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Office of Pesticides
and Toxic Substances
Washington, DC 20460

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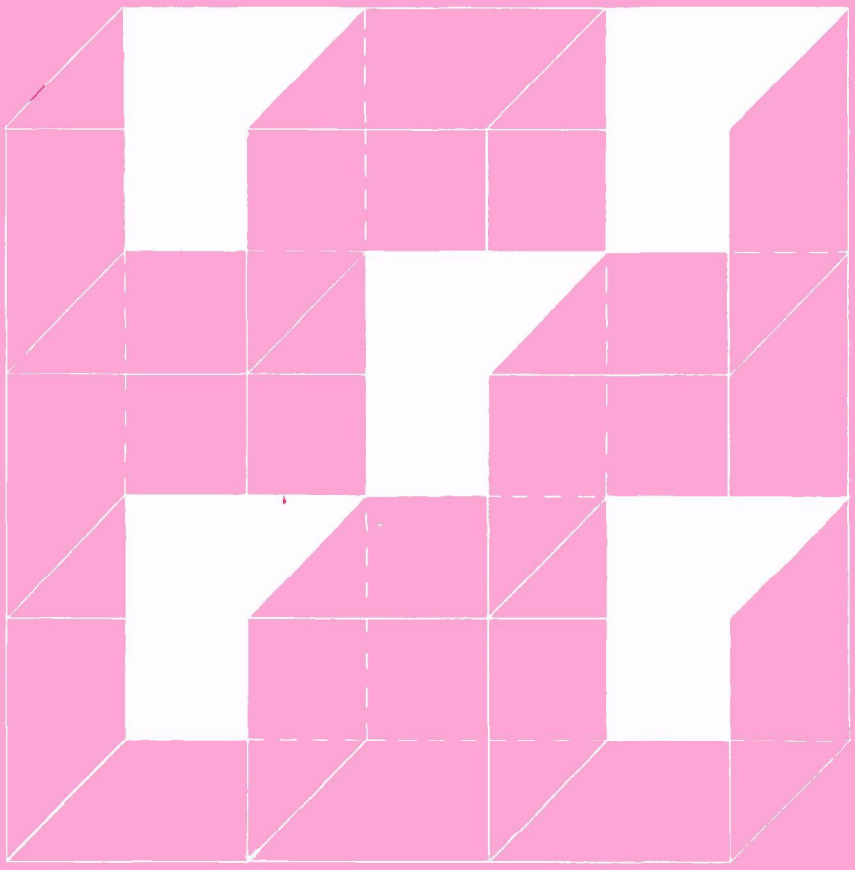
Toxic Substances

EPA

Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials



October, 1985

Asbestos in Buildings
Simplified Sampling Scheme for Friable Surfacing Materials

Exposure Evaluation Division
Office of Toxic Substances
Office of Pesticides and Toxic Substances
U.S. Environmental Protection Agency
Washington, DC 20460

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

Page

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

Acknowledgements

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1. INTRODUCTION

The Environmental Protection Agency (EPA) has an active technical assistance program which provides information on identifying and controlling asbestos-containing materials in buildings. This booklet describes a procedure for sampling friable sprayed- or troweled-on materials on ceilings, walls, and other surfaces. (Friable material is material that can be crumbled, pulverized, or reduced to powder by hand pressure.) Pipe and boiler insulation, and other types of material require different sampling procedures which are discussed in EPA's 1985 guidance (the "Purple Book", USEPA 1985a). The sampling procedure described here is a simplified version of the scheme described in "Asbestos-Containing Materials in School Buildings: Guidance for Asbestos Analytical Programs" (USEPA 1980). Like USEPA 1980, it uses random sampling to ensure that the samples are representative of the sampling area. However, the procedure has been simplified to eliminate tedious calculations. Sampling done according to the 1980 scheme is consistent with the recommendations in this booklet.

EPA has published "Guidance for Controlling Asbestos-Containing Materials in Buildings" (the "Purple Book", USEPA 1985a) to assist building owners. The guidance explains how to plan and conduct a building survey to determine if asbestos-containing material (ACM) is present. This booklet should be used in conjunction with Chapter 2 of the Purple Book.

The sampling scheme described here is designed to minimize errors in detecting asbestos. It takes into account two important sources of potential error:

- error caused when asbestos is not distributed uniformly throughout the material (one or more samples could miss asbestos even if it is present); and
- error caused when the laboratory analysis is incorrect.

Actual information on the likelihood of these errors was used to determine the number of samples to be collected and their location. The statistical basis for the design is given in USEPA (1985b).

