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AHERA Clearance at Twenty Abatement Sites

PEI Associates, Inc., Cincinnati, OH

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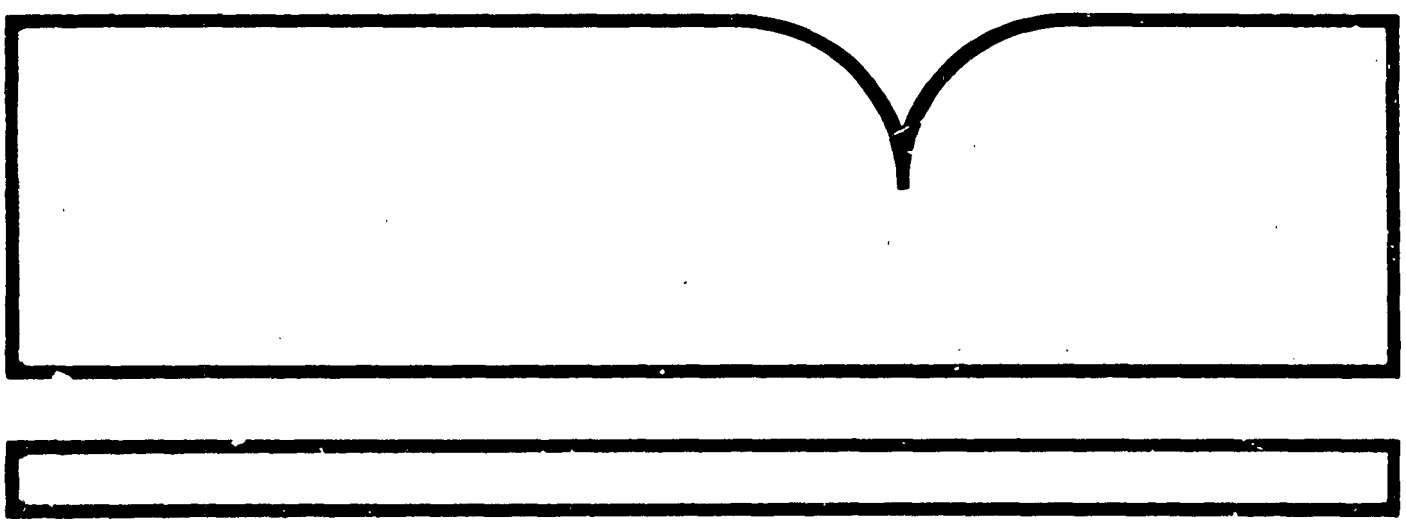

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AHERA CLEARANCE AT TWENTY ABATEMENT SITES

by

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16. ABSTRACT

A study was conducted during the summer of 1988 to document Asbestos Hazard Emergency Response Act (AHERA) clearance air-sampling practices and clearance concentrations of airborne asbestos at 20 asbestos-abatement sites in New Jersey. Each abatement took place in a school building and involved removal of surfacing material, thermal system insulation, or suspended ceiling tiles. The study shows that AHERA sampling and analytical requirements and recommendations are not completely understood and followed by consultants conducting clearance air monitoring. AHERA clearance discrepancies exist between sample analyses reported by consultants representing the building owners and those reported independently by the New Jersey Department of Health/U.S. Environmental Protection Agency. The study further suggests that the choice of a clearance reference point may determine whether a site is considered acceptable for occupancy.

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Asbestos cement products	Non metalliferous minerals	
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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of materials that, if improperly dealt with, can threaten both public health and the environment. The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. These laws direct the EPA to perform research to define our environmental problems, to measure the impacts, and to search for solutions.

The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research, development, and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

This report provides information on Asbestos Hazard Emergency Response Act (AHERA) clearance air-sampling practices and final clearance concentrations of asbestos at 20 asbestos-abatement sites in New Jersey.

E. Timothy Oppelt, Director
Risk Reduction Engineering Laboratory

ABSTRACT

A study was conducted during the summer of 1988 to document Asbestos Hazard Emergency Response Act (AHERA) clearance air-sampling practices and clearance concentrations of airborne asbestos at 20 asbestos-abatement sites in New Jersey. Each abatement took place in a school building and involved removal of surfacing material, thermal system insulation, or suspended ceiling tiles. The study shows that AHERA sampling and analytical requirements and recommendations are not completely understood and followed by consultants conducting clearance air monitoring. AHERA clearance discrepancies exist between sample analyses reported by consultants representing the building owners and those reported independently by the New Jersey Department of Health/U.S. Environmental Protection Agency. The study further suggests that the choice of a clearance reference point may determine whether a site is considered acceptable for occupancy.

PEI Associates, Inc., submitted this report to the U.S. Environmental Protection Agency's Risk Reduction Engineering Laboratory in fulfillment of Contract Nos. 68-03-4006 and 68-CO-0016. The report covers the period June 1988 to September 30, 1990, and work was completed as of September 30, 1990.

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SECTION 1

INTRODUCTION

Background

As required under the Asbestos Hazard Emergency Response Act (AHERA) of 1986, the U.S. Environmental Protection Agency (EPA) has promulgated a final rule regarding inspections, abatement, and management of asbestos-containing materials in schools (40 CFR Part 763). The rule describes procedures for determining when critical containment barriers can be removed.

After the abatement work site has passed a thorough visual inspection, clearance air monitoring is conducted. Before the air monitoring is begun, floors, walls, and ceilings should be swept with the exhaust of a 1-hp (minimum) leaf blower. Stationary fans, with the air directed towards the ceiling, must be used to provide continuous air circulation in the workplace. In most cases, air monitoring samples are analyzed by transmission electron microscopy (TEM). Air samples must be collected on either 0.4-micrometer (μm) (or smaller) pore-size polycarbonate or 0.45-μm (or smaller) pore-size mixed cellulose ester membrane filters contained in a three-piece cassette. For 25-millimeter filters, sampling rates between 1 and 10 L/min must be used to achieve a recommended air volume of 1200 to 1800 L. Under certain circumstances (depending on the size and nature of the abatement project), a site may be cleared by phase contrast microscopy (PCM).

The AHERA TEM clearance criterion is primarily comparative in nature; i.e., it is based on a comparison of airborne asbestos concentrations inside the abatement work area with those outside the abatement work area but not necessarily outside of the building.[1] Although indoor air samples may be collected when air intake to the abatement site is primarily from other areas of the building, outdoor samples are normally recommended because they are less likely to be affected by work practices that might contaminate other areas inside the building. The AHERA clearance test requires the collection of a minimum of five samples inside the abatement area and five samples outside of the area. A statistical test (the Z-test) is then used to determine if the average concentrations inside the area are higher than those outside. If the Z statistic

is less than or equal to 1.65, the site passes the clearance test and is considered acceptable for reoccupancy.

The AHERA Z-test is preceded by two preliminary tests--an initial screening test and a blank contamination test. The initial screening test compares the average filter concentration of the five samples collected inside the abatement area against a value of 70 structures per square millimeter (s/mm^2). If the average filter concentration is less than or equal to 70 s/mm^2, the work area passes the clearance test without analysis of the outside samples being required. If the work area samples do not pass the screening test, a minimum of three blanks (filters through which no air has been drawn) are analyzed to check for the possibility of filter contamination that would distort the test results.

A joint research effort by the U.S. EPA's Office of Research and Development, Risk Reduction Engineering Laboratory, and the New Jersey Department of Health (NJDOH) was conducted during the summer of 1988 to document Asbestos Hazard Emergency Response Act (AHERA) clearance air-sampling practices and clearance concentrations of airborne asbestos at 20 asbestos-abatement sites in New Jersey. Each abatement took place in a school building and involved removal of surfacing material, thermal system insulation, or suspended ceiling tiles.

Objectives

The primary objectives of this study were as follows:

- To document the AHERA clearance air-sampling practices used at 20 asbestos-abatement sites.

- To assess the final clearance concentrations of airborne asbestos at 20 abatement sites.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following are the principal conclusions reached during this study:

1) Consultants who conduct clearance air monitoring often do not completely understand and follow the AHERA sampling and analytical requirements and recommendations. The following clearance air sampling and analytical practices were noted at 20 asbestos-abatement sites:

   - At 18 of the sites (or 90%), the required five clearance air samples were collected inside the abatement area.
   - At 15 of the sites (or 75%), required sampling medium (i.e., 0.4-μm pore size, polycarbonate filter or 0.45-μm pore-size mixed cellulose ester filter) was used to collect clearance air samples.
   - At 18 of the sites (or 90%), recommended air sampling flow rates were used.
   - Twelve of the sites (or 60%) met the EPA-recommended drying time of 24 hours after final cleaning was completed and before final clearance air monitoring was conducted.
   - At 19 sites where aggressive air sampling techniques were used, only 5 of the sites (or 25%) met the EPA-recommended aggressive air-sweeping rate of at least 5 minutes per 1000 square feet of floor area.
   - At only 5 of the sites (or 25%), the recommended number of circulating fans were used during final clearance air monitoring.

2) AHERA clearance concentration discrepancies exist between results of sample analyses reported by the Asbestos Safety Control Monitor (ASCM) firms employed by the building owner and those reported independently by

NJDOH/EPA. Twelve abatement sites (60%) would have failed the AHERA initial screening test had the NJDOH/EPA sample analyses been used. Ten of these sites would have subsequently failed the AHERA Z-test.

3) The choice of either perimeter or outdoor samples as the "outside values" in the AHERA Z-test is critical in determining if an area is acceptable for occupancy. EPA sample analyses showed that two sites would have passed the AHERA Z-test if perimeter samples had been used as the "outside values," but would have failed had outdoor samples been used.

4) Although the general trend indicating increased asbestos concentrations after abatement (compared to preabatement concentrations at nine sites) was statistically significant, only three of the seven apparent increases were statistically significant on an individual basis.

Recommendations

The following recommendations are based on the preceding conclusions:

1) A comprehensive guidance document should be developed that addresses the procedures and protocols of AHERA air monitoring. Improper final clearance air monitoring resulted partly from a lack of understanding of AHERA air monitoring procedures. The contractors expressed concern that the current EPA-recommended protocols are contained in more than one document, which makes them difficult to understand completely. The contractors and ASTs recommended the preparation of a single guidance document containing both procedures and protocols for proper AHERA clearance air monitoring. This document would supplement existing EPA guidance (Guidelines for Conducting the AHERA TEM Clearance Test to Determine Completion of an Asbestos Abatement Project--EPA 560/5-89-001) which emphasizes interpretation of AHERA clearance results.

2) Outdoor ambient air samples are strongly recommended as the "outside values" in the AHERA Z-test because they are less likely to be affected by work practices that may contaminate other areas inside the building.

3) Followup air monitoring should be conducted at those sites that would have failed AHERA clearance based on the sample results reported by NJDOH/EPA. This followup monitoring will determine whether these airborne asbestos concentrations may currently be present at these sites. The results of this study may help direct future research efforts aimed at characterizing the effectiveness of asbestos abatement programs and at evaluating the need for EPA guidance on post-abatement management practices.

4) The inconsistent AHERA clearance sampling and analysis results obtained by monitoring firms and TEM laboratories should be investigated further in context of the new training and NAVLAP certification requirements to determine if further corrective measures are needed. EPA's Office of Toxic Substances is working in this area. In the interim, every effort should be made to encourage compliance with the AHERA sampling and analytical methods.

5) The persistent elevated asbestos concentrations found in perimeter and ambient areas require further definition to determine the sources and to identify the appropriate corrective measures. Research proposed by RREL for FY '91 includes assessing methods of field testing the HEPA negative-air units. In the interim, the need for strict adherence to containment practices prescribed in the AHERA regulations should be emphasized.

SECTION 3

STUDY DESIGN AND METHODS

Site Selection

Although selection of the 20 asbestos-abatement projects was based largely on availability, each site also met the following criteria:

1) Each abatement project was in a school building.

2) The abatement project involved one or more of the following: a) removal of sprayed- or troweled-on surfacing material; b) removal of thermal system insulation from mechanical equipment (i.e., boilers, tanks, heat exchangers, pipes, etc.); or c) removal of suspended ceiling panels.

3) The abatement project was governed by written specifications prepared to be in compliance with the minimum requirements of the State of New Jersey Asbestos Hazard Abatement Subcode (N.J.A.C. 5:23-8) and EPA guidance[2] for work practices and procedures to be used in performing asbestos-abatement projects.

4) The abatement project was cleared in accordance with the sampling protocol specified in the AHERA final rule (40 CFR Part 763).

Site Documentation

At each site, background information describing the abatement area and the ACM abated and other miscellaneous information were obtained by interviewing an Asbestos Safety Technician (AST) certified by the New Jersey Department of Community Affairs and employed by an Asbestos Safety Control Monitor (ASCM) firm. The ASCM is employed by the School District or Local Education Agency. The AST continuously monitors and inspects the asbestos-abatement project in accordance with the Asbestos Hazard Abatement Subcode (N.J.A.C. 5:23-8). The AST must be on the job site continuously during the abatement project to assure that the work is performed in accordance with the regulations specified in the Asbestos Hazard Abatement Subcode.

