A SunCam online continuing education course

Asbestos Fundamentals

By

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Description

The reader will learn what asbestos is, how it is used, and how it becomes dangerous to humans. You will have a basic understanding of asbestos in construction, the methods used to handle it safely and the requirements of the United States (US) law for doing so. You will also learn how certain demolitions, renovations and maintenance activities are regulated by US law in order to protect the public and the industry workers.

The regulations and standards presented here are an attempt to summarize the huge number of documentation in the asbestos-related laws in the US, their interpretations and practices in effect at this time. For additional detailed information, please go to the governmental agencies' websites. The medical research has been quite extensive and will hopefully continue. Those websites should also be visited for specific and detailed information.

Throughout the course material there will be comments regarding the desirable green or sustainable philosophy. An environmentally friendly ideology, action, standard, or process, which is usually more stringent than the law or regular construction standards and has a higher sensitivity toward human life and well being will be herein deemed to be "green".

For the reader's benefit, key words or concepts have been highlighted.

Introduction

Asbestos is a mineral, which can be mined in many parts of the world. It forms in crystalline needle-like bundles and has been used by humans for ages. In modern times, this cheap and abundant wonder material has been and still is used in many ways.

Asbestos is not consumed by fire. It is great for **noise** absorption, **thermal** insulation, **friction** and **wear** resistance, **fireproofing, electrical** insulation, **chemical** exposure resistance, **condensation** control, etc.

A significant problem is that it is harmful to humans, including serious diseases and death. Historically speaking, ancient romans were suspicious of the fact that slaves handling asbestos seemed to have an abnormally high incidence of respiratory illnesses. Likewise, in present times, the dangers of asbestos have been acknowledged and disseminated for decades, and yet the world in general has been slow in reacting to that reality.

The fact is that most people in the US and many countries around the world who live in urban or suburban areas are exposed to mostly insignificant amounts of asbestos fibers in the ambient air or drinking water on a daily basis. Different emissions from sources such as improper or illegal renovations and demolitions, old asbestos cement pipes, vehicle brakes, erosion or mining of natural nearby deposits, if any, contribute to it.

The mere fact that there are asbestos materials in a particular building does **not** necessarily mean that the people in it are exposed, as long as those materials are in good condition and not adversely disturbed. However, should there be any natural or human disturbances, asbestos fibers could expose the people in the building.

Picture No. 1 by www.canstockphoto.com
Asbestos Rock

For that reason, the **green** action for all of us to take should be to learn about asbestos and its dangers. Be aware of known or suspect asbestos materials in your home, office, factory or entertainment places. Monitor them, and be ready to take action through industry professionals or by notifying the responsible parties of possible exposure risks so they can get the professional help that is appropriate.

Many tens of millions of asbestos tons have already been placed around the world, mainly during the past 80 years or so, and more of it is along the way. Hopefully, the green ideology trends of today will help in responding to that problem.

Section 1- Types of Asbestos Minerals and Materials

Asbestos minerals are divided into two groups, **Serpentine** and **Amphibole**. Their microscopic fibers are measured in micrometers (microns). One micron is one millionth of a meter.

Under Serpentine, there is only one type, **chrysotile**, the white asbestos, which is the most widely used in the US at about **90%.** The fibers are generally long, thin and hollow. The Amphibole group includes **amosite, crocidolite, anthophylite, actinolite** and **tremolite**.

Amosite is the brown asbestos with solid, brittle short fibers, and is the second most used in the US. The other four in this group are rarely used. Crocidolite, the blue asbestos, is the strongest of all and has brittle fibers. Tremolite is related to the publicized vermiculite contamination story some years ago because of its veins in some vermiculite soils. Therefore, materials such as vermiculite potting soil, vermiculite fireproofing spray and vermiculite insulation for attics and walls may contain tremolite.

A significant amount of tainted vermiculite soil is located in Libby, Montana, where it used to be mined. Asbestos related diseases and deaths have occurred there at higher rates than the rest of the general US population. There were publicized allegations of deceit related to the company operating the mine. Its top executives were implicated in complicity to prevent the early dissemination or warning of the health dangers, which were allegedly known by them. Federal prosecutors filed criminal charges a few years ago.

Asbestos can be mixed with sand, concrete, vinyl, asphalt, cement, cellulose, clay, gypsum, adhesives, sealants, etc., which is called the **bonding** or **matrix** material. If the product contains **more than 1%** asbestos, it is known as an Asbestos Containing Material **(ACM)** in the US according to federal regulatory law.

That definition is important for certain litigations as well as most regulatory purposes. However, when the asbestos content is **more than 0% and up to 1%** it will be referred to as an **asbestos material** in this course from here on.

Keep in mind that when ACM or asbestos materials are damaged or deteriorated, regardless of the cause, even fire, the matrix is the one affected, but the asbestos mineral fibers would remain unscathed making them dangerous.

Now, the **green** way to define any material that contains asbestos should be when its content is **more than 0%.** And it should be strictly controlled and regulated.

The fact is that the legal definition of ACM was not based on any medical or scientific research and although those laws have protected Americans for the past few decades, they cannot be classified as green. Certainly, when those laws were enacted, green philosophy was not nearly as popular as it is today.

ACM can be either friable or non-friable. In the US, it is legally **friable** when the asbestos content is more than 1% and when dry, can be crumbled, pulverized or reduced to powder by hand pressure. For example, popcorn ceiling, sprayed fire insulation, and acoustic or ceiling tiles. They can emit fibers into the air with only minor disturbances such as energetic, careless or accidental touching, as well as vibrations from noises, machinery, earthquakes, wind, etc., and create exposure risks. **Asbestos materials** can also be friable and are just as likely to release dangerous airborne fibers, if similarly disturbed.

By law, **non-friable** ACM has asbestos content of more than 1% and when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure. Both non-friable ACM and non-friable **asbestos materials** can also be adversely disturbed, but it would take a lot more than just rubbing against them. Sanding, abrading, breaking, hammering, cutting, etc. would have to occur before hazardous asbestos fibers are released into the air, making them less of a hazard.

Friability and non-friability become important terms regarding the different asbestos laws during renovations, demolitions and maintenance operations.

Non-friable ACM are classified as either **Category I or Category II** by NESHAP (see Section 3, law # 1).

Category I non-friable ACM includes packings (valves, seals, etc.), gaskets, resilient floor coverings and asphalt roofing products.

Category II non-friable ACM are non-friables, excluding Category I. For example: cementitious boards/transite, laboratory hood linings, wallboards, etc. Some are likely to become friable during renovation, demolition or maintenance operations.

Additionally, AHERA (see Section 3, law # 2), identifies three categories of Asbestos Containing Building Materials (ACBM) for buildings depending on its uses and applications. They are: Surfacing Materials (**SM**), Thermal System Insulation (**TSI**) and Miscellaneous (**M**).

Many of AHERA's standards and guidelines have become **generally accepted industry standards**.

SM is either sprayed or troweled and is used for fireproofing, acoustics, decoration, etc. It is usually friable, for instance, popcorn ceiling, structural member fireproofing and plaster in general.

TSI is used to restrict heat transfer or condensation of pipes, boilers, heating, ventilating and air conditioning (HVAC) ducts, etc. It is usually friable and includes pipe wrap, blanket insulation, cement, joint sealers, muds, gaskets and other uses.

M is applicable to other uses such as wallboards, acoustic or ceiling tiles, cementitious boards, vinyl floor tiles, etc., and it is largely non-friable, except the ones such as ceiling tiles. However, some materials in this category like the cementitious boards, are indeed non-friable, but are likely to be made friable during renovations, demolitions or maintenance.

Asbestos may be found in materials where many people would never suspect such as chalkboards, vehicle clutches and brakes, acetylene cylinders, some papers or felts, automatic transmission components, etc. however, this course is focusing on construction uses.

The following is a list of **suspect** ACBM, meaning that they may or may not contain asbestos. Whether ACBM or ACM, the laboratory result would have to show that the asbestos content is more than 1%. Also, they could be Asbestos Materials (> 0%, up to 1%):

Flat cementitious boards sandwiched in partitions or walls
Flat cementitious boards for underside of overhangs

Wallboards	Joint compounds and tape
Flat cementitious roofing shingles	Seawall concrete
Asphalt roofing shingles	Concrete Seawall pilings
Cementitious siding boards	Acoustical or Ceiling tiles
Corrugated cementitious roofing boards	Patching compounds
Textured paints	Textured plasters
Caulking or putty	Elevator equipment panels
Stucco	Lightweight concrete roofs
Roofing felt or paper	Asphaltic roofing mix or bull
Blown-in insulation	Hand-laid insulation
Theater curtains	Hangar galbestos coatings
Vinyl floor tiles	Mastics
Congoleum sheets & backing	Linoleum sheets & backing
Pipe wraps	Blanket insulation
Cements	Muds
Cooling towers	Laboratory hoods
Boiler insulation	A/C duct joint compounds
Sprayed fireproofing	Vermiculite insulation
Plasters in general	Popcorn ceilings
Fire doors	Fuse box insulation
Wire insulation	Pipe joint components
Concrete block cell fillings	Elevator brake shoes

Figure No. 1 by Author. ACBM/ACM List (not all inclusive)

Contrary to popular belief, there are over 3,000 different ACM uses still legal in the US.

