PRELIMINARY REPORT ON INDOOR ASBESTOS IN HOMES BUILT WITH ASBESTOS CEMENT AIR DUCTS

NEW JERSEY DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH PROTECTION PROGRAM

JUNE 1986

SUMMARY

In response to health concerns from Willingboro Township officials and residents, the Environmental Health Program of the New Jersey Department of Health, conducted a pilot indoor air monitoring study of 8 homes with forced air heating system and asbestos-cement ductwork and 1 home with radiant heat to determine the possibility of an indoor airborne asbestos problem. Compared with outdoor airborne asbestos concentrations (none found), elevated levels of asbestos concentrations were detected in 3 of the 8 homes with asbestos-cement duct works ranging from 13.4 to 35.7 ng/cu M. The lifetime risk estimates calculated for the elevated indoor airborne asbestos concentrations in the 3 homes range from 14.4 per 100,000 to 48.6 per 100,000. These risks are higher than normally accepted in environmental contamination episodes. Because these homes were selected on the evidence of deteriorating ductwork and less frequent house cleaning, the results are not representative of conditions in homes built using this construction technique. To our knowledge, this is the first study to evaluate the relationship between residential airborne asbestos concentration and asbestos-cement ductworks. In light of the limited information on asbestos-cement ductworks and the findings of this pilot study, the New Jersey Department of Health recommends the further evaluation of the 3 homes with elevated airborne asbestos concentration to confirm the results and to determine home-specific activities that may be responsible for these levels. The Department also recommends the sampling of additional homes with asbestos-cement ductworks and homes without ductworks to provide a firmer baseline in order to evaluate the impact of asbestos-cement ductworks on residential indoor air quality and to formulate public health policy accordingly.

INTRODUCTION

In late 1984, the Environmental Health Program [EHP] of the New Jersey Department of Health was approached by Willingboro Township officials and residents with health concerns about possible health implications of the use of asbestos cement ductwork in the slab foundations of homes in Willingboro. Major construction in Willingboro began in 1956 with approximately 1000 homes built per year through 1970. The initial phases of construction utilized radiant hot water heating systems, but in response to a demand for central air conditioning, forced hot air heat systems were installed beginning in 1965. Nearly 60% of the 11,070 homes in Willingboro are constructed with forced hot air heating systems utilizing asbestos cement ductworks [1].

In the absence of information describing the likelihood of asbestos fiber release from asbestos-containing cement air ducts in homes, the EHP conducted a pilot sampling of indoor air in several Willingboro homes with these air ducts to determine the potential for unhealthy levels of airborne asbestos in homes with asbestos-cement air ducts.

BACKGROUND

Asbestos is a known carcinogen [2]. Inhalation of airborne asbestos fibers in occupational settings has caused asbestosis, bronchial carcinoma (lung cancer), mesothelioma (cancer of the lung cavity lining), and cancers of the gastrointestinal tract (throat, stomach, colon, and rectum). Exposure to asbestos fibers has not been linked to birth defects or to adverse reproductive effects such as reduced fertility and sterility. Lung cancer is the major exposure-related cancer affecting asbestos workers. Evidence indicates that combined exposure to both asbestos and cigarette smoke greatly increases the risk of lung cancer, some forms of gastrointestinal cancers, but not mesothelioma. Epidemiological evidence has shown higher incidences of mesothelioma in populations living in the vicinity of asbestos mines and manufacturing plants and family contacts of asbestos workers [3]. No documentation exists of an association between cancer and non-occupational exposure to asbestos containing consumer products.

Asbestos fibrous materials are resistant to heat and chemicals, have high tensile strength, and are flexible. This unique combination of properties allows for the use of asbestos in common consumer products such as ironing board covers, oven gloves, toasters, broilers, ovens, clothes washers and dryers, and in automobile brake pads and linings. Construction materials can also contain asbestos. These include asbestos-cement pipes and sheets, asbestos floor tiles, roofing and siding materials, textured paints, and its former use in spackling, patching and taping compounds [4].

