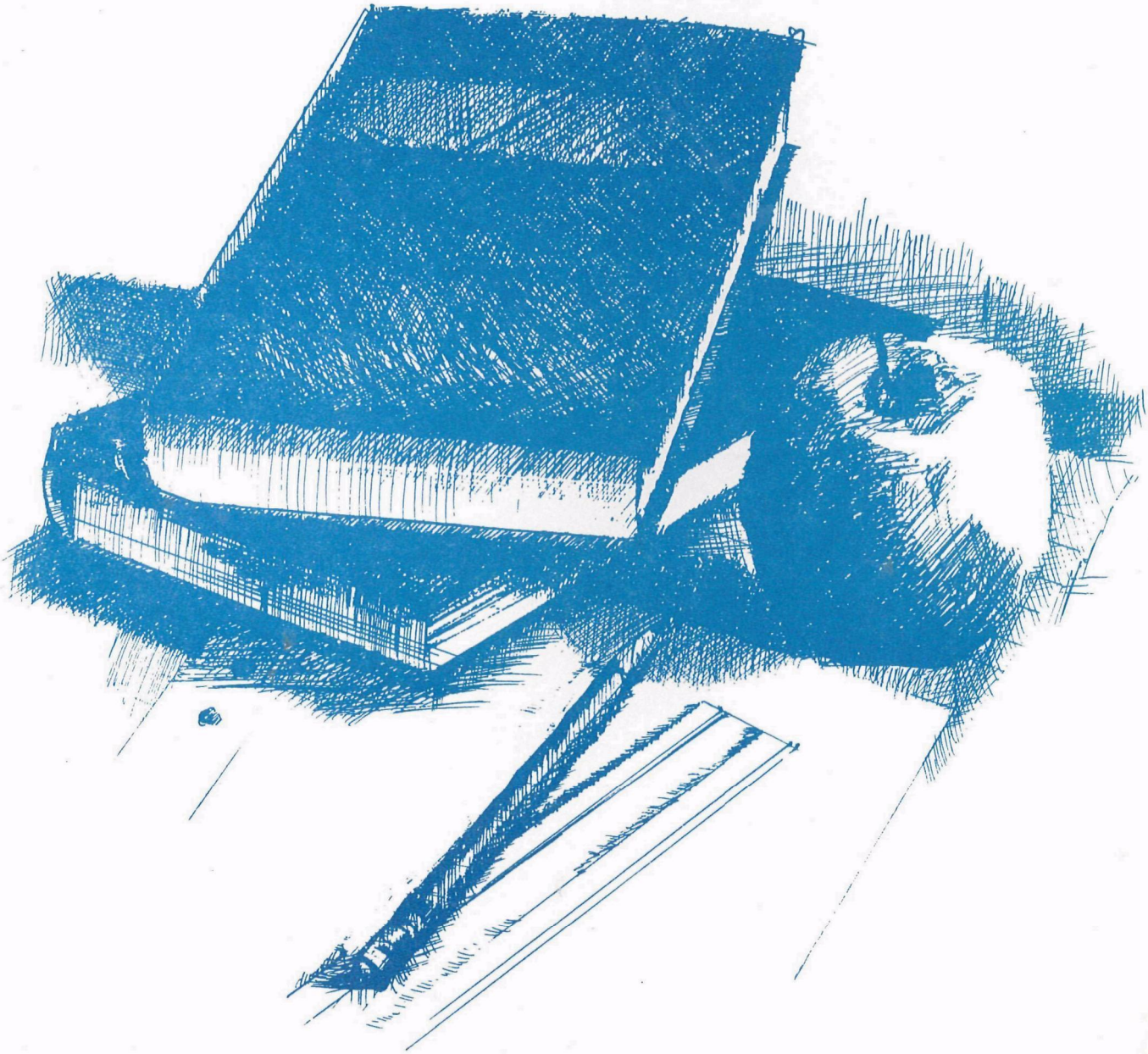
United States
Environmental Protection
Agency

Office of
Toxic Substances
Washington, D.C. 20460

EPA 560/4-91-012
June 1991

Office of Toxic Substances

Asbestos in Schools: Evaluation of the Asbestos Hazard Emergency Response Act (AHERA): A Summary Report



Asbestos in Schools: Evaluation of the Asbestos Hazard Emergency Response Act (AHERA): A Summary Report

By:

Alexa Fraser
Robert Clickner
Naomi Everett
Susan Viet

Westat, Inc.
1650 Research Boulevard
Rockville, MD 20850

Prepared for:

Economics and Technology Division
U.S. Environmental Protection Agency
Washington, D.C. 20460

June 1991

TABLE OF CONTENTS

Chapter		Page
1	INTRODUCTION	1-1
2	IDENTIFICATION AND ASSESSMENT OF MATERIAL	2-1
3	MANAGEMENT PLAN EVALUATION	3-1
4	RESPONSE ACTION EVALUATION	4-1
5	ORIGINAL AHERA INSPECTION EVALUATION	5-1
6	PROCESS OF NOTIFICATION	6-1
7	MAINTENANCE AND CUSTODIAL WORKER TRAINING AND EXPERIENCE	7-1
8	GLOSSARY	8-1

List of Exhibits

Exhibit		Page
2-1	Universe of suspect materials in school buildings	2-1
2-2	Percent of suspect materials identified	2-2
2-3	Percent of suspect material quantities identified	2-3
2-4	Percent of buildings with asbestos-containing material quantity properly estimated	2-4
2-5	Percent of areas with suspect materials present and recorded in management plans	2-5
3-1	Management plan completeness scores by sub-area	3-1
3-2	Management plan completeness scores	3-2
3-3	Number of usability elements found in management plans	3-3
4-1	Recommended response actions	4-2
4-2	Percent of school buildings with one or more remediations	4-3

List of Exhibits (continued)

Exhibit		Page
4-3	Adequacy of remediations	4-3
5-1	School average inspection scores	5-2
7-1	Percent of schools providing some training to maintenance workers	7-2
7-2	Percent of schools providing some training to custodians	7-2
7-3	Percent of schools providing various lengths of training to maintenance and custodial workers	7-3

1. INTRODUCTION

In Fall 1989, the United States Environmental Protection Agency's (EPA's) Office of Toxic Substances asked Westat, Inc., a survey research firm, to perform an evaluation of the initial implementation of the Asbestos Hazard Emergency Response Act (AHERA). The AHERA regulations called for the inspection of all elementary and secondary schools in the nation to identify any asbestos-containing building materials (ACBM) present, preparation of an asbestos management plan for each school, notification of parents and staff of the availability of the management plan for review, training of school maintenance and custodial workers, and other long-term tasks.

The AHERA evaluation study focused on occupied school buildings in the United States with students in any of grades 1 through 12. There were a few exclusions: buildings constructed after October 1988,[1] buildings where the original AHERA inspection found no asbestos, and buildings where no inspection was conducted in response to AHERA or where no management plan was prepared. Westat estimates that the schools in the target population, from which the sample for this evaluation was drawn, represent approximately 80 percent of all 106,000 schools in the nation.

The AHERA evaluation was conducted in a national statistical sample of 30 communities, in which Westat visited a total of 198 schools and 207 school buildings. Participation in this evaluation was voluntary and approximately 25 percent of the originally sampled schools elected not to participate. Specially selected and trained inspectors thoroughly reinspected[2] each participating school building; their findings were compared with the original AHERA inspection at each school as reported in the school's management plan. In-person interviews were conducted with each school principal and AHERA designated person (ADP) for each Local Education Agency (LEA). In addition, telephone interviews were conducted with the inspector who had performed the original AHERA inspection, the head of the PTA (or other active parent), and an active teacher in the school.

In both the original AHERA inspections and the Westat reinspections, the inspectors looked for suspect building materials. Suspect building materials are construction materials thought to contain asbestos because of past practices in their formulation and manufacture. Laboratory analysis of a bulk sample is required to determine if a particular suspect material in fact contains asbestos. Since AHERA required the identification of suspect material, bulk sampling

[1] Any building constructed after this date was not required to be inspected under AHERA. These buildings must, however, have a signed statement by the building's architect, project engineer, or an accredited inspector stating that no ACBM was specified or used in construction.