The following information was gathered to document the AHERA clearance air-sampling practices used by the ASCM firm at each site:

1) Conditions of sampling, i.e., aggressive versus nonaggressive sampling and use of circulating fans to maintain air circulation during clearance sampling.

2) Air sampling methods, i.e., filter medium, type of filter cassette, sampling rate, sample volume, and location of air samplers.

3) The AST's project report on the onsite supervision and AHERA clearance air monitoring.

Air Sampling Strategy

Table 1 shows the number and type of air samples collected at each site. Preabatement air samples were collected in the perimeter area (i.e., outside the intended work area but inside the building) before the containment barriers were constructed and outdoors. The preabatement samples were collected to determine whether the abatement action significantly affected the airborne asbestos concentrations in these areas. The preabatement sampling was conducted under static conditions (i.e., activity in the area was minimal, and the heating, ventilation, and air-conditioning system was not operating. Preabatement sampling was possible at only nine sites because of difficulties encountered in identifying sites that met the selection criteria. At eight of the nine sites (Sites B through G, S, and T), five samples were collected both in the perimeter of the intended abatement work area and outdoors. At Site P, three samples were collected in the intended abatement work area, two samples in the perimeter, and five samples were collected in the outdoors. The configuration of the building and the areas specified for abatement necessitated collection of the samples in the intended abatement area at Site P.

Postabatement air samples were collected at 20 abatement sites. Five area air samples were collected in each of three areas: the abatement work area, the perimeter, and outdoors. The samples were collected at approximately the same time and location (within a radius of 5 feet) as those samples collected by the AST for AHERA clearance of the site. In the abatement work area, samples were collected under the sampling conditions that existed during the final-clearance air sampling. The perimeter area samples were collected under static conditions.

In addition to analyses of the postabatement air samples collected by NJDOH/EPA, analyses of the postabatement clearance air samples collected by the ASCM firms were also obtained. Clearance of each abatement site was based on the results of the latter analyses.

TABLE 1. NUMBER AND TYPE OF SAMPLES COLLECTED AT EACH ABATEMENT SITE

Site	Preabatement			Postabatement		
	Work area	Perimeter	Out-doors	Work area	Perimeter	Out-doors
A	0	0	0	5	5	5
B	0	5	5	5	5	5
C	0	5	5	5	5	5
D	0	5	5	5	5	5
E	0	5	5	5	5	5
F	0	5	5	5	5	5
G	0	5	5	5	5	5
H	0	0	0	5	5	5
I	0	0	0	5	5	5
J	0	0	0	5	5	5
K	0	0	0	5	5	5
L	0	0	0[a]	5	5	5
M	0	5[a]	5[a]	5	5	5
N	0	0	0	5	5	5
O	0	0	0	5	5	5
P	3	2	5	5	5	5
Q	3[b]	2[b]	5[b]	5	5	5
R	0	0	0	5	5	5
S	0	5	5	5	5	5
T	0	5	5	5	5	5
Totals						
Samples	3	42	45	100	100	100
Sites	2	9	9	20	20	20

[a] Same samples as collected at Site C; i.e., Site M was the second abatement project at this site.

[b] Same samples as collected at Site B; i.e., Site Q was the second abatement project at this site.

Sampling Methodology

Air samples were collected on open-face, 25-mm diameter, 0.45-μm pore-size, mixed cellulose ester membrane filters with a 5-μm pore-size, mixed cellulose ester, backup diffusing filter and cellulose support pad contained in a three-piece cassette. The filter cassettes were positioned approximately 5 feet above the floor on tripods, with the filter face at approximately a 45-degree angle toward the floor. The filter assembly was attached to a 1/6-hp electric-powered vacuum pump operating at a flow rate of approximately 9 L/min. The sampling pumps were calibrated with a precision rotameter both before and after sampling. A primary calibration standard was used to calibrate the precision rotameter in the field.

Analytical Methodology

The mixed cellulose ester filters were prepared and analyzed in accordance with the nonmandatory transmission electron microscopy (TEM) method, as described in the AHERA final rule (40 CFR 763). A sufficient number of grid openings were analyzed for each sample to ensure a sensitivity (the concentration represented by a single structure) of no greater than 0.005 asbestos structure per cubic centimeter (s/cm^3) of air sampled. In addition to the requirements of the nonmandatory TEM method, the specific length and width of each structure were measured and recorded. The Public Health and Environmental Laboratories of the New Jersey Department of Health performed the TEM analyses on the field samples under a separate cooperative agreement with EPA's Risk Reduction Engineering Laboratory (RREL) in Cincinnati.

Statistical Analysis

The Wilcoxon Signed Rank test was used to evaluate differences in airborne asbestos concentrations before and after abatement.[3] The Wilcoxon test is a nonparametric statistical procedure that analyzes the relative ranks and magnitudes of the differences between paired data rather than analyzing the actual data values; this test requires fewer assumptions regarding the underlying statistical distribution of the data.

The AHERA Z-test was used to compare the final-clearance samples collected inside the abatement area with the samples collected outside the abatement work area (inside the building and outdoors).[1] The Z-test is carried out by the following calculation:

$$Z = \frac{Y_i - Y_o}{0.8(1/n_i + 1/n_o)^{1/2}}$$

where Y_i = the average of the natural log of the inside samples
Y_o = the average of the natural log of the outside samples
n_i = the number of samples collected inside the work area
n_o = the number of samples collected outside the work area

If the Z statistic is less than or equal to 1.65, the site passes the clearance test and the abatement site is considered acceptable for reoccupancy.

SECTION 4

QUALITY ASSURANCE

Sample Chain-of-Custody

During the study, sample chain-of-custody procedures were an integral part of both the sampling and analytical activities and were followed for all air samples collected. The field custody procedures documented each sample from the time of its collection until its receipt by the analytical laboratory. Internal laboratory records then documented the custody of the sample through its final disposition.

Standard sample custody (traceability) procedures were used. Each sample was labeled with a unique project identification number, which was recorded on a sampling data sheet along with other information such as sampling date, location of the sampler, sample flow rate, sample start/stop time, and conditions of sampling.

Sample Analyses

Specific quality assurance procedures outlined in the AHERA rule were used to ensure the precision of the collection and analysis of air samples, including filter lot blanks, sealed and open field blanks, and replicate and duplicate sample analyses.

Filter lot blanks, which are samples selected at random from the lot of filters used in this study, were analyzed to determine background asbestos contamination on the filters. Two laboratories each analyzed 2.5 percent of the total number of filters (2000 filters) from the lot of filters used in this research study. The filters were prepared and analyzed in accordance with the nonmandatory AHERA TEM method. The TEM analysis of the 100 mixed cellulose ester filters showed a background contamination of 0 asbestos structures per 10 grid openings on each filter.

Sealed field blanks are filter cassettes that have been transported to the sampling site and sent to the laboratory without being opened. Open field blanks are filter cassettes that have been transported to the sampling site, opened for a short time (<30 seconds) without any air having passed through the filter, and then sent to the laboratory. Two open and one sealed field blank were collected at each abatement site during the AHERA clearance phase of the abatement. Two open field blanks were

also collected during the preabatement sampling at Sites B through G, P, S, and T. Ten grid openings were examined on each filter. No asbestos structures were detected on any of the open or sealed field blanks.

The reproducibility and precision of the TEM analyses were determined by an evaluation of repeated analyses of randomly selected samples. A recount analysis was performed on 10 percent of the samples analyzed to assess the precision of the counting abilities of the microscopist. A recount analysis is a second analysis of the same field(s) performed by the same microscopist as in the original analysis. The microscopist uses the same grid preparation and recounts the same grid openings as originally read. The results of the recount analyses are shown in Table 2. A duplicate sample analysis was performed on 10 percent of the samples analyzed to assess the reproducibility of the TEM analysis and to quantify any analytical variability due to the filter preparation procedure. A duplicate analysis is the analysis of a second TEM grid prepared from a different area of the sample filter and analyzed by the same microscopist as in the original analysis. The results of the duplicate analyses are shown in Table 3.

The coefficient of variation (CV) for the recount and duplicate analyses were estimated by assuming a lognormal distribution for the data on the original scale and estimating the variance on the log scale. The variance was estimated by the mean square error obtained from a one-way analysis of variance of the log-transformed data with sample ID as the experimental factor. The coefficient of variations associated with the recount and duplicate analyses were 0.74 and 35 percent, respectively. Since the duplicate analyses used different filter preparations, a higher CV is not unexpected.

TABLE 2. DATA SUMMARY FOR RECOUNT ANALYSES[a]

Sample No.	Original analysis N[b]	Original analysis s/cm²	Recount analysis N	Recount analysis s/cm²
01P-1020	0	0	0	0
01A-4065	0	0	0	0
02P-2008	0	0	0	0
02P-2013	0	0	0	0
03A-2061	13	0.057	13	0.057
04P-5003	0	0	0	0
04A-2057	0	0	0	0
05F-8034	3	0.014	3	0.014
05A-8039	12	0.033	12	0.033
06A-20011	2	0.007	2	0.007
06P-1005	0	0	0	0
07A-2058	0	0	0	0
07A-1046	3	0.013	3	0.013
08F-3027	23	0.113	22	0.108
08A-5041	0	0	0	0
09A-4044	0	0	0	0
09A-4053	0	0	0	0
10A-6066	26	0.103	25	0.099
10A-7037	0	0	0	0
11A-5071	0	0	0	0
11A-6037	0	0	0	0
12A-7047	23	0.093	22	0.089
12A-7056	12	0.044	11	0.040
13A-9045	0	0	0	0
13A-9050	51	0.266	50	0.260
14A-10038	1	0.004	1	0.004
14A-10052	27	0.108	25	0.100
15A-9056	2	0.007	2	0.007
15A-9071	1	0.004	1	0.004
16A-11003	0	0	0	0
16A-11018	4	0.016	4	0.016
17A-10059	28	0.108	28	0.108
17A-10067	22	0.083	21	0.079
18A-30013	0	0	0	0
18A-30016	0	0	0	0
19P-7018	1	0.005	1	0.005
19A-30065	0	0	0	0
20P-6003	0	0	0	0
20P-6007	0	0	0	0

[a] The same grid openings were recounted by the same microscopist.

[b] Number of asbestos structures.

SECTION 5

RESULTS AND DISCUSSION

Site Descriptions

Table 4 describes the 20 sites where asbestos-abatement projects were evaluated. Sixteen of the abatement projects involved general occupancy areas (classrooms, offices, recreational rooms, corridors, etc.); three involved boiler rooms and mechanical equipment rooms; and one involved both of these types of areas. The ACM abated at 13 of the project sites involved surfacing material (acoustical plaster or fireproofing), the ACM at 3 sites involved both surfacing material and thermal system insulation, and the ACM at 2 sites involved suspended ceiling tiles. At 17 projects, the ACM contained chrysotile asbestos (from 2 to 93 percent); at 2 projects, amosite asbestos (from 2 to 10 percent); and at 1 project, both chrysotile (from 10 to 75 percent) and amosite (from 30 to 40 percent).

The projects involved 11 abatement contractors, 8 ASCM firms, and 5 transmission electron microscopy analytical laboratories (Table 5). No single abatement contractor, ASCM firm, or analytical laboratory was involved in more than 5, 6, or 12 projects, respectively.

Observed AHERA Clearance Practices

Aggressive Sampling

A 24-hour drying time is recommended prior to postabatement clearance air monitoring.[2] Postabatement air monitoring should be conducted under aggressive sampling conditions. The abatement area floors, walls, ledges, ceiling, and other surfaces should be swept with the exhaust from forced-air equipment (e.g., a minimum 1-hp leaf blower) to dislodge any remaining dust, and stationary fans should be used to keep fibers suspended during sampling. Current guidance on asbestos-abatement work practices and procedures recommends aggressive air-sweeping of the abatement area for at least 5 minutes per 1000 ft^2 floor area.[4] The AHERA rule recommends the use of at least one stationary fan per 10,000 ft^3 of workspace, with the air directed toward the ceiling to keep the asbestos fibers suspended during sampling.

TABLE 4. DESCRIPTIONS OF THE 20 ASBESTOS-ABATEMENT PROJECT SITES

Site	Type of ACM[a]	Abatement area	Approximate quantity of ACM, ft²	Type and percent asbestos	
				Chrysotile	Amosite
A	Acoustical plaster	General occupancy[b]	19,100	5 - 10	
B	Acoustical plaster	General occupancy	5,400	2 - 6	
C	Pipe/boiler insulation	General occupancy and boiler room	QNS[c]	40 - 60	
D	Acoustical plaster	Boiler and mechanical equipment rooms	QNS	20 - 35	
	Boiler insulation	Boiler room	QNS	40 - 60	
E	Ceiling panels	General occupancy	1,500		2 - 8
F	Pipe/boiler insulation	Boiler room	2,200	30 - 40	
G	Boiler insulation	Boiler room	QNS	10 - 75	30 - 40
H	Acoustical plaster	General occupancy	21,000	25 - 50	
	Pipe insulation	General occupancy	100	40 - 60	
I	Acoustical plaster	General occupancy	5,100	5 - 25	
J	Fireproofing	Mechanical equipment room	5,300	10 - 25	
K	Acoustical plaster	General occupancy	8,200	10 - 25	
L	Acoustical plaster	General occupancy	1,600	15 - 25	
M	Pipe insulation	General occupancy	QNS	40 - 60	
N	Acoustical plaster	General occupancy	11,000	10 - 25	
O	Ceiling tiles	General occupancy	2,100		5 - 10
P	Acoustical plaster	General occupancy	8,500	91 - 93	
	Pipe insulation	General occupancy	1,600	24 - 60	
Q	Acoustical plaster	General occupancy	5,400	2 - 6	
R	Pipe insulation	General occupancy	2,900	10 - 25	
S	Acoustical plaster	General occupancy	7,200	10 - 20	
T	Acoustical plaster	General occupancy	4,100	10 - 25	

[a] ACM = Asbestos-containing material

[b] General occupancy areas include classrooms, offices, recreational rooms, corridors, etc.