Since the popcorn ceiling shown in Picture No. 2 below is a friable spray-applied decorative surface treatment as shown on the banned list (Figure No. 2 below), it has not been legal to apply it for about 35 years. But before you hurry to do the math and figure out whether or not the popcorn ceiling in your house or office is ACM, you need to read some more.

ACM popcorn ceilings were legally allowed to continue to be used for some time after the ban, and therefore, new construction into the 1980's may or may not contain popcorn ceiling that is ACM.

However, if your residence or office was built in the 1990's or so, again, do not run to your spouse with the good news yet, read on. The only way to know if any popcorn ceiling contains asbestos would be to test it. If it is, in fact, positive for asbestos, leave it alone.
And should it be delaminating or falling off, usually because of water intrusion, get professional advice without delay.

The law # 1 in Section 3 below (NESHAP), covering regulated renovations and demolitions, allows any materials containing 1% or less asbestos to be placed, removed and/or taken to any disposal site without any requirements.

With the above paragraph in mind, it should not be surprising to know that some material manufacturers, distributors and asbestos contractors figured out a legal way to maximize profits. They came up with a way to not only completely use the existing popcorn ceiling ACM mixes past the deadline, but to actually create new mixes for years to come since asbestos is a cheap material. All they needed to do was to dilute the asbestos content of those mixes so that it would be **at, or below 1%**.

Disturbing only a few square feet of those diluted mixes, which are asbestos materials, can emit significant amounts of fibers into the air. Whether ACM or asbestos materials, OSHA's worker protection laws do cover the abatement of both even if legally placed. See Section 3, law # 4 and Section 4.

Banned by the Environmental Protection Agency (**EPA**):

Corrugated paper
Commercial paper
Specialty paper
New asbestos uses
Friable sprayed decorative surfacing
Rollboard
Flooring felt
Friable TSI
Friable sprayed fireproofing

Banned by the Consumer Product Safety Commission (**CPSC**):

Patching compounds
Artificial Fireplace Embers

Banned by the Food and Drug Administration (**FDA**):

Some Cosmetics, Drugs, Etc.

Figure No. 2 by Author. Banned ACM List (not all inclusive)

Picture No. 2 by Author. White Popcorn Ceiling

It would be quite pertinent to point out at this time that even when a particular ACM was or is legally placed (not banned), NESHAP still regulates it when renovations or demolitions reach or exceed the law's thresholds. The other three federal laws may apply as well, depending on the project particulars and the facility type.

Picture No. 3 by www.canstockphoto.com Corrugated Cementitious Roofing Boards or Transite Boards. They are found all over the world, and can be quite dangerous if disturbed

Picture No. 4 by Author. Vinyl Floor Tile, size 12” X 12”. All Vinyl Floor Tiles (VFT) including sheeting are also called Resilient Flooring and are asbestos suspect materials. The 9” X 9” Tiles are highly suspicious of being ACM

Picture No. 5 by www.canstockphoto.com Interior partitions, where wallboards are usually installed on both sides. All wallboards, including Sheetrock and Drywall, are asbestos suspect materials.
Those materials can also be found in ceilings

Section 2- Health Related Topics

When ACM, ACBM or asbestos materials are adversely disturbed, they release dangerous microscopic fibers into the air or water, which can then be **inhaled** or **ingested**.

With a higher exposure to asbestos, you can expect a higher chance of getting sick. That is called **dose-response.** And the time between exposure and illness occurrence is called the **latency period.** However, it is true that some people get significantly exposed and never get sick, while others after minimal exposure, become ill.

Breathing said fibers is the most common way humans get exposed, and the most feared. The fibers are subsequently lodged in the lungs where the future respiratory system illnesses can occur.

Three asbestos-related diseases linked to fiber inhalation have been identified. They are, **asbestosis, lung cancer and mesothelioma**.

Asbestosis is non-malignant, typical of workers who are exposed to high concentrations of fibers. It is a result of dose response. Asbestosis causes fibrotic scarring of the lungs with a lot of coughing and shortness of breath. The latency period is typically about 15 years.

Lung cancer is characterized by tumors, coughing and blocking of air passages. It has an average latency period of approximately 20 years. Asbestos workers or others with similar asbestos exposure who are smokers fall victim to a **synergy,** which causes them to be five or more times more likely to develop lung cancer than the average person.

Mesothelioma is a form of deadly cancer affecting the lining of the thoracic cavity and can be so far attributable **only** to asbestos exposure. The typical latency period is about 30 years.

Drinking municipally treated water and other beverages containing it, can put you at risk of developing **digestive system** diseases or abnormalities if the asbestos content is excessive. The higher the asbestos fiber content and exposure time, the higher the risk. See Section 7.

The kinds of pipe conveying the water together with the water chemistry of the geographical location, and how the pipe system is monitored, maintained or replaced will affect the amount of asbestos fibers in the water.

In some areas of the US it would also be possible for drinking water reservoirs to become contaminated with asbestos fibers because of natural deposits erosion. And, of course, the above mentioned piping system characteristics will still affect the asbestos content in addition to the reservoir contamination, if any.

Studies of individuals exposed to asbestos through ingestion have shown increased cases of cancers such as colon, stomach, kidney, esophagus, pancreas, etc., however, the medical evidence making the link is not as strong as that related to inhaled asbestos. Other diseases or abnormalities of the digestive system may be contracted.

In fact, EPA indicates in its website that benign intestinal polyps may develop in people who ingest drinking water with asbestos content in excess of the Maximum Contaminant Level (**MCL**), which is **seven million fibers per liter**. The exposure would also need to occur over many years.

Section 3- Asbestos Laws and Industry Standards

The **four federal laws** discussed below are important in relation to asbestos in construction, and are: **NESHAP, AHERA, ASHARA & OSHA (OSH ACT).** They are the backbone of the federal protection we all enjoy, namely, the public in general, certain schools and the asbestos workers. Although they cannot be labeled as green, we must keep in mind that they were enacted decades ago when green philosophies were not widely conceived.

The first three are regulated and enforced by the **EPA**, and the last one by the **OSH Administration (OSHA)**.

Federal Law # 1:

National Emission Standards for Hazardous Air Pollutants (**NESHAP**).
Found under 40 CFR, Chapter 61, Subpart M. Originally enacted in 1973 and amended last in 1990. NESHAP was developed by EPA, as mandated by the Clean Air Act (CAA), Section 112. The CAA was enacted in 1955 and has subsequent amendments.

NESHAP defines **ACM** as any material containing **more than 1% asbestos**. It regulates the **renovations** (disturbance, stripping or removal of ACM) of facilities, including ships, buildings, cooling towers, bridges, docks, seawalls, etc. See Section 4. It also applies to certain **demolitions** even if no ACM is present. See Section 5.

The intent of this law is to protect the public in general. This is probably the **most important** legislation concerning asbestos.

For the NESHAP law, EPA prefers to delegate most of the regulation and enforcement responsibilities to the states and local governments, mainly county, called Local Delegated Authorities (**LDA**). In addition, some states and municipalities in the US have already passed laws and ordinances with similar or higher standards, but can never be less stringent. Sometimes they also cover issues not addressed or perceived not to be clear enough in this federal law.

A Regulated Asbestos Containing Material (**RACM**) always falls under NESHAP. In plain English, it is ACM classified as friable; or non-friable that is, or may become friable during renovations or demolitions. And the **quantities** would also have to be at or above the thresholds, which are:

260 linear feet (LF) of pipe, **160** square feet (SF) of surface material, or **35** cubic feet (CF) of debris volume if the origin cannot be quantified in SF or LF.

The NESHAP regulations refer to the terms **facility** and **site**, which are quite important:

A **facility** is basically any institutional, commercial, public, industrial, waste disposal site or residential structure. For the latter, it includes individual units operated as cooperatives and condominiums. However, buildings containing **four or less** residential units, called **SFR** in this course hereafter, are **excluded**. All facilities are structures regulated by the law.

Although SFRs are exempt from the law, the renovation or demolition of **two or more** SFRs falls under the law. Similarly, **one** SFR would also lose its exemption if say, one commercial building and one SFR are involved in a project. The SFR, as a **second** building in the project site, is considered one of the facilities in that site.

