Designation: E2356 – 14

Standard Practice for Comprehensive Building Asbestos Surveys[1]

This standard is issued under the fixed designation E2356; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes procedures for conducting comprehensive surveys of buildings and facilities for the purpose of locating, identifying, quantifying, and assessing asbestos-containing materials.

1.2 The results of a Comprehensive Building Asbestos Survey are intended to be used for ongoing management of asbestos-containing materials, including Operations and Maintenance (O&M), removal, and other response actions. This includes response actions associated with renovations. A Comprehensive Building Asbestos Survey is also intended to provide information required for removal of asbestos-containing materials prior to demolition of a building or facility.

1.3 This practice discusses three types of surveys: Baseline Surveys, Project Design Surveys, and Pre-Construction Surveys.

1.4 This practice discusses the following activities for each of the above types of surveys:

1.4.1 Planning the survey to meet defined objectives;

1.4.2 Obtaining and reviewing information on the building or facility including previous surveys and response actions;

1.4.3 Conducting the physical activities of inspecting the premises and collecting bulk samples of suspect materials;

1.4.4 Analyzing the bulk samples for asbestos type and content;

1.4.5 Assessing the Current Condition and Potential for Disturbance of asbestos-containing materials; and

1.4.6 Preparing a report that includes a narrative discussion of the findings, tabulations of inspection, sampling and analysis results, graphical depiction of the areas inspected, and the results of the assessment.

1.5 A Comprehensive Building Asbestos Survey provides sufficient information about the asbestos-containing materials in a building or facility for purposes of a real property transaction. In situations where the amount of information required by a party to the transaction is minimal, a Limited Asbestos Screen (see Practice E2308) may suffice in place of the Comprehensive Building Asbestos Survey.

1.6 This practice does not include air sampling or surface (dust) sampling for purposes of evaluating a potential exposure hazard from airborne asbestos fibers.

1.7 **Warning—**Asbestos fibers are acknowledged carcinogens. Breathing asbestos fibers can result in disease of the lungs including asbestosis, lung cancer, and mesothelioma. Precautions in this practice should be taken to avoid creating and breathing airborne asbestos particles from materials known or suspected to contain asbestos. See 2.2 for regulatory requirements addressing asbestos.

1.8 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D7521 Test Method for Determination of Asbestos in Soil

D7712 Terminology for Sampling and Analysis of Asbestos

E631 Terminology of Building Constructions

E1368 Practice for Visual Inspection of Asbestos Abatement Projects

E1494 Practice for Encapsulation Testing of Friable Asbestos-Containing Surfacing Materials

E2308 Guide for Limited Asbestos Screens of Buildings (Withdrawn 2014)[3]

E2394 Practice for Maintenance, Renovation, and Repair of Installed Asbestos Cement Products

[1] This practice is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.07 on Sampling and Analysis of Asbestos.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

MNL-23 Manual on Asbestos Control: Surveys, Removal, and Management – Second Edition, 2005

2.2 *Other Documents:*

29 CFR 1910.134 Respiratory Protection Standard[4]

29 CFR 1910.146 Permit-required Confined Spaces[4]

29 CFR 1926.1101 Occupational Exposure to Asbestos (OSHA Construction Standard)[4]

40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants: Subpart M—Asbestos[5]

40 CFR Part 763 Subpart E—Asbestos-Containing Materials in Schools (EPA AHERA Regulations)[5]

40 CFR Part 763 Subpart E, Appendix C (EPA Model Accreditation Plan)[5]

EPA 560/5-85-024 Guidance for Controlling Asbestos-Containing Materials in Buildings ("Purple Book"), 1985[5]

EPA 560/5-85-030A Asbestos in Buildings: Simplified Sampling Scheme for Surfacing Materials ("Pink Book"), 1985[5]

EPA 600R-04/004 Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation, January 2004[5]

EPA 600/R-93/116 Method for the Determination of Asbestos in Bulk Building Materials, June 1993[5]

State of New York Environmental Laboratory Approval Program (ELAP) Certification Manual, Item No. 198.1 Polarized Light Microscopy Method for identifying and Quantifying Asbestos in Non-Friable Organically Bound Bulk Samples, May 15, 2000[6]

State of New York Environmental Laboratory Approval Program (ELAP) Certification Manual, Item No. 198.4 Transmission Electron Microscopy Method for identifying and Quantifying Asbestos in Non-Friable Organically Bound Bulk Samples, March 1, 1997[6]

3. Terminology

3.1 *Definitions*—For definitions of building terms, see Terminology E631.

3.2 *Terms Defined in Practice* E1368—The user is referred to Practice E1368 for terms specifically related to asbestos abatement for purposes of a Project Design Survey.

3.2.1 *asbestos-containing materials, n*—material containing more than one percent asbestos.

3.2.1.1 *miscellaneous materials, n*—material, other than surfacing material and thermal system insulation, on interior and exterior structural, mechanical, electrical, or architectural components, and surfaces. Miscellaneous material includes but is not limited to ceiling tiles, gaskets, floor coverings and mastics, wallboard joint compound, roofing materials, and cementitious products.

3.2.1.2 *surfacing material, n*—material that is sprayed, troweled-on, or otherwise applied to interior and exterior structural and architectural surfaces. Surfacing material includes acoustical plaster on ceilings, fireproofing on structural members, textured paint and exterior stucco, and other materials applied to surfaces for acoustical, decorative, fireproofing, and other purposes.

3.2.1.3 *thermal system insulation, n*—material which is applied to interior and exterior mechanical components to reduce heat gain or loss. Thermal system insulation includes insulation on pipes, fittings, boilers, breeching, tanks, ducts, and other mechanical components.

3.2.2 *crawl space, n*—an accessible area that may have a dirt floor, usually with low head room.

3.2.3 *high efficiency particulate air (HEPA) filter, n*—the final stage filter on a negative pressure ventilation device (see 3.2.19 in E1368)) or on a vacuum cleaner, capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometres in diameter.

3.2.4 *dust and debris, n*—visible particles, fragments, or chunks of material, large enough to have settled in the work area by virtue of their weight, that are presumed to have originated from the material abated by the response action, or from a fiber release episode.

3.2.5 *fiber release episode, n*—uncontrolled or unintentional disturbance of asbestos-containing materials which results in the generation of dust and debris.

3.2.6 *friable material, n*—material easily crumbled or powdered by moderate (hand) pressure.

3.2.7 *response action, n*—a method of abatement (such as removal, encapsulation, or enclosure) or operations and maintenance (such as repair, clean-up, or preventive measures) of asbestos-containing material in any form, for any purpose whatsoever.

3.2.8 *visual inspection process, n*—the activities before, during, and at the conclusion of a response action that are associated with detecting the presence of visible residue, dust and debris, or unremoved material and verifying the absence thereof at the completion of a response action.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *asbestos, n*—the asbestiform varieties of: chrysotile (serpentinite); crocidolite (riebeckite); amosite (cummingtonite-grunerite); anthophyllite; tremolite; and actinolite.

3.3.2 *accessible location, n*—a functional space or part thereof that can be inspected without requiring destructive testing or presenting an unacceptable health or safety risk to the inspector, and where entry is not prohibited by security or other institutional restrictions.

3.3.3 *building asbestos survey, n*—an activity to determine the presence, location, condition, and quantity of asbestos-containing materials in a building or facility, or on the property containing the building or facility.

3.3.4 *bulk sample, n*—a sample of suspect asbestos-containing material collected for identification of asbestos and determination of the percent of the components in the sample.

[4] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., Washington, DC 20210, http://www.osha.gov.

[5] Available from United States Environmental Protection Agency (EPA), Ariel Rios Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.

[6] Available from the Environmental Laboratory Approval Program (ELAP), Wadsworth Center, P.O. Box 509, Albany, NY 12201, http://www.wadsworth.org/labcert/elap/elap.htm.

3.3.5 *concealed space, n*—a location requiring destructive testing for penetration of a building or component surface for inspection and, if necessary, sampling of suspect material. Concealed spaces include, but are not limited to, cavities inside soffits, walls and chases, plenums above solid ceilings, subfloor ducts and cable runs, and the interior of HVAC equipment.

3.3.6 *destructive testing, n*—inspection procedures that necessarily involve objectionable or noticeable damage to building surfaces, or require penetration of a surface such as a wall, ceiling, chase, or shaft to gain access to a concealed space. Lifting a ceiling tile or opening a hatch is not destructive testing.

3.3.7 *excluded area, n*—a functional space or part thereof where entry is prohibited by security or other institutional restrictions.

3.3.8 *functional space, n*—an area within a building or facility that is used for a specific purpose. Examples include a warehouse in a manufacturing plant and a conference room in an office building. A functional space can be vertical in extent, such as a pipe chase, and span several floors.

3.3.9 *homogeneous area, n*—surfacing material, thermal system insulation material, or miscellaneous material that is uniform in color and texture and apparent or known date of installation.

3.3.10 *laboratory, n*—an entity that is equipped and qualified to perform one or more of the following analyses, using approved methods: *(1)* identify and quantify asbestos in bulk samples by Polarized Light Microscopy, *(2)* identify and quantify asbestos in bulk samples by Transmission Electron Microscopy, and *(3)* identify and quantify airborne fibers with Phase Contrast Microscopy.

3.3.11 *limits of abatement, n*—an area where asbestos-related activities will be conducted before, during and at the conclusion of the project, that is contiguous with and includes the limits of construction for an associated renovation or demolition project.

3.3.12 *non-friable organically bound (NOB) materials, n*—materials that are not friable and that consist of fibers and other particulate matter embedded in a solid matrix of asphaltic, vinyl or other organic substances.

3.3.13 *operations and maintenance (O&M) program, n*—a proactive management program to provide periodic surveillance of asbestos-containing materials, maintain them in good condition, mitigate fiber release from existing asbestos-containing materials, and clean up asbestos-containing dust and debris that has been released, in order to minimize worker or occupant exposure to asbestos fibers.

3.3.14 *polarized light microscopy (PLM), n*—a method of analytical mineralogy that uses an optical microscope to determine the optical properties of sample constituents and, in the case of bulk sample analysis for asbestos, to provide positive identification of suspect fibers as asbestos and to quantify the percent of asbestos in the sample.

3.3.15 *skim coat, n*—a thin finish coat applied to an existing plaster surface or other substrate to improve appearance or other reasons.

3.3.16 *suspect material, n*—material that is sampled or is presumed to contain asbestos on the basis of its location, purpose, appearance, and other factors considered by the inspector.

3.4 *Terms Defined in Practice* D7712:

3.4.1 *asbestos, n*—a collective term that describes a group of naturally occurring, inorganic, highly fibrous, silicate dominated minerals, which are easily separated into long, thin, flexible fibers when crushed or processed.

3.5 *Acronyms:*

3.5.1 *ACM*—Asbestos-containing material(s)

3.5.2 *AHERA*—Asbestos Hazard Emergency Response Act

3.5.3 *EPA*—U.S. Environmental Protection Agency

3.5.4 *HEPA*—High Efficiency Particulate Air

3.5.5 *NAD*—No Asbestos Detected

3.5.6 *NESHAP*—National Emission Standards for Hazardous Air Pollutants; specifically, the National Emission Standard for Asbestos (40 CFR Part 61, Subpart M)

3.5.7 *NOB*—Non-friable organically-bound

3.5.8 *OSHA*—U.S. Department of Labor, Occupational Safety and Health Administration

3.5.9 *PPE*—Personal Protective Equipment

3.5.10 *PLM*—Polarized Light Microscopy

3.5.11 *TEM*—Transmission Electron Microscopy

3.5.12 *VAI*—Vermiculite Attic Insulation

4. Significance and Use

4.1 Management of asbestos-containing materials in buildings and facilities requires knowledge of the location, type, quantity, and condition of the material. The more complete and accurate the information available, the more appropriate and cost-effective are the control measures used to reduce possible exposure to airborne asbestos fibers. This is true whether the asbestos-containing materials remain undisturbed and completely intact, are selectively removed for maintenance or prior to renovation, or are removed to the greatest extent feasible before demolishing the building or facility.

4.2 This practice describes three types of surveys that support different objectives. These are the Baseline Survey, the Project Design Survey, and the Pre-Construction Survey.

4.2.1 The Baseline Survey is a building-wide or facility-wide inspection that provides a general sense of the overall location, type, quantity, and condition of asbestos-containing materials present. It is thorough in that most accessible functional spaces are inspected and bulk samples taken of suspect materials observed. The baseline survey provides information for long-term management of asbestos-containing materials and prioritization of response actions. The presence of asbestos in suspect materials may be assumed or presumed in some cases without bulk samples being taken or analyzed. However, the baseline survey is unobtrusive in that samples are

not taken where doing so would result in objectionable damage to surfaces or where institutional barriers preclude access. In a baseline survey, destructive testing is avoided. Posting of signs and labels required for compliance with OSHA regulations would use the information generated during a Baseline Survey.

NOTE 1—A Baseline Survey is sometimes called an "AHERA" survey because it provides the type of information used for management of asbestos-containing materials in schools. However, the baseline survey described in this practice requires inspection, bulk sampling, quantification, and assessment of suspect materials that are excluded by virtue of their type and location from the AHERA regulations for schools.

NOTE 2—Suspect material subject to disturbance by planned or emergency maintenance may not always be identified as to asbestos content in a Baseline Survey. Collecting a single bulk sample, or a small number of samples, to determine if the material contains asbestos does not constitute a survey within the meaning of this practice. Nonetheless, the sample(s) should be collected in accordance with the methods described in Appendix X1 (this must be done by a properly-credentialed individual) and analyzed as set forth in 6.5.

4.2.2 The Project Design Survey is more focused than a Baseline Survey and is used to provide information to the Project Designer for preparing abatement plans and specifications. The locations inspected are limited to the areas that will be affected by the abatement project. If the project is being done prior to renovation or demolition, the construction plans or at least a clear statement of the scope of the renovation or demolition work are required for a proper Project Design Survey. Destructive testing is often required for a Project Design Survey. The presence of asbestos in suspect materials is always confirmed in a Project Design Survey rather than being assumed or presumed. Other information required for the Project Design is collected during the survey.

4.2.3 The Pre-Construction Survey is performed in anticipation of renovation or demolition where a Baseline Survey has not been conducted and there is no information, or insufficient information, as to the existence of asbestos-containing materials within the planned limits of construction. The Pre-Construction Survey requires destructive testing if concealed spaces are to be breached during construction. If asbestos-containing materials are found, a Project Design Survey is conducted to provide information for preparing the plans and specifications. The Pre-Construction Survey satisfies the EPA NESHAP requirements for renovation or demolition to "thoroughly inspect the affected facility" or the requirements of governmental agencies for issuance of a building permit.

4.3 The inter-relationships among the three types of surveys and with other ASTM asbestos control standards is shown in Fig. 1.

4.4 This practice emphasizes the concept that a Comprehensive Building Asbestos Survey consists of more than the collection and analysis of samples, and the report is more than a compilation of laboratory results. It is important to inspect as many functional spaces as possible and to document the reasons why certain functional spaces were not inspected and locations where no suspect materials were observed and, consequently, no samples were taken. Reasons might include access limitations, the absence of materials to sample, the existence of information from previous surveys, or the availability of reliable documentation such as Material Safety Data Sheets.

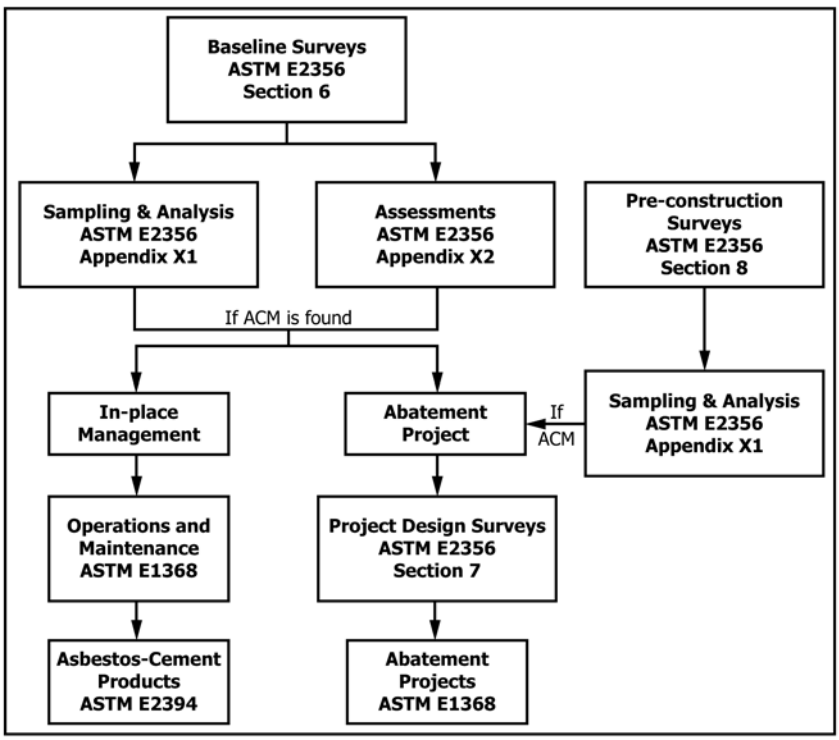

FIG. 1 Relationship Between E2356 Surveys and Other Standards

4.5 A Comprehensive Building Asbestos Survey is not limited to the class of materials commonly referred to as asbestos-containing building materials (ACBM), defined in the AHERA regulations as "... found in or on interior structural members or other parts of a building." Items that are difficult to distinguish as such may include cooling towers, laboratory hoods, gaskets, chalkboards, and other articles. These may be installed in, attached to, or adjacent to the building or facility but are not as clearly a part of the building or facility as fireproofing or floor tile. Nonetheless, such items still fall within the scope of an asbestos management program and therefore are addressed in this practice. Locations outside the building, in particular equipment in industrial facilities and power plants, and crawl spaces underneath the building are within the scope of a Comprehensive Building Asbestos Survey.

4.6 This practice is intended to be used by individuals who are conducting a Comprehensive Building Asbestos Survey for the owner or manager of a building or facility under a contractual arrangement for services as well as by employees of the owner or manager. If the individual is conducting the survey under a contractual arrangement (which may be with the firm employing the individual), the owner or manager of the building is still responsible for certain activities as described in this practice.

5. Qualifications and Responsibilities

5.1 This section describes the qualifications and responsibilities of the individuals who participate in the Comprehensive Building Asbestos Survey. The requirement for accreditation as an Inspector in accordance with the Model Accreditation Plan applies to the activities covered by this practice. Additional accreditations may be required, and qualifications may be imposed by state licensing requirements or the policies of the owner or manager of the building or facility that are beyond the scope of this practice. Field experience in performing asbestos building surveys as described in this practice is of paramount importance.

5.2 Not all of the qualifications discussed herein will be required for every Comprehensive Building Asbestos Survey conducted, and in many cases one individual (usually the accredited inspector) will have more than one, and possibly all, of the required credentials.

5.3 Qualifications and responsibilities of individuals conducting the survey:

5.3.1 *Accredited Inspector*—For both types of surveys, accreditation as an Inspector is required for the individual who takes the bulk samples and otherwise performs the physical activities comprising the survey. This includes review of relevant building documentation and preparation of the survey report.

5.3.2 *Management Planner*—For a baseline survey, accreditation as a management planner is only required for hazard assessment and determination of response actions if the survey is performed in a school, but is a desirable credential for all buildings and facilities.

5.3.3 *Project Designer*—For a project design survey, accreditation as a project designer is desirable because this survey will provide information for the plans and specifications to be used on an abatement project.

5.3.4 *Contractor/Supervisor*—For a project design survey, accreditation as a contractor/supervisor would be helpful because of the knowledge of abatement processes such an individual possesses.

5.4 In addition to the above accreditations, the following credentials are evidence of the ability to perform one or more of the aspects of a Comprehensive Building Asbestos Survey.

5.4.1 Credentials that indicate knowledge of building design include experience in building design, construction, or operations and academic degree(s), licensure, or registration as an architect or engineer. Academic degree(s) or certification in industrial hygiene, occupational safety or a related field indicates knowledge of the hazardous properties of asbestos and other substances as well as the means of controlling the hazards.

5.4.2 Credentials that indicate knowledge of building construction and operations include field experience in building construction, renovation, demolition, or maintenance, or a combination thereof; or formal or on-the-job training in construction technology or management.

5.5 *Qualifications and Responsibilities of Owner or Manager of Building or Facility*—To be able to provide the necessary information, access, and other support to the inspector(s), the staff of the building or facility owner or manager should have taken at least a two-hour Asbestos Awareness course.

5.6 Laboratories analyzing the samples shall possess one or more of the following qualifications in addition to, or as part of, any applicable state licensing requirements.

5.6.1 For bulk sample analysis using Polarized Light Microscopy:

5.6.1.1 Accreditation by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST),

5.6.1.2 Participation in the American Industrial Hygiene Association (AIHA) Bulk Asbestos Proficiency Analytical Testing Program,

5.6.1.3 Certification under the State of New York Environmental Laboratory Approval Program (ELAP), [6] and

5.6.1.4 Participation in a proficiency testing and certification program similar to 5.6.1.1 – 5.6.1.3.

5.6.2 For bulk sample analysis of NOBs using Transmission Electron Microscopy, the laboratory shall be certified under the State of New York Environmental Laboratory Approval Program (ELAP) or provide other evidence of capability and experience with the ELAP method[6] or its equivalent acceptable to the consultant.

5.6.3 Air samples are not collected or analyzed as part of a Comprehensive Survey.

6. Baseline Surveys

6.1 *Planning the Survey*—It is essential that the planning stage of an asbestos survey be complete in addressing the following issues and be defensible. A well-planned survey will

consult other appropriate professionals, trades, or knowledgeable individuals who may provide valuable information regarding systems included in the survey.

6.1.1 *Establishing the Purpose of the Survey*—The purpose of the Baseline Survey is to identify suspect asbestos-containing materials as defined in the scope of the survey. Management of the ACM will include normal O&M activities over a long term and will include prioritizing asbestos hazards for the purpose of planning future abatement activities. If the inspection is for pending demolition or renovation activities, see Section 7 on Project Design Surveys.

6.1.2 *Deciding Who Conducts the Survey*—Whether the inspection is conducted by an outside consultant or in-house staff, the inspector shall be properly-credentialed as an asbestos building inspector by either federal EPA or an EPA approved state program under the Model Accreditation Plan. The inspector may also be required to be licensed by the state, city, or local jurisdiction of the inspection, or combination thereof.

6.1.2.1 In-house staff should have a more intimate knowledge of the locations of suspect materials and the use and occupancy of the areas containing those materials. Bulk sample collection by in-house inspectors may be useful when dealing with emergency repairs or planning operations and maintenance activities when only a few bulk samples are required. However, in-house staff usually has other responsibilities that may preclude the timely completion of a baseline survey, and they may not have the experience necessary to perform a thorough survey.

6.1.2.2 The outside consultant should have insurance covering asbestos operations to insulate the owner from potential liability. In most cases, conflict of interest issues would be best avoided by using an outside consultant. Typically, outside consultants can complete a survey in a more timely fashion and provide a more thorough and unbiased report than in-house personnel. Additionally, building owners and managers can benefit from the consultant's experience gained while inspecting other facilities.