[c] QNS = Quantity of ACM not specified.

TABLE 5. ABATEMENT CONTRACTORS, ASCM FIRMS, AND ANALYTICAL LABORATORIES USED AT 20 ASBESTOS-ABATEMENT SITES

	Abatement contractor												ASCM firm									Laboratory				
Sites	1	2	3	4	5	6	7	8	9	10	11		1	2	3	4	5	6	7	8		1	2	3	4	5
A	X												X									X				
B		X												X									X			
C			X												X								X			
D			X												X								X			
E				X												X								X		
F	X															X								X		
G					X												X								X	
H			X												X								X			
I						X										X								X		
J							X											X								X
K								X											X				X			
L									X							X								X		
M			X												X								X			
N								X											X				X			
O	X														X								X			
P										X					X								X			
Q		X												X									X			
R	X																			X			X			
S	X																		X				X			
T											X						X								X	
Total	5	2	4	1	1	1	1	2	1	1	1		1	2	6	4	2	1	3	1		1	12	4	2	1

Eight of the 20 abatement sites allowed less than the EPA-recommended drying time of 24 hours after the completion of final cleaning before final clearance air monitoring was begun. The drying times for these eight sites ranged from 2 to 18 hours.

At 19 of the 20 abatement sites, aggressive sampling techniques were used. Fourteen of these 19 sites achieved less than the recommended aggressive air-sweeping rate of at least 5 minutes per 1000 ft^2 floor area. Table 6 presents actual and recommended aggressive sampling times at each of the 20 sites. Figure 1 shows the actual aggressive sampling rates per 1000 ft^2 of floor area at each site.

Only 12 of the 20 sites used stationary air fans to maintain air circulation during clearance air sampling. Box-type fans were used at nine of these sites, and pedestal-type fans were used at three sites. Fifteen of the observed sites failed to use the number of fans per given volume of workspace required by AHERA. The actual and recommended number of circulating fans for each site are listed in Table 6 and shown graphically in Figure 2.

Filter Types

Mixed cellulose ester membrane filters were used in the collection of clearance air samples at 14 of the 20 observed abatement sites. Polycarbonate membrane filters were used at six sites. The AHERA rule permits the use of either filter type; however, the pore size must be less than or equal to 0.45 μm for mixed cellulose ester filters and 0.4 μm for polycarbonate filters. At three sites, 0.8-μm pore-size mixed cellulose ester membrane filters were used to collect clearance air samples, which were not in compliance with the AHERA regulations. All filters used for clearance air monitoring were 25 mm in diameter and were contained in three-piece cassettes with a 50-mm extension cowl. Table 6 summarizes the type of filter used for clearance air sampling at each site.

Flow Rates and Air Volumes

Each filter assembly was attached to an electric-powered pump operating at a specified airflow rate. The air samples were generally collected for a set length of time to achieve a certain minimum air volume. The AHERA rule states that pump flow rates between 1 and 10 L/min may be used for 25-mm-diameter filters. This was the practice at 18 of the 20 sites observed. At two sites air samples were collected at flow rates greater than 10 L/min. These results are summarized in Table 6. Air volumes ranged from 1320 to 4161 L for the postabatement air samples collected inside and outside the abatement area at the observed sites. The AHERA rule recommends sampling between 1200 and 1800 L of air for 25-mm diameter filters.

TABLE 6. CLEARANCE SAMPLING AND ANALYTICAL PRACTICES OBSERVED AT 20 ASBESTOS-ABATEMENT SITES

	Clearance sampling			Aggressive air sweeping		Circulating fans		
Site	Flow rate, L/min	Filter type[a]	Pore size	Actual duration[b]	Recommended duration	No. used	No. recommended[c]	Analytical method[d]
A	7-19	MCE	0.8	25	96	0	28	TEM
B	≤10[e]	MCE	0.8	20	27	5	5	TEM
C	≤10	MCE	0.45	30	8	0	3	TEM
D	≤10	MCE	0.45	20	16	0	4	TEM
E	≤10	PC	0.4	30	75	6	17	TEM
F	≤10	PC	0.4	4	3	1	1	PCM
G	≤10	PC	0.4	0	10	2	2	TEM
H	≤10	MCE	0.45	30	30	0	10	TEM
I	≤10	PC	0.4	15	26	0	4	TEM
J	≤10	PC	0.4	20	27	4	8	PCM
K	≤10	MCE	0.8	20	42	4	12	TEM
L	≤10	MCE	0.45	10	8	0	28	TEM
M	9.3	MCE	0.45	60	16	2	4	TEM
N	9.5	MCE	0.45	13	55	0	3	TEM
O	≤10	MCE	0.45	34	22	2	7	TEM
P	≤10	MCE	0.45	30	43	4	4	TEM
Q	≤10	MCE	0.45	20	27	0	8	TEM
R	11-12	MCE	0.45	7	118	5	5	TEM
S	≤10	MCE	0.45	28	37	4	15	TEM
T	8	PC	0.4	15	21	4	6	TEM

[a] MCE = mixed cellulose ester; PC = polycarbonate; all filters were contained in three-piece cassettes with 50-mm extension cowls.

[b] Reported in minutes.

[c] Based on one fan per 10,000 ft^3 of work space.

[d] TEM = transmission electron microscopy; PCM = phase contrast microscopy.

[e] ≤10 indicates the flow rates were all less than or equal to 10 L/min. The minimum flow rate was not recorded.

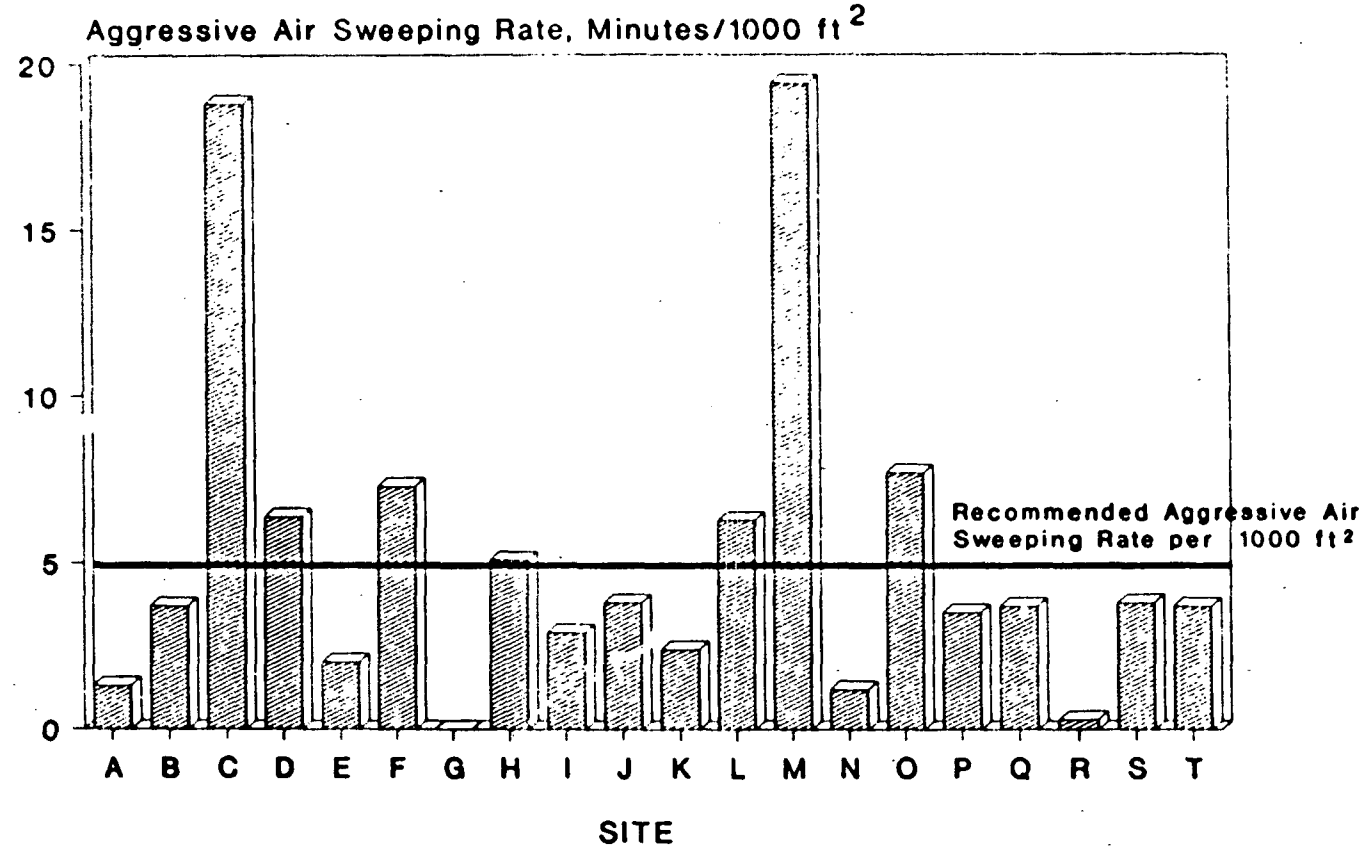

Figure 1. Observed aggressive sweeping times per 1000 square feet of floor space.

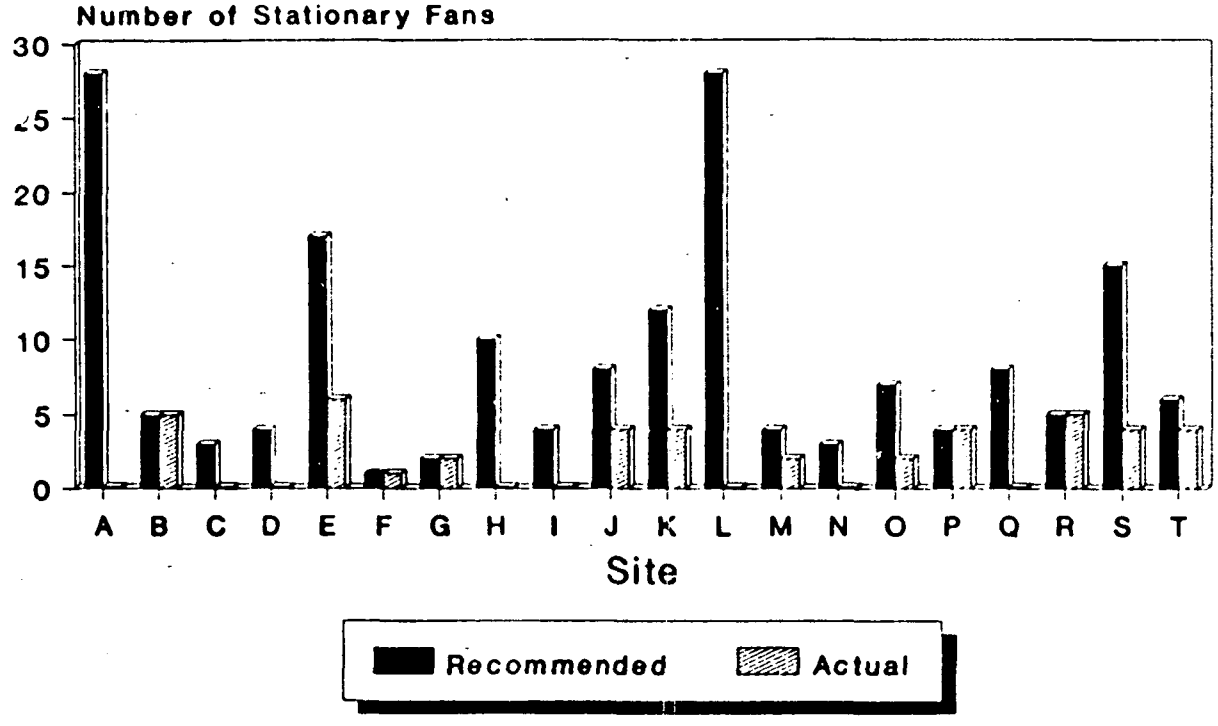

Figure 2. Recommended and actual number of stationary fans used during AHERA clearance air monitoring.