2. OUTLINE OF SAMPLING AND ANALYSIS PROCEDURE

Follow these steps (each step is described in more detail below):

- **Identify all friable surfacing materials and group them into homogeneous Sampling Areas.** A homogeneous Sampling Area contains material that is uniform in texture and ap-

pearance, was installed at one time, and is unlikely to consist of more than one type, or formulation, of material.

- **Prepare diagrams of each Sampling Area** to allow selection and documentation of sampling locations.
- **Divide the Sampling Area into nine equally sized subareas.** This is done to help in obtaining samples that are representative of the entire Sampling Area.
- **Determine the number of samples.** Nine samples (one per subarea) are recommended. When cost, or other constraints, limit the number of samples that can be collected, a minimum number of samples based on the size of the Sampling Area is specified.
- **Determine the sampling locations.** The locations are chosen to obtain a representative sample and to avoid biases that could be introduced if personal judgment alone were used.
- **Collect samples.** Follow guidelines designed to minimize fiber release.
- **Follow a Quality Assurance program.** This involves collecting extra samples to ensure reliability of the laboratory analyses.
- **Send the samples to a qualified laboratory** for analysis by polarized light microscopy.
- **Interpret the results.** If any sample has more than 1% asbestos, then either assume that the entire Sampling Area contains asbestos or collect additional samples to determine more precisely the extent of the ACM.
- **If asbestos is present, initiate a special operations and maintenance (O&M) program** to clean up any asbestos fibers previously released and to prevent future release. Refer to the Purple Book for more information.

3. IDENTIFYING SAMPLING AREAS

All friable surfacing materials in the building must be identified. Check all spaces in the building, including halls, closets, attic spaces, and tunnels. Carefully inspect walls, ceilings, beams, ducts, and any other surfaces. Determine if the material is friable. Several types of friable surfacing material may have been applied within a single building. These could have very different asbestos content; therefore, each type of

material must be sampled. Building records may provide useful information such as construction dates for different parts of the building.

Group friable surfacing material into "homogeneous" Sampling Areas. A homogeneous area contains friable material that is uniform in texture and color and appears identical in every other respect. Materials installed at different times belong to different Sampling Areas. If there is any reason to suspect that materials might be different, even though they appear uniform, assign them to separate Sampling Areas. For example, material in different wings of a building, on different floors, or in special areas such as cafeterias, machine shops, bandrooms, etc., should be assigned to separate Sampling Areas, unless there is good reason to believe that the material is identical throughout.

In a large multistory building (more than 10 stories), a separate Sampling Area for each floor may not be necessary. If the material appears identical on every floor, several floors can be grouped into one Sampling Area. Do not group floors if it is known that the material was applied at different times, or if there is some other reason to suspect that the material might not be homogeneous. The selection of homogeneous Sampling Areas is a subjective process. When in doubt, assign materials to separate Sampling Areas.

4. PREPARATION OF DIAGRAMS

For each Sampling Area, prepare a diagram approximately to scale showing all friable materials in the Sampling Area. An example is shown in Figure 1. The Sampling Area diagram should include:

- an identification number;
- brief description of the Sampling Area;
- area dimensions and scale;
- name and address of the building;
- name and telephone number of the asbestos program manager (See Chapter 2 of the Purple Book);
- name of inspector and date of inspection; and
- name of person preparing the diagram and date prepared.

If the Sampling Area contains areas of friable material that are not adjacent (for example, homogeneous areas on consecutive floors of a building), sketch each separate area and place all sketches on the same graph as close together as possible. The Sampling Area may contain areas that are not in one plane; for example, a ceiling and a wall with the same type of friable material. In this case, sketch each flat surface and place the sketches on the same graph, as close together as possible. The Sampling Area diagrams should be retained as part of the building owner's permanent asbestos program file.

Sampling Area # 2

Description:

