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UNION CARBIDE **INTERNAL CORRESPONDENCE**

Save

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Date October 31, 1977

Originating Dept. "Calidria" Asbestos

Answering letter date

Subject Society of Plastics Engineers Meeting, November 8, 1977

Copy to Messrs. C. R. Allenbach
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J. L. Myers
File ✓

We have a commitment to present a paper at the Society of Plastics Engineers Meeting in Denver on November 8, 1977, on the general subject of Consumer Safety with Asbestos-Containing Plastics. Hopefully, the data we have been using with the various regulatory agencies will be given the stamp of authenticity by publication in one of the Society's journals.

As usual, the press of other high priority items has delayed putting together the paper until the last minute. A draft is attached for your review and comments. I expect to excerpt from this for the oral presentation.

In order to assist in review, the data presented are those which were used in our CPSC activities plus some spraying and grinding data that was used in California and with the current EPA spraying proposal. A substantial portion of the text has been extracted from my CPSC testimony on the reports submitted, with little or no modification.

There is a small amount of new material, including the Lawrence concept of risk-benefit, in the latter part of the paper that should be examined. If pressed for time, the key sections are Consumer Safety and Summary and Conclusions.

My last day in the office before the meeting will be this Friday, November 4th. It would be very much appreciated if you could get your comments and suggestions back to me by Thursday, the 3rd, so they can be incorporated at least into the oral version.

H. B. Rhodes

H. B. Rhodes

HBR:dal
Attachment

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PLAINTIFF'S EXHIBIT
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CONSUMER "SAFETY" IN SOME CURRENTLY-USED PLASTICS SYSTEMS CONTAINING BOUND ASBESTOS FIBERS

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November 9, 1977

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INTRODUCTION

The overall theme of the meeting is Safety and Health with Plastics and this particular symposium emphasizes Consumer Safety. On the surface, these would appear to be simple, straightforward concepts, but in fact, they raise complex and controversial issues. The question of what is a "consumer" is in the courts today. The definition of "safety" is hotly contested and will undoubtedly also get into the courts. Decisions on these questions cannot be made on strictly scientific grounds but become involved in socio-political policy. The choices made can have a far-reaching impact on all of our lives.

This paper will present the results of airborne asbestos fiber measurements obtained during the use of a wide variety of asbestos-containing plastics materials. The data are mostly for commercial operations but substantial consumer use information is provided for one product. The exposure levels in themselves have little meaning if they cannot be related to the corresponding health hazard and to the current regulatory activities. On this basis the current controvery in this area will first be outlined briefly and then the data will be presented in the context of Today's situation. One product where most data are available, tape joint compounds, will be used as an example, followed by the data for the other products. Finally, a suggestion for a rational approach to the overall problem is presented.

ASBESTOS USE IN THE UNITED STATES

In view of the wide publicity that has been given to the health hazards of asbestos, both real and imagined, over the past ten years it may come as a surprise to many that asbestos is still in wide use, and more surprising, that [illegible] interested in writing about it. Presently, About 800,000 tons per year of asbestos is now used in this country. Of this approximately 125,000 tons is domestic production, largely from California and Vermont, and the remainder is mainly imported from Canada.

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The quantities of the various products manufactured from this asbestos changes somewhat from year-to-year but with the exception of the recession year of 1975 has been relatively constant for the last several years. A representative breakdown from the United States Bureau of Mines and Minerals Yearbook for 1974 is shown in Table 1. If the term "plastics" is defined very broadly to include naturally occurring tars, resins and other materials that cure to a permanent set as well as the usual synthetics, a total of 364,200 tons of asbestos, or 43.1% of the annual consumption, is associated with "plastics" of one kind or another. The largest use, 153,500 tons annually, is in flooring products. This includes both vinyl asbestos tile and sheet vinyl flooring. Next comes friction products at 79,800 tons annually. These are mainly phenolic based materials for automotive and railroad brakes and clutch facings. This is followed closely by roofing products at 75,000 tons per year. Included here are emulsified asphaltic coatings, trowelable? patching compounds, and some of the tar papers. The coatings and compounds category is next at 37,900 tons. This is a conglomeration of a wide variety of products including, but certainly not limited to such things as maintenance coatings, black coatings, foundation countings, automotive undercoatings and sound deadeners, caulks, sealants, adhesives, tape joint compounds, etc. The last category, plastics, at 17,800 tons annually largely consists of the familiar phenolic based electrical fixtures, although the 700 tons of anthophylite, shown probably went into polypropylene for heat-sensitive applications. It is clear, therefore, for that there continues to be a very substantial involvement of asbestos with plastics and that a substantial majority, i.e., about 80% of it, is in the familiar vinyl, phenolic, alkyd and epoxy resins.

The specific reasons for the inclusion of asbestos in each of these product types varies but is generally related to several of the materials' useful properties. Asbestos is inert, "fireproof" or heat resistant, and imparts strength and dimensional stability to plastics both at ambient conditions

and when subjected to high temperatures. These properties are particularly important for friction products. The strength plus resistance to mildew, rot, and weathering are important for roofing and flooring materials. When used in small quantities in liquid systems asbestos have a profound effect on rheological properties. It makes the materials sprayable or pumpable but ~~stay~~ sag resistant. Examples of this include flow control of paints and coatings, trowel workability of tape joint compounds, and the flow of caulks and sealants during application. The fact that asbestos is in wide use after six years of stringent regulations and tremendous adverse publicity attest to the difficulty of finding suitable replacements.

CURRENT REGULATORY CONTROVERSY AND GOVERNMENTAL POLICIES

In the health and regulatory arena today, both in the United States and throughout the world, the concern above all others is cancer. Testimony was presented at the OSHA hearings on MOCA several years ago from a study which showed that the word "cancer" evokes the greatest negative or fear response of any word in the English language by a wide margin, far surpassing "death." Hardly a day passes without new or repeated stories in the various media that another material has been discovered to be a carcinogen and a new group of people, usually very large, is alleged to be at risk. Well-known examples include such familiar things as as saccharin, benzene, certain dry cleaning solvents and most recently, fluoride in water. The statement that up to 90% of cancer is caused by "environmental factors" is repeated frequently. The impression is given that the country is in the grip of a cancer epidemic and that the principle cause is industrial pollution.

This is not the place to debate the issues of "epidemic" and the true meaning of "environmentally caused cancer" since they are only raised here to illustrate the climate as it relates to consumer safety activities. It would be

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remiss, however, not to point out in passing two recent studies that bear directly on the subject. The first is a paper by Dr. Leonard Chiazze( ) and his colleagues at the National Cancer Institute entitled, "The Cancer Mortality Scare: Problems of Estimation Using Monthly Data," wherein the statement is made that:

"nearly all of the [redacted] increase in the total cancer death rate from 1968 to 1974 was accounted for by the aging of the population."