6.1.3 *Establishing the Scope of the Survey*—It is essential that the inspector have documented, in writing, the exact scope of work for which he is responsible. A Baseline Survey would normally be comprehensive in nature. However, if the inspection is to be limited to certain buildings, or portions of buildings, the specific areas to be inspected must be documented in order for the inspector to achieve substantial completion of the contract, and not be held responsible for further work. One of the most important functions in-house personnel can provide is to participate in determining the purpose of the survey, planning the survey and reviewing the results of the inspection done by the outside consultant. In-house personnel should also play a role with providing access to all areas of the building/facility to the survey team(s) and be available to answer questions posed by the survey team and the building occupants.

6.1.3.1 Identify buildings, or portions of buildings, to be inspected. Each individual building shall be inspected separately and all functional spaces inspected, whether or not bulk samples are taken therein. A separate set of homogeneous areas of suspect material shall be identified, sampled or assumed, and determined to be ACM or non-ACM per building. A homogeneous area may not be extended to include more than one building, but may include components exterior to a building such as cooling towers, vessels, and piping. Data forms, supplies, and equipment must be sufficient to address multiple buildings if necessary.

6.1.3.2 ACM should be identified in the Baseline Survey regardless of whether it is used as a construction material or not, and whether located inside, outside or underneath the building, as long as the area inspected is within the scope of survey. This should specifically include stored materials such as gaskets, packing, or insulation not yet installed in or on the facility.

6.1.3.3 In some industrial facilities, there may be gaskets, packing, and other ACM installed in equipment (such as furnaces) that are not part of the building systems (such as HVAC). The equipment may be in operation at the time of the survey, or the suspected ACM may be inaccessible for other reasons. For example, the inspector may lack the tools and skills to properly disassemble the equipment for access to the suspected ACM. The scope of work for the survey should be clear as to whether this equipment is to be inspected and under what circumstances. The most convenient, and often the safest, time to inspect such equipment is when it is out of service for maintenance or while production is interrupted. The plant manager should make a list of equipment with suspect ACM and the plant's O&M plan should specify if and when gaskets, packing, etc., are to be sampled.

NOTE 3—Gaskets are usually installed in bolted flange fittings. If only one or two fittings are being worked with, the gaskets can be presumed to be asbestos-containing material (PACM) and the employee instructed to follow appropriate procedures. For such small-scale work, it may be faster and cheaper to follow these procedures rather than to sample and analyze the gaskets. If an inspector were to sample for demolition purposes, the same restrictions would apply. In a demolition situation, it makes more sense to cut the pipe, leave the fittings intact, and dispose of them.

6.1.4 *Inspection Requirements*—A typical scope of work for an asbestos survey will address the following topics: survey protocol, what materials will be sampled, what materials will be presumed/assumed (floor tiles, floor tile mastic, roofing materials, gaskets, and packings), what materials will not be included in the survey, quantification of materials, areas of the building/facility to be surveyed, access to specific areas of the building/facility (high ceilings, vaults, computer rooms, roofs, etc.), areas of the building/facility not to be surveyed (pipe chases, wall cavities, roofs), numbers of samples, quality control, follow-up analyses (point-counting, TEM), time schedules, and deliverables (reporting, reporting format, floor plans or drawing, and so forth). Bulk sampling shall be done to prove that the material in question is not ACM. Otherwise the suspect material shall be presumed to be ACM, and documented and managed accordingly. (See Appendix X1, Sampling Techniques and Equipment)

6.1.4.1 Under this practice, a minimum of three bulk samples representative of each different homogeneous area of suspect material to be sampled shall be collected and analyzed to prove that the material sampled is not ACM. See 6.4.6.1 for specific minimum numbers of samples by type of suspect

material. Situations that call for more than the accepted minimum should be called to the attention of the building owner.

6.1.4.2 Field notebooks should include forms for the collection of information as follows: a complete list and location of functional spaces to be inspected (see 6.4.2); bulk sample logs (see 6.4.3); a complete list and location of suspect materials and homogeneous areas (see 6.4.5); chain of custody (see 6.4.9.1); assessment information (see 6.6). Samples of forms are provided in Appendix X3, Field Data Collection Forms.

6.1.4.3 Destructive testing is not performed on a Baseline Survey and therefore suspect materials in concealed spaces are not directly sampled, assessed or quantified. However, the inspector may, if specifically requested by the building owner, indirectly infer the location, quantity and condition of concealed suspect materials on the basis of information from accessible confirmed ACM that appears to be part of the same homogeneous area. In this case the concealed material will be treated as ACM. The assumptions on which such extrapolations are based should be clearly spelled out in the survey report.

6.1.5 *Analytical Requirements*—At a minimum, Polarized Light Microscopy (PLM) shall be used to analyze bulk samples, as described in 6.5.1.1. A laboratory qualified in accordance with 5.6.1 shall be used. If confirmation of negative PLM results by gravimetric analysis and quantitative Transmission Electron Microscopy (TEM) may be required, a laboratory with those capabilities must be selected. A determination shall be made initially that all samples required to be collected will be analyzed unless the "positive stop" approach described in 6.5.5 is used.

6.1.6 *Survey Report*—A survey report will be generated that should include; at a minimum; the date of the inspection and report; the accreditation number and dates of accreditation for the inspector(s) conducting the survey; identification, quantification, and location of all suspect material; an indication of whether the material is ACM or non-ACM; assessment information on condition of ACM; and how the ACM relates to building function. The survey report will include a complete laboratory report detailing the analysis of each bulk sample analyzed. Applicable sections of this practice, including appendices, should be referenced in the report (see 6.7). Preparation of the survey report will be facilitated if the forms used for data collection in the field are designed so they are consistent in format with corresponding tables in the report. If information is recorded electronically in the field it may be possible to import the files directly into the survey report.

6.1.7 *Schedule*—A schedule must be coordinated with the building owner that will provide access as necessary for a preliminary site visit, as well as the performance of the comprehensive survey. Contractual issues on completion of work and submission of report must also be addressed as planning issues.

6.1.7.1 Preliminary site visits may be scheduled at any time and should give the inspector an indication of the type and variety of suspect materials present, the scope or extent of the work, and normal use and occupancy of various areas of the facility. Typically the preliminary site visit provides the inspector(s) the opportunity to become familiar with a building/facility and provides an opportunity to ask questions affecting the performance of the survey to develop a cost proposal for the completion of the survey.

6.1.7.2 Bulk sampling activities should be scheduled when the functional spaces to be inspected are unoccupied. This may mean night or weekend work, as the case may be. An inspector shall not disturb suspect material in the unprotected presence of building occupants. Facilities that operate on a 24-h basis may have to isolate or demarcate areas for sampling or may assume all identified suspect materials in areas that may not be isolated to be ACM. Because OSHA regulations requires respirator and protective clothing use in the absence of a negative exposure assessment, sampling in unoccupied areas is least troublesome to both the building owner as well as the inspector. Security systems or escort, or both, may also have to be coordinated with the owner.

6.2 *Estimating the Cost of the Survey—Estimated Cost of Survey*—Many factors affect the cost of performing a comprehensive asbestos survey. Some of these factors may vary over time and may be dependent upon regional, state, or other economic factors such as salaries, benefits, cost of living, and the economic condition of the companies, or individuals performing the survey or laboratory analyses. This practice does not attempt to identify or address those issues. This practice attempts to identify, but not quantify, the most common components that affect the cost of performing a comprehensive asbestos survey. Companies or individuals purchasing asbestos survey services should clearly define the scope of services to obtain the most accurate and comprehensive price.

6.2.1 The preliminary site visit may or may not affect the price of the survey. Depending upon the contractual arrangement and the company providing the proposal, the time and expense of the preliminary site visit may be absorbed into the cost of doing the survey or provided without charge.

6.2.2 *Document Review*—The review of construction documents including specifications, blueprints and possibly product receipts provide information regarding asbestos-containing products, locations, and quantities. This review is typically performed after the survey contract is awarded; however, a preliminary review of these documents may be helpful in determining the number of samples necessary. The extent and ultimate cost of the review will be dependent upon the scope of the survey, the size of the facility being inspected, organization/accessibility of the documents, and the amount of documents to be reviewed.

6.2.3 *Survey Preparation and Mobilization*—Prior to beginning the survey a number of technical and logistical tasks are required to prepare for the survey. Time is required to gather field supplies and coordinate travel. When surveys require air travel, it may be most cost-effective to ship supplies and materials to the survey site in advance. In this case, shipping fees would apply. If materials are not shipped, additional baggage fees may apply when baggage limits are exceeded, and extra time may be needed to clear airport security.

6.2.4 *Travel*—Travel time is a factor in developing the cost of the survey. The cost may be included in the billing rate of the consultants performing the survey or may be billed at a full rate, or reduced hourly/daily rate.

6.2.5 *Survey Personnel*—Surveys should preferably be performed in teams of two or more individuals in order to provide a more thorough inspection and to provide an added safety for the team members. Persons involved in the survey may include a Principal or Technical Director, Project Manager, and Survey Team Members, or individuals with equivalent titles.

6.2.5.1 The Principal/Technical Director has the overall authority and responsibility for the successful completion of the survey. The Principal/Technical Director should insure that the scope and technical aspects of the survey conform to regulatory and professional standards. The Principal/Technical Director is also responsible for the fiscal aspects of the survey and should insure that the budget for the survey is appropriate. The Principal/Technical Director typically has the highest billing rate of the personnel on the survey. His involvement is necessary at the beginning of the survey to review the proposed scope of work and budget, during the survey to review technical and budgetary progress, and at the completion of the survey to review the final work product to insure it is technically sound. On large surveys, the Principal/Technical Director may want to attend the Preliminary Site Visit (see 6.1.7.1).

6.2.5.2 The Project Manager has the responsibility for the survey team and the performance of the scope of work. The Project Manager should possess the experience and knowledge to complete the survey in the given survey environment. Accordingly, the Project Manager will have the highest billing rate for those in the field performing the work. The Project Manager is utilized in all phases of the survey.

6.2.5.3 Survey Team Members work with the Project Manager on-site to complete the scope of the survey. Team Members typically, have a lesser degree of experience than the Project Manager and as such have a lower hourly/daily rate. The Team member is utilized during the field survey and may be used to prepare sections of the report.

6.2.6 *Sample Login*—Sufficient time should be allowed to perform sample login following each sampling shift to insure that all samples are accounted for and proper chain-of-custody is maintained. Shipping to the laboratory will be determined by the time schedule of the survey or by the need to identify specific asbestos, or non-asbestos-containing material (see 6.4.9).

6.2.7 *Quantifying Asbestos-containing Materials*—Asbestos-containing materials (presumed and confirmed) should be quantified as part of the comprehensive asbestos survey. It may be possible to reduce the budget of the survey by postponing the quantification process until the laboratory reports are received allowing for the quantification of only the confirmed ACMs rather than all suspect materials. However, it may be most cost effective to develop quantities of limited homogeneous areas or when limited numbers of suspect ACMs are sampled, rather than returning to the survey site a second time. The Project Manager should determine the most cost-effective method of quantification of ACMs based on the specifics of the survey.

6.2.8 *Assessing Asbestos-Containing Materials*—Physical and hazard assessments should be performed for asbestos-containing materials (presumed and confirmed) as part of the comprehensive asbestos survey. It may be possible to reduce the budget of the survey by performing these assessments after the laboratory reports are received so that only the confirmed ACMs are assessed rather than all suspect materials. However, it may be more cost effective to perform these assessments at the time of the survey when limited functional spaces, homogeneous areas or numbers of suspect ACMs are identified. The Project Manager should determine the most cost-effective method of assessment of ACMs based on the specifics of the survey.

6.2.9 *Data Review and Interpretation*—It is important to provide sufficient time to review the survey laboratory data and interpret the results. Time is needed to determine if appropriate homogenous areas have been identified and to identify the need for follow up analyses such as PLM point count or confirmatory TEM.

6.2.10 Report preparation is performed by the Project Manager and the Survey Team members. Other individuals that may be utilized during report preparation include a draftsman/computer aided drafting designer and clerical staff. Completed reports should always be reviewed by a Principal/Technical Director or the Project Manager to insure compliance with the scope of work, standards of the industry, and technical competence.

6.2.11 *Laboratory Fees*—Complete budgets for comprehensive surveys should include all analyses required for the completion of the survey. Laboratory fees will vary depending upon the location of the laboratory, the workload of the laboratory, the number of samples being submitted, the type of analyses requested, and the turn-around time for the results. Some laboratories charge by the sample, while others charge to analyze each individual component of a layered sample such as floor tile and mastic. PLM analyses for a comprehensive building survey will include visual estimation at a minimum, and may include point count analyses. Quality control for PLM visual estimation will include sending duplicate samples to a second accredited laboratory.

6.2.11.1 *PCM Air Sample Analyses*—Personal air samples are required to comply with the OSHA asbestos in construction standard (29 CFR 1926.1101) for individuals who take bulk samples (see 9.2). Collection and analysis of air samples is outside the scope of this practice.

6.2.11.2 *TEM Bulk Sample Analyses*—TEM analyses of bulk samples may be necessary for surveys located in specific cities or states. Additionally, TEM analyses is commonly used to verify a reported no asbestos detected result for non-friable materials by PLM.

6.2.12 *Travel/Subsistence Expenses:*

6.2.12.1 Survey budgets should identify appropriate travel costs. The cost to travel between locations will depend upon many factors, the main issues being the type of travel, the amount of travel time required and the billing rates of the individuals, and the distance traveled.

6.2.12.2 *Subsistence*—Subsistence is typically provided through a daily per diem for those traveling, which may or may not include lodging costs. The government rate of per diem for each city in the country is useful for planning purposes.

6.2.13 *Miscellaneous Expenses*—Additional factors contributing to the cost of a comprehensive survey include:

6.2.13.1 *Ladders, Lifts, Scaffolds*—It may be necessary to rent such equipment or to hire contractors with specialized equipment or expertise to access elevated materials or areas.

6.2.13.2 *Electricians*—It may be necessary to contract an electrician to de-energize systems prior to sampling, subject to the approval of the building owner.

6.2.13.3 *Abatement Contractors*—Abatement contractors may be utilized to assist with the construction of mini-enclosures to control fibers during sampling. Additionally, contractors may be hired to assist with abatement/removal budgets.

6.2.14 *Survey and Reporting Expenses:*

6.2.14.1 *Shipping*—It may be necessary to ship equipment and supplies to and from the survey site. The budget should also include sufficient resources to ship samples to the laboratory.

6.2.14.2 *Copying*—The survey budget should provide resources for copying the appropriate number of reports. The building owner may request the use of color in drawings and photographs, in which case it would be necessary to include appropriate reproduction charges.

6.2.14.3 *Film and Photograph Processing,* including preparation of digital files for a report in electronic format.

6.2.14.4 *Sampling Equipment and Supplies,* in accordance with X1.1.

6.3 *Obtaining and reviewing information*—The following information may be provided in hard copy or electronic format. Provisions may be necessary for reproduction and for opening and manipulating electronic files in different formats.

6.3.1 *Building or Facility Information*—Floor plans and drawings, records of construction, renovation and maintenance, and lists of equipment and furnishings should be reviewed when readily available for information that may indicate the existence of suspect ACM in functional spaces.

6.3.2 Records of asbestos activities, including previous surveys and occasional bulk sampling, should be reviewed. If samples taken during a previous survey confirmed the presence of more than one percent asbestos in a material, there is no need to re-sample that material during the present Baseline Survey, providing a sufficient number of samples were taken. For a material where samples taken during a previous survey reported less than one percent asbestos for the samples collected for the homogeneous area, the accredited inspector should determine whether there is a need to re-sample that material during the present Baseline Survey. The decision should take into account whether a sufficient number of samples were previously taken and if analytical methods were adequate.

6.3.3 Records of abatement and O&M work should be reviewed briefly for an indication of where ACM may have been removed or repaired. However, statements by the building owner regarding the absence of ACM due to previous abatement should be viewed with skepticism in the absence of suitable documentation and not used as the sole reason to dispense with inspecting any functional spaces.

6.4 *Conducting Field Work:*

6.4.1 *Mobilizing Equipment and Supplies*—See Appendix X1 for a detailed list of equipment needed for a sampling inspection. Respirators and other personal protective equipment needed are discussed in Section 9, and standard forms on which to gather information are presented in Appendix X3. The needs will be determined by the Preliminary Site Visit discussed in 6.1.7.1.

6.4.2 *Identifying and Inspecting Functional Spaces*—Functional spaces are identified for the purpose of locating homogeneous areas of suspect ACM and non-ACM, and the subsequent management of the ACM in a building. All functional spaces must be identified and located, with occupancy and use data if possible. Functional space identification should be by normal use label, or by blueprint identification. The labeling system used should be one familiar to building management.

6.4.3 *Identifying Suspect ACM*—It is important that suspect materials be classified as Surfacing Material, Thermal System Insulation (TSI) or Miscellaneous Material as determined by direct application of the definitions in 3.2, as EPA and OSHA compliance depend on these classifications. Any other regulatory determination that may vary these classifications may be applied in addition to the referenced definition as a specific case may require.

6.4.3.1 Most building materials shall be considered suspect ACM and any person may assume that a suspect material contains asbestos. However, EPA and OSHA regulations permit only an accredited inspector to determine that thermal system insulation is fiberglass, foam glass, rubber, or other non-ACM without bulk sampling. The inspector must use his judgment in excluding apparently obvious non-asbestos materials such as glass, steel, concrete, porcelain, and wood from sampling. The complete identification and location of all suspect materials in a building is basic and essential to a comprehensive building asbestos survey, and if in doubt as to possible asbestos content, the inspector should sample the material.

6.4.3.2 Record the date, manner of sampling, sample identification number, exact sample location, and sampling inspector identification and certification. The location of each bulk sample shall be recorded on a sample log and a schematic drawing of the building or space of the building from which the sample was collected if available. The sample location description should provide sufficient detail that a person unfamiliar with the building could locate the exact sample location without undue difficulty.

6.4.3.3 The suspect material must also be described in a useful and functional way, such as: floor tile, fireproofing, or pipe insulation. Avoid the use of in-house, company, or construction industry acronyms in the report documents. Use material descriptions that will be meaningful to a person who may not be familiar with construction terminology.

6.4.4 *Quantifying Suspect ACM*—All suspect ACM must be quantified for bulk sampling procedures and for regulatory

applicability and compliance purposes under the various federal regulations. Since the NESHAP regulation specifies a quantification standard applicable to renovation and demolition and annual O&M reporting, all suspect ACM inspected for compliance with the NESHAP regulation shall be quantified in accordance with that standard. This will facilitate preparing an annual O&M notification as well as laying the foundation for a possible Project Design Survey in event of an abatement project. The NESHAP requirements are as follows:

6.4.4.1 Pipe insulation must be quantified in linear feet (metres) and a notation made if fittings are included or quantified separately.

6.4.4.2 Other thermal system insulation, miscellaneous material, surfacing material and all other suspect material on facility components must be quantified in square feet (square metres).

6.4.4.3 Bulk waste or material not installed on facility components must be quantified in cubic feet (cubic metres).

6.4.5 *Identifying Homogeneous Areas and Sampling Locations*—All suspect ACM must be identified by homogeneous area of material. A homogeneous area consists of material that is the same in color, texture, date of application and general appearance, and it may overlap adjacent functional spaces. It must either be assumed to be ACM and managed as such, or sampled and proven to be ACM or non-ACM. The homogeneous area is the basis of identification of suspect ACM. To aid in determining homogeneous areas the color, texture, and appearance of the suspect materials should be described for all layers of the material when viewed from different vantage points. For example, when describing a suspect ceiling tile, the inspector should provide a description of the exposed surface when viewed from below, the composition of the interior of the ceiling tile and the concealed (top) portion of the ceiling tile. An appropriate description in this example could be: white 2 ft by 4 ft ceiling tile with small gouges and small holes producing a flower pattern on the exposed surface of the ceiling tile visible from beneath. The interior of the ceiling tile is tan with visible fibrous material. The top of the tile is red in color.

6.4.5.1 *Sample Locations*—Where feasible, the manner used to determine sample locations for any suspect material within a homogeneous area shall be a random sampling method described in the sampling plan.

6.4.5.2 Without compromising safety, disturbing occupants or aesthetically damaging surfaces, use random sample locations for materials that may have been batch-mixed at the site. Such materials, which may vary in asbestos content throughout a homogeneous area, include fireproofing, ceiling and wall texture, acoustical plaster, hard plaster and pipe fitting insulation.

6.4.5.3 Flat surfaces such as floors, walls and ceilings may be divided into a grid, the cells of the grid numbered, and random numbers used to select cells in which to take the samples.[7] For large cylindrical objects such as tanks and vessels, an equivalent "flat" surface is an area defined by the height or length of the object and its circumference. For homogeneous areas that are one-dimensional (linear), such as pipe insulation and fireproofed beams and columns, use a random number table to select sampling locations along the length of the item.

6.4.5.4 Random sample locations are less important for homogeneous areas where the asbestos content is expected to be relatively uniform due to product specifications. Such materials include floor tile and mastic, ceiling tiles, straight runs of pipe insulation and asbestos-cement products. Sheet vinyl flooring should be sampled randomly due to the uneven absorption of adhesive by the backing.

6.4.6 *Collecting Bulk Samples* (also see Appendix X1). Bulk sample collection and analysis is used to determine the asbestos content of suspect materials identified during a survey. Sampling and analyses also distinguishes between suspect materials that appear identical in the field but may actually be different products. The proper homogeneous determination is of utmost importance to the person developing asbestos O&M programs and designing removal projects and other response actions. A sufficient number of bulk samples should be collected of suspect materials throughout a facility to thoroughly characterize the asbestos content. The samples should be spaced throughout the facility in such a manner to adequately cover all elevations, wings, additions, and renovations.

6.4.6.1 *Number of Samples to be Collected*—This practice encourages the collection of samples beyond the minimum numbers required below to ensure that homogeneous areas are defined as accurately as practical. The following requirements meet or exceed those in the AHERA regulations at 40 CFR Part 763, §763.86, which are also referenced for surfacing material and thermal system insulation in the OSHA construction standard at 29 CFR 1926.1101(k)(5). The number of negative samples required to exclude a material from treatment as asbestos-containing depends on the type of material and, for surfacing material, the area. Compliance with these requirements may dictate analysis of all samples collected to verify the absence of asbestos.

6.4.6.2 A minimum of three bulk samples representative of each distinct homogeneous area of suspect thermal system insulation material (TSI) should be collected. One sample should be collected of each TSI patch. For the purpose of this practice, a patch is a distinct location or replacement or repair which is less than or equal to 6.0 ft (1.82 m) or 6.0 ft^2 ($0.557 m^2$).

6.4.6.3 A minimum of three bulk samples shall be collected of each homogeneous miscellaneous material, except that a single sample may suffice for small manufactured items such as HVAC vibration dampeners, gaskets and friction products. This exception applies to individual components of less than 6 ft^2 (0.557 m^2) in size and not to multiple installations of similar components.