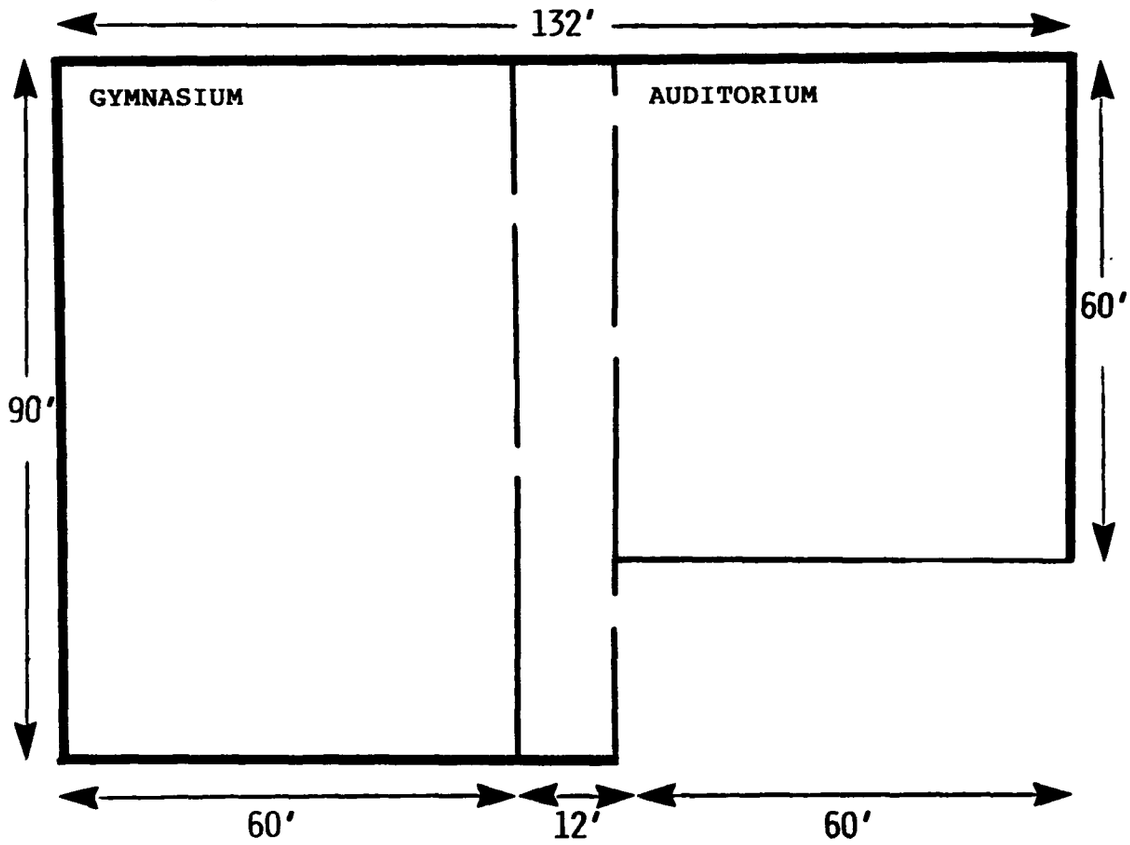
Activity Center Annex (constructed in 1962).

Friable ceiling material of Activity Center Annex:

Gray textured spray finish.

Stuccoed in appearance.

All ceiling areas sketched below comprise Sampling Area (2).



School Watterson Junior High Asbestos Program Manager Ted Barker

Address 706 Lakeview Dr Telephone No. (319) 488-5836

Inspector Steve Johnson Diagram prepared by Owen Martin

Date of Inspection 9/24/85 Date October 1, 1985

Figure 1. An example of a Sampling Area diagram.

5. NUMBER OF SAMPLES

Nine samples per homogeneous Sampling Area are recommended. With 9 samples, the likelihood of detecting asbestos when it is present is very high. Cost or other constraints may limit the number of samples that can be collected. If 9 samples cannot be collected, use Table 1 to determine the minimum number. This number depends on the size of the Sampling Area. In a very small (much less than 1,000 square feet) Sampling Area such as a closet, take 3 samples rather than the full 9.

Table 1. The Number of Samples to be Collected from each Sampling Area

Size of the Sampling Area	Recommended Number of Samples to be Collected	Minimum Number of Samples to be Collected
Less than 1,000 square feet	9	3
Between 1,000 & 5,000 square feet	9	5
Greater than 5,000 square feet	9	7

6. SELECTION OF SAMPLE LOCATIONS

In this sampling scheme, sample locations are selected so that they are representative of the Sampling Area. When nine samples are collected, they are distributed evenly throughout the Sampling Area. If fewer than nine samples are collected, a random sampling scheme is used to determine their location. Choosing sample locations according to personal judgment produces samples which may not be representative and can lead to a wrong decision about the presence or absence of asbestos. The sampling scheme described here avoids this problem and controls the frequency of mistakes.

Divide the Sampling Area into 9 equally sized subareas. This is done by dividing the length and breadth of the Sampling Area into 3 equal lengths and drawing a grid over the diagram (see Figure 2). This can be done carefully by eye. Exact measurements are not needed.