[2] For purposes of this report, reinspection refers to the work done under this evaluation and not the triennial reinspection.

was not needed as part of this evaluation. Instead, we focused on evaluating how well the original AHERA inspections identified, assessed, described, and quantified suspect materials. (AHERA does not require bulk sampling. Suspect material may be treated "as if" it contains asbestos.)

To supplement the statistical data, a number of focus groups (i.e., guided group discussions for in-depth exploration of a topic) were undertaken in communities nationwide. Four focus groups were held with parents and teachers not associated with schools in our sample. In addition, five focus groups were held with school maintenance and custodial workers also not associated with our sampled schools. In both cases, participants in the focus groups were selected in a non-random, non-statistical manner. Rather, as is usually the case in a focus group, participants were invited purposefully to create a group with many different types of people. While this small sample of focus groups is not a reliable basis for statistical estimates (and has not been used in such a way), it did provide useful qualitative insights into the notification process and maintenance and custodial training and experience.

The AHERA evaluation assessed the implementation of the initial phase of AHERA and did not attempt to study compliance with all elements of the AHERA legislation. First, schools that did not have a management plan were excluded, thus separating out this category of non-compliers. Second, certain activities required under AHERA were not evaluated. These included reviewing the "process" of carrying out response actions, such as verifying that appropriate containments were used when required and appraising Operations and Maintenance (O&M) Plans. Also, not all possible suspect items were included in the suspect materials category for this evaluation. For example, wallboard, cement and cinderblock, and flooring under wall-to-wall carpeting were excluded from the study, though they are included in AHERA.

Although we considered monitoring the air for asbestos fibers, we rejected it in favor of inspection and assessment of building materials that could potentially release asbestos fibers. This approach was used for two reasons. First, because the AHERA regulations specifically call for the inspection and assessment of building materials in schools, we wanted to determine how well this was done. In this sense, AHERA serves primarily as a preventive measure to ensure that existing asbestos in schools does not become friable or present a future exposure source. Second, since air monitoring covers a short period of time, sometimes air monitoring shows no asbestos fiber release, even though release can occur when asbestos-containing materials are disturbed (through contact, maintenance, renovation, etc.). Thus, air monitoring could miss the times that fibers are released. AHERA is concerned with preventing not only current asbestos fiber release, but potential future release as well.

The AHERA evaluation research consisted of six separate Research Areas. Each Research Area addressed a different aspect of the AHERA program: school building inspections, management plans, response actions, original AHERA inspection evaluation, notification, and maintenance and custodial worker training. The EPA, in consultation with Westat and the technical consultants who worked on this project, developed specific research questions for each Research Area. The goal of the evaluation re-

search was then to collect and analyze data to answer the questions. A summary of the research questions and the study findings is presented in the following six chapters.

The statistical estimates presented in this report were derived through the use of standard statistical packages. They are often followed by a number in parentheses, for example, "... 80 percent (± 6%) of schools nationally ..." The number in parentheses may be used to form a 95 percent confidence interval[3] for the estimated value. In the example, the 95 percent confidence interval would be 74 percent to 86 percent, and there is one chance in 20 that the difference between the estimate and the unknown population parameter exceeds 6 percent.

For greater detail, the full findings of the evaluation have been published by EPA under the title *Evaluation of the Asbestos Hazard Emergency Response Act (AHERA) Final Report*. The publication number is 566/4-91-013. Additional information concerning this, and other reports, can be obtained through the TSCA Assistance hotline. The number is (202) 544-1404.

[3]A confidence interval is a measure of the statistical precision of the estimate. Roughly, we are 95 percent confident that the ranges defined by the limits of the confidence interval include the unknown population parameter. More precisely, 19 samples out of 20 will yield computed intervals that include the estimated parameter.

2. IDENTIFICATION AND ASSESSMENT OF MATERIAL

- *Was all the suspect material found at the original AHERA inspection?*
- *Was the asbestos found at the original AHERA inspection properly assessed?*

The goal of this Research Area was to estimate how much of the suspect material was found in the original AHERA inspections and how much of the asbestos-containing material was assessed in conformance with AHERA regulations. "How much" was measured in three ways:

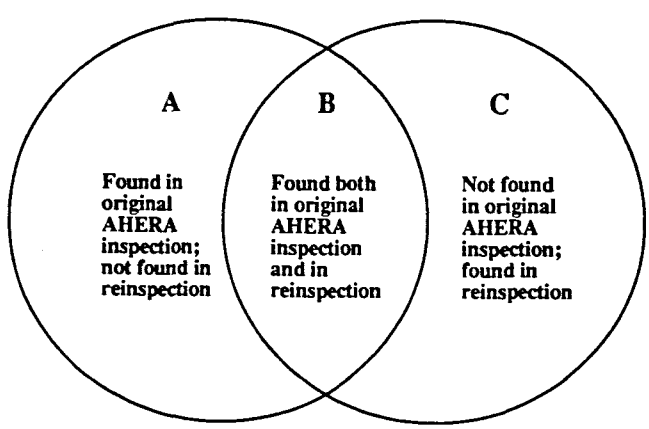
(1) **How many** of the individual suspect materials in school buildings were identified;

(2) **To what extent quantities** of identified materials were properly estimated; and

(3) **What percentage of the areas** with each type of suspect material was recorded in the original AHERA inspection.

Exhibit 2-1 illustrates the universe of suspect materials in school buildings and some of the difficulties inherent in evaluating building inspections after the passage of several months or more. Areas A, B, and C together represent the universe of suspect materials in school buildings at the time of the original AHERA inspection. The circle on the left (areas A and B) represents materials found in the original AHERA inspection. The circle on the right (areas B and C) represents materials found in the reinspection.

Exhibit 2-1.
Universe of suspect materials in school buildings[1]



[1]Diagram for illustration only. Ratios in actual data not shown.

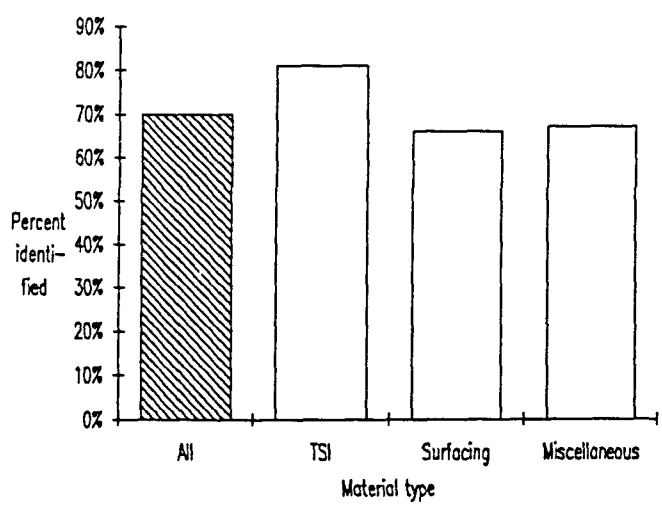
To estimate the percent of suspect materials identified in the original AHERA inspections, it is necessary to make two assumptions. First, materials found in the original AHERA inspection, but not in the reinspection (area A) are assumed to have been removed in the interim between the two inspections. Second, materials found in the reinspection but not in the original AHERA inspection (area C) are assumed to have been missed in the original inspection, rather than added after the original inspection. Under these assumptions, the ratio $\frac{A + B}{A + B + C}$ provides an estimate of the percent of suspect materials identified in the original inspections. In addition, we would also like to estimate the fraction of total quantity that the original inspector found for square or linear feet. Unfortunately, the quantity already abated (A) is not known. However, we can calculate $\frac{B}{B + C}$ as a lower bound on $\frac{A + B}{A + B + C}$. These lower bound estimates are reported later in this section.

Identification of Materials. We first address how well the original AHERA inspections identified suspect materials. Suspect asbestos-containing materials include every material in a school building which has not been sampled and analyzed by a NVLAP-accredited laboratory[2] for asbestos content. Suspect asbestos-containing building materials include specific thermal insulation, surfacing, and miscellaneous materials (defined by the EPA in the AHERA regulation and supporting documents) which have not been sampled and analyzed by a NVLAP-accredited laboratory for asbestos content. Asbestos-containing materials and asbestos-containing building materials are those materials which have been sampled and analyzed by an accredited laboratory and found to contain more than one percent asbestos.

