definitions are applicable to subsection (q) only: Asbestos consultant means any person who contracts to provide professional health and safety services relating to asbestos- containing construction material as defined in this subsection, which comprises 100 square feet or more of surface area. The activities of an asbestos consultant include building inspection, abatement project design, contract administration, sample collection, preparation of asbestos management plans, clearance monitoring, and supervision of site surveillance technicians as defined in this subsection.



Asbestos-containing Construction Material means any manufactured construction material which contains more than one tenth of 1 percent asbestos by weight.

Certified Asbestos Consultant means any asbestos consultant certified by the Division pursuant to this section.

Certified Site Surveillance Technician means any surveillance technician certified by the Division pursuant to the section.

Division means the Division of Occupational Safety and Health of the California Department of Industrial Relations.

Site Surveillance Technician means any person who acts as an independent on-site representative of an asbestos consultant. The site surveillance technician monitors the asbestos abatement activities of others, provides asbestos air monitoring services for area and personal samples, and performs building surveys and contract administration at the direction of an asbestos consultant.

State-of-the-art means all asbestos abatement and control work procedures currently in use which have been demonstrated to be the most effective, reliable, and protective of workers health. As new procedures are developed which demonstrate greater effectiveness, reliability, and worker protection and thereby come into use, they become state-of-the-art.

(q)(2) Certified Asbestos Consultant Criteria. To obtain certification, an asbestos consultant must apply to the Division and complete all application requirements specified in Section 341.15. In order to qualify as an asbestos consultant, the applicant must meet all of the following requirements:

(q)(2)(A) Achievement of a passing score as determined by the Division on an examination approved or administered by the Division including, but not limited to, the following subjects:

(q)(2)(A)1. The physical characteristics of asbestos;

(q)(2)(A)2. The health effects of asbestos;

(q)(2)(A)3. The regulatory requirements of the Division, the Federal Occupational Safety and Health Administration, the U.S. Environmental Protection Agency, air quality management districts, and the Department of Health Services, including protective clothing, respiratory protection, exposure limits, personal hygiene, medical monitoring, disposal, and general industry safety hazards;

(q)(2)(A)4. State-of-the-art asbestos abatement and control work procedures;

(q)(2)(A)5. Federal Asbestos Hazard Emergency Response Act training



- information and procedures for inspectors, management planners, and supervisors, as provided for under Subchapter II (commencing with Section 2641) of Chapter 53 of Title 15 of the United States Code, or the equivalent, as determined by the Division; and
- (q)(2)(A)6.** Information concerning industrial hygiene sampling methodology, including asbestos sampling and analysis techniques and recordkeeping.
- (q)(2)(B)** Providing such documentation and other information as the Division shall require to substantiate:
- (q)(2)(B)1.** The possession of a valid and appropriate federal Asbestos Hazard Emergency Response Act [Subchapter II (commencing with Section 2641) of Chapter 53 of Title 15 of the United States Code] certificate, or its equivalent, as determined by the Division; and
- (q)(2)(B)2.** Any one of the following combinations of education and experience:
- (q)(2)(B)2.A.** One year of asbestos-related experience and a bachelor of science degree in engineering, architecture, industrial hygiene, construction management, or a related biological or physical science;
- (q)(2)(B)2.B.** Two years of asbestos-related experience and a bachelor's degree;
- (q)(2)(B)2.C.** Three years of asbestos-related experience and an associate of arts degree in engineering, architecture, industrial hygiene, construction management, or a related biological or physical science; or
- (q)(2)(B)2.D.** Four years of asbestos-related experience and a high school diploma or its equivalent.
- (q)(3)** **Certified Site Surveillance Technician Criteria.** To obtain certification, a site surveillance technician must apply to the Division and complete all application requirements specified in Section 341.15. In order to qualify as a site surveillance technician, the applicant must meet all of the following requirements:
- (q)(3)(A)** Achievement of a passing score as determined by the Division on an examination approved or administered by the Division including, but not limited to, the following subjects:
- (q)(3)(A)1.** The physical characteristics of asbestos;
- (q)(3)(A)2.** The health effects of asbestos;
- (q)(3)(A)3.** The regulatory requirements of the Division, the Federal Occupational Safety and Health Administration, the U.S. Environmental Protection Agency, air quality management districts, and the Department of Health Services, including protective clothing, respiratory protection, exposure limits,



personal hygiene, medical monitoring, disposal, and general industry safety hazards;

(q)(3)(A)4. State-of-the-art asbestos abatement and control work procedures.

(q)(3)(A)5. Information concerning industrial hygiene sampling methodology, including sampling techniques and recordkeeping.

(q)(3)(B) Providing such documentation and other information as the Division shall require to substantiate all of the following:

(q)(3)(B)1. Possession of a valid federal Asbestos Hazard Emergency Response Act [Subchapter II (commencing with Section 2641) of Chapter 53 of Title 15 of the United States Code] certificate for the type of work being performed, or its equivalent, as determined by the Division.

(q)(3)(B)2. Six (6) months of asbestos-related experience under the supervision of an asbestos consultant.

(q)(3)(B)3. Possession of a high school diploma or equivalent.

(q)(4) No employer shall engage the services of an asbestos consultant or site surveillance technician unless that person provides proof of certification by the Division.

(r) **Report of Use and Asbestos-related Work Registration.**

(r)(1) The following definitions are applicable to subsection (r) only:

Asbestos-containing Construction Material means any manufactured construction material which contains more than one tenth of 1 percent asbestos by weight.

Asbestos-related Work means any activity which by disturbing asbestos-containing construction materials may release asbestos fibers into the air and which is not related to its manufacture, the mining or excavation of asbestos-bearing ore or materials, or the installation or repair of automotive materials containing asbestos. Asbestos-related work does not include the installation, repair, maintenance, or nondestructive removal of asbestos cement pipe used outside of buildings if the work operations do not result in employee exposures to asbestos in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8-hour time-weighted average and the employees and supervisors involved in the work operations are trained and certified by an asbestos cement pipe training program which is approved by the Division.

(r)(2) **Report of Use.** See section 5203.

Note: Employers registered with the Chief in accordance with Sections 341.6 to 341.9 for the purpose of conducting asbestos-related work involving over 100 square feet, as defined in Section 341.6(a), of asbestos-containing construction material shall be deemed to be in compliance with section 5203 for the asbestos-related work requiring



registration. Except that emergencies as defined in section 5203(a) must be reported as required in section 5203(f).

Exception: An employer need not register all the materials containing asbestos if objective data demonstrates that during all reasonably foreseeable uses, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the permissible exposure limit and/or excursion limit will be released. The objective data shall include at least those elements specified in subsection (n)(1) of this section.

NOTE: Authority cited: Sections 142.3, 6501.5, 9020, 9021.5, 9021.9, 9030 and 9040, Labor Code. Reference: Sections 142.3, 6501.5, 6501.7, 6501.8, 6501.9, 6502, 9003, 9004(b), 9005, 9006, 9009, 9020, 9021.5, 9021.9, 9030 and 9040, Labor Code; Section 25910, Health and Safety Code; and Sections 7180, 7180.5, 7181, 7182, 7183, 7183.5, 7184, 7185, 7187, 7189, 7189.5 and 7189.7, Business and Professions Code.

HISTORY

1. New section filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment of subsection (b) and NOTE and adoption of subsections (o)(6)-(o)(8) and (t) filed 1-21-92 as an emergency; operative 2-20-92 (Register 92, No. 13).
4. Change without regulatory effect amending definition of chief in subsection (b) filed 3-4-92 pursuant to section 100, title 1, California Code of Regulations (Register 92, No. 19).
5. Amendment of subsection (c)(1) filed 5-1-95; operative 5-31-95 (Register 95, No. 18).
6. Editorial correction of subsection (b) (Register 95, No. 41).
7. Change without regulatory effect deleting duplicate Certified supervisor definition filed 12-21-95 pursuant to section 100, title 1, California Code of Regulations (Register 95, No. 51).
8. Repealer and new section filed 5-3-96; operative 7-3-96 (Register 96, No. 18).
9. Amendment of subsections (k)(9)(B), (q)(2)-(3) and (r)(1) definition of Asbestos-related work, and amendment of Note filed 2-5-97; operative 3-7-97 (Register 97, No. 6).
10. New subsection (h)(2)(F), amendment of subsections (k)(6), (k)(8)(F) and (k)(9)(C)-(k)(9)(D)1., new (k)(9)(D)2.-3. and amendment of subsections (k)(9)(E) and (m)(1)(A)1. filed 10-3-97; operative 10-3-97. Submitted to OAL for printing only pursuant to Labor Code section 142.3(a)(3) (Register 97, No. 40).
11. Amendment of former subsections (h)(1)-(h)(4)(B) including subsection renumbering and relettering resulting in newly designated subsections (h)(1)-(h)(3)(D)3. filed 8-25-98; operative 11-23-98 (Register 98, No. 35).



12. Amendment of subsections (r)-(r)(2), repealer of subsection (r)(2)(A), Note 1. and Note 2. designator, amendment of former Note 2., and repealer of subsections (r)(2)(B)-(r)(2)(B)1. and (r)(2)(B)2.-(r)(5) filed 7-6-99; operative 8-5-99 (Register 99, No. 28).
13. Change without regulatory effect amending subsections (h)(3)(D)2.-3. filed 12-20-99 pursuant to section 100, title 1, California Code of Regulations (Register 99, No. 52).

Subchapter 4. Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases
§1529. Asbestos, Appendix A
OSHA Reference Method
Mandatory

This mandatory appendix specifies the procedure for analyzing air samples for asbestos and specifies quality control procedures that must be implemented by laboratories performing the analysis. The sampling and analytical methods described below represent the elements of the available monitoring methods (such as appendix B to this section, the most current version of the OSHA method ID-60, or the most current version of the NIOSH 7400 method) which OSHA considers to be essential to achieve adequate employee exposure monitoring while allowing employers to use methods that are already established within their organizations. All employers who are required to conduct air monitoring under subsection (f) of this section are required to utilize analytical laboratories that use this procedure, or an equivalent method, for collecting and analyzing samples.

Sampling and Analytical Procedure

1. The sampling medium for air samples shall be mixed cellulose ester filter membranes. These shall be designated by the manufacturer as suitable for asbestos counting. See below for rejection of blanks.
2. The preferred collection device shall be the 25-mm diameter cassette with an open-faced 50-mm extension cowl. The 37-mm cassette may be used if necessary but only if written justification for the need to use the 37-mm filter cassette accompanies the sample results in the employee's exposure monitoring record. Do not reuse or reload cassettes for asbestos sample collection.
3. An air flow rate between 0.5 liter/min and 2.5 liters/min shall be selected for the 25-mm cassette. If the 37-mm cassette is used, an air flow rate between 1 liter/min and 2.5 liters/min shall be selected.
4. Where possible, a sufficient air volume for each air sample shall be collected to yield between 100 and 1,300 fibers per square millimeter on the membrane filter. If a filter darkens in appearance or if loose dust is seen on the filter, a



- second sample shall be started.
5. Ship the samples in a rigid container with sufficient packing material to prevent dislodging the collected fibers. Packing material that has a high electrostatic charge on its surface (e.g., expanded polystyrene) cannot be used because such material can cause loss of fibers to the sides of the cassette.
 6. Calibrate each personal sampling pump before and after use with a representative filter cassette installed between the pump and the calibration devices.
 7. Personal samples shall be taken in the "breathing zone" of the employee (i.e., attached to or near the collar or lapel near the worker's face).
 8. Fiber counts shall be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.
 9. The microscope shall be fitted with a Walton-Beckett eyepiece graticule calibrated for a field diameter of 100 micrometers (+/- 2 micrometers).
 10. The phase-shift detection limit of the microscope shall be about 3 degrees measured using the HSE phase shift test slide as outlined below.
 - 10.a. Place the test slide on the microscope stage and center it under the phase objective.
 - 10.b. Bring the blocks of grooved lines into focus.

Note: The slide consists of seven sets of grooved lines (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7, seven being the least visible. The requirements for asbestos counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 and 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos.
 - 10.c. If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.
 11. Each set of samples taken will include 10% field blanks or a minimum of 2 field blanks. These blanks must come from the same lot as the filters used for sample collection. The field blank results shall be averaged and subtracted from the analytical results before reporting. A set consists of any sample or group of samples for which an evaluation for this standard must be made. Any samples represented by a field blank having a fiber count in excess of the detection limit of the method being used shall be rejected.
 12. The samples shall be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.
 13. Observe the following counting rules.
 - 13.a. Count only fibers equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.
 - 13.b. Count all particles as asbestos that have a length-to-width ratio (aspect ratio)



- of 3:1 or greater.
- 13.c. Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle, shall receive the count of one half (1/2). Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.
 - 13.d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.
 - 13.e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.
 - 14. Blind recounts shall be conducted at the rate of 10 percent.

Quality Control Procedures

- 1. **Intra-laboratory Program.** Each laboratory and/or each company with more than one microscopist counting slides shall establish a statistically designed quality assurance program involving blind recounts and comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In a company with more than one laboratory, the program shall include all laboratories and shall also evaluate the laboratory-to-laboratory variability.
- 2. a. **Inter-laboratory Program.** Each laboratory analyzing asbestos samples for compliance determination shall implement an inter-laboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory shall participate in round robin testing at least once every 6 months with at least all the other laboratories in its inter-laboratory quality assurance group. Each laboratory shall submit slides typical of its own work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.
- 2.b. All laboratories should participate in a national sample testing scheme such as the Proficiency Analytical Testing Program (PAT), the Asbestos Registry sponsored by the American Industrial Hygiene Association (AIHA).
- 3. All individuals performing asbestos analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos dust or an equivalent course.
- 4. When the use of different microscopes contributes to differences between counters and laboratories, the effect of the different microscopes shall be evaluated and the microscopes shall be replaced, as necessary.
- 5. Current results of these quality assurance programs shall be posted in each laboratory to keep the microscopists informed.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.



HISTORY

1. New Appendix A to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment filed 5-3-96; operative 7-3-96 (Register 96, No. 18).

Subchapter 4. Construction Safety Orders

Article 4. Dusts, Fumes, Mists, Vapors, and Gases

§1529. Asbestos, Appendix B

Sampling and Analysis (Non-mandatory)

Matrix Air: OSHA Permissible Exposure Limits:

Time Weighted Average..... 0.1 fiber/cc
Excursion Level (30 minutes) 1.0 fiber/cc

Collection Procedure: A known volume of air is drawn through a 25-mm diameter cassette containing a mixed-cellulose ester filter. The cassette must be equipped with an electrically conductive 50-mm extension cowl. The sampling time and rate are chosen to give a fiber density of between 100 to 1,300 fibers/mm² on the filter.

Recommended Sampling Rate..... 0.5 to 5.0 liters/minute (L/min)

Recommended Air Volumes:

Minimum 25 L
Maximum 2,400 L

Analytical Procedure: A portion of the sample filter is cleared and prepared for asbestos fiber counting by Phase Contrast Microscopy (PCM) at 400X. Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by USDOL-OSHA. Similar products from other sources can be substituted.

1. **Introduction:** This method describes the collection of airborne asbestos fibers using calibrated sampling pumps with mixed-cellulose ester (MCE) filters and analysis by phase contrast microscopy (PCM). Some terms used are unique to this method and are defined below: Asbestos: A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, crocidolite, amosite (cummingtonite-grunerite asbestos), tremolite asbestos, actinolite asbestos, anthophyllite asbestos, and any of these minerals that have been chemically treated and/or altered. The precise chemical formulation of each



species will vary with the location from which it was mined. Nominal compositions are listed:

Chrysotile..... $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$
Crocidolite..... $\text{Na}_2\text{Fe}_3\text{Fe}_{23}\text{Si}_8\text{O}_{22}(\text{OH})_2$
Amosite..... $(\text{Mg},\text{Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$
Tremolite-actinolite..... $\text{Ca}_2(\text{Mg},\text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$
Anthophyllite..... $(\text{Mg},\text{Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$

Asbestos Fiber: A fiber of asbestos which meets the criteria specified below for a fiber.

Aspect Ratio: The ratio of the length of a fiber to its diameter (e.g. 3:1, 5:1 aspect ratios).

Cleavage Fragments: Mineral particles formed by combination of minerals, especially those characterized by parallel sides and a moderate aspect ratio (usually less than 20:1).

Detection Limit: The number of fibers necessary to be 95% certain that the result is greater than zero.

Differential Counting: The term applied to the practice of excluding certain kinds of fibers from the fiber count because they do not appear to be asbestos.

Fiber: A particle that is 5 μm or longer, with a length-to-width ratio of 3 to 1 or longer.

Field: The area within the graticule circle that is superimposed on the microscope image.

Set: The samples which are taken, submitted to the laboratory, analyzed, and for which, interim or final result reports are generated.

Tremolite, Anthophyllite, and Actinolite: The non-asbestos form of these minerals which meet the definition of a fiber. It includes any of these minerals that have been chemically treated and/or altered.

Walton-Beckett Graticule: An eyepiece graticule specifically designed for asbestos fiber counting. It consists of a circle with a projected diameter of 100 plus or minus 2 μm (area of about 0.00785 mm^2) with a crosshair having tick marks at 3 μm intervals in one direction and 5 μm in the orthogonal direction. There are marks around the periphery of the circle to demonstrate the proper sizes and shapes of fibers. This design is reproduced in Figure 1. of this appendix. The disk is placed in one of the microscope eyepieces so that the design is superimposed on the field of view.



- 1.1. **History:** Early surveys to determine asbestos exposures were conducted using impinger counts of total dust with the counts expressed as million particles per cubic foot. The British Asbestos Research Council recommended filter membrane counting in 1969. In July 1969, the Bureau of Occupational Safety and Health published a filter membrane method for counting asbestos fibers in the United States. This method was refined by NIOSH and published as P & CAM 239. On May 29, 1971, OSHA specified filter membrane sampling with phase contrast counting for evaluation of asbestos exposures at work sites in the United States. The use of this technique was again required by OSHA in 1986. Phase contrast microscopy has continued to be the method of choice for the measurement of occupational exposure to asbestos.
- 1.2. **Principle:** Air is drawn through a MCE filter to capture airborne asbestos fibers. A wedge shaped portion of the filter is removed, placed on a glass microscope slide and made transparent. A measured area (field) is viewed by PCM. All the fibers meeting defined criteria for asbestos are counted and considered a measure of the airborne asbestos concentration.
- 1.3. **Advantages and Disadvantages:** There are four main advantages of PCM over other methods:
 - 1.3.(1) The technique is specific for fibers. Phase contrast is a fiber counting technique which excludes non-fibrous particles from the analysis.
 - 1.3.(2) The technique is inexpensive and does not require specialized knowledge to carry out the analysis for total fiber counts.
 - 1.3.(3) The analysis is quick and can be performed on-site for rapid determination of air concentrations of asbestos fibers.
 - 1.3.(4) The technique has continuity with historical epidemiological estimates of expected disease can be inferred from long-term determinations of asbestos exposures. The main disadvantage of PCM is that it does not positively identify asbestos fibers. Other fibers which are not asbestos may be included in the count unless differential counting is performed. This requires a great deal of experience to adequately differentiate asbestos from non-asbestos fibers. Positive identification of asbestos must be performed by polarized light or electron microscopy techniques. A further disadvantage of PCM is that the smallest visible fibers are about 0.2 μ m in diameter while the finest asbestos fibers may be as small as 0.02 μ m in diameter. For some exposures, substantially more fibers may be present than are actually counted.
- 1.4. **Workplace Exposure:** Asbestos is used by the construction industry in such products as shingles, floor tiles, asbestos cement, roofing felts, insulation and acoustical products. Non-construction uses include brakes, clutch facings, paper, paints, plastics, and fabrics. One of the most significant exposures in the workplace is the removal and encapsulation of asbestos in schools, public buildings, and homes.



Many workers have the potential to be exposed to asbestos during these operations. About 95% of the asbestos in commercial use in the United States is chrysotile. Crocidolite and amosite make up most of the remainder. Anthophyllite and tremolite or actinolite are likely to be encountered as contaminants in various industrial products.

- 1.5. **Physical Properties:** Asbestos fiber possesses a high tensile strength along its axis, is chemically inert, non-combustible, and heat resistant. It has a high electrical resistance and good sound absorbing properties. It can be woven into cables, fabrics or other textiles, and also matted into asbestos papers, felts, or mats.

2. **Range and Detection Limit**

- 2.1. The ideal counting range on the filter is 100 to 1,300 fibers/mm². With a Walton-Beckett graticule this range is equivalent to 0.8 to 10 fibers/field. Using NIOSH counting statistics, a count of 0.8 fibers/field would give an approximate coefficient of variation (CV) of 0.13.
- 2.2. The detection limit for this method is 4.0 fibers per 100 fields or 5.5 fibers/mm². This was determined using an equation to estimate the maximum CV possible at a specific concentration (95% confidence) and a Lower Control Limit of zero. The CV value was then used to determine a corresponding concentration from historical CV vs fiber relationships.

As an example:

Lower Control Limit (95% Confidence) = $AC - 1.645(CV)(AC)$

Where: AC = Estimate of the airborne fiber concentration (fibers/cc)

Setting the Lower Control Limit = 0 and solving for CV:

$$0 = AC - 1.645(CV)(AC) \quad CV = 0.61$$

This value was compared with CV vs. count curves. The count at which CV = 0.61 for Leidel-Busch counting statistics or for an OSHA Salt Lake Technical Center (OSHA-SLTC) CV curve (see Appendix A for further information) was 4.4 fibers or 3.9 fibers per 100 fields, respectively.