The mere presence of asbestos in consumer products or in residential construction materials does not pose a health risk to the occupants of the homes. Most asbestos is incorporated into finished products where the fibers are bound in a matrix (e.g., asbestos-cement, flooring and flooring products, and friction materials), thereby reducing their release into the air. However, use of sufficient energy, as in automobile braking, or natural wear and tear may dislodge fibers from tightly bound materials.

The release of asbestos fibers into the environment occurs by several means. The major sources include asbestos mining and milling, manufacturing and the use of asbestos products, particularly in automobile brakes, and the disposal of asbestos wastes. [4] Historically, asbestos was used as a sprayed-on fireproofing material, and this also contributed to ambient air levels. Thus, due to the combination of the natural occurrence, the wide uses, and the extreme difficulty of this material to biodegrade, asbestos fibers are widely dispersed in the environment, particularly in the ambient air (Table 1). A quantitive risk assessment of exposure to airborne asbestos is presented in Appendix A.

Table 1

Summary of U.S. Ambient Air Asbestos Sampling

Sample Set	Collection Period	Number of Samples	Mean Concentration (ng/cu M)
Quarterly Composite of 5 to 7 24-hr. U.S. Samples [a]	1969-70	187	3.3
Quarterly Composite of 5 to 7 24-hr. U.S. Samples [b]	1969-70	127	3.4
6 to 8 hr. Samples of New York City [c]	1969	22	16.0

[a] Reference 11 and 12
[b] Reference 13
[c] Reference 14

METHODS

A mail survey was conducted among residents of Willingboro who voiced a concern about possible health consequences from the ventilation system in their homes to Township officials or to the EHP. A copy of the questionnaire is provided in Appendix B. Based on responses to this survey field sampling was conducted in eight homes with gas, forced air heat systems with asbestos-cement ductworks (Homes A through H), along with one control home with oil, radiant heat (J). The responses to the survey for the homes selected are shown in Table 2. These homes were selected based on the following factors: original (or long term) occupancy, infrequency of cleaning, the presence of water in the ducts, visible damage to the ducts, and lack of alterations to the heating system. Twenty-one questionnaires were sent to residences with the suspect ductwork, 14 were completed and returned. Municipal officials provided the addresses of two homes with radiant heating systems. The "cleaner" of the two was selected as a control home.

To standardize the locations of the samples, one sample was taken at the breathing zone in a central location of the room which the family reported they used most often, a sample was taken approximately 2 feet above a heat register in the room which was located at the farthest point from the furnace along the main duct, and one sample was taken in the utility room where the furnace was located, in the room which was closest to the furnace, or in a second floor room if applicable. An exterior air sample was obtained on each of 2 days

Table 2

PRE-SAMPLING QUESTIONNAIRE

HOME #	YR Const.	YR Move	Remodel heat sys	Furnace cleaned	Ducts cleaned	FREQUENCY OF CLEANING often vacuumed	often dusted	often wet mop	dust in LR duct	how much	ever H2O	cracks in ducts
A	1969	1969	no	recent 85	10/84	c	c	c	YES	a	unk	unk
B	1969	1969	no	10/84	no	c	c	b	YES	a	YES	unk
C	1960	1960	no	82 or 83	unk	d	d	d	YES	c	YES	unk
D	1966	1966	no	no	no	b	b	b	YES	a	YES	YES
E	1967	1967	no	no	no	b	b	c	unk	unk	YES	unk
F	1962	1968	yes	10/83	9/78	c	c	NA	YES	b	YES	unk
G	unk	1970	no	84	83	c	c	b	unk	c	YES	no
H	unk	1982	no	no	no	c	c	c	YES	c	YES	unk
J*	1959	1968	yes	2/84	NA	a	a	NA	NA	NA	NA	NA

* Home has radiant heat.
NA = Not applicable.
unk = unknown/no response.