The question of how well the original AHERA inspection identified suspect materials is important because, if a material was not identified, it was not sampled to determine asbestos content. Moreover, it would not have been included in the asbestos management program, even if it contained asbestos.

An estimated 70 percent of the 971,000 individual suspect materials still present in school buildings at the time of reinspection was identified in the original AHERA inspections; 72 percent of the 506,000 suspect friable materials was identified. Thermal system insulation (TSI) was more likely to be identified than either miscellaneous or surfacing materials (see Exhibit 2-2).

Exhibit 2-2.
Percent of suspect materials identified



[2]National Voluntary Laboratory Accreditation Program, a proficiency program for laboratories that perform bulk sample analysis by polarized light microscopy, established by the National Institute of Science and Technology.

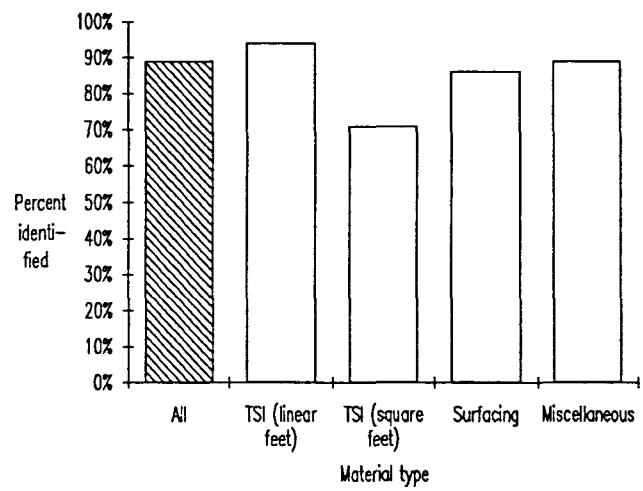
Many types of materials were identified in the vast majority of inspections, including floor tile, ceiling tile, and all types of thermal system insulation. However, certain types of materials were not regularly identified: vibration dampening cloth, fire doors, and linoleum.

When the numbers of the individual suspect materials identified were translated into quantities, 89 percent of the 4.7 billion square feet of suspect material present was identified. Suspect materials are generally quantified as square feet of surface covered by the material. A few materials, most notably pipe wrap, are quantified as linear feet of insulated pipe; 94 percent of the 89 million linear feet present of these materials was identified. (As discussed above, these quantity estimates are lower bounds.)

Over 90 percent of the total amount each of the following materials was identified in the original AHERA inspections: floor tile, ceiling surfacing material, and several categories of thermal system insulation--tank insulation, elbow/fitting/valve insulation, pipe insulation, and boiler insulation (see Exhibit 2-3). Materials that were highly likely to be identified accounted for most of the quantity of material. For example, there is an estimated 1.8 billion square feet of floor tile in the schools, 245 million square feet of ceiling surfacing material, and 65 million linear feet of pipe insulation. The least frequently identified suspect materials were vibration dampening cloth, fire doors, duct insulation, and linoleum. Less than 50 percent of these materials was identified in the original AHERA inspections. These least frequently identified materials tend to be small quantity materials. Together, they account for an estimated 59 million square feet of suspect material present in schools, of which only 19 million square feet is friable.

Despite the relatively high percentage of materials identified and material quantities reported,

Exhibit 2-3.
Percent of suspect material quantities identified



82 percent of school buildings[3] had at least one material unidentified in the original AHERA inspection. As would be expected from the previous paragraph, the unidentified materials tended to be the small quantity and nonfriable materials, such as vibration dampening cloth or fire doors. On the other hand, while ceiling tile and floor tile are present in about 85 percent of schools, they were not identified in 23 percent and 11 percent, respectively, of the school buildings containing them.

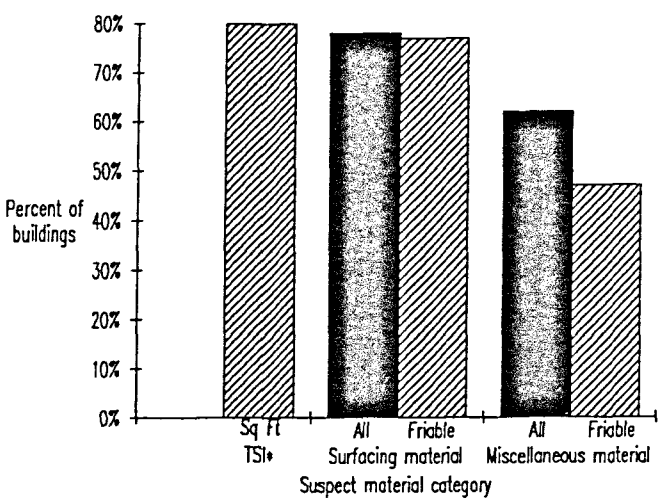
Estimation of Material Quantities. We examined the original AHERA inspector's ability to provide accurate information about the quantities of identified materials. Local Education Agencies need reasonably accurate quantifica-

[3]Some schools have more than one building.

tions of the asbestos materials in their schools to be able to estimate the costs of remediations. In determining underestimated amounts of material, we recognized that deviations in measurement among inspectors are fairly broad. Our expert consultants agreed that an original AHERA inspection quantity within 20 percent of the reinspection quantity should be considered an acceptably accurate estimate. Further, underestimated amounts calculated in this manner would clearly be attributable to the original AHERA inspector, rather than to differences in such factors as material description or architectural nomenclature.

Original AHERA inspectors estimated the quantity of each asbestos-containing material correctly in over 60 percent of buildings (see Exhibit 2-4).

Exhibit 2-4.
Percent of buildings with asbestos-containing material quantity properly estimated



*TSI is always considered friable; 83% of buildings had TSI measure in linear feet.

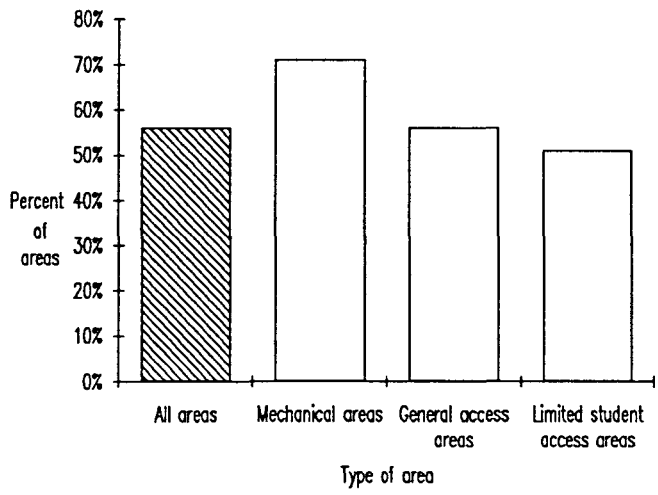
The overall quantity of asbestos-containing material estimated properly ranged from 91 percent (for thermal system insulation) to 45 percent (for friable miscellaneous materials). Our estimates for friable asbestos-containing miscellaneous materials and TSI are both based on so little data as to be subject to considerable error. More buildings have properly estimated quantities of asbestos-containing surfacing materials and thermal system insulation (about 75%) than miscellaneous materials (about 50%).

Recording Material Locations. This section continues the analysis of the original AHERA inspectors' ability to provide accurate information about identified materials. It addresses the question, "For materials which were identified at the original AHERA inspection, was every area where the material was present recorded?" AHERA requires the locations of suspect materials to be clearly indicated in the management plan by blueprints, diagrams, or written description so that school employees and parents can have reliable information about the location of asbestos-containing materials. In particular, school maintenance workers should know where to use appropriate work practices to protect themselves from potential exposure to asbestos fibers and where such work practices are unnecessary. Clear records of the locations of asbestos-containing materials and non-asbestos materials give workers information for differentiating among similar materials.