The second is a study by Dr. Harry B. Demopolis( ), " A rational View of Cancer in New Jersey," prepared while he was the director of the Cancer Institute of New Jersey. Dr. Demopolis found that a maximum of about 4% of the total cancers could be, but are not necessarily, "industry related." While this is not intended to imply that there is not a problem with products produced by industry, it is clear that we are neither in the midst of an epidemic nor are industrial sources the main factor in current cancer mortality.

This widespread "cancerphobia" has generated very heavy pressure on the regulatory agencies and a new approach to regulations has evolved over the past several years. This approach has two key elements, one basically scientific and one clearly socio-political. These are:

1. The one-molecule hypothesis of carcinogenesis.
2. The interpretation of "safe" to mean an absolutely zero level of risk to everybody, everywhere.

The scientific concept, i.e., the one-molecule hypothesis in simplest outline holds that:

1. A <u>single molecule</u> of a carcinogen is capable of causing cancer in a particularly susceptible person.
2. If enough people are exposed, the susceptible person will be exposed and get cancer so that it follows that there is no absolutely and totally safe "threshold" level for exposure for any carcinogen.

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It is useful to examine this theory in the light of where there is general agreement and where responsible opinions diverge. It is generally agreed by virtually all medical authorities that:

1. That there is a wide range of dosages for a carcinogen where a dose-response relationship exists. The larger the dose, the greater percentage of these exposed contract cancer and vice-versa.
2. In exposed populations, even at substantial exposure levels, large portions of those exposed do not contract cancer. Some form of hereditary or acquired bodily defense mechanism is involved.
3. As the dosage goes down, the median time to the appearance of a tumor increases.

The main medical disagreement occurs over what happens as the dosage is decreased to very low levels. There is one school of thought that some small number of cancers continue to occur. There are other responsible authorities who contend that a dosage level is reached where the body's defense mechanisms can effectively combat the altered cells and cancerous growths no longer occur. Supporters of this position cite the low level presence of certain metals and hormones that are essential to and are present in the human body in trace amounts that are carcinogens at higher levels.

Unfortunately, there is no way to demonstrate the correctness of either view since there is a background level of cancer in both man and experimental animals. As the dosage and the corresponding number of cancers decreases, a point is reached where the expected level disappears into the natural background. It cannot be distinguished whether an occasional cancer from the specific agent still occurs or whether the defense mechanisms are effective so that the added cases do not occur. These views can be partially resolved on the basis of the increased time to tumor at lower dosage, i.e., a very low exposure may cause a cancer but it may take 150 years for it to occur. With an expected life span

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of 70 years this, for all practical purposes, is a safe threshold exposure at least until life expectancy approaches 150 years. Since there is at present no provable scientific answer to this risk question, the problem becomes a socio-political decision as to what level of potential risk, if any, best serves society's overall needs. At the present time, most of the regulatory agencies are favoring an absolute zero risk to everybody, everywhere approach for all suspected carcinogens. Since there are over 2000 suspected human carcinogens, the impact of decisions made on this basis can have a tremendous effect on all of our lives.

AIRBORNE ASBESTOS EXPOSURE - PLASTICS PRODUCTS

The Union Carbide Corporation, in 1963, initiated commercial mining and milling of a short fiber asbestos from a unique deposit in central California. This material is sold only as fiber and no asbestos-containing products are manufactured. In the "plastics" applications categorized previously in Figure 1 this asbestos is used in flooring products, roofing products, in a variety of coatings, in compounds and in some plastics. It is not used in fricition products.

In 1972 the Corporation initiated an asbestos dust monitoring service to assist the product users in providing a safe and healthful work place for their employees and in complying with the applicable governmental regulations. The data to be presented here were obtained as part of this program. Unless otherwise noted, all of the samples have been collected under field conditions as part of normal, routine, user operations.

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SAMPLE COLLECTION AND COUNTING PROCEDURE

Sample collection and fiber counting was carried out in accordance with the prescribed NIOSH procedure( ) that was in effect at the time. Since this procedure is described in detail by NIOSH, it is only necessary to touch on it briefly here. Samples were collected on 37 mm. Millipore AA filters (0.8μ porosity) with a small MSA battery-driven vacuum pump. The filter cassette was attached

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in the collar area of the worker so that it was suspended facing downward in his breathing zone. Only data from such personal samples have been reported.

For fiber counting, a pie-shaped wedge was cut from the filter, mounted on a slide with the prescribed solution, and fibers were counted at 400X with a Nikon microscope Model _____ with wide-angle eyepieces. A Porton reticle was used for field definition.

The NIOSH procedure was originally developed to measure airborne dust concentrations where asbestos was the principle constituent in the dust. It's ability to distinguish between asbestos and other fibrous particulate of the prescribed dimensions is quite limited and well recognized (NIOSH)(NIOSH). ← (and references)

← The lack of specificity presents particular problems in the present study. Many of the samples were generated by spraying or by abrasion of plastics materials containing other mineral ingredients besides asbestos. Fiberglass, mica, various clays, fibrous talc and mineral wood were common.

The NIOSH procedure permits the use of "other information" to avoid counting non-asbestos fibers but does not specify what such information must be or how it is to be used. This laboratory collects bulk samples of known materials wherever practicable and maintains a "library" of reference samples and photographs. Scanning electron microscopy is also used to a limited extent. This information, gained from transmission electron microscopy and counter experience gained from them, is incorporated into a counting criteria that all fibrous particles meeting the NIOSH criteria of length greather than 5μ and aspect ratio greater than 3 are counted as asbestos unless an experienced counter recognized them unambiguously as not being asbestos. This criteria was used for all of the Union Carbide data reported herein.

ASBESTOS EXPOSURE FOR TAPE-JOINT COMPOUNDS ← L.C.- Capitals for first letters only.

The drywall system to be examined consists of gypsum board, usually 4' x 8', manufactured with a small beveled depression about 4" wide on the long edges of the sides to be finished. A paper tape to bridge the joint and a taping

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compound to fill the depression and form the joint between the boards completes the materials used.

The taping compound or "mud" is made up of primarily finely-ground limestone with lesser amounts of mica, clay, and asbestos. The asbestos content typically ranges from 2-5% by weight on a dry basis. The binder is vinyl acetate latex, starch, casein, or polyvinly alcohol. The compound is available as a dry powder which must be added to water at the time of use, or as a ready-mix which can be used directly.

During the installation of a wall boards are first attached to the studding with nails or screws. The joint is then made with three applications of taping compound as follows:

1. The paper tape is buried in compound or "mud." Nail holes are filled.
2. After drying, a second coating of "mud" is smoothed over the joint and nail holes and allowed to dry.
3. The dry "mud" is sanded lightly to remove high spots and a third application is made. After drying, the joints and holes may be sanded again if a smooth wall is desired, or a textured finish can be applied directly.

The potential for exposure to airborne asbestos fiber exists during the wet-out of the dry compound when it is used and during sanding and clean-up for both types. Exposure data for professional and consumer operations are available from a variety of sources.