KEY TO FREQUENCY OF CLEANING
a = at least 3 times per week
b = 1-2 times per week
c = 1-3 times per month
d = less than once a month

when sampling was conducted. Two blank monitors were submitted for analysis for each day of sampling. Environmental data regarding indoor temperature and relative humidity, number of people present, activity level, and status of the ventilation fan/heater and windows was obtained at the time of the sampling.

Asbestos air samples were collected and analyzed by Transmission Electron Microscopy [TEM] at the Environmental Sciences Laboratory, Mt. Sinai Medical Center in New York using a modified NIOSH Method 7400 [5]. Briefly, asbestos fibers were collected on a 0.45 micron cellulose ester filter (Millipore monitor MHWP037AO) in a pre-loaded cassette with an average flow rate of 7.4 liters per minute [LPM] (16 pumps, range 7.2 to 7.5 LPM with a 10 LPM critical orifice in line). At this sampling rate, each pump was permitted to operate for approximately 5 hours to collect a volume of at least 2000 liters of air. For air sample collection, the open faced filter cassettes were placed face down approximately 2 feet above the floor-mounted heat register. Filter cassettes were hand delivered to the Environmental Sciences laboratory within 24-48 hours of completion of sampling.

RESULTS

The data in Table 3 describe the conditions in each home at the time of sampling. Because sampling was conducted in April, the windows were closed in all homes sampled, however, the entrance and egress of pets did provide some variation. The level of activity, subjectively assessed by the sampling team based on the number of people present and their reported actions, was evenly distributed in the eight homes with asbestos-cement ductwork with 4 homes having moderate activity and 4 homes having low activity levels. The fan in the ventilation system in homes C, D, and F were turned off during the day of sampling thereby possibly resulting in lower levels of measured airborne asbestos fibers in these homes.

Table 4 describes the individual analytical data for residential samples and for laboratory blank samples. Analysis by TEM indicated that the airborne asbestos fibers were of the crysotile type. Other fiber types were not detected. The range in measured mass of asbestos on laboratory blank filters per volume of air collected was 0.19 to 2.15 nanograms per cubic meter [ng/cu M] with an average of 1.15 ng/cu M and a standard deviation of 0.18. Therefore, for the purpose of this study airborne asbestos concentrations up to 1.3 ng/cu M are not significantly different from laboratory background.

Table 5 describes the concentrations of airborne asbestos fibers in outside air and in the indoor air of the 9 homes based on data presented in Table 4. Asbestos fibers were not detected in outside

Table 3

Information From Date of Sampling

SAMPLE #	Fan / Heater	Temp (~F)/ R.H. (%)	Activity level	# of people	Windows	Heat Type
A	on	76/39	moderate	>2[a]	closed	gas forced air
B	on	73/40	low	2	closed	gas forced air
C	off	62/51	moderate	1	closed[b]	gas forced air
D	off	76/39	low	1	closed	gas forced air
E	on	78/47	moderate	3	closed	gas forced air
F	off	72/33	low	2	closed	gas forced air
G	on	78/44	low	2	closed	gas forced air
H	on	68/54	moderate	4	closed	gas forced air
J	on	74/38	moderate	5	closed	oil-radiant

R.H. - Relative Humidity.

a - number of people present at time of sampling.
b - window in second floor bedroom was open at the time of sampling.