Areas in school buildings were divided into three types for this analysis: **mechanical areas**, which include boiler rooms, elevator shafts, mechanical rooms, air and duct shafts, telephone closets, and electrical closets; **limited student access areas**, which include offices, supply rooms, teachers' lounges, janitors' closets, and kitchens; and **general access areas**, which include classrooms, gymnasiums, auditoriums, cafeterias, restrooms, and hallways.

Once a material was identified, original AHERA inspectors recorded its location in 56 percent of the areas where the material was present (Exhibit 2-5). This reflects a tendency among inspection reports to either not indicate areas where materials are present or to do so incompletely. There were no patterns of differences between areas with limited student access and general access areas in recording locations of material.

Exhibit 2-5.
Percent of areas with suspect materials present and recorded in management plans



For all three types of areas, surfacing and miscellaneous suspect materials were recorded in about 45 to 55 percent of the areas where they were located. On the other hand, thermal system insulation was significantly more likely to be recorded in mechanical areas than in nonmechanical areas. It was recorded in 74 percent (± 10%) in mechanical areas, in 48 percent (± 10%) of general access areas, and in 57 percent (± 7%) of limited student access areas.

Assessment of the Asbestos-Containing Material. This component of the AHERA evaluation checks the internal consistency of the management plan's logic and whether it complies with AHERA's assessment classification of materials. No comparisons were made between assessment categories reported in the management plans and the categories observed in the reinspection. Such comparisons would not be valid because there were numerous opportunities for changes in the assessment category in the year or two between the inspections. Materials may have been repaired or removed or, conversely, they may have suffered further damage or deterioration.

The first part of this analysis considers how often asbestos-containing materials were assessed appropriately in the original AHERA inspection. Assessment refers to the consideration of factors that may contribute to increased fiber release from a material. An assessment is appropriate if, at a minimum, it considers the condition of a material or amount of damage to thermal system insulation and other friable materials. An inappropriate assessment was one in which a damage rating was not included. AHERA regulations do not require nonfriable materials to be assessed, although this was occasionally done. Assessed nonfriable materials were included in the count of total number of materials assessed and were counted as appropriately assessed. Ninety-two percent of the asbestos-containing materials that should have been assessed according to AHERA were indeed assessed and were assessed appropriately.

The second part of this analysis addresses how often the seven AHERA assessment categories were employed in the original AHERA inspection and how often they were appropriately assigned. An appropriate assessment means the ori-

ginal AHERA inspector assigned the AHERA catgory number (1 through 7) or wording correctly, based on material type, reported amount of damage at the original inspection, and reported potential for damage. Forty-four percent of original AHERA inspections used the AHERA categories. Of those inspections which used the categories, 93 percent applied them appropriately.

3. MANAGEMENT PLAN EVALUATION

- *Do schools know and understand the regulation, as shown by the completeness of the management plan?*

This Research Area seeks to evaluate management plans nationwide. Westat considered five aspects of each management plan:

- Completeness
- Usability
- Detractions to use
- Correct use of terms
- Educational background required to interpret plan

Completeness. In consultation with technical consultants and two senior certified industrial hygienists (CIH), Westat designed and implemented a methodology to score each plan for completeness. The scores provided a method of comparing management plans from different schools. The methodology awarded points for the presence of selected features called for in the EPA's guidance documents for management plan preparers (see six sub-areas listed in Exhibit 3-1). The points were converted to scores ranging from 0 to 100 percent. All scoring was assigned by two senior CIHs who are also trained AHERA inspectors and management planners with many years of experience in asbestos abatement and inspection.

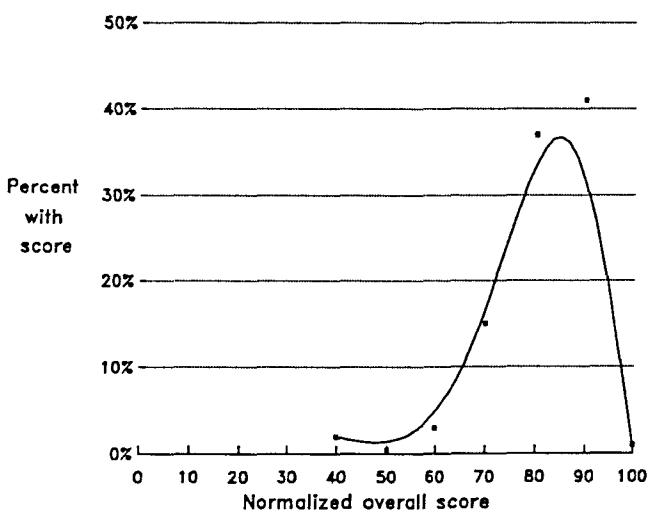
Based on the six subscores, an overall score was computed for the total management plan. The relative importance of each sub-area is reflected in its contribution to the overall score. For example, 6 percent of points in the overall score are based on the general inventory of buildings. The sub-areas, the relative importance of each, and the average score for the sub-area are provided in Exhibit 3-1.

Exhibit 3-1. Management plan completeness scores by sub-area

Sub-area of Completeness Score	Relative Importance	Average Score
General inventory of buildings	6%	92%
Exclusions and previous inspection information	42%	77%
Response action recommendations	18%	77%
Activity plans	24%	79%
Resource evaluation	6%	82%
Information on AHERA designated person	4%	86%
Overall	100%	81%

As shown in Exhibit 3-2, in regard to the overall score, management plans were generally complete with an overall average score of 81 percent. Most scored 75 percent or higher. However, 5 percent (± 4%) of management plans scored 64 percent or below, making it clear that a few plans, even with Federal and State guidelines, were substantially incomplete. Points were most commonly lost for items that were not clearly defined in AHERA, or where State-required AHERA forms and checklists failed to prompt for the specific information.

Exhibit 3-2.
Management plan completeness scores



Of particular interest and importance were the findings concerning the use of exclusion and previous inspection information. This was the single most important area evaluated for completeness in the plan. While a majority of the plans received the maximum points allowed under this heading, deficiencies were clustered in the areas that follow. (The percentage of plans nationally with the named deficiency are noted in parenthesis. The last two deficiencies were observed but not quantified.)

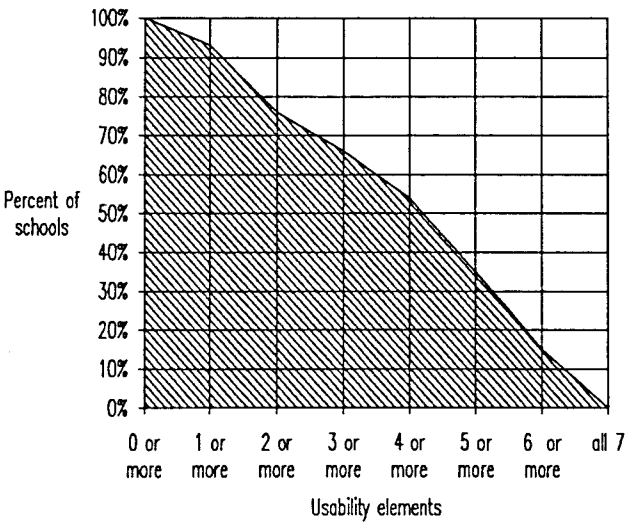
- Location of homogeneous areas not clearly described (42%)
- Nonstandard or insufficient identification of material type (55%)
- Insufficient description of bulk sampling locations (66%)
- Bulk samples collected from incorrect or undescribed locations (33% TSI, 58% surfacing)
- Date of analysis of bulk samples missing (31%)
- Failure to meet AHERA requirements when previous inspection results were used in the original AHERA inspection
- Insufficient evidence of EPA-approved accreditation for laboratories evaluating bulk samples

Usability. The second aspect of the management plan evaluation concerned usability. Westat evaluated how useful a plan would be and whether it could easily be used as a reference by its intended audiences, the public, and custodial and maintenance workers. We looked at seven elements of usability that would ease use of a management plan, such as table of contents, page numbering, and floorplans showing sampling locations, homogeneous areas, or ACBM. None of these elements is required by AHERA.