Although a lower detection limit of 4 fibers per 100 fields is supported by the OSHA-SLTC data, both data sets support the 4.5 fibers per 100 fields value.

3. **Method Performance - Precision and Accuracy** - Precision is dependent upon the total number of fibers counted and the uniformity of the fiber distribution on the filter. A general rule is to count at least 20 and not more than 100 fields. The count is discontinued when 100 fibers are counted, provided that 20 fields have already been counted. Counting more than 100 fibers results in only a small gain in precision. As the total count drops below 10 fibers, an accelerated loss of precision is noted. At this time, there is no known method to determine the absolute accuracy of the asbestos analysis. Results of samples prepared through the Proficiency Analytical Testing (PAT) Program and analyzed by the OSHA-SLTC showed no significant bias when compared to PAT reference values. The PAT samples were analyzed from 1987 to 1989 (N=36) and the concentration range was from 120 to 1,300 fibers/mm².

4. **Interferences** - Fibrous substances, if present, may interfere with asbestos



analysis. Some common fibers are:

fiberglass	anhydrite	plant fibers
perlite veins	gypsum	some synthetic fibers
membrane structures	sponge spicules	diatoms
micro-organisms	wollastonite	

The use of electron microscopy or optical tests such as polarized light, and dispersion staining may be used to differentiate these materials from asbestos when necessary.

5. Sampling

5.1. Equipment

5.1.1. Sample Assembly. Conductive filter holder consisting of a 25-mm diameter, 3-piece cassette having a 50-mm long electrically conductive extension cowl, Backup pad, 25-mm, cellulose. Membrane filter, mixed-cellulose ester (MCE), 25-mm, plain, white, 0.4- to 1.2 μ m pore size.

- Notes:**
- (a) DO NOT RE-USE CASSETTES.
 - (b) Fully conductive cassettes are required to reduce fiber loss to the sides of the cassette due to electrostatic attraction.
 - (c) Purchase filters which have been selected by the manufacturer for asbestos counting or analyze representative filters for fiber background before use. Discard the filter lot if more than 4 fibers/100 fields are found.
 - (d) To decrease the possibility of contamination, the sampling system (filter-backup pad-cassette) for asbestos is usually preassembled by the manufacturer.
 - (e) Other cassettes, such as the Bell-mouth, may be used within the limits of their validation.

5.1.2. Gel bands for sealing cassettes.

5.1.3. Sampling Pump. Each pump must be a battery operated, self-contained unit small enough to be placed on the monitored employee and not interfere with the work being performed. The pump must be capable of sampling at the collection rate for the required sampling time.

5.1.4. Flexible tubing, 6-mm bore.

5.1.5. Pump Calibration. Stopwatch and bubble tube/burette or electronic meter.

5.2. Sampling Procedure

5.2.1. Seal the point where the base and cowl of each cassette meet with a gel band or tape.

5.2.2. Charge the pumps completely before beginning.

5.2.3. Connect each pump to a calibration cassette with an appropriate length of 6-mm bore plastic tubing. Do not use luer connectors -- the type of cassette specified above has built-in adapters.

5.2.4. Select an appropriate flow rate for the situation being monitored. The sampling flow rate must be between 0.5 and 5.0 L/min for personal sampling and is commonly set between 1 and 2 L/min. Always choose a flow rate that will not produce overloaded filters.

5.2.5. Calibrate each sampling pump before and after sampling with a calibration



cassette in-line (Note: This calibration cassette should be from the same lot of cassettes used for sampling). Use a primary standard (e.g. bubble burette) to calibrate each pump. If possible, calibrate at the sampling site. If sampling site calibration is not possible, environmental influences may affect the flow rate. The extent is dependent on the type of pump used. Consult with the pump manufacturer to determine dependence on environmental influences. If the pump is affected by temperature and pressure changes, correct the flow rate using the formula shown in the section "Sampling Pump Flow Rate Corrections" at the end of this appendix.

- 5.2.6. Connect each pump to the base of each sampling cassette with flexible tubing. Remove the end cap of each cassette and take each air sample open face. Assure that each sample cassette is held open side down in the employee's breathing zone during sampling. The distance from the nose/mouth of the employee to the cassette should be about 10 cm. Secure the cassette on the collar or lapel of the employee using spring clips or other similar devices.
- 5.2.7. A suggested minimum air volume when sampling to determine TWA compliance is 25 L. For Excursion Limit (30 min sampling time) evaluations, a minimum air volume of 48 L is recommended.
- 5.2.8. The most significant problem when sampling for asbestos is overloading the filter with non-asbestos dust. Suggested maximum air sample volumes for specific environments are:
 - Environment Air Vol. (L)
 - Asbestos removal operations (visible dust) 100.
 - Asbestos removal operations (little dust) 240.
 - Office environments. 400 to 2,400.

CAUTION: Do not overload the filter with dust. High levels of non- fibrous dust particles may obscure fibers on the filter and lower the count or make counting impossible. If more than about 25 to 30% of the field area is obscured with dust, the result may be biased low. Smaller air volumes may be necessary when there is excessive non-asbestos dust in the air. While sampling, observe the filter with a small flashlight. If there is a visible layer of dust on the filter, stop sampling, remove and seal the cassette, and replace with a new sampling assembly. The total dust loading should not exceed 1 mg.

- 5.2.9. Blank samples are used to determine if any contamination has occurred during sample handling. Prepare two blanks for the first 1 to 20 samples. For sets containing greater than 20 samples, prepare blanks as 10% of the samples. Handle blank samples in the same manner as air samples with one exception: Do not draw any air through the blank samples. Open the blank cassette in the place where the sample cassettes are mounted on the employee. Hold it open for about 30 seconds. Close and seal the cassette appropriately. Store blanks for shipment with the sample cassettes.
- 5.2.10. Immediately after sampling, close and seal each cassette with the base and plastic plugs. Do not touch or puncture the filter membrane as this will



invalidate the analysis.

- 5.2.11. Attach and secure a sample seal around each sample cassette in such a way as to assure that the end cap and base plugs cannot be removed without destroying the seal. Tape the ends of the seal together since the seal is not long enough to be wrapped end-to-end. Also wrap tape around the cassette at each joint to keep the seal secure.

5.3. **Sample Shipment**

- 5.3.1. Send the samples to the laboratory with paperwork requesting asbestos analysis. List any known fibrous interferences present during sampling on the paperwork. Also, note the workplace operation(s) sampled.
- 5.3.2. Secure and handle the samples in such that they will not rattle during shipment nor be exposed to static electricity. Do not ship samples in expanded polystyrene peanuts, vermiculite, paper shreds, or excelsior. Tape sample cassettes to sheet bubbles and place in a container that will cushion the samples in such a manner that they will not rattle.
- 5.3.3. To avoid the possibility of sample contamination, always ship bulk samples in separate mailing containers.

6. **Analysis**

6.1. **Safety Precautions**

- 6.1.1. Acetone is extremely flammable and precautions must be taken not to ignite it. Avoid using large containers or quantities of acetone. Transfer the solvent in a ventilated laboratory hood. Do not use acetone near any open flame. For generation of acetone vapor, use a spark free heat source.
- 6.1.2. Any asbestos spills should be cleaned up immediately to prevent dispersal of fibers. Prudence should be exercised to avoid contamination of laboratory facilities or exposure of personnel to asbestos. Asbestos spills should be cleaned up with wet methods and/or a High Efficiency Particulate Air (HEPA) filtered vacuum.
CAUTION: Do not use a vacuum without a HEPA filter -- It will disperse fine asbestos fibers in the air.

6.2. **Equipment**

- 6.2.1. Phase contrast microscope with binocular or trinocular head.
- 6.2.2. Widefield or Huygenian 10X eyepieces (NOTE: The eyepiece containing the graticule must be a focusing eyepiece. Use a 40X phase objective with a numerical aperture of 0.65 to 0.75).
- 6.2.3. Kohler illumination (if possible) with green or blue filter.
- 6.2.4. Walton-Beckett Graticule, type G-22 with 100 plus or minus 2µm projected diameter.
- 6.2.5. Mechanical stage. A rotating mechanical stage is convenient for use with polarized light.
- 6.2.6. Phase telescope.
- 6.2.7. Stage micrometer with 0.01-mm subdivisions.
- 6.2.8. Phase-shift test slide, mark II (Available from PTR optics Ltd., and



also McCrone).

6.2.9. Precleaned glass slides, 25 mm X 75 mm. One end can be frosted for convenience in writing sample numbers, etc., or paste-on labels can be used.

6.2.10. Cover glass #1 1/2.

6.2.11. Scalpel (#10, curved blade).

6.2.12. Fine tipped forceps.

6.2.13. Aluminum block for clearing filter (see **Appendix D**).

6.2.14. Automatic adjustable pipette, 100-to 500- μ L.

6.2.15. Micropipette, 5 μ L.

6.3. Reagents

6.3.1. Acetone (HPLC grade).

6.3.2. Triacetin (glycerol triacetate).

6.3.3. Lacquer or nail polish.

6.4. **Standard Preparation:** A way to prepare standard asbestos samples of known concentration has not been developed. It is possible to prepare replicate samples of nearly equal concentration. This has been performed through the PAT program. These asbestos samples are distributed by the AIHA to participating laboratories. Since only about one-fourth of a 25-mm sample membrane is required for an asbestos count, any PAT sample can serve as a "standard" for replicate counting.

6.5. **Sample Mounting:** See Safety Precautions in Section 6.1. before proceeding. The objective is to produce samples with a smooth (non-grainy) background in a medium with a refractive index of approximately 1.46. The technique below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison. An aluminum block or similar device is required for sample preparation.

6.5.1. Heat the aluminum block to about 70 deg.C. The hot block should not be used on any surface that can be damaged by either the heat or from exposure to acetone.

6.5.2. Ensure that the glass slides and cover glasses are free of dust and fibers.

6.5.3. Remove the top plug to prevent a vacuum when the cassette is opened. Clean the outside of the cassette if necessary. Cut the seal and/or tape on the cassette with a razor blade. Very carefully separate the base from the extension cowl, leaving the filter and backup pad in the base.

6.5.4. With a rocking motion cut a triangular wedge from the filter using the scalpel. This wedge should be one-sixth to one-fourth of the filter. Grasp the filter wedge with the forceps on the perimeter of the filter which was clamped between the cassette pieces. DO NOT TOUCH the filter with your finger. Place the filter on the glass slide sample side up. Static electricity will usually keep the filter on the slide until it is cleared.



- 6.5.5. Place the tip of the micropipette containing about 200 μL acetone into the aluminum block. Insert the glass slide into the receiving slot in the aluminum block. Inject the acetone into the block with slow, steady pressure on the plunger while holding the pipette firmly in place. Wait 3 to 5 seconds for the filter to clear, then remove the pipette and slide from the aluminum block.
- 6.5.6. Immediately (less than 30 seconds) place 2.5 to 3.5 μL of triacetin on the filter (**NOTE:** Waiting longer than 30 seconds will result in increased index of refraction and decreased contrast between the fibers and the preparation. This may also lead to separation of the cover slip from the slide).
- 6.5.7. Lower a cover slip gently onto the filter at a slight angle to reduce the possibility of forming air bubbles. If more than 30 seconds have elapsed between acetone exposure and triacetin application, glue the edges of the cover slip to the slide with lacquer or nail polish.
- 6.5.8. If clearing is slow, warm the slide for 15 min on a hot plate having a surface temperature of about 50 deg.C to hasten clearing. The top of the hot block can be used if the slide is not heated too long.
- 6.5.9. Counting may proceed immediately after clearing and mounting are completed.
- 6.6. **Sample Analysis:** Completely align the microscope according to the manufacturer's instructions. Then, align the microscope using the following general alignment routine at the beginning of every counting session and more often if necessary.
- 6.6.1. **Alignment**
- 6.6.1.(1) Clean all optical surfaces. Even a small amount of dirt can significantly degrade the image.
- 6.6.1.(2) Rough focus the objective on a sample.
- 6.6.1.(3) Close down the field iris so that it is visible in the field of view. Focus the image of the iris with the condenser focus. Center the image of the iris in the field of view.
- 6.6.1.(4) Install the phase telescope and focus on the phase rings. Critically center the rings. Misalignment of the rings results in astigmatism which will degrade the image.
- 6.6.1.(5) Place the phase-shift test slide on the microscope stage and focus on the lines. The analyst must see line set 3 and should see at least parts of 4 and 5 but, not see line set 6 or 6. A microscope/microscopist combination which does not pass this test may not be used.
- 6.6.2. **Counting Fibers**
- 6.6.2.(1) Place the prepared sample slide on the mechanical stage of the microscope. Position the center of the wedge under the objective lens and focus upon the sample.
- 6.6.2.(2) Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Select fields randomly, without looking into the eyepieces, by



- slightly advancing the slide in one direction with the mechanical stage control.
- 6.6.2.(3) Continually scan over a range of focal planes (generally the upper 10 to 15 μm of the filter surface) with the fine focus control during each field count. Spend at least 5 to 15 seconds per field.
 - 6.6.2.(4) Most samples will contain asbestos fibers with fiber diameters less than 1 μm . Look carefully for faint fiber images. The small diameter fibers will be very hard to see. However, they are an important contribution to the total count.
 - 6.6.2.(5) Count only fibers equal to or longer than 5 μm . Measure the length of curved fibers along the curve.
 - 6.6.2.(6) Count fibers which have a length to width ratio of 3:1 or greater.
 - 6.6.2.(7) Count all the fibers in at least 20 fields. Continue counting until either 100 fibers are counted or 100 fields have been viewed; whichever occurs first. Count all the fibers in the final field.
 - 6.6.2.(8) Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle shall receive a count of 1/2. Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area. If a fiber touches the circle, it is considered to cross the line.
 - 6.6.2.(9) Count bundles of fibers as one fiber unless individual fibers can be clearly identified and each individual fiber is clearly not connected to another counted fiber. See Figure 1 of this appendix for counting conventions.
 - 6.6.2.(10) Record the number of fibers in each field in a consistent way such that filter non-uniformity can be assessed.
 - 6.6.2.(11) Regularly check phase ring alignment.
 - 6.6.2.(12) When an agglomerate (mass of material) covers more than 25% of the field of view, reject the field and select another. Do not include it in the number of fields counted.
 - 6.6.2.(13) Perform a "blind recount" of 1 in every 10 filter wedges (slides). Re-label the slides using a person other than the original counter.
- 6.7. **Fiber Identification:** As previously mentioned in Section 1.3., PCM does not provide positive confirmation of asbestos fibers. Alternate differential counting techniques should be used if discrimination is desirable. Differential counting may include primary discrimination based on morphology, polarized light analysis of fibers, or modification of PCM data by Scanning Electron or Transmission Electron Microscopy. A great deal of experience is required to routinely and correctly perform differential counting. It is discouraged unless it is legally necessary. Then, only if a fiber is obviously not asbestos should it be excluded from the count. Further discussion of this technique can be found in reference 8.10. If there is a question whether a fiber is



asbestos or not, follow the rule: **"WHEN IN DOUBT, COUNT."**

6.8. Analytical Recommendations – Quality Control System

- 6.8.1.** All individuals performing asbestos analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos or an equivalent course.
- 6.8.2.** Each laboratory engaged in asbestos counting shall set up a slide trading arrangement with at least two other laboratories in order to compare performance and eliminate inbreeding of error. The slide exchange occurs at least semiannually. The round robin results shall be posted where all analysts can view individual analyst's results.
- 6.8.3.** Each laboratory engaged in asbestos counting shall participate in the Proficiency Analytical Testing Program, the Asbestos Analyst Registry or equivalent.
- 6.8.4.** Each analyst shall select and count prepared slides from a "slide bank". These are quality assurance counts. The slide bank shall be prepared using uniformly distributed samples taken from the workload. Fiber densities should cover the entire range routinely analyzed by the laboratory. These slides are counted blind by all counters to establish an original standard deviation. This historical distribution is compared with the quality assurance counts. A counter must have 95% of all quality control samples counted within three standard deviations of the historical mean. This count is then integrated into a new historical mean and standard deviation for the slide. The analyses done by the counters to establish the slide bank may be used for an interim quality control program if the data are treated in a proper statistical fashion.

7. Calculations

- 7.1.** Calculate the estimated airborne asbestos fiber concentration on the filter sample using the following formula:

$$AC = \frac{\left[\left(\frac{FB}{FL} - \frac{BFB}{BFL} \right) \right] x ECA}{1000 x FR x T x MFA}$$

where:

AC = Airborne fiber concentration

FB = Total number of fibers greater than 5 Im counted

FL = Total number of fields counted on the filter

BFB = Total number of fibers greater than 5 Im counted in the blank

BFL = Total number of fields counted on the blank

ECA = Effective collecting area of filter (385 mm(2) nominal for a 25 - mm filter.)

FR = Pump flow rate (L/min)

MFA = Microscope count field area (mm(2)). This is 0.00785 mm(2) for a Walton-Beckett Graticule.

T = Sample collection time (min)

1,000 = Conversion of L to cc



The collection area of a filter is seldom equal to 385 mm². It is appropriate for laboratories to routinely monitor the exact diameter using an inside micrometer. The collection area is calculated according to the formula:

$$\text{Area} = \pi(d/2)^2$$

- 7.2. Short-Cut Calculation:** Since a given analyst always has the same interpupillary distance, the number of fields per filter for a particular analyst will remain constant for a given size filter. The field size for that analyst is constant (i.e. the analyst is using an assigned microscope and is not changing the reticle). For example, if the exposed area of the filter is always 385 mm² and the size of the field is always 0.00785 mm² the number of fields per filter will always be 49,000. In addition it is necessary to convert liters of air to cc. These three constants can then be combined such that $ECA/(1,000 \times$

$MFA) = 49$. The previous equation simplifies to:

$$AC = \frac{\left(\frac{FB}{FL}\right) - \left(\frac{BFB}{BFL}\right) \times 49}{FR \times T}$$

- 7.3. Recount Calculations:** As mentioned in step 13 of Section 6.6.2., a "blind recount" of 10% of the slides is performed. In all cases, differences will be observed between the first and second counts of the same filter wedge. Most of these differences will be due to chance alone, that is, due to the random variability (precision) of the count method. Statistical recount criteria enables one to decide whether observed differences can be explained due to chance alone or are probably due to systematic differences between analysts, microscopes, or other biasing factors. The following recount criterion is for a pair of counts that estimate AC in fibers/cc. The criterion is given at the type-I error level. That is, there is 5% maximum risk that we will reject a pair of counts for the reason that one might be biased, when the large observed difference is really due to chance. Reject a pair of counts if:

$$\sqrt{AC_2 - AC_1} > 2.78 \times \left(\sqrt{AC_{AVG}} \right) \times CV_{FB}$$

Where:

AC(1) = lower estimated airborne fiber concentration

AC(2) = higher estimated airborne fiber concentration

AC(avg) = average of the two concentration estimates

CV(FB) = CV for the average of the two concentration estimates



If a pair of counts are rejected by this criterion then, recount the rest of the filters in the submitted set. Apply the test and reject any other pairs failing the test. Rejection shall include a memo to the industrial hygienist stating that the sample failed a statistical test for homogeneity and the true air concentration may be significantly different than the reported value.

- 7.4. Reporting Results:** Report results to the industrial hygienist as fibers/cc. Use two significant figures. If multiple analyses are performed on a sample, an average of the results is to be reported unless any of the results can be rejected for cause.

8. References

- 8.1.** Dreesen, W.C., et al., U.S. Public Health Service: A Study of Asbestosis in the Asbestos Textile Industry (Public Health Bulletin No. 241), U.S. Treasury Dept., Washington, DC, 1938.
- 8.2.** Asbestos Research Council: The Measurement of Airborne Asbestos Dust by the Membrane Filter Method (Technical Note), Asbestos Research Council, Rockdale, Lancashire, Great Britain, 1969.
- 8.3.** Bayer, S.G., Zumwalde, R.D., Brown, T.A., Equipment and Procedure for Mounting Millipore Filters and Counting Asbestos Fibers by Phase Contrast Microscopy, Bureau of Occupational Health, U.S. Dept. of Health, Education and Welfare, Cincinnati, OH, 1969.
- 8.4.** NIOSH Manual of Analytical Methods, 2nd ed., Vol. 1 (DHEW/ NIOSH Pub. No. 77-157-A). National Institute for Occupational Safety and Health, Cincinnati, OH, 1977. pp. 239-1 -- 239-21.
- 8.5.** Asbestos, Code of Federal Regulations 29 CFR 1910.1001. 1971.
- 8.6.** Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite. Final Rule, Federal Register 51:119 (20 June 1986). pp. 22612-22790.
- 8.7.** Asbestos, Tremolite, Anthophyllite, and Actinolite, Code of Federal Regulations 1910.1001. 1988. pp. 711-752.
- 8.8.** Criteria for a Recommended Standard -- Occupational Exposure to Asbestos (DHEW/NIOSH Pub. No. HSM 72-10267), National Institute for Occupational Safety and Health, NIOSH, Cincinnati, OH, 1972. pp. III-1 -- III-24.
- 8.9.** Leidel, N.A., Bayer, S.G., Zumwalde, R.D., Busch, K.A., USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers (DHEW/NIOSH Pub. No. 79-127). National Institute for Occupational Safety and Health, Cincinnati, OH, 1979.
- 8.10.** Dixon, W.C., Applications of Optical Microscopy in Analysis of Asbestos and Quartz, Analytical Techniques in Occupational Health Chemistry, edited by D.D. Dollberg and A.W. Verstuyft. Wash. D.C.: American Chemical Society, (ACS Symposium Series 120) 1980. pp. 13-41.