The first published information on commercial use was that of Rohl et al( ), where a test was conducted at a location in New York City using professional installers. These results are summarized in Table II. A more extensive study was conducted in late 1975 by Rhodes and Ingalls[4] with the cooperation of the Gypsum Drywall Contractors International. Here a variety of routine commercial

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sanding operations were sampled in six states. Results are shown in Table III. Additional commercial sanding, wet-out, and clean-up data from State and Federal OSHA compliance inspections have been compiled by Equitable Environment Health Inc.( ) as part of an industry sponsored study of asbestos exposure in the construction industry. The compliance data and data from one short survey conducted by EEH are summarized in Tables IV and V.

Consumer use data are limited to two studies recently conducted by Union Carbide Corporation. In one case, extensive spackling was carried out in one room and a 7' x11' section of dry wall was removed and replaced in a second room located two floors away. In the other, drywall was installed to cover three walls and the ceiling in a 12' x 22' basement recreation room. In both cases the three-coat installation procedures described previously and recommended by the manufacturers of the compound were followed. A complete listing of samples and results for these two studies are provided in Tables VI and VII.

In order to visualize this rather extensive compilation of data, the range of airborne fiber concentrations measured for each basic operation at each location, together with the corresponding arithmetic mean, have been shown graphically in Figures 1 and 2. Figure 1 gives the airborne asbestos fiber concentrations measured during the actual sanding operations. The commercial operations are on the left, and the consumer uses on the far right. The type of sanding, i.e, hand or pole, and the number of samples included in the average are indicated along the horizontal axis.

The data of the far left are those of Rohl et al( ). Their results range basically from about 1 to 20 fibers/cc >5μ with averages of 10.0 and 5.3 fibers/cc for pole and hand sanding, respectively.

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The next group of results are those obtained by the Union Carbide Corporation in the survey of commercial operations in six different cities. Results range from about 0.2 to about 4 fibers/cc. The range found corresponds reasonably with the intensity of sanding, the room size and ventilation conditions, and the number of men operating in the same room. This reference also includes measurement of respirable dust and crystolline silica, which follow the same patterns as the asbestos, and may be of general interest.

The OSHA compliance and Equitable Environmental Health data are shown next. These fiber concentrations fall in the same range as the results just discussed.

The consumer-use data are shown on the far right. The first case is for the extensive spackling and the installation of three panels of drywall. The second is for the three walls and the ceiling of a large basement recreation room. This latter mud contained 2.6% asbestos by weight on a dry basis. Exposures in these tests were only 0.2 to 1.0 fibers/cc >5μ, which correspond roughly to the lower end of the range found for commercial use.

Data for the two other operations in tape-joint installation which present the possibility of exposure to free-form asbestos fiber, i.e, the addition of the dry powder compound to water and the cleanup after sanding, are shown in Figure 2. Here, in order to get the Rohl et al data on the graph, it was necessary to run the scale from zero to twenty as in the previous figure. Otherwise, the graph follows the same format and shows a very similar pattern. The Rohl et al data are far higher than the OSHA results and the consumer values are below or in the lower end of the range found for commercial use.

When the large differences between the Rohl and Union Carbide studies first became apparent, filters from three of the Union Carbide locations were counted "blind" by two other laboratories. The results shown in the next table demonstrate that the differences were not due to improper counting by the authors of that work.

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INTERLABORATORY COMPARISON

ASBESTOS FIBER COUNTS (2 5)

Sample Source		Airborne Asbestos Fiber Concentration (Fibers/cc longer than 5um) By UCC	By Lab A	By Lab B
Location I	(Filter #1)	0.4	0.3	0.2
"	(Filter #2)	0.4	0.0	0.2
Location II	(Filter #1)	1.5	1.0	1.6
"	(Filter #2)	1.3	1.0	0.6
Location III	(Filter #1)	0.6	0.0	0.9
"	(Filter #2)	0.4	0.2	0.2

Unfortunately, Rohl provides no details on the nature of the operation sampled, i.e., whether it was run as a specific test or as the sampling of a routine commercial installation, the asbestos content of the mud, the number of men sanding in a room, the size of the room or rooms sanded, or the presence or lack of ventilation. There is no way to evaluate the influence of the specific test conditions on the results reported or to determine how they may relate to other commercial operations. The tests also appear to cover a total sanding time of no more than 15 minutes for pole sanding and about the same time for hand sanding. It can be questioned whether this is a representative sample of commercial operations but there is insufficient information to really explain the differences.

The concentrations just described were obtained during the actual dust-generating operations. In virtually all cases, even the commercial operators do not engage in these operations for a full shift so that the 8-hour time-weighted average will be considerably less than the exposure while dust is being generated. Values for the sanding conditions in the 8-hour time-weighted average in the study of Rhodes and Ingalls( ) are shown in the table ~~below~~ following. The results ranged from 0.1 fibers/cc >5μ to the highest value of 0.9 f/cc >5μ.

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FIBER CONCENTRATIONS DURING DRYWALL SANDING ( )

Location	Ceiling Exposure (Fibers/cc >5µm)	Exposure Time During Sanding (Hours)	Estimated 8-Hour TWA Exposure (Fibers/cc >5µm)
New York City, NY	0.4	8.0	0.3
Hialeah, FL	1.0	4.0	0.4
Ft. Lauderdale, FL (Hand)	1.1	1.0	0.1
Detroit, MI	1.3	8.0	0.9
Dallas, TX	1.8	0.5	0.1
Ft. Lauderdale, FL (Pole)	3.4	3.3	0.6
Niagara Falls, NY	3.6	0.6	0.2

Eight-hour time-weighted average exposures have also been calculated for the two consumer installations and the highest exposure found was 0.2 fiber/cc >5µ for two days while asbestos-containing dust was being generated. In general it appears, therefore, that consumer operations may be characterized with ceiling exposures of the order of 1-2 fibers/cc >5µ and eight-hour time-weighted average exposures of several tenths of a fiber/cc >5µ.

ASBESTOS EXPOSURE FOR ROOFING COMPOUNDS ← low case. Caps only for first letters.

It was shown in Table I that about 76,000 tons of asbestos are used annually in asphaltic-based roofing compounds. The asbestos is an important ingredient in emulsified and cut-back coatings, trowelable? patching and sealing compounds and in some tar papers. It is not used in hot-melt roof coatings.

Data for the spraying of emulsified and cut-back asphaltic coatings is shown in Table VII. Similar data that includes both rip-off and installation of built-up roofs with asbestos-containing materials are shown in Table IX. These data were presented by the Flintkote Company and Johns-Manville Corporation, respectively, in response to an EPA proposal( ) to change the current Asbestos National Emission Stnadard for spraying of asbestos-containing materials. The results from eight field locations and one test sequence ranged from 0.0 to 0.6 fibers/cc >5µ and averaged 0.1 fibers/cc >5µ.