None of the plans contained all seven elements, and 7 percent contained no elements of usability. Exhibit 3-3 displays the distribution of plans with increasing numbers of usability elements.

The curve begins at 100 percent, indicating the percentage of plans with zero or more elements. The curve drops to 93 percent to reflect the number of plans with one or more elements, and further drops to 76 percent representing the number with two or more elements. The curve ends at 0 percent, reflecting the fact that no plans have all seven elements.

Exhibit 3-3.
Number of usability elements found in management plans



Detractions to Use. Beyond the usability elements, Westat went further to identify the features of plans that detracted from their use. Examples are an unclear inspection report, failure to use AHERA categories when assessing ACBM, failure to explain standard forms, and lack of floorplans. In total, 69 percent (± 9%) of the plans had one or more features that detracted from their ease of use.

Correct Use of Terms. Westat further found that plans often used four AHERA-defined terms incorrectly. These terms are "homogeneous area", "functional space", "exclusion", and "random sampling". For these four critical terms, 37 percent (± 9%) of the schools used all four correctly, 46 percent used no more than three correctly, and 12 percent used only two correctly. Five percent used one or none correctly.

Ease of Plan Interpretation. With regard to ease of reading and understanding the plans, we found that 39 percent (± 5%) of plans were readily interpretable only by persons who had some college coursework; 22 percent (± 6%) required that the reader had specialized instruction in the use of the plan. Only 39 percent (± 6%) of plans could be readily interpreted by those with a high-school education or less. Of those people who should be expected to understand plans better -- school principals and custodial workers -- a sound background in AHERA inspections appeared more helpful than knowledge of the building being reviewed.

4. RESPONSE ACTION EVALUATION

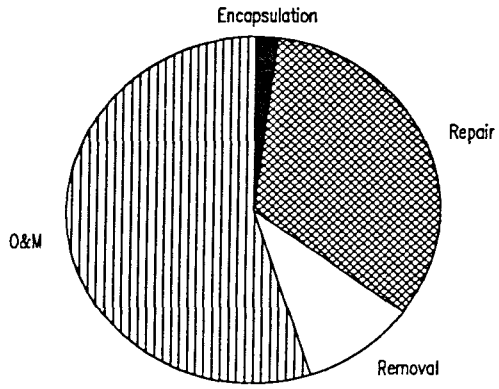
- *What response actions were recommended in the management plan?*
- *Are they appropriate, given the assessed condition of the asbestos?*
- *Have the remediations undertaken in the school been done properly?*

This Research Area is divided in three sections corresponding to the above questions. First, Westat analyzed the presence and type of response actions included in management plans. Second, experts evaluated whether the recommended responses quoted in the plans were appropriate for the type and severity of the problem as identified by the original AHERA inspection. Third, on-site inspectors evaluated whether the actions taken (i.e., "remedia-tions" taken) were done properly. The first two questions study response actions which included repair, encapsulation, enclosure, removal, and the implementation of an Operations and Maintenance (O&M) Plan. By contrast, the third question concerns only remediations, defined as repair, encapsulation, enclosure, and removal. Remediation does not include O&M.

Presence and Type of Response Actions in Plans. Seventy-one percent (± 6%) of the plans in our survey included recommendations for response actions. That is, response actions were included in plans of 126,282 of the estimated 179,093 school buildings with asbestos-containing building materials (ACBM). As shown in Exhibit 4-1, recognizing that each plan could contain multiple recommendations, we found that 55 percent (± 7%) of the recommendations called for handling problems through regular Operations and Maintenance techniques; 33 percent (± 8%) called for repair of the damaged areas; 10 percent (± 2%) called for removal of materials; and 2 percent (± 4%) recommended encapsulation.

The distribution of recommended response actions varied with the type of ACBM. For example, repair of damaged materials was recommended for 56 percent (± 5%) of the occurrences of thermal system insulation. In contrast, Operations and Maintenance was recommended for miscellaneous materials in 93 percent (± 4%) of the cases.

Exhibit 4-1.
Recommended response actions



These results all pertain to the 71 percent of the schools with ACBM whose plans include some recommended actions. Of concern are the plans in the 29 percent (± 18%) of the schools which had no recommended actions despite the documented presence of ACBM. In almost all cases these schools had reported having miscellaneous ACBM; in a few cases the asbestos was surfacing and/or TSI.

Appropriateness of Response Actions Recommended. Ninety-eight percent (± 1%) of recommended response actions were appropriate, that is, they were in accordance with AHERA, given the reported condition of the material. Examples of appropriate response actions are the recommendations of repair for damaged TSI, encapsulation of a damaged area of acoustical ceiling, and removal of asbestos-containing ceiling tiles. Examples of inappropriate response actions are recommendations of O&M for damaged pipe insulation or significantly damaged floor tile.

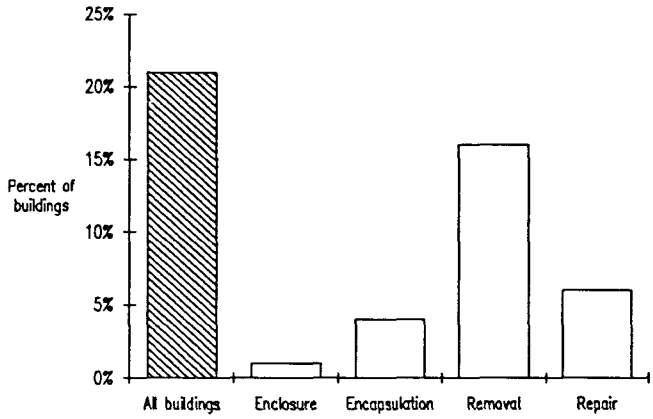
The finding that nearly all recommended response actions were appropriate must be tempered, though, by the observation that many of these recommendations (80%) were generic and failed to specify the locations where the response action should be performed. Response actions were considered generic if, for example, they recommended removal of all damaged material without indicating its locations. Examples of generic recommendations are "repair damaged pipe elbow insulation" or "enclose or encapsulate damaged ceiling tile," where the location of the material is not specified. Generic recommendations provide much less useful guidance to the school than specific recommendations.

A similar picture emerged when we computed our findings based on the number of buildings with ACBM instead of the number of recommendations. Ninety-eight percent (± 1%) of the buildings had appropriate response actions recommended, and 70 percent (± 9%) of the buildings had generic recommendations.

Evaluation of Remediations Conducted. An estimated 246,260 **remediations** were performed in approximately 36,390 school buildings, through Spring 1990. This represents 21 percent of the nation's school buildings with ACBM.[1] As shown in Exhibit 4-2, 16 percent of the nation's school buildings have had one or more removals of ACBM, while 6 percent have had some ACBM repaired, and fewer have had encapsulation or enclosure. Ninety-two percent (± 7%) of the remediations that were visually evaluated were judged to be adequate.

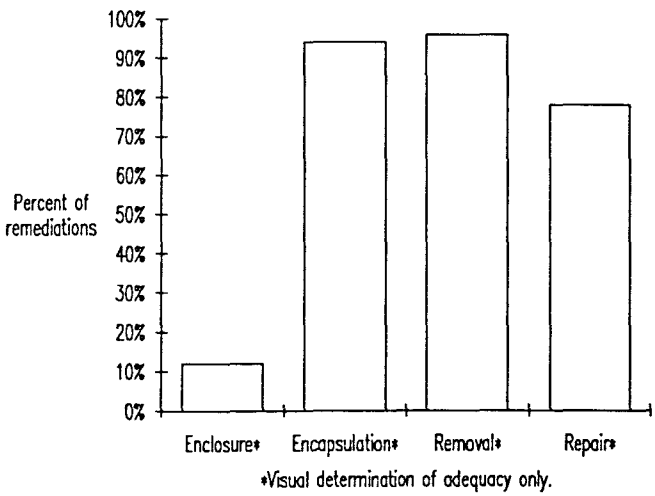
[1]Remediation includes enclosure, encapsulation, removal, and repair and does not include Operations and Maintenance.