Analytical Methods

At 18 of the 20 observed sites, the laboratory reports indicated that final clearance air samples were analyzed by TEM in accordance with either the mandatory or nonmandatory TEM methods described in AHERA. At two sites, phase contrast microscopy was used to analyze the clearance air samples (Table 6). Although the samples were reportedly analyzed in accordance with NIOSH Method 7400 at these two sites, improper filters were used to collect the clearance samples (0.4-μm pore-size polycarbonate filters were used instead of the 0.8-μm pore-size mixed cellulose ester filters specified in NIOSH Method 7400).

AHERA Clearance Tests

Two sets of data were collected: 1) data collected and analyzed by the ASCM firm (which were used to declare the site clean and to release the abatement contractor); and 2) data collected and analyzed independently by NJDOH/EPA.

ASCM Sample Analyses

Table 7 summarizes the airborne asbestos concentrations measured inside the work area during AHERA clearance. Two of the 20 sites (F and J) were cleared by phase contrast microscopy (PCM). During the TEM phase-in period, AHERA permitted the use of PCM for clearance of removals involving 3000 ft^2 or less of asbestos-containing material. At least five samples were required inside the abatement area, and each had to have a fiber concentration below the limit of reliable quantitation (0.01 f/cm^3) for NIOSH Method 7400 to pass the clearance criterion Clearance by PCM was permitted at Site F because the removal involved approximately 2200 ft^2 of ACM; however, the single sample used to clear the site was not sufficient. A minimum of 5 samples is required by AHERA for clearance by PCM. Site J, which involved the removal of approximately 5300 ft^2 of ACM, was cleared by PCM analysis of two samples even though TEM clearance was required. The other 18 sites were cleared based on the results of the initial screening test. These results are summarized in Table 8.

NJDOH/EPA Sample Analyses

Airborne asbestos concentrations measured during AHERA clearance inside the work area, in the perimeter area outside the work area, and in the ambient air are summarized in Appendix A and shown graphically in Figure 3. Individual estimates of airborne asbestos concentrations measured during AHERA clearance by NJDOH/EPA are presented in Appendix B.

TABLE 7. DATA SUMMARY FOR ASBESTOS CONCENTRATIONS MEASURED FOR AHERA CLEARANCE BY THE ASBESTOS SAFETY CONTROL MONITOR FIRMS[a]

Site	No. of samples	Asbestos concentration, s/cm³ (except as noted)			
		Mean	Minimum	Maximum	Standard deviation
A	5	0	0	0	0
B	5	0	0	0	0
C	5	0.003	0	0.010	0.005
D	5	0	0	0	0
E	5	0.001	0	0.004	0.002
F[b]	1	0.004 f/cm³	0.004 f/cm³	0.004 f/cm³	0
G	5	0.010	0.008	0.016	0.004
H	7	0.001	0	0.005	0.002
I	5	0.006	0	0.027	0.012
J[b]	2	0.001 f/cm³	0 f/cm³	0.002 f/cm³	0.001
K	5	0	0	0	0
L	5	0.013	0.005	0.037	0.012
M	5	0.002	0	0.010	0.004
N	5	0	0	0	0
O	5	0	0	0	0
P	5	0	0	0	0
Q	5	0	0	0	0
R	5	0	0	0	0
S	5	0	0	0	0
T	5	0.012	0.004	0.020	0.007

[a] This data summary is for the AHERA clearance samples collected inside the abatement area.

[b] Clearance samples were analyzed by phase contrast microscopy.

TABLE 8. AHERA CLEARANCE RESULTS FROM SAMPLES COLLECTED BY THE ASBESTOS SAFETY CONTROL MONITOR FIRMS

		Initial screening results	
Site	Number of samples	Average s/mm^2	Decision[a]
A	5	0	Pass
B	5	0	Pass
C	5	44	Pass
D	5	0	Pass
E	5	10	Pass
F[b]	1	-	Pass
G	5	46	Pass
H	7	4	Pass
I	5	36	Pass
J[b]	2	-	Pass
K	5	0	Pass
L	5	48	Pass
M	5	10	Pass
N	5	0	Pass
O	5	0	Pass
P	5	0	Pass
Q	5	0	Pass
R	5	0	Pass
S	5	0	Pass
T	5	52	Pass

[a] If the average asbestos structure concentration on filters used to collect AHERA clearance samples inside the work area was less than 70 s/mm^2, the site passed AHERA clearance.

[b] Phase contrast microscopy was used to clear this site. If the average fiber concentration in samples collected inside the work area was less than 0.01 f/cm3, the site passed AHERA clearance.

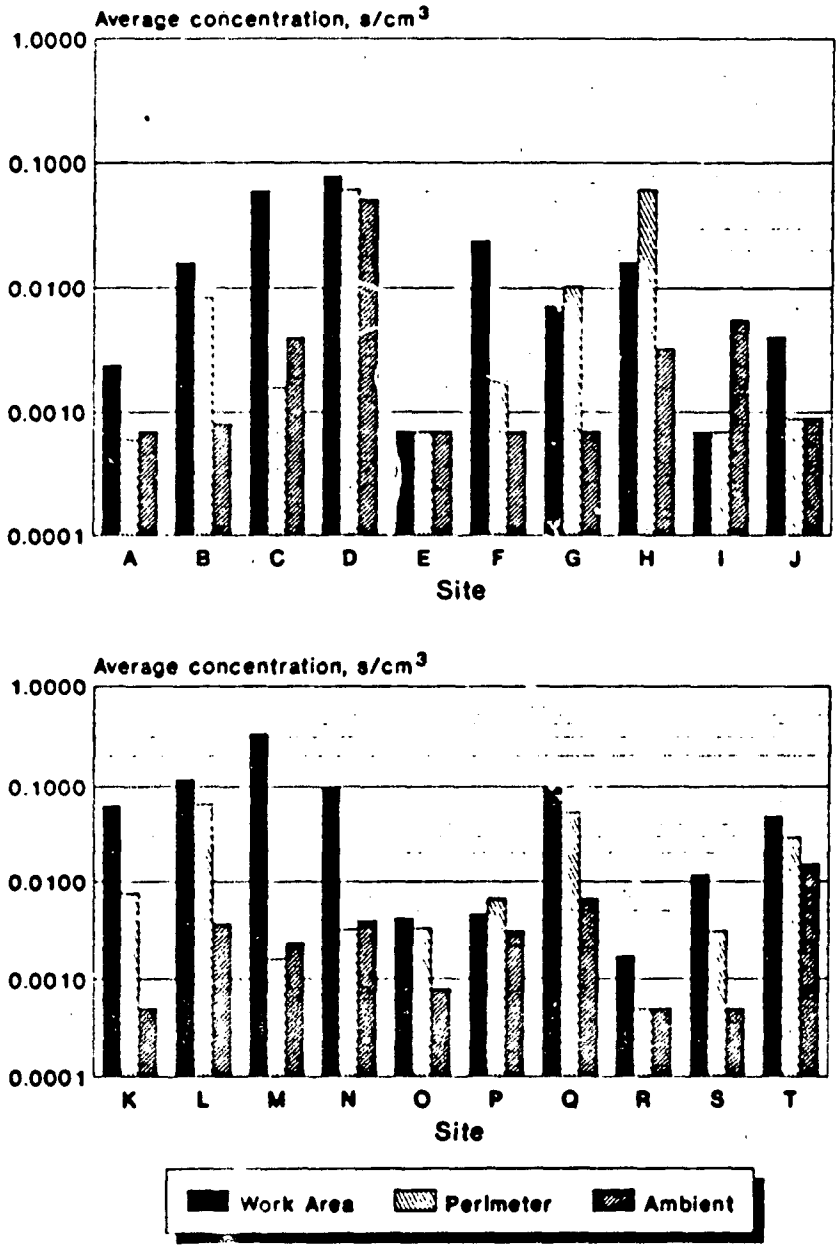

Figure 3. Airborne asbestos concentrations measured during AHERA clearance by the New Jersey Department of Health/U.S. Environmental Protection Agency.

Table 9 summarizes the results of the AHERA initial screening test and the AHERA Z-test for each abatement site based on the NJDOH/EPA samples. Twelve of the 20 sites would have failed the initial screening test had the samples collected by NJDOH/EPA been used (all 18 sites for which TEM analysis was used for clearance passed the initial screening test and were cleared for reoccupancy). Figure 4 presents a comparison of the ASCM's initial screening results and NJDOH/EPA's initial screening results. Ten of the 12 sites that would have failed the initial screening test had the NJDOH/EPA data been used would have subsequently failed the AHERA Z-test based on the ambient concentrations in the comparison. The other two sites (D and H) would have passed the AHERA Z-test, primarily because of elevated levels of asbestos in the ambient and perimeter air. The remaining eight sites would have passed both the initial screening test and the Z-test regardless of whether ambient or perimeter levels were used in the Z-test comparison.

The choice of either the perimeter area outside the work area but inside the building or the ambient air as the "outside" reference point in the AHERA Z-test would have affected the outcome of the clearance comparison at Sites B and S. In each case, the site would have passed the Z-test if the perimeter values had been used and failed if the ambient levels had been used in the comparison. The perimeter area outside the work area can be compromised by work practices that may contaminate other areas inside the building, by a breach in the critical barriers surrounding the work area, by the air-filtration systems (e.g., torn ductwork passing through adjacent building areas), or by preexisting ACM in the area. Outdoor samples are less likely to be affected by these conditions, and their use in the clearance comparison would generally provide a more stringent comparison.

Structure Morphology and Length Distributions

TEM analysis of the 100 abatement-area, 100 perimeter, and 100 ambient samples collected during AHERA clearance at 20 abatement sites yielded a total of 1634 asbestos structures. Of these, 99 percent were chrysotile and 1 percent were amphibole. Table 10 presents a summary of the structure morphology distribution, and Table 11 presents the summary statistics for overall lengths of structures found in the abatement area, perimeter, and ambient air at the nine abatement sites. Approximately 93 percent of the asbestos structures found in the abatement-area air and 95 percent of those found in the perimeter air were less than 5.0 μm in length. Approximately 1.5 percent of the asbestos structures found in the abatement-area and perimeter air were greater than 10 μm in length. Ninety-eight percent of the asbestos structures found in the ambient air at the 20 abatement sites were less than 5.0 μm in length.

TABLE 9. SUMMARY OF AHERA INITIAL SCREENING TEST AND AHERA Z-TEST RESULTS FROM SAMPLES COLLECTED BY THE NEW JERSEY DEPARTMENT OF HEALTH/ U.S ENVIRONMENTAL PROTECTION AGENCY

	Mean concentration, s/cm^3 (5 samples)			AHERA clearance test results		
Site	Abatement area	Perimeter	Ambient	Initial screening	Z-Test with perimeter	Z-Test with ambient
A	0.002	0.001	0	Pass	Pass	Pass
B	0.016	0.008	0.001	Fail	Pass	Fail
C	0.060	0.002	0.004	Fail	Fail	Fail
D	0.079	0.062	0.052	Fail	Pass	Pass
E	0	0	0	Pass	Pass	Pass
F	0.024	0.002	0.001	Fail	Fail	Fail
G	0.007	0.010	0	Pass	Pass	Pass
H	0.016	0.062	0.003	Fail	Pass	Pass
I	0	0	0.006	Pass	Pass	Pass
J	0.004	0.001	0.001	Pass	Pass	Pass
K	0.063	0.008	0	Fail	Fail	Fail
L	0.118	0.066	0.004	Fail	Fail	Fail
M	0.322	0.002	0.002	Fail	Fail	Fail
N	0.100	0.003	0.004	Fail	Fail	Fail
O	0.004	0.003	0.001	Pass	Pass	Pass
P	0.005	0.007	0.003	Pass	Pass	Pass
Q	0.099	0.055	0.007	Fail	Fail	Fail
R	0.002	0	0	Pass	Pass	Pass
S	0.012	0.003	0	Fail	Pass	Fail
T	0.049	0.030	0.015	Fail	Fail	Fail