Quality Control

The OSHA asbestos regulations require each laboratory to establish a quality control program. The following is presented as an example of how the OSHA-SLTC constructed its internal CV curve as part of meeting this requirement.



Data is from 395 samples collected during OSHA compliance inspections and analyzed from October 1980 through April 1986. Each sample was counted by 2 to 5 different counters independently of one another. The standard deviation and the CV statistic was calculated for each sample. This data was then plotted on a graph of CV vs. fibers/mm². A least squares regression was performed using the following equation:

$$CV = \text{antilog}_{10} [A(\log_{10}(x))^2 + B(\log_{10}(x)) + C]$$

where:

x = the number of fibers/mm²

Application of least squares gave:

$$A = 0.182205$$

$$B = 0.973343$$

$$C = 0.327499$$

Using these values, the equation becomes:

$$CV = \text{antilog}_{10} [0.182205(\log_{10}(x))^2 + 0.973343(\log_{10}(x)) + 0.327499]$$

Sampling Pump Flow Rate Corrections

This correction is used if a difference greater than 5% in ambient temperature and/or pressure is noted between calibration and sampling sites and the pump does not compensate for the differences.

$$Q_{act} = Q_{cal} x \sqrt{\left(\frac{P_{cal}}{P_{act}}\right) x \left(\frac{T_{act}}{T_{cal}}\right)}$$

Where:

Q(act) = actual flow rate

Q(cal) = calibrated flow rate (if a rotameter was used, the rotameter value)

P(cal) = uncorrected air pressure at calibration

P(act) = uncorrected air pressure at sampling site

T(act) = temperature at sampling site (K)

T(cal) = temperature at calibration (K)

Walton-Beckett Graticule

When ordering the Graticule for asbestos counting, specify the exact disc diameter needed to fit the ocular of the microscope and the diameter (mm) of the circular counting area. Instructions for measuring the dimensions necessary are listed:

- (1) Insert any available graticule into the focusing eyepiece and focus so that the graticule lines are sharp and clear.
- (2) Align the microscope.
- (3) Place a stage micrometer on the microscope object stage and focus the



- microscope on the graduated lines.
- (4) Measure the magnified grid length, PL (μ m), using the stage micrometer.
 - (5) Remove the graticule from the microscope and measure its actual grid length, AL (mm). This can be accomplished by using a mechanical stage fitted with verniers, or a jeweler's loupe with a direct reading scale.
 - (6) Let D = 100 μ m. Calculate the circle diameter, d(c)(mm), for the Walton-Beckett graticule and specify the diameter when making a purchase:

$$d_c = \frac{AL \times D}{PL}$$

Example: If PL = 108 μ m, AL = 2.93 mm and D = 100 μ m, then,

$$d_c = \frac{2.93 \times 100}{108} = 2.71 \text{ mm}$$

- (7) Each eyepiece-objective-reticle combination on the microscope must be calibrated. Should any of the three be changed (by zoom adjustment,

disassembly, replacement, etc.), the combination must be recalibrated.

Calibration may change if interpupillary distance is changed.

Measure the field diameter, D (acceptable range: 100 plus or minus 2 μ m) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine the field area (mm²).

$$\text{Field Area} = 3.14(D/2)^2$$

If D = 100 μ m = 0.1 mm, then

$$\text{Field Area} = 3.14(0.1 \text{ mm}/2)^2 = 0.00785 \text{ mm}^2$$



Figure 1: Walton-Beckett Graticule with some explanatory fibers.

The Graticule is available from: Graticules Ltd., Morley Road, Tonbridge TN9 1RN, Kent, England (Telephone 011-44-732-359061). Also available from PTR Optics Ltd., 145 Newton Street, Waltham, MA 02154 [telephone (617) 891-6000] or McCrone Accessories and Components, 2506 S. Michigan Ave., Chicago, IL 60616 [phone (312)- 842-7100]. The graticule is custom made for each microscope.

**Counts for the Fibers in the Figure**

Structure No.	Count	Explanation
1 to 6	1	Single fibers all contained within the Circle.
7	$\frac{1}{2}$	Fiber crosses circle once.
8	0	Fiber too short.
9	2	Two crossing fibers.
10	0	Fiber outside graticule.
11	0	Fiber crosses graticule twice.
12	$\frac{1}{2}$	Although split, fiber only crosses once.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix B to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1 (Register 91, No. 45).
3. Editorial correction of Appendix B (Register 95, No. 41).
4. Repealer and new appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).

California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix C Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases

1529. Asbestos, Appendix C (Repealed)

See Section 5144, Appendix A.

HISTORY

1. New Appendix C to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment of appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).
4. Deleted Appendix C; filed 8/25/98; effective 11/23/98.

Medical Questionnaires Mandatory

Part 1 INITIAL MEDICAL QUESTIONNAIRE

- 65



15. Race 1. White ___ 2. Black ___ 3. Asian ___
 4. Hispanic ___ 5. Indian ___ 6. Other ___
16. What is the highest grade completed in school? _____
(For example 12 years is completion of high school)

OCCUPATIONAL HISTORY

- 17A. Have you ever worked full time _____ 1. Yes ___
(30 hours per week or more for 6 months or more?) 2. No ___
- IF YES TO 17A:
- B. Have you ever worked for a year or more in any dusty job?
1. Does Not Apply ___
2. Specify job/industry _____
3. Total Years Worked _____
- Was dust exposure: 1. Mild ___ 2. Moderate ___ 3. Severe ___
- C. Have you even been exposed to gas or chemical fumes in your work?
1. Yes ___ 2. No ___
- Specify job/industry _____
- Total Years Worked _____
- Was exposure: 1. Mild ___ 2. Moderate ___ 3. Severe ___
- D. What has been your usual occupation or job--the one you have worked at the longest?
1. Job occupation _____
2. Number of years employed in this occupation _____
3. Position/job title _____
4. Business, field or industry _____
- (Record on lines the years in which you have worked in any of these industries. e.g. 1960-1969)
19. CHEST COLDS AND CHEST ILLNESSES
- 19A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time) 1. Yes ___ 2. No ___ 3. Don't get colds ___
- 20A. During then past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? 1. Yes ___ 2. No ___
- IF YES TO 20A
- B. Did you produce phlegm with any of these chest illnesses?
1. Yes ___ 2. No ___ 3. Does not apply ___
- C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more?
- Number of illnesses _____ No such illnesses _____
21. Did you have any lung trouble before the age of 16? 1. Yes ___ 2. No ___
22. Have you ever had any of the following?
- 1A. Attacks of bronchitis? 1. Yes ___ 2. No ___
- IF YES TO 1A:
- B. Was it confirmed by a doctor? 1. Yes ___ 2. No ___ 3. Does Not Apply ___
- C. At what age was your first attack? Age in Years _____ Does Not Apply ___



- 2A. Pneumonia (include bronchopneumonia)? 1.Yes ___ 2. No___
 IF YES TO 2A:
 B. Was it confirmed by a doctor? 1.Yes ___ 2. No___ 3. Does Not Apply___
 C. At what age did you first have it? Age in Years___ Does Not Apply___
- 3A. Hay fever? 1.Yes ___ 2. No___
 IF YES TO 3A:
 B. Was it confirmed by a doctor? 1.Yes ___ 2. No___ 3. Does Not Apply___
 C. At what age did it start? Age in Years___ Does Not Apply___
- 23A. Have you ever had chronic bronchitis? 1.Yes ___ 2. No___
 IF YES TO 23A:
 B. Do you still have it? 1.Yes ___ 2. No___ 3. Does Not Apply___
 C. Was it confirmed by a doctor? 1.Yes ___ 2. No___ 3. Does Not Apply___
 D. At what age did it start? Age in Years___ Does Not Apply___
- 24A. Have you ever had emphysema? 1.Yes ___ 2. No___
 IF YES TO 24A:
 B. Do you still have it? 1.Yes ___ 2. No___ 3. Does Not Apply___
 C. Was it confirmed by a doctor? 1.Yes ___ 2. No___ 3. Does Not Apply___
 D. At what age did it start? Age in Years___ Does Not Apply___
- 25A. Have you ever had asthma? 1.Yes ___ 2. No___
 IF YES TO 25A:
 B. Do you still have it? 1.Yes ___ 2. No___ 3. Does Not Apply___
 C. Was it confirmed by a doctor? 1.Yes ___ 2. No___ 3. Does Not Apply___
 D. At what age did it start? Age in Years___ Does Not Apply___
 E. If you no longer have it, at what age did it stop?
 Age stopped___ Does Not Apply___
26. Have you ever had:
 A. Any other chest illness? 1.Yes ___ 2. No___
 If yes, please specify _
 B. Any chest operations? 1.Yes ___ 2. No___
 If yes, please specify
 C. Any chest injuries? 1.Yes ___ 2. No___
 If yes, please specify
- 27A. Has a doctor ever told you that you had heart trouble?
 1.Yes ___ 2. No___
 IF YES TO 27A:
 B. Have you ever had treatment for heart trouble in the past 10 years?
 1.Yes ___ 2. No___ 3. Does not apply___
- 28A. Has a doctor ever told you that you had high blood pressure?
 1.Yes ___ 2. No___
 IF YES TO 28A:
 B. Have you ever had treatment for high blood pressure (hypertension) in the past 10 years? 1.Yes ___ 2. No___ 3. Does not apply___
29. When did you last have your chest X-rayed? (Year) ___ _ _ _
 30. Where did you last have your chest X-rayed (if known)? _____



What was the outcome? _____

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:

	FATHER			MOTHER		
	1.Yes	2.No	3. Don't Know	1.Yes	2.No	3. Don't Know
A. Chronic Bronchitis?	_____	_____	_____	_____	_____	_____
B. Emphysema?	_____	_____	_____	_____	_____	_____
C. Asthma?	_____	_____	_____	_____	_____	_____
D. Lung cancer?	_____	_____	_____	_____	_____	_____
E. Other chest conditions?	_____	_____	_____	_____	_____	_____
F. Is parent currently alive?	_____	_____	_____	_____	_____	_____
G. Please Specify						
Age if Living		_____			_____	
Age at Death		_____			_____	
Don't Know		_____			_____	
H. Please specify cause of death						
		_____			_____	

COUGH

32A. Do you usually have a cough? (Count a cough with first smoke or on first going out doors. Exclude clearing of throat) [If no, skip to question 32C.]

1.Yes ___ 2. No___

B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week?

1. Yes ___ 2. No___

C. Do you usually cough at all on getting up or first thing in the morning?

1.Yes ___ 2. No___

D. Do you usually cough at all during the rest of the day or at night?

1.Yes ___ 2. No___

IF YES TO ANY OF ABOVE (32A, B, C, OR D), ANSWER THE FOLLOWING. IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO NEXT PAGE.

E. Do you usually cough like this on most days for 3 consecutive months or more during the year?

1.Yes ___ 2. No___ 3.Does not apply___

F. For how many years have you had the cough?

Number of Years___ Does Not Apply___

33A. Do you usually bring up phlegm from your chest?

(Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) (If no, skip to 33C)

1.Yes ___ 2. No___



- B. Do you usually bring up phlegm like this as much as twice a day 4 or more days out of the week? 1.Yes ___ 2. No___
- C. Do you usually bring up phlegm at all on getting up or first thing in the morning? 1.Yes ___ 2. No___
- D. Do you usually bring up phlegm at all during the rest of the day or at night? 1.Yes ___ 2. No___

IF YES TO ANY OF THE ABOVE (33A, B, C, OR D), ANSWER THE FOLLOWING: IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO 34A.

- E. Do you bring up phlegm like this on most days for 3 consecutive months or more during the year? 1.Yes ___ 2. No___ 3. Does not apply___
- F. For how many years have you had trouble with phlegm?
Number of years___ Does not apply___

EPISODES OF COUGH AND PHLEGM

- 34A. Have you had periods or episodes of (increased*) and phlegm lasting for 3 weeks or more each year? *(For persons who usually have cough and/or phlegm) 1.Yes ___ 2. No___

IF YES TO 34A

- B. For how long have you had at least 1 such episode per year?
Number of years___ Does not apply___

WHEEZING

- 35A. Does your chest ever sound wheezy or whistling

1. When you have a cold? 1.Yes ___ 2. No___
2. Occasionally apart from colds? 1.Yes ___ 2. No___
3. Most days or nights? 1.Yes ___ 2. No___

IF YES TO 1, 2, or 3 in 35A

- B. For how many years has this been present?

Number of years___ Does not apply___

- 36A. Have you ever had an attack of wheezing that has made you feel short of breath? 1.Yes ___ 2. No___

- B. How old were you when you had your first such attack?

Age in years___ Does not apply___

- C. Have you had 2 or more such episodes?

1.Yes ___ 2. No___ 3.Does not apply___

- D. Have you ever required medicine or treatment for the(se) attack(s)?

1.Yes ___ 2. No___ 3. Does not apply___

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A.

Nature of condition(s) _____



38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? 1. Yes ___ 2. No ___

IF YES TO 38A

B. Do you have a walk slower than people of your age on the level because of breathlessness? 1. Yes ___ 2. No ___ 3. Does not apply ___

C. Do you ever have to stop for breath when walking at your own pace on the level? 1. Yes ___ 2. No ___ 3. Does not apply ___

D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? 1. Yes ___ 2. No ___ 3. Does not apply ___

E. Are you too breathless to leave the house or breathless on dressing or climbing one flight of stairs? 1. Yes ___ 2. No ___ 3. Does not apply ___

TOBACCO SMOKING

39A. Have you ever smoked cigarettes? (No means less than 20 packs of cigarettes or 12 oz. of tobacco in a lifetime or less than 1 cigarette a day for 1 year.)

1. Yes ___ 2. No ___

IF YES TO 39A

B. Do you now smoke cigarettes (as of one month ago)

1. Yes ___ 2. No ___ 3. Does not apply ___

C. How old were you when you first started regular cigarette smoking?

Age in years ___ Does not apply ___

D. If you have stopped smoking cigarettes completely, how old were you when you stopped? Age stopped ___ Check if still smoking ___ Does not apply ___

E. How many cigarettes do you smoke per day now?

Cigarettes per day ___ Does not apply ___

F. On the average of the entire time you smoked, how many cigarettes did you smoke per day? Cigarettes per day ___ Does not apply ___

G. Do or did you inhale the cigarette smoke?

1. Does not apply ___ 2. Not at all ___ 3. Slightly ___
4. Moderately ___ 5. Deeply ___

40A. Have you ever smoked a pipe regularly?

(Yes means more than 12 oz. of tobacco in a lifetime.)

1. Yes ___ 2. No ___

IF YES TO 40A:

B. 1. How old were you when you started to smoke a pipe regularly?

Age ___

2. If you have stopped smoking a pipe completely, how old were you when you stopped? Age stopped ___ Check if still smoking pipe ___ Does not apply ___

C. On the average over the entire time you smoked a pipe how much pipe tobacco did you smoke per week? (a standard pouch of tobacco contains 1 1/2 oz.) oz. per week ___ Does not apply ___

D. How much pipe tobacco are you smoking now?

oz. per week ___ Not currently smoking a pipe ___



- E. Do you or did you inhale the pipe smoke?
 1. Never smoked__ 2. Not at all__ 3. Slightly__
 4. Moderately__ 5. Deeply__
- 41A. Have you ever smoked cigars regularly? (Yes means more than 1 cigar a week for a year) 1.Yes __ 2. No__

IF YES TO 41A FOR PERSONS WHO HAVE EVER SMOKED CIGARS

- B. 1. How old were you when you started smoking cigars regularly?
 Age__
2. If you have stopped smoking cigars completely, how old were you when you stopped? Age stopped__ Check if still smoking cigars__ Does not apply__
- C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week? Cigars per week__ Does not apply__
- D. How many cigars are you smoking per week now?
 Cigars per week__ Check if not smoking cigars currently__
- E. Do or did you inhale the cigar smoke?
 1. Never smoked__ 2. Not at all__ 3.Slightly__
 4. Moderately__ 5. Deeply__
 Signature _____ Date_____

Part 2 PERIODIC MEDICAL QUESTIONNAIRE

1. NAME _____
2. SOCIAL SECURITY _____
 1 2 3 4 5 6 7 8 9
3. CLOCK NUMBER _____
 10 11 12 13 14 15
4. PRESENT OCCUPATION _____
5. PLANT _____
6. ADDRESS _____
7. _____ (Zip Code)
8. TELEPHONE NUMBER _____
9. INTERVIEWER _____
10. DATE _____
 16 17 18 19 20 21

12. OCCUPATIONAL HISTORY

- 12A. Have you ever worked full time (30 hours per week or more for 6 months or more?) 1. Yes __ 2. No __

IF YES TO 12A:

- 12B. Have you ever worked for a year or more in any dusty job?
 1. Does Not Apply ____
 2. Specify job/industry ____
 3. Total Years Worked ____



- 12C. Was dust exposure: 1. Mild __ 2. Moderate __ 3. Severe __
12D. In the past year, were you exposed to gas or chemical fumes in your work? 1. Yes __ 2. No __
12E. Was exposure: 1. Mild __ 2. Moderate __ 3. Severe __
12F. In the past year, what was your
1. Job/occupation? _____
2. Position/job title? _____

13. RECENT MEDICAL HISTORY

- 13A. Do you consider yourself to be in good health? Yes __ No __
IF NO, state reason _____
13B. In the past year, have you developed:
Epilepsy? Yes __ No __
Rheumatic fever? Yes __ No __
Kidney disease? Yes __ No __
Bladder disease? Yes __ No __
Diabetes? Yes __ No __
Jaundice? Yes __ No __
Cancer? Yes __ No __

14. CHEST COLDS AND CHEST ILLNESSES

- 14A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time) 1. Yes __ 2. No __ 3. Don't get colds __
15A. During the past year, have you had any chest illnesses that have kept you off work, indoors at home, or in bed?
1. Yes __ 2. No __ 3. Does Not Apply __
IF YES TO 15A:
15B. Did you produce phlegm with any of these chest illnesses?
1. Yes __ 2. No __ 3. Does Not Apply __
15C. In the past year, how many such illnesses with (increased) phlegm did you have which lasted a week or more?
Number of illnesses __ No such illnesses __

16. RESPIRATORY SYSTEM

In the past year have you had:

	Yes or No		Further Comment on Positive Answers
Asthma	___	___	_____
Bronchitis	___	___	_____
Hay Fever	___	___	_____
Other Allergies	___	___	_____
Pneumonia	___	___	_____
Tuberculosis	___	___	_____
Chest Surgery	___	___	_____
Other Lung Problems	___	___	_____
Heart Disease	___	___	_____



Do you have:

	Yes or No		Further Comment on Positive Answers
Frequent colds	_____	_____	_____
Chronic cough	_____	_____	_____
Shortness of breath	_____	_____	_____
when walking or			
climbing one			
flight of stairs			
Do you:			
Wheeze	_____	_____	_____
Cough up phlegm	_____	_____	_____
Smoke cigarettes	_____	_____	_____
Packs per day	_____	_____	_____
How many years	_____	_____	_____
Signature _____			Date _____

NOTE Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix D to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment of appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).
4. Editorial correction of Part 1, No. 16 (Register 99, No. 28).



**California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix E Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases**

**Interpretation and Classification of Chest Roentgenograms
Mandatory**

- (a) Chest roentgenograms shall be interpreted and classified in accordance with a professionally accepted classification system and recorded on an interpretation form following the format of the CDC/NIOSH (M) 2.8 form. As a minimum, the content within the bold lines of this form (items 1 through 4) shall be included. This form is not to be submitted to NIOSH.
- (b) Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconioses.
- (c) All interpreters, whenever interpreting chest roentgenograms made under this section, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

- 1. New Appendix E to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346(d) (Register 91, No. 19).
- 2. Editorial correction of HISTORY 1. (Register 91, No. 45).
- 3. Amendment of appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).



**California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix F Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases**

**Work Practices and Engineering Controls
for Class I Asbestos Operations
(Non-mandatory)**

This is a non-mandatory appendix to the asbestos standards for construction and for shipyards. It describes criteria and procedures for erecting and using negative pressure enclosures for Class I Asbestos Work, when NPEs are used as an allowable control method to comply with subsection (g)(5)(A) of this section.

Many small and variable details are involved in the erection of a negative pressure enclosure. OSHA and most participants in the rulemaking agreed that only the major, more performance oriented criteria should be made mandatory.

These criteria are set out in subsection (g) of this section. In addition, this appendix includes these mandatory specifications and procedures in its guidelines in order to make this appendix coherent and helpful. The mandatory nature of the criteria which appear in the regulatory text is not changed because they are included in this "non-mandatory" appendix. Similarly, the additional criteria and procedures included as guidelines in the appendix, do not become mandatory because mandatory criteria are also included in these comprehensive guidelines.

In addition, none of the criteria, both mandatory and recommended, are meant to specify or imply the need for use of patented or licensed methods or equipment.

Recommended specifications included in this attachment should not discourage the use of creative alternatives which can be shown to reliably achieve the objectives of negative-pressure enclosures.

Requirements included in this appendix, cover general provisions to be followed in all asbestos jobs, provisions which must be followed for all Class I asbestos jobs, and provisions governing the construction and testing of negative pressure enclosures. The first category includes the requirement for use of wet methods, HEPA vacuums, and immediate bagging of waste; Class I work must conform to the following provisions:



- oversight by competent person
- use of critical barriers over all openings to work area
- isolation of HVAC systems
- use of impermeable dropcloths and coverage of all objects within regulated areas

In addition, more specific requirements for NPEs include:

- maintenance of -0.02 inches water gauge within enclosure
- manometric measurements
- air movement away from employees performing removal work
- smoke testing or equivalent for detection of leaks and air direction
- deactivation of electrical circuits, if not provided with ground-fault circuit interrupters.

