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Review of NIOSH Testing of 30 Hand Held and Standing Hair Dryers for Asbestos Release

Report to CPSC

Contract # CPSC-C-78-0109

William J. Nicholson, Ph. D.
Mount Sinai
School of Medicine

ENVIRONMENTAL SCIENCES LABORATORY
MOUNT SINAI SCHOOL OF MEDICINE OF THE CITY UNIVERSITY OF NEW YORK

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Introduction

This report is in response to a request by the Consumer Product Safety Commission (CPSC) to review the National Institute for Occupational Safety and Health (NIOSH) study of asbestos emissions from various hand held and standing hair dryers. The review includes a discussion of the sampling and analytical techniques utilized by NIOSH, a comparison of results obtained by NIOSH with other environmental asbestos measurements, and, in an appendix, a discussion of possible health consequences from asbestos concentrations that are found in the effluent of some hair dryers.

Sampling and Analytical Techniques

The procedures developed to sample the effluent air from hair dryers are, by far, the best utilized in any available report to date. Care is taken to assure that clean air, uncontaminated by asbestos fibers, enters the dryer and a good determination is made of total dryer effluent and the fraction collected for analysis. While isokinetic sampling was not utilized, this would be difficult to achieve under the circumstances of testing high velocity air streams from a variety of dryers. The absence of isokinetic conditions may result in an underestimate (as the air velocity through the sampling head exceeded the duct air velocity), but this would be a relatively small effect.

A greater underestimate of fiber release from the dryers may occur from the analytical procedures used to quantitate the number and mass of asbestos fibers released. Firstly, collection of fibers on Millipore filters and the subsequent dissolution of the filters by a Jaffe wick method can lead to significant fiber loss (perhaps up to 80%) unless extreme care is taken.

percent of the effluents measured were typical of the ambient air. However, without further data it is not possible to determine if this is an attribute of the model tested or the particular dryer tested (in its current state of use). Special concern must be paid to standing dryers because of the possibility of their nearly continuous use, often in confined spaces, in hair salons. Here a build up of asbestos concentrations in excess of that in dryer effluents can occur.

SUMMARY

Using analytical techniques which may underestimate the concentration of asbestos, NIOSH has clearly demonstrated that some hair dryers release considerable quantities of asbestos fiber. The fiber concentrations in the effluent of some dryers exceeded the highest we have measured in eight years of surveillance of environmental asbestos contamination. Appendix 1 discusses the possible health risks of such concentrations. While the risk to an individual from the intermittent use of an asbestos emitting hair dryer is less than that from many current occupational asbestos exposures, the large number of individuals that may be exposed clearly calls for the elimination of the exposure.

Appendix 1

ENVIRONMENTAL ASBESTOS CONTAMINATION AND HUMAN HEALTH EFFECTS

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The contamination from spray sites was extensive, with asbestos debris o n covering the sidewalks and streets adjacent to the building. Attempts were made on some job sites to contain the spray by tarpaulins, but these were often torn, loosely secured, and ineffective as containment. It is difficult to imagine contamination about a factory, even forty years ago, exceeding that from the direct spraying of asbestos materials into a community from a building 40 or more stories high. The evaluation of building air was in schools in which damage, sometimes extensive, had occurred to friable asbestos surfacing material in hallways or cafeterias. In some schools, the students had reached up to the ceiling and physically dislodged asbestos material. The household measurements were made in the homes of workers employed in chrysotile mining operations in California and Newfoundland. At the time neither shower facilities nor adequate change rooms were available to the workers. Thus, the households sar ed occassionally had visible asbestos fibers in the living areas of the house as well as dusty clothes awaiting cleaning in laundry facilities.

ANALYTICAL TECHNIQUES

In these measurements, the same analytical techniques have been utilized as were originally developed for the analysis of ambient air samples of chrysotile asbestos.[5] Thus, there is a direct comparability in the results of all analyses reported here. All samples were collected on 0.8 μm pore size membrane filters and analyzed using electron microscopic techniques that determined the amount of chrysotile asbestos in each specimen. This variety of asbestos was quantitated because it could easily be identified on the basis of its unique tubular structure. Amphibole asbestos (either amosite or crocidolite) could also be present in the air of buildings or in the ambient air, but it is much less commonly found. However, if sent in the air sampled, such asbestos would add to the concentrations reported here.

...rs, higher values than those mentioned above were obtained.[7] These were six-to-eight hour samples collected between 8:00 A.M. and 5:00 P.M., and reflect what could be intermittently higher concentrations during those hours compared to night time periods, for example. Table 2 records the chrysotile content of 22 samples collected in the five boroughs of New York. It should be noted that the samples analyzed in all of the studies discussed above were taken during a period when fireproofing high rise buildings by spraying asbestos-containing materials was permitted. The practice was especially common in New York City. While no sampling station was known to be located adjacent to an active construction site, unusually high levels could nevertheless have resulted from the procedure. Other sources that may have contributed to these air concentrations include automobile braking, other construction activities, consumer use of asbestos products and maintenance or repair activities of asbestos-containing materials (thermal insulation, for example).

CHRYSOTILE ASBESTOS CONCENTRATIONS ABOUT CONSTRUCTION SITES

To determine if construction activities could indeed be a significant source of chrysotile fiber in the ambient air, six-to-eight hour daytime sampling was conducted in lower Manhattan in 1969 about sites where extensive spraying of asbestos-containing fireproofing material was taking place.[4,7] Eight sampling sites were established about the World Trade Center construction site during the period when asbestos materials were sprayed on the steelwork of the first tower. Table 3 shows the results of those sites located within one-half mile of the Trade Center site and demonstrated that spray fireproofing can contribute significantly to asbestos air pollution. In some instances, ch ...otile asbestos levels approximately 100 times the concentrations typically found in the ambient air were observed.

CHRYSOTILE CONCENTRATIONS IN THE HOMES OF WORKERS

The finding of asbestos disease in family contacts of individuals occupationally exposed to the fiber directs attention to air concentrations in the homes of such workers. Thirteen samples have been collected in the homes of asbestos mine and mill employees and analyzed for chrysotile. The workers were employed at mine operations in California and Newfoundland and did not, at the time of sampling (1973 and 1976) have access to shower facilities nor commonly change clothes before going home. Table 5 lists the concentrations range of these samples. Three samples taken in homes of non-miners in Newfoundland yielded concentrations of 32, 45, and 65 ng/m^3. In contrast, the workers homes were much higher, pointing to the need for appropriate shower and change facilities in asbestos workplaces. As asbestos cancers have been documented in family contacts of workers, concentrations such as seen here should be viewed with particular concern.

DISCUSSION

Three sets of data have been obtained demonstrating significant environmental contamination by asbestos in different circumstances. Seventeen samples collected at various sites about the World Trade Center during the spraying of asbestos materials on the steelwork for fireproofing purposes were analyzed for chrysotile asbestos. Twenty-seven samples collected in public schools with damaged asbestos surfaces and 13 in the homes of asbestos mine and mill employees were also studied. In all cases the sampling was designed to reflect the more serious instances of contamination in these circumstances. The severity of some of the conditions sampled was sufficiently great that it is difficult to imagine conditions even in past years, more egregious than those considered here.

would primarily consist of deaths from mesothelioma and lung cancer.

Other data are in hand linking the incidence of lung cancer in workers engaged in asbestos mining and milling and asbestos products manufacturing to total dust concentrations in the workplace. [13,14] The best fit to these data demonstrate a linear relationship between total dust and the rate of excess mortality from bronchogenic carcinoma. Even though fiber concentrations are unavailable in these studies, the linear relationship, with no evidence of a threshold below which disease does not appear, suggests that any extrapolation of the risk of asbestos disease in occupational circumstances to environmental exposures should utilize a linear relationship. If 10% of the deaths in workers exposed to 60,000 ng/m^3 are asbestos related, such an extrapolation suggests that 1/6000 deaths will be asbestos related at daily environmental exposures of 100 ng/m^3 and 1/600 at 1000 ng/m^3. If the exposures are intermittent, the risk would be correspondingly reduced.

While these risks are considerably less than those of occupational circumstances, concern arises from the fact that millions of people may be exposed to multiple sources of lower concentrations through the daily use of such products as asbestos insulated hair dryers, habitation of public and private buildings containing asbestos materials as fireproofing, acoustic or thermal insulation, and in other environmental circumstances.