If the Sampling Area does not easily fit into a rectangular shape, parts of the grid might not be in the Sampling Area. This is not a problem in most cases. If, however, a large part of the grid falls outside the Sampling Area (for example, if the Sample Area is L-shaped), it is advisable to divide the Sampling Area into two or more separate Sampling Areas,

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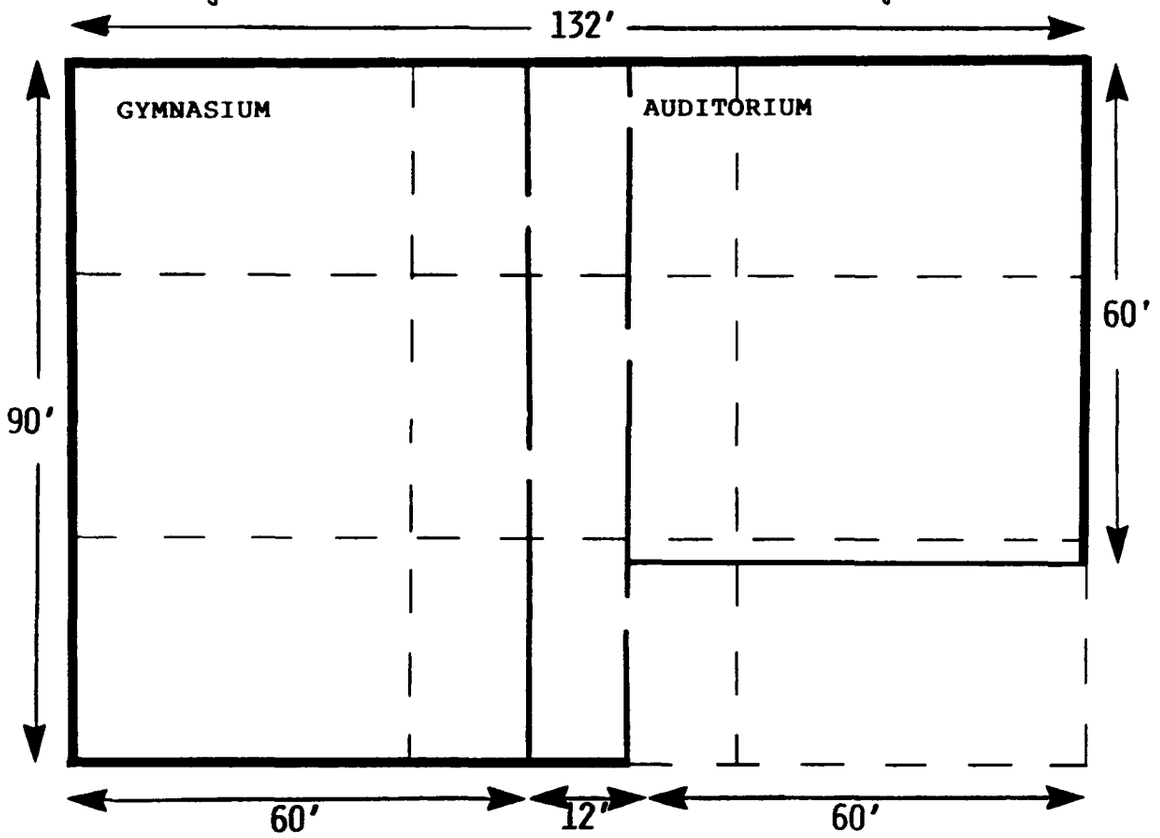

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Figure 2. Sampling Area divided into nine subareas.

each of which is approximately rectangular, and select sample locations by applying the sampling scheme to each Sampling Area.

For greatest coverage, one sample from each of the nine regions should be collected. If fewer samples are to be collected, the diagrams in Table 2 show which subareas to use in order to follow a random sampling scheme. For the first area you intend to sample, number the 9 subareas as shown for Sampling Area #1 in Table 2. If 3 samples are needed, take them from the subareas marked 1, 2 and 3. If 5 samples are needed, take them from the subareas marked 1, 2, 3, 4 and 5, and so on. Take samples from approximately the center of a subarea or as close as possible to the center if accessibility, presence of light fixtures, etc., make the center location impractical. If a subarea is specified that falls entirely outside the Sampling Area, use the next specified subarea instead. For example, if subarea 3 falls outside the Sampling Area, take the third sample from subarea 4.

For very irregularly shaped areas, the Sampling Area may be divided into 9 approximately equally sized subareas that do not necessarily form a rectangular grid. The diagrams in Table 2 will then need to be adapted to the specific situation. Figure 3 shows an example of a Y-shaped Sampling Area that was divided into 9 equally sized subareas. The first diagram of Table 1 was adapted accordingly to number the subareas. When adapting sampling diagrams, retain the order of the numbered subareas from left to right and top to bottom wherever possible.

For each Sampling Area use a new diagram in Table 2. If you have more than 18 Sampling Areas start again at the top of Table 2 (Sampling Area #1) to determine sampling locations for Sampling Area 19.