Exhibit 4-2.
Percent of school buildings with 1 or more remediations



However, Exhibit 4-3 shows that only 12 percent (± 12%) of the 4,376 performed enclosures were adequate. When "buildings" is the unit of analysis, inadequate remediations were found in 17 percent of school buildings where we were able to visually evaluate remediation efforts.

Exhibit 4-3.
Adequacy of remediations



Many methodological issues were encountered in the evaluation process. Foremost, the remediations studied occurred up to two and one-half years ago. Only the results of each remediation, and not the process, could be evaluated. Second, there are no industry-wide procedures or guidelines for assessing remediations. Even though guidelines were developed for this study, our trained inspectors were frequently asked to make judgments in the field. Finally, this study categorized remediations in four categories -- enclosure, encapsulation, removal, and repair. There are few industry-wide definitions of these terms, and they are not mutually exclusive.

5. ORIGINAL AHERA INSPECTION EVALUATION

- *Given the quality of the original AHERA inspection, as shown by a comparison between the reinspection findings and the findings presented in the management plan, what is the importance of the original AHERA inspector's training, experience, and background in inspection quality?*

This Research Area required a comparison of the reinspection findings and the findings presented in the management plan. Westat performed this comparison by assigning each inspection a rating using a scoring system developed by the EPA and the research team in consultation with our technical consultants. The original AHERA inspectors were then interviewed by telephone to gather information about their education, experience, and background. Where more than one inspector performed the original AHERA inspection, only the most senior inspector was interviewed. Statistical analyses of the relationship between the inspection scores and the inspectors' backgrounds were conducted.

We found no statistically significant associations between any measured characteristic (e.g., education) of the inspectors and the inspection scores. We suspect that this negative finding occurred because all of our information on the original AHERA inspections was obtained from reviews of the management plans. Many inspection companies use standard inspection forms and pre-programmed management plan outlines and shells. These standard forms and the outlines tend to cancel out much of the variation among individual inspectors which, in turn, negates the effects of their backgrounds.

As shown below, sub-elements of this comparison -- the ratings found for the AHERA inspections and the assessment of inspectors backgrounds -- were interesting in their own right.

The inspection scoring system developed for this Research Area identified six factors to measure dimensions of the quality of the inspection and rated each material found using these criteria. Each suspect **material** in a school building was scored on a scale from 0 to 40 according to the original AHERA inspector's performance on these six components. The percentage following each factor represents the frequency with which each criterion was met.

The items are listed in descending order of importance.

- Was the suspect homogeneous material identified? (70%, ± 5%))
- Was the material assessed appropriately? (67%, ± 4%)
- Did the inspector identify at least 80 percent of the areas in the school with the material? (42%, ± 7%)
- Was at least 80 percent of the material quantified? (41%, ± 8%)
- Were the correct number of bulk samples taken? (68%, ± 5%)
- Were the AHERA designated assessment categories used appropriately? (31%, ± 6%)

These findings are consistent with those in Chapter 2 where we reported that 70 percent of all homogeneous suspect materials was identified by the original AHERA inspectors. Once a material was identified, nearly all inspectors assessed it appropriately and took the correct number of bulk samples. Approximately 60 percent of materials was adequately located and quantified.

The material scores were then averaged to obtain a **school average inspection score**. The percentage of inspections in each score category is listed below.

16% Thorough inspection

On average, 16 percent (± 5%) of inspections satisfied the four most important components, but may have failed on one or both of the other two components.

46% Some deficiencies

On average, 46 percent (± 10%) of inspections satisfied the two most important factors, but failed either to accurately quantify the material or to adequately locate it.

17% Deficient

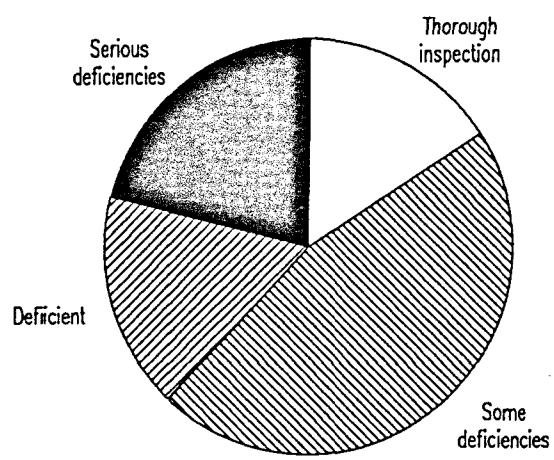
On average, 17 percent (± 6%) of inspections satisfied the two most important factors, but neither accurately quantified the material nor adequately located it.

21% Serious deficiencies

On average, 21 percent (± 6%) of inspections failed to identify the material or assess it appropriately. Inspections may have also failed to adequately quantify or locate the material.

Exhibit 5-1 displays the average scores graphically.

Exhibit 5-1.
School Average Inspection Scores



The primary causes of deficient inspections were failure to identify all suspect material in a school, to record the locations of the ACBM, or to quantify it within acceptable standards of accuracy. The percentage of "thorough inspections" declines as the number of materials increases, from 29 percent (± 12%) in schools with one to five materials, to 8 percent (± 8%) in schools with nine or more materials. Similarly, the percentage of "seriously deficient" scores increases as the number of materials increases.

The methodology used to create average inspection scores balanced competing concerns. The system began with a score applied to each homogeneous suspect material identified in the reinspection. Extreme care was taken to account for differences in inspection terminology, protocol, and reporting format. To allow some leeway, credit was given if the original AHERA inspection reported a material present in at least 80 percent of the areas in which the reinspection found the material. Likewise, credit was given if the original AHERA inspection reported a total quantity of a specific material which was within 20 percent of the quantity found by the reinspection. Finally, the scoring procedure gave full credit to the original inspection when asbestos materials had been totally removed or otherwise abated.

Inspector Experience. All original AHERA inspectors had AHERA accreditation, had conducted asbestos inspections for a median 14 months, and had inspected a median 45 schools. In addition, 65 percent (± 10%) had non-AHERA training in asbestos, 50 percent had finished college, and 46 percent had experience in building trades, environmental occupations, architecture, or engineering. A few inspectors were professional engineers (PE), certified industrial hygienists (CIH), registered architects (RA), or certified safety professionals (CSP).

6. PROCESS OF NOTIFICATION

- *Who has been notified?*
- *Were these people notified through a letter, meeting, article in a school newspaper, or in another way?*
- *After notification occurred, did parents review the management plan, attend meetings to discuss asbestos in the school, or respond to notification with any other action?*
- *What might parent and staff reactions be to differently worded notification letters?*

The goal of this Research Area was to study parent and teacher reactions to notification. Through interviews and focus groups with principals, teachers, and with parents who are active in their school's PTA, the topic of notification was studied with consistent results. In general, while principals recalled notifying parents about the presence of a management plan, parents and teachers often did not recall either being notified or the contents of the notification. Specifically, 50 percent of parents and 23 percent of teachers said they did not receive or remember receiving notification about AHERA. By contrast, 82 percent of principals said that they had sent these notifications. In the schools where school principals did recall notification, 66 percent (± 10%) reported that parents were notified more than once. However, of those who remembered being notified, teachers in 62 percent (± 8%) of schools and parents in 51 percent (± 8%) of schools recalled being notified more than once.

Letters were the most common notification method. For those who recalled being notified, there were some serious differences in principals' and parents' recall of the presence of various important elements in the notifications. While 84 percent (± 7%) of principals recalled notifying parents of the availability of a management plan, parents recalled that only 27 percent (± 7%) of schools sent this information.

In the focus groups, Westat learned that both parents and teachers believe letters are the most effective method of notification, particularly if mailed rather than hand-delivered to parents by students.

Both the survey and the focus groups showed that **parent reactions to notification** tended to be slight. According to the survey, parents in less than 20 percent of schools reacted to notification in any way. In the focus groups, almost no one recalled reacting to notification, and only a handful of participants predicted that they would react to any of the model notifications presented to them. Among those who did react or predicted that they would react, both in the survey and focus groups, the range of actions was very small. They included only such activities as reviewing the management plan, calling the ADP for additional information or, at the most severe, requesting that a discussion of asbestos be added to a meeting agenda.