Planning the Project

The standard requires that an exposure assessment be conducted before the asbestos job is begun [Subsection 1529(f)(1)]. Information needed for that assessment, includes data relating to prior similar jobs, as applied to the specific variables of the current job. The information needed to conduct the assessment will be useful in planning the project, and in complying with any reporting requirements under this standard, when significant changes are being made to a control system listed in the standard, [see also those of USEPA (40 CFR 61, subpart M). Thus, although the standard does not explicitly require the preparation of a written asbestos removal plan, the usual constituents of such a plan, i.e., a description of the enclosure, the equipment, and the procedures to be used throughout the project, must be determined before the enclosure can be erected. The following information should be included in the planning of the system:

- A physical description of the work area;
- A description of the approximate amount of material to be removed;
- A schedule for turning off and sealing existing ventilation systems;
- Personnel hygiene procedures;
- A description of personal protective equipment and clothing to be worn by employees;
- A description of the local exhaust ventilation systems to be used and how they are to be tested;
- A description of work practices to be observed by employees;
- An air monitoring plan;
- A description of the method to be used to transport waste material; and
- The location of the dump site.
- Materials and Equipment Necessary for Asbestos Removal

Although individual asbestos removal projects vary in terms of the equipment



required to accomplish the removal of the materials, some equipment and materials are common to most asbestos removal operations.

Plastic sheeting used to protect horizontal surfaces, seal HVAC openings or to seal vertical openings and ceilings should have a minimum thickness of 6 mils.

Tape or other adhesive used to attach plastic sheeting should be of sufficient adhesive strength to support the weight of the material plus all stresses encountered during the entire duration of the project without becoming detached from the surface.

Other equipment and materials which should be available at the beginning of each project are:

- HEPA Filtered Vacuum is essential for cleaning the work area after the asbestos has been removed. It should have a long hose capable of reaching out-of-the-way places, such as areas above ceiling tiles, behind pipes, etc.
- Portable air ventilation systems installed to provide the negative air pressure and air removal from the enclosure must be equipped with a HEPA filter.
- The number and capacity of units required to ventilate an enclosure depend on the size of the area to be ventilated. The filters for these systems should be designed in such a manner that they can be replaced when the air flow is reduced by the build-up of dust in the filtration material. Pressure monitoring devices with alarms and strip chart recorders attached to each system to indicate the pressure differential and the loss due to dust buildup on the filter are recommended.
- Water sprayers should be used to keep the asbestos material as saturated as possible during removal; the sprayers will provide a fine mist that minimizes the impact of the spray on the material.
- Water used to saturate the asbestos containing material can be amended by adding at least 15 milliliters (1/4 ounce) of wetting agent in 1 liter (1 pint) of water. An example of a wetting agent is a 50/50 mixture of polyoxyethylene ether and polyoxyethylene polyglycol ester.
- Backup power supplies are recommended, especially for ventilation systems.
- Shower and bath water should be with mixed hot and cold water faucets. Water that has been used to clean personnel or equipment should either be filtered or be collected and discarded as asbestos waste. Soap and shampoo should be provided to aid in removing dust from the workers' skin and hair.
- See subsections (h) and (i) of this section for appropriate respiratory protection and protective clothing.



- See subsection (k) of this section for required signs and labels.

Preparing the Work Area

Disabling the HVAC Systems: The power to the heating, ventilation and air conditioning systems that service the restricted area must be deactivated and locked off. All ducts, grills, access ports, windows and vents must be sealed off with two layers of plastic to prevent entrainment of contaminated air.

Operating HVAC Systems in the Restricted Area: If components of a HVAC system located in the restricted area are connected to a system that will service another zone during the project, the portion of the duct in the restricted area must be sealed and pressurized. Necessary precautions include caulking the duct joints, covering all cracks and openings with two layers of sheeting, and pressurizing the duct throughout the duration of the project by restricting the return of air flow. The power to the fan supplying the positive pressure should be locked "on" to prevent pressure loss.

Sealing Elevators: If an elevator shaft is located in the restricted area, it should be either shut down or isolated by sealing with two layers of plastic sheeting. The sheeting should provide enough slack to accommodate the pressure changes in the shaft without breaking the air-tight seal.

Removing Mobile Objects: All movable objects should be cleaned and removed from the work area before an enclosure is constructed unless moving the objects creates a hazard. Mobile objects will be assumed to be contaminated and should be either cleaned with amended water and a HEPA vacuum and then removed from the area or wrapped and then disposed of as hazardous waste.

Cleaning and Sealing Surfaces: After cleaning with water and a HEPA vacuum, surfaces of stationary objects should be covered with two layers of plastic sheeting. The sheeting should be secured with duct tape or an equivalent method to provide a tight seal around the object.

Bagging Waste: In addition to the requirement for immediate bagging of waste for disposal, it is further recommended that the waste material be double-bagged and sealed in plastic bags designed for asbestos disposal. The bags should be stored in a waste storage area that can be controlled by the workers conducting the removal. Filters removed from handling units and rubbish removed from the area are to be bagged and handled as hazardous waste.

Constructing the Enclosure

The enclosure should be constructed to provide an air-tight seal around ducts and openings into existing ventilation systems and around penetrations for electrical conduits, telephone wires, water lines, drain pipes, etc. Enclosures should be both airtight and watertight except for those openings designed to provide entry and/or



air flow control.

Size: An enclosure should be the minimum volume to encompass all of the working surfaces yet allow unencumbered movement by the worker(s), provide unrestricted air flow past the worker(s), and ensure walking surfaces can be kept free of tripping hazards.

Shape: The enclosure may be any shape that optimizes the flow of ventilation air past the worker(s).

Structural Integrity: The walls, ceilings and floors must be supported in such a manner that portions of the enclosure will not fall down during normal use.

Openings: It is not necessary that the structure be airtight; openings may be designed to direct air flow. Such openings should be located at a distance from active removal operations. They should be designed to draw air into the enclosure under all anticipated circumstances. In the event that negative pressure is lost, they should be fitted with either HEPA filters to trap dust or automatic trap doors that prevent dust from escaping the enclosure. Openings for exits should be controlled by an airlock or a vestibule.

Barrier Supports: Frames should be constructed to support all unsupported spans of sheeting.

Sheeting: Walls, barriers, ceilings and floors should be lined with two layers of plastic sheeting having a thickness of at least 6 mil.

Seams: Seams in the sheeting material should be minimized to reduce the possibilities of accidental rips and tears in the adhesive or connections. All seams in the sheeting should overlap, be staggered and not be located at corners or wall-to-floor joints.

Areas Within an Enclosure: Each enclosure consists of a work area, a decontamination area, and waste storage area. The work area where the asbestos removal operations occur should be separated from both the waste storage area and the contamination control area by physical curtains, doors, and/or airflow patterns that force any airborne contamination back into the work area.

See subsection (j) of this section for requirements for hygiene facilities.

During egress from the work area, each worker should step into the equipment room, clean tools and equipment, and remove gross contamination from clothing by wet cleaning and HEPA vacuuming. Before entering the shower area, foot coverings, head coverings, hand coverings and coveralls are removed and placed in impervious bags for disposal or cleaning. Airline connections from airline



respirators with HEPA disconnects and power cables from powered air-purifying respirators (PAPRs) will be disconnected just prior to entering the showering room.

Establishing Negative Pressure Within the Enclosure

Negative Pressure: Air is to be drawn into the enclosure under all anticipated conditions and exhausted through a HEPA filter for 24 hours a day during the entire duration of the project.

Air Flow Tests: Air flow patterns will be checked before removal operations begin, at least once per operating enclosure. The primary test for air flow is to trace air currents with smoke tubes or other visual methods. Flow checks are made at each opening and at each doorway to demonstrate that air is being drawn into the enclosure and to each worker's position to show that air is being drawn away from the breathing zone.

Monitoring Pressure Within the Enclosure: After the initial air flow patterns have been checked, the static pressure must be monitored within the enclosure. Monitoring may be made using manometers, pressure gauges, or combinations of these devices. It is recommended that they be attached to alarms and strip chart recorders at points identified by the design engineer.

Corrective Actions: If the manometers or pressure gauges demonstrate a reduction in pressure differential below the required level, work should cease and the reason for the change investigated and appropriate changes made. The air flow patterns should be retested before work begins again.

Pressure Differential: The design parameters for static pressure differentials between the inside and outside of enclosures typically range from 0.02 to 0.10 inches of water gauge, depending on conditions. All zones inside the enclosure must have less pressure than the ambient pressure outside of the enclosure (-0.02 inches water gauge differential). Design specifications for the differential vary according to the size, configuration, and shape of the enclosure as well as ambient and mechanical air pressure conditions around the enclosure.

Air Flow Patterns: The flow of air past each worker shall be enhanced by positioning the intakes and exhaust ports to remove contaminated air from the worker's breathing zone, by positioning HEPA vacuum cleaners to draw air from the worker's breathing zone, by forcing relatively uncontaminated air past the worker toward an exhaust port, or by using a combination of methods to reduce the worker's exposure.

Air Handling Unit Exhaust: The exhaust plume from air handling units should be located away from adjacent personnel and intakes for HVAC systems.

Air Flow Volume: The air flow volume (cubic meters per minute) exhausted



(removed) from the workplace must exceed the amount of makeup air supplied to the enclosure. The rate of air exhausted from the enclosure should be designed to maintain a negative pressure in the enclosure and air movement past each worker. The volume of air flow removed from the enclosure should replace the volume of the container at every 5 to 15 minutes. Air flow volume will need to be relatively high for large enclosures, enclosures with awkward shapes, enclosures with multiple openings, and operations employing several workers in the enclosure.

Air Flow Velocity: At each opening, the air flow velocity must visibly "drag" air into the enclosure. The velocity of the air flow within the enclosure must be adequate to remove airborne contamination from each worker's breathing zone without disturbing the asbestos-containing material on surfaces.

Airlocks: Airlocks are mechanisms on doors and curtains that control the air flow patterns in the doorways. If air flow occurs, the patterns through doorways must be such that the air flows toward the inside of the enclosure. Sometimes vestibules, double doors, or double curtains are used to prevent air movement through the doorways. To use a vestibule, a worker enters a chamber by opening the door or curtain and then closing the entry before opening the exit door or curtain. Airlocks should be located between the equipment room and shower room, between the shower room and the clean room, and between the waste storage area and the outside of the enclosure. The air flow between the adjacent rooms must be checked using smoke tubes or other visual tests to ensure the flow patterns draw air toward the work area without producing eddies.

Monitoring for Airborne Concentrations

In addition to the breathing zone samples taken as outlined in subsection (f) of this section, samples of air should be taken to demonstrate the integrity of the enclosure, the cleanliness of the clean room and shower area, and the effectiveness of the HEPA filter. If the clean room is shown to be contaminated, the room must be relocated to an uncontaminated area. Samples taken near the exhaust of portable ventilation systems must be done with care.

General Work Practices

Preventing dust dispersion is the primary means of controlling the spread of asbestos within the enclosure. Whenever practical, the point of removal should be isolated, enclosed, covered, or shielded from the workers in the area. Waste asbestos containing materials must be bagged during or immediately after removal; the material must remain saturated until the waste container is sealed.

Waste material with sharp points or corners must be placed in hard airtight containers rather than bags.

Whenever possible, large components should be sealed in plastic sheeting and removed intact.



Bags or containers of waste will be removed to the waste holding area, washed, and wrapped in a bag with the appropriate labels.

Cleaning the Work Area

Surfaces within the work area should be kept free of visible dust and debris to the extent feasible. Whenever visible dust appears on surfaces, the surfaces within the enclosure must be cleaned by wiping with a wet sponge, brush, or cloth and then vacuumed with a HEPA vacuum.

All surfaces within the enclosure should be cleaned before the exhaust ventilation system is deactivated and the enclosure is disassembled. An approved encapsulant may be sprayed onto areas after the visible dust has been removed.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix F to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Repealer and new appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).

California Code of Regulations Title 8, Section 1529. Asbestos Appendix G Subchapter 4. Construction Safety Orders Article 4. Dusts, Fumes, Mists, Vapors, and Gases

°1529. Asbestos, Appendix G (Repealed)

NOTE: Authority cited: Sections 142.3, 6501.5, 9020, 9021.5, 9030, and 9040, Labor Code. Reference: Sections 142.3, 6501.5, 6501.7, 6501.8, 6501.9, 6502, 9003, 9004(b), 9005, 9006, 9009, 9020, 9021.5, 9030, and 9040, Labor Code, and Section 25910, Health and Safety Code.

HISTORY

1. New Appendix G to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Editorial correction of Figure G-1 (Register 95, No. 36).
4. Repealer of appendix filed 5-3-96; operative 7-3-96 (Register 96, No. 18).



California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix H Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases

Substance Technical Information for Asbestos
Non-Mandatory

I. Substance Identification

- I.A. Substance:** “Asbestos” is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysotile, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.
- I.B.** Asbestos is used in the manufacture of heat-resistant clothing, automotive brake and clutch linings, and a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet, and fire-resistant drywall. Asbestos is also present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls.
- I.C.** The potential for an asbestos-containing product to release breathable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felt are considered non-friable if intact and generally do not emit airborne fibers unless subjected to sanding, sawing and other aggressive operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken.
- I.D. Permissible exposure:** Exposure to airborne asbestos fibers may not exceed 0.1 fibers per cubic centimeter of air (0.1 f/cc) averaged over the 8-hour workday, and 1 fiber per cubic centimeter of air (1.0 f/cc) averaged over a 30 minute work period.

II. Health Hazard Data

- II.A.** Asbestos can cause disabling respiratory disease and various types of cancers if the fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these



diseases generally do not appear for 20 or more years after initial exposure.

- II.B.** Exposure to asbestos has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

III. Respirators and Protective Clothing

- III.A. Respirators:** You are required to wear a respirator when performing tasks that result in asbestos exposure that exceeds the permissible exposure limit (PEL) of 0.1 f/cc and when performing certain designated operations. Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos fiber concentrations do not exceed 1.0 f/cc; otherwise, more protective respirators such as air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos work. For effective protection, respirators must fit your face and head snugly. Your employer is required to conduct fit tests when you are first assigned a respirator and annually thereafter. Respirators should not be loosened or removed in work situations where their use is required.
- III.B. Protective Clothing:** You are required to wear protective clothing in work areas where asbestos concentrations exceed the permissible exposure limit (PEL) of 0.1 f/cc.

IV. Disposal Procedures and Clean-up

- IV.A.** Wastes that are generated by processes where asbestos is present include:
- IV.A.1.** Empty asbestos shipping containers.
 - IV.A.2.** Process wastes such as cuttings, trimmings, or reject material.
 - IV.A.3.** Housekeeping waste from wet-sweeping or HEPA-vacuuming.
 - IV.A.4.** Asbestos fireproofing or insulating material that is removed from buildings.
 - IV.A.5.** Asbestos-containing building products removed during building renovation or demolition.
 - IV.A.6.** Contaminated disposable protective clothing.
- IV.B.** Empty shipping bags can be flattened under exhaust hoods and packed into airtight containers for disposal. Empty shipping drums are difficult to clean and should be sealed.
- IV.C.** Vacuum bags or disposable paper filters should not be cleaned, but should be sprayed with a fine water mist and placed into a labeled waste container.
- IV.D.** Process waste and housekeeping waste should be wetted with water or a mixture of water and surfactant prior to packaging in disposable



containers.

IV.E. Asbestos-containing material that is removed from buildings must be disposed of in leak-tight 6-mil plastic bags, plastic-lined cardboard containers, or plastic-lined metal containers. These wastes, which are removed while wet, should be sealed in containers before they dry out to minimize the release of asbestos fibers during handling.

V. Access to Information

V.A. Each year, your employer is required to inform you of the information contained in this standard and appendices for asbestos. In addition, your employer must instruct you in the proper work practices for handling asbestos-containing materials, and the correct use of protective equipment.

V.B. Your employer is required to determine whether you are being exposed to asbestos. Your employer must treat exposure to thermal system insulation and sprayed-on and troweled-on surfacing material as asbestos exposure, unless results of laboratory analysis show that the material does not contain asbestos. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure, and, if you are exposed above the permissible exposure limit, he or she is required to inform you of the actions that are being taken to reduce your exposure to within the permissible limit.

V.C. Your employer is required to keep records of your exposures and medical examinations. These exposure records must be kept for at least thirty (30) years, Medical records must be kept for the period of your employment plus thirty (30) years.

V.D. Your employer is required to release your exposure and medical records to your physician or designated representative upon your written request.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix H to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment of appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).
4. Change without regulatory effect amending section III.A. of appendix H filed 12-23-99 pursuant to section 100, title 1, California Code of Regulations (Register 99, No. 52).



**California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix I Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases**

**Medical Surveillance Guidelines for Asbestos
Non-Mandatory**

I. Route of Entry: Inhalation, Ingestion

II. Toxicology

Clinical evidence of the adverse effects associated with exposure to asbestos is present in the form of several well-conducted epidemiological studies of occupationally exposed workers, family contacts of workers, and persons living near asbestos mines. These studies have shown a definite association between exposure to asbestos and an increased incidence of lung cancer, pleural and peritoneal mesothelioma, gastrointestinal cancer, and asbestosis. The latter is a disabling fibrotic lung disease that is caused only by exposure to asbestos.

Exposure to asbestos has also been associated with an increased incidence of esophageal, kidney, laryngeal, pharyngeal, and buccal cavity cancers. As with other known chronic occupational diseases, disease associated with asbestos generally appears about 20 years following the first occurrence of exposure.

There are no known acute effects associated with exposure to asbestos. Epidemiological studies indicate that the risk of lung cancer among exposed workers who smoke cigarettes is greatly increased over the risk of lung cancer among non-exposed smokers or exposed nonsmokers. These studies suggest that cessation of smoking will reduce the risk of lung cancer for a person exposed to asbestos but will not reduce it to the same level of risk as that existing for an exposed worker who has never smoked.

III. Signs and Symptoms of Exposure-Related Disease

The signs and symptoms of lung cancer or gastrointestinal cancer induced by exposure to asbestos are not unique, except that a chest X-ray of an exposed patient with lung cancer may show pleural plaques, pleural calcification, or pleural fibrosis. Symptoms characteristic of mesothelioma include shortness of breath, pain in the walls of the chest, or abdominal pain. Mesothelioma has a much longer latency period compared with lung cancer (40 years versus 15-20 years), and mesothelioma is therefore likely to be found among workers who were first exposed to asbestos at an early age. Mesothelioma is always



fatal.

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Symptoms include shortness of breath, coughing, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. The diagnosis of asbestosis is based on a history of exposure to asbestos, the presence of characteristic radiologic changes, end inspiratory crackles (rales), and other clinical features of fibrosing lung disease. Pleural plaques and thickening are observed on X-rays taken during the early stages of the disease. Asbestosis is often a progressive disease even in the absence of continued exposure, although this appears to be a highly individualized characteristic. In severe cases, death may be caused by respiratory or cardiac failure.

IV. Surveillance and Preventive Considerations

As noted above, exposure to asbestos has been linked to an increased risk of lung cancer, mesothelioma, gastrointestinal cancer, and asbestosis among occupationally exposed workers. Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as cancer, from exposure to asbestos do not presently exist. However, some tests, particularly chest X-rays and pulmonary function tests, may indicate that an employee has been overexposed to asbestos, thus increasing his or her risk of developing exposure-related chronic disease. It is important for the physician to become familiar with the operating conditions in which occupational exposure to asbestos is likely to occur. This is particularly important in evaluating medical and work histories and in conducting physical examinations. When an active employee has been identified as having been overexposed to asbestos, measures taken by the employer to eliminate or mitigate further exposure should also lower the risk of serious long-term consequences.

The employer is required to institute a medical surveillance program for all employees who are or will be exposed to asbestos at or above the permissible exposure limit (0.1 fiber per cubic centimeter of air). All examinations and procedures must be performed by or under the supervision of a licensed physician, at a reasonable time and place, and at no cost to the employee.

Although broad latitude is given to the physician in prescribing specific tests to be included in the medical surveillance program, the following elements in the routine examination are required:

- (i) Medical and work histories with special emphasis directed to symptoms of the respiratory system, cardiovascular system, and digestive tract.
- (ii) Completion of one of the respiratory disease questionnaires contained in Appendix D: Part 1 for the initial examination and part 2 for



- periodic examinations.
- (iii) A physical examination including a chest X-ray (at the discretion of the examining physician for construction work) and pulmonary function testing that includes measurement of the employee's forced vital capacity (FVC) and forced expiratory volume at one second (FEV1).
 - (iv) Any laboratory or other test that the examining physician deems by sound medical practice to be necessary or appropriate.

The employer is required to make the prescribed tests available at least annually to those employees covered; more often than specified if recommended by the examining physician; and upon termination of employment.

The employer is required to provide the physician with the following information: a copy of this standard and appendices; a description of the employee's work assignments as they relate to asbestos exposure; the employee's representative level of exposure to asbestos; a description of any personal protective and respiratory equipment used; and information from previous medical examinations of the affected employee that is not otherwise available to the physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, if required.

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

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix I to section 1529 filed 2-15-91; operative 2-15-91 pursuant to Government Code section 11346.2(d) (Register 91, No. 19).
2. Editorial correction of HISTORY 1. (Register 91, No. 45).
3. Amendment of appendix and Note filed 5-3-96; operative 7-3-96 (Register 96, No. 18).



**California Code of Regulations
Title 8, Section 1529. Asbestos
Appendix J Subchapter 4.
Construction Safety Orders
Article 4. Dusts, Fumes, Mists, Vapors, and Gases**

**Smoking Cessation Program Information
for Asbestos Non-Mandatory**

The following organizations provide smoking cessation information.