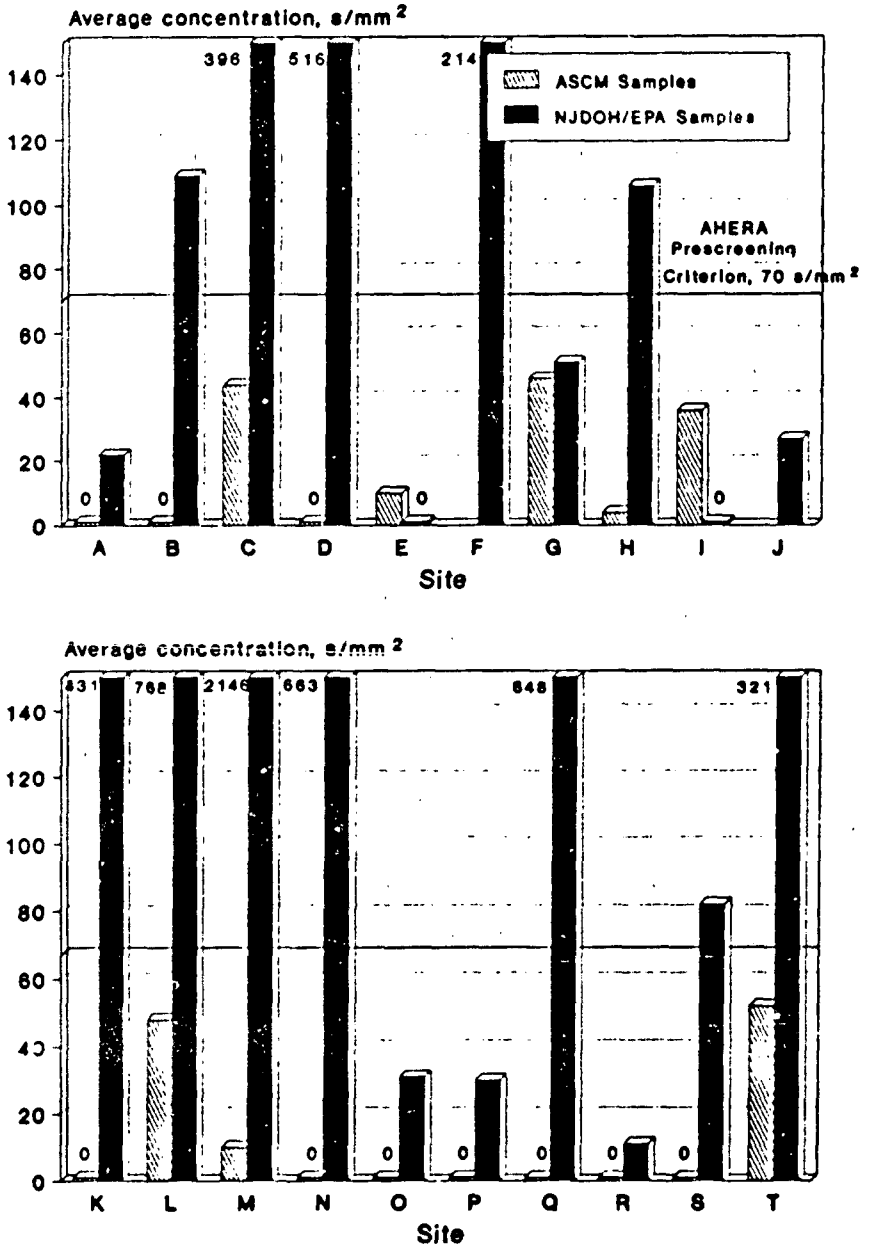

Figure 4. AHERA initial screening results for samples collected by the Asbestos Safety Control Monitor (ASCM) firms and the New Jersey Department of Health (NJDOH)/U.S. Environmental Protection Agency (EPA).

TABLE 10. ASBESTOS STRUCTURE DISTRIBUTIONS FROM SAMPLES COLLECTED DURING AHERA CLEARANCE SAMPLING AT 20 ABATEMENT SITES

	Type of asbestos			Structure morphology				
Sample location	Chrysotile	Amphibole	Total	Fibers	Bundles	Clusters	Matrices	Total
Abatement area	1085[a]	8	1093	762	35	91	205	1093
Perimeter	412	8	420	320	8	33	59	420
Ambient	120	1	121	102	2	2	15	121
Total	1617	17	1634	1184	45	126	279	1634

[a] Table entries represent total number of asbestos structures.

TABLE 11. DATA SUMMARY FOR ASBESTOS STRUCTURE LENGTHS FROM SAMPLES COLLECTED DURING AHERA CLEARANCE SAMPLING AT 20 ABATEMENT SITES

		Structure length, μm			
Sample location	N[a]	Mean	Minimum	Median	Maximum
Abatement area	1093	2.02	0.59	1.20	33.60
Perimeter	420	1.74	0.59	0.96	37.08
Ambient	121	1.13	0.59	0.88	7.20

[a] Total number of asbestos structures.

Asbestos Concentrations Before and After Abatement

Preabatement samples were collected in the perimeter area and outdoors at nine sites. Individual estimates of airborne asbestos measured by the NJDOH/EPA before abatement are presented in Appendix C. Appendix D summarizes the results of these measurements. Figure 5 presents a comparison of the airborne asbestos concentrations before and after abatement at nine sites. Overall, the trend toward higher concentrations of airborne asbestos after abatement was significant in both the perimeter and ambient air ($p < 0.05$). The cause of elevated asbestos concentrations in the perimeter and ambient air, particularly at sites D and T, is unknown; however, conditions such as torn ductwork, improper seals on air filtration units, and breached containment were observed at several sites.

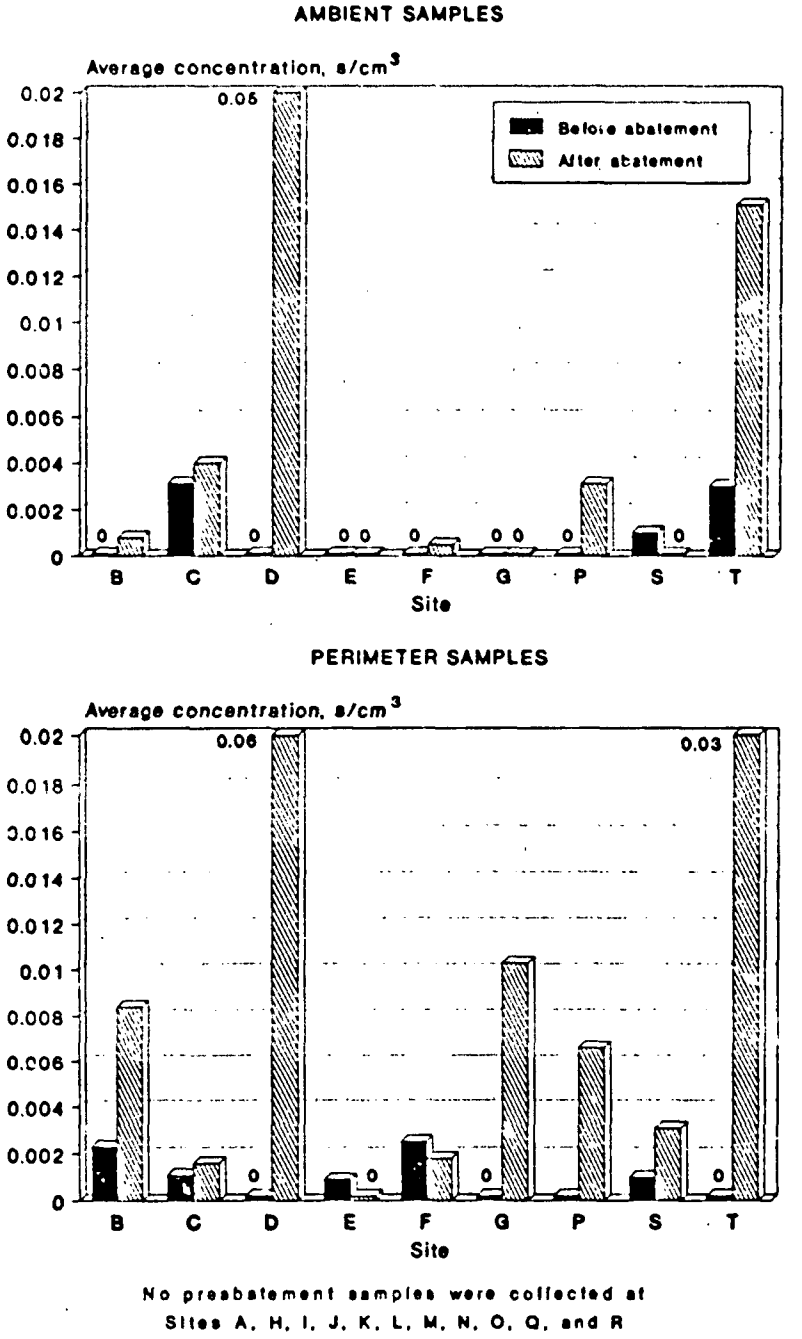

Figure 5. Comparison of airborne asbestos concentrations measured before and after abatement by the New Jersey Department of Health/U.S. Environmental Protection Agency.

REFERENCES

1. U. S. Environmental Protection Agency. Guidelines for Conducting the AHERA TEM Clearance Test To Determine Completion of an Asbestos Abatement Project. EPA 560/5-89-001. 1989.

2. U. S. Environmental Protection Agency. Guidance for Controlling Asbestos-Containing Materials in Buildings. EPA 560/5-85-024. 1985.

3. Hollander, M., and D. A. Wolfe. Nonparametric Statistical Methods. John Wiley and Sons, New York. 1973.

4. U.S. Environmental Protection Agency. Measuring Airborne Asbestos Following an Abatement Action. EPA 600-4-85-049. November 1985.

APPENDIX A

DATA SUMMARY FOR ASBESTOS CONCENTRATIONS MEASURED FOR AHERA CLEARANCE BY THE NEW JERSEY DEPARTMENT OF HEALTH/ U.S. ENVIRONMENTAL PROTECTION AGENCY

Sample location	No. of samples	Asbestos concentration, s/cm³			
		Mean	Minimum	Maximum	Standard deviation
Site A					
Abatement area	5	0.002	0	0.006	0.003
Perimeter	5	0.001	0	0.003	0.001
Ambient	5	0	0	0	0
Site B					
Abatement area	5	0.016	0.004	0.030	0.010
Perimeter	5	0.008	0	0.023	0.009
Ambient	5	0.001	0	0.004	0.002
Site C					
Abatement area	5	0.060	0.004	0.146	0.065
Perimeter	5	0.002	0	0.008	0.004
Ambient	5	0.004	0	0.016	0.007
Site D					
Abatement area	5	0.079	0.013	0.129	0.045
Perimeter	5	0.062	0.032	0.099	0.029
Ambient	5	0.052	0.004	0.093	0.038
Site E					
Abatement area	5	0	0	0	0
Perimeter	5	0	0	0	0
Ambient	5	0	0	0	0
Site F					
Abatement area	5	0.024	0.009	0.052	0.018
Perimeter	5	0.002	0	0.009	0.004
Ambient	5	0.001	0	0.003	0.001
Site G					
Abatement area	5	0.007	0	0.022	0.009
Perimeter	5	0.010	0	0.026	0.011
Ambient	5	0	0	0	0
Site H					
Abatement area	5	0.016	0.004	0.045	0.017
Perimeter	5	0.062	0.013	0.207	0.062
Ambient	5	0.003	0	0.012	0.005
Site I					
Abatement area	5	0	0	0	0
Perimeter	5	0	0	0	0
Ambient	5	0.006	0	0.020	0.008

(continued)

(continued)

Sample location	No. of samples	Asbestos concentration, s/cm²			
		Mean	Minimum	Maximum	Standard deviation
Site J					
Abatement area	5	0.004	0.004	0.004	0.001
Perimeter	5	0.001	0	0.004	0.002
Ambient	5	0.001	0	0.004	0.002
Site K					
Abatement area	5	0.063	0.035	0.103	0.025
Perimeter	5	0.008	0	0.015	0.007
Ambient	5	0	0	0	0
Site L					
Abatement area	5	0.118	0.093	0.156	0.027
Perimeter	5	0.060	0.026	0.181	0.065
Ambient	5	0.004	0	0.015	0.006
Site M					
Abatement area	5	0.322	0.054	0.533	0.190
Perimeter	5	0.002	0	0.008	0.003
Ambient	5	0.002	0	0.004	0.002
Site N					
Abatement area	5	0.100	0.076	0.129	0.021
Perimeter	5	0.003	0	0.016	0.007
Ambient	5	0.004	0.004	0.004	0
Site O					
Abatement area	5	0.004	0.003	0.007	0.002
Perimeter	5	0.003	0	0.010	0.005
Ambient	5	0.001	0	0.004	0.002
Site P					
Abatement area	5	0.005	0	0.012	0.005
Perimeter	5	0.007	0	0.018	0.007
Ambient	5	0.003	0	0.016	0.007
Site Q					
Abatement area	5	0.099	0.030	0.156	0.047
Perimeter	5	0.055	0	0.115	0.047
Ambient	5	0.007	0	0.021	0.009
Site R					
Abatement area	5	0.002	0	0.009	0.004
Perimeter	5	0	0	0	0
Ambient	5	0	0	0	0

(continued)

(continued)

Sample location	No. of samples	Asbestos concentration, s/cm²			
		Mean	Minimum	Maximum	Standard deviation
Site S					
Abatement area	5	0.012	0	0.028	0.012
Perimeter	5	0.003	0	0.008	0.003
Ambient	5	0	0	0	0
Site T					
Abatement area	5	0.049	0.037	0.061	0.010
Perimeter	5	0.030	0	0.071	0.028
Ambient	5	0.015	0	0.050	0.022

APPENDIX B

INDIVIDUAL ESTIMATES OF AIRBORNE ASBESTOS CONCENTRATIONS MEASURED BY THE NEW JERSEY DEPARTMENT OF HEALTH/ U.S. EPA AFTER ABATEMENT

Sample numbers ending in 'R' represent recount analyses.
Sample numbers ending in 'D' represent duplicate sample analyses.