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ASBESTOS EXPOSURE FOR COATINGS, COMPOUNDS, AND PLASTICS

These categories encompass a myriad of products consuming about 56,000 tons of asbestos annually. Typical examples include high-performance maintenance coatings, special purpose trade paints such as block coatings, caulks, sealants, adhesives, and certain laminating resins. In these products the asbestos functions primarily as a rheological agent and is usually present in small quantities such as 0.5-3% and seldom exceeds 5% by weight. Some of these products are ~~generally~~ normally applied by spraying and those based on thermoset resins may in some cases be subject to abrasion during finishing or in the process of subsequent replacement.

Data on the airborne asbestos levels during the spraying of nine different systems at twelve locations are provided in Tables X and XI. The highest asbestos content examined was 6% with values in the 0.5-3% range much more common. Fiber counts ranged from 0.0 to 0.6 fibers/cc >5μ and averaged 0.15 fibers/cc >5μ. It should be noted that the highest values occurred during the simultaneous use of fiberglass with a "chopper" gun and fiberglass ~~strips~~ chips undoubtedly made a substantial contribution to the "asbestos" total reported.

Data for the sanding of polyester laminating resin and of a vinyl latex paint are shown in Table XII. Results for six locations ranged from 0.0 to 0.4 fibers/cc >5μ and averaged 0.16 fibers/cc >5μ. Here, too, there were counting problems due to unidentifiable particles of non-asbestos material being included in the reported asbestos count.

CONSUMER SAFETY

The ~~last~~ key point to consider is how much risk the levels of exposure just described pose to the consumer. It is important to recognize first of all that consumer exposure is quite different ~~thing~~ from that encountered by the worker who is manufacturing a product or the professional who installs it. These workers are exposed to whatever level of airborne fiber that is characteristic of their

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particular operation for a full working day over extended time periods up to a full working lifetime. The consumer, on the other hand, may have a brief exposure while the particular product is being used and spend the rest of his life without measurable exposure from the particular item.

The best known correlation and extrapolation procedure for the risk of lung cancer from asbestos exposure is that of Enterline( ). In the simplest sense this approach includes the assumptions of a linear dose-response relationship with no safe threshold, a log-normal distribution of asbestos-related respiratory cancer with a standard deviation of 1.5, and a cube root relationship for median time to tumor. The log-normal distribution curve is fitted to high-level industrial exposure data or more typically estimates of past exposure to calibrate the constants and then is used to extrapolate to other exposure levels. An example for continuous exposure to four levels 1.5-15 fibers/cc >5μ from Enterline is shown for illustrative purposes in Figure 3. The predicted number of cases for any given time period after exposure is found by integrating the area under the curve from zero out to the time after exposure selected.

Since the Enterline correlation deals mainly with industrial exposure levels over extended time periods, Dr. Steven Bayard( ), of the Consumer Products Safety Commission, modified the approach for very low exposures to include an assumption that the effect of dose is cumulative. This builds a geometric increase in risk into the model which can be seriously questioned but this is not the place to debate the issue. This Bayard modification will be used to calculate cumulative risk for periods of 40 and 100 years from onset of exposure for the consumer exposure levels reported here.

In the first case, following Bayard's directions in page 3, Part C, of the reference cited, for the highest time-weighted average of 0.2 fibers/cc for two days found for the consumer application, an annual exposure of 0.004 fibers/cc per day for one year, a mean latent period to tumor of 621 years, and

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zero deaths of asbestos-induced cancer in a 40-year period after exposure are obtained. If the period examined is extended to 100 years, the number of deaths predicted would be 0.000003, which is obviously still far less than a single death.

It is also instructive to point out that if an exposure of 5 fibers/cc for two full 8-hour days is assumed and it is emphasized that this is well above that found in commercial use, the yearly rate becomes 0.1 fiber/cc. This yields a median time to tumor of 212.5 years and an asbestos-induced cancer estimate of 0.02 deaths.

For the roofing application, it seems very likely that the amount of roofing sprayed by consumers is probably extremely small since special equipment is required. The removal of old built-up roofing and replacement with new tar paper and trowelable emulsions by the consumer is undoubtedly quite common. The commercial data available indicates that exposures during installation would be substantially below those for tape-joint compounds, but quite possibly would still be detectable.

The situation for the various coating and laminating resins is similar. While the consumer may not have access to many of these products, it is possible that he may occasionally sand certain of the coatings and finished products. In these cases a very low, but still not zero, exposure to fiber can occur.

Regardless of the exposures found for the use of tape-joint compounds and the risks predicted therefrom, the Consumer Product Safety Commission is going ahead to ban this use on the basis of the "not proven safe" and "zero risk for everybody" philosophy. This is true even though the product has been in widespread use for over 35 years and it has not been implicated in a single case of cancer. More importantly, the CPSC is very actively looking for other asbestos-containing products that will be subject to the same kind of treatment.

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Extensive application of this approach by the CPSC and other agencies to the more than 2000 carcinogens now suspected will have a massive and chaotic impact on our way of life. A more rational approach such as that described by Lowrance ( ) is needed. In this reference "safe" is defined as:

"A thing is safe if its risks are found to be acceptable."

The risks are then balanced against the benefits to society to serve as a basis for a decision on where it is appropriate to use the product. The balancing of risks and benefits is admittedly a difficult and controversial activity, but there is really no alternative. There is much that needs to be done to protect the worker on the job and the public at large. An emotion-driven zero risk approach will be self defeating in the long run and possibly in the short run as the saccharin controversy suggests. Awareness, concern, and constructive rational action, not emotion is urgently needed.

SUMMARY AND CONCLUSIONS

Typical asbestos consumption in the United States is about 850,000 tons annually. Of this total 364,000 tons or 43% of the total is used in asphaltic or synthetic plastics-based materials. The largest use is vinyl flooring products at 153,000 tons followed by friction products at 79,600 tons, roofing products at 73,800 tons, and coatings, compounds, and plastics at a total of 53,900 tons.

The regulatory philosophy towards carcinogens that is currently popular with most federal regulatory agencies can be summarized as follows:

1. For a carcinogen an exposure level that is absolutely safe for everyone, everywhere has not been demonstrated and will be assumed not to exist.
2. The appropriate regulatory goal is an absolute zero level of risk for everybody.
3. All carcinogens, therefore, should be banned or controlled to the

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lowest detectable level.

Extensive airborne asbestos exposure data for both commercial and consumer use of one plastics-based material, tape-joint compounds, were presented. The consumer results show a short-term peak exposure of the order of 1 - 2 fibers/cc >5μ and 8 hour-time weighted of several tenths of a fiber/cc >5 μ. Such exposures can be expected to occur for only several days out of a life time so that there effect on a person's overall exposure cannot be distinguished from the naturally occurring background.

Data for exposures during the commercial use of roofing materials and during spraying and abrasion of a variety of coatings showed levels which were substantially below those for tape-joint compounds. Consumer exposures for the relatively few of these products ~~they might~~ acceptable for consumer use is expected to be considerably lower than the commercial operations but are quite possibly still distinguishable from background.