A **site** is not specifically defined in the asbestos NESHAP regulations, however EPA interprets it as a defined project area with one or more facilities. The shape and size could vary depending on the project characteristics. Multiple facilities make up a **site** when there is **one** company or entity doing **one** renovation or demolition project and those facilities are part of the **same** schedule, planning or common purpose. The definition of a site is sometimes ground for controversy because some project owners try to circumvent the regulations by fragmenting the work in a site so that the work would not fall under NESHAP.

NESHAP stipulations specifically prohibit the staging/scheduling of regulated renovations or demolitions for the purpose of circumventing the law.

For example, that would apply when major RACM renovations are purposely done one at a time, and in each occasion for less than the 160 SF, 260 LF or 35 CF threshold in order to avoid compliance with the NESHAP stipulations.

With the above paragraph in mind, for example, a project proposing to demolish one SFR and one facility such as a commercial or industrial building, would also circumvent the law if they are demolished one at a time while applying for a SFR demolition permit without disclosing the fact that there is another building (facility) demolition in the site. That would mean that the owner would cheat and save the expenses of the SFR survey and the probable abatement requirements prior to its demolition. Of course, remember that the renovation or demolition of **any** commercial, industrial or other facilities in a site always falls under NESHAP.

For renovations or demolitions of one or more facilities comprising a site, the 160 SF, 260 LF and 35 CF RACM thresholds are reached as **cumulative** amounts from every room and every **type** of RACM in a facility, and also from every facility in that site. In addition, the amounts are calculated for a rolling twelve months period.

Facility renovations and demolitions must meet specific requirements of this law, but we must understand the meaning of those terms as they apply to NESHAP.

Renovation has **two** meanings:

One, the **stripping** or **removal** of **RACM** from a facility or facilities in a site, in which case, the law would always apply. The stripping or removal action requires **abatement. Disturbance** of either ACM or RACM also falls under this renovation definition, and abatement would be required. For example: sanding plaster, or painting popcorn ceiling with a brush or roller. Prior to starting the field work, a Ten Day Notice (see below) and evidence of a thorough asbestos inspection/asbestos survey have to be submitted to LDA, the State or EPA. See Section 4.

Two, the **alteration** (retrofitting or remodeling) of one or more facilities in any way, as part of a site; or the alteration of their components in any way. NESHAP initially applies as far as the need for an asbestos survey goes. The survey would only be required if the asbestos suspect materials being disturbed, stripped or removed are at, or over, the previously mentioned RACM thresholds. If a required survey shows that there is no RACM, the law would not apply beyond that. However, if the project involves ACM or RACM disturbance in quantities at or above the thresholds, then of course, definition **one** above would apply.

However, please note that even if no RACM exists, the law would still apply should the alteration include any regulated **demolition**. For example: the permanent removal of a column. Then, a Ten-Day Notification for the column demolition and its asbestos survey would be needed, among other things.

Demolition:

NESHAP has a broad definition for demolition, and in simple language, it is the total removal or wreckage of a facility or its components; the permanent removal of any structural member of a facility or its component; and the intentional burning of any facility, component of a facility, or structural member.

The NESHAP regulations always apply for all those regulated demolitions even if no RACM exists. Also, before field operations of regulated demolitions start, any existing RACM would have to be properly removed (abated) and taken to a hazardous waste site. See Section 5.

The Notice Of Demolition Or Asbestos Renovation is also known as the **Ten-Day Notice.** That is applicable to both regulated renovations and demolitions and must be filed at least 10 working days prior to the beginning of the field work. The most important items that must appear on it are:

Type of project (demolition or renovation/abatement); Facility address; Owner's name and address; Demolition Contractor or Asbestos Contractor's name and address; Start and finish dates; Waste site name and location; Type and quantities of RACM to be abated, if a renovation project; Type and quantities of non-friable ACM that are to remain in the facility at the time of the demolition, if a demolition project; Name and signature of owner or operator; and Date of submittal.

The method specified in the law to determine the asbestos content of a material in percent is Polarized Light Microscopy (**PLM**). It determines whether or not a material is classified as ACM, asbestos material or non-asbestos material.

However, in order to comply with the NESHAP requirement of a **thorough asbestos inspection/asbestos survey** (discussed in law # 2 below), the EPA interpretation must be followed. In common language, it indicates that a proper effort or due diligence must be made to obtain a correct asbestos content assessment. That may include the use of newer methods or technologies.

For instance, vinyl floor tiles (VFT) that happen to be ACM, usually contain a considerable percentage of very **small** asbestos fibers. They can, and should be analyzed using a more modern, powerful, but more expensive method that can properly detect them. For instance, Transmission Electron Microscopy (**TEM**), which is the most common of the newer methods. Therefore, all VFT bulk samples taken during the asbestos survey should be analyzed using said method to meet EPA's interpretation.

The **PLM** method is **not** suitable for non-friable ACM analysis in general, and in the case of VFT, it would not be able to detect such very small fibers. If an asbestos survey does **not** properly identify non-friable ACM, and in particular the VFT small fiber percent, it can be considered a NESHAP violation. The problem is that some in the industry know well about the newer methods, but choose to go with the cheaper PLM anyway. They would later argue in vain that it is the method mentioned in the NESHAP regulations, which is of course, decades old.

Some typical NESHAP violations are:

a) Failure to submit the Ten Day Notification to LDA, the State, or EPA prior to starting field operations of regulated renovations or demolitions.
b) Creating improper or visual RACM emissions (debris or dust).
c) Improper handling, storage, transportation or disposal of RACM debris.
d) Lack of both an Asbestos Survey and the Ten Day Notification when two or more SFRs are being renovated or demolished.

Federal Law # 2:

Asbestos Hazard Emergency Response Act of 1986 (**AHERA**).
This law is in 40 CFR, Chapter 763, Subpart E. Then, in 1987, EPA developed the Model Accreditation Plan (MAP) as Appendix C. It was the result of a mandate from Section 206 of the Toxic Substances Control Act (TSCA).

AHERA was specifically passed for the purpose of protecting children in public, and private **not for profit** schools (Kindergarten to 12th Grade). Charter schools as well as the ones in military bases outside the US are included in the law. It encourages states to develop similar programs, but never less stringent than AHERA's. Higher standards and additional topics not addressed or perceived as gray can be included.

The above-mentioned MAP defines accreditation requirements for individuals involved with ACBM inspections, abatements and maintenance operations. It includes the number of training hours and examinations that the different employees carrying out the above responsibilities must take to be qualified for a particular job.

There are five **basic** asbestos course accreditations: Worker, Inspector, Management Planner, Project Designer and Contractor/Supervisor. Some States not only have additional basic courses for the asbestos industry, such as Respiratory Protection in Florida, but they also decide which basic course or courses must be successfully taken before certain other classifications or titles can be achieved.

For example, Asbestos **Consultants**, who in Florida need to be registered professionals in other construction-related disciplines, must take and pass an examination after several required basic courses are completed. Asbestos **Contractors** are not generally required to have a college degree or related field professional registration, however, they have to attend and pass several basic courses, and in some states, like Florida, an additional examination.

Consultants usually represent the owner, conduct asbestos surveys, develop project specifications, monitor the air quality in the project and oversee the Contractor's activities for overall compliance, including regulatory mandates. Consultants may also be titled Asbestos Project Managers in some states and have similar responsibilities.

Workers carry out the abatement or maintenance work, Inspectors conduct the asbestos surveys, Management Planners develop and monitor Management Plans, while Project Designers develop specifications for Consultants. The Contractor/Supervisor basic course is usually required, among other courses, for Contractors, Project Monitors and Competent Persons. Planners and Designers may be required to take one or more of the basic courses, in addition to theirs. AHERA does not have specific training requirements for other than those five basic classifications.

Project **Monitors** and **Competent** Persons are additional classifications in Florida, but the industry titles may vary in other states. The Project Monitors usually work under a registered Consultant or Project Manager and do most of the project monitoring. A specific course related to air monitoring techniques would be required if those responsibilities were included. The latter is also the same as Foremen, work under the Contractor and assure that the project's work is carried out properly.

AHERA regulates ACBM and specifies three categories, **SM, TSI & M** (see Section 1). Also, it includes requirements for inspections, asbestos management plans, removal, disposal and post-abatement interior clearance.

Many of the AHERA stipulations have become **generally accepted asbestos industry standards**. A few good examples of that would be:

The **number** of suspect ACM bulk samples in asbestos surveys, see Figure 4 below; post-abatement **air clearance** thresholds (0.01 f/cc or 70 s/mm^2 for PCM and TEM, respectively), see Section 4; and many of the **practices** for a sound Asbestos Management Plan (see Section 6).

However, should any of the above standards, and any others in AHERA be desired by owners, operators, managers, lessees and others in control of facilities (called **owners** hereafter), they should be listed in the **specifications** and not assume that they will be automatically implemented by the Asbestos Professionals. Litigation and delays could happen, if you do not.

AHERA applies only to ACBM inside the building and therefore, an AHERA asbestos survey would **not** be acceptable for the purposes of a total demolition, which is regulated by NESHAP.