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
01A-2072	ABATEMENT AREA	1	0.004	0.004
01A-4064	ABATEMENT AREA	4	0.015	0.004
01A-4068	ABATEMENT AREA	8	0.030	0.004
01A-4069	ABATEMENT AREA	5	0.019	0.004
01A-4070	ABATEMENT AREA	3	0.011	0.004
01A-4059	AMBIENT	0	0.000	0.004
01A-4062	AMBIENT	1	0.004	0.004
01A-4065	AMBIENT	0	0.000	0.004
01A-4065R	AMBIENT	0	0.000	0.004
01A-4067	AMBIENT	0	0.000	0.004
01A-4071	AMBIENT	0	0.000	0.004
01A-3072	FIELD BLANK	0	.	.
01A-4066	FIELD BLANK	0	.	.
01A-4061	SEALED BLANK	0	.	.
01A-1072	PERIMETER	0	0.000	0.004
01A-4060	PERIMETER	3	0.012	0.004
01A-4063	PERIMETER	2	0.008	0.004
01A-4072	PERIMETER	6	0.023	0.004
01A-5072	PERIMETER	0	0.000	0.004
02A-5051	ABATEMENT AREA	38	0.146	0.004
02A-5055	ABATEMENT AREA	29	0.114	0.004
02A-5056	ABATEMENT AREA	5	0.020	0.004
02A-5060	ABATEMENT AREA	4	0.016	0.004
02A-5062	ABATEMENT AREA	1	0.004	0.004
02A-5053	AMBIENT	1	0.004	0.004
02A-5057	AMBIENT	4	0.016	0.004
02A-5065	AMBIENT	0	0.000	0.004
02A-5066	AMBIENT	0	0.000	0.004
02A-5067	AMBIENT	0	0.000	0.004
02A-5052	FIELD BLANK	0	.	.
02A-5058	FIELD BLANK	0	.	.
02A-5068	SEALED BLANK	0	.	.
02A-5054	PERIMETER	0	0.000	0.004
02A-5059	PERIMETER	0	0.000	0.004
02A-5061	PERIMETER	2	0.008	0.004
02A-5063	PERIMETER	0	0.000	0.004
02A-5064	PERIMETER	0	0.000	0.004
03A-2043	ABATEMENT AREA	25	0.105	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
03A-2059	ABATEMENT AREA	13	0.057	0.004
03A-2059R	ABATEMENT AREA	13	0.057	0.004
03A-2061	ABATEMENT AREA	30	0.129	0.004
03A-2061D	ABATEMENT AREA	31	0.134	0.004
03A-2062	ABATEMENT AREA	22	0.090	0.004
03A-2070	ABATEMENT AREA	3	0.013	0.004
03A-2042	AMBIENT	15	0.066	0.004
03A-2065	AMBIENT	1	0.004	0.004
03A-2066	AMBIENT	17	0.077	0.005
03A-2068	AMBIENT	21	0.093	0.004
03A-3038	AMBIENT	4	0.018	0.004
03A-2064	FIELD BLANK	0	.	.
03A-3039	FIELD BLANK	0	.	.
03A-2069	SEALED BLANK	0	.	.
03A-2060	PERIMETER	23	0.099	0.004
03A-2063	PERIMETER	8	0.032	0.004
03A-2063R	PERIMETER	8	0.032	0.004
03A-2067	PERIMETER	9	0.035	0.004
03A-2071	PERIMETER	16	0.062	0.004
03A-3037	PERIMETER	21	0.082	0.004
04A-2044	ABATEMENT AREA	0	0.000	0.004
04A-2048	ABATEMENT AREA	0	0.000	0.005
04A-2049	ABATEMENT AREA	0	0.000	0.004
04A-2050	ABATEMENT AREA	0	0.000	0.004
04A-2057	ABATEMENT AREA	0	0.000	0.004
04A-2057R	ABATEMENT AREA	0	0.000	0.004
04A-2039	AMBIENT	0	0.000	0.004
04A-2045	AMBIENT	0	0.000	0.004
04A-2051	AMBIENT	0	0.000	0.004
04A-2053	AMBIENT	0	0.000	0.004
04A-2056	AMBIENT	0	0.000	0.004
04A-2046	FIELD BLANK	0	.	.
04A-2047	FIELD BLANK	0	.	.
04A-2055	SEALED BLANK	0	.	.
04A-2038	PERIMETER	0	0.000	0.004
04A-2040	PERIMETER	0	0.000	0.003
04A-2041	PERIMETER	0	0.000	0.003
04A-2052	PERIMETER	0	0.000	0.004
04A-2052D	PERIMETER	0	0.000	0.004
04A-2054	PERIMETER	0	0.000	0.004
05A-8038	ABATEMENT AREA	19	0.052	0.003
05A-8039	ABATEMENT AREA	12	0.033	0.003
05A-8039R	ABATEMENT AREA	12	0.033	0.003
05A-8042	ABATEMENT AREA	5	0.018	0.004
05A-8043	ABATEMENT AREA	3	0.009	0.003
05A-8045	ABATEMENT AREA	3	0.009	0.003

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
05A-8049	AMBIENT	0	0.000	0.003
05A-8051	AMBIENT	0	0.000	0.003
05A-8053	AMBIENT	0	0.000	0.003
05A-8055	AMBIENT	1	0.003	0.003
05A-8058	AMBIENT	0	0.000	0.003
05A-8048	FIELD BLANK	0	.	.
05A-8072	FIELD BLANK	0	.	.
05A-8071	SEALED BLANK	0	.	.
05A-8059	PERIMETER	0	0.000	0.003
05A-8061	PERIMETER	0	0.000	0.003
05A-8063	PERIMETER	3	0.009	0.003
05A-8065	PERIMETER	0	0.000	0.003
05A-8068	PERIMETER	0	0.000	0.003
06A-20003	ABATEMENT AREA	0	0.000	0.004
06A-20005	ABATEMENT AREA	2	0.007	0.004
06A-20006	ABATEMENT AREA	6	0.022	0.004
06A-20011	ABATEMENT AREA	2	0.007	0.004
06A-20011R	ABATEMENT AREA	2	0.007	0.004
06A-20016	ABATEMENT AREA	0	0.000	0.004
06A-20008	AMBIENT	0	0.000	0.004
06A-20009	AMBIENT	0	0.000	0.004
06A-20010	AMBIENT	0	0.000	0.004
06A-20013	AMBIENT	0	0.000	0.004
06A-20015	AMBIENT	0	0.000	0.004
06A-20007	FIELD BLANK	0	.	.
06A-20017	FIELD BLANK	0	.	.
06A-20018	SEALED BLANK	0	.	.
06A-20001	PERIMETER	3	0.011	0.004
06A-20002	PERIMETER	4	0.015	0.004
06A-20004	PERIMETER	7	0.026	0.004
06A-20004D	PERIMETER	4	0.015	0.004
06A-20012	PERIMETER	0	0.000	0.004
06A-20014	PERIMETER	0	0.000	0.004
07A-1041	ABATEMENT AREA	11	0.045	0.004
07A-1041D	ABATEMENT AREA	9	0.037	0.004
07A-1045	ABATEMENT AREA	4	0.015	0.004
07A-1047	ABATEMENT AREA	1	0.004	0.004
07A-1049	ABATEMENT AREA	2	0.008	0.004
07A-1051	ABATEMENT AREA	2	0.008	0.004
07A-1037	AMBIENT	0	0.000	0.004
07A-1038	AMBIENT	1	0.004	0.004
07A-1048	AMBIENT	0	0.000	0.004
07A-1052	AMBIENT	3	0.012	0.004
07A-2058	AMBIENT	0	0.000	0.004
07A-2058R	AMBIENT	0	0.000	0.004
07A-1040	FIELD BLANK	0	.	.

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
07A-1044	FIELD BLANK	0	.	.
07A-1043	SEALED BLANK	0	.	.
07A-1039	PERIMETER	8	0.034	0.004
07A-1042	PERIMETER	11	0.045	0.004
07A-1042D	PERIMETER	13	0.053	0.004
07A-1046	PERIMETER	3	0.012	0.004
07A-1046R	PERIMETER	3	0.012	0.004
07A-1050	PERIMETER	3	0.013	0.004
07A-1053	PERIMETER	51	0.206	0.004
08A-5037	ABATEMENT AREA	0	0.000	0.004
08A-5039	ABATEMENT AREA	0	0.000	0.004
08A-5041	ABATEMENT AREA	0	0.000	0.004
08A-5041R	ABATEMENT AREA	0	0.000	0.004
08A-5042	ABATEMENT AREA	0	0.000	0.004
08A-5043	ABATEMENT AREA	0	0.000	0.004
08A-5040	AMBIENT	1	0.004	0.004
08A-5046	AMBIENT	0	0.000	0.004
08A-5047	AMBIENT	0	0.000	0.004
08A-5048	AMBIENT	5	0.020	0.004
08A-5050	AMBIENT	1	0.004	0.004
08A-10072	FIELD BLANK	0	.	.
08A-5045	FIELD BLANK	0	.	.
08A-5038	SEALED BLANK	0	.	.
08A-5044	PERIMETER	0	0.000	0.004
08A-5049	PERIMETER	0	0.000	0.004
08A-5049D	PERIMETER	1	0.004	0.004
08A-6072	PERIMETER	0	0.000	0.004
08A-7072	PERIMETER	0	0.000	0.004
08A-7072D	PERIMETER	0	0.000	0.004
08A-9072	PERIMETER	0	0.000	0.004
09A-4042	ABATEMENT AREA	1	0.004	0.004
09A-4043	ABATEMENT AREA	1	0.004	0.004
09A-4047	ABATEMENT AREA	1	0.004	0.004
09A-4049	ABATEMENT AREA	1	0.004	0.004
09A-4058	ABATEMENT AREA	1	0.004	0.004
09A-4041	AMBIENT	0	0.000	0.004
09A-4045	AMBIENT	0	0.000	0.004
09A-4051	AMBIENT	1	0.004	0.004
09A-4051D	AMBIENT	0	0.000	0.004
09A-4052	AMBIENT	0	0.000	0.004
09A-4056	AMBIENT	0	0.000	0.004
09A-4048	FIELD BLANK	0	.	.
09A-4054	FIELD BLANK	0	.	.
09A-4055	SEALED BLANK	0	.	.
09A-4044	PERIMETER	0	0.000	0.004
09A-4044R	PERIMETER	0	0.000	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
09A-4046	PERIMETER	0	0.000	0.004
09A-4050	PERIMETER	0	0.000	0.004
09A-4053	PERIMETER	0	0.000	0.004
09A-4053R	PERIMETER	0	0.000	0.004
09A-4057	PERIMETER	1	0.004	0.004
10-A-6065	ABATEMENT AREA	9	0.035	0.004
10-A-6066	ABATEMENT AREA	26	0.103	0.004
10-A-6066R	ABATEMENT AREA	25	0.099	0.004
10-A-6067	ABATEMENT AREA	16	0.063	0.004
10-A-6068	ABATEMENT AREA	16	0.061	0.004
10-A-6068D	ABATEMENT AREA	15	0.058	0.004
10-A-6069	ABATEMENT AREA	14	0.054	0.004
10-A-7037	AMBIENT	0	0.000	0.004
10-A-7037R	AMBIENT	0	0.000	0.004
10-A-7038	AMBIENT	0	0.000	0.004
10-A-7039	AMBIENT	0	0.000	0.004
10-A-7040	AMBIENT	0	0.000	0.004
10-A-7041	AMBIENT	0	0.000	0.004
10-A-6057	FIELD BLANK	0	.	.
10-A-6070	FIELD BLANK	0	.	.
10-A-6056	SEALED BLANK	0	.	.
10-A-6054	PERIMETER	3	0.012	0.004
10-A-6055	PERIMETER	4	0.015	0.004
10-A-6071	PERIMETER	0	0.000	0.004
10-A-7042	PERIMETER	0	0.000	0.004
10-A-7043	PERIMETER	3	0.011	0.004
11-A-6037	ABATEMENT AREA	0	0.000	0.003
11-A-6037R	ABATEMENT AREA	0	0.000	0.003
11-A-6040	ABATEMENT AREA	1	0.003	0.003
11-A-6042	ABATEMENT AREA	0	0.000	0.003
11-A-6046	ABATEMENT AREA	1	0.003	0.003
11-A-6049	ABATEMENT AREA	2	0.006	0.003
11-A-5071	AMBIENT	0	0.000	0.004
11-A-5071R	AMBIENT	0	0.000	0.004
11-A-6038	AMBIENT	0	0.000	0.004
11-A-6038D	AMBIENT	0	0.000	0.004
11-A-6039	AMBIENT	0	0.000	0.004
11-A-6041	AMBIENT	0	0.000	0.004
11-A-6047	AMBIENT	0	0.000	0.004
11-A-6044	FIELD BLANK	0	.	.
11-A-6045	FIELD BLANK	0	.	.
11-A-6043	SEALED BLANK	0	.	.
11-A-5069	PERIMETER	0	0.000	0.004
11-A-5070	PERIMETER	0	0.000	0.003
11-A-6048	PERIMETER	1	0.003	0.003
11-A-6050	PERIMETER	0	0.000	0.003