Table 2

Distribution of 4- to 8-hour daytime chrysotile asbestos concentrations in the ambient air of New York City 1969 - 1970

Asbestos concentration (ng/m^3) Less than	Number of samples	Percentage of samples
1	0	0.0
2	1	4.5
5	4	18.1
10	8	36.4
20	16	72.7
50	21	95.4
100	22	100.0

Table 4

Distribution of chrysotile asbestos concentrations in 4- to 8-hour samples taken in public schools with damaged asbestos surfaces

Asbestos concentration (ng/m^3) Less than	Number of samples	Percentage of samples
5	0	0.0
10	1	3.7
20	1	3.7
50	6	22.2
100	12	44.4
200	19	70.4
500	25	92.6
1000	26	96.3
2000	27	100.0

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TESTING OF HAIR DRYERS FOR ASBESTOS EMISSIONS

Charles L. Geraci, Jr., Ph.D.
Paul A. Baron, Ph.D.
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Interagency Agreement NIOSH IA-79-29

with

U.S. Consumer Product Safety Commission

U. S. Department of Health, Education, and Welfare
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
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Cincinnati, Ohio

September, 1979

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REPORT TO THE U.S. COMSUMER PRODUCT SAFETY
COMMISSION ON TESTING OF HAIR DRYERS
FOR ASBESTOS EMISSIONS
BY
THE DIVISION OF PHYSICAL SCIENCES AND ENGINEERING
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Background

Beginning in April 1979, the National Institute for Occupational Safety and Health (NIOSH) furnished to the Consumer Product Safety Commission (CPSC) the laboratory and other support services necessary to test the effluent air of hand-held hair dryers for asbestos fibers. The need to determine the possible release of asbestos fibers from hand-held hair dryers containing asbestos insulation materials was realized by CPSC as a result of news media disclosure of asbestos release and a petition by the Environmental Defense Fund, Inc. (EDF). The petition presented by EDF requested that CPSC proceed under the Consumer Product Safety Act to remove hair dryers containing asbestos from the consumer marketplace. Preliminary evidence was presented by EDF which allegedly demonstrated the ability of several hair dryers containing asbestos insulation material to emit asbestos fibers. To fully evaluate the potential consumer exposure to asbestos from asbestos containing hand-held hair dryers CPSC determined that the identification and quantitation of fibers emitted by the dryers having lengths and diameters of as little as 1 micrometer (um) or less would be necessary. To accomplish this task any samples generated would require analysis by a transmission electron microscope (TEM) capable of performing energy dispersive analysis of x-rays (EDAX) and selected area electron diffraction (SAED). The actual sampling of effluent air from the hair dryers would also require expertise and capabilities in the area of

air sampling and the fabrication of controlled atmosphere test systems Both the sampling and analysis experience necessary to perform a study o this type reside within the Division of Physical Sciences and Engineerin (DPSE) of NIOSH. On April 12, 1979, NIOSH and CPSC entered into a interagency Agreement to accomplish the task of evaluating potentia consumer exposure to asbestos released by hair dryers.

Objective

The primary objective of the project was to quantitate and identif asbestos structures in the effluent air of hand-held hair dryers durin operation. Making this determination would require the following:

1. A count of asbestos structures and fibers sampled during operatio of the product.

2. Qualitative identification by EDAX or SAED of fibers sampled a being asbestos or non-asbestos.

3. Determination of the size distribution of sampled asbestos fibe lengths and diameters.

4. Determination of fiber count and fiber mass per cubic meter o effluent air.

To meet the needs of the project a system to determine asbesto emissions from hair dryers was fabricated and validated by NIOSH. sampling of hair dryers, new and used, that contained asbestos wa collected by CPSC and submitted to NIOSH for testing. All dryers wer

tested as received from CPSC.

Test System

The valid determination of asbestos release from the hair dryers demanded the test system meet several requirements. Previous tests (1-4) indicated that a valid determination of the amount of asbestos emitted by various hair dryers would require a clean sampling system capable of accurately determining asbestos concentrations over a wide range. Therefore, the air entering the hair dryers in the test system was filtered to eliminate the possibility of external asbestos contamination and to reduce the amount of background particulate that might interfere with the electron microscope analysis of the samples. The high flowrate of air through many of the dryers precluded complete collection of the effluent. Therefore, the test system was designed to obtain an accurate representative sample of the hair dryer effluent.

The hair dryer test system consisted of several components including a clean air source, a sampling duct assembly, several types of monitoring equipment and filter samplers. A schematic of the test system is shown in Figure 1.

The high flowrate (up to 2 m^3/min) produced by some hair dryers required a high flowrate, clean air source to eliminate background interferences during testing. A test tunnel in the NIOSH dust laboratory was adapted for these tests. Two 60 cm x 60 cm high efficiency particulate air (HEPA) filters in series were used to remove ambient particulate. The ducting around the high flowrate blower was sealed to prevent

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recontamination of the air introduced into the specially constructed clean air test chamber (volume ~ 1 m^3). The airstream entering the test chamber was deflected by a metal plate and diffused through a punched-hole screen. Excess air exhausted from the test chamber via a 25 cm square port through which the sampling duct entered. With the entire system operational and a hair dryer operating, a positive pressure in the hood of approximately 0.15 cm H_2O was obtained. This pressure was low enough to preclude any significant effect on hair dryer operation. The air velocity through the exit port was high enough (100 cm/sec) to prevent turbulent back diffusion of ambient air into the hood. That portion of the test system in which the dryer was placed is herein referred to as the clean air hood.

A dry box glove was fitted to the side of the hood to permit manipulation of the hair dryer controls during a test run without contaminating the hood with ambient air.

The air exhausting from the sampling duct was fed back into the inlet of the test tunnel HEPA filter to prevent potential asbestos escape into the laboratory.

A velocity profile was obtained in the return air duct in order to estimate the total air flow through the clean air supply. The velocity in the 12.7 cm diameter duct was uniformly 762 cm/sec indicating a flowrate of 5.78 m^3/min.

The sampling duct assembly consisted of a one meter length of 18 cm diameter duct and various tapered adapters which allowed direct connection to the outlet of various shaped hair dryers. The duct was selected to be

large enough to easily contain three side by side 37 mm filter cassette samplers. The sampling protocol was subsequently changed to use a single Millipore aerosol open-type 47 mm filter holder with a stainless steel body and support screen. The walls of the duct and tapered sections were coated with oil to prevent reentrainment of particles from the surface of the duct, thereby assuring that particulate from any one dryer would not be detected during subsequent tests.

Based on work by Liu and Agarwal (5) the losses in the duct of particles smaller than 5 um aerodynamic diameter were expected to be less than 10% for the flowrates of all the hair dryers tested. The air flow through the duct for these flowrates was in the turbulent regime indicating that the potential source of any primary particle losses expected would be turbulent impaction on the of the duct rather than gravitational settling of the particles.

Sampling the hair dryer air supply and effluent was accomplished by using 37 mm and 47 mm filter cassettes, respectively, and 0.8 um pore size mixed cellulose ester membrane filters. These filters have greater than 99% efficiency for all particles of interest (6).

A vacuum pump was used to draw 69.4 liters per minute of air through the 47 mm filter cassettee. The sampling system was calibrated using a American Meter Company 150 liter spirometer. An MSA Model G pump was used to sample the supply air at 2 liters per minute with a 37 mm open-face cassette. Calibration of this system was accomplished with a soap film bubble meter.

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Sampling at 69.4 L/min allowed collection of a sufficient volume of effluent in a reasonable amount of time to allow an accurate determination of airborne particulate concentrations. Any possible error because of the resulting anisokinetic sampling was judged negligible since the major source of error lies with particles larger and heavier than those expected from the hair dryers. Also, most treatments of anisokinetic sampling error assume laminar flow in the sample stream. As stated previously, the flow in the sampling duct was turbulent and not laminar.

Three different real time particle monitors were used during the assembly and initial testing of the hair dryer test system. These instruments included a Royco Model 225 connected to a multichannel analyzer, a Particle Measuring Systems (PMS) ASAS-X particle spectrometer and a GCA Fibrous Aerosol Monitor (FAM). All of these instruments detect particles by their light scattering properties.