The required asbestos survey would need to include the outside of the building, hidden areas and spaces such as the ones inside walls and partitions, and all asbestos suspect materials. In addition, the sampling method would have to be of a destructive/invasive nature.

A typical problem arising from the above paragraph content is that some school districts try to use their existing AHERA surveys for NESHAP regulated operations such as the total demolition of a school. When the inspector from the LDA responsible for regulating NESHAP tells them that their existing survey is not acceptable, and that a new or revised survey must be submitted, friction between governmental bodies can occur.

The content of a **thorough inspection** (as called in NESHAP)/**asbestos survey** should be tailor made for its **purpose** to prevent unnecessary work and waste of money. For example, an asbestos survey intended exclusively for the total demolition of a facility should not include a physical assessment (condition) of the ACBM, which is used for an Asbestos Management Plan.

Similarly, for a facility renovation where no future construction activity is in the horizon, the survey should cover only the materials known to be affected by said renovation, rather than include all of the suspect materials in the whole facility. And, of course, no physical assessment or destructive sampling should be included.

However, mainly for large sites, if near future renovations, demolitions and an asbestos management plan are scheduled, it may make financial sense to specify an All-inclusive or Full Asbestos Survey (AHERA items and more) for the first phase of the project**.** It should include items such as the **outside** of buildings, an **assessment** of the ACBM, a **destructive/invasive** method of obtaining bulk samples for the areas identified to be demolished and other valuable information as shown below. Afterwards, the future project phases would already have the necessary asbestos survey information and the related plan of action, which could then be implemented without delays or interruptions.

Whether intended for Renovations, Demolitions or Asbestos Management Plans, **all** suspect materials must be sampled, regardless of the installation date. However, OSHA allows TSI and SM installed through 12-31-80 to be labeled as presumed asbestos containing materials (PACM). If that were to apply to a particular building, the owner could **presume**, rather than test, however, those materials would have to be treated as ACM in relation to all of the applicable regulations.

a) The name, signature, accreditation state and No. of the Inspector who conducted the survey, as well as the licensed Asbestos Consultant responsible for it.
b) The date(s) of the inspection.
c) Review of plans and asbestos records.
d) The laboratory report showing: the analysis date; the name, address and accreditation number of the laboratory; the name and signature of the technician who conducted the analysis and the result of the analysis. The laboratory needs to be certified by the National Voluntary Laboratory Accreditation Program (NVLAP).
e) The facility drawing or sketch clearly indicating the location of every sampled homogeneous (similar texture, color & installation dates) area and the exact location where every sample was collected within those areas. A reasonable effort should always be made to obtain and list samples from inaccessible areas.

f) A list of homogeneous areas and samples showing all of the friable ACM, non-friable ACM (Category I or II), asbestos materials (> 0%, up to 1%), as well as their percent of asbestos and matrix materials. Said list should indicate the ACBM type (SM, TSI or M), and whether the samples were from the inside, outside, or obtained through a destructive method. All laboratory-confirmed non-asbestos material samples need to be listed.

g) The drawing indicating the location of any material presumed to be ACM, but not sampled.

h) The facility drawing showing functional areas (cafeteria, lobby, library, classroom, etc.) depicting the different homogeneous areas within them.

i) A discussion of how the bulk sampling locations were randomly selected and properly represented the different homogeneous areas.

j) A physical assessment of every functional area's ACBM, the location and the potential for disturbances (accessibility, nearby vibrations, frequency, etc.) of every category shown below:

1-Damaged or significantly damaged TSI
2-Damaged friable SM
3-Significantly damaged friable SM
4-Damaged or significantly damaged friable M
5-ACBM with potential for damage
6-ACBM with potential for significant damage
7-Any other friable ACBM or ACBM suspected of being friable

Figure No. 3 by Author. Full Asbestos Survey

SM	TSI	M
For < 1,000 SF, **3**	For < 6 SF or LF, **1**	**Take enough samples to determine**
For 1,000 to 5,000 SF, **5**	For > 6 SF or LF, **3**	**whether ACBM. In EPA's Region IV,**
For > 5,000 SF, **7**		**SE of US, a min. of 2**
Recommended for all SM areas, **9**		

Figure No. 4 by Author. AHERA's Bulk Sample Numbers

Federal Law # 3:

Asbestos School Hazard Abatement Reauthorization Act (**ASHARA**).
This law has the same origin as AHERA, except that this Act was an amendment made in 1990. It mandated that the **MAP** be revised to **extend** the accreditation requirements to Public and Commercial buildings, in addition to the regulated schools.

The Public and Commercial regulation extension is **interpreted** to include facilities such as government, commercial, rented residential dwellings in buildings with 11 or more units, industrial and institutional. Similar to AHERA, this law applies to the inside of buildings only, and also encourages states to adopt similar programs. In some cases, those laws have a higher standard and may cover situations not addressed by this federal law. ASHARA and similar state laws intend to prevent untrained and unqualified people from improperly disturbing asbestos.

ASHARA specifies accreditation requirements for individuals involved with ACBM inspections, abatements and maintenance operations. It includes the number of minimum training hours, which are increased.

Some large facilities such as hospitals and power plants make the green decision to hire a Planner to effectively control the existing ACM and asbestos materials. However, this law exempts them from having to hire an accredited Asbestos Management Planner. But, of course, other activities by ASHARA regulated facilities such as asbestos inspections, renovations, repairs and maintenance work certainly fall under this law.

Some unscrupulous contractors hire asbestos workers without the mandated training or credentials, and either falsify or know that the training certificates produced by some of the workers have been falsified. Similarly, some facility owners hire untrained and unqualified workers to remove known friable ACM to save thousands of dollars, which otherwise would go to a licensed Asbestos Contractor. The job is usually done without any protective gear, and most of the time the workers do not even know they are disturbing dangerous materials.

The above practices can create a serious hazardous condition to not only the workers themselves, but to the facility tenants, other workers in the building, visitors and the public in general. When caught, the contractor or owner, respectively, can face civil and criminal charges for violating not only ASHARA, but also NESHAP and OSHA laws. AHERA could also be violated if the work is for regulated schools, however, that is unlikely.

Another typical violation of this law occurs when the owner of a regulated facility such as an apartment building orders an asbestos survey. The sale of the building or tenant concerns may trigger such action. Sometimes a real estate inspector, engineer, etc. is the one who takes a few bulk samples, sends them to the laboratory and includes the findings in his/her inspection report. That would be a violation of ASHARA unless that individual has been properly accredited as an Asbestos Inspector. Additionally he/she must work under the supervision of a licensed Asbestos Consultant.

Federal Law # 4:

Occupational Safety and Health Act (**OSHA**).
The Act of 1970 was passed with the purpose of protecting workers in general inside the US. The most pertinent parts are 29CFR 1910.1001 covering Asbestos General Industry Standards; 29CFR 1926.1101, which talks about Asbestos Construction Standards; and 29CFR 1910.134 specifying use of Respirators.

OSHA encourages states to adopt similar, but never less stringent regulations. The OSHA inspired state laws can have higher standards and cover hazards not included in the federal version. About half of the states in the US have OSHA approved programs.

In contrast with EPA, OSHA does not delegate the regulatory and enforcement responsibilities to the local governments. Its regulations protect asbestos workers within reasonable parameters, but are not quite green. They recognize that there are risks to such endeavors.

When a licensed Asbestos Contractor is doing the work by himself or herself, OSHA does not apply. However, its regulations would take effect if at least **one** employee were utilized, even for **SFRs**. Additionally, OSHA does not regulate work with ACMs like asphalt roof coatings, cements or mastics.

If a facility owner proposes to remove 165 SF of popcorn with asbestos content of 0.4%, he/she does not have to meet NESHAP, because the work entails asbestos materials below the law's percent threshold. However, work with **asbestos materials**, which is termed **unclassified**, still applies under OSHA, but only for wetting and prompt clean up. PELs may also be required.

Similarly, in the following example, a facility project where 155 SF of popcorn ACM are being removed, NESHAP would not have to be met either, because the amount is less than the threshold of 160 SF. However, OSHA regulations still apply if one or more employees are used.

The following terms are important under this law and are specifically related to employees' asbestos fiber inhalation control:

PF stands for Protection Factor and is a pre-determined rating number by the National Institute for Occupational Safety and Health (**NIOSH)** for the different types of respirators or masks. The rating varies between 10 and 10,000. The higher the number, the better the protection.

PEL means Permissible Exposure Limit. It applies overwhelmingly to the asbestos workers inside a regulated area where asbestos abatement takes place. In addition, individuals doing asbestos related repairs and maintenance as well as any employees anywhere are covered by this parameter. This regulatory item is set at a maximum allowed concentration of **0.1 f/cc**, as a Time Weighted Average (**TWA**). When the PF equation below is solved for "i", it must be compared to this **allowable** PEL. The "i" stands for air fiber count inside the respirator.