1. The National Cancer Institute operates a toll free Cancer Information Service (CIS) with trained personnel to help you. Call 1-800-4-CANCER to reach the CIS office serving your area, or write: Office of Cancer Communications, National Cancer Institute, National Institutes of Health, Building 31 Room 10A24, Bethesda, Maryland 20892.
2. American Cancer Society, 3340 Peachtree Road, N.E., Atlanta, Georgia 30026, (404) 320-3333. The American Cancer Society (ACS) is a voluntary organization composed of 58 divisions and 3,100 local units. Through "The Great American Smokeout" in November, the annual Cancer Crusade in April, and numerous educational materials, ACS helps people learn about the health hazards of smoking and become successful ex-smokers.
3. American Heart Association, 7320 Greenville Avenue, Dallas, Texas 75231, (214) 750-5300. The American Heart Association (AHA) is a voluntary organization with 130,000 members (physicians, scientists, and lay persons) in 55 state and regional groups. AHA produces a variety of publications and audiovisual materials about the effects of smoking on the heart. AHA also has developed a guidebook for incorporating a weight-control component into smoking cessation programs.
4. American Lung Association, 1740 Broadway, New York, New York 10019, (212) 245-8000. A voluntary organization of 7,500 members (physicians, nurses, and lay persons), the American Lung Association (ALA) conducts numerous public information programs about the health effects of smoking. ALA has 59 state and 85 local units. The organization actively supports legislation and information campaigns for non-smokers' rights and provides help for smokers who want to quit, for example, through "Freedom From Smoking," a self-help smoking cessation program.
5. Office on Smoking and Health, U.S. Department of Health and Human



Services, 5600 Fishers Lane, Park Building, Room 110, Rockville, Maryland 20857. The Office on Smoking and Health (OSH) is the Department of Health and Human Services' lead agency in smoking control. OSH has sponsored distribution of publications on smoking-related topics, such as free flyers on relapse after initial quitting, helping a friend or family member quit smoking, the health hazards of smoking, and the effects of parental smoking on teenagers. In Hawaii, on Oahu call 524-1234 (call collect from neighboring islands), Spanish-speaking staff members are available during daytime hours to callers from the following areas: California, Florida, Georgia, Illinois, New Jersey (area code 201), New York, and Texas. Consult your local telephone directory for listings of local chapters.

NOTE: Authority cited: Section 142.3. Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Appendix J to section 1529 filed 5-3-96; operative 7-3-96 (Register 96, No. 18).

California Code of Regulations Title 8, Section 1529. Asbestos Appendix K Subchapter 4. Construction Safety Orders Article 4. Dusts, Fumes, Mists, Vapors, and Gases

Polarized Light Microscopy of Asbestos Non-Mandatory

Method number: ID-191

Matrix: Bulk

Collection Procedure: Collect approximately 1 to 2 grams of each type of material and place into separate 20 mL scintillation vials.

Analytical Procedure: A portion of each separate phase is analyzed by gross examination, phase-polar examination, and central stop dispersion microscopy. Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by USDOL-OSHA. Similar products from other sources may be substituted.



1. Introduction This method describes the collection and analysis of asbestos bulk materials by light microscopy techniques including phase-polar illumination and central-stop dispersion microscopy. Some terms unique to asbestos analysis are defined below:

Amphibole: A family of minerals whose crystals are formed by long, thin units which have two thin ribbons of double chain silicate with a brucite ribbon in between. The shape of each unit is similar to an "I beam". Minerals important in asbestos analysis include cummingtonite-grunerite, crocidolite, tremolite-actinolite and anthophyllite.

Asbestos: A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, cummingtonite-grunerite asbestos (amosite), anthophyllite asbestos, tremolite asbestos, crocidolite, actinolite asbestos and any of these minerals which have been chemically treated or altered. The precise chemical formulation of each species varies with the location from which it was mined. Nominal compositions are listed:

Chrysotile $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$

Crocidolite (Riebeckite asbestos) $\text{Na}_2\text{Fe}_3\text{2Fe}_2\text{3Si}_8\text{O}_{22}(\text{OH})_2$

Cummingtonite-Grunerite asbestos (Amosite) $(\text{Mg},\text{Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$

Tremolite-Actinolite asbestos $\text{Ca}_2(\text{Mg},\text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$

Anthophyllite asbestos $(\text{Mg},\text{Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$

Asbestos Fiber: A fiber of asbestos meeting the criteria for a fiber. (See section 3.5. of this Appendix)

Aspect Ratio: The ratio of the length of a fiber to its diameter usually defined as "length : width", e.g. 3:1.

Brucite: A sheet mineral with the composition $\text{Mg}(\text{OH})_2$.

Central Stop Dispersion Staining (microscope): This is a dark field microscope technique that images particles using only light refracted by the particle, excluding light that travels through the particle unrefracted. This is usually accomplished with a McCrone objective or other arrangement which places a circular stop with apparent aperture equal to the objective aperture in the back focal plane of the microscope.

Cleavage Fragments: Mineral particles formed by the combination of minerals, especially those characterized by relatively parallel sides and moderate aspect ratio.

Differential Counting: The term applied to the practice of excluding



certain kinds of fibers from a phase contrast asbestos count because they are not asbestos.

Fiber: A particle longer than or equal to 5 μm with a length to width ratio greater than or equal to 3:1. This may include cleavage fragments. (see section 3.5 of this appendix).

Phase Contrast: Contrast obtained in the microscope by causing light scattered by small particles to destructively interfere with unscattered light, thereby enhancing the visibility of very small particles and particles with very low intrinsic contrast.

Phase Contrast Microscope: A microscope configured with a phase mask pair to create phase contrast. The technique which uses this is called Phase Contrast Microscopy (PCM).

Phase-Polar Analysis: This is the use of polarized light in a phase contrast microscope. It is used to see the same size fibers that are visible in air filter analysis. Although fibers finer than 1 μm are visible, analysis of these is inferred from analysis of larger bundles that are usually present.

Phase-Polar Microscope: The phase-polar microscope is a phase contrast microscope which has an analyzer, a polarizer, a first order red plate and a rotating phase condenser all in place so that the polarized light image is enhanced by phase contrast.

Sealing Encapsulant: This is a product which can be applied, preferably by spraying, onto an asbestos surface which will seal the surface so that fibers cannot be released.

Serpentine: A mineral family consisting of minerals with the general composition $\text{Mg}_3(\text{Si}_2\text{O}_5)(\text{OH})_4$ having the magnesium in brucite layer over a silicate layer. Minerals important in asbestos analysis included in this family are chrysotile, lizardite, antigorite.

- 1.1. **History** Light microscopy has been used for well over 100 years for the determination of mineral species. This analysis is carried out using specialized polarizing microscopes as well as bright field microscopes. The identification of minerals is an on-going process with many new minerals described each year. The first recorded use of asbestos was in Finland about 2500 B.C. where the material was used in the mud wattle for the wooden huts the people lived in as well as strengthening for pottery. Adverse health aspects of the mineral were noted nearly 2000 years ago



when Pliny the Younger wrote about the poor health of slaves in the asbestos mines. Although known to be injurious for centuries, the first modern references to its toxicity were by the British Labor Inspectorate when it banned asbestos dust from the workplace in 1898.

Asbestosis cases were described in the literature after the turn of the century. Cancer was first suspected in the mid 1930's and a causal link to mesothelioma was made in 1965. Because of the public concern for worker and public safety with the use of this material, several different types of analysis were applied to the determination of asbestos content.

Light microscopy requires a great deal of experience and craft. Attempts were made to apply less subjective methods to the analysis. X-ray diffraction was partially successful in determining the mineral types but was unable to separate out the fibrous portions from the non-fibrous portions. Also, the minimum detection limit for asbestos analysis by X-ray diffraction (XRD) is about 1%. Differential Thermal Analysis (DTA) was no more successful. These provide useful corroborating information when the presence of asbestos has been shown by microscopy; however, neither can determine the difference between fibrous and non-fibrous minerals when both habits are present. The same is true of Infrared Absorption (IR). When electron microscopy was applied to asbestos analysis, hundreds of fibers were discovered present too small to be visible in any light microscope. There are two different types of electron microscope used for asbestos analysis: Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). Scanning Electron Microscopy is useful in identifying minerals. The SEM can provide two of the three pieces of information required to identify fibers by electron microscopy: morphology and chemistry. The third is structure as determined by Selected Area Electron Diffraction -- SAED which is performed in the TEM. Although the resolution of the SEM is sufficient for very fine fibers to be seen, accuracy of chemical analysis that can be performed on the fibers varies with fiber diameter in fibers of less than 0.2 μ m diameter. The TEM is a powerful tool to identify fibers too small to be resolved by light microscopy and should be used in conjunction with this method when necessary. The TEM can provide all three pieces of information required for fiber identification. Most fibers thicker than 1 μ m can adequately be defined in the light microscope. The light microscope remains as the best instrument for the determination of mineral type. This is because the minerals under investigation were first described analytically with the light microscope. It is inexpensive and gives positive identification for most samples analyzed. Further, when optical techniques are inadequate, there is ample indication that alternative techniques should be used for complete identification of the sample.



1.2. Principle Minerals consist of atoms that may be arranged in random order or in a regular arrangement. Amorphous materials have atoms in random order while crystalline materials have long range order. Many materials are transparent to light, at least for small particles or for thin sections. The properties of these materials can be investigated by the effect that the material has on light passing through it. The six asbestos minerals are all crystalline with particular properties that have been identified and cataloged. These six minerals are anisotropic. They have a regular array of atoms, but the arrangement is not the same in all directions. Each major direction of the crystal presents a different regularity. Light photons traveling in each of these main directions will encounter different electrical neighborhoods, affecting the path and time of travel. The techniques outlined in this method use the fact that light traveling through fibers or crystals in different directions will behave differently, but predictably. The behavior of the light as it travels through a crystal can be measured and compared with known or determined values to identify the mineral species. Usually, Polarized Light Microscopy (PLM) is performed with strain-free objectives on a bright-field microscope platform. This would limit the resolution of the microscope to about 0.4 μm . Because OSHA requires the counting and identification of fibers visible in phase contrast, the phase contrast platform is used to visualize the fibers with the polarizing elements added into the light path. Polarized light methods cannot identify fibers finer than about 1 μm in diameter even though they are visible. The finest fibers are usually identified by inference from the presence of larger, identifiable fiber bundles. When fibers are present, but not identifiable by light microscopy, use either SEM or TEM to determine the fiber identity.

1.3. Advantages and Disadvantages

The **advantages** of light microscopy are:

- (a) Basic identification of the materials was first performed by light microscopy and gross analysis. This provides a large base of published information against which to check analysis and analytical technique.
- (b) The analysis is specific to fibers. The minerals present can exist in asbestiform, fibrous, prismatic, or massive varieties all at the same time. Therefore, bulk methods of analysis such as X-ray diffraction, IR analysis, DTA, etc. are inappropriate where the material is not known to be fibrous.
- (c) The analysis is quick, requires little preparation time, and can be performed on-site if a suitably equipped microscope is available.

The **disadvantages** are:

- (a) Even using phase-polar illumination, not all the fibers present may be seen. This is a problem for very low asbestos concentrations where agglomerations or large bundles of fibers may not be present to allow



identification by inference.

- (b) The method requires a great degree of sophistication on the part of the microscopist. An analyst is only as useful as his mental catalog of images. Therefore, a microscopist's accuracy is enhanced by experience. The mineralogical training of the analyst is very important. It is the basis on which subjective decisions are made.
- (c) The method uses only a tiny amount of material for analysis. This may lead to sampling bias and false results (high or low). This is especially true if the sample is severely inhomogeneous.
- (d) Fibers may be bound in a matrix and not distinguishable as fibers so identification cannot be made.

1.4. Method Performance

- 1.4.1. This method can be used for determination of asbestos content from 0 to 100% asbestos. The detection limit has not been adequately determined, although for selected samples, the limit is very low, depending on the number of particles examined. For mostly homogeneous, finely divided samples, with no difficult fibrous interferences, the detection limit is below 1%. For inhomogeneous samples (most samples), the detection limit remains undefined. NIST has conducted proficiency testing of laboratories on a national scale. Although each round is reported statistically with an average, control limits, etc., the results indicate a difficulty in establishing precision especially in the low concentration range. It is suspected that there is significant bias in the low range especially near 1%. EPA tried to remedy this by requiring a mandatory point counting scheme for samples less than 10%. The point counting procedure is tedious, and may introduce significant biases of its own. It has not been incorporated into this method.
- 1.4.2. The precision and accuracy of the quantitation tests performed in this method are unknown. Concentrations are easier to determine in commercial products where asbestos was deliberately added because the amount is usually more than a few percent. An analyst's results can be "calibrated" against the known amounts added by the manufacturer. For geological samples, the degree of homogeneity affects the precision.
- 1.4.3. The performance of the method is analyst dependent. The analyst must choose carefully and not necessarily randomly the portions for analysis to assure that detection of asbestos occurs when it is present. For this reason, the analyst must have adequate training in sample preparation, and experience in the location and identification of asbestos in samples. This is usually accomplished through substantial on-the-job training as well as formal education in mineralogy and microscopy.
- 1.5. **Interferences** Any material which is long, thin, and small enough to be viewed under the microscope can be considered an interference for asbestos. There are literally hundreds of interferences in workplaces. The techniques described in this method are normally sufficient to eliminate the



interferences. An analyst's success in eliminating the interferences depends on proper training. Asbestos minerals belong to two mineral families: the serpentines and the amphiboles. In the serpentine family, the only common fibrous mineral is chrysotile. Occasionally, the mineral antigorite occurs in a fibril habit with morphology similar to the amphiboles. The amphibole minerals consist of a score of different minerals of which only five are regulated by federal standard: amosite, crocidolite, anthophyllite asbestos, tremolite asbestos and actinolite asbestos. These are the only amphibole minerals that have been commercially exploited for their fibrous properties; however, the rest can and do occur occasionally in asbestiform habit. In addition to the related mineral interferences, other minerals common in building material may present a problem for some microscopists: gypsum, anhydrite, brucite, quartz fibers, talc fibers or ribbons, wollastonite, perlite, attapulgite, etc. Other fibrous materials commonly present in workplaces are: fiberglass, mineral wool, ceramic wool, refractory ceramic fibers, kevlar, nomex, synthetic fibers, graphite or carbon fibers, cellulose (paper or wood) fibers, metal fibers, etc. Matrix embedding material can sometimes be a negative interference. The analyst may not be able to easily extract the fibers from the matrix in order to use the method.

Where possible, remove the matrix before the analysis, taking careful note of the loss of weight. Some common matrix materials are: vinyl, rubber, tar, paint, plant fiber, cement, and epoxy. A further negative interference is that the asbestos fibers themselves may be either too small to be seen in Phase contrast Microscopy (PCM) or of a very low fibrous quality, having the appearance of plant fibers. The analyst's ability to deal with these materials increases with experience.

- 1.6. **Uses and Occupational Exposure** Asbestos is ubiquitous in the environment. More than 40% of the land area of the United States is composed of minerals which may contain asbestos. Fortunately, the actual formation of great amounts of asbestos is relatively rare. Nonetheless, there are locations in which environmental exposure can be severe such as in the Serpentine Hills of California. There are thousands of uses for asbestos in industry and the home. Asbestos abatement workers are the most current segment of the population to have occupational exposure to great amounts of asbestos. If the material is undisturbed, there is no exposure. Exposure occurs when the asbestos-containing material is abraded or otherwise disturbed during maintenance operations or some other activity. Approximately 95% of the asbestos in place in the United States is chrysotile. Amosite and crocidolite make up nearly all the difference. Tremolite and anthophyllite make up a very small percentage. Tremolite is found in extremely small amounts in certain chrysotile deposits. Actinolite exposure is probably greatest from environmental sources, but has been identified in vermiculite containing, sprayed-on insulating materials which may have



been certified as asbestos-free.

- 1.7. Physical and Chemical Properties** The nominal chemical compositions for the asbestos minerals were given in **Section 1**. Compared to cleavage fragments of the same minerals, asbestiform fibers possess a high tensile strength along the fiber axis. They are chemically inert, noncombustible, and heat resistant. Except for chrysotile, they are insoluble in Hydrochloric acid (HCl). Chrysotile is slightly soluble in Hcl. Asbestos has high electrical resistance and good sound absorbing characteristics. It can be woven into cables, fabrics or other textiles, or matted into papers, felts, and mats.
- 1.8. Toxicology** (This Section is for Information Only and Should Not Be Taken as OSHA Policy) Possible physiologic results of respiratory exposure to asbestos are mesothelioma of the pleura or peritoneum, interstitial fibrosis, asbestosis, pneumoconiosis, or respiratory cancer. The possible consequences of asbestos exposure are detailed in the NIOSH Criteria Document or in the OSHA Asbestos Standards 29 CFR 1910.1001, 29 CFR 1926.1101, and 29 CFR 1915.1001.
- 2. Sampling Procedure**
- 2.1. Equipment for sampling**
- 2.1.(a)** Tube or cork borer sampling device
- 2.1.(b)** Knife
- 2.1.(c)** 20 mL scintillation vial or similar vial
- 2.1.(d)** Sealing encapsulant
- 2.2. Safety Precautions** Asbestos is a known carcinogen. Take care when sampling. While in an asbestos-containing atmosphere, a properly selected and fit-tested respirator should be worn. Take samples in a manner to cause the least amount of dust. Follow these general guidelines:
- 2.2.(a)** Do not make unnecessary dust.
- 2.2.(b)** Take only a small amount (1 to 2 g).
- 2.2.(c)** Tightly close the sample container.
- 2.2.(d)** Use encapsulant to seal the spot where the sample was taken, if necessary.
- 2.3. Sampling Procedure** Samples of any suspect material should be taken from an inconspicuous place. Where the material is to remain, seal the sampling wound with an encapsulant to eliminate the potential for exposure from the sample site. Microscopy requires only a few milligrams of material. The amount that will fill a 20 mL scintillation vial is more than adequate. Be sure to collect samples from all layers and phases of material. If possible, make separate samples of each different phase of the material. This will aid in determining the actual hazard.



DO NOT USE ENVELOPES, PLASTIC OR PAPER BAGS OF ANY KIND TO COLLECT SAMPLES.

The use of plastic bags presents a contamination hazard to laboratory personnel and to other samples. When these containers are opened, a bellows effect blows fibers out of the container onto everything, including the person opening the container. If a cork-borer type sampler is available, push the tube through the material all the way, so that all layers of material are sampled. Some samplers are intended to be disposable. These should be capped and sent to the laboratory. If a non-disposable cork borer is used, empty the contents into a scintillation vial and send to the laboratory. Vigorously and completely clean the cork borer between samples.

- 2.4.** **Shipment** Samples packed in glass vials must not touch or they might break in shipment.
- 2.4.(a)** Seal the samples with a sample seal over the end to guard against tampering and to identify the sample.
- 2.4.(b)** Package the bulk samples in separate packages from the air samples. They may cross-contaminate each other and will invalidate the results of the air samples.
- 2.4.(c)** Include identifying paperwork with the samples, but not in contact with the suspected asbestos.
- 2.4.(d)** To maintain sample accountability, ship the samples by certified mail, overnight express, or hand carry them to the laboratory.

3. Analysis

The analysis of asbestos samples can be divided into two major parts: sample preparation and microscopy. Because of the different asbestos uses that may be encountered by the analyst, each sample may need different preparation steps. The choices are outlined below. There are several different tests that are performed to identify the asbestos species and determine the percentage. They will be explained below.

- 3.1.** **Safety**
- 3.1.(a)** Do not create unnecessary dust. Handle the samples in HEPA filter equipped hoods. If samples are received in bags, envelopes or other inappropriate container, open them only in a hood having a face velocity at or greater than 100 fpm. Transfer a small amount to a scintillation vial and only handle the smaller amount.
- 3.1.(b)** Open samples in a hood, never in the open lab area.
- 3.1.(c)** Index of refraction oils can be toxic. Take care not to get this material on the skin. Wash immediately with soap and water if this happens.
- 3.1.(d)** Samples that have been heated in the muffle furnace or the drying oven may be hot. Handle them with tongs until they are cool enough to handle.