7. IDENTIFICATION OF SAMPLING LOCATIONS

Assign a non-systematic but unique sample ID number to each sample location. This ID number will be on the sampling container when it goes to the laboratory for analysis. Record the ID number and the sample location on the Sampling Area diagram and also in a permanent logbook. This must be done carefully so that there is no uncertainty about the location and identity of each sample. Make sure that no two samples have the same ID number. Unique non-systematic numbers are used to prevent the laboratories from knowing which samples come from the same Sampling Areas or the same buildings. This "blind" procedure helps prevent bias on the part of the analyst since there is no temptation to assume that the next sample will be similar to the previous one.

Table 2. Sampling locations. For each Sampling Area, take the First Sample from the Center of the Subarea Marked 1, take the Second Sample from the Center of the Subarea Marked 2, etc.

Sampling Area	Sampling Locations	Sampling Area	Sampling Locations	Sampling Area	Sampling Locations
1	9 8 1 2 7 6 5 3 4	7	5 8 1 4 3 6 2 7 9	13	8 5 2 3 6 9 7 1 4
2	8 7 1 3 9 5 4 2 6	8	5 7 1 6 3 4 2 8 9	14	4 1 6 3 9 7 8 5 2
3	4 1 7 2 9 6 8 5 3	9	3 6 4 9 2 7 5 8 1	15	3 5 6 9 2 8 7 4 1
4	6 1 8 5 9 3 2 7 4	10	5 7 3 8 1 6 2 9 4	16	4 8 3 2 5 9 7 1 6
5	6 4 3 1 5 8 9 2 7	11	5 1 6 3 4 9 7 8 2	17	8 2 7 4 5 3 1 9 6
6	7 4 3 6 1 5 2 9 8	12	7 1 9 2 4 5 6 8 3	18	2 5 9 6 1 8 4 7 3