Every worker in the regulated area has an **individual TWA** for personal monitoring. He/she wears an air pump having a filter and cassette to measure the fiber content next to him/her. Then, the TWA is calculated for **8 hours** even if the worker was in the regulated area for less time. That result is plugged into the PF equation below as the numerator "o", meaning air fiber count outside the mask.

PF = o/i

This equation can be used to calculate whether or not the above-mentioned PEL is met. Let us assume that the "o" happens to be 5 f/cc. The "i" is always the only unknown, which can be calculated.

The NIOSH PF rating is always known. For this case, we assume to have a full mask, which has a rating of 50.

Thus, 50= 5/i

And therefore, solving for "i", you get 0.1 f/cc, which is OK, and is right at the maximum allowed value in this example. However, a half mask, which has a rating of 10, would not have been adequate for the job to meet OSHA. And note that the lower the "i", the greener it is.

STEL is a 30-minute duration parameter called Short Term Excursion Limit. The maximum **allowed** is **1 f/cc**.

NEA means Negative Exposure Assessment. It is a documented **work practice** by a particular asbestos contractor, for a particular type of abatement. The NEA must yield worker TWAs at or below the PELs (including STELs), otherwise, it would not be a NEA. If, for a particular job, a contractor does not happen to have a NEA, he/she can get an initial estimate from different sources within the industry, or measure it at the beginning of the job, and proceed conservatively until a work practice for that kind of abatement work can establish a NEA.

An asbestos contractor's discipline and knowledge affect the NEA. The training and experience of the workers as well as the established engineering controls and work practices such as the wetting of ACM or asbestos materials, the prompt collection and bagging of the debris, etc., affect the air fiber count and, therefore the NEA.

When there is no NEA, the contractor's work can be more cumbersome and more OSHA regulations would apply, depending on the work class. They may involve decontamination units, air monitoring, protective clothing, more expensive and difficult to handle respirators, etc. See Section 4.

This law specifies four asbestos worker classes when the activity is done with **ACM**, which are Class I thru IV. Class I has the most potential exposure to asbestos fibers, while Class IV, the least.

However, as previously discussed, when the work is conducted with **asbestos materials** (> 0% and up to 1%), some worker safety stipulations still apply, although the activity is unclassified, and it would **not** be defined as one of the four worker classes.

Class I work involves removal abatement with friable ACM, namely, TSI or SM. That is, of course, a major disturbance, and therefore, the workers must **always** wear respirators.

For small Class I jobs **up to** 25 LF of pipe or 10 SF of surface area, a mini-enclosure with an equipment/dirty room (decontamination unit) is required together with some other regulatory items.

Please note that for Class I work with **more** than the 25/10 threshold, a NPE with a three-chamber decontamination unit (clean, shower and dirty room), as shown in Figure 5 & Picture 6 below, is used together with protective clothing and other mandatory details. A mini-enclosure with a three-chamber decontamination unit and other regulatory details is also allowed, but not used as often.

However, if removal abatement of pipe TSI is involved for a Class I project, an alternative method called Glove Bag System or Negative-Pressure Glove Bag System may be used. Those systems involve the use of a bag with attached long sleeve gloves for the handling of the abatement inside the bag. The material usually consists of six to eight mil polyethylene plastic. Said bag has a small opening so that water sprayers or HEPA vacuum nozzles can be handled safely. Since the operation engages in Class I work, respirators must always be worn and the job done in a regulated area.

Class II entails removal abatement work with other than TSI or SM, mainly non-friable ACM. Some disturbances can be expected. Should removal jobs render the ACM **not intact**, respirators would be required.

Class III involves activities such as repairs and maintenance, which typically have minor disturbances of ACM. Bulk sample collection by asbestos inspectors is one of those activities. If disturbance of SM or TSI are involved, then respirators are mandated.

Class IV work consists of custodial and housekeeping activities where no disturbances of ACM are expected. Typically, debris and dust clean up.

The PELs, NEAs, friability of abated materials, dry removal methods, etc., determine some more regulatory parameters such as air monitoring, training, equipment, medical surveillance, etc., for the different work classes. Accredited Competent Persons or Foremen are required to be present for all Classes, albeit at different levels.

A typical OSHA violation consists of the failure of an asbestos contractor to properly monitor the respiratory, PELs and engineering control guidelines. In particular, improper thorough wetting of the ACM or asbestos materials and failure to change the HEPA filters on time.
At this point, it should be pointed out that the two federal agencies (EPA & OSH Admin.) in charge of regulating and enforcing the above four laws, must sometimes make difficult interpretations. The reason is that the laws cannot, and do not possibly cover every situation that may arise. However, anyone disagreeing with any interpretation has the right to challenge it in court.

Section 4- Building Renovations (Abatements)

This Section will discuss the **renovation** definition **number one** as previously mentioned in Section 3, law # 1 (NESHAP). Those facility renovations involve the disturbance, stripping or removal of **RACM**, which are always quantities at or above the NESHAP thresholds of 160 SF, 260 LF and 35 CF. Proper **abatemen**t procedures must always meet both NESHAP and OSHA. AHERA would have to be met only if the work is proposed for a regulated school. ASHARA would probably apply most of the time, depending of course, on the type of facility.

Also, this Section applies to the disturbance, stripping or removal of **asbestos materials** (> 0%, up to 1%). That **unclassified** class of work is **not** technically called renovation under NESHAP, and the law does not apply to those related **abatement** operations either. But the three previously discussed worker safety regulations by OSHA still apply (wetting, prompt clean up & PELs, when specifically required).

Abatement pertains to three different procedures: the **removal** of ACM or asbestos materials, which is the most popular, effective and **green** method, but more expensive than the other two; **encapsulation** consisting of the application of a coating to either penetrate or bridge the material and extend the preservation of the ACM or asbestos materials; and **enclosement,** characterized by the isolation of the ACM or asbestos material in its existing location, which is made airtight, impermeable and safe from occasional intrusion or disturbance by anyone.

Should the renovation work include the **disturbance** of ACM or RACM, such as sanding, painting of friable surfaces with a brush or roller, hammering, cutting, abrading, etc., the activities must be properly **abated**, similar to removal abatements.

Most or all of AHERA's pertinent "generally accepted industry standards" will be adhered to by dependable Asbestos Consultants or Asbestos Project Managers and Contractors involved with any abatement project, including non-AHERA jobs. Of course, they must also follow the NESHAP, OSHA and ASHARA regulations. See Section 3 above.

After the removals of abatement projects are completed and the abated surfaces are fully dry, the **lockdown** procedure follows. It consists of applying a sealant or protective coating. The intent is to prevent any asbestos fibers that may remain in small cracks or grooves from becoming airborne. Such potential is always there even when the abated surface may appear to be very clean. Then, you are ready for a new non-asbestos coating.

NESHAP specifically prohibits the creation of visual asbestos emissions into the air originating from RACM anywhere, regardless of the name of the operation. That includes not only renovations and demolitions, but also activities related to Asbestos Management Plans. Additionally, those regulations prohibit RACM visual debris or dust from laying or accumulating on the ground, floors, other surfaces, or outside. That applies, before abatement ever begins, during or after abatement. If during abatement, the debris or dust would have to be wet and properly bagged without delay.

For abatement work with either ACM or asbestos materials, as well as repairs and maintenance operations involving asbestos, **thorough wetting** is always required by federal law, except in very special cases. That is probably the most important, or one of the most important engineering controls in the industry. Dry sweeping or dry removals are not allowed, except in very particular instances.

Negative Pressure Enclosures (**NPE**) are generally used by most contractors for the majority of abatement projects of any significant size. Critical barriers in the form of double layer plastic sheeting, usually polyethylene, are placed inside the NPE to cover all openings as well as the inside of the NPE surfaces. See Figure No. 5 and Picture No. 6 below.

Although most of the time, a particular room or hallway becomes the NPE, sometimes it is necessary to build it using 2" X 4" wood studs or other materials if the abatement area is not inside the building, or only partially inside. Then, the critical barriers are attached to the walls, floors or roof wood members to define the NPE area.

All NPEs are regulated areas with maximum safety features, but not all regulated areas are NPEs. The advantages of using them, even if not necessarily required by regulation, include increased productivity, the reduction of airborne fibers and an easier final cleanup. In addition, they prevent the asbestos fibers from the work area to migrate to the outside of the enclosure. Both AHERA and OSHA specify when and how they should be used, or need to be used.

The workers enter the NPE through the Decontamination (Decon) unit's Clean room, change into working clothes, put on their masks after inspecting them, and go past the Shower into the Dirty room. There they obtain the tools and enter the Work Area inside the NPE.

When they leave the Work Area, they enter the Dirty room, remove the work clothes and proceed into the Shower room where they remove the respirator and wash it.