A risk assessment model for asbestos-related cancer that has been developed by the Consumer Product Safety Commision was used to calculate the risks associated with the consumer exposure levels found for tape joint compounds. For a forty-year period following exposure this risk was not distinguishable from zero whereas at 100 years it was 0.00003. For an exposure 250 times as high, which is well above most of the commercial data, the risk only increased to 0.02 deaths. In spite of this, the CPSC is moving ahead with a ban on asbestos in tape-joint compounds and is actively looking for other asbestos-containing products for the same treatment.

Extensive application of this approach to the more than 2000 carcinogens now suspected will have a massive and chaotic impact on our way of life. A more rational approach such as that described by Lowrance is needed in this reference. Thus "safe" is defined as:

"A thing is safe if its risks are found to be acceptable."

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The risks are then balanced against the benefits to society to serve as a basis for a decision it is appropriate to use where the product fits. The balancing of risks and benefits is admittedly a difficult and controversial activity but there is really no alternative. There is much that needs to be done to protect the worker on the job and the public at large. An emotion-driven zero risk approach will be self defeating in the long run and possibly in the short run as the saccharin controversy suggests. Awareness, concern, and constructive rational action not emotion is urgently needed.

A-0717

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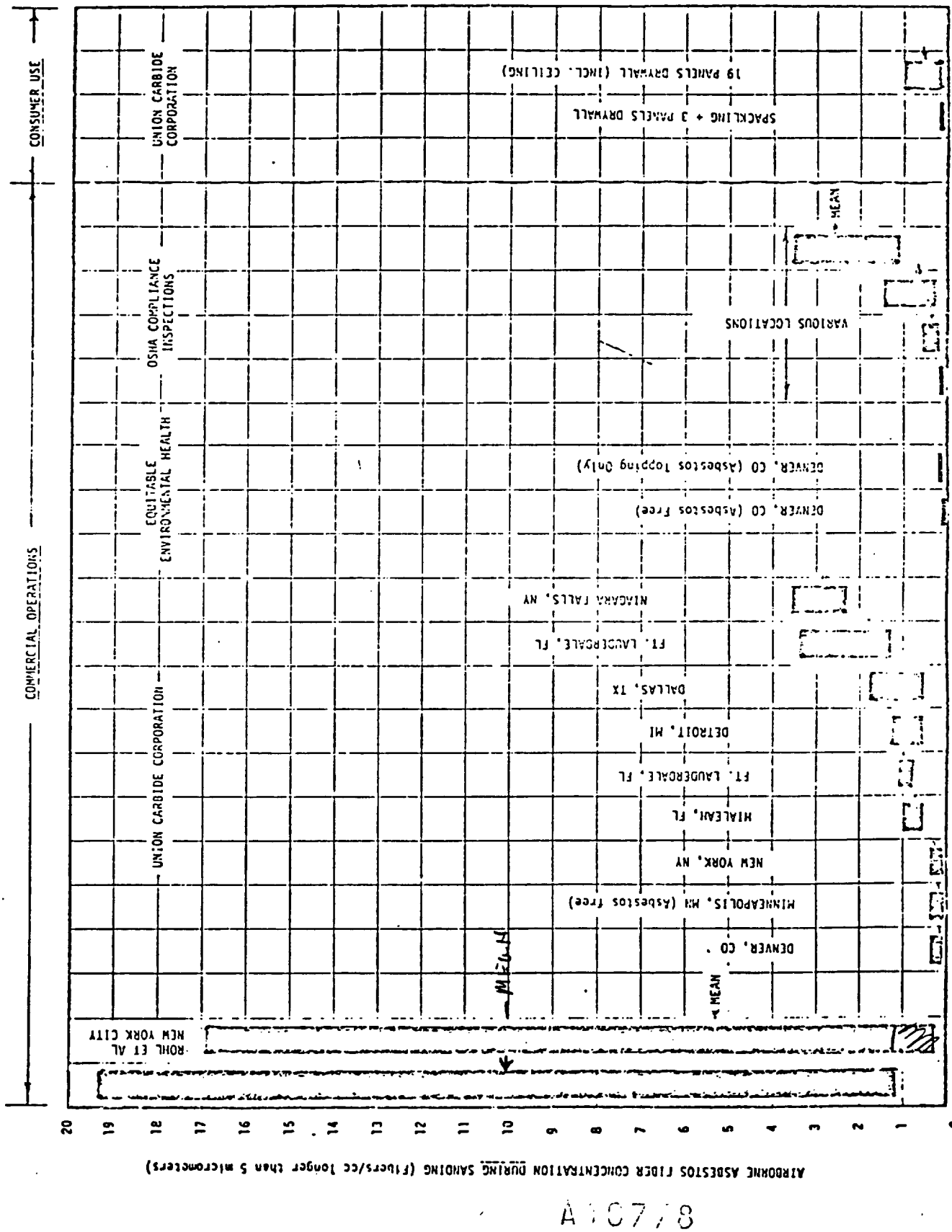