Through the use of focus groups, Westat also explored preferences for types of notification. Both parents and teachers were eager for a more thorough level of notification than they had experienced to date. Specifically, they wanted a school-based notification mailed to each parent. They wanted this letter to contain the name and telephone number of the ADP (or other school representative such as the principal), a description of any planned response actions and the associated timetable, and brief but informative health risk information.

7. MAINTENANCE & CUSTODIAL WORKER TRAINING AND EXPERIENCE

- *Are maintenance and custodial workers trained to work with and around asbestos?*
- *What topics were included in this training?*
- *What tasks relative to asbestos or suspect ACBM are regularly required of maintenance and custodial workers, and do these tasks correspond to the level of training received?*

This Research Area assessed the level of training and types of work responsibilities of maintenance and custodial personnel. Two different research methods were used: in-person interviews with AHERA designated persons and a qualitative data collection effort. The qualitative effort consisted of focus group interviews in five locations with maintenance workers and custodians from schools where asbestos was present. In each group there was a mix of maintenance workers and custodians who worked in various types of schools.

Maintenance workers, by definition, are responsible for repair and upkeep of systems such as plumbing, heating ventilation, and air conditioning. Custodians by definition are responsible for janitorial jobs and, in some cases, minor maintenance such as changing light bulbs. AHERA requires all members of a school's maintenance and custodial staff who may work in a building that contains ACBM to receive awareness training of at least two hours, whether or not they are required to work with ACBM. Moreover, AHERA requires that all staff who conduct any activities that will result in the disturbance of ACBM receive 14 hours of additional training beyond that required for awareness (a total of 16 hours).

Even though a person is classified as a maintenance worker, he or she may not perform the traditional maintenance worker activities. Conversely, custodians in some schools perform more traditional maintenance worker activities.

Training of Maintenance and Custodial Workers

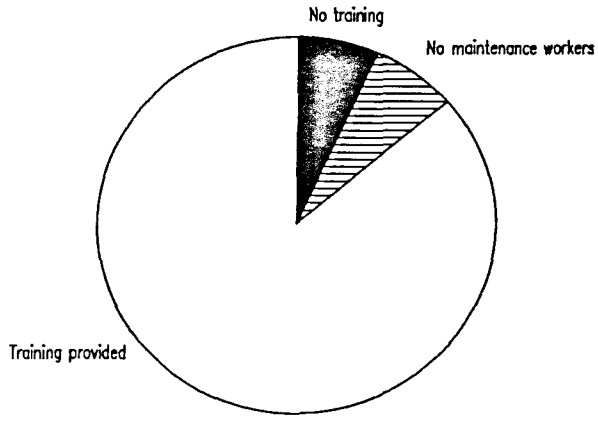
The first question in this Research Area considered training of maintenance and custodial workers. The issues were addressed through an in-person survey of the ADP from each sampled school and through focus groups with maintenance and custodial workers.

Survey Results. The survey results presented for this Research Area are based on the estimated 83,840 schools nationally that performed an AHERA inspection, found asbestos-containing materials, and wrote a management plan.

The level of training reported by the ADPs may not reflect that actually received by maintenance workers and custodians. The ADPs may be motivated to overreport the number of training courses to show a greater level of compliance with the AHERA regulation than actually occurred. Also, there may be a difference between the percentage of schools that offer training and the percentage of maintenance workers and custodians actually trained (e.g., due to absenteeism, not all maintenance workers or custodians in a school will be trained through any given course).

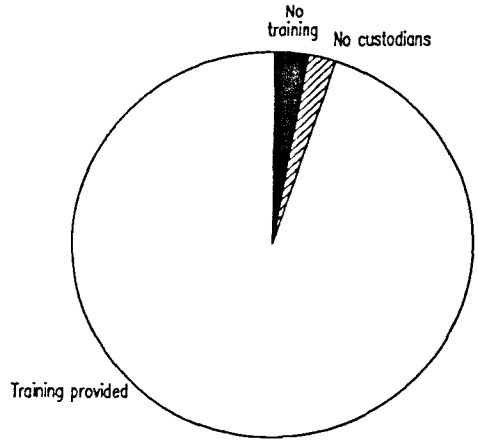
In general, ADPs reported that the length of training received by maintenance workers was somewhat below that required by AHERA for workers who work directly with ACBM. Specifically, 87 percent (± 9%) of schools provided asbestos-related training to maintenance workers in the post-AHERA period, while 7 percent (± 5%) offered no training, and 7 percent (± 6%) of schools did not have this type of employee (see Exhibit 7-1).

Exhibit 7-1.
Percent of schools providing some training to maintenance workers



Training for custodial workers was not statistically different than that for maintenance workers. Ninety-five percent (± 6%) of schools had conducted training classes that met the AHERA requirement for awareness training for custodial workers since October 1987 (Exhibit 7-2). Three percent offered no training, and 2 percent of schools did not hire any custodians.

Exhibit 7-2.
Percent of schools providing some training to custodians



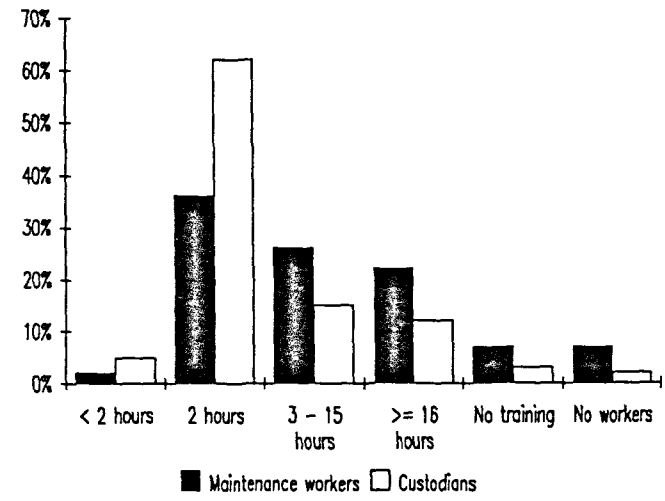
Schools that did not provide training may not employ staff requiring training under AHERA. For instance, if a worker's responsibilities do not require work in a building with ACBM, he or she may not require training. Statistical information about worker responsibilities cannot be learned from the AHERA evaluation.

A closer look at the training of maintenance and custodial workers employed by the school district shows that 85 percent (± 10%) of schools have conducted both maintenance worker and custodial training since October 1987. Three percent (± 3%) of schools have not trained either their maintenance or custodial workers at all.

The duration of training received by custodians and maintenance workers varied. Twenty-two percent (± 5%) of schools that trained their maintenance workers provided 16 or more hours of training. AHERA requires 16 hours of training for staff with traditional maintenance worker responsibilities in schools in which asbestos-containing materials were found. Workers not required to work in any buildings with ACBM could require less than the 16-hour training mandated by AHERA.

Eighty-nine percent (± 5%) of schools trained custodians two hours or longer or, stated differently, nine out of ten schools' custodial training courses are in compliance with the AHERA guidelines for the length of awareness training required for workers who do not come into contact with ACBM. Exhibit 7-3 shows that five percent (± 6%) of the courses were under two hours, indicating that a small percentage of schools does not meet the minimum length requirement for AHERA awareness training. On the other hand, 12 percent (± 8%) of custodians received a 16-hour training, indicating the school's awareness that some custodial workers do come into direct contact with ACBM.

Exhibit 7-3.
Percent of schools providing various lengths of training to maintenance and custodial workers



Maintenance and Custodial Worker Focus Group Results. A majority of the maintenance workers who participated in the focus groups reported receiving at least the AHERA-required hours of training, given their specific job responsibilities. However, there were workers who work with and potentially disturb ACBM and received only an awareness training. These workers' training did not meet AHERA requirements relative to their job responsibilities. In addition, there were few maintenance workers who received no training at all, but were simply told not to work near asbestos. Since these workers reported working in buildings with ACBM, they should have received an awareness course at a minimum.

Most custodians reported receiving two to four hours of training since October 1987 and thus met or exceeded the required level of awareness training. However, many custodians also reported disturbing ACBM and said they had not received the AHERA-required 16-hour minimum training.