Then, they clean up thoroughly and go to the Clean room, put on their street clothes, dry up the mask and exit the Decon unit.

A mini-enclosure is referred to in both AHERA and OSHA. It is a regulated area similar to the NPE, except that it is much smaller and does not have the negative pressure feature. It usually needs to be constructed with 2" X 4" wood studs, or similar materials, and plastic sheeting. OSHA requires that either a Dirty room or a three-chamber Decon area be connected to it when used. A NPE can always be used in lieu of a mini-enclosure. See Section 3, law # 4.

All regulated areas require proper signs to keep non-asbestos individuals out. And, depending on the asbestos activity, its magnitude, the OSHA Class of work, etc., critical barriers and other requirements would apply.

By the way, HEPA filters are the standard for asbestos work and need to be used for equipment such as vacuum cleaners, non-supplied air respirators, etc. They retain fibers with a 0.3 micron diameter or larger, having a minimum of 99.97% efficiency.

One or more high efficiency particulate air **HEPA Filtered Powered Exhaust Apparatus (portable unit)** are used in NPEs. They draw the NPE air inward through the filter of those units and away from the workers and perimeter areas. That is accomplished by maintaining a negative pressure differential of 0.02 inches of water between the NPE and the outside.

There must be enough units inside the NPE with the proper capacity to provide **four** air changes per hour. That also means an air change every 15 minutes.

The portable HEPA units generally have an air handling capacity of between 1,000 and 2,000 cubic feet per minute with clean filters. The **number** of those units needed to attain the proper ventilation requirement is obtained as follows:

First, calculate the total air volume inside the NPE in cubic feet and divide it by 15 minutes. The result is the total airflow requirement in cubic feet per minute.
Then, take that airflow figure and divide it by the capacity of the HEPA unit, which must also be in cubic feet per minute.

The result is the number of HEPA units required inside the NPE.

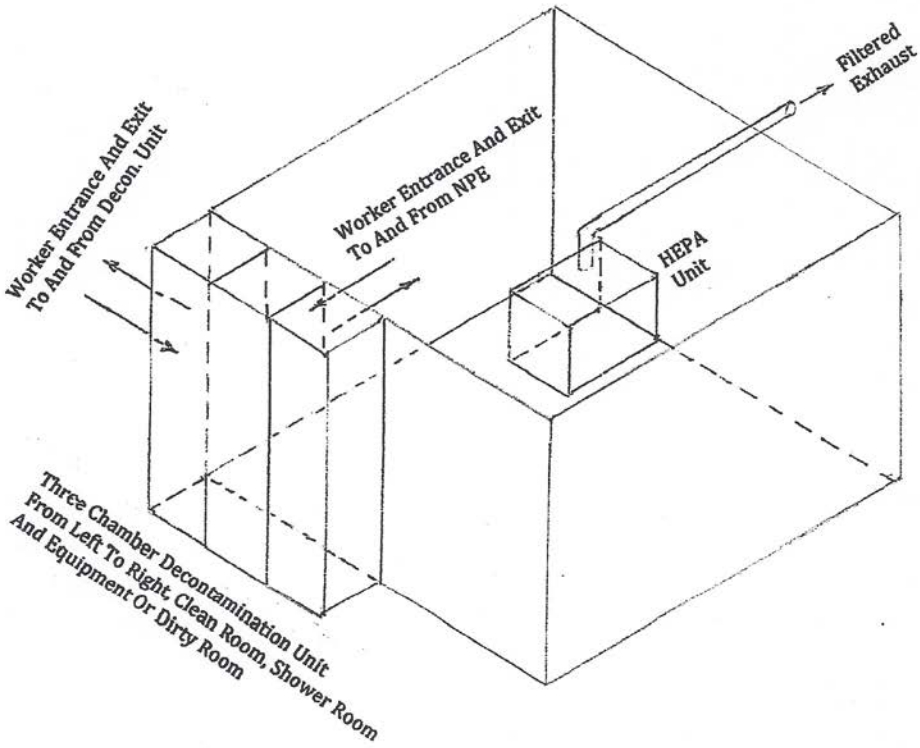


Figure No. 5 by Author. Isometric of a NPE. It depicts the **removal abatement** of a facility room, which is the most common and recommended type. Encapsulation and Enclosement are the other two types of abatement

Picture No. 6 by www.canstockphoto.com NPE with the polyethylene sheeting in place. Popcorn ceiling or similar coating appears to have already been abated.

For major projects, which may include NESHAP renovations, non-NESHAP renovations (alterations of a non-ACM nature), and some demolitions, a green **action plan** should create a **multidisciplinary team** during design. This approach is very important in order to make the job either completely trouble free, or mostly so, and safe. It should include Architects, Engineers, the Asbestos Consultant or Asbestos Project Manager, and the Asbestos Contractor.

The Asbestos Consultant should start his/her responsibilities in the team during design by conducting a thorough written asbestos survey and working with the Architects and Engineers to develop a draft action plan. However, the initial team participation of the Asbestos Contractor could be part of his/her technical proposal and bid submittal. And a mandatory pre-bid meeting should be imposed before the owner can accept those submittals.

The General Contractor and Subcontractors should join the team as they begin their later participation in the project. And similar to the above, a mandatory pre-bid meeting required before the bids with action plan ideas can be accepted.

Then, the team members can come up with a well thought out plan and determine the portions of the building(s) that should be abated in rational sequence while concurrent non-asbestos renovations and demolitions can proceed. Doing this not only accelerates the project progress, but also avoids friction between contractors and between them and the owner.

During said concurrent operations, some of the abatements could occur quite close to other alterations or demolitions and, therefore signs and barriers would need to be properly placed to avoid non-asbestos workers or others in the building(s) from encroaching and being contaminated.

Area air monitoring needs to be done both inside the regulated areas, including NPEs, as well as outside of them. The inside readings yield general air fiber measurements in the regulated areas for the benefit of the Asbestos Workers, while the outside readings indicate whether or not asbestos fibers are migrating outside of the abatement areas, which can expose the non-asbestos individuals. That should keep all employees and others in the facilities safe within the OSHA regulations.

As previously discussed under the OSHA law in Section 3, personal air monitoring of the Asbestos Workers is also mandated. A certified **Project Monitor** measures both area and personal air measurement activities, and works under an Asbestos Consultant. He/she also monitors the abatement project to assure that the project specifications and regulations are being met including the safety procedures. And, by the way, as discussed under the AHERA law, the Asbestos Workers report to a certified **Competent Person** or Foreman who is employed by the Asbestos Contractor.

PCM stands for Phase Contrast Microscopy and is the technique more commonly used to measure inside air fibers in non-school facilities.
It is important for the purpose of **air clearance** after abatement has been completed in a particular area. This method can neither detect very small fibers nor distinguish the asbestos ones from others. The applicable **clean air** threshold is 0.01 fibers per cubic centimeter (**0.01 f/cc**), or less.

TEM means Transmission Electron Microscopy, a very powerful method, and it measures asbestos fiber content in the air, used mainly for air clearance purposes. The **clean air** threshold for this technique is 70 asbestos structures (single fibers or fiber bundles) per square millimeter (**70 s/mm^2**), or less. This method is more expensive than the PCM one above and takes longer to get the results from the laboratory, but certainly more desirable from the green point of view.

Picture No. 7 by www.canstockphoto.com Multidiscipline team coordinating the proposed overall approach of a major project

The fact is that, on average, **ambient air** in the US has much less asbestos fiber content than AHERA's PCM or TEM definitions of clean air.
Therefore, for post-abatement green air **clearance**, the specifications should call for the **pre-abatement** air measurement as well as the use of the TEM method. First, measure the air inside the building room proposed for abatement, before it starts. Then, after the abatement completion, do aggressive sampling techniques and perform the final air measurements.

The **aggressive** sampling technique is required by AHERA. It consists of using leaf blowers or similar ways to agitate the asbestos fibers that may have already settled on the floor or other surfaces inside the abatement area. Then, while they are airborne, the final post-abatement air measurements are taken. This is a conservative way to ascertain inside air quality.

Asbestos Measurement Clarification- The **PLM** and **TEM** methods are utilized to analyze **bulk samples** and determine the asbestos content of suspect materials. Then, they are classified as ACM, asbestos material, or non-asbestos material. It was previously discussed under Section 3, law # 1. However, for the measurement of **fibers in the air**, **PCM** and **TEM** methods are used.

It should be pointed out that owners should always have two different contracts. One would be with the Asbestos Consultant or Asbestos Project Manager for the asbestos survey, the monitoring of the asbestos contractor's work and the air sampling. And two, with the Asbestos Contractor who would conduct the work based on the asbestos law requirements and the owner's specifications. Of course, for most projects there are other professionals and contractors from other disciplines, which would require additional contracts.