TABLE 4
ANALYTICAL DATA

Sample number	Measured Mass of asbestos* on filter (nanograms)	Laboratory background (ng)**	Less lab background (ng)**	Air Volume (cu M)	Asbestos Concentration (ng/cu M)
A1	10.1	4.6	5.5	2.14	2.6
A2	6.0	4.6	1.4	2.26	0.5
A3	6.2	4.6	1.6	2.26	0.7
B1	2.1	0.4	1.7	2.36	0.7
B2	31.6	0.4	31.2	2.33	13.4
B3	5.8	0.4	5.4	2.23	2.4
C1	79.6	0.4	79.2	2.22	35.7
C2	32.1	0.4	31.7	2.22	14.3***
C3	49.7	0.4	49.3	2.22	22.2
D1	0.9	0.4	0.5	2.14	0.2
D2	0.6	4.6	0.0	2.18	0.0
D3	5.3	0.4	4.9	2.12	2.3
E1	38.0	0.4	37.6	2.22	16.9
E2	54.5	4.6	49.9	2.25	22.2
E3	20.4	4.6	15.8	2.29	6.9
E4 e	0.7	4.6	0.0	2.51	0.0
F1	2.0	4.6	0.0	2.19	0.0
F2	2.2	4.6	0.0	2.19	0.0
F3	3.7	0.4	3.3	2.22	1.5
G1	2.1	4.6	0.0	2.32	0.0
G2	12.0	4.6	7.4	2.23	3.3
G3	2.3	0.4	1.9	2.24	0.8
H1	1.8	4.6	0.0	2.25	0.0
H2	1.4	4.6	0.0	2.22	0.0
H3	0.1	0.4	0.0	2.19	0.0
J1	4.9	4.6	0.3	2.22	0.1
J2	1.9	4.6	0.0	2.22	0.0
J3	2.8	0.4	2.4	2.25	1.1
J4 e	0.4	0.4	0.0	2.22	0.0

* Crysotile only, no amphiboles were detected.

** Based on the average of two sets of 4 or 5 blanks, one blank filter being processed with each 4 samples.

*** Additionally, one large respirable clump was found that would contribute an additional mass of about 100 ng.

e Exterior sample.

Table 5

WILLINGBORO AIR SAMPLES
FOR ASBESTOS

HOME	Nanograms/cu Meter: Room most Frequently Used (Center of Room)	Room Farthest from Furnace (Above Register)	Utility Room, Room closest to Furnace (Center), or 2nd Fl. Room (Above Register)
A	2.6 Den	0.5 M.Bedrm	0.7 Util.Rm
B	0.7 Den	13.4 Living Rm	2.4 2nd Fl Office
C*	35.7 Living Rm	14.3 Left Rear Rm	22.2 2nd Fl M.Bedrm
D	0.2 Den	0.0 M.Bedrm	2.3 Util.Rm
E	16.9 Den	22.2 M.Bedrm	6.9 Living Rm
F	0.0 Kitchen	0.0 Rt Front Rm	1.5 Util. Rm
G	0.0 Dining Rm	3.3 M.Bedrm	0.8 Util. Rm
H	0.0 Fam. Rm	0.0 Den	0.0 Util. Rm
J	0.1 Fam. Rm	0.0 Rt Front Rm	1.1 2nd Fl Rt Rm

EXTERIOR SAMPLES

Date	Location	Nanograms/cu Meter
3/13/85	Exterior of Home J	0.0
3/14/85	Exterior of Home E	0.0

NOTE: * Additionally, one large respirable clump was found which would contribute an additional mass of about 100 nanograms.

air after a single sampling at two locations on different days. Indoor asbestos concentrations in Homes F, H, and J (the control home) were found to be within the variation of laboratory background. A single sample in Homes A [2.6 ng/cu M], D [2.3 ng/cu M], and G [3.3 ng/cu M] were above laboratory background variation. The remaining samples in these homes were within laboratory variation. Airborne asbestos concentrations significantly higher than laboratory background and ambient air were detected in all three sample locations in Homes C and E and in two of the three samples from Home B. The highest levels of indoor airborne asbestos were found in Homes B, C, and E, with Home C having the highest levels of 35.7, 14.3, and 22.2 ng/cu M.

DISCUSSION

Elevated indoor airborne asbestos concentrations, compared with background levels, were detected in all 3 samples from 2 homes and one sample from a third home among the 8 homes in Willingboro evaluated under worst case conditions. To our knowledge, this study is the first to evaluate the relationship between residential airborne asbestos and asbestos-cement ductwork. In light of the absence of information on these ductworks, the sampling protocol was designed to ascertain the potential for unhealthy levels of residential airborne asbestos in homes with these ductworks under worst case conditions, and, based on the findings, to determine if further sampling is warranted. As such, these results are not representative of conditions in homes with asbestos-cement ductworks. The results suggest, however, the possibility for residential indoor air asbestos problems in homes with asbestos-cement ductworks, and, therefore, additional sampling is necessary to further characterize the range of indoor airborne asbestos concentration in homes with and without asbestos in heating systems.