6.4.6.4 A minimum of three bulk samples shall be collected of surfacing materials of less than 1000 ft^2 (93 m^2). A minimum of five bulk samples shall be collected of homogeneous surfacing materials ranging between 1000 to 5000 ft^2 (93 to 465 m^2) and a minimum of seven bulk samples shall be

[7] A random sampling scheme for flat surfaces is described in the EPA 560/5-85-030A "Pink Book."

collected of surfacing material >5000 ft^2 (465 m^2). The inspector should attempt to collect samples of surfacing from each wing, floor, or level of large facilities, or combination thereof.

6.4.6.5 Collection methods and equipment are provided in Appendix X1 for a wide range of suspect materials. For many materials, disposable coring devices are the most practical means of talking a bulk sample. Maintaining the integrity of layered samples, sample containers for friable and non-friable materials, labeling of sample containers, sample packaging and sample labeling are discussed in detail in Appendix X1.

6.4.7 *Identifying Presumed/Assumed ACM*—When conducting a baseline survey for asbestos management and planning in a building that will remain occupied, it may be more appropriate to assume that some suspect materials are ACM, rather than sample to prove that they are not. When this is done, these materials must be listed in the report as "Assumed ACM" rather than "ACM." This means that they have never been sampled, but must be treated as ACM. In most cases, they would then be sampled later in a Project Design Survey (see Section 7). It may be more appropriate to assume rather than sample when maintaining the integrity of a fire rated assembly, maintaining an undamaged aesthetic appearance, complying with restrictions on sampling for safety reasons, or if access is not provided to a functional space or a concealed space. An example of such an assumption for a concealed space would be an inaccessible chase where the insulation on the pipes in the chase resembles that on the pipes to which they connect in the plenum and the insulation of the pipes in the plenum is confirmed, assumed or presumed to be ACM." Regulatory requirements on presuming (OSHA) or assuming (EPA) materials to contain asbestos must be followed.

6.4.8 *Documentation of Field Work*—If information is being recorded manually in the field, the sample forms in Appendix X3 may be used. These are non-mandatory and may be modified as needed to suit the needs of a particular survey. Because the survey report will probably be prepared and submitted in electronic format, any data collection and information recording system used in the field must be compatible with the electronic formats to which it will eventually be converted.

6.4.8.1 Field notes shall contain the following information for each bulk sample: location of sample; material category: surfacing material, thermal system insulation, miscellaneous material; description: for example, fireproofing, floor tile and size, if applicable; friable or non-friable; color, homogeneity (layers) and texture; asbestos content by type and percent (or No Asbestos Detected); quantity of material; assessment of current condition; and potential for disturbance with reason for rating. If the assessment is performed after the samples are analyzed these ratings can be omitted from the field notes during sample collection and added later.

6.4.8.2 In addition to bulk sample information, the field notes shall contain a complete list of functional spaces inspected where no samples were taken, including inaccessible locations and excluded areas with the reasons they were not inspected.

6.4.9 *Sample Processing*—After the samples are collected, they must be processed for shipment to the laboratory.

6.4.9.1 *Chain of Custody*—The control and custody of the bulk samples from collection to submission to an accredited laboratory should be documented with a chain-of-custody document. The bulk sample numbers for each sample set should be entered on the chain of custody. The action taken on the sample at the time when the custody of the samples change should be documented and attested to by the signature by those participating in the custody change. This practice understands that shipping of bulk samples to laboratories is common practice. Prior to shipping the samples should be properly labeled and sealed to prevent tampering or inadvertent opening by those other than the intended recipient. It is not necessary for the courier to sign the original chain of custody as their handling of the samples is documented with the routing paper work provided through billing. When samples are shipped, it is the recipients' responsibility to inspect the sample packaging to ensure that tampering has not taken place. A signature of receipt signifies that the package was inspected and the samples had not been damaged or tampered during shipping.

6.4.9.2 Quality control samples, split samples and archived samples should be prepared during sample processing and sent to the proper laboratories for analysis or stored in a secure location under the control of the accredited inspector.

6.5 *Bulk Sample Analysis*—Analysis of the bulk samples must consider the material being analyzed in selecting the type(s) of analysis to be performed. Confirmation of results is an important part of this process. Reporting of laboratory results is an integral part of the analytical effort. Finally, one must consider whether it is necessary to analyze all of the samples collected.

6.5.1 *Analytical Methods*—For most materials, the analytical procedures in EPA/600/R-93/116 Method for the Determination of Asbestos in Bulk Building Materials, will suffice. These methods use a combination of Polarized Light Microscopy (PLM) and Transmission Electron Microscopy (TEM).

6.5.1.1 *Polarized Light Microscopy*—PLM with dispersion staining uses the optical properties of the fibers and their morphology to establish the type of asbestos present in the sample. The analyst uses a technique known as visual estimation to quantify the asbestos content to a reasonable degree of precision. PLM and visual estimation of asbestos content may be relied on to establish the presence of asbestos in amounts greater than one percent for any material, which means it must be treated as asbestos-containing. Additionally, analyses by PLM with visual estimation may be relied upon to conclude that certain suspect materials do not contain asbestos with a result of "no asbestos detected." In the event the laboratory reports a result of trace, less than one percent or one percent, additional analyses is necessary as discussed in 6.5.2.

6.5.1.2 *Transmission Electron Microscopy*—TEM uses a higher magnification (up to 20 000×) to detect fibers that are too short or thin to be reliably detected by PLM at a magnification of 100×. Fiber type is determined by Energy-Dispersive X-ray (EDXA) analysis of the sample. Gravimetric reduction is used to eliminate interfering substances that obscure the fibers. A variation of the EPA/600/R-93/116 method known as the " Chatfield method" is used frequently for floor tile analysis.

6.5.1.3 *EPA Research Method*—Sometimes referred to as the "Cincinnati Method," this is a combination of PLM and TEM techniques used to analyze vermiculite attic insulation for the presence of tremolite asbestos. The method is described in EPA 600R-04/004.

6.5.2 *Protocol for Confirmation of Results*—In order to exclude a material from treatment as asbestos-containing materials, the absence of asbestos fibers at the regulated level must be reliably demonstrated by analysis. Fig. 2 shows the steps taken to determine if a single sample is asbestos-containing material (ACM) or Non-ACM.

NOTE 4—"Non-ACM" means an asbestos content of one percent or less. If the laboratory reports a value for the asbestos content of a sample that is one percent or less, the reported value should be used in the survey report even though the material meets the definition of "non-ACM" for purposes of this practice. Some building owners may elect to treat materials with one percent or less asbestos as ACM.

6.5.2.1 "Non-friable Organically Bound" or "NOB" materials are analyzed in accordance with the left side of the chart. If asbestos fibers are detected and visual estimation or point-counting shows the asbestos content to be more than one percent, the sample is reported as ACM. If no asbestos fibers are detected, or if the content is one percent or less, the sample is analyzed with a combination of gravimetric methods and TEM. If this analysis identifies asbestos fibers with a content of more than one percent, the result is reported as ACM. Otherwise, the result is reported as "non-ACM" based on either "No Asbestos Detected" or "NAD" if no asbestos fibers were found, or it is reported as "non-ACM" and the asbestos content (which will be one percent or less) is given (see Note 4).

6.5.2.2 The most common application of this requirement is vinyl asbestos floor tile, but these procedures should be considered for any material where small fiber size and the presence of interfering substances render Polarized Light Microscopy unreliable for definitive confirmation of asbestos content below one percent. It is common for laboratories to include a disclaimer to this effect on the sample results. A sample of material that was not friable when manufactured and installed but has become friable through damage or deterioration is still considered non-friable for purposes of Section 6.

6.5.2.3 At least one sample of each distinct homogeneous area of NOB materials shall be reanalyzed by quantitative transmission electron microscopy with gravimetric reduction when all samples in the homogeneous area sample set are reported to be one percent or less asbestos by PLM. The inspector should consider the factors in 6.5.5.1 and 6.5.5.3 in deciding whether to re-analyze one or more of the remaining samples, deferring to the regulations in the local, state, or county government in which the survey is being performed as some locales require all NOB samples to be analyzed by TEM.

6.5.2.4 Materials other than "NOB" are analyzed in accordance with the right side of the chart. If no asbestos fibers are detected on three replicate slide mounts, the sample is reported as "NAD." If asbestos fibers are detected and visual estimation or point-counting shows the asbestos content to be more than one percent, the sample is reported as ACM. If the content is one percent or less by visual estimation or point-counting, the sample is analyzed with a combination of gravimetric methods and TEM. If this analysis identifies asbestos fibers with a

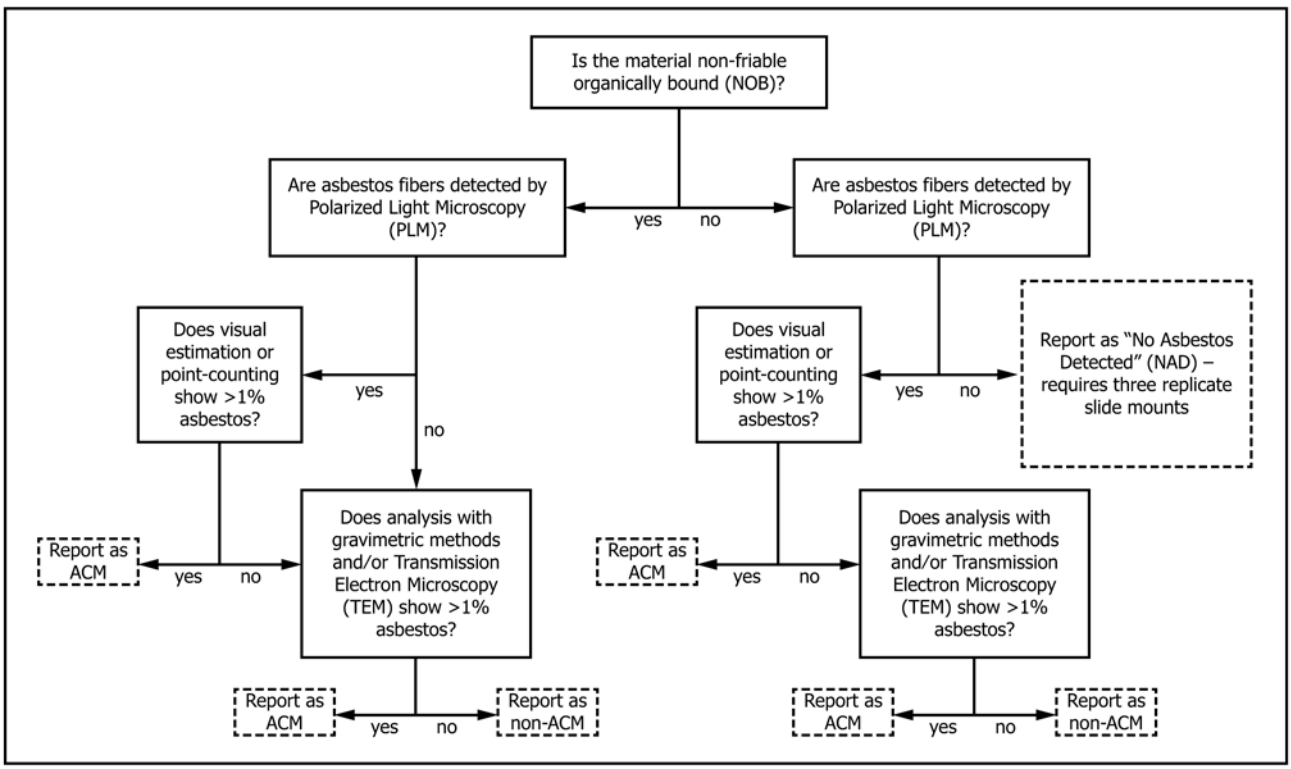

FIG. 2 Protocol for Analysis of Bulk Samples

content of more than one percent the result is reported as ACM. Otherwise, the result is reported as "non-ACM" based on either "No Asbestos Detected" or "NAD" if no asbestos fibers were found, or it is reported as "non-ACM" and the asbestos content (which will be one percent or less) is given (see Note 4).

6.5.2.5 The inspector may elect to bypass PLM analysis for NOB materials and proceed directly with quantitative transmission electron microscopy with gravimetric reduction. In deciding whether to analyze more than one sample from a homogeneous area, the inspector shall adhere to the constraints in 6.5.2.3.

6.5.3 *Reporting of Results*—The laboratory results should be very clear on what is meant by "trace" and "NAD" if these terms are used.

6.5.3.1 The accepted definition of "NAD" is that no asbestos fibers were identified on three replicate slide mounts from the same sample under Polarized Light Microscopy, or that no asbestos fibers were detected with TEM and EDXA on any of the grids analyzed.

6.5.3.2 "Trace" usually means that at least one asbestos fiber was identified in the sample but the amount was estimated at one percent or less. However, the use of this term varies among laboratories and the specific meaning assigned to the analytical results should be requested. In no case should a *Trace* result based on PLM with visual estimation or point counting be used to exclude material from treatment as asbestos-containing without confirmation by gravimetric or TEM analysis.

6.5.3.3 All discrete layers of a sample shall be analyzed separately and the results reported for each individual layer. The layers shall not be physically composited for analysis, nor shall the results be mathematically combined into a single result. For example, mastic on floor tile is a separate layer and the components of a wallboard system including the joint compound, tape and skim cost (texturizer) are all individual layers. An exception may be made for layers of paint that cannot be physically separated for analysis.

NOTE 5—EPA requires that layers of wallboard samples be analyzed and reported separately, but also allows a "composite" result to be reported for purposes of determining if a wallboard "system" contains more than one-percent asbestos for purposes of complying with the NESHAP. OSHA does not permit sampling or reporting of "composite" results for wallboard systems. Because of the need for information on the individual components of the wallboard system to comply with the OSHA regulations that apply to any work on the material, it is important to maintain the integrity of the separate components during analysis and report the results for separate layers. The laboratory may, at its option, report a composite result in addition to the results for individual layers.

6.5.4 *Vermiculite Attic Insulation*—Loose fill insulation containing vermiculite presents difficulties in the detection of amphibole asbestos using conventional PLM techniques. The EPA "Research Method," which is commercially available, consists of separating the amphibole fibers—usually tremoilite—from the vermiculite flakes by flotation and analyzing the settled fiber bundles by PLM. If no fibers are detected by PLM, fibers extracted from the flotation liquid by filtration are analyzed by TEM.

6.5.5 *Positive Stop*—The "positive stop" approach holds that one positive (more than one-percent asbestos) sample from a homogeneous area can be considered evidence that all suspect material in that homogeneous area contains asbestos without analyzing the remaining samples. Factors to consider in deciding whether to use this approach are illustrated in Fig. 3.

6.5.5.1 *The Inherent Homogeneity of the Material*—Straight runs of pipe insulation, resilient floor tile, ceiling tiles, asbestos-cement pipes, ducts, roofing and siding, for example, were manufactured to specifications that included the amount

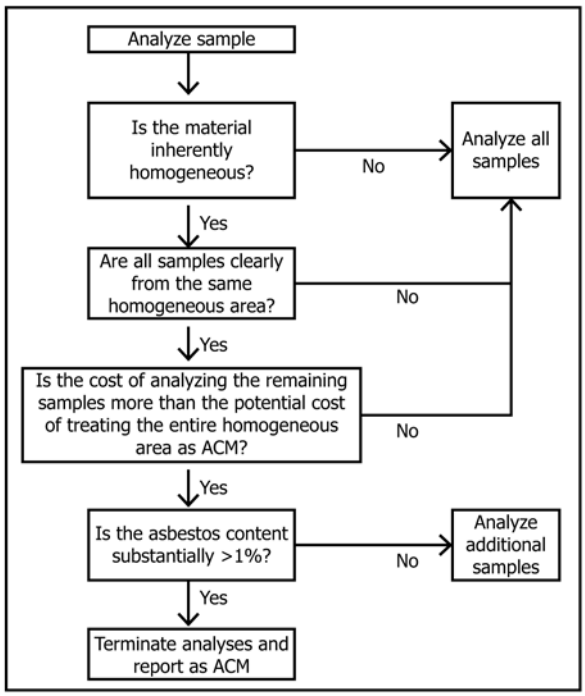

FIG. 3 Decision Chart for Positive Stop

of asbestos in the product. Therefore, if one sample from such a material contained asbestos, the remaining samples from similar-appearing materials could reasonably be expected to do so as well. On the other hand, batch-mixed materials such as fireproofing, ceiling and wall texture, acoustical plaster, hard plaster and pipe fitting insulation ("mudded joints") are more likely to vary in their asbestos content. This will not be apparent to the inspector who is taking the samples, and is due to adding the asbestos fiber at the job site or mixing asbestos-containing products with other materials, thereby diluting the asbestos content. For this reason, a single positive sample may not be indicative of the overall homogeneous area and all samples should be analyzed to determine if more than one homogeneous area actually exists, including some where no asbestos is present. If the material is inherently inhomogeneous, all samples should be analyzed.

6.5.5.2 *The Uncertainty of Identifying Homogeneous Areas*—Identification of homogeneous areas is a matter of judgment, and using "positive stop" could result in treating material as asbestos-containing because it was incorrectly included in a homogeneous area from which only one sample was positive. If there is any doubt as to the homogeneity of a sampling area, all samples from that area should be analyzed. For example, fireproofing in a facility may appear identical in color and texture (tan color, high density); however, it is possible that the fireproofing in two locations may be distinct materials, one with intentionally added asbestos and the other a non-asbestos containing replacement product. In this example, the inspector might identify the two distinct materials (products) as one homogeneous area and could cause unnecessary expense to the facility owner by removing or performing other response actions on non-ACM materials. Complete and proper sampling of these materials should be performed to identify inconsistencies within designated homogeneous areas. If doubt exists, all samples should be analyzed.

6.5.5.3 *The Ultimate Value of the Information*—For purposes of managing asbestos, the elimination of functional spaces from consideration reduces the number of employees and contractors affected. The resultant cost saving and other intangible benefits can easily outweigh the additional analysis and documentation costs. If a decision is made to abate the ACM, reducing the quantities reported on the NESHAP notification will, in some jurisdictions, reduce the notification fees. Of course, other abatement costs will also be reduced. If the potential cost of treating the entire homogeneous area as asbestos-containing material exceeds the cost of analyzing the remaining samples, analyze the samples.

6.5.5.4 *The Relative Uncertainty of Analytical Results*—If a sample contains substantially greater than one percent asbestos, it is highly unlikely that other samples from the same homogeneous area will have one percent or less asbestos, or no asbestos at all. In that case, analyzing one sample may suffice (given that 6.5.5.1 and 6.5.5.3 are satisfied). As the reported asbestos content approaches one percent, the uncertainty of the result increases to the point where confirmation by analyzing more samples is advisable. The laboratory must receive clear instructions as to what constitutes "substantially greater than one percent asbestos" for purposes of terminating or continuing the analyses.

6.6 *Assessment of ACM*—For purposes of deciding whether to abate ACM or continue managing it in place, and to select the appropriate response actions, the ACM must be assessed in accordance with one of the protocols in Appendix X2. Particularly when a large number of functional spaces and homogeneous areas are included in the survey, assessments are a valuable tool in setting priorities for response actions. Assessments complement, but do not replace, experience and common sense when determining priorities for response actions.

6.6.1 Qualitative assessments include the "AHERA" categories (undamaged, damaged, significant damaged, potential for damage, potential for significant damage, and remaining undamaged ACBM with low potential for damage) and other classification systems (good/fair/poor, accessible, etc.), hazard ranking, response action priorities, and recommendations (abatement, O&M) for controlling the asbestos hazard.

6.6.2 Quantitative assessments are based on numerical ratings for Current Condition and Potential for Disturbance. Tabulation of assessment ratings and preparation of Abatement versus O&M decision charts are used to develop recommendations for response actions.

6.7 *Preparing a Report*—The Baseline Survey report is developed from the information collected during the field work, the laboratory results and the assessment. Using forms compatible with the survey report requirements, including electronic formats and file structures, for data collection and manipulation facilitates this process.

6.7.1 Copies of field data sheets filled in during the inspection, copies of laboratory results and copies of inspector and laboratory credentials should be included as appendices to the hardcopy version of the survey report, or scanned for inclusion in an electronic copy. Unless the building owner has specified the use of color in the survey documentation, homogeneous areas and functional spaces should be identified in black and white on the survey drawings to facilitate copying survey reports without a loss of information in the reproduction process.

6.7.2 Appendix X3 contains a set of forms that can be used as templates for collecting and manipulating the survey information, as well as compiling it in the form of the survey report. In addition to the forms in this appendix, drawings must be prepared (or marked up) showing all functional spaces inspected whether or not samples were taken, locations of samples taken and the locations of confirmed or presumed ACM, and locations of functional space not inspected because they were inaccessible or excluded areas.

6.7.3 Before submitting the survey report to the building owner, it should be reviewed by the Survey Team Members who conducted the field work and by the person who performed the assessments. If applicable, it should also be reviewed by the Project Manager and Principal/Technical Director (see 6.2.5).

6.7.4 The report shall contain a statement that it is not to be provided to potential bidders for the purpose of soliciting proposals for asbestos abatement.

7. Project Design Surveys

7.1 The Project Design Survey is limited to the functional space(s) in the building or facility that are going to be affected by an abatement project. Besides this limitation, other factors define the scope and conduct of a Project Design Survey.

7.1.1 OSHA regulations require that certain persons and agencies be notified of the presence of ACM whenever abatement takes place. For renovation and demolition, the NESHAP regulation requires verification that asbestos-containing materials were looked for and, if any are found, the categories and quantities must be reported. The AHERA regulations require that a project design be prepared for abatement of friable ACM in schools. Some local agencies require that an asbestos survey be conducted as a condition of issuing a building permit for renovation.

7.1.2 If a Baseline Survey or Pre-Construction Survey has provided sufficient information on ACM in an area to be impacted by an abatement project, the information from that survey will satisfy the regulatory notification requirements without conducting additional survey activities. However, a Project Design Survey is still needed for other purposes as described herein.

7.1.3 As the main purpose of the Project Design Survey is to provide information for preparing abatement plans and specifications, the person who conducts the survey should be accredited as a Project Designer. If he signs the contract documents, accreditation is mandatory.

NOTE 6—ACM is frequently removed without the preparation of plans and specifications, particularly from industrial facilities. Unless the abatement contractor or an in-house staff member is accredited as a Project Designer, it is prudent to avoid using the term "project design" or similar terminology when documenting the work. While the concepts and approaches in this section may still be useful in such cases, reference to this practice in project documents is discouraged to avoid the appearance of a project design being prepared by an unqualified person. The best course of action is to have the plans and specifications prepared by an accredited Project Designer.

7.1.4 Presumption or assumption of asbestos content is not permitted for a Project Design Survey. All suspect materials are sampled and analyzed so that materials which were not determined to be asbestos-containing may be left in place.

7.1.5 Unless decisions still remain to be made as to whether to remove ACM or leave it in place, assessments as described in Appendix X2 are not performed for a Project Design Survey.

7.2 *Perform the Planning Activities Necessary for the Survey:*

7.2.1 If a Baseline Survey has been conducted, review the portions of the survey report pertaining to the functional space(s) that may be affected by the abatement project. The scope of the project may be determined by renovation or demolition, in which case the plans and specifications prepared by the architect or engineer should be consulted, regardless of whether or not a Baseline Survey has been performed.