The Royco Model 225 was used to determine the uniformity of distribution of particles across the sampling duct. Monodisperse, 12 um potassium biphthalate particles were generated using a TSI, Berglund-Liu generator. These particles were injected into the duct just downstream of an operating hair dryer which produced a duct air velocity of 58 cm/sec. A probe connected to the Royco particle counter was inserted into the duct at the sampling location and nine representative locations across the duct were sampled. The coefficient of variation at these nine traverse point locations was less than 0.08, indicating acceptably uniform distribution of particles within the duct. Sampling the hair dryer effluent at various locations within the duct was thus expected to be representative of the

entire effluent.

The PMS ASAS-X aerosol spectrometer was used to monitor the effectiveness of the air cleaning system. Particles in the 0.15 to 0.30 um range were monitored with the ASAS-X since this size produced a rapid instrument response and was expected to have the highest penetration into the clean air system. Ambient particle concentrations (0.15 - 0.30 um) were reduced by a factor of 40 in the clean air hood (see Table 1). Background filter samples were found to be quite clean by electron microscopy, so no further effort was made to reduce this concentration. The production of particles by some of the hair dryers was also noted with the ASAS-X.

TABLE I

Particles Larger than 0.15 um Using ASAS-X Spectrometer

Ambient air	35-50 particles/cm^3
Clean air hood	1-2 particles/cm^3
Test duct, dryer on	2-4 particles/cm^3

These particles were apparently generated by motor bearing or electrical brush wear, although these concentrations were barely above the clean air background.

The clean air system was found to be entirely adequate to supply air to all the dryers. Using the ASAS-X, it was found that the particle concentration in the hood was brought down to its baseline level less than one minute after the high volume blower was turned on.

The third monitoring instrument used was the FAM. This device was used

to indicate the fiber concentration in the hair dryer effluent. The FAM responds only to the larger fibers (and not just to asbestos) visible by light microscopy. The FAM was used with several hair dryers. In some cases, a single fiber was noted in a two hour period, and in others, none were detected. A one fiber count in a two hour period indicated approximately 0.01 fibers/cc. The statistical significance of one fiber counted in the size range limitations of the FAM was questionable for this study. Use of the FAM on this study was discontinued because of its lack of sensitivity at such low concentrations. It should be noted that the FAM was designed to operate primarily in the 0.1 to 20 fiber/cc range to meet the requirements of the OSHA standard for asbestos (7).

Sampling Procedure

Before positioning the dryer to be tested in the clean air hood, the appropriate reducer was attached to the sampling duct. Various size reducers were fabricated to ensure the best interface possible between the dryer and sampling duct. The dryer was firmly clamped into position and sealed to the sampling duct reducer with duct tape. The dryer was then plugged into the power supply located inside the clean air hood. The clean air supply blower was then turned on and allowed to flush the clean air hood for 15 minutes and the dryer was then turned on. An air velocity profile was determined in the sampling duct using a Sierra Instruments Model 440 thermo-anemometer. A uniform velocity profile indicated a good placement of the dryer. If the velocity profile indicated nonhomogeneous flow, the dryer was repositioned to produce uniform flow. Dryer velocities

were determined with a Taylor rotating vane anemometer. Dryer flow rates were also checked by interfacing a 2 inch plastic pipe to the dryer inlet nd determining the air velocity with the thermo-anemometer.

A 47 mm diameter filter, Millipore AAWP, was placed in the stainless steel filter holder and the assembly placed in the sampling duct. Also, a 37 mm filter, Millipore AAWP preloaded in a styrene open-faced cassette was positioned inside the clean air hood near the dryer inlet. Pumps for both filter samplers were started and the dryer effluent was sampled for 2 hours. The dryer was accessed when necessary during the high-heat-low-heat cycle via the glove port in the clean air hood wall. At the end of the sampling period the 47 mm filter sample was removed from the filter holder and carefully placed in a 47 mm petri dish and brought to the TEM laboratory for examination. Background samples were obtained both in the clean air hood and at the end of the sampling tunnel while operated without a dryer in the test chamber.

TEM Analysis

The asbestos analyses for the study were performed on a JEOL 100B electron microscope equipped with both selected area electron diffraction (SAED) and energy dispersive analysis of x-rays (EDAX). The microscope magnification was calibrated using 0.5 um Latex spheres, and during the course of the study individual fibers were identified on a random basis by diffraction patterns and metal content.

Due to the light loading of fibers seen on samples obtained early in the study, the decision was made to scan the entire grid in order to

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to acquire a representative sample. Each grid contained approximately 200 fields each measuring 80 x 80 um. Counting time varied from 2 hours for lightly loaded samples to 3.5 days for the most heavily loaded samples. Background samples of the supply air showed very clean, fiber free filters. A detection limit of one fiber per grid would result in a sensitivity of 9 x 10^{-5} fiber/cc. Representative photomicrographs are presented in Appendix I.

Sample Preparation

. The Millipore AA filters used in sampling the effluent from the hair dryers were prepared for analysis following the standard NIOSH procedure described in Technical Information Bulletin #77-204 (8). A disk was removed from the center of each filter with a No. 5 cork bore. The sample disks were affixed to a clean glass slide and allowed to clear in acetone vapor for 5 minutes. The samples were then coated with a thin carbon film .n a vacuum evaporator to provide an electron beam transparent surface to which the collected particles could adhere. After coating, the cleared filter disks were cut out and placed upside down on pre-coated 200 mesh copper grids which had been placed in a petri dish on absorbent Whatman #41 filters. The Whatman filters were carefully saturated with acetone and left to sit overnight to allow complete dissolution of the sample filters. When dry, the preparations were ready for analysis by electron microscopy.

Fiber Count

The sample grids were scanned initially to ensure that at least 70% of the preparation remained intact. A fiber search was carried out at a magnification of 1700X and fibers were sized and counted at a magnification of 10,000X. Fiber clumps and bundles which exhibited unequal or ambiguous

dimensions were sized in segments or were assigned an average diameter based on 3 or more measurements. In all cases, multiple measurements taken on fiber bundles, clumps, and clusters were bracketed in the data record to indicate that they be treated as a single airborne structure in calculating air concentrations.

The length and diameter of each individual fiber was determined to allow calculation of the volume of each fiber. Calculating the volume of each fiber allowed an accurate estimation of fiber mass. The only assumption made was that each fiber approximated a solid cylinder.

All recorded data were reduced by computer to obtain air concentrations and fiber size distributions. A description of the calculation can be found in Appendix I, Test Data.

Summary

During the testing program conducted for CPSC, 30 dryers were tested. Of these, 25 were home use hand-held appliances, 3 were table-top hooded models, one was a hobby heat gun, and one was a heavy duty commercial salon style dryer. Airborne asbestos concentrations generated by these dryers ranged from 0 to 0.11 structures/cc and the mass concentrations ranged from 0 to 7652 ng/m^3. During the test program, one asbestos fiber was detected in the entire group of background samples. The pooled results of these background samples resulted in a background concentration of 3×10^{-5} fibers/cc.

The pairs of results obtained by running each hair dryer on high heat versus cycled heat were used to determine an upper limit on the variability of the sampling and analysis. The geometric mean of the ratios of the

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structures/cc concentrations of high heat to cycled heat for 21 pairs of non-zero results was 1.19 with a 95% confidence interval of 0.82 to 1.73. Thus, the successive sample ratio for each dryer cannot be considered significantly different from unity, indicating no significant differance between samples taken at high heat or at cycled heat. The paired samples were evaluated to find the variability due to sampling and analysis techniques. The geometric standard deviation was used to determine the upper and lower 95% confidence limits on any measurement, N. These limits can be determined by respectively multiplying and dividing N by the factor 3.4. In other words, at a 95% confidence the true value for any measurement, N, is between N X 3.4 and N/3.4.

Figures 2 and 3 show frequency distribution graphs of the hair dryer test results as a function of the number of asbestos structures emitted and the mass of asbestos emitted, respectively. In each figure, the bar on the extreme left indicates the number of dryers from which zero emissions were observed.