The airborne asbestos levels in Homes B, C, and E, provided risk estimates ranging from 14.4 per 100,000 to 48.6 per 100,000 (Table 6). These risk estimates are greater than those which are usually considered acceptable with environmental contamination. The risk estimates represent worst case exposure scenarios such as a continuous, 24-hr exposure to the highest level of asbestos measured in each home for the specified exposure duration and an inhalation rate representative of an asbestos worker's strenuous activity. The actual risks under realistic exposure conditions (i.e., an average 16-hr occupancy of one's home and a breathing rate half of that of an asbestos worker) are likely to be less. Furthermore, because of the interactive relationship between smoking and asbestos in lung cancer, the absence of smoking would significantly reduce the risk for lung cancer. The assumed linear model for risk extrapolation inherently provides the most conservative, or highest risk estimates. In other words, the calculated upper range in risk estimates for residential exposure to airborne asbestos most likely represents a maximum and estimates under actual exposure conditions are likely to be less than the above calculated estimates.

Table 6

LIFETIME RISKS OF DEATH/100,000 FROM ALL ASBESTOS-RELATED CANCERS FROM EXPOSURE TO ELEVATED INDOOR AIRBORNE ASBESTOS LEVELS IN 3 WILLINGBORO HOMES

HOME	HIGHEST ASBESTOS LEVEL (ng/cu M)	RESIDENTIAL DURATION (yrs)	CUMULATIVE EXPOSURE (ng/cu M)(yrs)	Female (Deaths/100,000)	Male (Deaths/100,000)
				Risk Levels With Onset of Exposure at Birth	
B	13.4	16	214.4	7.3(0.4-136)	7.6(0.5-124)
C	35.7	25	892.5	30.3(1.7-568)	32.0(2.2-515)
E	22.2	18	399.6	14.0(0.8-254)	14.0(1.0-231)
				Risk Levels With Onset of Exposure From Age 20	
B	13.4	16	214.4	3.0(0.2- 52)	4.3(0.4- 58)
C	35.7	25	892.5	12.6(0.8-216)	18.0(1.5-242)
E	22.2	18	399.6	5.6(0.4- 97)	8.0(0.7-108)
				Lifetime Risk	
B	13.4			14.4(0.9-255)	18.2(1.4-261)
C	35.7			38.3(2.3-680)	48.6(3.8-694)
E	22.2			23.8(1.4-423)	30.2(2.3-432)
Ambient*	3.3			3.5(0.2- 63)	4.5(0.3- 64)

* Assumes 24 hour exposure

RECOMMENDATIONS

Based on the findings of this pilot study, the Department of Health recommends the following:

1. Resamplimg of all three homes with elevated indoor airborne asbestos levels to confirm the results. The sampling protocol should include bulk and wipe samples of the ductworks.

2. An inspection of each of the three homes to determine home-specific activities that may be responsible for these levels.

3. Expansion of the study to additional homes with heating systems with and without asbestos-containing materials to provide a firmer baseline before formulating public health policy on this issue.

APPENDIX A

Quantitative Risk Assessment

Ideally, the potential for long term health problems from exposure to indoor airborne asbestos should be predicted from dose-response data describing adverse health outcomes from exposure to low, environmental concentrations of asbestos. Epidemiological studies of family contacts of asbestos workers or of communities near asbestos mines have not provided dose-response relationships of sufficient quality to use for risk assessment. Therefore, it is necessary to use occupational data for extrapolating risks for environmental exposures.