NOTE 7—If the abatement project will precede a renovation or partial demolition, consult the architectural or engineering drawings to determine the "limits of construction." The Project Design Survey should include all spaces within these limits, as well as adjacent areas where ACM may be disturbed by construction activities. ACM within this expanded area must also be abated, and the survey must define these "limits of abatement." It may be necessary, for example, to abate ACM on floors above and below the floor on which renovation is taking place, or in an adjacent attic or crawl space.

7.2.2 Decide who conducts the survey—a consultant or in-house staff—and select the analytical laboratory to be used. Whoever conducts the survey must be qualified in accordance with Section 5 and the laboratory must be qualified to perform the type of bulk sample analysis required.

7.2.3 Establish the scope of the survey to include the buildings and facilities or portions thereof impacted by the abatement requirements.

7.2.4 Determine the required number of bulk samples by type and location of suspect ACM that may be present in the areas affected by the abatement. It may not be necessary to sample some materials if the contemplated abatement will not disturb them. However the design team may make the determination that it may be beneficial, from a cost standpoint, to include these materials in the abatement project.

7.2.5 Determine the analytical requirements and decide whether the primary method of analysis—PLM—must be supplemented by PLM with point-counting or by TEM. Establish a protocol for results with less than or equal to one percent asbestos.

7.2.6 Establish the content and format of the report (narrative, tables, drawings and attachments such as the laboratory report) to document the results of the survey. This will include, but not be limited to, information that the Project Designer will use in preparing the abatement plans and specifications. The survey report, for example, will contain the survey methodology and complete laboratory results, information that the Project designer may decide not to include in the contract documents for the abatement project. Establish submittal dates and a review process for the report before it is submitted.

7.2.7 Establish a schedule with the building owner for a preliminary site visit, if necessary, and the dates on which the field work will be started and completed. Arrange to meet with the architect or engineer who is designing the renovation, if applicable, to get a copy of the renovation plans as soon as they are available. Determine the available times of access for the areas to be included in the survey, and find out if the premises will be occupied at the time of the survey. Find out if lights and power will be available in the building during the survey.

7.2.8 The estimated cost of survey will include labor charges for field work, office support and management oversight. Laboratory charges will depend on the number of samples and type of analyses requested and the turn-around time if expedited results are needed. Other expenses include travel and subsistence for out-of-town surveys, rental of equipment such as man-lifts and photographic documentation. For a detailed discussion of survey costs, see 6.2.

7.3 *Conducting the Field Work*—Information regarding ACM and other aspects of project design will be collected during one or more visits to the building or facility.

7.3.1 Mobilizing equipment and supplies is an important prelude to conducting field work efficiently. Sampling equipment, bulk sample containers, lights, tools, ladders, PPE

and other items should be assembled for ready access. See Appendix X1 for a list of equipment and supplies.

7.3.2 Conducting the field work may include destructive testing if access to concealed spaces is needed. These spaces may contain suspect ACM or it may be necessary to confirm that none are present therein. If destructive testing must be done in occupied spaces, it may be necessary to temporarily patch the opening in the wall or ceiling. Penetrating building surfaces may create dust that is harmful to equipment or objectionable to occupants, and measures to control the dust must be taken during the survey. It may be necessary to perform a preliminary survey of a building system or component prior to performing destructive sampling to determine if the surface being breached contains asbestos. For example, an inspector may need to collect bulk samples of plaster prior to creating a hole in a ceiling to prevent the spread of asbestos fibers, dust and debris in the space during the destructive testing.

7.3.3 Locate and inspect the functional space(s) that will be impacted by the abatement project. Any functional spaces that cannot be inspected due to restricted accessibility or other reasons must be documented. Identify suspect ACM in accordance with the type of material (surfacing material, thermal system insulation or miscellaneous material) and its description (pipe insulation, fireproofing, floor tile, etc.) If no suspect ACM is present in a functional space, or if the only materials present are those which an accredited inspector can determine without sampling do not contain asbestos, document this information.

7.3.4 Identify the homogeneous areas within each functional space, and those that overlap adjacent functional spaces, by similarities in the type of material, its appearance, color, texture and probable date of installation. For each homogeneous area, determine the number of samples to be taken from random and non-random locations, consistent with 6.4.6.1 – 6.4.6.4 and the following provisions:

7.3.4.1 Where feasible, the manner used to determine sample locations for any suspect material within a homogeneous area shall be a random sampling method described in the sampling plan.

7.3.4.2 Without compromising safety or disturbing occupants, use random sample locations for materials that may have been batch-mixed at the site. Such materials, which may vary in asbestos content throughout a homogeneous area, include fireproofing, ceiling and wall texture, acoustical plaster, hard plaster and pipe fitting insulation.

7.3.4.3 Flat surfaces such as floors, walls and ceilings may be divided into a grid, the cells of the grid numbered, and random numbers used to select cells in which to take the samples (See Footnote 7). For large cylindrical objects such as tanks and vessels, an equivalent “flat” surface is an area defined by the height or length of the object and its circumference. For homogeneous areas that are one-dimensional (linear), such as pipe insulation and fireproofed beams and columns, use a random number table to select sampling locations along the length of the item.

7.3.4.4 Random sample locations are less important for homogeneous areas where the asbestos content is expected to be relatively uniform due to product specifications. Such materials include floor tile and mastic, ceiling tiles, straight runs of pipe insulation and asbestos-cement products. Sheet vinyl flooring should be sampled randomly due to the uneven absorption of adhesive by the backing.

7.3.4.5 If samples taken during the Baseline Survey or Pre-Construction Survey confirmed the presence of more than one percent asbestos in a material, there is no need to re-sample that material during the Project Design Survey, providing the proper number of samples were taken and the inspector and Project Designer concur as to the homogeneous area designation of the material. For a material where samples taken during the Baseline Survey or Pre-Construction Survey were reported to have no more than one percent asbestos, the accredited inspector should determine whether there is a need to re-sample that material during the Project Design Survey, taking into account whether an sufficient number of samples were taken and if analytical methods were adequate.

7.3.4.6 For OSHA notification purposes, the number of samples taken should be sufficient to rebut the presumption of asbestos-containing material (PACM) as specified in 29 CFR 1926.1101(k)(5), which references the AHERA regulations in §763.86. Inspection for NESHAP notification purposes does not have any sampling requirements in 40 CFR Part 61.145, but as the inspection constitutes a rebuttal of the presumption of asbestos content, the requirements of 29 CFR 1926.1101(k)(5) that reflect the AHERA regulations in §763.86 should be followed. Inspections for building permit applications should follow any applicable requirements of the permitting authority. Otherwise, revert to the OSHA requirements or any state or local rules that apply.

7.3.5 Material quantities may be determined at the same time that bulk samples are collected, in which case all suspect ACM must be quantified. If quantities are determined on a subsequent visit after the sample results are known, only confirmed ACM need to be quantified.

7.3.5.1 The type of material and description determine the units of measure. Square feet (square metres) is used for surfacing material, floor tile, tank and duct insulation and other materials for which area is the most logical unit. This might include fireproofing on structural members where calculation of surface area is overly complex. The thickness of these materials should be measured in order to estimate disposal quantities. Linear feet (metres) is the measure used for straight runs of pipe insulation, for window caulking, asbestos-cement pipe and ducts, and other materials where length is more descriptive of the quantities. For pipe fittings, either count the number of insulated valves, tees, elbows, etc. or indicate that they are included in the linear feet (metres) of pipe insulation, being sure to count fittings separately if the straight runs of insulation are not asbestos-containing material.

7.3.5.2 Quantities are required for OSHA and NESHAP notification purposes, and notification fees levied against the building owner may depend on the quantities of ACM reported on the NESHAP notification. In addition, OSHA requires that the percent of asbestos present in the material be provided (and, by implication, the type). Where the sample results show varying percentages of asbestos, indicate the range of percentages.

7.3.5.3 Estimation of quantities of ACM to be removed is very important for project design purposes. The Project Designer must include this information in the plans and specifications in sufficient detail to give the prospective bidders a reasonable indication of the scope of work. While the bidders are responsible for their own estimates, gross discrepancies between the design documents and the bidders' estimates may indicate that ACM was over-looked or incorrectly quantified during the Project Design Survey. Such situations obviously must be rectified before the abatement contract is awarded.

7.3.6 Collect the bulk samples using methods and equipment discussed in Appendix X1, being careful to maintain the integrity of layered samples where necessary. In addition to sampling accessible materials, perform necessary destructive testing to inspect concealed spaces and sample suspect materials therein. Access to concealed spaces that might be impacted by the abatement project should not be precluded by physical or institutional reasons (such as refusal of permission to enter). Since the material is going to be removed during abatement or subsequent renovation, aesthetic considerations and damage to building surfaces is not of concern during a Project Design Survey.

7.3.6.1 Crawl spaces must be carefully inspected if abatement of installed ACM, dust and debris or contaminated soil is intended. Pipes, ducts and fireproofed surfaces must be sampled and quantified as in an occupied part of the building. If dust and debris are present on the surface of the dirt, is mixed in with loose dirt, or is impacted into the hard-pan, the inspector must determine over what area of the crawl space, and to what depth, such contamination extends. Trenches under pipe runs may have been filled with dirt containing the remains of insulation that had been removed during a previous renovation. If moisture is present, water may have soaked into soft dirt, along with asbestos dust and debris. Samples of dust and debris should be separated from the dirt in which they are mixed so they can be analyzed for their own asbestos content, not as a composite of a soil mixture. If analysis of soil samples for asbestos content is required for the Project Design, see Test Method D7521. Respirators and protective clothing should be worn when inspecting a suspected contaminated crawl space, due to the high fiber levels that can result from stirring up dry contaminated soil. It may be necessary to treat the crawl space as a confined space (see Section 9).

7.3.6.2 If several floors of a multi-story building are to be abated, care must be taken not to incorrectly attribute quantities and characteristics of ACM observed on one floor to another floor. While some repetition is to be expected, each floor is its own set of functional spaces and may have different mechanical, structural and architectural requirements from those above and below it. Stairwells, pipe and duct chases, elevator and cable shafts, and air shafts are separate and distinct functional spaces from the floors they traverse. These spaces should be inspected with the expectation that the project design will treat them individually for abatement purposes.

7.3.7 Processing of collected samples before sending them to the laboratory may include dividing the samples for quality control and splits, retention of archive samples or sample examination prior to shipment. Handling samples in this manner means opening the containers, which must be done in a HEPA-filtered ventilation hood for friable materials. A properly-executed chain of custody must accompany the shipment of samples to the laboratory, along with instructions as to the type of analysis requested and expedited turn-around if needed (see 6.4.9.1). The inspector should retain a copy of the chain-of-custody and the original chain-of-custody should remain with the samples.

7.3.8 Analyzing the bulk samples by PLM or TEM, or both, as needed must be done in accordance with 6.5.1.

7.3.9 *Non-Sampling Considerations*—In addition to taking bulk samples and quantifying ACM, the Project Design Survey affords the opportunity to obtain other information essential to project design. Many of the following items require consultation with the building owner or the design professional responsible for the renovation, and their representatives should be available during the Project Design Survey. The extent to which some of the following items need to be investigated also depends on whether a "means and methods" approach to project design is contemplated, or if the Project Designer intends to leave the details of execution to the abatement contractor.

7.3.9.1 *Phased Abatement*—Renovation is often performed in phases, with one or more areas vacated and renovated, then reoccupied while other areas are vacated and renovated. The areas for renovation may be contiguous or separated, and work may proceed in more than one area at the same time. Abatement project design must consider the renovation sequence and schedule and be phased accordingly. In addition to consulting the renovation plans, the Project Designer must visit the site to identify the limits of construction for each phase and area of the renovation, so that the limits of abatement and the abatement schedule can be set accordingly.

7.3.9.2 *Emergency Egress*—Provisions for egress from the enclosure in event of fire or other emergency must be anticipated by the project designer. If abatement is to be done in an occupied building, emergency egress routes for occupants must be preserved in accordance with local fire and safety codes and facility safety requirements. Access routes for emergency services such as fire and rescue must be located so that they remain unimpeded by the abatement preparations.

7.3.9.3 *Essential Facility Services*—Power must remain on outside the affected area, and the Project Designer must locate the panels to determine if access to them will be restricted by abatement activities. He must also locate controls for fire alarms, security and telecommunications to ensure that they can remain operable if within the regulated area, or if they must be temporarily relocated by facility staff. Special provisions may be needed for access to this equipment during the project, including uncontaminated enclosures or entry into the regulated area by properly trained and equipped maintenance staff for limited periods of time. In some buildings and facilities, gas and liquid services such as sprinkler systems, oxygen lines in a hospital and process piping in a factory must remain in operation and be protected from damage or contamination, with controls and shut-offs accessible during the abatement project.

7.3.9.4 *HVAC*—HVAC systems serving the spaces to be abated must be identified so they can be turned off during site preparation and abatement. If abatement is to be done in an occupied building, provisions must be made to maintain ventilation in adjacent areas not undergoing abatement, including above and below.

7.3.9.5 *Contractor Mobilization*—Space must be identified where the contractor can store his equipment and supplies outside the regulated area (enclosure, decontamination unit, and load-out). It must be possible to secure this space against unauthorized entry while the contractor and project monitor are not on site.

7.3.9.6 *Restricted Areas*—Parts of the building or facility that will be off-limits to the contractor's workers, or limited to access by the supervisor, must be identified during the Project Design Survey. If toilet facilities in the building are not to be used by the contractor, this must be determined during the Project Design Survey.

7.3.9.7 *Hazardous Working Conditions*—The need to work at elevated locations must be evaluated during the Project Design Survey, including the height above the floor or ground of the ACM to be abated. If confined spaces must be entered for abatement, they should be identified so they can be described in the project documents. Operating machinery that must remain in use, electrical lines that cannot be de-energized, and pipes that cannot be de-pressurized or cooled down must be identified. Sources of chemical hazards that must be removed during preparation or remain in the area must also be identified.

7.3.9.8 *Water and Power*—The Project Designer should determine where the contractor will be able to obtain water for removal and decontamination, and electrical power for his equipment. One or more electrical panels should be found outside the negative pressure enclosure where leads can be brought out to the contractor's power panel(s). Power for high-volume air sampling pumps should also be located. If water or power, or both, cannot be provided by the building or facility owner, locations where the contractor can position a portable tank or generator, or both, need to be identified.

7.3.9.9 *Decontamination and Load-out*—The personnel decontamination facility and waste load-out are part of the regulated area accessible from the contractor's mobilization area, and adequate space must be provided for them. The Project Design Survey should identify possible locations inside or outside the building, including space to position a trailer-mounted decontamination unit if necessary. The availability of water and power for the decontamination unit and load-out, and a place for disposal of filtered water, must also be addressed.

7.3.9.10 *Negative Pressure Enclosures*—Satisfactory operation of a negative pressure enclosure is affected by many characteristics of the building or facility. Provisions must be made to exhaust the discharge of the HEPA-filtered ventilation units outside the building if possible, or at least into an unoccupied space where air samples can be taken regularly. The enclosure must be protected from intentional or accidental damage in areas not conducive to routine surveillance. The Project Designer should inspect the building for conditions that could compromise the integrity of the negative pressure enclosure and its ability to provide the required pressure differential. These include penetrations in the building envelope, such as broken windows, that allow air infiltration, as well as loading docks and other large openings where wind can affect air flow and pressure distributions inside the building.

7.3.9.11 *Waste Disposal*—Locations must be found where bags and drums of removed ACM and contaminated waste material may be temporarily stored while awaiting disposal. These locations may be inside the building or outside, and also include a place where waste transport containers may be positioned for the duration of the project or temporarily during loading and pick-up. Provisions must be made for securing the waste transport containers against tampering.

7.3.9.12 *Visibility Barriers*—OSHA regulations require that signs with specified wording be posted at the entrance to regulated areas. However, some building owners do not want these signs to be visible to occupants of adjacent spaces. The Project Designer should identify the locations from which the regulated area and contractor's mobilization area can be seen, so that "visibility barriers" can be constructed to shield the contractor's operations from view. (Bear in mind that workers often change clothes in the "mobilization area" outside the clean room of the decontamination unit.)

7.3.9.13 *Demolition*—There are times when even destructive testing during the Project Design Survey cannot adequately locate all of the ACM that will have to be abated. In such cases, the abatement contractor must demolish parts of walls and ceilings to expose suspect materials for additional sampling. Because this often results in additional abatement through change orders after the contract is signed, the Project Design Survey should include examination of functional spaces to determine where this situation might occur.

7.3.9.14 *Spot Removal*—The Project Designer must carefully examine the perimeter of the limits of abatement to determine if any ACM must be removed, encapsulated or enclosed to complete construction of the negative pressure enclosure. If "spot removal" of ACM must be done to provide uncontaminated work space for unprotected tradesmen such as plumbers and electricians involved in the renovation, such locations must be identified during the Project Design Survey.

7.3.9.15 *Testing Fireproofing*—If encapsulation is being considered as an abatement technique for fireproofing, the fireproofing should be tested for internal strength (cohesion) and bonding to the substrate (adhesion). The Project Designer must determine the number of places to do the tests and their locations, and prepare a test plan. The results of the tests will show whether use of a penetrating or bridging encapsulant is acceptable and, if so, provide information for the plans and specifications. Practice E1494 includes the test methods to be used. The Project Designer should consult the fireproofing manufacturer for specifications on cohesion and adhesion performance.

7.3.9.16 *Substrates*—The characteristics of substrates to which surfacing materials are applied should be determined in order to evaluate the difficulty of removal. Rusted steel, pitted concrete, metal lath and floor leveling compound are just a few

examples of substrates that should be identified during the Project Design Survey so they can be addressed in the project design.

7.3.9.17 *Asbestos-Cement Materials*—If asbestos-cement products such as roofing or siding on a building, cooling tower or other structure located outdoors are to be removed, the Project Designer should determine if the surface has weathered to the extent that loose fibers are exposed, or if there is dust and debris from other causes. For roofing, determine if the panels are cracked or otherwise damaged to the extent that they may not support a worker's weight and present a hazard of falling through. For siding installed near ground level, dust and debris may have contaminated the dirt near the building. Note the presence of paint or encapsulants, which will contain asbestos fibers released from the surface of the roofing or siding. Determine the locations of nearby ventilation intakes, windows or doors to establish whether they need to be covered or if the removal should be done within a negative pressure enclosure. See Practice E2394 for uses of asbestos-cement products, appropriate precautions and work practices.

7.3.9.18 *Consultant's Field Office*—A space must be located near the abatement area, but separate from the contractor's mobilization area, where the owner's representative can establish a temporary field office. Space must be provided to store and calibrate sampling pumps, and store personal protective equipment, leaf blowers and other items used by the project monitor. The space must be sufficiently clean and removed from sources of airborne fibers to perform on-site Phase Contrast Microscopy analysis of air samples. Provisions must be made to secure this space when unattended.

7.3.9.19 *ACM Inaccessible for Removal*—ACM may have been installed in locations where it is not possible to remove it due to access limitations, such as fireproofing behind a beam or column that it too close to a wall for a worker to reach into the cavity. This ACM represents a potential source of fiber release during clearance air sampling and during subsequent renovation and re-occupancy. The Project Designer must identify such locations so that he can include measures in the plans and specifications such as encapsulation or enclosure of the ACM to prevent fiber release.

7.3.10 Renovation following an abatement project often includes installation of non-asbestos materials to replace the ACM removed. Frequently, the same consultant and contractor who handle the abatement project will also do the replacement work. Even though information for the replacement work may be collected at the same time that the Project Design Survey is being conducted, this work is not considered part of the abatement project. For this reason, replacement of fireproofing, plaster, pipe and boiler insulation, floor covering and other removed ACM is not within the scope of this practice.

7.4 Documentation of the Project Design Survey includes: the sample data sheets for bulk samples taken, a record of inspection of all functional spaces, including those where no samples were taken, floor plans or drawings showing sample locations, functional spaces and homogeneous areas, and photographs of representative or significant inspection and sampling locations. The Project Design Survey report shall also include information relevant to the non-sampling considerations in 7.3.9 as applicable as well as other issues noted by the Project Designer that will have to be discussed in plans and specification. The Project Design Survey report is a resource for preparing the plans and specification and not a substitute for it. The report must not be used as a document with which to solicit bids for abatement.

7.5 Analyzing the bulk samples by PLM or TEM, or both, as needed must be done in accordance with a recognized method such as those described in EPA 600/R-93/116 (see 6.5.1).

8. Pre-Construction Surveys

8.1 Renovation and demolition often proceed in the absence of information from a Baseline Survey or other knowledge of the presence or absence of ACM. For various reasons, it may not be feasible to conduct a Baseline Survey of the entire building or facility within the time constraints of an impending construction project. However, the NESHAP regulations require the owner to "thoroughly inspect the affected facility" prior to activities that might disturb asbestos-containing materials. A Project Design Survey would be premature because, at this point, the existence of ACMs and the need for an abatement project has not been established. The Pre-Construction Survey therefore answers the question of whether there is any asbestos-containing material in the area of intended construction; if not, work proceeds as ordinary construction. If ACM is found, a Project Design Survey is performed and abatement takes place before construction commences.

8.2 *Planning the Survey:*

8.2.1 The plans and specifications prepared by the architect or engineer for renovation or demolition should be consulted to determine the scope of the Pre-Construction Survey. The survey must include all spaces within the "limits of construction," as well as adjacent areas where ACM may be disturbed by construction activities. The survey must define these "limits of abatement" because it may be necessary, for example, to abate ACM on floors above and below the floor on which renovation is taking place, including an attic or crawl space.

8.2.2 Decide who conducts the survey—a consultant or in-house staff—and select the analytical laboratory to be used. Whoever conducts the survey must be qualified as an accredited inspector and the laboratory must be qualified to perform the type of bulk sample analysis required.

8.2.3 Establish the scope of the survey to include the buildings and facilities or portions thereof impacted by the renovation or demolition requirements. Document the areas where work will be performed and the materials within those areas that will be disturbed by the work.

8.2.4 Determine the required number of bulk samples by type and location of suspect ACM that may be present in the affected areas. It may not be necessary to sample some materials if the contemplated construction will not disturb them. However, it may be beneficial, from a cost standpoint to include these materials in the survey.

8.2.5 Establish the content and format of the report (narrative, tables, drawings and attachments such as the laboratory report) to document the survey methodology and complete laboratory results. Establish submittal dates and a review process for the report before it is submitted.

8.2.6 Establish a schedule with the building owner for a preliminary site visit, if necessary, and the dates on which the field work will be started and completed. Arrange to meet with the architect or engineer who is designing the renovation, if applicable, to get a copy of the renovation plans as soon as they are available. Determine the available times of access for the areas to be included in the survey, and find out if the premises will be occupied at the time of the survey. Find out if lights and power will be available in the building during the survey.

8.2.7 The estimated cost of survey will include labor charges for field work, office support and management oversight. Laboratory charges will depend on the number of samples and type of analyses requested and the turn-around time if expedited results are needed. Other expenses include travel and subsistence for out-of-town surveys, rental of equipment such as man-lifts and photographic documentation. For a detailed discussion of survey costs, see 6.2.

8.3 *Conducting the Field Work*—Information regarding the presence, locations and quantities of ACM will be collected during one or more visits to the building or facility.