- 3.1.(e)** Some of the solvents used, such as THF (tetrahydrofuran), are toxic and should only be handled in an appropriate fume hood and according to instructions given in the Material Safety Data Sheet (MSDS).
- 3.2. Equipment**
- 3.2.(a)** Phase contrast microscope with 10x, 16x and 40x objectives, 10x wide-field eyepieces, G-22 Walton-Beckett graticule, Whipple disk, polarizer, analyzer and first order red or gypsum plate, 100 Watt illuminator, rotating position condenser with oversize phase rings, central stop dispersion objective, Kohler illumination and a rotating mechanical stage. (see Figure 1. of this appendix)
- 3.2.(b)** Stereo microscope with reflected light illumination, transmitted light illumination, polarizer, analyzer and first order red or gypsum plate, and rotating stage.
- 3.2.(c)** Negative pressure hood for the stereo microscope
- 3.2.(d)** Muffle furnace capable of 600 deg.C
- 3.2.(e)** Drying oven capable of 50 -- 150 deg.C
- 3.2.(f)** Aluminum specimen pans
- 3.2.(g)** Tongs for handling samples in the furnace
- 3.2.(h)** High dispersion index of refraction oils (Special for dispersion staining.)
 n = 1.550
 n = 1.585
 n = 1.590
 n = 1.605
 n = 1.620
 n = 1.670
 n = 1.680
 n = 1.690
- 3.2.(i)** A set of index of refraction oils from about n=1.350 to n=2.000 in n=0.005 increments. (Standard for Becke line analysis.)
- 3.2.(j)** Glass slides with painted or frosted ends 1x3 inches 1mm thick, precleaned.
- 3.2.(k)** Cover Slips 22x22 mm, #1 1/2
- 3.2.(l)** Paper clips or dissection needles
- 3.2.(m)** Hand grinder
- 3.2.(n)** Scalpel with both #10 and #11 blades
- 3.2.(o)** 0.1 molar HCl
- 3.2.(p)** Decalcifying solution (Baxter Scientific Products)
 Ethylenediaminetetraacetic Acid, Tetrasodium 0.7 g/l
 Sodium Potassium Tartrate 8.0 mg/liter Hydrochloric Acid
 99.2 g/liter Sodium Tartrate 0.14 g/liter
- 3.2.(q)** Tetrahydrofuran (THF)
- 3.2.(r)** Hotplate capable of 60 deg.C



- 3.2.(s) Balance
- 3.2.(t) Hacksaw blade
- 3.2.(u) Ruby mortar and pestle
- 3.3. **Sample Pre-Preparation** Sample preparation begins with pre-preparation which may include chemical reduction of the matrix, heating the sample to dryness or heating in the muffle furnace. The end result is a sample which has been reduced to a powder that is sufficiently fine to fit under the cover slip. Analyze different phases of samples separately, e.g., tile and the tile mastic should be analyzed separately as the mastic may contain asbestos while the tile may not.
- 3.3.(a) **Wet Samples** – Samples with a high water content will not give the proper dispersion colors and must be dried prior to sample mounting. Remove the lid of the scintillation vial, place the bottle in the drying oven and heat at 100 deg.C to dryness (usually about 2 h). Samples which are not submitted to the lab in glass must be removed and placed in glass vials or aluminum weighing pans before placing them in the drying oven.
- 3.3.(b) **Samples With Organic Interference – Muffle Furnace** These may include samples with tar as a matrix, vinyl asbestos tile, or any other organic that can be reduced by heating. Remove the sample from the vial and weigh in a balance to determine the weight of the submitted portion. Place the sample in a muffle furnace at 500 deg.C for 1 to 2 hrs. or until all obvious organic material has been removed. Retrieve, cool and weigh again to determine the weight loss on ignition. This is necessary to determine the asbestos content of the submitted sample, because the analyst will be looking at a reduced sample. Heating above 600 deg.C will cause the sample to undergo a structural change which, given sufficient time, will convert the chrysotile to forsterite. Heating even at lower temperatures for 1 to 2 h may have a measurable effect on the optical properties of the minerals. If the analyst is unsure of what to expect, a sample of standard asbestos should be heated to the same temperature for the same length of time so that it can be examined for the proper interpretation.
- 3.3.(c) **Samples With Organic Interference – THF** Vinyl asbestos tile is the most common material treated with this solvent, although, substances containing tar will sometimes yield to this treatment. Select a portion of the material and then grind it up if possible. Weigh the sample and place it in a test tube. Add sufficient THF to dissolve the organic matrix. This is usually about 4 to 5 mL. Remember, THF is highly flammable. Filter the remaining material through a tared silver membrane, dry and weigh to determine how much is left after the solvent extraction. Further process the sample to remove carbonate or mount directly.



- 3.3.(d) Samples With Carbonate Interference** Carbonate material is often found on fibers and sometimes must be removed in order to perform dispersion microscopy. Weigh out a portion of the material and place it in a test tube. Add a sufficient amount of 0.1 M HCl or decalcifying solution in the tube to react all the carbonate as evidenced by gas formation; i.e., when the gas bubbles stop, add a little more solution. If no more gas forms, the reaction is complete. Filter the material out through a tared silver membrane, dry and weigh to determine the weight lost.
- 3.4. Sample Preparation** Samples must be prepared so that accurate determination can be made of the asbestos type and amount present. The following steps are carried out in the low-flow hood (a low-flow hood has less than 50 fpm flow):
- 3.4.(1)** If the sample has large lumps, is hard, or cannot be made to lie under a cover slip, the grain size must be reduced. Place a small amount between two slides and grind the material between them or grind a small amount in a clean mortar and pestle. The choice of whether to use an alumina, ruby, or diamond mortar depends on the hardness of the material. Impact damage can alter the asbestos mineral if too much mechanical shock occurs. (Freezer mills can completely destroy the observable crystallinity of asbestos and should not be used). For some samples, a portion of material can be shaved off with a scalpel, ground off with a hand grinder or hack saw blade. The preparation tools should either be disposable or cleaned thoroughly. Use vigorous scrubbing to loosen the fibers during the washing. Rinse the implements with copious amounts of water and air-dry in a dust-free environment.
- 3.4.(2)** If the sample is powder or has been reduced as in (1) above, it is ready to mount. Place a glass slide on a piece of optical tissue and write the identification on the painted or frosted end. Place two drops of index of refraction medium $n=1.550$ on the slide. (The medium $n=1.550$ is chosen because it is the matching index for chrysotile. Dip the end of a clean paper-clip or dissecting needle into the droplet of refraction medium on the slide to moisten it. Then dip the probe into the powder sample. Transfer what sticks on the probe to the slide. The material on the end of the probe should have a diameter of about 3 mm for a good mount. If the material is very fine, less sample may be appropriate. For non-powder samples such as fiber mats, forceps should be used to transfer a small amount of material to the slide. Stir the material in the medium on the slide, spreading it out and making the preparation as uniform as possible. Place a cover-slip on the preparation by gently lowering onto the slide and allowing it to fall "trapdoor" fashion on the preparation to push out any bubbles. Press gently on the cover slip to



even out the distribution of particulate on the slide. If there is insufficient mounting oil on the slide, one or two drops may be placed near the edge of the coverslip on the slide. Capillary action will draw the necessary amount of liquid into the preparation. Remove excess oil with the point of a laboratory wiper. Treat at least two different areas of each phase in this fashion. Choose representative areas of the sample. It may be useful to select particular areas or fibers for analysis. This is useful to identify asbestos in severely inhomogeneous samples. When it is determined that amphiboles may be present, repeat the above process using the appropriate high-dispersion oils until an identification is made or all six asbestos minerals have been ruled out. Note that percent determination must be done in the index medium 1.550 because amphiboles tend to disappear in their matching mediums.

3.5. Analytical Procedure This method presumes some knowledge of mineralogy and optical petrography. The analysis consists of three parts: The determination of whether there is asbestos present, what type is present and the determination of how much is present. The general flow of the analysis is:

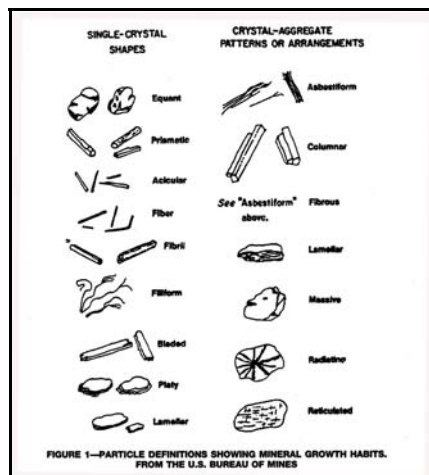
3.5.(1) Gross examination.

3.5.(2) Examination under polarized light on the stereo microscope.

3.5.(3) Examination by phase-polar illumination on the compound phase microscope.

3.5.(4) Determination of species by dispersion stain. Examination by Becke line analysis may also be used; however, this is usually more cumbersome for asbestos determination.

3.5.(5) Difficult samples may need to be analyzed by SEM or TEM, or the results from those techniques combined with light microscopy for a definitive identification. Identification of a particle as asbestos requires that it be asbestiform. Description of particles should follow the suggestion of Campbell. (Figure 1 of this appendix)





For the purpose of regulation, the mineral must be one of the six minerals covered and must be in the asbestos growth habit. Large specimen samples of asbestos generally have the gross appearance of wood. Fibers are easily parted from it.

Asbestos fibers are very long compared with their widths. The fibers have a very high tensile strength as demonstrated by bending without breaking. Asbestos fibers exist in bundles that are easily parted, show longitudinal fine structure and may be tufted at the ends showing "bundle of sticks" morphology. In the microscope some of these properties may not be observable. Amphiboles do not always show striations along their length even when they are asbestos. Neither will they always show tufting. They generally do not show a curved nature except for very long fibers. Asbestos and asbestiform minerals are usually characterized in groups by extremely high aspect ratios (greater than 100:1). While aspect ratio analysis is useful for characterizing populations of fibers, it cannot be used to identify individual fibers of intermediate to short aspect ratio. Observation of many fibers is often necessary to determine whether a sample consists of "cleavage fragments" or of asbestos fibers. Most cleavage fragments of the asbestos minerals are easily distinguishable from true asbestos fibers. This is because true cleavage fragments usually have larger diameters than 1 μm . Internal structure of particles larger than this usually shows them to have no internal fibrillar structure.

In addition, cleavage fragments of the monoclinic amphiboles show inclined extinction under crossed polars with no compensator. Asbestos fibers usually show extinction at zero degrees or ambiguous extinction if any at all. Morphologically, the larger cleavage fragments are obvious by their blunt or stepped ends showing prismatic habit. Also, they tend to be circular rather than filiform. Where the particles are less than 1 μm in diameter and have an aspect ratio greater than or equal to 3:1, it is recommended that the sample be analyzed by SEM or TEM if there is any question whether the fibers are cleavage fragments or asbestiform particles. Care must be taken when analyzing by electron microscopy because the interferences are different from those in light microscopy and may structurally be very similar to asbestos. The classic interference is between anthophyllite and biopyribole or intermediate fiber. Use the same morphological clues for electron microscopy as are used for light microscopy, e.g. fibril splitting, internal longitudinal striation, fraying, curvature, etc.

(1) Gross Examination: Examine the sample, preferably in the glass vial. Determine the presence of any obvious fibrous component. Estimate a percentage based on previous experience and current observation. Determine whether any pre-preparation is necessary. Determine the number of phases present. This step may be carried out or augmented by observation at 6 to 40 x under a stereo microscope.



- (2) After performing any necessary pre-preparation, prepare slides of each phase as described above. Two preparations of the same phase in the same index medium can be made side-by-side on the same glass for convenience. Examine with the polarizing stereo microscope. Estimate the percentage of asbestos based on the amount of birefringent fiber present.
- (3) Examine the slides on the phase-polar microscopes at magnifications of 160 and 400x. Note the morphology of the fibers. Long, thin, very straight fibers with little curvature are indicative of fibers from the amphibole family. Curved, wavy fibers are usually indicative of chrysotile. Estimate the percentage of asbestos on the phase-polar microscope under conditions of crossed polars and a gypsum plate. Fibers smaller than 1.0 μ m in thickness must be identified by inference to the presence of larger, identifiable fibers and morphology. If no larger fibers are visible, electron microscopy should be performed. At this point, only a tentative identification can be made. Full identification must be made with dispersion microscopy. Details of the tests are included in the appendices.
- (4) Once fibers have been determined to be present, they must be identified. Adjust the microscope for dispersion mode and observe the fibers. The microscope has a rotating stage, one polarizing element, and a system for generating dark-field dispersion microscopy (see Section 4.6. of this appendix). Align a fiber with its length parallel to the polarizer and note the color of the Becke lines. Rotate the stage to bring the fiber length perpendicular to the polarizer and note the color. Repeat this process for every fiber or fiber bundle examined. The colors must be consistent with the colors generated by standard asbestos reference materials for a positive identification. In $n=1.550$, amphiboles will generally show a yellow to straw-yellow color indicating that the fiber indices of refraction are higher than the liquid. If long, thin fibers are noted and the colors are yellow, prepare further slides as above in the suggested matching liquids listed below:

Type of asbestos Index of refraction:

Chrysotile $n = 1.550$.

Amosite $n = 1.670$ or 1.680 .

Crocidolite $n = 1.690$.

Anthophyllite $n = 1.605$ and 1.620 .

Tremolite $n = 1.605$ and 1.620 .

Actinolite $n = 1.620$.

Where more than one liquid is suggested, the first is preferred; however, in some cases this liquid will not give good dispersion color. Take care to avoid interferences in the other liquid; e.g., wollastonite in $n=1.620$ will give the same colors as tremolite. In $n=1.605$ wollastonite will appear yellow in all directions. Wollastonite may be determined under crossed polars as it will



change from blue to yellow as it is rotated along its fiber axis by tapping on the cover slip. Asbestos minerals will not change in this way. Determination of the angle of extinction may, when present, aid in the determination of anthophyllite from tremolite. True asbestos fibers usually have 0 deg. extinction or ambiguous extinction, while cleavage fragments have more definite extinction. Continue analysis until both preparations have been examined and all present species of asbestos are identified. If there are no fibers present, or there is less than 0.1% present, end the analysis with the minimum number of slides (2).

(5) Some fibers have a coating on them which makes dispersion microscopy very difficult or impossible. Becke line analysis or electron microscopy may be performed in those cases. Determine the percentage by light microscopy. TEM analysis tends to overestimate the actual percentage present.

(6) Percentage determination is an estimate of occluded area, tempered by gross observation. Gross observation information is used to make sure that the high magnification microscopy does not greatly over-or under-estimate the amount of fiber present. This part of the analysis requires a great deal of experience. Satisfactory models for asbestos content analysis have not yet been developed, although some models based on metallurgical grain-size determination have found some utility. Estimation is more easily handled in situations where the grain sizes visible at about 160x are about the same and the sample is relatively homogeneous. View all of the area under the cover slip to make the percentage determination. View the fields while moving the stage, paying attention to the clumps of material. These are not usually the best areas to perform dispersion microscopy because of the interference from other materials. But, they are the areas most likely to represent the accurate percentage in the sample. Small amounts of asbestos require slower scanning and more frequent analysis of individual fields.

Report the area occluded by asbestos as the concentration. This estimate does not generally take into consideration the difference in density of the different species present in the sample. For most samples this is adequate. Simulation studies with similar materials must be carried out to apply microvisual estimation for that purpose and is beyond the scope of this procedure.

(7) Where successive concentrations have been made by chemical or physical means, the amount reported is the percentage of the material in the "as submitted" or original state. The percentage determined by microscopy is multiplied by the fractions remaining after pre-preparation steps to give the percentage in the original sample. For example:

Step 1. 60% remains after heating at 550 deg.C for 1 h.

Step 2. 30% of the residue of step 1 remains after dissolution of carbonate in 0.1 m HCl.

Step 3. Microvisual estimation determines that 5% of the sample is



chrysotile asbestos.

The reported result is:

$$R = (\text{Microvisual result in percent}) \times (\text{Fraction remaining after step 2}) \\ \times (\text{Fraction remaining of original sample after step 1}) \\ R = (5) \times (.30) \times (.60) = 0.9\%$$

(8) Report the percent and type of asbestos present. For samples where asbestos was identified, but is less than 1.0%, report "Asbestos present, less than 1.0%." There must have been at least two observed fibers or fiber bundles in the two preparations to be reported as present. For samples where asbestos was not seen, report as "None Detected."

Auxiliary Information Because of the subjective nature of asbestos analysis, certain concepts and procedures need to be discussed in more depth. This information will help the analyst understand why some of the procedures are carried out the way they are.

4. 1. **Light** Light is electromagnetic energy. It travels from its source in packets called quanta. It is instructive to consider light as a plane wave. The light has a direction of travel. Perpendicular to this and mutually perpendicular to each other, are two vector components. One is the magnetic vector and the other is the electric vector. We shall only be concerned with the electric vector. In this description, the interaction of the vector and the mineral will describe all the observable phenomena. From a light source such a microscope illuminator, light travels in all different direction from the filament. In any given direction away from the filament, the electric vector is perpendicular to the direction of travel of a light ray. While perpendicular, its orientation is random about the travel axis. If the electric vectors from all the light rays were lined up by passing the light through a filter that would only let light rays with electric vectors oriented in one direction pass, the light would then be POLARIZED. Polarized light interacts with matter in the direction of the electric vector. This is the polarization direction. Using this property it is possible to use polarized light to probe different materials and identify them by how they interact with light.

The speed of light in a vacuum is a constant at about 2.99×10^8 m/s. When light travels in different materials such as air, water, minerals or oil, it does not travel at this speed. It travels slower. This slowing is a function of both the material through which the light is traveling and the wavelength or frequency of the light. In general, the more dense the material, the slower the light travels. Also, generally, the higher the frequency, the slower the light will travel. The ratio of the speed of light in a vacuum to that in a material is called the index of refraction (n). It is usually measured at 589 nm (the sodium D line). If white light (light containing all the visible wavelengths) travels through a material, rays of longer wavelengths will travel faster than those of shorter wavelengths, this separation is called dispersion. Dispersion



is used as an identifier of materials as described in Section 4.6.

- 4.2. Material Properties** Materials are either amorphous or crystalline. The difference between these two descriptions depends on the positions of the atoms in them. The atoms in amorphous materials are randomly arranged with no long range order. An example of an amorphous material is glass. The atoms in crystalline materials, on the other hand, are in regular arrays and have long range order. Most of the atoms can be found in highly predictable locations. Examples of crystalline material are salt, gold, and the asbestos minerals. It is beyond the scope of this method to describe the different types of crystalline materials that can be found, or the full description of the classes into which they can fall. However, some general crystallography is provided below to give a foundation to the procedures described. With the exception of anthophyllite, all the asbestos minerals belong to the monoclinic crystal type. The unit cell is the basic repeating unit of the crystal and for monoclinic crystals can be described as having three unequal sides, two 90 deg. angles and one angle not equal to 90 deg.. The orthorhombic group, of which anthophyllite is a member has three unequal sides and three 90 deg. angles. The unequal sides are a consequence of the complexity of fitting the different atoms into the unit cell. Although the atoms are in a regular array, that array is not symmetrical in all directions. There is long range order in the three major directions of the crystal. However, the order is different in each of the three directions. This has the effect that the index of refraction is different in each of the three directions.

Using polarized light, we can investigate the index of refraction in each of the directions and identify the mineral or material under investigation. The indices alpha, beta, and gamma are used to identify the lowest, middle, and highest index of refraction respectively. The x direction, associated with alpha is called the fast axis. Conversely, the z direction is associated with gamma and is the slow direction. Crocidolite has alpha along the fiber length making it "length-fast". The remainder of the asbestos minerals have the gamma axis along the fiber length. They are called "length-slow". This orientation to fiber length is used to aid in the identification of asbestos.

- 4.3. Polarized Light Technique** Polarized light microscopy as described in this section uses the phase-polar microscope described in Section 3.2. A phase contrast microscope is fitted with two polarizing elements, one below and one above the sample. The polarizers have their polarization directions at right angles to each other. Depending on the tests performed, there may be a compensator between these two polarizing elements. A compensator is a piece of mineral with known properties that "compensates" for some deficiency in the optical train. Light emerging from a polarizing element has its electric vector pointing in the polarization direction of the element. The light will not be subsequently transmitted through a second element set at a right angle to the first element. Unless the light is altered as it passes from



one element to the other, there is no transmission of light.

- 4.4. Angle of Extinction** Crystals which have different crystal regularity in two or three main directions are said to be anisotropic. They have a different index of refraction in each of the main directions. When such a crystal is inserted between the crossed polars, the field of view is no longer dark but shows the crystal in color. The color depends on the properties of the crystal. The light acts as if it travels through the crystal along the optical axes. If a crystal optical axis were lined up along one of the polarizing directions (either the polarizer or the analyzer) the light would appear to travel only in that direction, and it would blink out or go dark. The difference in degrees between the fiber direction and the angle at which it blinks out is called the angle of extinction. When this angle can be measured, it is useful in identifying the mineral. The procedure for measuring the angle of extinction is to first identify the polarization direction in the microscope. A commercial alignment slide can be used to establish the polarization directions or use anthophyllite or another suitable mineral. This mineral has a zero degree angle of extinction and will go dark to extinction as it aligns with the polarization directions. When a fiber of anthophyllite has gone to extinction, align the eyepiece reticle or graticule with the fiber so that there is a visual cue as to the direction of polarization in the field of view. Tape or otherwise secure the eyepiece in this position so it will not shift.

After the polarization direction has been identified in the field of view, move the particle of interest to the center of the field of view and align it with the polarization direction. For fibers, align the fiber along this direction. Note the angular reading of the rotating stage. Looking at the particle, rotate the stage until the fiber goes dark or "blinks out". Again note the reading of the stage. The difference in the first reading and the second is an angle of extinction.

The angle measured may vary as the orientation of the fiber changes about its long axis. Tables of mineralogical data usually report the maximum angle of extinction. Asbestos forming minerals, when they exhibit an angle of extinction, usually do show an angle of extinction close to the reported maximum, or as appropriate depending on the substitution chemistry.

- 4.5. Crossed Polars with Compensator** When the optical axes of a crystal are not lined up along one of the polarizing directions (either the polarizer or the analyzer) part of the light travels along one axis and part travels along the other visible axis. This is characteristic of birefringent materials. The color depends on the difference of the two visible indices of refraction and the thickness of the crystal. The maximum difference available is the difference between the alpha and the gamma axes. This maximum difference is usually tabulated as the birefringence of the crystal. For this test, align the fiber at 45 deg. to the polarization directions in order to maximize the contribution to each of the optical axes. The colors seen are called retardation colors. They



arise from the recombination of light which has traveled through the two separate directions of the crystal. One of the rays is retarded behind the other since the light in that direction travels slower.