Quantitative risk assessments on asbestos have been conducted by the Occupational Safety and Health Administration [6], the National Academy of Science [7], the British and Canadian governments [9,3], the U.S. Consumer Product Safety Commission [8], and by Doll and Peto [10]. An authoritative risk assessment report on asbestos was recently written for the EPA by Nicholson [2]. The report is a comprehensive review of occupational and environmental data on asbestos and of the quantitative risk assessments for non-occupational exposures conducted by several federal agencies including that of the author's. All reviewed quantitative risk assessments concluded that the linear model for lung cancer and mesothelioma was most appropriate, although small differences in risk units were noted which were largely the result of the choice of studies considered. All groups recognized the limitations in the data on which extrapolations were based. These limitations are:

1. The dependence of extrapolation on a linear dose-response relationship which was necessary since occupational studies could not provide sufficient exposure data for a dose-response relationship.
2. The dependence of extrapolation on uncertain asbestos exposure concentrations in past years.
3. The dependence of extrapolation on occupational exposure data which are exclusively for asbestos fibers greater than 5 microns in length, the detection limit of phase contrast microscopy. The calculated potencies are based on asbestos concentrations measured in occupational settings using a phase contrast microscopy [PCM] method which has an asbestos fiber resolution of 5 microns [um] in length. In contrast, typically encountered environmental asbestos fibers (ambient air, school buildings) are less than 5 um in length, and therefore, cannot be detected by PCM. For these exposures, a more sensitive method, Transmission Electron Microscopy, is used which has a resolution of 0.0002 um. The uncertain relationship between environmental and occupational asbestos fiber dimensions with respect to health effects is unlikely to be resolved epidemiologically. Therefore, from a public health point of view, this relationship is assumed to exist unless indicated otherwise.

A comparison of the 6 different quantitative risk estimates showed that Nicholson [2] had the largest range and highest risks estimates because they were based on worst case exposure assumptions and represent upper limits of risks for non-occupational exposures to asbestos. For the purposes of this report, Nicholson's estimates were used but were modified to include all asbestos-related cancers (Table A-1).

The risk estimates presented in Table A-1 were calculated using the best estimates for KL, and KM, the fractional increases in lung cancer and mesothelioma risk per fiber-year/cc (potencies), respectively. The risk estimates were also based on a continuous 24-hr exposure to asbestos, thus, representing a worst case scenario. The best estimate for KL is 0.01 and for KM, $1x10^{-8}$. The estimates were based on an analysis of the unit exposure risk for both types of cancer in epidemiological studies (all studies for which unit exposure risks can be estimated except chrysotile mining and milling). The 95 percent confidence limit on KL was from 0.004 to 0.027 (a factor of 2.5). The data would not permit a direct estimate of the 95 percent confidence limit on KM due to the large uncertainty factors compared to the data for KL. Nicholson [2] suggested a factor of 5 as a reasonable limit for the average value of KM. Recognizing the dependability of the extrapolations on assumptions that may have a wide range of uncertainty for environmental exposure, Nicholson [2] suggested factors of 10 and 20 for 95 percent confidence limits for KL and KM, respectively, on their applications to any unknown exposure circumstance. Although this represents a 1000-fold range in risk

Table A-1

LIFETIME RISKS OF DEATH/100,000
FROM ALL ASBESTOS-RELATED CANCER
FROM CONTINUOUS EXPOSURE TO 0.001 f/cc *
ACCORDING TO AGE AT FIRST EXPOSURE AND DURATION OF EXPOSURE

Age at Onset of Exposure	Years of Exposure				
	1	5	10	20	Lifetime
			FEMALE		
0	1.6(0.09-31.5)	7.4(0.4-141)	13.5(0.75-256)	22.4(1.3-420)	35.4(2.1-629)
10	1.1(0.06-20.5)	4.9(0.3- 93)	8.9(0.52-164)	14.7(0.9-266)	21.8(1.4-370)
20	0.7(0.04-12.7)	3.2(0.2- 57)	5.7(0.36-100)	9.3(0.6-160)	13.0(0.9-209)
30	0.5(0.03- 7.7)	2.0(0.1- 33)	3.6(0.26- 58)	5.7(0.5- 92)	7.3(0.6-110)
50	0.2(0.02- 2.2)	0.7(0.05- 9)	1.1(0.1- 15)	1.6(0.2- 20)	1.7(0.2- 21)
			MALE		
0	1.6(0.10-26)	7.3(0.5-124)	14.0(0.9-227)	23.5(1.6-381)	44.9(3.5-642)
10	1.1(0.07-18)	5.3(0.4- 84)	10.3(0.7-161)	17.4(1.3-259)	32.0(2.6-427)
20	0.9(0.06-13)	4.0(0.3- 56)	7.5(0.6-105)	13.3(1.1-179)	22.1(1.9-273)
30	0.7(0.05- 9)	3.1(0.3- 40)	5.9(0.5- 75)	10.5(1.0-125)	15.0(1.3-172)
50	0.4(0.04- 4)	1.8(0.2- 19)	3.2(0.3- 34)	5.0(0.5- 48)	4.7(0.5-49.5)