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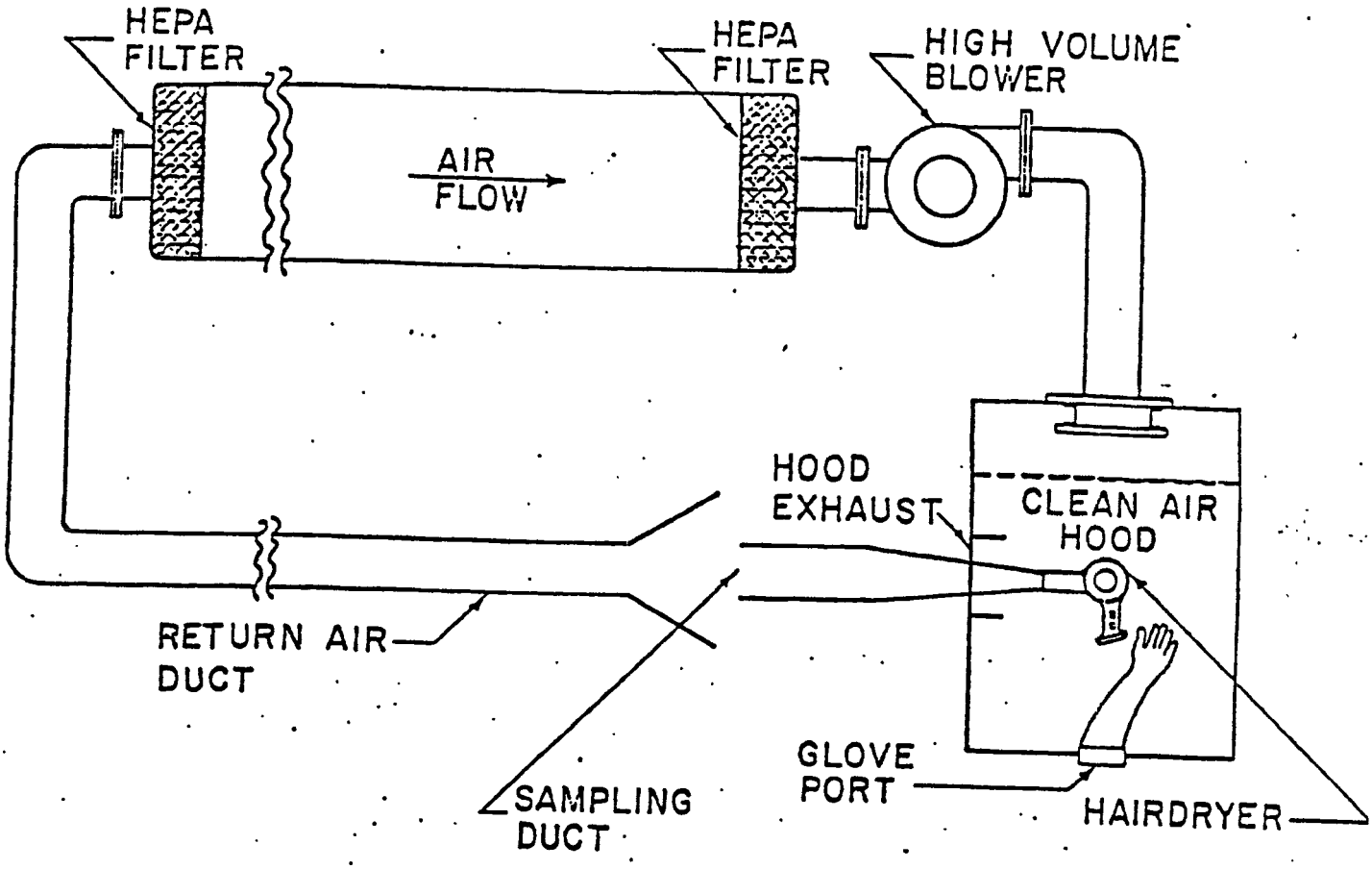


Figure 1. Schematic of Test System

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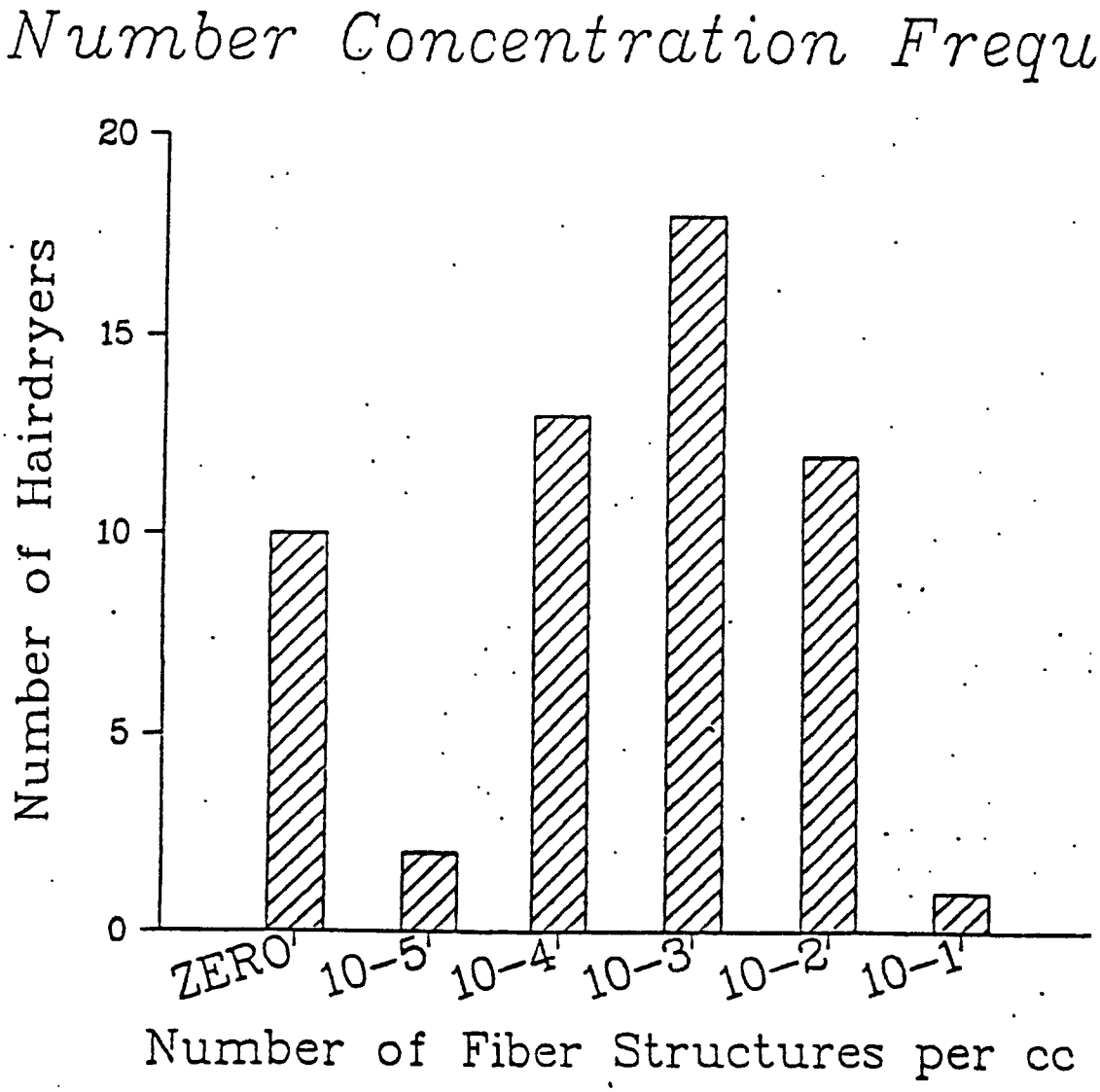