8.3.1 Mobilizing equipment and supplies is an important prelude to conducting field work efficiently. Sampling equipment, bulk sample containers, lights, tools, ladders, PPE and other items should be assembled for ready access. See Appendix X1 for a list of equipment and supplies.

8.3.2 Conducting the field work may include destructive testing if access to concealed spaces is needed. These spaces may contain suspect ACM or it may be necessary to confirm that none are present therein. If destructive testing must be done in occupied spaces, it may be necessary to temporarily patch the opening in the wall or ceiling. Penetrating building surfaces may create dust that is harmful to equipment or objectionable to occupants, and measures to control the dust must be taken during the survey. It may be necessary to perform a preliminary survey of a building system or component prior to performing destructive sampling to determine if the surface being breached contains asbestos. For example, an inspector may need to collect bulk samples of plaster prior to creating a hole in a ceiling to prevent the spread of asbestos fibers, dust and debris in the space during the destructive testing.

8.3.3 Locate and inspect the functional space(s) that will be impacted by the construction project. Any excluded areas or functional spaces that cannot be inspected due to restricted accessibility or other reasons must be documented. Identify suspect ACM in accordance with the type of material (surfacing material, thermal system insulation or miscellaneous material) and its description (pipe insulation, fireproofing, floor tile, etc.) If no suspect ACM is present in a functional space, or if the only materials present are those which an accredited inspector can determine without sampling do not contain asbestos, document this information.

8.3.4 Identify the homogeneous areas within each functional space, and those that overlap adjacent functional spaces, by similarities in the type of material, its appearance, color, texture and probable date of installation. For each homogeneous area, determine the number of samples to be taken from random and non-random locations, consistent with 6.4.6.1 – 6.4.6.4 and the following provisions:

8.3.4.1 Where feasible, the manner used to determine sample locations for any suspect material within a homogeneous area shall be a random sampling method described in the sampling plan.

8.3.4.2 Without compromising safety or disturbing occupants, use random sample locations for materials that may have been batch-mixed at the site. Such materials, which may vary in asbestos content throughout a homogeneous area, include fireproofing, ceiling and wall texture, acoustical plaster, hard plaster and pipe fitting insulation.

8.3.4.3 Flat surfaces such as floors, walls, and ceilings may be divided into a grid, the cells of the grid numbered, and random numbers used to select cells in which to take the samples (see Footnote 7). For large cylindrical objects such as tanks and vessels, an equivalent “flat” surface is an area defined by the height or length of the object and its circumference. For homogeneous areas that are one-dimensional (linear), such as pipe insulation and fireproofed beams and columns, use a random number table to select sampling locations along the length of the item.

8.3.4.4 Random sample locations are less important for homogeneous areas where the asbestos content is expected to be relatively uniform due to product specifications. Such materials include floor tile and mastic, ceiling tiles, straight runs of pipe insulation, and asbestos-cement products. Sheet vinyl flooring should be sampled randomly due to the uneven absorption of adhesive by the backing.

8.3.5 Material quantities may be determined at the same time that bulk samples are collected, in which case all suspect ACM must be quantified. If quantities are determined on a subsequent visit after the sample results are known, only confirmed ACM need to be quantified.

8.3.5.1 The type of material and description determine the units of measure. Square feet (square metres) is used for surfacing material, floor tile, tank and duct insulation and other materials for which area is the most logical unit. This might include fireproofing on structural members where calculation of surface area is overly complex. The thickness of these materials should be measured in order to estimate disposal quantities. Linear feet (metres) is the measure used for straight runs of pipe insulation, for window caulking, asbestos-cement pipe and ducts, and other materials where length is more descriptive of the quantities. For pipe fittings, either count the number of insulated valves, tees, elbows, etc., or indicate that they are included in the linear feet (metres) of pipe insulation, being sure to count fittings separately if the straight runs of insulation are not asbestos-containing material.

8.3.5.2 Quantities are required for OSHA and NESHAP notification purposes, and the notification fees levied against the building owner may depend on the quantities of ACM reported on the NESHAP notification. In addition, OSHA

requires that the percent of asbestos present in the material be provided (and, by implication, the type). Where the sample results show varying percentages of asbestos, indicate the range of percentages.

8.3.6 Collect the bulk samples using methods and equipment discussed in Appendix X1, being careful to maintain the integrity of layered samples where necessary. In addition to sampling accessible materials, perform necessary destructive testing to inspect concealed spaces and sample suspect materials therein. Access to concealed spaces that might be impacted by the construction project should not be precluded by physical or institutional reasons (such as refusal of permission to enter). Since the material is going to be removed during renovation or demolition, aesthetic considerations and damage to building surfaces is of less concern during a Pre-Construction Survey.

8.3.6.1 Crawl spaces must be carefully inspected if abatement of installed ACM, dust and debris or contaminated soil may be required. Pipes, ducts and fireproofed surfaces must be sampled and quantified as in an occupied part of the building. If dust and debris are present on the surface of the dirt, is mixed in with loose dirt or is impacted into the hard-pan, the inspector must determine over what area of the crawl space, and to what depth, such contamination extends. Trenches under pipe runs may have been filled with dirt containing the remains of insulation that had been removed during a previous renovation. If moisture is present, water may have soaked into soft dirt, along with asbestos dust and debris. Samples of dust and debris should be separated from the dirt in which they are mixed so they can be analyzed for their own asbestos content, not as a composite of a soil mixture. If analysis of soil samples for asbestos content is required for the Pre-Construction Survey, see Test Method D7521. Respirators and protective clothing should be worn when inspecting a suspected contaminated crawl space, due to the high fiber levels that can result from stirring up dry contaminated soil. It may be necessary to treat the crawl space as a confined space (see Section 9).

8.3.6.2 If several floors of a multi-story building are to be inspected, care must be taken not to incorrectly attribute quantities and characteristics of ACM observed on one floor to another floor. While some repetition is to be expected, each floor is its own set of functional spaces and may have different mechanical, structural and architectural requirements from those above and below it. Stairwells, pipe and duct chases, elevator and cable shafts, and air shafts are separate and distinct functional spaces from the floors they traverse.

8.3.7 Processing of collected samples before sending them to the laboratory may include dividing the samples for quality control and splits, retention of archive samples or sample examination prior to shipment. Handling samples in this manner means opening the containers, which must be done in a HEPA-filtered ventilation hood for friable materials. A properly-executed chain of custody must accompany the shipment of samples to the laboratory, along with instructions as to the type of analysis requested and expedited turn-around if needed (see 6.4.9.1). The inspector should retain a copy of the chain-of-custody and the original chain-of-custody should remain with the samples. Analysis of the bulk samples by PLM or TEM, or both, must be done in accordance with 6.5.1.

8.4 Documentation of the Pre-Construction Survey includes: the sample data sheets for bulk samples taken, a record of inspection of all functional spaces, including those where no samples were taken, floor plans or drawings showing sample locations, functional spaces and homogeneous areas, and photographs of representative or significant inspection and sampling locations. If no ACM was found, the Pre-Construction Survey report shall state “No asbestos was found in samples taken during this survey.” If ACM is found, the Pre-Construction Survey report shall identify its location, type (surfacing material, thermal system insulation or miscellaneous material), description (pipe insulation, floor tile, plaster, etc.), quantity and type, and percent of asbestos.

8.4.1 The Pre-Construction Survey report is a resource for initiating the Project Design Survey if ACM is found and an abatement project is planned. It is not a substitute for a Project Design Survey report and must not be used as a document with which to solicit bids for abatement.

8.4.2 The results of the Pre-Construction Survey may affect the plans for the renovation or demolition, even to the extent of cancelling the project. If the construction plans are altered to include areas not covered by the Pre-Construction Survey, it will be necessary to return to the site for additional inspections and sampling, and to amend the Pre-Construction Survey report accordingly.

9. Safety and Health Considerations

9.1 While conducting the field work portion of the survey, the inspector shall comply with all applicable safety and health regulations, as well as the policies of the building or facility owner or manager. Submittal and approval of a written safety plan may be required.

9.2 *Respiratory Protection:*

9.2.1 This practice requires that a half-mask, negative-pressure respirator be worn, as a minimum, while collecting bulk samples of suspect materials.

NOTE 8—Bulk sampling is considered Class III work by OSHA under 29 CFR 1926.1101 and respiratory protection is required unless a Negative Exposure Assessment is in effect. Respiratory protection shall be provided in compliance with 29 CFR 1926.1101(h) and 29 CFR 1910.134, which require a written respiratory protection program.

9.2.2 Respiratory protection shall also be worn whenever a space must be entered where the potential for exposure to airborne asbestos fibers from sources other than bulk sampling is indicated by the presence of dust and debris or damaged suspect materials.

9.3 Disposable protective clothing shall be worn when entering any location where the potential for contamination by asbestos fibers from sources other than bulk sampling is indicated by the presence of dust and debris or damaged suspect materials. This clothing shall consist of coveralls, hoods and foot coverings of impermeable or breathable fabric, in combination or separately. The choice of fabric should consider the potential for heat stress in the functional space being inspected. Used clothing shall be decontaminated by wet

wiping or HEPA-vacuuming, or both, and disposed of with other consumable supplies used during the inspection.

9.4 Other personal protective equipment to be used as determined by the inspector includes gloves, safety glasses, hard hat, hearing protection, safety shoes, and a fall protection harness.

9.5 The inspector shall take necessary precautions against the following safety and health hazards:

9.5.1 Electrical circuits, including those with high voltage. Ground Fault Circuit Interruption shall be provided for all 110 VAC and 220 VAC equipment.

9.5.2 Ladders, scaffolds, and catwalks shall be used for access to elevated work sites, and fall protection provided where required.

9.5.3 Crawl spaces, chases, plenums, equipment housings, tanks, and other spaces that meet the definition of confined spaces shall be entered in accordance with the precautions in 29 CFR 1910.146, the applicability of that regulation to a Comprehensive Building Asbestos Survey notwithstanding. Particular attention shall be paid to testing the atmosphere in the confined space, providing a breathable air supply if necessary, maintaining communications between persons in the confined space and outside attendants. Precautions shall be taken against getting trapped or otherwise incapacitated in the confined space, and rescue from the space without endangering other persons.

9.5.4 The possibility of chemical hazards during surveys of industrial facilities shall be considered and potential sources of exposure shall be identified through consultation with the appropriate plant staff.

9.5.5 Inspectors are subject to heat stress in boiler rooms, foundries, attics and other hot environments, in addition to outside locations in hot weather. They should recognize heat stress symptoms and be aware of prevention and treatment from the safety segments of their accredited inspector training.

9.5.6 Energized equipment such as pressurized lines and vessels, electrical lines and mechanical devices present potential hazards during the survey. These hazards should be identified through consultation with the building or facility staff, and appropriate lockout/tagout procedures followed by the inspector(s).

APPENDIXES

(Nonmandatory Information)

X1. SAMPLING TECHNIQUES AND EQUIPMENT

X1.1 Sampling Equipment and Supplies

X1.1.1 Assemble the following equipment and supplies in a kit that is dedicated for bulk sampling activities. Make sure that disposable supplies are routinely inventoried and replaced before they are needed. Not all of these items are needed on every sampling job.

X1.1.2 Most of these items are available from ordinary consumer sources and safety equipment suppliers. Others can be obtained from suppliers of asbestos sampling equipment or testing laboratories.

X1.1.3 Refer to Section 9 for safety and personal protective equipment.

X1.2 General Sampling Procedures

X1.2.1 *Preparation for Sampling:*

X1.2.1.1 Hang warning tape to demarcate the work area and post warning signs to prevent unauthorized persons from entering the area. Close doors to the area when inside a building. If taking samples on a catwalk with open grating, make sure that the levels below have been cleared and secured.

X1.2.1.2 A ladder, if needed, should be taken to the site or other arrangements made for working at elevated locations. Putting the necessary items in a tool pouch around the waist frees the hands for climbing a ladder and taking the sample. The precautions in Section 9 for elevated work must be followed.

X1.2.1.3 Set up necessary equipment (ladder, lighting, etc.). Spread a plastic drop cloth underneath the area where the sample is to be taken. When working outside, you may need to tape the drop cloth in place.

NOTE X1.1—Keeping an extension ladder in place depends on the coefficient of friction between the ladder feet and the surface on which they are resting. A plastic drop cloth has a lower coefficient of friction than the floor, and a loose drop cloth creates a second sliding interface. For this reason, always place the drop cloth under an extension ladder—never place the feet of the ladder on the drop cloth.

X1.2.1.4 For each sample, label a sample container with its identification number and record this identification number, the sample location, and type of material being sampled on a sampling data form. Always place the label on the container itself, not on a lid, as lids can be inadvertently switched by a laboratory analyst handling numerous sample containers. On a floor plan or equipment schematic, mark the location of the sample with the sample identification number. Record sample number, sample location, and a detailed description of the material sampled on a sample data sheet.

X1.2.1.5 Put on your respirator and perform a user seal check. In contaminated areas, put on a disposable protective suit, including head covering if overhead PACM might be disturbed.

X1.2.1.6 Whenever possible, take samples from undamaged, intact material. If samples are taken from material that has been exposed to chemicals in a corrosive atmosphere or from leaking water, these contaminants may interfere with the optical properties on which Polarized Light Microscopy depends for identification of asbestos fibers. If it is necessary to collect samples from damaged areas or areas of discoloration to

TABLE X1.1 Sampling Equipment and Supplies

Item	Comments
Catch pans	Rectangular aluminum pans, 3 to 5 in. size, are available in grocery stores.
Caulking compound	Used to seal hole left by taking sample.
Chisel or scraper blade	A painter's "5 in1" tool has a sharp point as well as a sharp blade. The point and edges will become dull with use and must be kept sharpened.
Coring tubes or tools	Coring tubes or tools help to preserve the integrity of layered samples, allowing each layer to be identified and analyzed separately. Laboratory cork borers are acceptable, and coring tubes can be made from ½ in. copper tubing sharpened on one end. Tubes with detachable handles can be purchased from sampling equipment distributors.
Disposal bags	6-mil labeled.
Flashlight, drop light and extension cord	A "snake light" worn around the neck leaves hands free.
Glue	Household glue (Elmers Glue™ or equivalent).
Hammer	For lifting floor tile and removing cove bases.
HEPA-filtered vacuum cleaner[A]	For use in event of a fiber release episode and for evacuating 6-mil disposal bags.
Hole punch	Industrial punch, 1 in. or larger, for sampling wallboard materials
Knife (fixed-blade)	A "TLC" (tile, linoleum, carpet) knife with a hooked blade and sharp point works well for cutting floor tile and other non-friable materials.
Knife (retractable-blade)	A utility knife (box-cutter) with extra blades, or a pocket knife.
Paper towels or wet-wipes	Roll or C-fold towels.
Permanent marker pens	
Plastic bags	Sealable freezer bags, quart and gallon size.
Plastic scoop	With flat edge for sampling VAI
Plastic drop cloths	6-mil drop cloths can be made from labeled disposal bags. 1 to 2 mil painters' drop cloths are lighter and available in larger sizes. Mark the drop cloth "TOP" on one side.
Mineral spirits	Also sold as paint thinner. Used to clean asphalt based materials from tools.
Rigid sample containers	Sealable non-breakable laboratory vials or plastic 35 mm film containers for friable materials Rigid plastic food containers, with detachable lids, one litre minimum size, for VAI.
Roofing sealant	Asphalt based—may contain asbestos fibers (check label and MSDS)
Sample labels	The labels should show the date, sample number and the legend "This sample may contain asbestos." One label is affixed to the sample container and a duplicate is placed on (or near) the material sampled.
Screwdrivers	Flat and Phillips-head for removing access panels.
Shrink band	Cellulose band used to seal air sampling cassettes; will fit 35 mm film containers.
Spray adhesive	Holds duct tape to surfaces that may become wet.
Spray bottle with soapy water	The penetrating ability of "amended water" is not as important for bulk sampling as for abatement, and liquid detergent is an adequate surfactant.
Tool pouch	Worn around waist to keep hands free for carrying things and climbing ladders.
Tweezers	
Vinyl electrical tape and duct tape	Used to seal sampling containers and plastic bags.
Warning signs and barrier tape	Should have "Asbestos-Danger".
Waste/catch bag	Sealable plastic freezer bags (quart and gallon size) used to catch debris when sampling some materials and to contain contaminated waste. These bags are easier to carry around than a 6-mil disposal bag. They must be labeled or remain under the control of the inspector until placed in a 6-mil disposal bag when all samples have been taken.
Wettable adhesive lagging cloth	Used to cover holes in insulation.

[A] In a settlement agreement with the steel industry, OSHA permits the use of wet methods or a HEPA-filtered vacuum cleaner for Class III work. Since bulk sampling is Class III work in accordance with OSHA, a HEPA-filtered vacuum cleaner is not necessary where wet methods will suffice for clean-up.

characterize "patch" insulation or to verify homogeneous areas, note the type, extent, and source of damage.

X1.2.1.7 Do not use plastic bags as sample containers for friable material. If the material is dry, fiber release can occur when you squeeze the air out of the bag before sealing it. If the sample is excessively wet, contaminated water can leak out of the bag.

X1.2.1.8 The procedures for sampling friable materials call for the use of a waste/catch bag or a catch pan to catch debris that may fall while taking the sample.

(1) The waste/catch bag may be either a quart-size or gallon-size sealable plastic bag. It should be labeled "WASTE" with a permanent marking pen. When sampling pipe and duct insulation, tape the bag to the surface beneath where you will take the sample. Because water loosens duct tape adhesive, you must work quickly to collect the sample before the bag falls off. Another problem encountered with using such a bag is keeping it open and positioning it to catch the debris. Putting the strip of duct tape across the seam of the bag instead of along the side will hold it open better. Folding the top of the bag over like a cuff will add rigidity that helps keep it open.

(2) The catch pan can be taped to a wall or other surface, or held under the place where you are taking the sample if duct tape will not stick to the surface (such as fireproofing or plaster). Spray adhesive will help to keep the duct tape from coming loose.

X1.2.1.9 Catch pans can also be used as temporary sample containers for ceiling plaster and other materials that may be too thin for a coring tool. Immediately after taking the sample, the pan can be collapsed and taped to seal it. Put a sample label on the catch pan (temporary sample container). At a later time, part of the material collected can be transferred to a rigid sample container to be sent to the analytical laboratory and the remainder disposed of, saved for archival purposes or sent to another lab as a split sample.

X1.2.1.10 Complete a chain-of-custody (COC) for each set of samples collected (see 6.4.9.1).

X1.2.2 *Continuation and Completion of Sampling:*

X1.2.2.1 Clean the sampling tools immediately after taking each sample. Place the used paper towels or wet-wipes in a gallon-size sealable bag that has been labeled for suspect asbestos containing waste. Wet-wipe the outside of the sealable bag.

X1.2.2.2 If no more samples are to be taken in the area where you have spread the drop cloth, inspect it for visible debris. Mist the drop cloth with soapy water and wet-wipe visible debris. Carefully fold the sides and corners of the drop cloth to the center with the top side in and place it in a gallon-size sealable bag.

X1.2.2.3 Remove your respirator after finishing the clean-up. If you have been in a contaminated area, wet-wipe the respirator before removing it. If you wear a disposable suit, wet-wipe and remove it and place it in the disposal bag before removing your respirator. If you wore gloves, take them off before removing your respirator.

X1.2.2.4 When all samples have been taken in the area, take down all warning signs and tape and proceed to the next sampling location.

X1.2.2.5 When all samples have been taken in all sampling areas, place the gallon-size sealable bags containing the paper towels, wet-wipes and other debris into a 6-mil labeled disposal bag. Squeeze the bag to evacuate the air from it, tightly twist the neck of the bag, fold it over to form a "goose neck" and securely tape the goose neck. Evacuating the bag will reduce the volume of waste for easier management and will reduce the likelihood of the bag rupturing.

X1.3 Specific Sampling Procedures for Friable Materials

This section includes procedures for the following friable materials:
Thermal System Insulation
- Pipe Insulation
- Duct Insulation
- Skim Coat
- Boiler, Breeching and Tank Insulation

Surfacing Material
- Fireproofing
- Plaster
- Textured Finishes
- Soundproofing

Miscellaneous Friable Materials:
- Acoustical Ceiling Tiles
- Glued-on Tiles
- Wallboard Systems
- Sheet Vinyl Flooring
- Vibration Dampeners
- Gaskets and Packing
- Loose Fill Attic Insulation

X1.3.1 *Thermal System Insulation:*

X1.3.1.1 *Pipe Insulation* samples must be taken independently from straight runs and fittings, since they are different materials. Straight sections of pipe insulation were factory-made, while the insulation on fittings were typically mixed on site.

(1) If metal jacketing covers the pipe insulation remove the jacketing from the section of pipe being sampled. Make sure that steam lines and hot water lines have been cooled and de-pressurized. Follow lock-out/tag-out procedures. Be careful not to cause fiber release by disturbing adjacent material through excessively vigorous activity (shaking or hitting the pipe, for example). It may be necessary to wrap damaged insulation with 6-mil plastic prior to collecting the sample(s).

(2) Tape a waste/catch bag to the insulation covering beneath the sample location to catch any debris from the sampling operation.

(3) Using the spray bottle, saturate the covering where the sample is to be extracted with soapy water. Cut through the covering with a knife, then wet the insulation.

(4) Use a coring tube or tool to extract a small piece of material, making sure to penetrate all layers of the material. Transfer the material from the coring tube or tool into a rigid container, or put then entire coring tube in the container. Keep the material wet by spraying additional water while extracting the sample. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time. Copper coring tubes are preferable for sampling pipe insulation because they do not scratch the pipe, which could cause an explosion. A coring tube 1-¾ in. long will suffice for most pipe insulation, which is usually one inch thick regardless of the size of the pipe. Coring tools and tubes work well on firm insulation such as 85 % magnesia, but not as well on materials that "give" such as Aircell. For such materials, remove the material in small pieces with tweezers. Insulation on fittings is firm enough to sample with a coring tool, but very hard cementitious insulation may require a hole saw and hand (not power) drill.

(5) Seal the lid of the sample container with vinyl electrical tape or shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sampling. Place the wet-wipes in the waste/catch bag attached to the covering. Spray or wet-wipe, or both, the exterior of the pipe, as necessary, to remove any debris that may be present from the sample collection, place the wipe in the waste/catch bag, then remove and seal the waste/catch bag.

(6) To prevent fiber release in the future, fill the hole where the sample was taken with caulking compound or encapsulant that is compatible with the service temperature of the equipment. Spray water into the hole before filling it. Air bubbles in the caulking or encapsulant can cause a fiber release from dry material. Cover the filled hole with adhesive cloth (lag cloth) or duct tape.

(7) Re-install the metal insulation jacket if it was removed. Affix a sample label to the adhesive cloth or duct tape, or on the metal jacket. For high-temperature, wet or corrosive environments a metal sample tag may be needed.

(8) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.1.2 *Duct Insulation* on the inside or outside of ventilation ducts may contain asbestos, as may the adhesive or mastic sealing joints on the outside of the insulation.

(1) To sample the lining inside a duct it will be necessary to remove a supply or return grill after ensuring that the ventilation system is turned off, locked out and tagged out.