* 0.001 f/cc is equivalent to 33 ng/cu M

Source: References 2 and 6

estimates, the range is significantly less than the range in estimates normally encountered in risk extrapolations for other chemical carcinogens. The reason for this observation may be due partially to the lesser degree of uncertainty in the fractional increase in cancer risk per unit exposure (potency) calculated from several epidemiological studies of asbestos workers compared with other dose-response data for other occupational carcinogens.

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APPENDIX B

QUESTIONNAIRE

[illegible]

WILLINGBORO RESIDENTS

DECEMBER 1984

QUESTIONNAIRE SENT: Dec. 12, 1984

PLEASE COMPLETE EACH APPLICABLE ITEM AS INSTRUCTED.

NAME ______________________ QUESTIONNAIRE COMPLETED

ADDRESS ______________________ ____/___/____

______________________ PHONE _____________

1. IN WHAT YEAR WAS YOUR HOME CONSTRUCTED? ______

2. IN WHAT YEAR DID YOU MOVE INTO YOUR HOME? ______

3. WHAT TYPE OF HOME DO YOU LIVE IN? [CHECK ONE]

   SINGLE FAMILY HOUSE _____
   ATTACHED TOWNHOUSE _____

4. IS YOUR HOME: [CHECK ONE]

   ONE STORY _____(go to #5)
   TWO STORIES _____(continue)

   a. HOW MANY BEDROOMS ARE ON THE SECOND FLOOR?
   _____ROOMS

5. WHAT TYPE OF HEATING SYSTEM DO YOU HAVE IN YOUR HOME? [CHECK ONE]

   RADIANT ____ GAS HOT AIR ____
   OTHER (describe) ____

6. HAVE YOU OR A PREVIOUS OWNER EVER REMODELED YOUR HEATING SYSTEM? [CHECK ONE]

   _____NO (go to #7) _____YES (continue)
   _____DON'T KNOW OR DON'T REMEMBER (go to #7)

   a. DID YOU OR A PREVIOUS OWNER REPLACE THE FURNACE?
   _____NO _____YES

   b. DID YOU OR A PREVIOUS OWNER REPAIR OR REPLACE DUCTWORK?
   _____NO _____YES

   c. WHAT OTHER MODIFICATIONS DID YOU OR A PREVIOUS OWNER MAKE?
   _____NONE _____SOME

   (if some, describe)____

7. IN WHAT MONTH & YEAR WAS YOUR FURNACE LAST CLEANED?

   ___/_____ _____NEVER
   _____DON'T KNOW OR DON'T REMEMBER

8. IN WHAT MONTH & YEAR WAS YOUR DUCTWORK LAST CLEANED?
___/___ (continue) _____NEVER (go to #10)
_____DON'T KNOW OR DON'T REMEMBER (go to #10)

9. WHO CLEANED THE DUCTWORK? [CHECK ONE]
A PROFESSIONAL SERVICE? _____ DON'T KNOW OR
FAMILY MEMBERS? _____ DON'T REMEMBER _____
OTHER? (specify)_________________________________

10. WHEN DID YOU (OR SOMEONE ELSE) LAST VACUUM (ALL OR ANY PORTION OF) YOUR HOME?
___/___/_____ _____DON'T KNOW OR DON'T REMEMBER