Some owners and contractors conducting minor renovations with asbestos suspect material quantities that fall below the NESHAP's RACM thresholds sometimes do not bother to order an asbestos survey because it is not required. However, they may end up creating dangerous asbestos fiber emissions if those materials happen to be either ACM or asbestos materials. And keep in mind that although NESHAP should be out of the picture, OSHA would still apply. Then, violation citations could be issued, if caught.

Section 5- Structure/Facility Demolitions

Should any **RACM** be identified in the asbestos survey, its **removal** would be the **only** lawful abatement option prior to any demolition, except for specifically approved situations or emergencies such as natural disasters.

The non-friable ACM (usually Category I); friable ACM that cumulatively falls below the 260 LF and 160 SF RACM threshold; as well as asbestos materials (> 0% up to 1%) that NESHAP allows to stay, and usually do during demolitions, do not have to be taken to a hazardous waste site according to that law.

However, the **green** philosophy would call for the removal of **all** ACM and asbestos materials prior to the demolition, and their disposal in a **hazardous** waste site. The rest of the debris can then go to a cheaper disposal site.

It should be pointed out that the materials mentioned in the above paragraph, which generally stay during demolitions, create a non-green situation for obvious reasons. However, in addition, some of the asbestos OSHA regulations are applicable.

Demolition is usually the total removal or wreckage of a facility. But other detailed definitions are shown under Section 3, law # 1. All those defined regulated demolitions fall under the NESHAP stipulations **regardless** of the amount of RACM, even if none exists. That definition of the law is very important and may even appear to be controversial to some when they discover that the structures they plan to demolish or have already demolished must meet, or should have met, the NESHAP requirements.

For any NESHAP regulated demolition, the most important action to remember doing is the submittal of the **Ten Day Notification** to LDA, State or EPA. That is, of course, after a destructive/invasive method of survey has been conducted and where apparent inaccessible areas were either reached or a reasonable attempt to do so was made for bulk sampling. That may include taking core samples of walls and ceilings, using high ladders or other ways to reach out and gain access into apparent inaccessible places, attics and crawl spaces.

Picture No. 8 by www.canstockphoto.com Total demolition, which is the most common among the NESHAP definition of demolitions

Section 6- Maintenance of Buildings

Maintenance may sound less important when compared to renovations and demolitions, but it is not. The problem with maintenance is that from major facilities to SFRs, it is done quite often informally by asbestos untrained individuals and without an asbestos survey to properly identify the existing ACM and asbestos materials, which is the first step. The underlying reason is simply the lack of asbestos awareness.

Building/Facility owners are required by OSHA to post signs at the entrance to mechanical rooms, if ACM is present. The same goes for any other areas with known ACM. The sign must show the type of materials, specific location and the proper work practices that prevent their disturbance.

All AHERA regulated schools must have a written Asbestos Management Plan by a certified Management Planner. The Plan must follow AHERA's guidelines and specifications, however, facilities other than the regulated schools do not have to abide by AHERA and do not need a certified Management Planner (according to ASHARA) to write the Plan, if they choose to do one.

However, be aware of the fact that some public and commercial facilities may be forced, by state and local laws, to have an Asbestos Management Plan.

Major facilities where owners have decided to implement an Asbestos Management Plan would be less likely to create asbestos related health hazards. In contrast, to no surprise, those large facilities that do not have said Plan are much more likely to cause harmful emissions. But even if the facility owners have decided that they do not wish to implement a written Plan, hazardous conditions could be avoided to a certain extent if the maintenance or building engineers have had some training on asbestos basics, have an asbestos survey, know how to monitor the existing ACM and asbestos materials, and understand when to get professional help. Those trained individuals should also be aware of, and proactively oversee both the occasional and everyday activities, which might result in accidental fiber emissions. However, the **green** thing to do for most large facilities with asbestos is to have a written Asbestos Management Plan by qualified professionals and have the trained personnel to put it into action.

A proper Asbestos Management Plan should have several different items, among them, the proper recording of the asbestos survey results into the building drawings and documents; an Operations & Maintenance (O & M) Plan; re-inspection frequency; and an estimate of the financial resources needed to carry it out.

All rooms or areas having ACM or asbestos materials need to be priority rated for future abatement or response actions as part of that O & M Plan with the three abatement types given the proper consideration. However, removal is always the most recommended one, if it can be afforded financially. Then, those abatements or response actions should be recorded, including the dates, contractor's name, type of activity, materials, etc.

The O & M Plan should also specify the control and monitoring of construction activity in the building by any of the tenants or their contractors. Trained individuals should be assigned those responsibilities to avoid accidental fiber emissions. Those activities could include contractors for CATV, alarm, telephone, plumbing, masonry, sprinklers and others.

In addition, the O & M Plan should include worker training; regular surveillance of the ACM and asbestos materials; and the communication of asbestos-related information to all building occupants. The latter could be accomplished through posted signs and flyers for the building tenants, their employees, and other people including the maintenance or cleaning crews. Such notice needs to include the ACM and asbestos material types and locations.

The locations containing friables or deteriorated non-friables where casual contact between the individuals and said dangerous materials can occur, are of particular importance. In fact, if those areas need to be frequented by people on a regular basis, or there are fans, machinery, vibrations from different sources, etc., nearby, an immediate abatement action would be in order.

Buildings which are not AHERA-regulated, but where an Asbestos Management Plan is being established, should consider specifying the following AHERA standards (and many others):

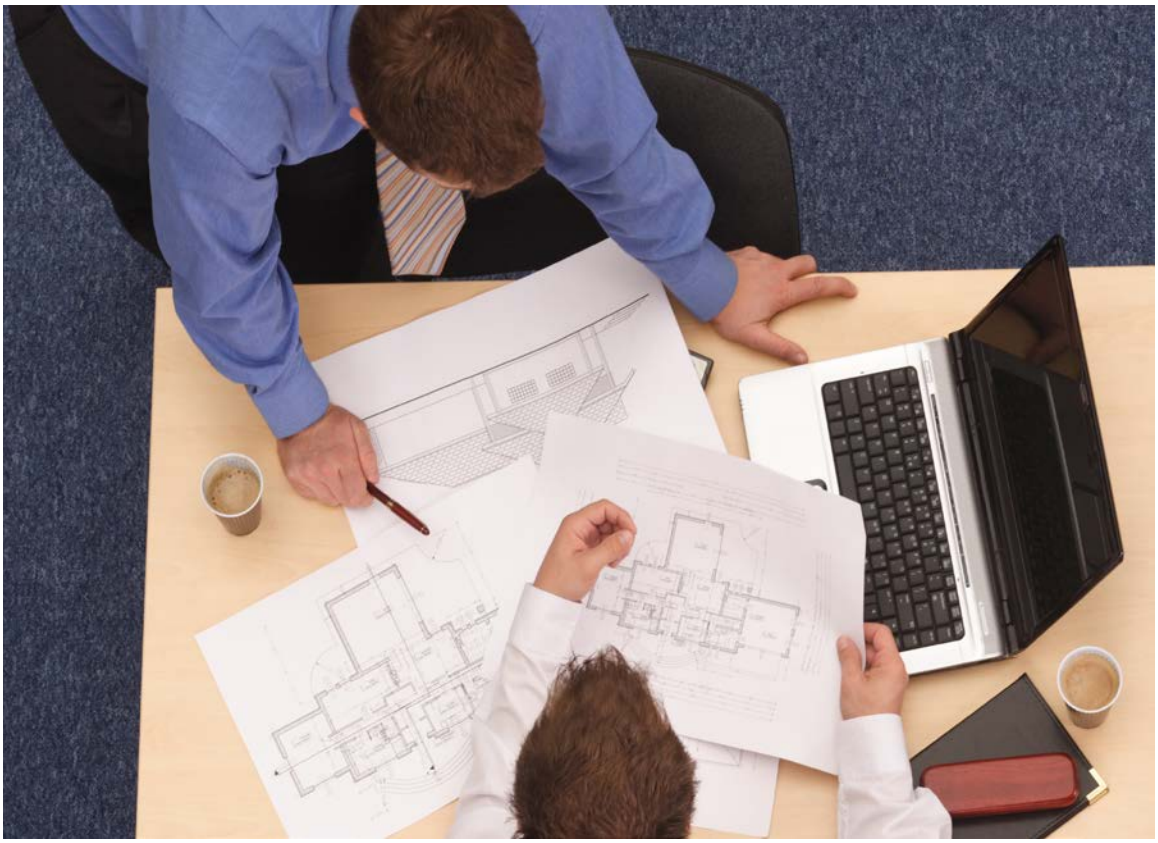
Small-Scale, Short Duration (**SSSD**) activities are part of a maintenance activity, which include removal of friable ACBM and minor repairs. When SSSD work involves quantities at, or below 3 SF or 3 LF, it is considered **minor**. As such, the requirement for accredited Project Designers and Workers is exempted. But if the quantities are above 3 SF or 3 LF, the exemption does not apply.