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
11-A-6051	PERIMETER	0	0.000	0.004
12-A-6053	ABATEMENT AREA	25	0.098	0.004
12-A-7047	ABATEMENT AREA	23	0.093	0.004
12-A-7047R	ABATEMENT AREA	22	0.089	0.004
12-A-7049	ABATEMENT AREA	40	0.156	0.004
12-A-7052	ABATEMENT AREA	27	0.107	0.004
12-A-7054	ABATEMENT AREA	34	0.135	0.004
12-A-6025	AMBIENT	4	0.015	0.004
12-A-7045	AMBIENT	0	0.000	0.004
12-A-7046	AMBIENT	0	0.000	0.004
12-A-7050	AMBIENT	1	0.004	0.004
12-A-7055	AMBIENT	0	0.000	0.004
12-A-7055D	AMBIENT	1	0.004	0.004
12-A-7044	FIELD BLANK	0	.	.
12-A-7051	FIELD BLANK	0	.	.
12-A-7057	SEALED BLANK	0	.	.
12-A-6052	PERIMETER	11	0.040	0.004
12-A-6058	PERIMETER	10	0.037	0.004
12-A-7048	PERIMETER	7	0.026	0.004
12-A-7053	PERIMETER	50	0.181	0.004
12-A-7053D	PERIMETER	60	0.217	0.004
12-A-7056	PERIMETER	12	0.044	0.004
12-A-7056R	PERIMETER	11	0.040	0.004
13-A-9038	ABATEMENT AREA	54	0.282	0.005
13-A-9038D	ABATEMENT AREA	55	0.288	0.005
13-A-9039	ABATEMENT AREA	69	0.530	0.008
13-A-9040	ABATEMENT AREA	60	0.473	0.008
13-A-9050	ABATEMENT AREA	51	0.265	0.005
13-A-9050R	ABATEMENT AREA	50	0.260	0.005
13-A-9052	ABATEMENT AREA	14	0.054	0.004
13-A-9037	AMBIENT	0	0.000	0.004
13-A-9041	AMBIENT	1	0.004	0.004
13-A-9044	AMBIENT	1	0.004	0.004
13-A-9046	AMBIENT	0	0.000	0.004
13-A-9051	AMBIENT	1	0.004	0.004
13-A-9047	FIELD BLANK	0	.	.
13-A-9054	FIELD BLANK	0	.	.
13-A-9049	SEALED BLANK	0	.	.
13-A-9042	PERIMETER	0	0.000	0.004
13-A-9043	PERIMETER	2	0.008	0.004
13-A-9045	PERIMETER	0	0.000	0.004
13-A-9045R	PERIMETER	0	0.000	0.004
13-A-9048	PERIMETER	0	0.000	0.004
13-A-9053	PERIMETER	0	0.000	0.004
14-A-10044	ABATEMENT AREA	26	0.102	0.004
14-A-10046	ABATEMENT AREA	33	0.129	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
14-A-10048	ABATEMENT AREA	21	0.084	0.004
14-A-10052	ABATEMENT AREA	27	0.108	0.004
14-A-10052R	ABATEMENT AREA	25	0.100	0.004
14-A-10053	ABATEMENT AREA	19	0.076	0.004
14-A-10038	AMBIENT	1	0.004	0.004
14-A-10038R	AMBIENT	1	0.004	0.004
14-A-10040	AMBIENT	1	0.004	0.004
14-A-10042	AMBIENT	1	0.004	0.004
14-A-10045	AMBIENT	1	0.004	0.004
14-A-10049	AMBIENT	1	0.004	0.004
14-A-10037	FIELD BLANK	0	.	.
14-A-10041	FIELD BLANK	0	.	.
14-A-10047	SEALED BLANK	0	.	.
14-A-10039	PERIMETER	4	0.016	0.004
14-A-10043	PERIMETER	0	0.000	0.004
14-A-10050	PERIMETER	0	0.000	0.004
14-A-10050D	PERIMETER	0	0.000	0.004
14-A-10051	PERIMETER	0	0.000	0.004
14-A-10054	PERIMETER	0	0.000	0.004
15-A-9056	ABATEMENT AREA	2	0.007	0.003
15-A-9056R	ABATEMENT AREA	2	0.007	0.003
15-A-9060	ABATEMENT AREA	1	0.003	0.003
15-A-9064	ABATEMENT AREA	1	0.003	0.003
15-A-9068	ABATEMENT AREA	1	0.003	0.003
15-A-9070	ABATEMENT AREA	1	0.003	0.003
15-A-7064	AMBIENT	0	0.000	0.003
15-A-9057	AMBIENT	0	0.000	0.004
15-A-9063	AMBIENT	0	0.000	0.004
15-A-9069	AMBIENT	0	0.000	0.004
15-A-9071	AMBIENT	1	0.004	0.004
15-A-9071R	AMBIENT	1	0.004	0.004
15-A-9059	FIELD BLANK	0	.	.
15-A-9062	FIELD BLANK	0	.	.
15-A-9061	SEALED BLANK	0	.	.
15-A-9055	PERIMETER	2	0.007	0.003
15-A-9058	PERIMETER	0	0.000	0.003
15-A-9065	PERIMETER	0	0.000	0.003
15-A-9066	PERIMETER	3	0.010	0.003
15-A-9067	PERIMETER	0	0.000	0.003
15-A-9067D	PERIMETER	0	0.000	0.003
16A-11002	ABATEMENT AREA	3	0.011	0.004
16A-11003	ABATEMENT AREA	0	0.000	0.004
16A-11003R	ABATEMENT AREA	0	0.000	0.004
16A-11004	ABATEMENT AREA	2	0.008	0.004
16A-11008	ABATEMENT AREA	0	0.000	0.004
16A-11011	ABATEMENT AREA	1	0.004	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
16A-11006	AMBIENT	0	0.000	0.004
16A-11009	AMBIENT	0	0.000	0.004
16A-11010	AMBIENT	0	0.000	0.004
16A-11013	AMBIENT	0	0.000	0.004
16A-11018	AMBIENT	4	0.016	0.004
16A-11018R	AMBIENT	4	0.016	0.004
16A-11005	FIELD BLANK	0	.	.
16A-11007	FIELD BLANK	0	.	.
16A-11016	SEALED BLANK	0	.	.
16A-11001	PERIMETER	1	0.004	0.004
16A-11012	PERIMETER	1	0.004	0.004
16A-11014	PERIMETER	5	0.018	0.004
16A-11014D	PERIMETER	5	0.018	0.004
16A-11015	PERIMETER	2	0.007	0.004
16A-11017	PERIMETER	0	0.000	0.004
17A-10057	ABATEMENT AREA	41	0.157	0.004
17A-10059	ABATEMENT AREA	28	0.108	0.004
17A-10059R	ABATEMENT AREA	28	0.108	0.004
17A-10066	ABATEMENT AREA	7	0.029	0.004
17A-10067	ABATEMENT AREA	22	0.083	0.004
17A-10067R	ABATEMENT AREA	21	0.079	0.004
17A-10071	ABATEMENT AREA	31	0.119	0.004
17A-10056	AMBIENT	0	0.000	0.004
17A-10058	AMBIENT	1	0.004	0.004
17A-10063	AMBIENT	5	0.021	0.004
17A-10063D	AMBIENT	1	0.004	0.004
17A-10068	AMBIENT	0	0.000	0.004
17A-10070	AMBIENT	2	0.008	0.004
17A-10055	FIELD BLANK	0	.	.
17A-10060	FIELD BLANK	0	.	.
17A-10061	SEALED BLANK	0	.	.
17A-10062	PERIMETER	24	0.090	0.004
17A-10064	PERIMETER	7	0.026	0.004
17A-10065	PERIMETER	33	0.115	0.003
17A-10069	PERIMETER	0	0.000	0.004
17A-10069D	PERIMETER	1	0.004	0.004
17A-10081	PERIMETER	11	0.042	0.004
18A-30001	ABATEMENT AREA	2	0.008	0.004
18A-30008	ABATEMENT AREA	0	0.000	0.004
18A-30013	ABATEMENT AREA	0	0.000	0.004
18A-30013R	ABATEMENT AREA	0	0.000	0.004
18A-30037	ABATEMENT ARE\	0	0.000	0.004
18A-30040	ABATEMENT AREA	0	0.000	0.004
18A-30005	AMBIENT	0	0.000	0.004
18A-30007	AMBIENT	0	0.000	0.004
18A-30009	AMBIENT	0	0.000	0.004

(continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
18A-30016	AMBIENT	0	0.000	0.004
18A-30016R	AMBIENT	0	0.000	0.004
18A-30054	AMBIENT	0	0.000	0.004
18A-30004	FIELD BLANK	0	.	.
18A-30006	FIELD BLANK	0	.	.
18A-30010	SEALED BLANK	0	.	.
18A-30015	PERIMETER	0	0.000	0.004
18A-30015D	PERIMETER	0	0.000	0.004
18A-30017	PERIMETER	0	0.000	0.004
18A-30018	PERIMETER	0	0.000	0.004
18A-30039	PERIMETER	0	0.000	0.004
18A-30053	PERIMETER	0	0.000	0.004
19A-30063	ABATEMENT AREA	3	0.012	0.004
19A-30064	ABATEMENT AREA	7	0.028	0.004
19A-30065	ABATEMENT AREA	0	0.000	0.004
19A-30065R	ABATEMENT AREA	0	0.000	0.004
19A-30070	ABATEMENT AREA	5	0.020	0.004
19A-30073	ABATEMENT AREA	0	0.000	0.004
19A-30058	AMBIENT	0	0.000	0.004
19A-30061	AMBIENT	0	0.000	0.004
19A-30062	AMBIENT	0	0.000	0.004
19A-30066	AMBIENT	0	0.000	0.004
19A-30071	AMBIENT	0	0.000	0.004
19A-30067	FIELD BLANK	0	.	.
19A-30074	FIELD BLANK	0	.	.
19A-30068	SEALED BLANK	0	.	.
19A-30059	PERIMETER	1	0.004	0.004
19A-30060	PERIMETER	1	0.004	0.004
19A-30069	PERIMETER	0	0.000	0.004
19A-30072	PERIMETER	0	0.000	0.004
19A-30072D	PERIMETER	0	0.000	0.004
19A-30075	PERIMETER	2	0.008	0.004
20A-30045	ABATEMENT AREA	9	0.037	0.004
20A-30046	ABATEMENT AREA	15	0.061	0.004
20A-30048	ABATEMENT AREA	10	0.041	0.004
20A-30050	ABATEMENT AREA	11	0.046	0.004
20A-30057	ABATEMENT AREA	14	0.058	0.004
20A-30038	AMBIENT	0	0.000	0.004
20A-30039	AMBIENT	0	0.000	0.004
20A-30041	AMBIENT	6	0.026	0.004
20A-30041D	AMBIENT	3	0.013	0.004
20A-30052	AMBIENT	12	0.050	0.004
20A-30056	AMBIENT	0	0.000	0.004
20A-10114	FIELD BLANK	0	.	.
20A-30043	FIELD BLANK	0	.	.
20A-10111	SEALED BLANK	0	.	.