Curriculum of Training

The second question in this Research Area considered training curriculum and was addressed through in-person interviews with ADPs and focus group discussions with maintenance and custodial workers. Survey results are presented for schools that employ their own maintenance and custodial workers.

Survey Results. This study examined course content from the perspective of whether training included a description of the locations of ACBM. Up to 25 percent (± 8%) of schools did not include such a description for their maintenance workers. Moreover, 18 percent (± 7%) of the schools did not describe the locations of ACBM to their custodians.

Of the courses that did provide location description, three methods stand out. The most common method of presentation was through a verbal description of the locations of ACBM in the school. Ninety-two percent (± 4%) of the schools used this method in training maintenance workers, while 91 percent used it for training custodians (± 5%). The second most common method was presenting the floorplan of the building [81% (± 10%) for maintenance workers and 75% (± 11%) for custodians]. Third, approximately half of the schools provided a walkthrough to both types of workers. These methods do not total 100 percent as schools often used more than one training method.

Maintenance and Custodial Worker Focus Group Results. Many maintenance workers and custodians reported course content as consistently containing similar items. Maintenance workers who received 16 hours of training were told about the health effects of asbestos and were presented the standard information for an awareness course. Most were shown some safety procedures to follow when working around asbestos. Whenever films, videos, or slides were used, a knowledgeable person was present to answer questions. In a few situations the workers recalled that the location of ACBM was discussed during the training.

Based on discussion in the focus groups, it appears that the curriculum meets the requirements outlined by AHERA, though the lack of knowledge about specific locations of ACBM suggests that it may be inadequate for promoting good work practices.

Many of the participants stated that they did not believe they retained much of the training information.

Approximately half the maintenance workers received training on respirator use, learning how to perform positive and negative pressure testing. However, none of these people were fit-tested by the Occupational Health and Safety Administration (OSHA) definition of the term, and virtually none met OSHA's medical examination and other requirements for respirator use. No custodians, whatever their responsibilities around ACBM, reported receiving respirator training or having access to a respirator.

Tasks Required of Maintenance and Custodial Workers

The third question in this Research Area considered the tasks relative to asbestos or suspect ACBM regularly required of maintenance and custodial personnel, and whether tasks corresponded to the level of training received. This topic was addressed solely through focus group discussions with maintenance and custodial personnel.

Maintenance and Custodial Personnel Focus Group Results. Although the length of training appears adequate for both types of workers, the focus group findings show that frequent unprotected and inappropriate work practices are used in schools in the five communities in which focus groups were held. On the whole, these inappropriate work practices were performed while cleaning up fiber release episodes of less than three linear or square feet, or as routine maintenance/custodial activities. Because the workers were unaware that a material might contain asbestos, because of inadequate or no training, or because of pressure to act immediately in an "emergency" situation (such as a leaking roof), it is almost certain that exposure to asbestos occurs and that appropriate procedures are followed in only a few cases. Most workers did not express concern that they might disturb asbestos and create a health hazard when they removed suspended ceiling tiles or brushed against insulated pipes. ACBM was seen as being disturbed only when it was sawed, cut, or in some other way visibly damaged.

Many maintenance and custodial workers reported being concerned about the security of their jobs if they "say anything about asbestos" or take the time to follow appropriate working practices around asbestos. Only one maintenance worker claimed to have faced the loss of his job over asbestos issues, though other workers expressed concern for job security.

8. GLOSSARY

ACBM: Asbestos-containing building material is surfacing ACM, thermal system insulation ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a building.

ACM: Asbestos-containing material is, when referring to school buildings, any material which contains more than one percent asbestos.

Activity Plans: Written procedures in a school's management plan which detail the steps an LEA will follow in performing the initial and additional cleaning, operations and maintenance program tasks, periodic surveillance, and reinspections required by AHERA.

AHERA Designated Person (ADP): A person designated by the Local Education Agency to ensure that the AHERA requirements are properly implemented.

Assessment (1-7): Evaluation of the physical condition and potential for damage of all friable ACM and thermal system ACM. AHERA requires classification of each ACBM assessed into one of seven categories based on material type and damage/potential for damage.

Bulk Sample: A small portion (usually about thumbnail size) of a suspect asbestos-containing building material collected by the asbestos inspector for laboratory analysis to determine asbestos content.

Encapsulation: The treatment of asbestos-containing material (ACM) with a liquid that covers the surface with a protective coating or embeds fibers in an adhesive matrix to prevent the release of asbestos fibers.

Enclosure: An airtight, impermeable, permanent barrier around asbestos-containing material to prevent the release of fibers.

Exclusion: One of several situations which permit a LEA to delete one or more of the items required by AHERA, e.g. records of previous sample collection and analysis may be used by the accredited inspector in lieu of AHERA bulk sampling.

Friable: Material that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Functional Space: Under AHERA, a room, group of rooms, or homogeneous area designated by a person accredited to prepare management plans, design abatement projects, or conduct response actions.

Homogeneous Area: In accordance with AHERA definitions, an area of surfacing material, TSI, or miscellaneous material that is uniform in color and texture.

Local Education Agency (LEA): An educational agency at the local level that exists primarily to operate schools or to contract for educational services. This includes primary and secondary public and private schools.

Management Plan: A document that each Local Education Agency is required to prepare under AHERA regulations. This document describes all activities planned and undertaken by a school to comply with AHERA regulations, including: building inspections to identify asbestos-containing materials, response actions, and operations and maintenance programs to minimize the risk of exposure to asbestos in school buildings.

Material Category: Broad classification of suspect materials into TSI, surfacing material, and miscellaneous material.

Material Type: Classification of suspect material by its specific use or application, e.g., pipe insulation, fireproofing, and floor tile.

Miscellaneous Material: Interior building material on structural components, such as floor or ceiling tiles. Does not include TSI or surfacing material.

Operations and Maintenance Program (O&M): Program of work practices to maintain friable ACBM in good condition, ensure cleanup of asbestos fibers previously released, and prevent future release by minimizing and controlling friable ACBM disturbance or damage.

Original AHERA Inspection/Original Inspection/Inspection: Examination of school buildings arranged by Local Education Agency, pursuant to AHERA, to identify asbestos-containing materials, evaluate the condition of those materials, and take samples of materials suspected to contain asbestos. Inspections are to be performed by inspectors accredited by the EPA.

OSHA: Occupational Safety and Health Administration.

PSU: Primary Sampling Unit, a geographic area, usually a county or group of counties, defined by the Census Bureau for survey sampling purposes.

Random Sample: Method of collecting bulk samples of asbestos that assures statistical randomness.

Reinspection: The examination of homogeneous materials in which an original AHERA inspection has been performed previously. For this study, reinspections were performed without knowledge of the results of the original AHERA inspection.

Remediation: For the AHERA evaluation, repair, encapsulation, enclosure, or removal of greater than 3 linear feet or square feet of ACBM.

Removal: The taking out or stripping of ACBM from an area, a functional space, or a homogeneous area.

Repair: Procedures used to patch or cover damaged asbestos-containing materials other than enclosure or encapsulation. Examples include covering the damage with plastic sheeting, duct tape, or plaster.

Response Actions: Any of the following actions taken in school buildings in response to AHERA, to reduce the risk of exposure to asbestos in school buildings: removal, encapsulation, enclosure, repair, and Operations and Maintenance.

Surfacing Material: Material sprayed or troweled onto structural members (beams, columns or decking) for fire protection; or on ceilings or walls for fireproofing, acoustical or decorative purposes. Includes fireproofing, textured plaster, and other textured wall and ceiling surfaces.

Suspect Material: Building material suspected of containing asbestos because of past practices in its manufacture and use; includes surfacing material, floor tile, ceiling tile, thermal system insulation, and miscellaneous other materials. Suspect materials are classified as ACM or non-ACM by analyzing bulk samples to determine asbestos content.

TSI: Thermal System Insulation; i.e., insulation applied to steam and hot and cold water systems and HVAC systems to prevent heat transfer and water condensation. Includes pipe insulation; pipe joint, valve, fitting and elbow insulation; and insulation applied to boilers, water tanks, compressors, air-handling equipment, radiators, ducts, etc.