Minor episodes of unintentional dislodging of friable ACBM include quantities of 3 SF or 3 LF, or less. And similar to the above, accreditation is not required. However, episodes involving more than 3 SF or 3 LF are **Major**, and require accredited individuals. The latter episode is a maintenance **response action**.

1- Dry buffing of VFT floors. It may be done only if there is enough finishing material so that the VFT surface is not affected. If there is little or no finishing material, the buffing must be done only under wet conditions, using a non-abrasive pad and keeping the RPMs under 300. That is according to federal law
2- Slamming doors near known areas with friable or damaged materials
3- Relocating or removing ceiling tiles
4- Disturbing, removing or handling ceiling tiles (whether ACM or not), where fireproofing (from above beams) dust or debris has accumulated with time
5- Dry sweeping of dust or debris
6- Sandblasting or water pressure cleaning

7- Energetic work activity in a location where friable or damaged materials are expected to be too close to the workers
8- Vibrating machinery and loud noises if friable or disintegrating materials are close by
9- Accidental impacts with tools, equipment or vehicles
10- Prolonged weather exposure
11- Spilling acid or other abrasive chemicals
12- Painting friable or delaminating surfaces using brushes or rollers
13- Aggressively disturbing A/C or ventilation filters
14- Using regular vacuum cleaners
15- Nailing, hammering, abrading, cutting, drilling, etc.
16- Activities not properly planned, supervised or authorized by the Asbestos Management Plan or trained professionals, if no plan is in place

Figure No. 6 by Author. List of activities for maintenance, custodial workers and non-asbestos contractors to either avoid, or be aware of. That is applicable to both, **known** or **suspected** ACM and asbestos materials



Picture No. 9 by www.canstockphoto.com Building/Maintenance asbestos trained Professionals keeping track of ACM and asbestos materials in the facility, including areas already abated

Picture No. 10 by Author. Acoustic or ceiling tiles having minor water intrusion damage. The regular surveillance activity should pay particular attention to materials where decay or damage has already started. Friable ACM Tiles such as these are still legal to install in the US

Section 7- Drinking Water and Asbestos Cement Pipes (ACP)

For several decades, ACPs have been used in the US and other parts of the world to convey drinking water and sewerage. Hundreds of thousands of miles are already in place in the US alone.

We know that ACPs for drinking water systems can degrade because of high acid, chlorine and fluoride in the water. Consequently, asbestos fibers can be released into the drinking water. However, many pipe systems that are coated with iron and calcium deposits may emit fibers at levels less than significant.

Age deterioration and activities such as pipe maintenance can generate pipe damage. Likewise, excavations because of highway jobs, utility work, etc. can cause pipe breakages. As a result of all those reasons, fiber releases into the water can occur. When those asbestos fibers reach the public in significant amounts, a health risk can be created.

If the above occurs, and the Maximum Contaminant Level (MCL) of seven million fibers per liter set by EPA were to be exceeded in any Public Water Utility, the public would have to be notified. Additionally, the water would have to be tested once every three months. Then, if those levels stay consistently above said MCL, the Utility would have to use EPA approved treatment methods to remove asbestos fibers from the water and bring the levels consistently below said threshold. Those methods are: Coagulation/Filtration; Direct and Diatomite filtration; and Corrosion control. Other solutions such as providing different and less contaminated water supplies to their customers can also be exercised.

Abandoned buried ACPs, even in good condition, are certainly not a green scenario. In fact, they are considered **hazardous** waste sites, which qualify for the **Superfund** federal program by EPA. Said program identifies and investigates complex, uncontrolled or abandoned hazardous waste sites. Some sites on the list may qualify for clean up depending on the assigned priority.

A fairly recent method of replacing buried pipes has gained popularity mainly in the US and Europe. It is called “Pipe Bursting” or “In-Situ pipe replacement”. It is an excellent method, as long as it does not involve ACPs. The technique simultaneously bursts the existing pipe while pushing a new one in its place. Considering the above-mentioned sites regarding ACPs in good condition, and yet classified as hazardous, what could one possibly say when those pipes are broken up resulting in ACM pieces and asbestos dust mingled with the ground?

Picture No. 11 by www.canstockphoto.com Asbestos Cement Pipes (ACP) or Transite Pipes

Section 8- Typical Case Studies.

These cases are based on real life asbestos related issues. Some were not specifically discussed in the main text of this course and are intended to be just as educational.

a) Paul, the owner of a small retail space in a shopping center is doing some minor renovations together with one of his employees, which include the removal of a ten foot long interior partition made of wood studs and wallboards on both sides.

He knows that the NESHAP regulations apply to his commercial site. However, since the partition being removed is only ten feet long and eight feet high, he decides that an asbestos survey is not needed. He thinks that because the area of the asbestos suspect material is only 80 SF (10' X 8'), which is below the NESHAP threshold of 160 SF, that law does not apply.

Is Paul right?

No, he is wrong on three counts. First, he is in violation of two NESHAP regulations and one ASHARA mandate. Regarding NESHAP, for not conducting the survey and for creating uncontrolled RACM debris and asbestos emissions. The amount of wallboard area he is removing is 160 SF, that is, 80 SF of wallboard on each side of the partition. In fact since neither Paul nor his employee are accredited, an ASHARA violation can also be cited.

Second, Paul is also in violation of OSHA because he is using one employee to conduct Class II asbestos work improperly and unsafely. That would apply for any amount of ACM. Sometimes, OSHA could be notified of a possible violation through LDA, neighbors and others. In addition, an OSHA inspector could stop by the construction site.

Third, from the green point of view, ordering an asbestos survey should always be the first thing to do when either removing or disturbing any amounts of suspect materials. Then, should the laboratory report indicate the presence of ACM or asbestos materials, a licensed Asbestos Contractor should be contacted.

Note: A wallboard system always has joint compound and tape, which actually have an even higher possibility of containing asbestos than the wallboards themselves. If asbestos is present in any percentage, and sanded, abraded, cut, hammered, etc., dangerous asbestos fibers would be released into the air.

b) One single-family residence and one fourplex are next to each other. The owner plans to demolish both structures (SFRs) to make space for a new building. He/she proceeds to demolish them without delay because the NESHAP regulations exempt SFR buildings from the law.

Is he/she proceeding inside the law?

No, he/she is wrong, even when the demolition permits from the Building Department are pulled separately for each SFR. NESHAP applies when a SFR is the second building/facility in any project site. Those regulations are federal requirements separate from the local or state building codes. Also, OSHA and ASHARA could apply depending on the details of the demolition.

In addition to the legal issue, the owner is entirely wrong, as in case “a” above, from the green perspective.

c) The Project Engineer of a highway reconstruction project has to oversee the demolition of an existing relatively new bridge, which will be replaced by a larger one. He/she decides that the existing bridge cannot have asbestos because it is fairly new. Therefore, the demolition goes on without an attempt to meet NESHAP.
Is he/she acting improperly or illegally?

Yes, both. Many of the asbestos suspect materials that can be found in bridges are not banned. Certainly such action is not green. But, even worse, bridge demolitions fall under the NESHAP law regardless of the built date or asbestos content. Therefore, several violations concerning said law could be cited. In addition, depending on the type of asbestos content and the demolition methods, OSHA could also apply.

Bridges can have asbestos in cementitious/ transite gutters, bearing pads, guardhouse, machinery gaskets, brakes, concrete patching materials, attached ACPs, etc.

d) A General Contractor tells his/her crew to remove 1,000 SF of ACM resilient flooring/VFT because they are non-friable and are in good condition. He/she thinks that if they do it carefully, then no harm is done, and no laws are broken.

Is he/she right?

No, but it is true that NESHAP does not apply as long as the VFT is not made friable and no visual fiber emissions occur. However, the Contractor needs to be aware that some states and LDAs would require advance Notification (not necessarily the Ten Day Notice). Also, OSHA considers this activity as Class II and it pertains to any quantities. General Contractors do not usually have the many requirements for such endeavor including knowledge, equipment, NEAs, protective clothing, asbestos Competent Persons, asbestos trained Workers, etc. In fact, according to OSHA, the removal of VFT using the mechanical chipping method requires the use of a NPE, which only a licensed Asbestos Contractor could implement.

e) The owner of a 15 unit apartment building assigns a maintenance employee to remove ACM popcorn ceiling in the 10’ X 15’ room of a recently vacated apartment. Said worker does not have any asbestos training and creates both, debris laying on the floor and visible dust emissions.

A LDA inspector notices the work, stops by and issues a cease and desist order and several NESHAP violations.

Is that inspector right?

No, because the ACM area (150 SF) is below the NESHAP threshold. However, OSHA is involved because one employee is being used and its regulations have been violated. That kind of work is defined as Class I and there are quite a few requirements (see Section 3, law # 4).

Additionally, the ASHARA stipulations have been violated.