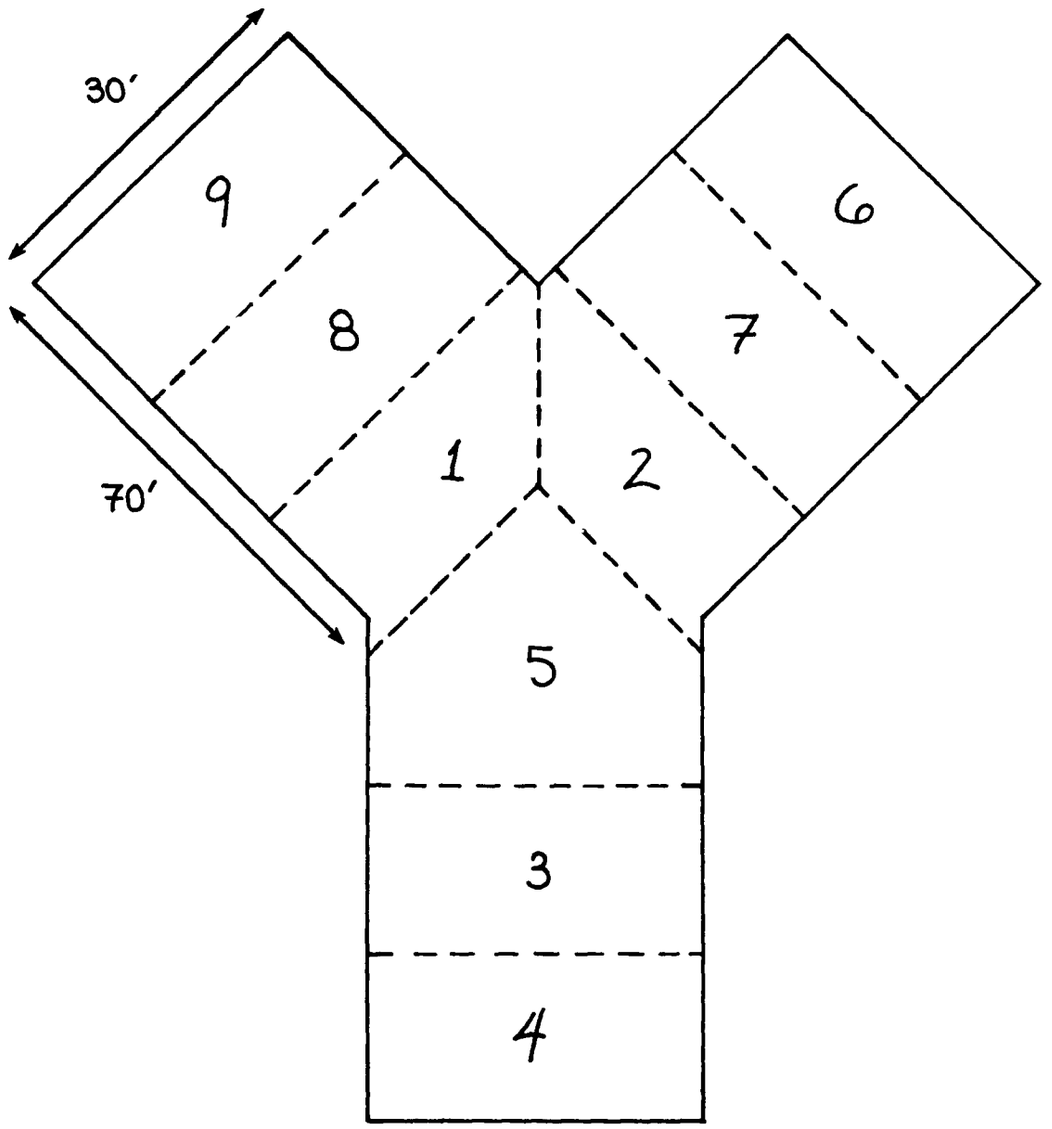

Figure 3. An example of an irregularly shaped Sampling Area divided into nine equally sized subareas. The first sampling diagram from Table 1 was modified to number the subareas.

8. SAMPLE COLLECTION

Collect samples while the area is unoccupied. The following guidelines for sample collection are designed to minimize damage to the ACM and subsequent fiber release.

- Wear at least a half-face respirator with disposable filters.
- Wet the surface of the material to be sampled with water mist from a spray bottle or place a plastic bag around the sampler with the open end of the bag pressed tightly against the wall or ceiling.
- Sample with a reusable sampler such as a cork borer or a single-use sampler such as a glass vial, or metal or plastic container.
- With a twisting motion, slowly push the sampler into the material. Be sure to penetrate any paint or protective coating and all the layers of the friable material.
- For reusable samplers, extract and eject the sample into a container. Wet-wipe the tube and plunger. For single-use samplers, extract, wet-wipe the exterior, and cap it.
- Label the container with the unique sample ID number that is marked on the Sampling Area diagram.
- Clean debris using wet towels and discard them in a plastic bag.
- Use latex spray paint, or a sealant, to cover the spot where the sample was taken.

9. EXAMPLE

The sampling procedure is illustrated by this example. A school was visually inspected for friable materials. The Activity Center Annex was found to contain friable ceiling materials. All the materials were believed to be the same and thus comprise one Sampling Area.

Approximate room dimensions were obtained by pacing and diagrammed as shown in Figure 1.

There were not enough funds for nine samples to be collected in every Sampling Area. Therefore, the minimum number, based on area, was calculated. The total area of friable materials is 10,080 square feet, as calculated by

$$\text{Area} = [60' \times 90'] + [12' \times 90'] + [60' \times 60']$$

$$= 10{,}080 \text{ square feet.}$$

Since this area is greater than 5,000 square feet, seven samples should be collected (Table 1).

The Sampling Area diagram was divided into 9 subareas. Assuming this is the second Sampling Area to be sampled, the second diagram of Table 2 is used. The region marked 6 in the diagram does not fall within the Sampling Area. Therefore the regions marked 1 through 5, and 7 and 8 were used to obtain 7 samples. These 7 locations were marked on the Sampling Area diagram as shown in Figure 4. Each sampling location was assigned a unique, non-systematic sample ID number and this number was marked on the Sampling Area diagram. A quality control sample (see below) was also collected in region 4 immediately adjacent to the original sample. This sample was also given a unique, non-systematic sample ID number.

10. QUALITY ASSURANCE

A quality assurance program is important to ensure the reliability of results from laboratory analyses. Essentially identical samples — samples which should have the same content — are submitted for laboratory analysis and the results are compared. These quality control (QC) samples may be obtained by taking two samples immediately adjacent to each other ("side-by-side" samples). The QC samples are labelled and handled in the same way as ordinary samples. The laboratory should not know which samples are QC samples. Collect at least 1 QC sample per building or 1 QC sample per 20 samples, whichever is larger. The QC sample should be analyzed by the primary laboratory or at a second laboratory to confirm the results of the first analysis. Any disagreements about the presence or absence of asbestos should be investigated by reanalyzing the samples or collecting additional samples.