Figure 2

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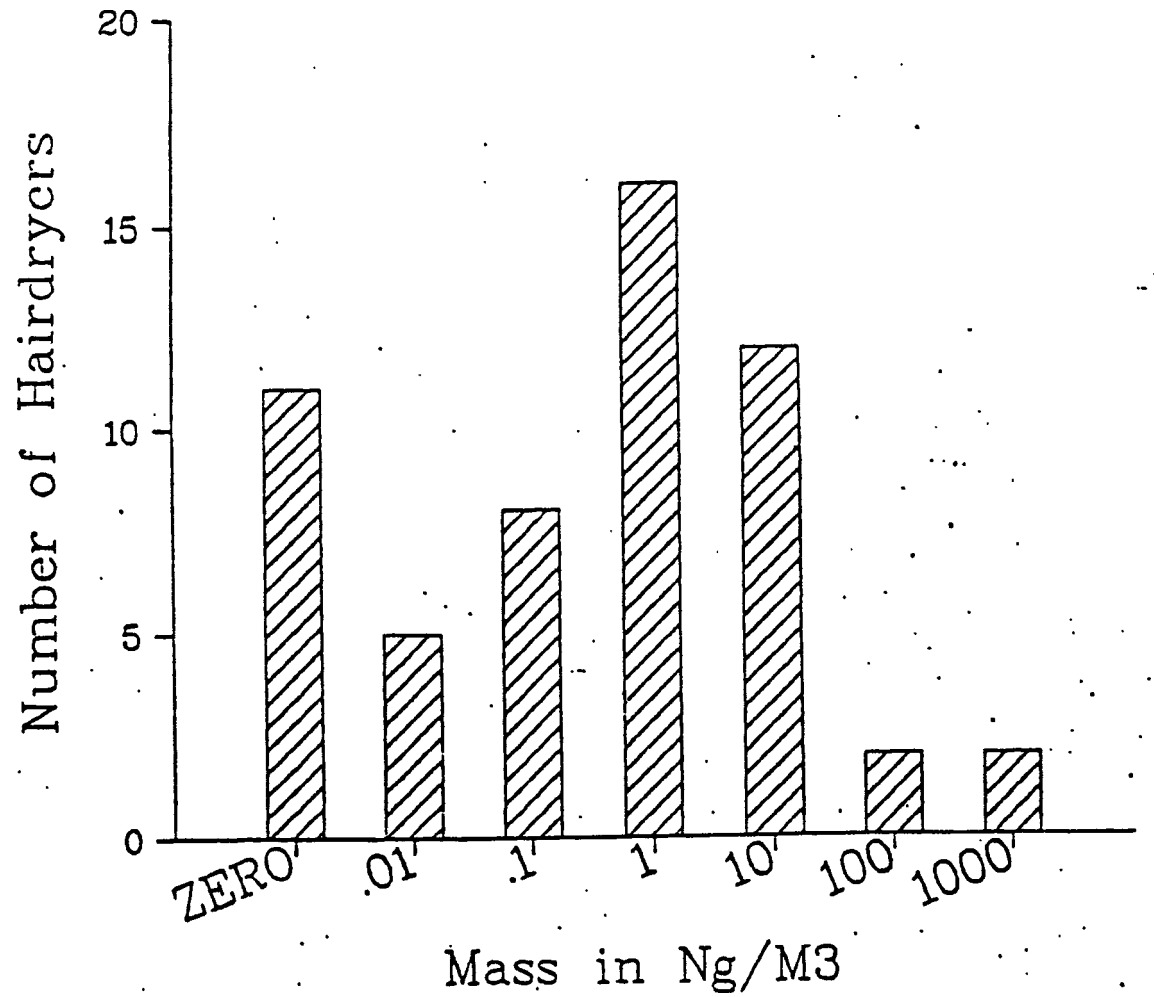


Figure 3

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APPENDIX I

TEST DATA AND SAMPLING AND ANALYSIS INFORMATION

1. Sampling rate: 69.4 L/min (2.45 cfm)

2. Sampling time: 2 hours

3. Fiber counts are presented as follows:

   I = Individual fibers not part of a clump or bundle

   B/C = Number of bundles or clumps

   T = Number of individual fibers (I) plus the number of fibers contained in each clump or bundle

4. The structures/cc calculation treats each bundle or clump as one airborne structure e.g.: from a count of I = 5, B/C = 7, and T = 45 the number used to calculate structures/cc would be I + B/C = 12.

$$\text{Structures/cc} = \frac{(FC/TEM) \times ECA}{VOL}$$

   FC = Total structures counted (I + B/C)
   TEM = TEM grid area examined (mm^2)
   ECA = Effective filter collecting area (960 mm^2)
   VOL = Sample volume in cc

Example Calculation:

   If: I = 55 TEM = 1.22 mm^2
   B/C = 30 VOL = 8328000 cc

   Then: Airborne structures/cc = $\frac{(85/1.22)960}{(8328000)} = 0.008$

   If effluent volume is 170 m^3, total airborne structures in effluent = (0.008 structures/cc) x (1.7 x 10^8 cc) = 1.36 X 10^6 structures

5. The volume of each fiber counted, both individual fibers and those in clumps (T value), is calculated and its mass determined using a density of 2.4 grams/cc for chrysotile asbestos. Total fiber mass as reported is a sum of individual massess.

0029

GI00029

Sample Number: D-870-5361

Manufacturer/Distributor: New York Merchandise Co.

Dryer Name: Mighty 1200

Model/Series: Model 10/2100

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	673	673
Effluent Volume (L):	8.1×10^4	8.1×10^4
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=171 B/C=4 T=181	I=23 B/C=1 T=25
Airborne Structures/cc:	1.6×10^{-2}	7.1×10^{-3}
Total Structures in Effluent:	1.3×10^6	5.7×10^5
Fiber Mass (ng/m^3):	13.9	8.8
Total Fiber Mass in Effluent (ng):	1121	709
Fiber Length Range (um):	0.6-26	0.8-23
Mean Fiber Length (um):	3.7	4.1
Fiber Diameter Range (um):	0.05-1.2	0.005-0.8
Mean Fiber Diameter (um):	0.21	0.22
Total TEM Fie Field Area Examined (mm^2):	1.24	0.39

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0030

GI00030

Sample Number: D-835-3535

Manufacturer/Distributor: Schick

Dryer Name: Shick 1000

Model/Series: PD-1001A

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining to the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	2632	2632
Effluent Volume (L):	3.16×10^5	3.16×10^5
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=6 B/C=0 T=6	I=13 B/C=2 T=20
irborne Structures/cc:	5.2×10^{-4}	1.3×10^{-3}
Total Structures in Effluent:	1.6×10^5	4.1×10^5
Fiber Mass (ng/m^3):	0.22	2.2
Total Fiber Mass in Effluent (ng):	71	693
Fiber Length Range (um):	0.8-13.2	0.7-9.0
Mean Fiber Length (um):	5.0	3.5
Fiber Diameter Range (um):	0.06-0.3	0.05-1.2
Mean Fiber Diameter (um):	0.2	0.2
Total TEM Field Area Examined (mm^2):	1.32	1.3

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0031
GI00031

Sample Number: CPSC-2

Manufacturer/Distributor: General Electric

Dryer Name: Power Turbo 1200 Watts

Model/Series: S1-5115-0

Asbestos Use and Comments: Used hand held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (l/min):	1089	1089
Effluent Volume (l):	135161	135161
Sample Volume (l):	8328	8328
Airborne Asbestos Structures Counted:	I=8 B/C=4 T=29	I=5 B/C=1 T=9
Airborne Structures/cc:	1.4×10^{-3}	6.5×10^{-4}
Total Structures in Effluent:	1.9×10^{5}	1.1×10^{5}
Fiber Mass (ng/m^3):	15	13
Total Fiber Mass in Effluent (ng):	2027	1757
Fiber Length Range (um):	0.6-15	1.3-11.5
Mean Fiber Length (um):	3.8	3.8
Fiber Diameter Range (um):	0.05-1	0.1-1.3
Mean Fiber Diameter (um):	0.25	0.31
Total TEM Field Area Examined (mm^2):	0.98	1.07

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

revised 6/3/1980

Sample Number: E-100-375

Manufacturer/Distributor: General Electric

Dryer Name: Super-Pro 1400

Model/Series: S1-5112-0

Asbestos Use and Comments: Used, hand held, hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (l/min):	1398	1398
Effluent Volume (l):	167760	167760
Sample Volume (l):	8328	8328
Airborne Asbestos Structures Counted:	I=37 B/C=0 T=37	I=8 B/C=1 T=10
Airborne Structures/cc:	3.6×10^{-3}	1.1×10^{-3}
Total Structures in Effluent:	6×10^{5}	1.8×10^{5}
Fiber Mass (ng/m^3):	0.44	0.69
Total Fiber Mass in Effluent (ng):	73.8	168
Fiber Length Range (um):	0.8-23	1.8-13
Mean Fiber Length (um):	4.7	5.7
Fiber Diameter Range (um):	0.05-8	0.15-1.4
Mean Fiber Diameter (um):	0.2	0.4
Total TEM Field Area Examined (mm^2):	1.19	0.95

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

*revised 6/3/1980

Sample Number: CPSC-8

Manufacturer/Distributor: North American Phillips Corp.