On recombination, some of the colors which make up white light are enhanced by constructive interference and some are suppressed by destructive interference. The result is a color dependent on the difference between the indices and the thickness of the crystal. The proper colors, thicknesses, and retardations are shown on a Michel-Levy chart. The three items, retardation, thickness and birefringence are related by the following relationship:

$$R = t (n_{\gamma} - n_{\alpha})$$

R = retardation, t = crystal thickness in :m, and
n_{alpha}, n_{gamma} = indices of refraction.

Examination of the equation for asbestos minerals reveals that the visible colors for almost all common asbestos minerals and fiber sizes are shades of gray and black. The eye is relatively poor at discriminating different shades of gray. It is very good at discriminating different colors. In order to compensate for the low retardation, a compensator is added to the light train between the polarization elements. The compensator used for this test is a gypsum plate of known thickness and birefringence. Such a compensator when oriented at 45 deg. to the polarizer direction, provides a retardation of 530 nm of the 530 nm wavelength color. This enhances the red color and gives the background a characteristic red to red-magenta color. If this "full-wave" compensator is in place when the asbestos preparation is inserted into the light train, the colors seen on the fibers are quite different.

Gypsum, like asbestos has a fast axis and a slow axis. When a fiber is aligned with its fast axis in the same direction as the fast axis of the gypsum plate, the ray vibrating in the slow direction is retarded by both the asbestos and the gypsum. This results in a higher retardation than would be present for either of the two minerals. The color seen is a second order blue. When the fiber is rotated 90 deg. using the rotating stage, the slow direction of the fiber is now aligned with the fast direction of the gypsum and the fast direction of the fiber is aligned with the slow direction of the gypsum. Thus, one ray vibrates faster in the fast direction of the gypsum, and slower in the slow direction of the fiber; the other ray will vibrate slower in the slow direction of the gypsum and faster in the fast direction of the fiber. In this case, the effect is subtractive and the color seen is a first order yellow. As long as the fiber thickness does not add appreciably to the color, the same basic colors will be seen for all asbestos types except crocidolite. In crocidolite the colors will be weaker, may be in the opposite directions, and will be altered by the blue absorption color natural to crocidolite. Hundreds of other materials will give the same colors as asbestos, and therefore, this test is not definitive for asbestos. The test is useful in discriminating against fiberglass or other



amorphous fibers such as some synthetic fibers. Certain synthetic fibers will show retardation colors different than asbestos; however, there are some forms of polyethylene and aramid which will show morphology and retardation colors similar to asbestos minerals. This test must be supplemented with a positive identification test when birefringent fibers are present which cannot be excluded by morphology. This test is relatively ineffective for use on fibers less than 1 μm in diameter. For positive confirmation TEM or SEM should be used if no larger bundles or fibers are visible.

- 4.6. Dispersion Staining** Dispersion microscopy or dispersion staining is the method of choice for the identification of asbestos in bulk materials. Becke line analysis is used by some laboratories and yields the same results as does dispersion staining for asbestos and can be used in lieu of dispersion staining. Dispersion staining is performed on the same platform as the phase-polar analysis with the analyzer and compensator removed. One polarizing element remains to define the direction of the light so that the different indices of refraction of the fibers may be separately determined. Dispersion microscopy is a dark-field technique when used for asbestos. Particles are imaged with scattered light. Light which is unscattered is blocked from reaching the eye either by the back field image mask in a McCrone objective or a back field image mask in the phase condenser. The most convenient method is to use the rotating phase condenser to move an oversized phase ring into place. The ideal size for this ring is for the central disk to be just larger than the objective entry aperture as viewed in the back focal plane. The larger the disk, the less scattered light reaches the eye. This will have the effect of diminishing the intensity of dispersion color and will shift the actual color seen. The colors seen vary even on microscopes from the same manufacturer. This is due to the different bands of wavelength exclusion by different mask sizes. The mask may either reside in the condenser or in the objective back focal plane. It is imperative that the analyst determine by experimentation with asbestos standards what the appropriate colors should be for each asbestos type. The colors depend also on the temperature of the preparation and the exact chemistry of the asbestos. Therefore, some slight differences from the standards should be allowed. This is not a serious problem for commercial asbestos uses. This technique is used for identification of the indices of refraction for fibers by recognition of color. There is no direct numerical readout of the index of refraction. Correlation of color to actual index of refraction is possible by referral to published conversion tables. This is not necessary for the analysis of asbestos. Recognition of appropriate colors along with the proper morphology are deemed sufficient to identify the commercial asbestos minerals. Other techniques including SEM, TEM, and XRD may be required to provide additional information in order to identify other types of asbestos



Make a preparation in the suspected matching high dispersion oil, e.g., $n=1.550$ for chrysotile. Perform the preliminary tests to determine whether the fibers are birefringent or not. Take note of the morphological character. Wavy fibers are indicative of chrysotile while long, straight, thin, frayed fibers are indicative of amphibole asbestos. This can aid in the selection of the appropriate matching oil. The microscope is set up and the polarization direction is noted as in Section 4.4. Align a fiber with the polarization direction. Note the color. This is the color parallel to the polarizer. Then rotate the fiber rotating the stage 90 deg. so that the polarization direction is across the fiber. This is the perpendicular position. Again note the color. Both colors must be consistent with standard asbestos minerals in the correct direction for a positive identification of asbestos. If only one of the colors is correct while the other is not, the identification is not positive. If the colors in both directions are bluish-white, the analyst has chosen a matching index oil which is higher than the correct matching oil, e.g. the analyst has used $n=1.620$ where chrysotile is present. The next lower oil (Section 3.5.) should be used to prepare another specimen. If the color in both directions is yellow-white to straw-yellow-white, this indicates that the index of the oil is lower than the index of the fiber, e.g. the preparation is in $n=1.550$ while anthophyllite is present. Select the next higher oil (Section 3.5.) and prepare another slide. Continue in this fashion until a positive identification of all asbestos species present has been made or all possible asbestos species have been ruled out by negative results in this test. Certain plant fibers can have similar dispersion colors as asbestos. Take care to note and evaluate the morphology of the fibers or remove the plant fibers in pre-preparation. Coating material on the fibers such as carbonate or vinyl may destroy the dispersion color. Usually, there will be some outcropping of fiber which will show the colors sufficient for identification. When this is not the case, treat the sample as described in Section 3.3. and then perform dispersion staining. Some samples will yield to Becke line analysis if they are coated or electron microscopy can be used for identification.

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NOTE: Authority cited: Section 142.3. Labor Code. Reference: Section 142.3, Labor Code.

HISTORY: 1. New Appendix K to section 1529 filed 5-3-96; operative 7-3-96 (Register 96, No. 18).



State of Utah

Rule R307-801. Asbestos.

As in effect on March 1, 2002

Table of Contents

R307-801-1.	Purpose and Authority.	page 2
R307-801-2.	Applicability and General Provisions.	page 2
R307-801-3.	Definitions.	page 2
R307-801-4.	Adoption and Implementation of TSCA Title II.	page 6
R307-801-5.	Company Certifications.	page 6
R307-801-6.	Individual Certification.	page 6
R307-801-7.	Denial and Cause for Suspension and Revocation of Company and Individual Certifications.	page 7
R307-801-8.	Approval of Training Courses.	page 7
R307-801-9.	Renovation and Demolition: Requirement to Inspect.	page 9
R307-801-10.	Renovation and Demolition: Asbestos Inspection Procedures.	page 9
R307-801-11.	Renovation and Demolition: Notification and Asbestos Removal Requirements.	page 10
R307-801-12.	Renovation and Demolition: Notification Procedures and Contents.	page 12
R307-801-13.	Renovation and Demolition: Requirements for Certified Workers.	page 14
R307-801-14.	Renovation and Demolition: Asbestos Work Practices.	page 15
R307-801-15.	Disposal and Handling of Asbestos Waste.	page 18
R307-801-16.	Records.	page 19

KEY

Date of Enactment or Last Substantive Amendment

Notice of Continuation

Authorizing, Implemented, or Interpreted Law



R307-801-1. Purpose and Authority.

Rule R307-801 establishes procedures and requirements for asbestos projects and training programs, procedures, and requirements for the certification of persons engaged in asbestos activities and work practice standards for performing such activities. This rule is promulgated under the authority of 19-2-104(1)(d), (3)(r), (3)(s), (3)(t). Penalties are authorized by 19-2-115.

R307-801-2. Applicability and General Provisions.

(1) Applicability.

- (1)(a)** The following persons are operators and are subject to the requirements of R307-801:
 - (1)(a)(i)** Persons who contract for hire to conduct renovation of structures or facilities, or to conduct demolition of structures or facilities, except for residential outbuilding structures of less than 100 square feet;
 - (1)(a)(ii)** Persons who conduct renovation or demolition in areas to which the general public has unrestrained access; or
 - (1)(a)(iii)** Persons who conduct renovation or demolition in school buildings subject to AHERA or who conduct asbestos inspections in structures subject to TSCA Title II.
- (1)(b)** The following persons are subject to certification requirements:
 - (1)(b)(i)** Persons required by TSCA Title II to be accredited as inspectors, management planners, project designers, supervisors, or workers;
 - (1)(b)(ii)** Persons who work on an asbestos project as workers, supervisors, inspectors, project designers, or management planners; and
 - (1)(b)(iii)** Companies that conduct asbestos projects or inspections, create project designs, or prepare management plans in structures or facilities.
- (2)** All persons who are required by R307-801 to obtain an approval, certification, determination or notification from the executive secretary must obtain it in writing.
- (3)** Persons wishing to deviate from the certification, notification, work practice, or other requirements of R307-801 may do so only after requesting and obtaining the written approval of the executive secretary.

R307-801-3. Definitions.

The following definitions apply to R307-801:

"Adequately Wet" means sufficiently mix or penetrate with liquid to prevent the



release of particulates. If visible emissions are observed coming from asbestos-containing material, then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet.

"Amended Water" means a mixture of water and a chemical wetting agent that provides control of asbestos fiber release.

"AHERA" means the federal Asbestos Hazard Emergency Response Act of 1986 and the Environmental Protection Agency implementing regulations, 40 CFR Part 763, Subpart E - Asbestos-Containing Materials in Schools.

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

"Asbestos Containing Material (ACM)" means any material containing more than one percent (1%) asbestos by the method specified in Appendix A, Subpart F, 40 CFR Part 763 Section 1, Polarized Light Microscopy (PLM), or, if the asbestos content is less than 10%, the asbestos concentration must be determined by point counting using PLM procedure.

"Asbestos Inspection" means any activity undertaken to determine the presence or location, or to assess the condition, of asbestos-containing material or suspected asbestos-containing material, whether by visual or physical examination, or by taking samples of the material. This term includes re-inspections of the type described in AHERA, 40 CFR 763.85(b), of known or assumed asbestos-containing material which has been previously identified. The term does not include the following:

- (a) Periodic surveillance of the type described in AHERA, 40 CFR 763.92(b), solely for the purpose of recording or reporting a change in the condition of known or assumed asbestos-containing material;
- (b) Inspections performed by employees or agents of federal, state, or local government solely for the purpose of determining compliance with applicable statutes or regulations; or
- (c) Visual inspections of the type described in AHERA, 40 CFR 763.90(i), solely for the purpose of determining completion of response actions.

"Asbestos Project" means any activity involving the removal, renovation, repair, demolition, salvage, disposal, cleanup, or other disturbance of regulated asbestos-containing material greater than small scale short duration.

"Asbestos Removal" means the stripping of friable asbestos-containing material from surfaces or components of a structure or taking out structural components that contain or are covered with friable ACM from a structure.

"Asbestos Survey Report" means a written report as specified in R307-801-10(6) describing an asbestos inspection performed by a certified asbestos inspector.

"Asbestos Waste" means any waste that contains asbestos. This term includes filters from control devices, friable asbestos-containing waste material, and bags or other similar packaging contaminated with asbestos. As applied to demolition and renovations, this term includes materials contaminated with asbestos including disposable equipment and clothing.



"Containerized" means sealed in a leak-tight and durable container.

"Debris" means asbestos-containing material that has been dislodged and has fallen from its original substrate and position or which has fallen while remaining attached to substrate sections or fragments, and is friable or regulated in its current condition.

"Demolition" means the wrecking, salvage, or removal of any load-supporting structural member of a structure together with any related handling operations, or the intentional burning of any structure. This includes the moving of an entire building.

"Disturb" means to disrupt the matrix of ACM or regulated asbestos-containing material, crumble or pulverize ACM or regulated asbestos-containing material, or generate visible debris from ACM or regulated asbestos-containing material.

"Division" means the Division of Air Quality.

"Emergency Renovation Operation" means any asbestos project which was not planned and results from a sudden, unexpected event that, if not immediately attended to, presents a safety or public health hazard, is necessary to protect equipment from damage, or is necessary to avoid imposing an unreasonable financial burden as determined by the Division. This term includes operations necessitated by non-routine failure of equipment and does not include situations caused by the lack of planning.

"Encapsulant" means a permanent coating applied to the surface of friable ACM for the purpose of preventing the release of asbestos fibers. The encapsulant creates a membrane over the surface (bridging encapsulant) or penetrates the material and binds its components together (penetrating encapsulant).

"Facility" means any institutional, commercial, public, industrial, or residential structure, installation, or building, including any structure, installation, or building containing condominiums or individual dwelling units operated as a residential co-operative; any ship; and any active or inactive waste disposal site. For purposes of this definition, any building, structure, or installation that contains a loft used as a dwelling is not considered a residential structure, installation, or building. Any structure, installation or building that was previously subject to the NESHAP is not excluded, regardless of its current use or function. Public building and commercial building have the same meanings as they do in TSCA Title II.

"Friable Asbestos Containing Material (Friable ACM)" means any asbestos-containing material that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

"Glovebag" means an impervious plastic bag-like enclosure, not more than a 60 x 60 inches, affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

"HEPA Filtration" means the high efficiency particulate air filtration found in respirators and vacuum systems capable of filtering particles greater than 0.3 micron in diameter with 99.97% efficiency, designed for use in asbestos-contaminated environments.



"Inaccessible" means in a physically restricted or obstructed area or covered in such a way that detection or removal is prevented or severely hampered.

"Management Plan" means a document that meets the requirements of AHERA for management plans for asbestos in schools.

"Management Planner" means a person who prepares a management plan for a school building subject to AHERA.

"Model Accreditation Plan (MAP)" means 40 CFR Part 763, Subpart E, Appendix C, Asbestos Model Accreditation Plan.

"NESHAP" means the National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M, the National Emission Standard for Asbestos.

"NESHAP Amount" means combined amounts in a project that total:

- (a) 260 linear feet (80 meters) of pipe covered with RACM;
- (b) 160 square feet (15 square meters) of RACM used to cover or coat any duct, boiler, tank, reactor, turbine, equipment, structure, structural member, or structural component; or
- (c) 35 cubic feet (one cubic meter) of RACM removed from structural members or components where the length and area could not be measured previously.

"NESHAP-Sized Asbestos Project" means any asbestos project that involves at least a NESHAP amount of ACM.

"Regulated Asbestos-Containing Material (RACM)" means friable ACM, Category I nonfriable ACM that has become friable, Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, or Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

"Renovation" means the alteration in any way of one or more structural components, excluding demolition.

"Small-Scale, Short-Duration (SSSD) Asbestos Project" means an asbestos project that removes or disturbs less than 3 square feet or 3 linear feet of RACM in a facility or structure.

"Strip" means to take off ACM from any part of a structure or structural component.

"Structural Component" means any pipe, duct, boiler, tank, reactor, turbine, or furnace at or in a structure, or any structural member of the structure.

"Structural Member" means any load-supporting member of a structure, such as beams and load-supporting walls or any non-load-supporting member, such as ceilings and non-load-supporting walls.

"Structure" means, for the purposes of R307-801, any institutional, commercial, residential, or industrial building, equipment, building component, installation, or other construction.

"TSCA Accreditation" means successful completion of training as an inspector, management planner, project designer, contractor/supervisor, or worker, as specified in the TSCA Title II.



"TSCA Title II" means 15 U.S.C. 2601 et seq., Toxic Substances Control Act, Subchapter II - Asbestos Hazard Emergency Response, and 40 CFR Part 763, Subpart E - Asbestos-Containing Materials in Schools, including appendices, as in effect on July 1, 1999.

"Unrestrained Access" means without fences, closed doors, personnel, or any other method intended to restrict public entry.

"Waste Generator" means any owner or operator of an asbestos project covered by R307-801 whose act or process produces asbestos waste.

"Working Day" means Monday through Friday and includes holidays that fall on any of the days Monday through Friday.

R307-801-4. Adoption and Implementation of TSCA Title II.

- (1) The provisions of TSCA Title II are adopted and incorporated herein by reference.
- (2) Implementation of the provisions of 40 CFR Part 763, Subpart E, except for the Model Accreditation Plan, shall be limited to those provisions for which the EPA has waived its requirements in accordance with 40 CFR Subpart 763.98, Waiver; delegation to State, as published at 52 FR 41826, (October 30, 1987).

R307-801-5. Company Certifications.

- (1) All persons must have an Asbestos Company Certification before contracting for hire to conduct asbestos inspections, create management plans, create project designs, monitor asbestos projects, or to remove or otherwise disturb more than the SSSD amount of asbestos.
- (2) To obtain Utah Asbestos Company Certification, all persons shall submit a completed application for certification on a form provided by the executive secretary.
- (3) Unless revoked or suspended, a company certification shall remain in effect until the end of the calendar year in which it was issued.

R307-801-6. Individual Certification.

- (1) To obtain certification as a worker, supervisor, inspector, project designer, or management planner, each person shall first:
 - (1)(a) Provide personal identifying information;
 - (1)(b) Pay the appropriate fee;



- (1)(c) Fill out the appropriate form provided by the executive secretary;
- (1)(d) Provide certificates of initial and current training that demonstrate accreditation in the corresponding discipline. Any of the following TSCA accreditation courses is acceptable unless the executive secretary has determined that the course does not meet the requirements of TSCA accreditation training required by R307-801: courses approved by the executive secretary, approved in a state that has a Contractor Accreditation Program that meets the TSCA Title II Appendix C Model Plan, or approved by EPA under TSCA Title II.
- (2) Duration and Renewal of Certification.
- (2)(a) Unless revoked or suspended, a certification shall remain in effect until the expiration date of the current certificate of TSCA accreditation for the specific discipline.
- (2)(b) To renew certification, the individual shall first:
 - (2)(b)(i) Submit a completed application for renewal on a form provided by the executive secretary; and
 - (2)(b)(ii) Submit a current certificate of TSCA accreditation for initial or refresher training in the appropriate discipline.

R307-801-7. Denial and Cause for Suspension and Revocation of Company and Individual Certifications.

- (1) An application for certification may be denied if the individual, applicant company, or any principle officer of the applicant company has a documented history of noncompliance with the requirements, procedures, or standards established by R307-801, R307-214, which incorporates 40 CFR Part 61, Subpart M, the National Emission Standard for Asbestos, AHERA, or with the requirements of any other entity regulating asbestos activities and training programs.
- (2) The executive secretary may revoke or suspend any certification based upon documented violations of any requirement of R307-801, AHERA, or 40 CFR Part 61, Subpart M, including but not limited to:
 - (2)(a) Falsification of or knowing omission in any written submittal required by those regulations;
 - (2)(b) Permitting the duplication or use of a certificate or TSCA accreditation for the purpose of preparing a falsified written submittal; or
 - (2)(c) Repeated work practice violations.

R307-801-8. Approval of Training Courses.

- (1) To obtain approval of a training course, the course provider shall first provide a written application to the executive secretary that includes:



- (1)(a) Name, address, phone number, and institutional affiliation of person sponsoring the course;
- (1)(b) The course curriculum;
- (1)(c) A letter that clearly indicates how the course meets the Model Accreditation Plan and R307_801 requirements for length of training in hours or days, amount and type of hands-on training, examinations, including length, format, example of examination or questions, and passing scores, and topics covered in the course;
- (1)(d) A copy of all course materials, including student manuals, instructor notebooks, handouts, etc.;
- (1)(e) Names and qualifications of all course instructors, including all academic credentials and field experience in asbestos abatement; and
- (1)(f) Description and an example of numbered certificates issued to students who attend the course and pass the examination. The certificate shall include a unique certificate number, the name of the student and the course completed, the dates of the course and the examination, an expiration date one year from the date the student completed the course and examination, the name, address, and telephone number of the training provider that issued the certificate, and a statement that the person receiving the certificate has completed the requisite training for TSCA accreditation.

- (2) To maintain approval of a training course, the course provider shall:
 - (2)(a) Provide training that meets the requirements of R307-801 and the MAP;
 - (2)(b) Provide the executive secretary with the names, social security numbers or government-issued picture identification card number, and certificate numbers of all persons successfully completing the course within 30 days of successful completion;
 - (2)(c) Keep the records specified for training providers in the MAP for three years;
 - (2)(d) Permit the executive secretary or authorized representative to attend, evaluate and monitor any training course without receiving advance notice from the executive secretary and without charge to the executive secretary; and
 - (2)(e) Notify the executive secretary of any new course instructor 10 working days prior to the day the new instructor presents or teaches any course for TSCA Accreditation purposes. The notification shall include:
 - (2)(e)(i) Name and qualifications of each course instructors, including all academic credentials and field experience in asbestos abatement; and
 - (2)(e)(ii) A list of the courses or specific topics that will be taught by the instructor.

- (3) All course providers that provide an AHERA training course or refresher course in the state of Utah shall:



- (3)(a) Notify the executive secretary of the location, date, and time of the course at least ten days before the first day of the course;
- (3)(b) Update the notification as soon as possible, and no later than the original course date, if the course is rescheduled or cancelled before the course is held; and
- (3)(c) Allow the executive secretary to conduct an audit of any course provided to determine whether the course provider meets the requirements of the MAP and of R307-801.