FIGURE 1

IN OPERATOR BREATHING ZONE
DURING SANDING OF TAPE-JOINT COMPOUND

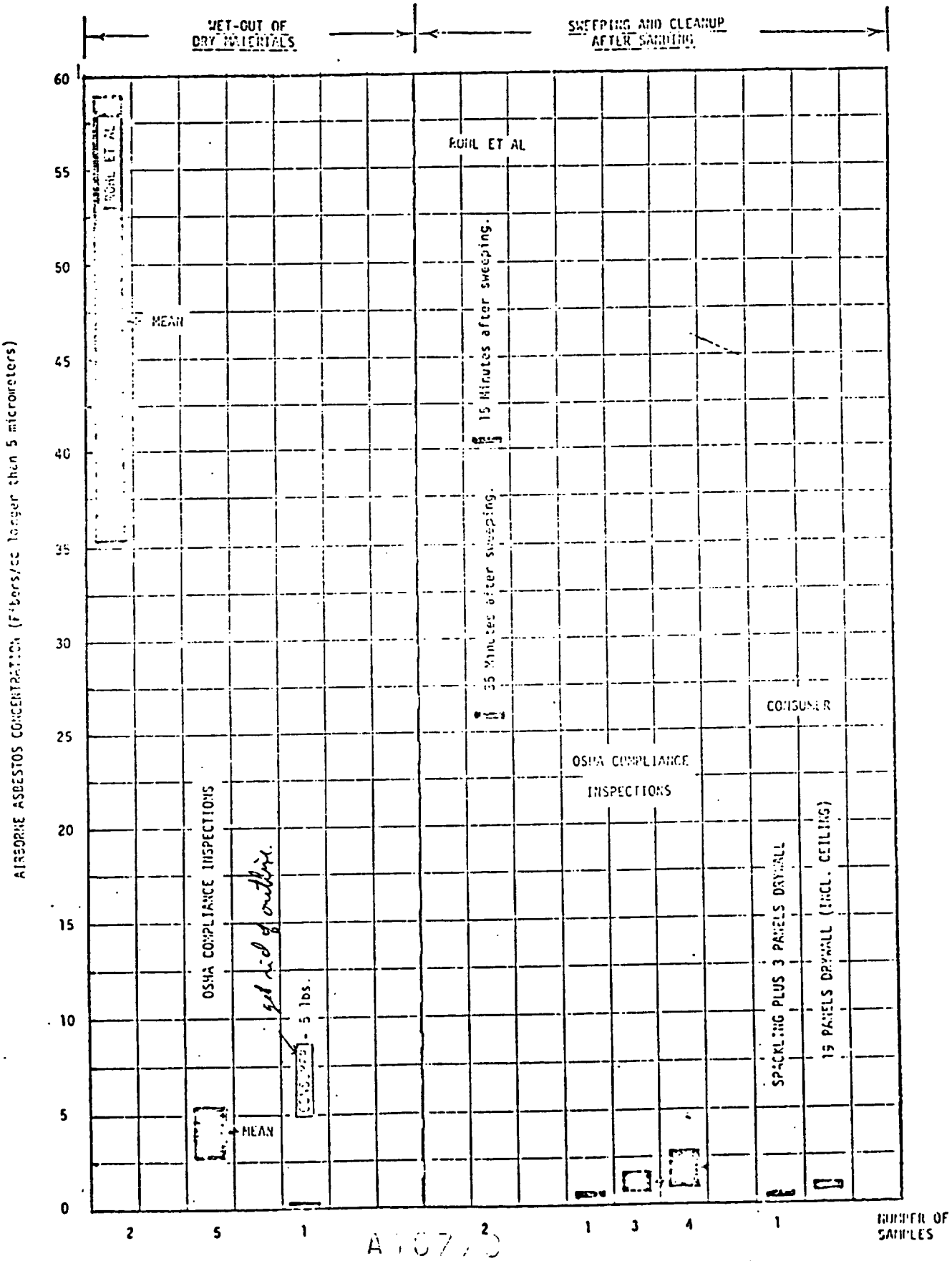
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IN OPERATOR BREATHING ZONE

DURING WET-OUT OF DRY MATERIALS

AND

CLEANUP AFTER SANDING



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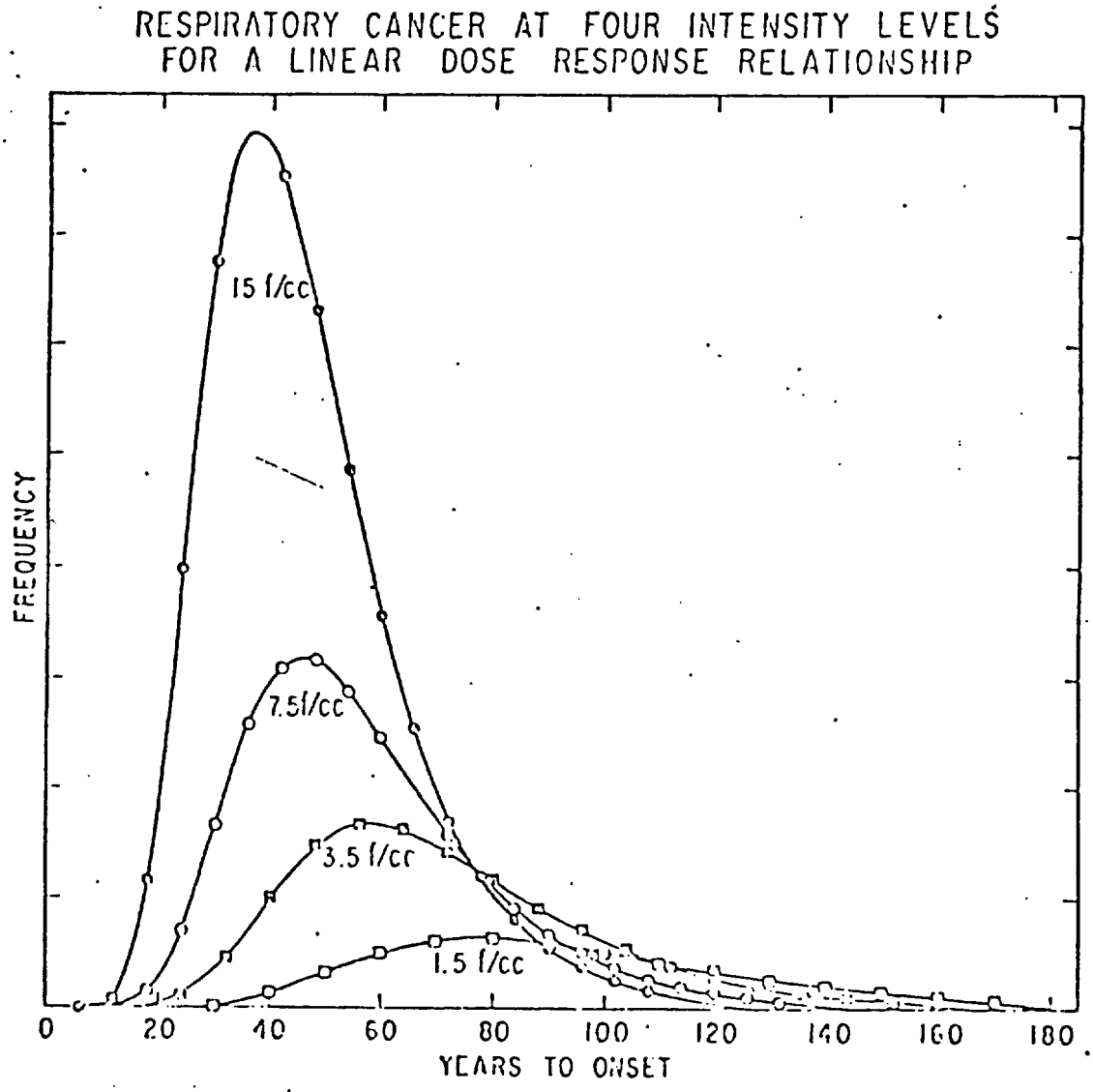


Figure 3

Source:

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TABLE I

ASBESTOS DISTRIBUTION BY END USE AND TYPE, 1974(1)
(Short Tons)

	CHRYSOTILE	CROCIDOLITE	AMOSITE	ANTHOPHYLLITE	TOTAL ASBESTOS
Asbestos Cement Pipe	185,200	36,400	1,100	200	222,900
Asbestos Cement Sheet	90,500	-	4,300	-	94,800
Flooring Products	153,500	-	-	-	153,500
Roofing Products	73,800	-	1,700	-	75,500
Packing and Gaskets	28,700	100	-	-	28,800
Insulation, Electrical	7,300	-	1,800	-	9,100
Insulation, Thermal	4,700	-	-	-	4,700
Friction Products	79,600	-	-	200	79,800
Coatings and Compounds	37,900	-	-	-	37,900
Plastics	16,900	200	-	700	17,800
Textile	20,400	-	-	-	20,400
Paper	63,100	200	-	-	63,300
Other	36,400	400	500	-	37,300
	798,000	37,300	9,400	1,100	845,800

(1) Abstracted from U.S. Bureau of Mines, Minerals Yearbook, Volume 1, Page 181, Table 3.