(2) Wet the lining with soapy water and cut completely through the lining with knife. A piece 1 by 2 in. (3 by 5 cm) is sufficient for a sample. Roll the piece into a cylinder and insert it into a rigid container, seal the lid and affix a sampling label

to the container. Affix another label on the outside of the duct or vent near the location of the sample. Wet-wipe or HEPA vacuum the surface of the duct from which the sample was collected to remove any fibers or debris, or both, that may have been generated in the sample collection process.

(3) Sample the insulation on the outside of a duct in a manner similar to pipe insulation. Tape a waste/catch bag to the insulation covering to catch any debris from the sampling operation.

(4) Using the spray bottle, saturate the covering with soapy water where the sample is to be extracted. Cut through the covering with a knife, then wet the insulation.

(5) Use a coring tube or tool to extract a small piece of material, making sure to penetrate all layers of the material. Transfer the material from the coring tube or tool into a rigid container, or put the entire coring tube in the container. Keep the material wet by spraying additional water while extracting the sample. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time. A coring tube 1-¾ in. long may not completely penetrate some duct insulation. Coring tools and tubes work well on firm insulation such as 85 % magnesia, but not as well on some types of laminated insulation that " give." For such materials, it may be necessary to remove the material in small pieces with tweezers.

(6) Seal the lid of the sample container with vinyl electrical tape or shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sampling. Place the wet-wipes in the waste/catch bag attached to the covering. Spray or wet-wipe, or both, the exterior of the pipe, as necessary, to remove any debris that may be present from the sample collection, place the wipe in the waste/catch bag, then remove and seal the waste/catch bag.

(7) To prevent fiber release in the future, fill the hole where the sample was taken with caulking compound or encapsulant. Spray water into the hole before filling it, as air bubbles in the caulking or encapsulant can cause a fiber release from dry material. Cover the filled hole with adhesive cloth (lag cloth) or duct tape. Place a sample identification label at or near the location of the sample.

(8) To sample the mastic covering a seam or repair on the duct insulation, begin by taping a waste/catch bag to the surface of the insulation below where the sample will be taken. Wet the mastic, which is usually a strip about two inches wide, for about a three-inch length.

(9) Cut through the mastic and the underlying foil or cloth covering with a knife. Peel off the mastic and covering, wetting the covering as you do so and being careful to maintain the integrity of the layers. A piece 1 by 2 in. (3 by 5 cm) is sufficient for a sample. Roll the piece into a cylinder and insert it into a rigid container, seal the lid and affix a sampling label to the container.

(10) Cover the area where you removed the mastic with duct tape or wettable adhesive lagging cloth. Place a sample identification label at or near the location of the sample.

(11) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.1.3 *A Skim Coat* of asbestos-containing material, usually about ⅛ in. thick, sometimes covers fiberglass, foamglass, styrofoam, cork, foam rubber insulation at seams, fitting connections, and on valves, fittings and duct insulation. When sampling this material, it is not necessary to sample the underlying fiberglass, but a note should be made of its existence.

NOTE X1.2—The definitions of skim coat in 3.3.15 is more applicable to wallboard systems (See X1.3.3.3) than to thermal system insulation, where considerations of heat transfer are more important than appearance.

(1) To sample the skim coat, begin by taping a quart-size sealable plastic bag to the covering on the insulation below where the sample will be taken. Wet the covering with soapy water.

(2) Cut through the covering and skim coat with a knife. Peel off the covering and skim coat, wetting the material as you do so and being careful to maintain the integrity of the layers. A piece 1 by 2 (3 by 5 cm) is sufficient for a sample. Roll the piece into a cylinder and insert it into a rigid container, seal the lid and affix a sampling label to the container. Affix another label near where you took the sample. Use a large enough diameter container to avoid rolling the material too tightly, which might cause the layers to separate. Alternately, put the sample in a catch pan without rolling or folding the sample and collapse the catch pan.

(3) Cover the area where you removed the sample with duct tape or wettable adhesive lagging cloth.

(4) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.1.4 *Boiler, Breeching, and Tank Insulation* is usually thicker than pipe insulation, and may be installed in the form of blocks held in place with wire, metal bands, or a wire mesh resembling chicken wire. A skim coat may cover the blocks and fill the spaces between them or cover the wire mesh. The skim coat should be sampled separately or identified as part of a layered sample.

NOTE X1.3—Large tanks may be covered with a metal jacket. A core sample taken through the jacket is likely to miss the skim coat or mastic on a seam between the insulation blocks, which may contain asbestos even though the blocks do not. Removing the metal jacket from large tanks will probably require skills and equipment not available to the inspector taking the samples, and therefore should wait until the metal jacket is removed for other reasons

(1) Using the spray bottle, saturate the covering where the sample is to be extracted with soapy water. Remove a piece of the covering with a knife, put the piece in a rigid container, then wet the insulation. Some coring tools may penetrate the covering, in which case it is not necessary to remove a piece with a knife. Some coverings such as tar paper will not absorb water, but wet the surface anyway.

(2) Use a coring tube or tool to extract a small piece of material, making sure to penetrate all layers of the material. Transfer the material from the coring tube or tool into a rigid container, or put the entire coring tube in the container. Keep the material wet by spraying additional water while extracting the sample. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time. A coring tube 1-¾ in. long may not completely penetrate some

boiler, breeching and tank insulation. Coring tools and tubes work well on firm insulation such as 85 % magnesia, but not as well on some types of laminated insulation that "give." For such materials, it may be necessary to remove the material in small pieces with tweezers.

(3) Seal the lid of the sample container with vinyl electrical tape or a shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sampling. Place the wet-wipes in the gallon-size sealable bag attached to the covering. Spray or wet-wipe, or both, the exterior of the pipe, as necessary, to remove any debris that may be present from the sample collection, place the wipe in the waste/catch bag, then remove and seal the waste/catch bag.

(4) To prevent fiber release in the future, fill the hole where the sample was taken with caulking compound or encapsulant. Spray water into the hole before filling it, as air bubbles in the caulking or encapsulant can cause a fiber release from dry material. Cover the filled hole with adhesive cloth (lag cloth) or duct tape.

(5) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.2 *Surfacing Material:*

X1.3.2.1 *Fireproofing* was applied by spraying in most cases, and by troweling in a few instances. The sprayed material is either high-density or low-density, while troweled fireproofing is typically high-density. Some low-density products may have been tamped in place. There may be a protective mastic covering the fireproofing. The sampling procedure for all of these materials is essentially the same.

(1) Fireproofing is found on beams, columns, and other structural members as well as on the underside of the deck. These locations may be accessible with or without a ladder or man-lift, may be in a plenum above a lay-in or solid ceiling, or concealed in a vertical chase or horizontal soffit. Destructive testing to access the material for sampling may be required.

(2) High density and low density fireproofing materials readily release debris during sample collection. Fireproofing samples are difficult to collect directly into a rigid sample container and the action of collecting the sample typically creates falling debris. An added measure of safety can be obtained by using a waste/catch bag in accordance with X1.2.1.8 or a catch pan in accordance with X1.2.1.9.

(3) Using the spray bottle, saturate the fireproofing where the sample is to be extracted with soapy water. If a mastic covering is present, wet the covering and remove a piece as part of the sample.

(4) Use a coring tube or tool to extract a small piece of fireproofing, making sure to penetrate the fireproofing to the substrate. Transfer the fireproofing from the coring tube or tool into a rigid container, or put the entire coring tube in the container. Keep the fireproofing wet by spraying additional water while extracting the sample. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time. Coring tools and tubes work well on high density fireproofing, but not as well on low density materials that "give." For softer materials, remove the material in small pieces with a knife and tweezers. Very hard cementitious fireproofing may require a hole saw and hand (not power) drill.

(5) Seal the lid of the sample container with vinyl electrical tape or a shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sampling. Place the wet-wipes in a gallon-size sealable bag.

(6) To prevent fiber release in the future, fill the hole where the sample was taken with caulking compound. If a mastic covering is present, cover the filled hole with adhesive cloth (lag cloth) or duct tape. Affix a sample label to the rigid container, and another to a surface near the place where the sample was taken. (The label may not stick to the fireproofing, but it may stick to the mastic covering of present.)

(7) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.2.2 *Plaster* may be acoustical or decorative in purpose and found on walls as well as ceilings. The plaster may be a single homogeneous layer or it may be one component of a multi-layer wall or ceiling system. The plaster or underlying substrates may be applied to wood lath, metal lath, or a solid surface such as cement grouting or wallboard. Ordinarily asbestos will be found in the finish coat of a multi-layer system, which is the surface visible from inside the room. However, the inspector must determine all possible locations of asbestos within the system and take samples of all suspect layers, ensuring the integrity of all layers during the sampling and handling processes.

NOTE X1.4—See X1.2.1.8 and X1.2.1.9 regarding the use of waste/catch bags and catch pans for sampling the materials covered in this Section.

(1) Using the spray bottle, wet the plaster where the sample is to be taken with soapy water.

(2) Use a coring tube or tool to extract a small piece of plaster, making sure to penetrate all layers (excluding a cement grout substrate) in a multi-layer system. Transfer the sample from the coring tube or tool into a rigid container, or put the entire coring tube in the container. Keep the material wet by spraying additional water while extracting the sample.

(3) Some plaster coatings are too thin to obtain a sufficient amount of sample with a coring tool or tube. In such cases, use a chisel or scraper blade to scrape the material off the ceiling or wall. It is difficult to direct the material into a rigid container without contaminating the area with debris. Use a catch pan to collect the material as you scrape it off the ceiling or wall, as described in X1.2.1.9. Label the pan with the sample number, fold the pan closed and seal it with duct tape. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time.

(4) In a multi-layer system with a thin finish coat on a thicker substrate it may be necessary to take a core sample as well as scraping off a surface sample. If the substrate is wallboard the core sample should be taken at a joint if possible. Removing sufficient plaster or taking a core sample may be considered destructive testing (see 3.3.8) in that it leaves visible damage to an architectural finish.

(5) Affix a sample label to the container, and another to a surface near the place where the sample was taken. (The label may not stick to the plaster.) To prevent fiber release in the future, fill the hole where the sample was taken with patching plaster.

(6) Transfer the material to a rigid container during sample processing. Seal the lid of the sample container with vinyl electrical tape or a shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sample transfer. Place the wet-wipes in a waste/catch bag.

(7) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.2.3 *Textured Finishes* are generally applied to a wallboard substrate and may be a thick coat of paint or a material resembling plaster that is commonly called a "popcorn" finish. This section describes collecting the textured finish, which is considered a surfacing material, and underlying wallboard (including skim coat and joint materials) which is considered a miscellaneous material, in a single sample that is analyzed and results reported separately as a layered sample. Sampling of an unpainted wallboard system and joint materials is covered in X1.3.3.3.

(1) Wallboard joints are most easily located above a lay-in ceiling, if one is present, where the joint has not been painted or papered over. If the ceiling is solid, a magnetic or electronic "stud finder" may be used to find the joints. A piece of cove base molding may be pulled back and the sample taken at floor level. If you sample wallboard joint compound behind cove base molding, be sure to keep the cove base mastic out of the sample of joint compound. You could take this opportunity to sample the cove base mastic, but keep it separate.

(2) Using the spray bottle, wet the material where the sample is to be taken with soapy water. Most textured finishes are too thin to obtain a sufficient amount of sample with a coring tool or tube and it is preferable to use a chisel or scraper blade to scrape the material off the ceiling or wall. It is difficult to direct the material into a small rigid container without contaminating the area with debris. Use a catch pan to collect the material as you scrape it off the ceiling or wall, as described in X1.2.1.9. Label the pan with the sample number, fold the pan closed and seal it with duct tape. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time.

(3) Transfer the material to a rigid container during sample processing. Seal the lid of the sample container with vinyl electrical tape or a shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sample transfer. Place the wet-wipes in a waste/catch bag.

(4) If a wallboard joint can be located a sample of the joint material can be taken along with the textured finish by cutting out a piece about an inch on either side of the stud with a knife, or gouging out the painted wallboard with a coring tool or industrial hole punch. Place a catch pan taped inside a gallon-size sealable plastic bag underneath the sampled area and collapse the pan around the removed material to form a temporary sample container. Removing sufficient textured finish or taking a core sample may be considered destructive testing (see 3.3.8) in that it leaves visible damage to an architectural finish.

(5) Affix a sample label to the container, and another to a surface near the place where the sample was taken. (The label may not stick to the textured finish.) To prevent fiber release in the future, cover the area where the sample was taken with patching plaster.

(6) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.2.4 *Soundproofing* may resemble fireproofing or plaster in its composition and appearance, and may be found on a metal lath or other substrate inside a wall or ceiling, in which case destructive testing may be required to access it for sampling. Soundproofing may have also have been applied as a finish coat to a surface visible and accessible from the room being inspected. Soundproofing may also include acoustical tiles that are applied to walls and ceilings.

(1) For sprayed or troweled-on soundproofing, use the sampling techniques described in X1.3.2.1 for fireproofing and X1.3.2.2 for plaster.

(2) Use the sampling techniques described in X1.3.3.2 for glued-on tiles.

X1.3.3 *Miscellaneous Friable Materials:*

X1.3.3.1 *Acoustical Ceiling Tiles* include lay-in or splined systems. Lay-in tiles are most commonly 2 by 4 ft or 2 by 2 ft in size, while splined tiles are usually the 1 by 1 ft size.

(1) Tiles with different facing colors and surface patterns, or different color interior or top surfaces, should be sampled separately. Select tiles for sampling that can be lifted without disruption of people, equipment or operations.

(2) When lifting the first tile, do so carefully so as not to release fibers and debris from the edges. If there is exposed or damaged asbestos-containing material (fireproofing, thermal insulation or other systems) immediately above the tile, replace the tile carefully and lift another.

(3) Slide the tile over so it rests on the adjacent tiles or grid. Wet a small area near the edge. Use a knife to cut off a piece about an inch long and half-inch wide, and place it in a rigid container. Be careful to maintain the integrity of layers. Do not cut through the facing that extends beyond the grid and is visible from below. Keep the tile wet by spraying additional water while removing the sample. Adding water to the sample container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time.

(4) Wet-wipe or HEPA vacuum any debris from the top of the tile and adjacent tiles. Replace the tile slowly so as not to release fibers and debris from the edges.

(5) Affix a sample label to the container, and another to a surface near the place where the sample was taken, such as the ceiling grid if there is one or a surface in the plenum. (The label may not stick to the ceiling tile.)

(6) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.3.2 *Glued-on Tiles* may be affixed to wall or ceiling. The mastic that holds the tile to the substrate often contains

asbestos, and may be friable or non-friable. It is normally applied in circular spots two or three inches in diameter.

(1) The tile may be sampled with a coring tool or tube, or with a knife. Remove a small piece of the tile, including the facing material and paint, if present. Put the material in a rigid container, being careful to maintain the integrity of the layers. Keep the material wet by spraying additional water while removing the sample. Adding water to the sample container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time.

(2) If aesthetic reasons preclude damaging the visible surface of the tile, a sample may be obtained by removing an entire tile or a partial tile (less than 1 by 1 ft), taking the sample from the back side of the tile, then gluing the tile back in place. Keep the entire backside and edges of the tile wet to prevent fiber release and use a waterproof adhesive to re-attach it. If sufficient mastic has stuck to the backside of the tile (approximately two cubic centimetres), scrape the mastic off and put it in a separate rigid container. If not, scrape some mastic off the wall or ceiling as described below.

(3) To sample glue spots or mastic on the substrate, wet the mastic and scrape it off with a chisel. Use a catch pan to collect the material as you scrape it off the ceiling or wall, as described in X1.2.1.9. Label the pan with the sample number, fold the pan closed and seal it with duct tape. Adding water to the sample in the container is discouraged because of possible leakage, and because the laboratory will have to dry the sample, which takes extra time.

(4) Affix a sample label to the container, and another to a surface near the place where the sample was taken.

(5) Transfer the material to a rigid container during sample processing. Seal the lid of the sample container with vinyl electrical tape or a shrink band. Wet-wipe the exterior of the container to remove any material that may have adhered to it during sample transfer. Place the wet-wipes in a waste/catch bag.

(6) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.3.3 *Wallboard Systems*—The area of most interest in a wallboard system is the vertical or horizontal joint between two adjacent sheets of wallboard, where asbestos may be found in one or more friable or non-friable materials. The gypsum wallboard core and paper facing generally do not contain asbestos, but is suspect ACM that should be included as part of the sample. Asbestos is most likely to be found in the non-friable joint compound that fills the gap, and the friable texturizer, or skim coat, used in the "tape and float" operation to produce a smooth surface. However, all layers must be sampled and the integrity of the layers maintained.

(1) This procedure is intended for unfinished wallboard where the joints are exposed. For finished walls and ceilings where the joints are covered with a textured finish or wallpaper, see X1.3.2.3.

(2) Place a catch pan taped inside a gallon-sized sealable plastic bag underneath the area to be sampled. Wet the area around the joint thoroughly with soapy water. Use a knife, coring tool or industrial hole punch to cut completely through the tape, joint compound, facing and core. These materials may come out in pieces—keep wetting the material as you remove the pieces.

(3) Collapse the pan around the removed material to form a temporary sample container. Put the sample in a rigid container, seal the lid and affix a sampling label to the container. Affix another label to the wall near where you took the sample. Fill the hole in the wall with caulking compound to prevent further fiber release.

(4) Refer to X1.2.2 regarding continuation or completion of sampling.

NOTE X1.5—EPA requires that layers of wallboard samples be analyzed and reported separately, but also allows a "composite" result to be reported for purposes of determining if the wallboard "system" contains more than one-percent asbestos for purposes of complying with the NESHAP. OSHA does not permit sampling or reporting of "composite" results for wallboard systems. Because of the need for information on the individual components of the wallboard system to comply with the OSHA regulations that apply to any work on the material, it is important to maintain the integrity of the separate components during sampling and not homogenize them during sampling or subsequent handling.

X1.3.3.4 *Sheet Vinyl Flooring,* commonly called "linoleum," has a non-asbestos vinyl facing and a matted or woven backing. The backing is friable unless saturated with adhesive and often contains a high percentage of chrysotile asbestos. Sheet vinyl flooring is sometimes found with more than one underlying layer, or is installed on top of resilient floor tile. In such cases, be sure to maintain the integrity of the layers in the sample.

(1) Select a location where a piece of linoleum can be removed without disrupting people, operations or equipment, or affecting the appearance of the premises. Corners and walls are the most suitable locations. In kitchens and rest rooms, take the sample behind plumbing fixtures and toilets.

(2) Wet the surface of the linoleum with soapy water, then cut through the vinyl facing with a knife. A piece 1 by 2 in. (3 by 5 cm) is sufficient for a sample. Wet the linoleum again where you cut it and allow the water to soak into the backing.

(3) Cut completely through the backing with the knife. Insert the blade of a small chisel or narrow scraper under the backing and pry the piece off the substrate, keeping the backing wet as you do so. Make sure to collect as much of the backing that has stuck to the floor as possible.

(4) Roll the piece into a cylinder and insert it into a rigid container, seal the lid and affix a sampling label to the container. Affix another label near where you took the sample.

(5) To prevent water from migrating under the sheet flooring during custodial activities and also to prevent fiber release, seal the exposed edges of the backing and the floor surface with household glue.

(6) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.3.5 *Vibration Dampeners* that isolate HVAC fans from metal ductwork are often woven from chrysotile asbestos fiber. These components may be readily visible, or they may be underneath fiberglass duct insulation.

(1) If the HVAC system is operating, the integrity of the vibration dampener must be maintained. In this case, look for loose threads protruding from the fabric and cut these off for the sample. Place them in a rigid container, seal the lid and affix a sampling label to the container. Affix another label near where you took the sample.

(2) If the HVAC system is inoperative, cut off a piece of the dampener approximately one inch (2 to 3 cm) square, fold it and place it in a rigid container, seal the lid, and affix a sampling label to the container. Affix another label near where you took the sample.

(3) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.3.6 *Gaskets and Packing* containing asbestos are used in a multitude of applications. They are found in mechanical systems and process equipment in all types of buildings and facilities. They come in all shapes and sizes, are friable and non-friable, and may be part of an assembly with non-asbestos materials.

(1) Gaskets and packing are generally installed in energized systems that are under pressure or vacuum. Sampling the gasket requires dismantling of the component in which it is installed. These systems must be de-energized and possibly cooled before the component is disassembled and the sample taken.

(2) The exact procedure for dismantling the component and removing the gasket or packing will vary considerably, depending on whether it is a small valve, a flange in a piping system, an access hatch on a boiler or any of the other applications for gaskets and packing. If the component is to be returned to service after the sample is taken, it should be disassembled by a qualified person who may be someone other than the inspector taking the sample.

(3) Use solvents to loosen bolts and separate flanges sparingly as the solvent might interfere with the optical properties of the gasket or packing material during Polarized Light Microscopy analysis. Separate the flanges slowly and carefully, observing what happens to the gasket as you do so and wetting the gasket material as it becomes visible.

(a) The gasket may come free of both mating surfaces without applying any force. If so, wet a piece small enough to fit into a rigid container, cut it away from the rest of the gasket and put it in the container.

(b) The gasket may adhere to both of the surfaces, delaminating in the middle. If so, wet it on one of these surfaces, scrape a piece off with a chisel and put it in the container.

(c) The gasket may adhere to one of the surfaces, in which case you should wet it, scrape it off the surface with a chisel and put it in the container.

(4) Affix a sample label to the container, and another to a surface near the place where the sample was taken.

(5) Refer to X1.2.2 regarding continuation or completion of sampling.

X1.3.3.7 *Loose Fill Attic Insulation* that has been installed between the joists on top of a ceiling may contain asbestos-contaminated vermiculite. This material is very friable.

NOTE X1.6—The sample collection procedure in EPA.600R-04/004 states: "A 1-gallon resealable plastic bag full of VAI is collected for each sample. Care must be given to collecting a representative sample of the material. A metal scoop (approximately 12 cm by 5 cm) with a flat edge is recommended for collecting randomly-spaced aliquots of VAI to make up the 1-gallon sample total. The scoop must be thrust into the VAI until it reached the substrate, moved along the bottom, then raised through the remaining material and deposited in the sample bag. Multiple scoops of material are collected to make up the 1 gallon sample. This procedure is intended to insure that any heavy materials, such as fibrous amphiboles which may have settled in the VAI, will be sampled. A minimum of three 1-gallon samples are recommended." This procedure is not acceptable for two reasons. A metal scoop could cut through the insulation on wires buried in the VAI and cause an electrical hazard. Placing the VAI directly into a plastic bag would allow fibers to be released when air is squeezed out of the bag.

(1) Select sampling locations in the attic that are safely accessible. Collect samples within easy reach of flooring that is securely-attached to the joists. Do not go onto unstable flooring or out onto the joists. Do not collect samples near light fixtures or wiring. Do not collect samples near ventilation grills that go through the ceiling.

(2) Lightly mist the VAI with soapy water. Do not saturate the material. Insert the plastic scoop into the VAI until it reaches the substrate. Moved the scoop along the bottom, then raise it to remove the VAI, lightly misting it as you do so.

(3) Deposit the collected material in the rigid (one-liter minimum) sample container. Multiple scoops of material may be needed to fill one sample container. Snap the lid in place on the container and seal the lid with duct tape.

(4) Repeat (2) and (3) with more containers until a one-gallon sample has been collected. Put the containers in plastic bags, seal the bags and tape them closed.