11. LABORATORY ANALYSIS

The recommended method of bulk sample analysis for asbestos is polarized light microscopy. The average cost of analysis is $25 per sample. EPA administers a bulk asbestos sample quality assurance program. Lists of participating laboratories, their performance scores and further

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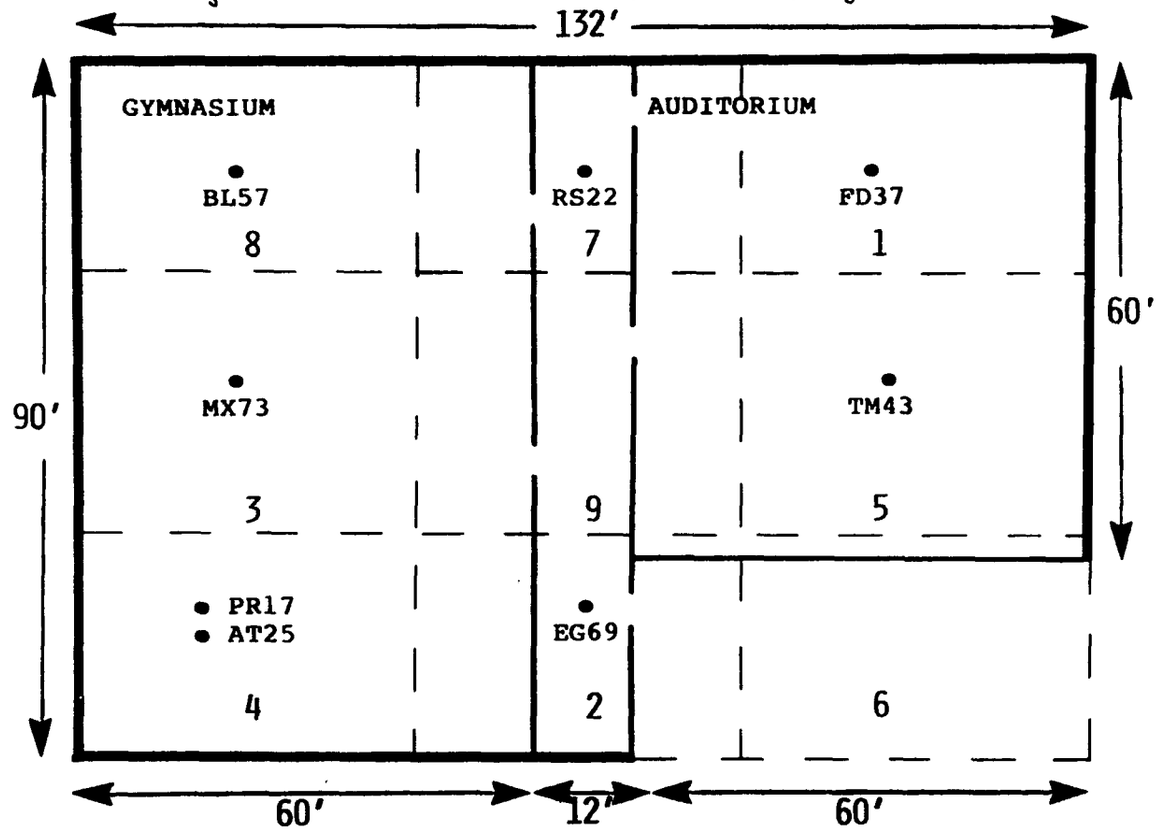

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Figure 4. Location of samples. The Sampling Area was divided into nine subareas which were labelled according to the second diagram in Table 2. Samples were taken at locations marked with a • and given unique ID numbers as shown.

information on the program are available from the Asbestos Technical Information Services at (800)334-8571. After analysis, samples should be kept permanently in a safe location, such as the Local Education Agency (LEA) with appropriate documentation so that the samples can be retrieved easily if needed.

It is not always necessary to collect or have all samples analyzed at once since sometimes a decision can be reached after the analysis of only some of the samples. This is discussed in more detail in the next section.

12. INTERPRETATION OF RESULTS

If one or more samples from a Sampling Area has more than 1% asbestos, then treat the Sampling Area as if it contains asbestos. If any doubt remains, or if further information is needed, then collect additional samples. For example, the initial sampling might suggest that the Sampling Area is asbestos-free with the exception of one end of a hallway which opens into a foyer. In this case, rather than treating the whole hallway as if it contained asbestos, the area could be subdivided into two new Sampling Areas and each one sampled according to the scheme above to confirm the absence of asbestos in the hallway and its presence in the foyer.