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TABLE II

AIRBORNE ASBESTOS FIBER CONCENTRATIONS
SANDING, DRY-MIXING AND SWEEPING( )

Operations	Number of Samples	Peak Fiber Concentration (Fibers Per Milliliter) Mean	Range
Pole Sanding (1 to 1.5 m)	10	10.0	1.2 to 19.3
Background (2.5 m), same room	3	8.6	3.5 to 19.8
Background (7.5 m), adjacent room	2	4.8	0.7 to 8.8
Hand Sanding (1 to 1.5)	11	5.3	1.3 to 16.9
Background (2.5 m), same room	2	2.3	2.1 to 2.5
Background (4.5 m), adjacent room	2	4.3	1.5 to 7.1
Dry Mixing (1 to 1.5 m)	2	47.2	35.4 to 59.0
Background (3 to 6 m), same room	3	5.8	0.5 to 13.1
Background (5 to 10 m), adjacent room	2	2.6	2.1 to 3.1
Sweeping Floor (3 to 15 m)			
15 Minutes after sweeping	1	41.4	
35 Minutes after sweeping	1	26.4	

( ) A.N. Rohl, A.M. Langer, I.J. Selikoff and W.J. Nicholson, Science, Vol. 189, August 15, 1975, p. 52

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TABLE III

AIRBORNE ASBESTOS FIBER CONCENTRATIONS

DURING SANDING OF TAPE-JOINT COMPOUND

DATA FROM UNION CARBIDE CORPORATION

Location	Structure	TJC Definition: App. Tool	TJC Definition: Type	Sanding Definition: Tool	Walls	Ceiling	Description	Sample Definition: Total Sample Time (Hrs.)	Sample Definition: No. Samples	Airborne Asbestos Fiber Concentration (Fibers/cc >5μ): Range	Average
New York City, NY	High rise apt. building. Windows open, light breeze. 13, 14, 15th story. Humid ~750ft.^{2} of floor area per apt.	Hand	General Purpose, Ready-Mix	Pole & Hand	x	x	Finishing touch-up operation by tapers. Scraping, sanding (generally light) & filling. 5 man crew, 1 man/room.	5	5 Personal 1 Area	0.1-0.4 0.2	0.3 0.2
Ft. Lauderdale, FL	Condominium apt. bldg. Windows in and generally closed. Little breeze.	Ames	General Purpose, Ready-Mix	Pole	x	x	Steady sanding by laborer. 10-15 minutes to complete 1 B.R. apt., ~500 ft.^{2} of floor area.	1.5	7 Personal 7 Area	1.3-3.4 0.3-1.5	1.8 0.9
				Hand	x	-	Spot sanding bad areas.	0.5	2 Personal	0.8-1.1	1.0
Hialeah, FL	Condominium apt. bldg. Windows in and generally closed. Little breeze.	Ames	General Purpose, Ready-Mix	Pole	x	-	Steady sanding by laborer. 15-20 minutes to do a 3-5 room apt.	1	2 Personal 1 Area	0.6-1.0 0.6	0.8 0.6
Dallas, TX	Single level residential dwelling. ~2000 ft.^{2} floor area. Windows in and closed.	Ames	General Purpose, Ready-Mix	Pole	x	x	Steady sanding by 2 laborers. 30 minutes to do complete house.	1	4 Personal 1 Area (after)	0.6-1.8 0.1	1.1 0.1
Niagara Falls, NY	Remodeled office. 12'x10'x12' No ventilation.	Hand	General Purpose, Ready-Mix	Hand	x	-	One man, heavy sanding.	0.6	3 Personal	2.3-3.6	2.9
Detroit, MI	Multilevel residential dwelling. ~3000 ft.^{2} of floor area. No ventilation.	Ames	Topping Compound, Dry Mix	Pole	x	x	Steady sanding by laborer. ~4 hours to complete.	4	8 Personal 1 Area	0.6-1.3 0.5	1.0 0.5
Minneapolis, MN	Two-level residential dwelling. ~2300 ft.^{2} of floor area. Moderate ventilation.	Ames	Topping Compound, Dry- Mix Asbestos Free	Pole	x	x	Steady, heavy sanding. 1 man ~4 hours	4	6 Personal 3 Area	0.1-0.4 0.0-0.4	0.2 0.2
Denver, CO	Two-story medical bldg. Two-story hall, many small rooms. Rain, no ventilation.	Hand	Ready-Mix to bury tape. Non-asbestos Ready-Mix Topping.	Pole	x	x	One man, moderate sanding. ~30 mins.	3	3 Personal 2 Area	0.1-0.4 0.2	0.2 0.2

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TABLE IV

AIRBORNE ASBESTOS FIBER CONCENTRATIONS
DURING SANDING OF TAPE-JOINT COMPOUNDS[1]

Location	Structure	TJC Definition: App. Tool	TJC Definition: Type	Sanding Definition: Tool	Sanding Definition: Walls	Sanding Definition: Ceiling	Sanding Definition: Description	Sample Definition: Total Sample Time (Hrs.)	Sample Definition: No. Samples	Airborne Asbestos Fiber Concentration (Fibers/cc >5μ): Range	Airborne Asbestos Fiber Concentration (Fibers/cc >5μ): Average
DATA FROM OSHA COMPLIANCE INSPECTIONS[1]											
A	-	-	Ready-mix	Pole	X	X	Apparently 3 men sanding.	0.5-2	8 Personal 4 Area	1.5-5.0 1.0-10.0	4.3[2] 5.0[2]
F	-	-	-	Pole	-	-	-	0.7	1 Personal	0.1	0.1
H	-	-	-	-	-	-	-	-	9 Personal	0.3-1.5	0.7
I	-	-	-	-	-	-	-	1.2	3 Personal	0.2-0.6	0.4
DATA FROM EQUITABLE ENVIRONMENTAL HEALTH, INC.											
CO	One story annex to existing building.	-	Non-asbestos for tape, finished with asbestos-containing.	Pole	-	X	Heavy sanding. One man on stilts.	0.5	1 Personal 2 Area	0.2 0.1	0.2 0.1
	"	-	Non-asbestos throughout.	Pole	-	X	"	0.5	1 Personal 1 Area	0.1 0.1	0.1 0.1

1. Supplied to Equitable Environmental Health, Inc. as part of a study of asbestos exposure in the construction industry. Specific locations not identified.

2. Includes all particles L/D >3 L>5μ . Estimated by TEM proceeding to be about 50-70% chrysotile plus amphibole. No split on relative amounts is available.