X1.4 Specific Sampling Procedures for Non-Friable Materials

This section includes procedures for the following non-friable materials:
Resilient Floor Tile and Mastic
Asbestos-cement Materials
Roofing Materials

X1.4.1 *Resilient Floor Tile and Mastic:*

X1.4.1.1 Floor tiles of different sizes (usually 9 by 9 in. and 12 by 12 in.), colors and patterns should be sampled separately. Floor tile and mastic should be considered a layered sample, whether the mastic remains on the back of the tile for the laboratory to remove or is collected separately.

X1.4.1.2 Select a location where a piece of tile can be removed without disrupting people, operations or equipment, or affecting the appearance of the premises. Corners and walls are the most suitable locations.

X1.4.1.3 Find an edge, or a seam between two tiles, where a piece of tile 3 to 4 in. (7 to 10 cm) wide can be removed. Remove cove base molding if necessary.

NOTE X1.7—Be sure to keep the cove base mastic out of the sample of floor tile mastic. You could take this opportunity to sample the cove base mastic, but keep it separate.

X1.4.1.4 Wet the surface of the tile with soapy water. Insert a chisel or scraper blade into the seam and tap the chisel or scraper gently with a hammer to insert the blade under the tile, lifting the tile until a piece breaks off. Wet the mastic under the tile as you lift it. The tile may break into smaller pieces than you intended—this is acceptable.

NOTE X1.8—To control the size of the piece you remove, you may want to score the tile where you want it to break. Wet the tile where you score it. A "TLC" (tile, linoleum, carpet) knife, which has a heavy, pointed blade, works best for this purpose.

X1.4.1.5 Wet the backside of the tile and place it in a quart-size sealable plastic bag. Affix a sampling label to the bag and put this bag in a second quart-size bag. Fold the bags tightly around the tile so the bags will not tear, or wrap the pieces of tile in a paper towel.

X1.4.1.6 If there is only a thin layer of mastic on the tile, there may not be sufficient material for analysis. In this case, wet the mastic on the floor with soapy water, scrape off some mastic with the chisel or scraper blade and spread it on the backside of the tile.

NOTE X1.9—Refer to 6.5.1 regarding the analysis of floor tile and mastic and the importance of taking a sufficient quantity of non-friable organically bound (NOB) materials for analysis by TEM. Typically, two cubic centimetres of mastic is necessary for this analysis.

X1.4.1.7 If there is leveling compound under the mastic, include some of this material in the sample. Also sample any vapor barrier or other material underneath the tile. If the tile is installed on plywood underlayment, do not sample the plywood.

X1.4.1.8 Cover the exposed floor and seal the exposed edges of the remaining tile with household glue. If aesthetic appearance matters, put down a piece of replacement (non-asbestos) floor tile. You may want to remove and dispose of (as asbestos waste) the remainder of the tile piece sampled and replace the entire tile.

X1.4.1.9 Refer to X1.2.2 regarding continuation or completion of sampling.

X1.4.2 *Asbestos-cement Materials:*

X1.4.2.1 Asbestos-cement products are the most widely-used asbestos-containing material in the world. They include pipes for water and wastewater, corrugated and flat roofing and siding, panels on cooling towers, ducts for wiring and ventilation, electrical insulating panels, boiler flues and many other uses. A generic term for some products is "Transite," which is actually a trademark for a product with a specific formulation.

X1.4.2.2 Find a location where a sample can be taken without disrupting the function of equipment. Sampling material that is physically damaged is preferable to disturbing intact material, but do not sample material that may have been contaminated by leaking water or corrosive chemicals, or exposed to high temperatures, if possible. Sample from the edge of flat or corrugated material and from the end of pipes and ducts.

X1.4.2.3 Wet the surface with soapy water over an area about one inch (2 to 3 cm) square. The water will not penetrate but will reduce dust and fiber release from the surface. Use a knife to score the material where you intend for it to break.

NOTE X1.10—A "TLC" (tile, linoleum, carpet) knife, which has a heavy, pointed blade, works best for this purpose. Some highly-chlorinated household liquids will soften asbestos-cement products and make them easier to score. Observe appropriate precautions when using these products.

X1.4.2.4 PUT ON YOUR SAFETY GLASSES. Slowly bend the material until a piece breaks off. It may be necessary to use vise-grip pliers to apply the necessary force, and you may have to break off more than one piece to obtain a sufficient sample.

X1.4.2.5 Put the piece(s) in a rigid container, seal the lid and affix a sample label to the container. If the piece will not fit in the container, wrap it in duct tape to keep the sharp edges from tearing the bag and put it in a quart-size sealable plastic bag. Put this bag in a second quart-size bag.

X1.4.2.6 Refer to X1.2.2 regarding continuation or completion of sampling.

X1.4.3 *Roofing Materials*

X1.4.3.1 *Roofing Materials* containing asbestos include the built-up membrane, flashings around parapets and penetrations, adhesives and sealants. Many roofing materials have the asbestos fibers embedded in an asphalt matrix. They may be non-friable when installed but become friable through weathering. Light weight concrete roofing decks are suspect asbestos-containing materials. These materials may be sampled during the roofing survey.

NOTE X1.11—A court decision in 1997 specifically excluded roofing cements, mastics and coatings from regulation by OSHA under the asbestos standard for the construction industry. Because it is difficult to separate these substances from other parts of a roofing system and because they present a potential source of fiber release if they become friable, this practice advises that they be sampled and analyzed.

X1.4.3.2 Taking a sample of roofing materials creates the possibility of water leakage unless the penetration is properly sealed. For some buildings, the roof warranty may be voided unless this is done by a qualified roofing contractor. NEVER sample roofing materials without the express written permission of the building owner and clear instructions as to who is responsible for sealing the penetrations made by taking the samples.

X1.4.3.3 *Roofing Membranes* may be sampled with a coring tool or tube, making sure to penetrate all layers of the material. The membrane may have several layers and be too thick to use the 1-¾ in. copper tubes that will fit in a 35 mm film container. Transfer the material from the coring tube or tool into a rigid container, or put then entire coring tube in the container. If the membrane has dried out and become friable, keep the material wet by spraying soapy water while extracting the sample.

X1.4.3.4 *Roofing Membranes* may be sampled with a coring tool or tube, making sure to penetrate all layers of the material. Transfer the material from the coring tube or tool into a rigid container, or put then entire coring tube in the container.

(1) If the membrane has dried out and become friable, keep the material wet by spraying soapy water while extracting the sample. A reusable coring tool must be cleaned before taking the next sample. The asphalt residue may not come off with soapy water, and you may have to use a solvent such as mineral spirits to clean the tool.

(2) Patch the hole made by the coring tool or tube with roofing sealant, unless the owner has made other arrangements to do so. Be aware that some commercially available roof patching compounds may contain asbestos fibers. These products should be avoided and should not be used as a replacement or repair material.

X1.4.3.5 *Flashings* cover penetrations varying in size from two-inch rest room vents to HVAC units several feet on a side, and also cover the joint between the membrane and parapets. The material is usually an asphalt-impregnated cloth or paper and may be painted.

(1) Wet the surface of the flashing with soapy water. Cut off a piece approximately 1 by 2 in. and roll it into a cylinder. Wet the back side of the piece if it is dry and friable. Put the piece in a rigid container, being careful to maintain the integrity of any layers present.

(2) Affix a label to the sample container and to a surface near where you took the sample. (The label may not stick to the flashing.)

(3) Fill the hole left in the flashing with asphalt roofing sealant, unless the owner has made other arrangements to do so. Clean the knife and tools used to apply the sealant with soapy water or mineral spirits. Be aware that some commercially available roof patching compounds may contain asbestos fibers. These products should be avoided and should not be used as a replacement or repair material.

X2. ASSESSMENT PROTOCOLS

X2.1 Purpose and Background

X2.1.1 One objective of a building survey is to provide information on which decisions relating to the management of asbestos-containing materials can be made. This information includes the current condition of the materials and the factors that could result in a deterioration of that condition. Assessment of condition and potential disturbance has been performed according to numerous protocols since the late 1970s.

X2.1.2 Unlike bulk sample analysis and quantification of asbestos-containing materials, assessment is a subjective procedure that relies on observation and informed judgment. However, there are principles that can be followed for validity and consistency of assessments, whether the results are expressed qualitatively or quantitatively.

X2.1.3 It has become common practice to distinguish between assessment of the condition of asbestos-containing materials and their potential disturbance—called the physical assessment—and the assessment of the possible exposure that could result—called the hazard assessment. One reason for this distinction is that the EPA AHERA regulations permit an accredited inspector to do the physical assessment in schools, while an accredited management planner must perform the hazard assessment and recommend response actions based on the assessment. Although these regulations apply only to schools, the concept has been codified in some state regulations and accepted elsewhere. This standard practice considers the assessment process as a single, continuous activity, conducted without regard to barriers imposed by regulations on who can do what part of the assessments.

X2.1.4 Assessments conducted in schools must follow the protocol in 40 CFR Part 763, §763.88—Assessment. Having met that obligation, the inspector is not prohibited from using the protocols in this appendix to further characterize asbestos-containing materials, providing that no conflict with the AHERA regulations is established.

X2.1.5 Every homogeneous area is assessed as to the current condition and potential for disturbance if it is in an *accessible location* (3.3.2) and not in a *concealed space* (3.3.5) or *excluded area* (3.3.9). Some locations may be accessible for assessment by permitting observation of the material but not accessible for bulk sampling. Friable and non-friable suspect asbestos-containing materials are assessed during the inspection, regardless of their location inside or outside the building or facility. Assessment is not limited to installed materials — referred to as asbestos-containing building materials (ACBM) in the AHERA regulations — but also includes asbestos-containing materials in storage or awaiting disposal.

X2.1.6 Regardless of the assessment protocol used, it is important to realize that they are not risk assessments that attempt to predict the probability of developing an asbestos-related disease, or the potential incidence of disease (for example, cases of cancer) that might occur due to the circumstances described by the assessment. These assessment protocols, furthermore. do not predict the exposure levels that might occur if asbestos-containing materials in their current or potential future condition were to be disturbed.

X2.1.7 Asbestos-containing materials are assessed as part of a Baseline Survey described in Section 6. If a decision has been made to remove materials prior to renovation or demolition, there is no need to assess these materials as part of a Project Design Survey (Section 7) or a Pre-construction Survey (Section 8). However, in certain instances assessment of the Potential for Disturbance of the material during the renovation or demolition, taking into account the nature of the construction activity to be performed, may affect the decision whether and how to remove an asbestos-containing material.

X2.2 Recommended Qualitative Assessment Protocol

X2.2.1 The recommended approach for prioritizing response actions focuses on the two characteristics of asbestos-containing materials that are most indicative of the potential for fiber release: the current condition of the material based on what has already happened to it and the potential for disturbing it, based on what is likely to happen in the future.

X2.2.2 *Current Condition*—Based on visual observation by the inspector, the material is qualitatively ranked as shown in Table X2.1, which also includes the analogous AHERA classifications. The presence of damage or debris is evidence of previous “disturbance” as defined by OSHA in the Construction Industry standard for asbestos (29 CFR 1926.1101) as “...activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM.” These rankings of good, fair and poor reflect the condition of the material, not the cause. The inspector

should also record the cause of the Current Condition if it can be determined by observation, including but not limited to, the following:

X2.2.2.1 *Physical Disturbance*—caused by people working or living in the building or facility that resulted in the observed damage or debris, or both. This might include impact from tools, equipment, furniture and machinery, vandalism, installation or removal of fixtures and equipment, or improper maintenance and custodial activities.

X2.2.2.2 *Environmental Disturbance*—These factors are the result of things that can happen without human intervention, although they may be caused by human error or inaction. Environmental factors often result in fiber release episodes where debris may be present. The inspector should look for, and record, evidence of *vibration*, *air movement*, *dust erosion*, *water damage*, and *corrosion/weathering*.

(1) Vibration occurs from mechanical equipment in or near the functional space where the asbestos-containing materials are located, but not necessarily attached to the materials. An example would be an HVAC fan in a penthouse with fireproofing on the deck. Pipes can vibrate from air or water hammer, causing the insulation to fail.

(2) Air movement occurs inside a duct or plenum and can dislodge loose fibers if the air velocity and volume are sufficient.

(3) Dust erosion occurs when dust particles are ejected from air ducts and impact the surfacing material on a ceiling or wall.

(4) Water damage from a leaking roof or condensation can cause fireproofing or plaster to loosen and fall, and water leaking from a tank or pipe can result in the covering and insulation to fail. Water damage to fireproofing or thermal system insulation is often signaled by rust showing through the material.

(5) Corrosion occurs in industrial facilities where liquids or vapors cause a chemical deterioration of the covering on thermal system insulation. Weathering of asbestos-cement materials outdoors is a mild form of corrosion.

X2.2.2.3 The inspector may use the AHERA damage categories as an aid to classifying asbestos-containing materials if they are in fair (damaged) or poor condition (significantly damaged), according to the analogies shown in Table X2.1. He may also use approximate visual estimations of up to 25% localized damage and up to 10 % distributed damage to classify a material in fair condition, and over 25% localized damage and over 10% distributed damage to classify a material in poor condition. These percentage criteria are not part of the AHERA regulations but are widely taught in inspector training courses. Quantitative thresholds are used as follows: 1 to 25% localized damage over the assessment area, would categorize the material as a damaged material. Greater than 25% localized damage would be representative of significant damage. For distributed damage, 1 to 10% damage indicates a damaged material and greater than 10% distributed damage is categorized as a significantly damaged material.

X2.2.2.4 Although friability does not directly enter into the assessment, it is an important characteristic of asbestos-containing materials and should be recorded as friable or non-friable. Non-friable material that has become friable through damage or deterioration should be recorded as such. The inspector should touch the material if there is doubt as to its friability, remembering that doing so may release fibers or debris, or both.

X2.2.3 *Potential for Disturbance*—To determine what might happen to the material in the future, the inspector assesses each homogeneous area for potential disturbance using the physical and environmental factors explained above.

X2.2.3.1 *Physical Disturbance*—The factors used in this part of the assessment protocol are *activity* and *accessibility*.

(1) Activity factor reflects the extent to which things that happen in the normal course of working or living in the building or facility can disturb the asbestos-containing materials. This may include maintenance or custodial work, traffic by pedestrians or motorized equipment, storage and retrieval of furniture, fixtures or equipment and numerous other things that people do in buildings and facilities.

(2) Accessibility factor reflects how easily the asbestos-containing materials can be reached, including their height above normal occupancy levels but also taking into consideration barriers between the materials and areas of normal occupancy. A deck 20 ft above the floor in a retail store is obviously less accessible than an 8-ft ceiling in a residential apartment, and a mechanical room with a closed door is less accessible than exposed pipe risers in a hallway.

X2.2.3.2 *Environmental Disturbance*—The factors used in this part of the assessment are the same as in X2.2.2.2 except that the inspector looks for evidence that they will occur in the future. In most cases the Current Condition is the result of these factors having occurred in the past and the assessment for Potential for Disturbance establishes that the underlying cause has not been corrected and may have worsened.

X2.2.3.3 Other physical and environmental disturbances may be taken into account when determining the Potential for Disturbance ranking. For example, air pressure variations in elevator shafts may subject fireproofing to forces that affect its adhesive and cohesive properties, or weathering of asbestos-cement siding may render it friable. The inspector should describe such factors if they are used in the assessment.

X2.2.3.4 Every homogeneous area will be subject to a combination of the above factors. The inspector determines the relative importance of each to the overall ranking for potential for disturbance as low, medium or high. The contributions of physical and environmental disturbance, and their components, to the ranking should be explained in the report.

X2.2.4 A summary of this qualitative protocol is shown in Table X2.2. Depending on the answers to the questions in the first column, the inspector describes his observations and records the rankings for Current Condition and Potential for Disturbance.

X2.2.5 Combining the Current Condition and Potential for Disturbance rankings in a single table will generate an assessment of the asbestos-containing material in each functional space. An example of the materials in Fig. X2.1 is shown in Table X2.3. Other factors notwithstanding, this assessment would recommend giving priority to abating the pipe insulation over removing the ceiling plaster.

X2.3 Recommended Quantitative Assessment Protocol[8]

X2.3.1 The Quantitative Assessment Protocol recommended by this practice uses a graphical technique to apply numerical ratings to the physical assessment factors—Current Condition and Potential for Disturbance—discussed in X2.2 for the recommended Qualitative Assessment Protocol. These ratings are then tabulated and plotted on an Abatement versus O&M Decision Chart to prioritize response actions.

X2.3.2 The first step in using this protocol is replacing the AHERA analogies in Table X2.1 with numerical ratings corresponding to the qualitative ranges, as shown in Table X2.4. The lower the numerical Current Condition rating, the worse the condition of the material based on observed damage and debris.

X2.3.3 The second step is to associate the numerical Potential for Disturbance ratings with the qualitative rankings of low, medium and high, based on the physical and environmental factors in X2.2.3.1 and X2.2.2.2. The qualitative rankings and quantitative ratings in Table X2.4 correspond as follows:
Low — 1, 2, or 3
Medium — 4, 5, 6, or 7
High — 8, 9, or 10
The rating indicates the likelihood that the material will be disturbed, not the severity of the damage that might occur.

X2.3.4 Note that the quantitative ratings for Current Condition and Potential for Disturbance are always integers; no fractional or decimal values are used. **This is not an algorithm**—the ratings will not be added, multiplied or mathematically combined in any way. They will be tabulated and plotted on a chart.

X2.3.5 A summary of this quantitative protocol is shown in Table X2.5. Depending on the answers to the questions in the first column, the inspector describes his observations and records the ratings for Current Condition and Potential for Disturbance.

X2.3.6 The next step is to tabulate the asbestos-containing materials and their quantitative ratings, along with the reasons those ratings were assigned. The reasons should be specific to the materials as based on the inspector's observations. The table is then sorted by Current Condition and Potential for Disturbance so that the most heavily-damaged and accessible asbestos-containing materials are at the top of the list. For the materials in Fig. X2.2 and Fig. X2.3, the tabulation is shown in Table X2.6.

X2.3.7 Fig. X2.4 is the Abatement versus O&M Decision Chart for the ACM in Table X2.6. The axes of the chart are Current Condition (CC) and Potential for Disturbance (PFD) and the location of the asbestos-containing materials assessed in each functional space is shown at the intersection of the ratings for that material. This example includes friable ACM and also non-friable ACM that has become friable (C1 and W2) which moves its Current Condition toward the lower end of the scale and increases its priority for abatement.

X2.3.8 The location and shape of the line reflects many aspects of the asbestos management program for the specific facility that has been surveyed. These include the willingness to tolerate some disturbance of asbestos-containing materials, the ability of in-house maintenance staff or an outside contractor to respond to fiber release episodes and the perceptions of building occupants and their attitudes toward asbestos, as well as the complexity and frequency of maintenance and repair if asbestos-containing materials are left in place. Fig. X2.4 shows a Decision Chart where the frequency and complexity of anticipated O&M is slightly above average and the Asbestos Program Manager is willing to tolerate a moderate degree of disturbance regardless of the condition of the ACM.

X2.3.9 Fig. X2.5 is a blank Abatement versus O&M chart with the line indicating a preference for O&M, Fig. X2.6 is a blank Abatement versus O&M chart with the line indicating a preference for abatement and Fig. X2.7 is a blank Abatement versus O&M chart with no line. These charts can be reproduced and used with attribution as shown below the titles of the charts.

X2.3.10 Bear in mind that the Decision Chart is a graphical tool for visualizing the relative priorities of abating different asbestos-containing materials and deciding which ones can be managed in place. The Decision Chart is meant to complement, rather than replace, the experience and judgment of trained professionals in making their decisions. The cost of abatement and O&M should be recognized as a consequence of making these decisions, not the basis for the decisions, which should be made in the interests of protecting worker and community health and the environment.

[8] This Quantitative Assessment Protocol is adapted from the *Customized Compliance Program for Asbestos*, copyrighted by Environment-i-media, Inc. (http://www.environment-i-media.com), and is used by permission.

TABLE X2.1 Qualitative Rankings for Current Condition

Qualitative Ranking	Description of Current Condition	AHERA Analogy
Good	Surfacing material has no visible damage or small amounts of damage; covering on thermal system insulation is intact or has small amounts of damage; miscellaneous materials intact; no visible debris or small amounts of debris.	Undamaged
Fair	Surfacing material has moderate but not extensive amounts of visible damage; covering on thermal system insulation is cut or torn, exposing moderate but not extensive amounts of insulation; moderate but not extensive damage to miscellaneous materials such as floor tile; moderate but not extensive amounts of visible dust and debris.	Damaged thermal system insulation Damaged friable surfacing material Damaged friable miscellaneous material
Poor	Extensive damage to surfacing material; covering on thermal system insulation is cut or torn extensively and insulation itself is damaged; miscellaneous materials such as floor tile extensively damaged and underlying mastic exposed; extensive amounts of dust and debris.	Significantly damaged friable surfacing material Significantly damaged thermal system insulation Significantly damaged friable miscellaneous ACM.

(a) Hallway Ceiling Plaster

(b) Pipe Insulation in Mechanical Room

FIG. X2.1 Examples

TABLE X2.2 Summary of Qualitative Assessment Protocol

Observations by the Inspector	Existing damage or debris, or both	No existing damage or debris, or both
Is there evidence of existing damage or debris, or both?	Describe the damage or debris, or both and rank the Current Condition as good, fair or poor.	Rank the Current Condition as good with no damage or debris.
Was the existing damage or debris, or both, apparently caused by physical disturbance?	Describe the apparent cause(s) of physical disturbance.	
Was the existing damage or debris, or both apparently caused by environmental disturbance?	Describe the apparent cause(s) of environmental disturbance as vibration, air movement, dust erosion, water damage, corrosion/weathering or other factor(s).	
Is there existing or anticipated activity that could result in future disturbance?	Describe the activity and associated accessibility of the ACM.	
Are there existing or anticipated environmental factors that could result in future disturbance?	Describe the existing or anticipated causes(s) of environmental disturbance as vibration, air movement, dust erosion, water damage, corrosion/weathering or other factor(s) . Rank the Potential for Disturbance as low, medium, or high.	