Dryer Name: Norelco 1000

Model/Series: HB1700

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	849	849
Effluent Volume (L):	95880	95880
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=18 B/C=6 T=30	I=21 B/C=6 T=56
Airborne Structures/cc:	2.5×10^{-3}	2.7×10^{-3}
Total Structures in Effluent:	2.4×10^{5}	2.6×10^{5}
Fiber Mass (ng/m^3):	15	8.6
Total Fiber Mass in Effluent (ng):	1438	1822
Fiber Length Range (um):	0.5-12	0.7-22
Mean Fiber Length (um):	3.4	3.2
Fiber Diameter Range (um):	0.05-2	0.05-1.2
Mean Fiber Diameter (um):	0.31	0.23
Total TEM Field Area Examined (mm^2):	1.2	1.25

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0034

GI00034

Sample Number: E-100-352

Manufacturer/Distributor: Conair

Dryer Name: Prostyle 1200

Model/Series: 065

Asbestos Use and Comments: Used, hand-held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1284	1284
Effluent Volume (L):	154080	154080
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=1 B/C=0 T=1	I=4 B/C=0 T=4
Airborne Structures/cc:	1.15×10^{-4}	4.2×10^{-4}
Total Structures in Effluent:	1.77×10^{4}	6.5×10^{4}
Fiber Mass (ng/m^3):	0.096	7.7
Total Fiber Mass in Effluent (ng):	14.7	1.2×10^{3}
Fiber Length Range (um):	no range	3.8-36
Mean Fiber Length (um):	7.1	12.9
Fiber Diameter Range (um):	no range	0.05-1
Mean Fiber Diameter (um):	0.25	0.5
Total TEM Field Area Examined (mm^2):	1.0	1.05

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0035

GI00035

Sample Number: E-100-377

Manufacturer/Distributor: General Electric

Dryer Name: Power Pro 1000

Model/Series: 5105-013

Asbestos Use and Comments: Used, hand-held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1035	1035
Effluent Volume (L):	124200	124200
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=16 B/C=1 T=18	I=92 B/C=6 T=108
Airborne Structures/cc:	1.7×10^{-3}	9.3×10^{-3}
Total Structures in Effluent:	2.1×10^{5}	1.2×10^{6}
Fiber Mass (ng/m^3):	2.9	17
Total Fiber Mass in Effluent (ng):	361	2148
Fiber Length Range (um):	0.8-25	0.7-45
Mean Fiber Length (um):	6.9	5.2
Fiber Diameter Range (um):	0.03-0.7	0.05-1.0
Mean Fiber Diameter (um):	0.25	0.22
Total TEM Field Area Examined (mm^2):	1.17	1.2

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

C036

GI00036

Sample Number: E-840-5924

Manufacturer/Distributor: Zayre Corp.

Dryer Name: 1200 Foldaway

Model/Series: JK-115

Asbestos Use and Comments: Hand-held hair dryer. The asbestos insulation was present as a lining to the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	418	415
Effluent Volume (L):	170160	170160
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=7 B/C=1 T=13	I=1 B/C=0 T=1
Airborne Structures/cc:	7×10^{-4}	1.1×10^{-4}
Total Structures in Effluent:	1.2×10^{5}	1.8×10^{4}
Fiber Mass (ng/m^3):	39	0.098
Total Fiber Mass in Effluent (ng):	6609	16
Fiber Length Range (um):	1.0-25	no range
Mean Fiber Length (um):	8.6	5.3
Fiber Diameter Range (um):	0.03-3.0	no range
Mean Fiber Diameter (um):	0.8	0.3
Total TEM Field Area Examined (mm^2):	1.31	1.06

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0037

GI00037

Sample Number: E-100-361

Manufacturer/Distributor: Hamilton Beach

Dryer Name: Groomer II

Model/Series: 423

Asbestos Use and Comments: Used, hand-held, comb type dryer. The asbestos was present as a lining to the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	184	Dryer has only one setting
Effluent Volume (L):	19017	
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=7 B/C=3 T=17	
Airborne Structures/cc:	1.1×10^{-3}	
Total Structures in Effluent:	2.1×10^{4}	
Fiber Mass (ng/m^3):	2.2	
Total Fiber Mass in Effluent (ng):	42	
Fiber Length Range (um):	1-21	
Mean Fiber Length (um):	6.4	
Fiber Diameter Range (um):	0.05-0.8	
Mean Fiber Diameter (um):	0.25	
Total TEM Field Area Examined (mm^2):	1.06	

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0039

GI00039

Sample Number: E-100-376

Manufacturer/Distributor: Montgomery Ward

Dryer Name: Montgomery Ward 1200

Model/Series: 53-19375

Asbestos Use and Comments: Used, hand-held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1104	1104
Effluent Volume (L):	132480	132480
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=2 B/C=1 T=4	I=5 B/C=0 T=5
Airborne Structures/cc:	3.0×10^{-4}	4.6×10^{-4}
Total Structures in Effluent:	4.0×10^{4}	6.1×10^{4}
Fiber Mass (ng/m^3):	0.22	0.16
Total Fiber Mass in Effluent (ng):	29	21
Fiber Length Range (um):	3.5-17	1.5-5.5
Mean Fiber Length (um):	9.75	3.44
Fiber Diameter Range (um):	0.08-0.3	0.07-0.4
Mean Fiber Diameter (um):	0.17	0.2
Total TEM Field Area Examined (mm^2):	1.16	1.25

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-100-360

Manufacturer/Distributor: Gillette

Dryer Name: Super Max

Model/Series: HD-5

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos was present as a component of the support for the heating element.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	618	618
Effluent Volume (L):	74160	74160
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=314 B/C=24 T=386	I=177 B/C=8 T=206
Airborne Structures/cc:	3.4×10^{-2}	2.0×10^{-2}
Total Structures in Effluent:	2.5×10^{6}	1.5×10^{6}
Fiber Mass (ng/m^3):	34	21
Total Fiber Mass in Effluent (ng):	2.5×10^{3}	1.6×10^{3}
Fiber Length Range (um):	0.3-50	0.4-40
Mean Fiber Length (um):	4.1	3.5
Fiber Diameter Range (um):	0.05-1.3	0.05-1.1
Mean Fiber Diameter (um):	0.2	0.2
Total TEM Field Area Examined (mm^2):	1.23	1.22

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-100-390

Manufacturer/Distributor: Frazier

Dryer Name: Frazier Blow Out Comb Styler

Model/Series: K-069-1

Asbestos Use and Comments: Used, hand-held, comb type dryer. The asbestos was present as a conical lining around the heating element.
* Uncountable due to high background level of amorphous,opaque material from the dryer. Insulation material in dryer was identified as chrysotile asbestos.
** Low speed inoperative; therefore, only high heat test conducted.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	99	**
Effluent Volume (L):	11880	
Sample Volume (L):	8328	
Airborne Asbestos Structures Counted:	*	

Airborne Structures/cc:

Total Structures in Effluent:

Fiber Mass (ng/m^3):

Total Fiber Mass in Effluent (ng):

Fiber Length Range (um):

Mean Fiber Length (um):

Fiber Diameter Range (um):

Mean Fiber Diameter (um):

Total TEM Field Area Examined (mm^2):

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0042
GI00042

Sample Number: E-100-355

Manufacturer/Distributor: Montgomery Ward

Dryer Name: Variable Power 1400

Model/Series: 52-19361

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1417	1417
Effluent Volume (L):	1.7×10^5	1.7×10^5
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=28 B/C=5 T=41	I=8 B/C=4 T=30
Airborne Structures/cc:	3.1×10^{-3}	1.1×10^{-3}
Total Structures in Effluent:	5.3×10^5	1.9×10^5
Fiber Mass (ng/m^3):	3	0.35
Total Fiber Mass in Effluent (ng):	5.15×10^2	60
Fiber Length Range (um):	0.5-48	0.7-10.5
Mean Fiber Length (um):	4.9	2.9
Fiber Diameter Range (um):	0.03-0.7	0.02-0.4
Mean Fiber Diameter (um):	0.19	0.12
Total TEM Field Area Examined (mm^2):	1.18	1.16