11. ON A ROUTINE BASIS, HOW OFTEN IS YOUR HOME VACUUMED?
____ AT LEAST 3 TIMES PER WEEK ____ 1-3 TIMES PER MONTH
____ 1-2 TIMES PER WEEK ____ LESS THAN ONCE A MONTH

12. WHEN DID YOU (OR SOMEONE ELSE) LAST DUST (ALL OR ANY PORTION OF) YOUR HOME?
___/___/_____ _____DON'T KNOW OR DON'T REMEMBER

13. ON A ROUTINE BASIS, HOW OFTEN DO YOU DUST?
____ AT LEAST 3 TIMES PER WEEK ____ 1-3 TIMES PER MONTH
____ 1-2 TIMES PER WEEK ____ LESS THAN ONCE A MONTH

14. WHEN DID YOU (OR SOMEONE ELSE) LAST WET MOP (ALL OR ANY PORTION OF) YOUR HOME?
___/___/_____ _____DON'T KNOW OR DON'T REMEMBER

15. ON A ROUTINE BASIS, HOW OFTEN DO YOU WET MOP?
____ AT LEAST 3 TIMES PER WEEK ____ 1-3 TIMES PER MONTH
____ 1-2 TIMES PER WEEK ____ LESS THAN ONCE A MONTH

REMOVE THE COVER TO THE HOT AIR DUCT IN YOUR LIVING ROOM.

16. IS THERE DUST OR DEBRIS VISIBLE IN THE LIVING ROOM HOT AIR DUCT WHEN THE COVER IS REMOVED?
_____NO (go to #17) _____YES (continue)

a. THE AMOUNT OF DEBRIS OR DUST IS [CHECK ONE]:
_____MINIMAL (less than 10 distinct pieces)
_____NOT MINIMAL (10 or more distinct pieces)
_____CAN'T DISTINGUISH DISTINCT PIECES

17. IS THERE STANDING WATER IN THE HOT AIR DUCT NOW?
_____NO (go to #18) _____YES (continue)

a. THE WATER PRESENT IS _____ INCHES DEEP.

REPLACE THE HOT AIR DUCT COVER.

18. HAS THERE EVER BEEN STANDING WATER IN ANY OF THE AIR DUCTS?
_____YES (continue) _____NO (go to #21)
_____ DON'T KNOW OR DON'T REMEMBER (go to #21)

WATER IN THE DUCT?

___/___/_____ _____DON'T KNOW OR DON'T REMEMBER

20. HOW DEEP DOES THE WATER USUALLY GET IN THE DUCT?

______ INCHES _____DON'T KNOW OR DON'T REMEMBER

21. ARE THERE ANY CRACKS IN THE DUCTS IN THE SLAB FOUNDATION OF YOUR HOME?

_____NO _____YES

_____DON'T KNOW OR DON'T REMEMBER

22. HOW MANY MONTHS PER YEAR DO YOU USE YOUR CENTRALIZED SYSTEM:

a. FOR HEATING? _____MONTHS

b. FOR AIR CONDITIONING? _____MONTHS

23. FOR EACH HAIR DRYER IN YOUR HOME, PLEASE LIST THE FOLLOWING:

BRAND NAME	MODEL (Name and/or Model No.)	SERIAL NO.
____________________	____________________	_______________
____________________	____________________	_______________
____________________	____________________	_______________

24. FOR EACH PERSON WHO LIVES IN YOUR HOME, PLEASE ANSWER THE FOLLOWING:

AGE	SEX	DAILY AVERAGE NUMBER OF HOURS HOME	CURRENT OCCUPATION	[CIRCLE ONE] EVER WORKED WITH ASBESTOS?	IF Y # OF YEARS
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____
_____	___	___	__________________	N Y	____

Please return by Friday, December 21, in the enclosed envelope to:

Dr. R. Zagraniski
Environmental Health Program
New Jersey Dept. of Health
CN 360--Room 706
Trenton, N.J. 08625

Thank you for your time and cooperation.