TABLE X2.3 Qualitative Assessment Example for Two Functional Spaces and AMCs

Functional Space	Type of AMC	Ranking		
		Current Condition	Potential for Disturbance	Based on
Office hallway	Ceiling plaster (surfacing material)	Good	Medium	Maintenance of light fixtures
Mechanical room	Pipe insulation (thermal system insulation)	Poor	High	Operation of valves; custodial activities

TABLE X2.4 Qualitative Assessment and Quantitative (Numerical) Ratings for Current Condition

Qualitative Ranking	Description of Current Condition	Numerical Rating
Good	Surfacing material has no visible damage or small amounts of damage; covering on thermal system insulation is intact or has small amounts of damage; miscellaneous materials intact; no visible debris or small amounts of debris.	8, 9, 10
Fair	Surfacing material has moderate but not extensive amounts of visible damage; covering on thermal system insulation is cut or torn, exposing moderate but not extensive amounts of insulation; moderate but not extensive damage to miscellaneous materials such as floor tile; moderate but not extensive amounts of visible dust and debris.	4, 5, 6, 7
Poor	Extensive damage to surfacing material; covering on thermal system insulation is cut or torn extensively and insulation itself is damaged; miscellaneous materials such as floor tile extensively damaged and underlying mastic exposed; extensive amounts of debris.	1, 2, 3

TABLE X2.5 Summary of Quantitative Assessment Protocol

Observations by the Inspector	Existing damage or debris, or both	No existing damage or debris, or both
Is there evidence of existing damage or debris, or both?	Describe the damage and/or debris and rate the Current Condition from 1 (poor) to 9 (good)	Rate the Current Condition as 10 with no damage or debris
Was the existing damage or debris, or both apparently caused by physical disturbance?	Describe the apparent cause(s) of physical disturbance	
Was the existing damage or debris, or both, apparently caused by environmental disturbance?	Describe the apparent cause(s) of environmental disturbance as vibration, air movement, dust erosion, water damage, corrosion/weathering or other factor(s)	
Is there existing or anticipated activity that could result in future disturbance?	Describe the activity and associated accessibility of the ACM	
Are there existing or anticipated environmental factors that could result in future disturbance?	Describe the existing or anticipated causes(s) of environmental disturbance as vibration, air movement, dust erosion, water damage, corrosion/weathering or other factor(s)	
	Rank the Potential for Disturbance from 1 (low) to 10 (high)	

(a) Restroom Ceiling Plaster C1

(d) Textured Ceiling Finish in Plenum C4

(b) Closet Ceiling Plaster C2

(e) Hallway Ceiling Plaster C5

(c) Textured Ceiling Finish in Lobby C3

(f) Mechanical Room Pipe hanger P1

FIG. X2.2 Examples

(g) Kitchen Floor Tile Mastic F1

(i) Office Tile under Carpet F2

(h) Valve and Piper Insulation P2

(j) Hallway Wallboard W1

(k) Corrugated Cement Siding W2

FIG. X2.3 Examples

TABLE X2.6 Example of Current Condition and Potential for Disturbance Ratings

Location of ACM	Description of ACM	Assessment			
		Code	CC	PFD	Reason
Kitchen closet	Floor and tile mastic	F1	2	9	Exposed mastic; frequent access
Office	Textured ceiling finish	C4	2	8	Delamination; HVAC maintenance
Mechanical room	Pipe and valve insulation	P2	2	5	Water damage; valve operation
Hallway	Wallboard	W1	2	4	Extensive damage; infrequent access
Office	Floor tile	F2	3	2	Exposed mastic; under carpet
Loading dock	Corrugated siding	W2	5	8	Vehicle impact
Lobby	Textured ceiling finish	C3	7	9	Low ceiling; recessed light fixtures
Restroom	Hard ceiling plaster	C1	7	5	Moderate damage; flush fixture
Restroom closet	Textured ceiling plaster	C2	9	8	Slight damage; frequent access
Mechanical room	Pipe hanger insulation	P1	9	8	Intact; low & crowded; vibration
Hallway	Ceiling plaster	C5	9	3	Fixture maintenance; indirect lighting

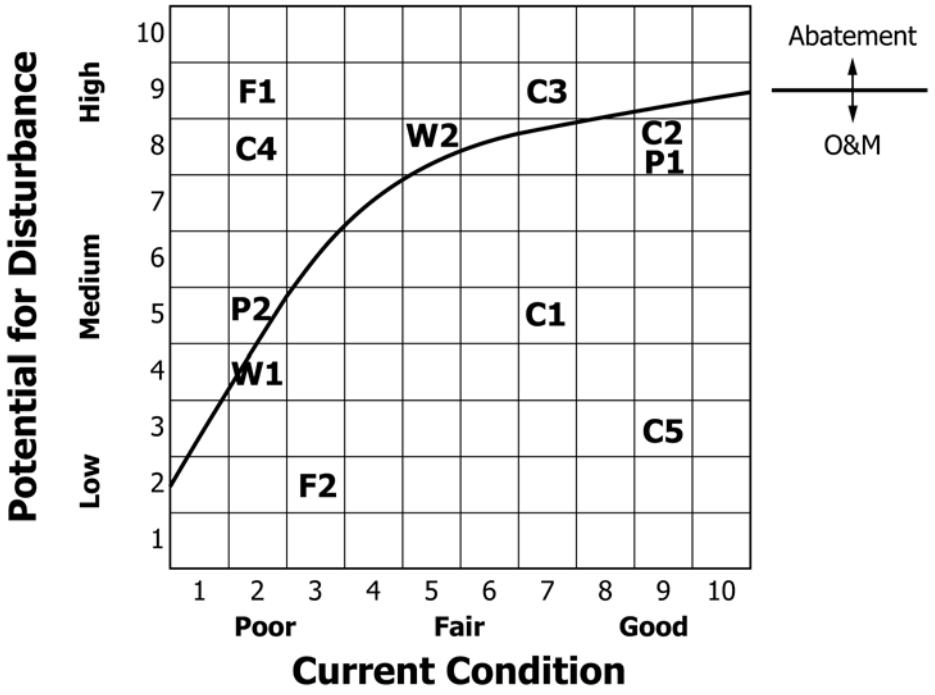

FIG. X2.4 Abatement versus O&M Chart for Examples

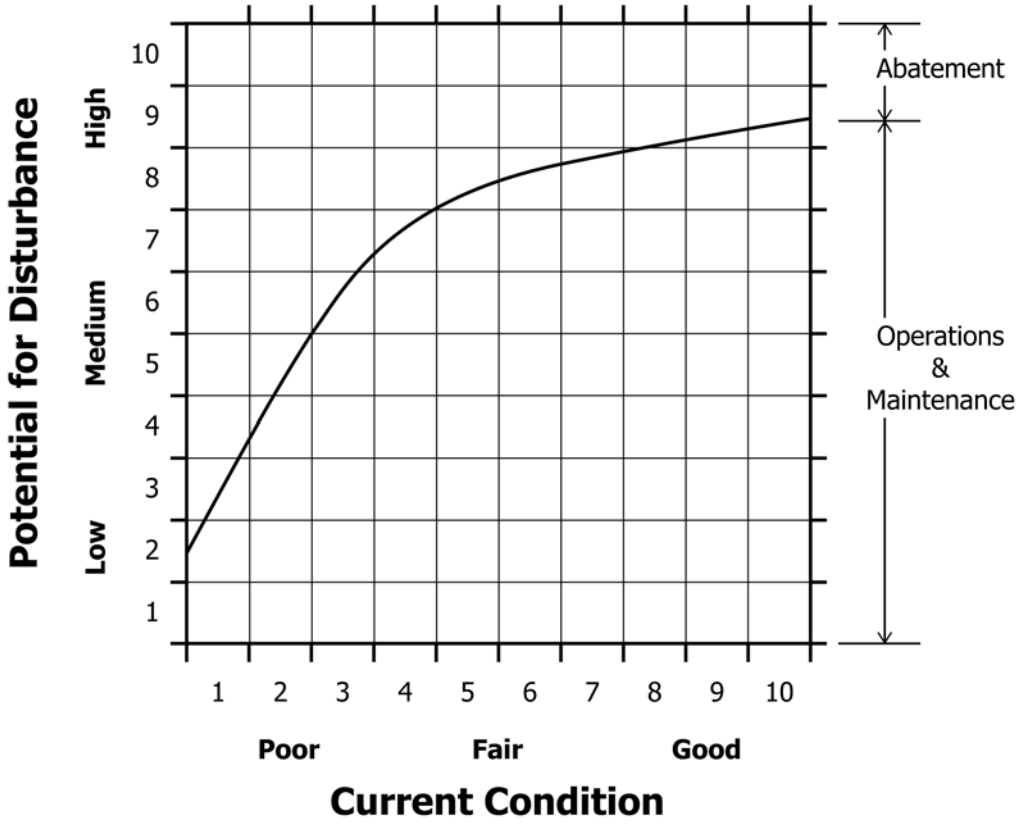

FIG. X2.5 Abatement versus O&M Chart Favoring Operations and Maintenance

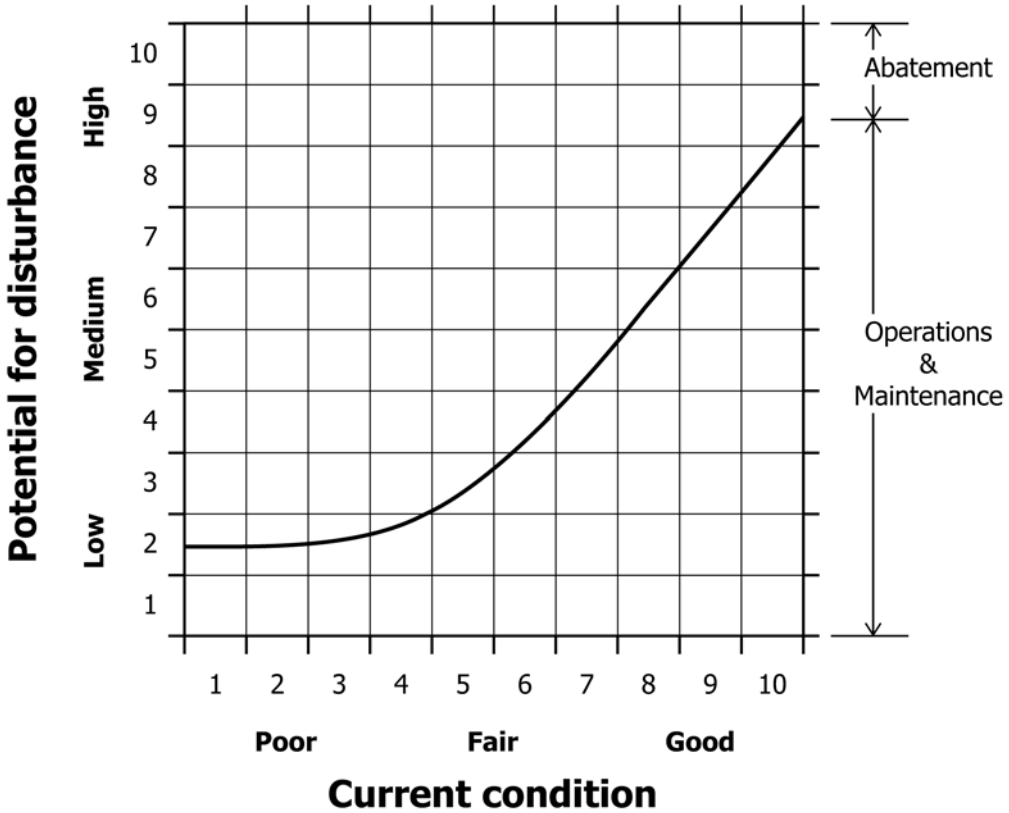

FIG. X2.6 Abatement versus O&M Chart Favoring Abatement

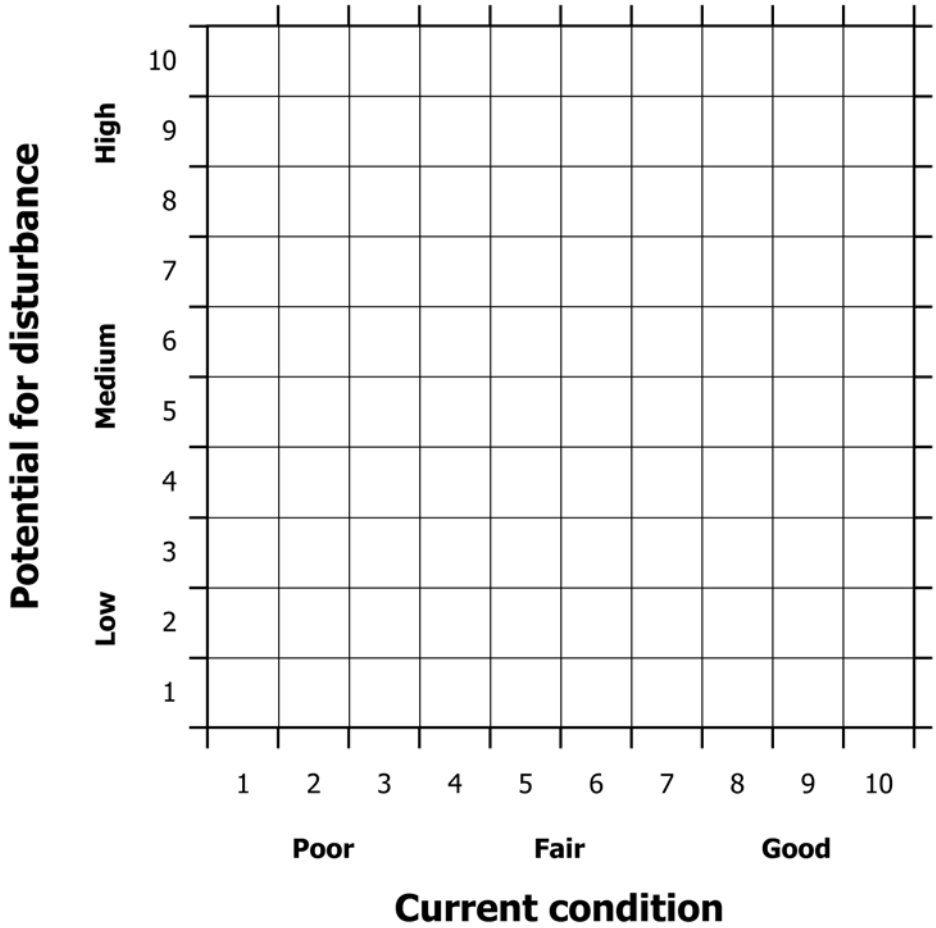

FIG. X2.7 Abate versus O&M chart (blank)

X3. FIELD DATA FORMS AND REPORT FORMAT TEMPLATE

X3.1 See Figs. X3.1-X3.10.

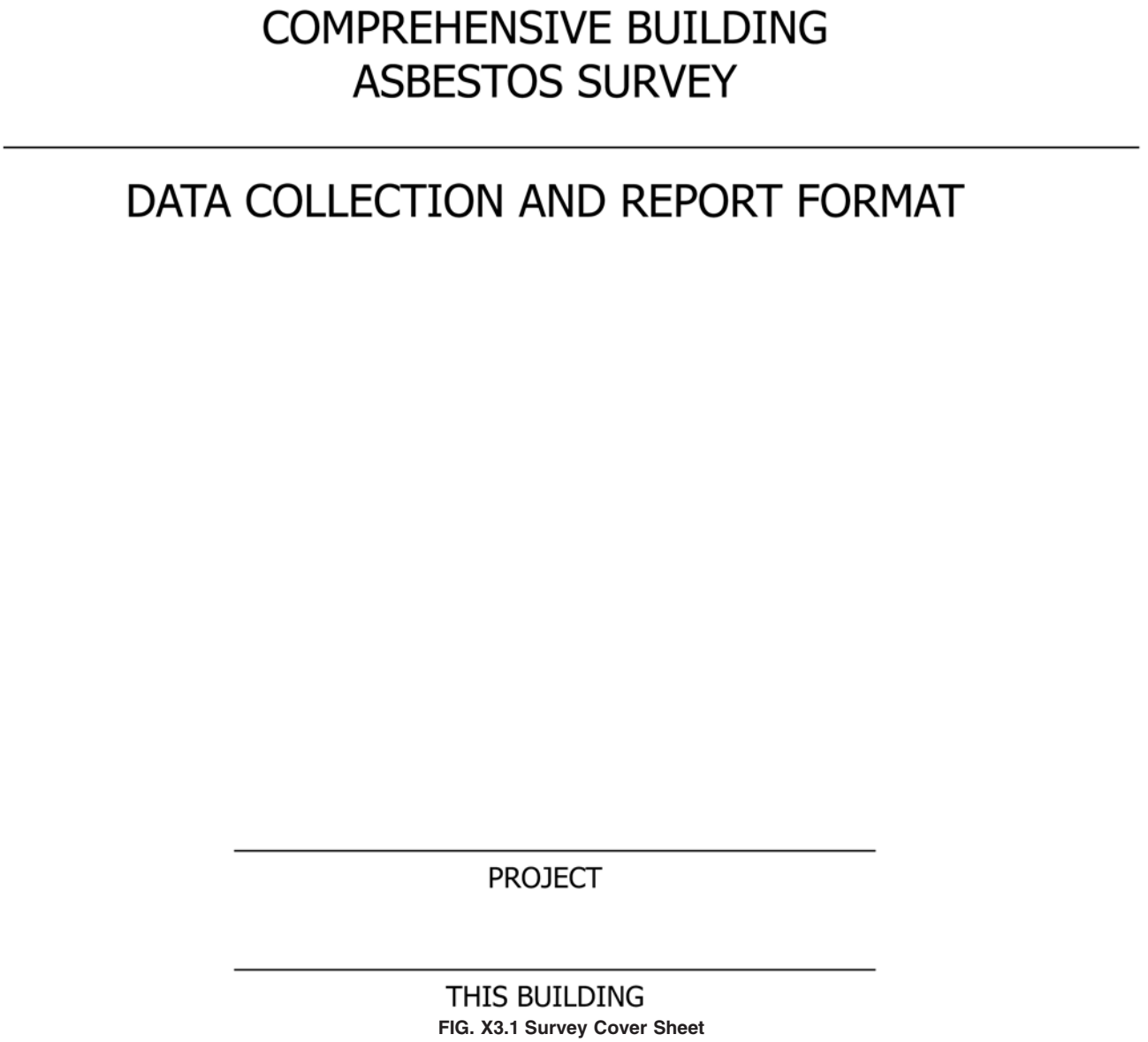

FIG. X3.1 Survey Cover Sheet

SUSPECT ACM HOMOGENEOUS AREAS

Project Name: _____

Address: _____

Building: _____

Area #	Area Description	Amt	Friable Y/N	Type S/T/M	# of Samples	ACM Y/N/A	Assess

FIG. X3.2 Suspect ACM Homogeneous Areas

LOCATION BY FUNCTIONAL SPACE

Project Name: _____

Address: _____

Building: _____

Description of Functional Spaces

Functional Space Letter	Homogeneous Areas Found in Given Functional Spaces						
	Floor	Base	Wall	Ceiling	Fireproof	TSI	Other

FIG. X3.3 Location by Functional Space

MANNER OF SAMPLING

Date:_____

Description of Manner Used to Determine Sample Locations

Random Sampling (Documented) Homogeneous Area Numbers		Convenience Sampling Homogeneous Area Numbers	

Print Inspectors Name: _____

Signature: _____

Accreditation Agency:_____ Accreditation Number: _____

State or EPA Accreditation (circle one) Accreditation Date: _____

FIG. X3.4 Manner of Sampling

HOMOGENEOUS AREAS ASSUMED (NOT SAMPLED) TO BE ACBM

Homogeneous Area #	Homogeneous Area Description	Functional Space

FIG. X3.5 Homogeneous Areas Assumed (Not Sampled) to be ACBM

MANNER OF SAMPLING DOCUMENTATION

Project Name: _____

Building/Addition: _____

Homogeneous Area Description: _____ #: _____

Functional Space or Room: _____

Floor Plan and Sample Locations:

FIG. X3.6 Manner of Sampling Documentation

BULK SAMPLE LOG

Homogeneous Area Description:		Sampling Manner: circle one: Convenience Random
		Date of Sampling:
Homogeneous Area #:		circle one: Surfacing TSI Misc
Square Feet:	Linear Feet:	circle one: Friable Non-friable
NESHAP: circle one: RACM Cat. I Cat. II		OSHA Removal: circle one: Class I Class II

Number	Location

Homogeneous Area Description:		Sampling Manner: circle one: Convenience
		Date of Sampling:
Homogeneous Area #:		circle one: Surfacing TSI Misc
Square Feet:	Linear Feet:	circle one: Friable Non-friable
NESHAP: circle one: RACM Cat. I Cat.		OSHA Removal: circle one: Class I Class II

Number	Location

Print Inspectors Name: _____ Signature: _____

Accreditation Agency: _____ Accreditation Number: _____

State or EPA Accreditation (circle one) Accreditation Date: _____

FIG. X3.7 Bulk Sample Log

CHAIN OF CUSTODY

Client/Project #: _____ Job #: _____ Purchase Order #: _____

Send lab report to: _____ Lab Destination: _____

Date Shipped: _____

Lab Contact: _____

Attention: _____ Lab Phone Number: _____

Invoice to: _____ Date Report Required: _____

_____ Client Contact: _____

_____ Client Phone Number: _____

Sampling Inspector Print Name: _____ Signature: _____

Sample ID	Sample Description	Date Collected	Remarks

Relinquished By	Date/Time	to	Received By	Date/Time

FIG. X3.8 Chain of Custody

QUALITATIVE ASSESSMENT OF ACM

Owner					
Site Address					
Building/Addition					
Area ID Number:		Year of construction			
Description of Homogeneous Area					
Functional Space or Room					
Quantity of Material in Homogeneous Area		sq ft ln ft ea			
Complete during survey: Was material sampled?	Yes - Provide sample number	No - assumed to be ACM			
If sample taken, complete when analysis complete	Type(s) of asbestos	Percent asbestos in sample (by type)	No Asbestos Detected (NAD)		
Type of Material	Surfacing Material	Thermal System Insulation	Miscellaneous		
Is material	Friable	Non-friable			
Qualitative Rating of Current Condition (See Appendix X2, Table X2.1)	Good	Fair	Poor	Reason	
Qualitative Rating of Potential for Disturbance (See Appendix X2, Table X2.2)	Low	Medium	High	Reason	
Required for schools, optional for other buildings	Damaged	Significantly Damaged			
	Potential for damage	Potential for significant damage			
Average Usage of Space	People/hour	Hours/Day	Days/Year		
Main Occupant Population					
Preventive measures which could be taken to reduce potential for disturbance (optional)					
Comments					
Inspector's Name					
License # and State		EPA Accreditation #			
Inspectors Signature		Date			

FIG. X3.9 Qualitative Assessment of ACM

QUANTITATIVE ASSESSMENT OF ACM

Owner			
Site Address			
Building/Addition			
Area ID Number:		**Year of construction**	
Description of Homogeneous Area			
Functional Space or Room			
Quantity of Material in Homogeneous Area		**sq ft ln ft ea**	
Complete during survey: Was material sampled?	**Yes - Provide sample number**	**No - assumed to be ACM**	
If sample taken, complete when analysis complete	**Type(s) of asbestos**	**Percent asbestos in sample (by type)**	**No Asbestos Detected (NAD)**
Type of Material	**Surfacing Material**	**Thermal System Insulation**	**Miscellaneous**
Is material	**Friable**	**Non-friable**	
Quantitative Rating of Current Condition (See Appendix X2, Table X2.4)	**1-10**	**Reason**	
Quantitative Rating of Potential for Disturbance (See Appendix X2, Table X2.5)	**1-10**	**Reason**	
Required for schools, optional for other buildings	**Damaged**	**Significantly Damaged**	
	Potential for damage	**Potential for significant damage**	
Average Usage of Space	**People/hour**	**Hours/Day**	**Days/Year**
Main Occupant Population			
Preventive measures which could be taken to reduce potential for disturbance (optional)			
Comments			
Inspector's Name			
License # and State		**EPA Accreditation #**	
Inspectors Signature		**Date**	

FIG. X3.10 Quantitative Assessment of ACM