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-100-375

Manufacturer/Distributor: General Electric

Dryer Name: Super-Pro 1400

Model/Series: S1-5112-0

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1398	1398
Effluent Volume (L):	1697760	I697760
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=37 B/C=0 T=37	I=8 B/C=1 T=10
Airborne Structures/cc:	3.6×10^{-3}	1.1×10^{-3}
Total Structures in Effluent:	6×10^{5}	1.8×10^{5}
Fiber Mass (ng/m^3):	0.44	0.69
Total Fiber Mass in Effluent (ng):	740	1179
Fiber Length Range (um):	0.8-23	1.8-i3
Mean Fiber Length (um):	4.7	5.7
Fiber Diameter Range (um):	0.05-8	0.15-1.4
Mean Fiber Diameter (um):	0.2	0.4
Total TEM Field Area Examined (nm^2):	1.19	0.95

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-805-1292

Manufacturer/Distributor: Conair

Dryer Name: Professional Blow Comb

Model/Series: Model 067

Asbestos Use and Comments: Used, hand-held comb type dryer. The dryer was of a configuration such that the inside could not be inspected for asbestos position.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	98.7	98.7
Effluent Volume (L):	11844	11844
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=0 B/C=0 T=0	I=1 B/C=0 T=1
Airborne Structures/cc:		9.1×10^{-5}
Total Structures in Effluent:		1.1×10^{3}
Fiber Mass (ng/m^3):		0.02
Total Fiber Mass in Effluent (ng):		0.25
Fiber Length Range (um):		no range
Mean Fiber Length (um):		20
Fiber Diameter Range (um):		no range
Mean Fiber Diameter (um):		0.25
Total TEM Field Area Examined (mm^2):	0.98	1.27

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0045

GI00045

Sample Number: CPSC-3

Manufacturer/Distributor: Sears

Dryer Name: Sears 1000

Model/Series: 253-8754

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	863	863
Effluent Volume (L):	103560	103560
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=267 B/C=16 T=304	I=139 B/C=10 T=163
Airborne Structures/cc:	0.031	0.016
Total Structures in Effluent:	3.2×10^6	1.6×10^6
Fiber Mass (ng/m^3):	16	1.9
Total Fiber Mass in Effluent (ng):	1.6×10^3	2×10^2
Fiber Length Range (um):	0.3-55	0.4-24
Mean Fiber Length (um):	3.5	2.5
Fiber Diameter Range (um):	0.02-0.9	0.02-0.5
Mean Fiber Diameter (um):	0.12	0.1
Total TEM Field Area Examined (mm^2):	1.15	1.11

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0046

GI00046

Sample Number: E-100-354

Manufacturer/Distributor: Hartman

Dryer Name: PRO 1000

Model/Series:

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	696	696
Effluent Volume (L):	83400	83400
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=32 B/C=8 T=64	I=9 B/C=5 T=27
Airborne Structures/cc:	4.4×10^{-3}	1.5×10^{-3}
Total Structures in Effluent:	3.7×10^{5}	1.3×10^{5}
Fiber Mass (ng/m^3):	5.3	1.4
Total Fiber Mass in Effluent (ng):	439	118
Fiber Length Range (um):	0.8-12	0.4-14
Mean Fiber Length (um):	3.3	3.2
Fiber Diameter Range (um):	0.05-1.4	0.05-1.0
Mean Fiber Diameter (um):	0.22	0.18
Total TEM Field Area Examined (mm^2):	1.13	1.13

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0047

GI00047

Sample Number: CPSC-2

Manufacturer/Distributor: General Electric

Dryer Name: Power Turbo 1200 Watts

Model/Series: S1-5115-0

Asbestos Use and Comments: Used, hand-held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1089	1089
Effluent Volume (L):	39960	39960
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=8 B/C=4 T=29	I=5 B/C=1 T=9
Airborne Structures/cc:	1.4×10^{-3}	6.5×10^{-4}
Total Structures in Effluent:	5.6×10^{5}	2.6×10^{5}
Fiber Mass (ng/m^3):	15	13
Total Fiber Mass in Effluent (ng):	604	536
Fiber Length Range (um):	0.6-15	1.3-11.5
Mean Fiber Length (um):	3.8	3.8
Fiber Diameter Range (um):	0.05-1	0.1-1.3
Mean Fiber Diameter (um):	0.25	0.31
Total TEM Field Area Examined (mm^2):	0.98	1.07

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0048

GI00048

Sample Number: E-100-359

Manufacturer/Distributor: Korvettes

Dryer Name: Super 1400

Model/Series: HA-1214S

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1064	1064
Effluent Volume (L):	127680	127680
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=1 B/C=1 T=3	I=0 B/C=0 T=0
Airborne Structures/cc:	1.9×10^{-4}	
Total Structures in Effluent:	2.4×10^{4}	
Fiber Mass (ng/m^3):	0.23	
Total Fiber Mass in Effluent (ng):	29	
Fiber Length Range (um):	1.5-9.5	
Mean Fiber Length (um):	4.5	
Fiber Diameter Range (um):	0.15-0.6	
Mean Fiber Diameter (um):	0.35	
Total TEM Field Area Examined (mm^2):	1.2	1.24

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0049

GI00049

Sample Number: CPSC-1

Manufacturer/Distributor: Sanyei Corp.

Dryer Name: Sanyei Corp.

Model/Series: E-2100

Asbestos Use and Comments: Used, hand-held hair dryer.
The asbestos insulation was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1104	1104
Effluent Volume (L):	132480	132480
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=256 B/C=27 T=318	I=141 B/C=15 T=181
Airborne Structures/cc:	2.9×10^{-2}	1.5×10^{-2}
Total Structures in Effluent:	3.8×10^{6}	2.0×10^{6}
Fiber Mass (ng/m^3):	8.7	4.3
Total Fiber Mass in Effluent (ng):	1200	560
Fiber Length Range (um):	0.5-42	0.3-35
Mean Fiber Length (um):	2.6	3.0
Fiber Diameter Range (um):	0.01-1	0.03-7
Mean Fiber Diameter (um):	0.14	0.14
Total TEM Field Area Examined (mm^2):	1.25	1.23

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: CPSC-9

Manufacturer/Distributor: General Electric

Dryer Name: Super-Pro 1400

Model/Series: S1-5112-0

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos was present as a tubular lining of the barrel.

* Fiber dimensions could not be determined

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1398	1398
Effluent Volume (L):	167760	167760
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=0 B/C=1 T=2	I=0 B/C=1 T=1
Airborne Structures/cc:	1×10^{-4}	1×10^{-4}
otal Structures in Effluent:	1.7×10^{4}	1.7×10^{4}
Fiber Mass (ng/m^3):	1.1×10^{-2}	*
Total Fiber Mass in Effluent (ng):	1.9	
Fiber Length Range (um):	1.5-2.5	
Mean Fiber Length (um):	2.0	
Fiber Diameter Range (um):	0.05-.15	
Mean Fiber Diameter (um):	0.1	
Total TEM Field Area Examined (mm^2):	1.17	0.96

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0051

Sample Number: E-100-353

Manufacturer/Distributor: Sunbeam

Dryer Name: Professionaire 1000

Model/Series: 52-9C

Asbestos Use and Comments: Used, hand-held hair dryer. The asbestos was present as a tubular lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	987	987
Effluent Volume (L):	118440	118440
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=1 B/C=0 T=1	I=1 B/C=0 T=1
Airborne Structures/cc:	1.1×10^{-4}	1.5×10^{-4}
tal Structures in Effluent:	1.3×10^{4}	1.8×10^{4}
Fiber Mass (ng/m^3):		
Total Fiber Mass in Effluent (ng):	17	3.1
Fiber Length Range (um):	no range	no range
Mean Fiber Length (um):	4.6	4.1
Fiber Diameter Range (um):	no range	no range
Mean Fiber Diameter (um):	0.4	0.15
Total TEM Field Area Examined (mm^2):	1.09	0.75

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0052
GI00052

Sample Number: E-100-374

Manufacturer/Distributor: Presto Mist

Dryer Name: Presto Mist Hair Dryer

Model/Series: PP-19A

Asbestos Use and Comments: Used, table top hood type dryer. The asbestos insulation was present as a sheet under the heating element.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1302	1302
Effluent Volume (L):		
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=12 B/C=0 T=12	I=15 B/C=0 T=12
Airborne Structures/cc:	1.1×10^{-3}	1.4×10^{-3}
Total Structures in Effluent:	1.7×10^{5}	2.2×10^{5}
Fiber Mass (ng/m^3):	19.8	0.278
Total Fiber Mass in Effluent (ng):	3104	43
Fiber Length Range (um):	1.3-48	1.1-6
Mean Fiber Length (um):	7.5	2.8
Fiber Diameter Range (um):	0.1-1.5	0.05-0.3
Mean Fiber Diameter (um):	0.3	0.17
Total TEM Field Area Examined (mm^2):	1.22	1.21