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
20A-30042	PERIMETER	0	0.000	0.004
20A-30044	PERIMETER	10	0.041	0.004
20A-30047	PERIMETER	2	0.008	0.004
20A-30051	PERIMETER	7	0.029	0.004
20A-30055	PERIMETER	17	0.070	0.004
21A-1055	ABATEMENT AREA	1	0.004	0.004
21A-1056	ABATEMENT AREA	2	0.008	0.004
21A-1065	ABATEMENT AREA	6	0.025	0.004
21A-1065R	ABATEMENT AREA	6	0.025	0.004
21A-1067	ABATEMENT AREA	37	0.150	0.004
21A-1071	ABATEMENT AREA	1	0.004	0.004
21A-1060	AMBIENT	0	0.000	0.004
21A-1061	AMBIENT	0	0.000	0.004
21A-1063	AMBIENT	0	0.000	0.004
21A-1070	AMBIENT	0	0.000	0.004
21A-2037	AMBIENT	0	0.000	0.004
21A-1064	FIELD BLANK	0	.	.
21A-1068	FIELD BLANK	0	.	.
21A-1058	SEALED BLANK	0	.	.
21A-1057	PERIMETER	0	0.000	0.004
21A-1059	PERIMETER	0	0.000	0.004
21A-1062	PERIMETER	1	0.004	0.004
21A-1066	PERIMETER	0	0.000	0.004
21A-1069	PERIMETER	0	0.000	0.004
21A-1069D	PERIMETER	0	0.000	0.004
22A-3040	ABATEMENT AREA	3	0.013	0.004
22A-3045	ABATEMENT AREA	1	0.004	0.004
22A-3046	ABATEMENT AREA	12	0.053	0.004
22A-3048	ABATEMENT AREA	6	0.026	0.004
22A-3049	ABATEMENT AREA	12	0.052	0.004
22A-3043	AMBIENT	1	0.004	0.004
22A-3051	AMBIENT	7	0.028	0.004
22A-3052	AMBIENT	0	0.000	0.004
22A-3052R	AMBIENT	0	0.000	0.004
22A-3053	AMBIENT	12	0.049	0.004
22A-3054	AMBIENT	2	0.008	0.004
22A-3054D	AMBIENT	3	0.012	0.004
22A-3042	FIELD BLANK	0	.	.
22A-3050	FIELD BLANK	0	.	.
22A-3041	SEALED BLANK	0	.	.
22A-3044	PERIMETER	0	0.000	0.004
22A-3047	PERIMETER	1	0.004	0.004
22A-3055	PERIMETER	0	0.000	0.004
22A-3056	PERIMETER	2	0.008	0.004
22A-3057	PERIMETER	6	0.024	0.004
23A-30022	ABATEMENT AREA	20	0.087	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
23A-30024	ABATEMENT AREA	18	0.078	0.004
23A-30031	ABATEMENT AREA	17	0.074	0.004
23A-30031D	ABATEMENT AREA	9	0.039	0.004
23A-30033	ABATEMENT AREA	9	0.039	0.004
23A-30036	ABATEMENT AREA	11	0.048	0.004
23A-30019	AMBIENT	1	0.004	0.004
23A-30027	AMBIENT	0	0.000	0.004
23A-30029	AMBIENT	0	0.000	0.004
23A-30029R	AMBIENT	0	0.000	0.004
23A-30034	AMBIENT	1	0.004	0.004
23A-30035	AMBIENT	5	0.020	0.004
23A-30023	FIELD BLANK	0	.	.
23A-30028	FIELD BLANK	0	.	.
23A-30032	SEALED BLANK	0	.	.
23A-30020	PERIMETER	2	0.008	0.004
23A-30021	PERIMETER	5	0.019	0.004
23A-30025	PERIMETER	0	0.000	0.004
23A-30026	PERIMETER	9	0.035	0.004
23A-30030	PERIMETER	0	0.000	0.004
24A-3061	ABATEMENT AREA	26	0.115	0.004
24A-3061R	ABATEMENT AREA	24	0.106	0.004
24A-3065	ABATEMENT AREA	34	0.151	0.004
24A-3067	ABATEMENT AREA	54	0.316	0.006
24A-3068	ABATEMENT AREA	49	0.215	0.004
24A-3070	ABATEMENT AREA	45	0.196	0.004
24A-3059	AMBIENT	0	0.000	0.004
24A-3063	AMBIENT	0	0.000	0.004
24A-3064	AMBIENT	0	0.000	0.004
24A-4037	AMBIENT	0	0.000	0.004
24A-4038	AMBIENT	0	0.000	0.004
24A-3071	FIELD BLANK	0	.	.
24A-4040	FIELD BLANK	0	.	.
24A-4039	SEALED BLANK	0	.	.
24A-3058	PERIMETER	28	0.123	0.004
24A-3060	PERIMETER	41	0.179	0.004
24A-3062	PERIMETER	4	0.017	0.004
24A-3062D	PERIMETER	5	0.022	0.004
24A-3066	PERIMETER	6	0.027	0.004
24A-3069	PERIMETER	40	0.176	0.004
25A-6061	ABATEMENT AREA	27	0.112	0.004
25A-6062	ABATEMENT AREA	9	0.037	0.004
25A-6064	ABATEMENT AREA	4	0.016	0.004
25A-6064R	ABATEMENT AREA	3	0.012	0.004
25A-7060	ABATEMENT AREA	18	0.074	0.004
25A-7070	ABATEMENT AREA	28	0.115	0.004
25A-7059	AMBIENT	1	0.004	0.004

(continued)

APPENDIX B (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
25A-7061	AMBIENT	0	0.000	0.004
25A-7068	AMBIENT	0	0.000	0.004
25A-7069	AMBIENT	0	0.000	0.004
25A-7069D	AMBIENT	0	0.000	0.004
25A-7071	AMBIENT	1	0.004	0.004
25A-7066	FIELD BLANK	0	.	.
25A-7067	FIELD BLANK	0	.	.
25A-7062	SEALED BLANK	0	.	.
25A-6060	PERIMETER	23	0.090	0.004
25A-6063	PERIMETER	15	0.059	0.004
25A-7058	PERIMETER	3	0.012	0.004
25A-7063	PERIMETER	1	0.004	0.004

(continued)

APPENDIX C

INDIVIDUAL ESTIMATES OF AIRBORNE ASBESTOS CONCENTRATIONS MEASURED BY THE NEW JERSEY DEPARTMENT OF HEALTH/ U.S. EPA BEFORE ABATEMENT

Sample numbers ending in 'R' represent recount analyses.
Sample numbers ending in 'D' represent duplicate sample analyses.

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
01P-1012	AMBIENT	0	0.000	0.004
01P-1014	AMBIENT	0	0.000	0.004
01P-1016	AMBIENT	0	0.000	0.005
01P-1016D	AMBIENT	0	0.000	0.005
01P-1018	AMBIENT	0	0.000	0.005
01P-1020	AMBIENT	0	0.000	0.004
01P-1020R	AMBIENT	0	0.000	0.004
01P-1021	FIELD BLANK	0	.	.
01P-1024	FIELD BLANK	0	.	.
01P-1002	PERIMETER	0	0.000	0.005
01P-1002D	PERIMETER	0	0.000	0.005
01P-1004	PERIMETER	0	0.000	0.005
01P-1006	PERIMETER	0	0.000	0.005
01P-1008	PERIMETER	1	0.004	0.004
01P-1010	PERIMETER	0	0.000	0.004
02P-2006	AMBIENT	0	0.000	0.005
02P-2008	AMBIENT	0	0.000	0.006
02P-2008R	AMBIENT	0	0.000	0.006
02P-2009	AMBIENT	2	0.011	0.005
02P-2011	AMBIENT	1	0.005	0.005
02P-2011D	AMBIENT	0	0.000	0.005
02P-2013	AMBIENT	0	0.000	0.005
02P-2013R	AMBIENT	0	0.000	0.005
02P-2021	FIELD BLANK	0	.	.
02P-2024	FIELD BLANK	0	.	.
02P-2001	PERIMETER	1	0.005	0.005
02P-2003	PERIMETER	0	0.000	0.005
02P-2015	PERIMETER	0	0.000	0.005
02P-2017	PERIMETER	0	0.000	0.005
02P-2019	PERIMETER	0	0.000	0.006
03P-3011	AMBIENT	0	0.000	0.005
03P-3011D	AMBIENT	0	0.000	0.005
03P-3013	AMBIENT	0	0.000	0.005
03P-3015	AMBIENT	0	0.000	0.005
03P-3017	AMBIENT	0	0.000	0.005
03P-3019	AMBIENT	0	0.000	0.005
03P-3021	FIELD BLANK	0		

(continued)

APPENDIX C (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
03P-3023	FIELD BLANK	0	.	.
03P-3001	PERIMETER	0	0.000	0.004
03P-3003	PERIMETER	0	0.000	0.004
03P-3005	PERIMETER	0	0.000	0.004
03P-3007	PERIMETER	0	0.000	0.005
03P-3009	PERIMETER	0	0.000	0.005
04P-5011	AMBIENT	0	0.000	0.004
04P-5013	AMBIENT	0	0.000	0.004
04P-5015	AMBIENT	0	0.000	0.004
04P-5017	AMBIENT	0	0.000	0.005
04P-5019	AMBIENT	0	0.000	0.005
04P-5019D	AMBIENT	0	0.000	0.005
04P-5021	FIELD BLANK	0	.	.
04P-5023	FIELD BLANK	0	.	.
04P-5001	PERIMETER	0	0.000	0.005
04P-5003	PERIMETER	0	0.000	0.005
04P-5003R	PERIMETER	0	0.000	0.005
04P-5005	PERIMETER	1	0.005	0.005
04P-5007	PERIMETER	0	0.000	0.005
04P-5009	PERIMETER	0	0.000	0.005
05P-8001	AMBIENT	0	0.000	0.004
05P-8003	AMBIENT	0	0.000	0.005
05P-8007	AMBIENT	0	0.000	0.004
05P-8009	AMBIENT	0	0.000	0.004
05P-8009D	AMBIENT	0	0.000	0.004
05P-8011	AMBIENT	0	0.000	0.005
05P-8021	FIELD BLANK	0	.	.
05P-8024	FIELD BLANK	0	.	.
05P-8005	PERIMETER	0	0.000	0.004
05P-8013	PERIMETER	0	0.000	0.005
05P-8015	PERIMETER	0	0.000	0.006
05P-8017	PERIMETER	1	0.005	0.005
05P-8019	PERIMETER	2	0.008	0.004
06P-10012	AMBIENT	0	0.000	0.004
06P-10014	AMBIENT	0	0.000	0.004
06P-10016	AMBIENT	0	0.000	0.004
06P-10016D	AMBIENT	0	0.000	0.004
06P-10018	AMBIENT	0	0.000	0.004
06P-10020	AMBIENT	0	0.000	0.004
06P-10021	FIELD BLANK	0	.	.
06P-10024	FIELD BLANK	0	.	.
06P-10001	PERIMETER	0	0.000	0.005
06P-10003	PERIMETER	0	0.000	0.005
06P-10005	PERIMETER	0	0.000	0.005
06P-10005R	PERIMETER	0	0.000	0.005

(continued)

APPENDIX C (continued)

Sample number	Sample location	Number of asbestos structures	Concentration, s/cm^3	Analytical sensitivity, s/cm^3
06P-10007	PERIMETER	0	0.000	0.005
06P-10009	PERIMETER	0	0.000	0.005
16P-4002	AMBIENT	0	0.000	0.004
16P-4004	AMBIENT	0	0.000	0.004
16P-4006	AMBIENT	0	0.000	0.004
16P-4008	AMBIENT	0	0.000	0.004
16P-4010	AMBIENT	0	0.000	0.004
16P-4022	FIELD BLANK	0	.	.
16P-4023	FIELD BLANK	0	.	.
16P-4012	PERIMETER	0	0.000	0.005
16P-4014	PERIMETER	0	0.000	0.004
16P-4016	PERIMETER	1	0.005	0.005
16P-4018	PERIMETER	0	0.000	0.004
16P-4020	PERIMETER	0	0.000	0.004
19P-7002	AMBIENT	0	0.000	0.004
19P-7004	AMBIENT	0	0.000	0.004
19P-7006	AMBIENT	0	0.000	0.005
19P-7008	AMBIENT	1	0.005	0.005
19P-7010	AMBIENT	0	0.000	0.005
19P-7021	FIELD BLANK	0	.	.
19P-7023	FIELD BLANK	0	.	.
19P-7012	PERIMETER	0	0.000	0.005
19P-7014	PERIMETER	0	0.000	0.005
19P-7014D	PERIMETER	0	0.000	0.005
19P-7016	PERIMETER	0	0.000	0.005
19P-7018	PERIMETER	1	0.005	0.005
19P-7018R	PERIMETER	1	0.005	0.005
19P-7020	PERIMETER	0	0.000	0.005
20P-6011	AMBIENT	0	0.000	0.005
20P-6013	AMBIENT	1	0.005	0.005
20P-6015	AMBIENT	1	0.005	0.005
20P-6015D	AMBIENT	0	0.000	0.005
20P-6017	AMBIENT	0	0.000	0.005
20P-6019	AMBIENT	1	0.005	0.005
20P-6021	FIELD BLANK	0	.	.
20P-6023	FIELD BLANK	0	.	.
20P-6001	PERIMETER	0	0.000	0.005
20P-6003	PERIMETER	0	0.000	0.005
20P-6003R	PERIMETER	0	0.000	0.005
20P-6005	PERIMETER	0	0.000	0.005
20P-6007	PERIMETER	0	0.000	0.005
20P-6007R	PERIMETER	0	0.000	0.005
20P-6009	PERIMETER	0	0.000	0.005

(continued)

APPENDIX D

DATA SUMMARY FOR ASBESTOS CONCENTRATIONS MEASURED BY THE NEW JERSEY DEPARTMENT OF HEALTH/U.S. ENVIRONMENTAL PROTECTION AGENCY BEFORE ABATEMENT AT NINE SITES

	Asbestos concentration, s/cm^3				
Sample location	Mean	Minimum	Maximum	No. of samples	Standard deviation
		Site B			
Ambient	0	0	0	5	0
Perimeter	0.001	0	0.005	5	0.002
		Site C			
Ambient	0.003	0	0.011	5	0.005
Perimeter	0.001	0	0.005	5	0.002
		Site D			
Ambient	0	0	0	5	0
Perimeter	0	0	0	5	0
		Site E			
Ambient	0	0	0	5	0
Perimeter	0.001	0	0.005	5	0.002
		Site F			
Ambient	0	0	0	5	0
Perimeter	0.003	0	0.008	5	0.004
		Site G			
Ambient	0	0	0	5	0
Perimeter	0	0	0	5	0
		Site P			
Ambient	0	0	0	5	0
Perimeter	0	0	0	5	0
		Site S			
Ambient	0.001	0	0.005	5	0.002
Perimeter	0.001	0	0.005	5	0.002
		Site T			
Ambient	0.003	0	0.005	5	0.003
Perimeter	0	0	0	5	0

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