R307-801-9. Renovation and Demolition: Requirement to Inspect.

1. Except as described in (2) below, the operator shall ensure that the structure or facility to be demolished or renovated is inspected for ACM by an inspector certified under the provisions of R307-801-6. An asbestos survey report shall be generated according to the provisions of R307-801-10. The operator shall make the asbestos survey report available on site to all persons who have access to the site for the duration of the renovation or demolition activities, and to the executive secretary upon request.
- (2) If the structure has been ordered to be demolished because it is found by a local jurisdiction to be structurally unsound and in danger of imminent collapse, the operator may demolish the structure without having the structure or facility inspected for asbestos. If no asbestos inspection is conducted, the operator shall ensure that all resulting demolition debris is disposed of as asbestos waste, according to R307-801-15. If the demolition debris cannot be containerized, the operator shall obtain approval for an alternative procedure from the executive secretary.

R307-801-10. Renovation and Demolition: Asbestos Inspection Procedures.

Asbestos inspectors shall use the following procedures when conducting an asbestos inspection of facilities to be demolished or renovated.

- (1) Determine the scope of demolition or renovation activities.
- (2) Inspect the affected facility or part of the facility where the demolition or renovation operation will occur.
- (3) Identify all accessible suspect ACM building materials in the affected facility or part of the facility where the demolition or renovation operation will occur.



- (4) Follow a sampling method approved by the executive secretary, to demonstrate that suspect ACM does not contain asbestos.
- (5) Assume that unsampled suspect ACM contains asbestos and is ACM; and
- (6) Complete an asbestos survey report containing all of the following information in a format approved by the executive secretary:
 - (6)(a) A brief description of the affected area;
 - (6)(b) A list of all suspect materials identified in the affected area. For each suspect material provide the following information:
 - (6)(b) (i) The amount of material in linear feet, square feet, or cubic yards;
 - (6)(b) (ii) A clear description of the distribution of the material in the affected area;
 - (6)(b) (iii) A statement of whether the material was assumed to contain asbestos, sampled and shown to contain asbestos, or sampled and demonstrated to not contain asbestos; and
 - (6)(b) (iv) A determination of whether the material is RACM or may become RACM when subjected to the proposed renovation or demolition activities.
 - (6)(c) A list of samples collected from suspect materials in the affected area. For each sample provide the following information:
 - (6)(c) (i) Which suspect material, in the above list, the sample represents;
 - (6)(c) (ii) A clear description of the original location of the sample;
 - (6)(c) (iii) The types of analyses performed on the sample;
 - (6)(c) (iv) The amounts of each type of asbestos in the sample as indicated by the analytical results.
 - (6)(d) A list of potential locations of suspect materials that were not accessible to inspection that may be part of the affected area.
- (7) Floor plans or architectural drawings and similar representations may be used to aid in conveying the location of suspect materials or samples, but if so, they must be appended to the asbestos survey report.

R307-801-11. Renovation and Demolition: Notification and Asbestos Removal Requirements.

- (1) Demolitions.
 - (1)(a) If the amount of RACM in the structure is less than the SSSD amount, the operator shall submit a notification of demolition at least 10 working days before the start of demolition, and remove the RACM before commencing demolition.
 - (1)(b) If the amount of RACM in the structure is greater than or equal to the



- SSSD amount but less than the NESHAP amount, the operator shall submit an asbestos notification at least 10 working days before the start of demolition and at least one working day before commencing removal, and shall remove the RACM according to the work practice provisions of R307-801 before demolition proceeds.
- (1)(c) If the amount of RACM in the structure is greater than or equal to the NESHAP amount, the operator shall submit an asbestos notification at least 10 working days before the asbestos removal begins. Demolition shall not proceed until after all RACM has been removed from the structure.
- (1)(d) If any structure is to be demolished by intentional burning, the operator, in addition to the notification specified in (a), (b) or (c), shall ensure that all ACM, including non friable ACM and RACM, is removed from the structure before burning.
- (1)(e) If the structure has been ordered to be demolished because it is found by a local jurisdiction to be structurally unsound and in danger of imminent collapse, the operator shall submit a notification of demolition as soon as possible, but no later than the next working day after demolition begins.
- (2) Renovations.
- (2)(a) If the amount of RACM that would be disturbed or rendered inaccessible by renovation activities is less than the SSSD amount, the operator shall remove the RACM before commencing the renovation.
- (2)(b) If the amount of RACM that would be disturbed or rendered inaccessible by renovation activities is greater than the SSSD amount but smaller than NESHAP amount, the operator shall submit an asbestos notification at least one working day before asbestos removal begins, unless the removal was properly included in an annual asbestos notification submitted pursuant to (d) below, and shall remove RACM according to general work practices of R307-801 before performing renovation activities.
- (2)(c) If the amount of RACM that would be disturbed or rendered inaccessible by renovation activities is greater than or equal to the NESHAP amount, then the operator shall submit an asbestos notification as described below, and shall ensure that RACM that would be disturbed by renovation activities and non-friable ACM that may be rendered friable or regulated by renovation activities is removed according to the work practice and disposal requirements of R307-801. The operator shall not commence renovation activities until the asbestos removal process is completed.
- (2)(c)(i) If the renovation is an emergency renovation operation, then the notification shall be submitted as soon as possible before and no later than the next business day after asbestos removal begins.
- (2)(c)(ii) If the renovation is not an emergency renovation operation, then the



notification shall be submitted at least ten working days before asbestos removal begins.

- (2)(d) The operator shall submit an annual notification according to the requirements of 40 CFR 61.145(a)(4)(iii) no later than 10 working days before the first day of January of the year during which the work is to be performed in the following circumstances:
 - (2)(d) (i) The asbestos projects are unplanned operation and maintenance activities;
 - (2)(d) (ii) The asbestos projects are less than NESHAP-sized; and
 - (2)(d) (iii) The total amount of asbestos to be disturbed in a single facility during these asbestos projects is expected to exceed the NESHAP amount in a calendar year.

R307-801-12. Renovation and Demolition: Notification Procedures and Contents.

- (1) All notifications required by R307-801 shall be in writing on the appropriate form provided by the executive secretary and shall be postmarked or received by the Division by the date specified. The type of notification and whether the notification is original or revised shall be indicated.
- (2) If the notification is an original notification of demolition, an original asbestos notification for a NESHAP-sized asbestos project, or an original annual notification, the written notice shall be sent with an original signature by U.S. Postal Service, commercial delivery service, or hand delivery. If U.S. Postal Service is used, the submission date is the postmark date. If other service or hand delivery is used, the submission date is the date that the document is received at the Division.
- (3) An original asbestos notification for a less than NESHAP-sized asbestos project or any revised notification may be submitted by any of the methods in (2), or by facsimile, by the date specified in R307-801-11. The sender shall ensure that the fax is legible.
- (4) All original notifications shall contain the following information:
 - (4)(a) The name, address, and telephone number of the owner of the structure, and of any contractor working on the project;
 - (4)(b) Whether the operation is a demolition or a renovation project;
 - (4)(c) A description of the structure that includes the size in square feet or square meters, the number of floors, the age, and the present and prior uses of the structure;
 - (4)(d) The procedures, including analytical methods, used to inspect for the



- presence of ACM;
- (4)(e) The location and address, including building number or name and floor or room number, street address, city, county, state, and zip code of the structure being demolished or renovated;
 - (4)(f) A description of procedures for handling the discovery of unexpected ACM or of nonfriable ACM that has become friable or regulated;
 - (4)(g) A description of planned demolition or renovation work, including the demolition and renovation techniques to be used and a description of the affected structural components.
- (5) In addition to the information in (4) above, an original demolition notification shall contain the following information:
- (5)(a) An estimate of the amount of non-friable and non-regulated ACM that will not become regulated as a result of demolition activities and that will remain in the building during demolition;
 - (5)(b) The starting and ending dates of demolition activities; and
 - (5)(c) If the structure will be demolished under an order of a state or local government agency, the name, title, and authority of the government representative ordering the demolition, the date the order was issued, and the date the demolition was ordered to commence. A copy of the order shall be attached to the notification.
- (6) In addition to the information in (4) and (5) above, an original asbestos notification or an annual notification shall contain the following information:
- (6)(a) An estimate of the approximate amount of ACM to be stripped, including which units of measure were used;
 - (6)(b) The scheduled starting and completion dates of asbestos removal work in a renovation or demolition;
 - (6)(c) The beginning and ending dates for preparation and asbestos removal, and of renovation activities if applicable;
 - (6)(d) If an emergency renovation operation will be performed, the date and hour the emergency occurred, a description of the event and an explanation of how the event has caused unsafe conditions or would cause equipment damage or unreasonable financial burden;
 - (6)(e) A description of work practices and engineering controls to be used to prevent emissions of asbestos at the demolition or renovation work site;
 - (6)(f) The name and location of the waste disposal site where the asbestos waste will be deposited, including the name and telephone number of the waste disposal site contact;
 - (6)(g) The name, address, contact person, and phone number of the waste transporters; and
 - (6)(h) The name, contact person, and phone number of the person receiving the waste shipment record as required by 40 CFR 61.150(d)(1).



- (7) A revised notification shall contain the following information:
 - (7)(a) The name, address, and telephone number of the owner of the structure, and any demolition or asbestos abatement contractor working on the project;
 - (7)(b) Whether the operation is a demolition or a renovation project;
 - (7)(c) The date that the original notification was submitted;
 - (7)(d) The applicable original start and stop dates for asbestos removal, renovation, or demolition;
 - (7)(e) Revised start and stop dates, if applicable, for asbestos removal or demolition activities;
 - (7)(f) Changes in amount of asbestos to be removed, if applicable; and
 - (7)(g) All other changes.
- (8) If a NESHAP-sized asbestos project that requires a notification under (4) above or a demolition project that requires a notification under (4) above will commence on a date other than the date submitted in the original written notification, the executive secretary shall be notified of the new starting date by the following deadlines.
 - (8)(a) If the new starting date is later than the original starting date, notice by telephone shall be given as soon as possible before the original starting date and a revised notice shall be submitted in accordance with R307-801-12(7) as soon as possible before, but no later than, the original starting date.
 - (8)(b) If the new starting date is earlier than the original starting date, submit a written notice in accordance with R307-801-12(7) at least ten working days before beginning the project.
 - (8)(c) In no event shall an asbestos project covered by this subsection begin on a date other than the new starting date submitted in the revised written notice.

R307-801-13. Renovation and Demolition: Requirements for Certified Workers.

- (1) A supervisor who has been certified under R307-801 shall be on site during asbestos project setup, asbestos removal, stripping, cleaning and dismantling of the project, and other handling of uncontainerized RACM.
- (2) All persons handling greater than the SSSD amount of uncontainerized RACM shall be workers or supervisors certified under R307-801.



R307-801-014. Renovation and Demolition: Asbestos Work Practices.

- (1) Persons performing any asbestos project shall follow the work practices in this subsection. Where the work practices in R307-801-14(1) and (2) are required, wrap and cut, open top catch bags, glove bags, and mini-enclosures may be used in combination with those work practices.
- (1)(a) Adequately wet RACM with amended water before exposing or disturbing it.
- (1)(b) Install barriers and post warning signs to prevent access to the work area. Warning signs shall conform to the specifications of 29 CFR 1926.1101(k)(7).
- (1)(c) Keep RACM adequately wet until it is containerized and disposed of in accordance with R307-801-15.
- (1)(d) Ensure that RACM that is stripped or removed is promptly containerized.
- (1)(e) Prevent visible particulate matter and uncontainerized asbestos-containing debris and waste originating in the asbestos work area from being released outside of the negative pressure enclosure or designated work area.
- (1)(f) Filter all waste water to 5 microns before discharging it to a sanitary sewer.
- (1)(g) Decontaminate the outside of all persons, equipment and waste bags before they leave the work area.
- (1)(h) Apply encapsulant to RACM that is exposed but not removed during stripping.
- (1)(i) Clean the work area, drop cloths, and other interior surfaces of the enclosure using HEPA vacuum and wet cleaning techniques until there is no visible residue before dismantling barriers.
- (1)(j) After cleaning and before dismantling enclosure barriers, mist the space and surfaces inside of the enclosure with a penetrating encapsulant designed for that purpose.
- (1)(k) Handle and dispose of friable ACM or RACM according to the disposal provisions of R307-801.
- (2) All operators of NESHAP-sized asbestos projects shall install a negative pressure enclosure using the following work practices.
- (2)(a) All openings to the work area shall be covered with at least one layer of 6 mil or thicker polyethylene sheeting sealed with duct tape or an equivalent barrier to air flow.
- (2)(b) If RACM debris is present, the site shall be prepared by removing the debris using the work practice and disposal requirements of R307-801. If the total amount of loose visible RACM debris throughout the entire



work area is less than the SSSD amount, then site preparation may begin after notification and before the end of the ten-day waiting period.

- (2)(c) All persons shall enter and leave the negative pressure enclosure or work area only through the decontamination unit.
- (2)(d) All persons subject to R307-801 shall shower before entering the clean-room of the decontamination unit when exiting the enclosure.
- (2)(e) No materials may be removed from the enclosure or brought into the enclosure through any opening other than a waste load-out or a decontamination unit.
- (2)(f) The negative pressure enclosure of the work area shall be constructed with the following specifications:
 - (2)(f)(i) Apply at least two layers of 6 mil or thicker polyethylene sheeting or its equivalent to the floor extending at least one foot up every wall and seal in place with duct tape or its equivalent;
 - (2)(f)(ii) Apply at least 2 layers of 4 mil or thicker polyethylene sheeting or its equivalent to the walls without locating seams in wall or floor corners;
 - (2)(f)(iii) Seal all seams with duct tape or its equivalent; and
 - (2)(f)(iv) Maintain the integrity of all enclosure barriers.
- (2)(f)(v) Where a wall or floor will be removed as part of the asbestos project, polyethylene sheeting need not be applied to that component.
- (2)(g) View ports shall be installed in the enclosure or barriers where feasible. View ports shall be:
 - (2)(g)(i) At least one foot tall and one foot wide;
 - (2)(g)(ii) Made of clear material that is impermeable to the passage of air, such as an acrylic sheet;
 - (2)(g)(iii) Positioned so as to maximize the view of the inside of the enclosure from a position outside the enclosure; and
 - (2)(g)(iv) Accessible to a person outside of the enclosure.
- (2)(h) A decontamination unit shall be constructed according to the following specifications:
 - (2)(h)(i) The unit shall be attached to the enclosure or work area;
 - (2)(h)(ii) The decontamination unit shall consist of at least 3 chambers as specified by 29 CFR 1926.1101(j)(1);
 - (2)(h)(iii) The clean room, which is the chamber that opens to the outside, shall be no less than 3 feet wide by 3 feet long;
 - (2)(h)(iv) The dirty room, which is the chamber that opens to the negative pressure enclosure or the designated work area, shall be no less than 3 feet wide by 3 feet long;
 - (2)(h)(v) The dirty room shall be provided with an accessible waste bag at any time that asbestos work is being done.
- (2)(i) A separate waste load-out following the specifications below may be attached to the enclosure for removal of decontaminated waste containers and decontaminated or wrapped tools from the enclosure.
 - (2)(i)(i) The waste load-out shall consist of at least one chamber constructed of



- 6 mil or thicker polyethylene walls and 6 mil or thicker polyethylene flaps or the equivalent on the outside and inside entrances;
- (2)(i)(ii) The waste load-out chamber shall be at least 3 feet long, 3 feet high, and 3 feet wide; and
- (2)(i)(iii) The waste load-out supplies shall be sufficient to decontaminate bags, and may include a water supply with filtered drain, clean rags and clean bags.
- (2)(j) Negative air pressure and flow shall be established and maintained within the enclosure by:
 - (2)(j)(i) Maintaining four air changes per hour in the enclosure;
 - (2)(j)(ii) Routing the exhaust from HEPA filtered ventilation units to the outside of the structure whenever possible;
 - (2)(j)(iii) Maintaining a minimum of 0.02 column inches of water pressure differential relative to outside pressure; and
 - (2)(j)(iv) Maintaining a monitoring device to measure the negative pressure in the enclosure.
- (3) In lieu of two layers of polyethylene on the walls and the floors as required by R307-801-(2)(f)(i) and (ii), the following work practices and controls may be used only under the circumstances described below:
 - (3)(a) If an asbestos project is conducted in a crawl space or pipe chase and the available space is less than 6 feet high or is less than 3 feet wide, then the following may be used:
 - (3)(a)(i) Drop cloths extending at least 6 feet around all RACM to be removed, or extended to a wall and attached with duct tape or equivalent; and
 - (3)(a)(ii) Either glovebags, wrap and cut, or the open top catch bag method must be used. The open top catch bag method may be used only if the material to be removed is pre-formed RACM pipe insulation.
 - (3)(b) Scattered ACM. If the RACM is scattered in small patches, such as isolated pipe fittings, the following procedures may be used.
 - (3)(b)(i) Glovebags, mini-enclosures as described in R307-801-14(5), or wrap and cut methods with drop cloths large enough to capture all RACM fragments that fall from the work area may be used.
 - (3)(b)(ii) If all asbestos disturbance is limited to the inside of negative pressure glovebags or mini-enclosure, then openings need not be sealed and negative pressure need not be maintained outside of the glovebags or mini- enclosure during the asbestos removal operation.
 - (3)(b)(iii) A remote decontamination unit may be used as described in R307-801-14(5)(d) only if an attached decontamination unit is not feasible.
- (4) During outdoor asbestos projects, the work practices of R307-801-8 shall be followed, with the following modifications:
 - (4)(a) Negative pressure need not be maintained if there is not an enclosure;
 - (4)(b) Six mil polyethylene or equivalent drop cloth large enough to capture all RACM fragments that fall from the work area shall be used; and
 - (4)(c) A remote decontamination unit as described in R307-801-14(5)(d) may be used.



- (5) Special work practices.
- (5)(a) If the wrap and cut method is used:
 - (5)(a)(i) The component shall be cut at least 6 inches from any RACM on that component;
 - (5)(a)(ii) If asbestos will be removed from the component to accommodate cutting, the asbestos removal shall be done using a single glove bag for each cut, and no RACM shall be disturbed outside of a glove bag;
 - (5)(a)(iii) The wrapping shall be leak tight and shall consist of two layers of 6 mil polyethylene, each individually sealed with duct tape, and all RACM between the cuts shall be sealed inside wrap; and
 - (5)(a)(iv) The wrapping shall remain intact and leak-tight throughout the removal and disposal process.
- (5)(b) If the open top catch bag method is used:
 - (5)(b)(i) Asbestos waste bags that are leak tight and strong enough to hold contents securely shall be used;
 - (5)(b)(ii) The bag shall be placed underneath the stripping operation to minimize ACM falling onto the drop cloth;
 - (5)(b)(iii) All material stripped from the component shall be placed in the bag;
 - (5)(b)(iv) One worker shall hold the bag and another worker shall strip the ACM into the bag; and
 - (5)(b)(v) A drop cloth large enough to capture all RACM originating in the work area shall be used.
- (5)(c) If glove bags are used, they shall be negative pressure, and the procedures required by 29 CFR 1926.1101(g)(5) shall be followed.
- (5)(d) A remote decontamination unit may be used under the conditions set forth in R307-801-14(3)(b) or (4), or when approved by the executive secretary. The remote decontamination unit and procedures shall include:
 - (5)(d)(i) Outerwear shall be HEPA vacuumed or removed, and additional clean protective outerwear shall be put on;
 - (5)(d)(ii) Either polyethylene sheeting shall be placed on the path to the decontamination unit and the path shall be blocked or taped off to prevent public access, or workers shall be conveyed to the remote decontamination unit in a vehicle that has been lined with two layers of 6 mil or thicker polyethylene sheeting or its equivalent; and
 - (5)(d)(iii) The polyethylene path or vehicle liner shall be removed at the end of the project, and disposed of as asbestos waste.
- (5)(e) Mini-enclosures, when used under approved conditions, shall conform to the requirements of 29 CFR 1926.1101(g)(5)(vi).

R307-801-15. Disposal and Handling of Asbestos Waste.

- (1) Containerize ACWM while adequately wet.



- (2) Asbestos waste containers shall be leak-tight and strong enough to hold contents securely.
- (3) Containers shall be labeled with the waste generator's name, address, and phone number, and the contractor's name and address, before they are removed from the work area.
- (4) Containerized RACM shall be disposed of at a landfill which complies with 40 CFR 61.150.
- (5) The waste shipment record shall include a list of items and the amount of asbestos waste being shipped. The waste generator originates and signs this document.

R307-801-16. Records.

- (1) Certified asbestos companies shall maintain records of all asbestos projects that they perform and shall make these records available to the executive secretary upon request. The records shall be retained for at least five years. Maintained records shall include the following:
 - (1)(a) Names and state certification numbers of the asbestos workers and supervisors who performed the asbestos project;
 - (1)(b) Location and description of the asbestos project and amount of Friable ACM removed;
 - (1)(c) Starting and completion dates of the asbestos project;
 - (1)(d) Summary of the procedures used to comply with applicable requirements including copies of all notifications; and
 - (1)(e) Waste shipment records maintained in accordance with 40 CFR Part 61, Subpart M, NESHAP.
 - (1)(f) Asbestos surveys associated with the asbestos project.
- (2) All other persons subject to the inspection requirements of R307-801-9 shall maintain copies of asbestos survey reports for at least one year after renovation or demolition activities have ceased, and shall make these reports available to the executive secretary upon request.

KEY

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Authorizing, Implemented, or Interpreted Law

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Notes and Scribbles