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: CPSC-26

Manufacturer/Distributor: Westinghouse

Dryer Name:

Model/Series: H 10-2

Asbestos Use and Comments: Used, table top bonnet type dryer. The position of any asbestos insulation was not noted.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	277	277
Effluent Volume (L):	33240	33240
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=0 B/C=0 T=0	I=0 B/C=0 T=0
Airborne Structures/cc:		
Total Structures in Effluent:		
Fiber Mass (ng/m^3):		
Total Fiber Mass in Effluent (ng):		
Fiber Length Range (um):		
Mean Fiber Length (um):		
Fiber Diameter Range (um):		
Mean Fiber Diameter (um):		
Total TEM Field Area Examined (mm^2):	1.23	1.1

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0055

GI00055

Sample Number: CPSC-22

Manufacturer/Distributor: General Electric

Dryer Name: Professional Hair Dryer

Model/Series: HD51

Asbestos Use and Comments: Used, table top hood type dryer. The asbestos was present as a pad under the heating element.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	2207	2207
Effluent Volume (L):	264840	264840
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=0 B/C=0 T=0	I=0 B/C=0 T=0
Airborne Structures/cc:		
Total Structures in Effluent:		
Fiber Mass (ng/m^3):		
Total Fiber Mass in Effluent (ng):		
Fiber Length Range (um):		
Mean Fiber Length (um):		
Fiber Diameter Range (um):		
Mean Fiber Diameter (um):		
Total TEM Field Area Examined (mm^2):	1.13	1.23

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0056

Sample Number: E-850-5327

Manufacturer/Distributor: Bonat Inc.

Dryer Name: Bonat Blower Dryer

Model/Series: Model 10

Asbestos Use and Comments: Used, stand mounted professional dryer. The asbestos insulation was present as a lining to the barrel.

	High Heat	High-Heat-Low-Hear Cycle
Dryer Flow Rate (L/min):	1044	1044
Effluent Volume (L):	125312	125312
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=650 B/C=137 T=1375	I=450 B/C=72 T=720
Airborne Structures/cc:	0.11	0.08
Total Structures in Effluent:	1.3×10^7	9.6×10^6
Fiber Mass (ng/m^3):	7652	651
Total Fiber Mass in Effluent (ng):	918211	78088
Fiber Length Range (um):	0.15-95	0.2-95
Mean Fiber Length (um):	7.1	6.1
Fiber Diameter Range (um):	0.04-15	0.01-3.5
Mean Fiber Diameter (um):	0.4	0.3
Total TEM Field Area Examined (mm^2):	0.83	0.73

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-860-1440

Manufacturer/Distributor: Clairol

Dryer Name: Super Zap

Model/Series: SZ-1

Asbestos Use and Comments: Used, hand-held hair dryer. The insulation was present as a lining to the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	687	687
Effluent Volume (L):	82440	82440
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=18 B/C=1 T=20	I=17 B/C=5 T=37
Airborne Structures/cc:	2×10^{-3}	1.9×10^{-3}
Total Structures in Effluent:	1.6×10^{5}	1.6×10^{5}
Fiber Mass (ng/m^3):	1.1	9.6
Total Fiber Mass in Effluent (ng):	89	789
Fiber Length Range (um):	1.0-11.5	0.9-31.5
Mean Fiber Length (um):	3.5	5.0
Fiber Diameter Range (um):	0.05-0.7	0.7-1.4
Mean Fiber Diameter (um):	0.2	0.25
Total TEM Field Area Examined (mm^2):	1.08	1.3

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

0058

Sample Number: E-805-1291

Manufacturer/Distributor: Jheri Redding

Dryer Name: Jr. Pro 1000

Model/Series: 066

Asbestos Use and Comments: Hand-held dryer.
Its asbestos insulation was present as a lining to the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	829	829
Effluent Volume (L):	99480	99480
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=360 B/C=17 T=410	I=148 B/C=8 T=174
Airborne Structures/cc:	3.3×10^{-2}	1.4×10^{-2}
Total Structures in Effluent:	3.6×10^{6}	1.5×10^{6}
Fiber Mass (ng/m^3):	26	30
Total Fiber Mass in Effluent (ng):	2627	2975
Fiber Length Range (um):	0.3-43	0.1-95
Mean Fiber Length (um):	3.2	4.9
Fiber Diameter Range (um):	0.03-1.2	0.05-1.5
Mean Fiber Diameter (um):	0.18	0.2
Total TEM Field Area Examined (mm^2):	1.3	1.32

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: D-815-0580

Manufacturer/Distributor: Topflite

Dryer Name: Monokote Heat Gun

Model/Series: none present

Asbestos Use and Comments: Hand-held hobby heat gun. The asbestos insulation was present as a lining of the barrel.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	182	182
Effluent Volume (L):	21840	21840
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=324 B/C=20 T=439	I=100 B/C=6 T=121
Airborne Structures/cc:	3.8×10^{-2}	1.3×10^{-2}
Total Structures in Effluent:	8.4×10^{5}	2.9×10^{5}
Fiber Mass (ng/m^3):	4154	168
Total Fiber Mass in Effluent (ng):	91395	3700
Fiber Length Range (um):	0.8-90	0.4-60
Mean Fiber Length (um):	6.3	6.2
Fiber Diameter Range (um):	0.05-13	0.03-3.5
Mean Fiber Diameter (um):	0.36	0.33
Total TEM Field Area Examined (mm^2):	1.05	0.93

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

Sample Number: E-840-4024

Manufacturer/Distributor: Conair

Dryer Name: Pro Style 1200 Watts

Model/Series: Model 065 Series 0278

Asbestos Use and Comments: Used, hand-held dryer.
No asbestos was present in the dryer. It was run as a control.

	High Heat	High-Heat-Low-Heat Cycle
Dryer Flow Rate (L/min):	1284	1284
Effluent Volume (L):	154080	154080
Sample Volume (L):	8328	8328
Airborne Asbestos Structures Counted:	I=0 B/C=0 T=0	I=0 B/C=0 T=0
Airborne Structures/cc:		
Total Structures in Effluent:		
Fiber Mass (ng/m^3):		
Total Fiber Mass in Effluent (ng):		
Fiber Length Range (um):		
Mean Fiber Length (um):		
Fiber Diameter Range (um):		
Mean Fiber Diameter (um):		
Total TEM Field Area Examined (mm^2):	0.83	1.29

I=Individual Fibers
B/C=Bundles or Clumps

I+B/C=Airborne Structures Counted
T=Individual Fibers Plus Estimated Number of Fibers in Bundles or Clumps

APPENDIX II

PHOTOMICROGRAPHS

1. (Plate 479) - Supply air sample showing absence of dust and fibers in supply air (Mag. = 1000X).

2. (Plate 548) - Very long asbestos fibers associated in a loose cluster (Mag. = 2000X).

3. (Plate 549) - Typical asbestos fiber bundle showing splayed ends and small fibril fragments (Mag. = 2700X).

4. (Plate 555) -Typical asbestos clump/bundle association showing random orientation of some fibril. (Mag. = 5000X).

5. (Plate 551) - A large cluster of individual fibers, large bundles, and clumps deposited as a single structure on filter (Mag. = 3300X).

6. (Plate 562) - Numerous asbestos fibers and bundle structures deposited in close proximity on filter (Mag 1300X).

7. (Plate 553) - Typical small chrysotile fiber bundle deposited singly (Mag = 2000X).

8. (Plate 556) - Extremely large chrysotile bundle 15 to 25 um in diameter deposited on filter. (Mag = 1700X).

9. (Plate 552) - Asbestos fiber bundles with organic globular particulates adhering to surface (Mag = 6700X).

10. (Plate 563) - Large asbestos bundles deposited as a single structure on filter (Mag =1700X).

11. (Plate 560) - Large asbestos fibers associated in a single cluster. (Mag = 1200X).

12. (Plate 560) - Large asbestos bundle and fibrils associated as a single structure. (Mag = 2000X).

13. (Plate 557) - Typical heavy loading of asbestos structures on filter. (Mag = 1000X).

14. (Plate 465) - Sample of bulk insulation material taken from a dryer.

15. Example EDAX spectrum from a dryer air sample.

C062
GI00062