Since a decision regarding the presence of asbestos can be made as soon as one sample shows more than 1% asbestos, the samples can be collected and analyzed sequentially, beginning with a minimum of three samples. Send samples from regions marked 1, 2 and 3 to the laboratory first. If one or more samples has more than 1% asbestos, then treat the Sampling Area as if it contains asbestos. (Note: the May 27, 1982 EPA "Friable Asbestos-Containing Materials in Schools; Identification and Notification Rule" (40 CFR Part 763), currently requires the collection and analysis of three samples from each Sampling Area within a school building.) If none of the first three samples contain asbestos then send samples from regions 4 and 5 to the laboratory. Continue in this manner until either asbestos is found in a sample from the Sampling Area, or until at least the minimum number of samples for the Sampling Area have been analyzed. Alternatively, to reduce shipping costs, collect and send all samples to the laboratory at once with instructions to analyze the samples in the appropriate order. Be careful not to reveal to the laboratory which samples come from the same Sampling Area.

The potential savings in analysis costs have to be weighed against the extra information obtained by analyzing all the samples. In many cases, it may be more efficient to collect and have all the samples analyzed at once rather than follow this sequential plan.

13. WHAT TO DO IF ASBESTOS IS PRESENT

If ACM is found in a building, a special operations and maintenance (O&M) program should be implemented immediately. The program is designed to clean up asbestos fibers previously released, prevent future release by minimizing ACM disturbance or damage, and monitor the condition of ACM. Details are given in Chapter 3 of the Purple Book. EPA's illustrated pamphlet, "Asbestos in Buildings: Guidance for Service and Maintenance Personnel" (USEPA 1985), may also be useful in publicizing and initiating the special O&M program.

Once a special O&M program is in place, the ACM should be assessed to see if further control action, such as removal or encapsulation of the ACM, is necessary. If abatement work is to be done, additional bulk samples may help to confirm the results of the initial survey and to obtain information about the material which will be useful in selecting and implementing the abatement program. Further information is provided in the Purple Book or can be obtained from your EPA Regional Asbestos Coordinator (Appendix 1).

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USEPA. 1985c. U.S. Environmental Protection Agency. Asbestos in buildings: guidance for service and maintenance personnel. Washington, DC: Office of Toxic Substances, USEPA. EPA 560/5-85-018.

Appendix 1. EPA Regional Asbestos Coordinators

Region 1
(617) 223-0585
JFK Federal Building
Boston, MA 02203

Maine
Vermont
New Hampshire
Connecticut
Massachusetts
Rhode Island

Region 2
(201) 321-6668
Woodbridge Avenue
Edison, NJ 08837

New York
New Jersey
Puerto Rico
Virgin Islands

Region 3
(215) 597-9859
841 Chestnut Street
Philadelphia, PA 19107

Pennsylvania
Maryland
Delaware
Virginia
West Virginia
District of Columbia

Region 4
(404) 881-3864
345 Courtland Street NE
Atlanta, GA 30365

Georgia
Alabama
Mississippi
Florida
North Carolina
South Carolina
Tennessee
Kentucky

Region 5
(312) 886-6006
230 S. Dearborn Street
Chicago, IL 60604

Indiana
Ohio
Illinois
Michigan
Wisconsin
Minnesota

Region 6
(214) 767-2734
Interfirst Two Building
Dallas, TX 75270

Texas
New Mexico
Oklahoma
Arkansas
Louisiana

Region 7
(913) 236-2835
726 Minnesota Avenue
Kansas City, KS 66101

Kansas
Missouri
Nebraska
Iowa

Region 8
(303) 293-1742
1860 Lincoln Street
Denver, CO 80295

Colorado
Utah
Wyoming
Montana
North Dakota
South Dakota

Appendix 1. EPA Regional Asbestos Coordinators—Continued

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215 Fremont Street
San Francisco, CA 94105

California
Nevada
Arizona
Hawaii
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Region 10
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Washington
Oregon
Idaho
Alaska

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14.

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This report was prepared for the Exposure Evaluation Division of the Office of Toxic Substances. Copies of the document can be obtained by calling toll-free 800-424-9065. (Call 554-1404 in the District of Columbia.)

16. Abstract (Limit: 200 words)
This simplified document provides EPA guidance for sampling friable sprayed-on or trowelled-on materials on ceilings, walls, and other surfaces for asbestos. The document furnishes advice for 1) identifying a sampling area, 2) applying a sampling scheme to the area, 3) determining the number to collect, 4) deciding upon sampling locations within the area, 5) formulating a quality assurance program for sampling and analysis, 6) collecting the samples, 7) submitting the samples for analysis, and 8) interpreting the laboratory results. The material presented is a summary of information and experience gained by EPA through its Asbestos in Schools and Buildings Program.

17. Document Analysis a. Descriptors
Asbestos
Asbestos-Containing Materials
Asbestos Sampling Scheme
Asbestos Analytical Program

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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