TABLE V

AIRBORNE FIBER CONCENTRATIONS FROM OSHA COMPLIANCE INSPECTIONS (1) DURING WET-OUT OF DRY PRODUCT AND CLEANUP AFTER SPRAYING OR SANDING

Location	Product Identification	Operation	Sample Time (Min.)	Ceiling Concentration Fibers/cc >5μ
B	All purpose TJC	Wet-out	10	5.4
C	Spray Texture(2)	"	10	4.4
E	Spray Texture(2)	"	20	4.9
G	TJC	"	2	4.0
H	TJC (Morter)	"	-	2.7
D	TJC	Sweeping	15	2.7
		"	15	2.5
		"	15	2.0
		"	30	0.9
	TJC	Sweeping and Scraping	15	1.5
		"	15	0.6
		"	15	1.6
H	TJC	Sweeping	-	0.6

1. Supplied to Equitable Environmental Health, Inc. as part of a study of asbestos exposure in the construction industry. Specific locations not identified.

2. Spray texture compounds are generally similar in composition to dry-mix tape-joint compounds with texturing material added.

A-0735

SUMMARY OF AIRBORNE "FIBER" CONCENTRATIONS
CONSUMER SPACKLING AND DRYWALL INSTALLATION

There day 1 in = - out

Sample No.	Date	Air Sample On	Air Sample Off	Minutes	Description of Operation	No. of Fields Counted	No. of Filter Section Used	Airborne Fiber Concentrations: Chrysotile Fibers/100 Fields	Chrysotile Fiber/cc >5μ	Possible Amphibole "Fiber" Fibers/100 Fields	Possible Amphibole "Fiber" Fiber/cc >5μ	Comments
BACKGROUND PRIOR TO TEST (6/21/77)												
M-32	6/21/77	11:07A	7:16P	489	Outdoors- about 4' in air. See Figure 1 (d).	500	2	1.93	0.005	1.1	0.002	
M-21	6/21	Blank	-	-	-	500	2	0.8 0.5	-	0.2		
M-25	6/21	12:58P	9:10P	492	Bedroom-4' off floor, 3 1/2' from side wall, 9' from end wall. See Figure 1 (a).	200	1	0.5 7.5	0.0020.01	1.5	0.001	
M-37	6/21	11:27A	7:27P	480	Living room-4' off floor, 3 1/2' from side wall. See Figure 1 (b).	200	1	8.5	0.01	0.0	0.0	
M-23	6/21	10:55A	7:20P	505	Recreation room - Center about 4' off floor. See Figure 1 (c).	300	2	4.8 5.4	0.006	0.0	0.001	
PREPARATION AND INSTALLATION (6/22/77)												
M-24	6/22	9:00A 3:58P	2:48P 5:39P	429	Personal sample. Operator preparing cracks for spackling. Removing old drywall. Cleanup after three operations. Installation of drywall. Spackling and taping with "wet" compound. (Taping in same area as TJC wet out.)	100	1	141	0.2	0.0	0.0	Too heavily loaded to count accurate! Better than 1/5 of field obscured by particulate. Particulate in 5μ range may not be chrysotile.
M-30	6/22	3:38P	3:55P	17	Personal sample. Operator wetting out dry tape joint compound.	200	1	3.5 6.5	0.3 0.2	3.0	0.2	
M-28	6/22	9:18A 4:10P	2:02P 5:48P	422	Bedroom- 8' from side wall. See Figure 2 (a). During preparation, cleanup, and spackling.	100	1	14.0 18.5	0.02 0.1	5.0	0.08	
M-27	6/22	8:57A 4:09P	2:41P 5:45P	440	Living room - Same location as M-37. During various activities on other floors as noted.	100	1	14.0 17.	0.03 0.02	6	0.009	
M-36	6/22	9:10A 4:30P	2:40P 5:40P	400	Cellar- 4' from side wall. 12' from wall replaced. 4' from floor. See Figure 2 (b). During drywall removal.	100	1	169.5 171.5	0.3	4	0.007	Loaded with small particulate fibers, short but within 5μ range. Some evidence of asbestos.
M-18	6/22	3:38P	4:30P	70	Cellar- Same location as M-36. During wet out of TJC and immediately following.	200	1	3.4 7	0.07 0.03	4	0.04	
SANDING OF SECOND COAT AND APPLICATION OF FINISH COAT (6/24/77)												
M-26	6/24	7:10A	7:30A	20	Personal sample. Operator sanding spackling. Upstairs bedroom. Cleanup after sanding.	200	1	3.5 5.5	0.2	2.0	0.09	
M-35	6/24	7:31A	7:31A	20	Bedroom - During sanding and cleanup. Same location as M-28.	200	1	0.0 8	0.2 0.3	8	0.07	
M-27	6/24	7:32A	3:00P	448	Bedroom - After sanding and cleanup. Same location as M-28.	100	1	0.0 47.5	0.0 0.07	47.5	0.07	Geometric chunky material present. Also rod-shaped with light refractive index.
M-29	6/24	7:10A	2:54P	464	Living room - During and after sanding and cleanup of spackling and application of finish coat.	100	1	12.5	0.02	8	0.6	
M-19	6/24	7:37A	8:50A	73	Personal sample. During sanding of drywall in cellar. Cleanup after sanding. Application of finish coat.	100	1	0.0 10	0.1 0.08	2.0	0.02	
M-22	6/24	7:17A	7:52A	16	Cellar - during sanding and cleanup. Same location as M-36.	300	1	3.6 4.1	0.2	0.6	0.03	
M-34	6/24	7:54A	2:55P	421	Cellar - after sanding and cleanup. Same location as M-36.	200	1	6.36 8.5	0.01	2.5	0.004	
FINAL SANDING AND CLEANUP (6/25/77)												
M-66	6/25	12:43P	12:57P	14	Personal sample. Operator sanding spackling. Upstairs bedroom. Cleanup after sanding.	500	2	1.9	0.09	1	0.04	
M-60	6/25	12:42P	12:58P	16	Bedroom - during sanding and cleanup. Same location as M-28.	500	2	1.0 0.6	0.04 0.02	0.5	0.02	
M-68	6/25	12:59P	8:00P	421	Bedroom - after sanding and cleanup. Same location as M-28.	300	2	4.4 5.2	0.008 0.02	0.6	0.001	
M-64	6/25	12:15P	8:00P	465	Living room - During and after second sanding and cleanup.	300	2	5.2 5.3	0.007	1.2	0.001	
M-72	6/25	1:03P	1:36P	33	Personal sample. Operator sanding TJC in cellar. Cleanup after sanding.	500	2	1.7	0.01 0.04	0.4	0.008	
M-85	6/25	1:03P	1:37P	34	Cellar - During sanding and cleanup. Same location as M-36.	300	1	3.3 3.6	0.03	0.06	0.01	
M-12	6/25	1:45P	7:11P	326	Cellar - After sanding and cleanup. Same location as M-36.	500	2	1.6	0.002	0.6	0.001	
M-22	6/25	1:55P	2:05P	10	Personal sample. Handling of work clothes after sanding. Other clothes sorted and added to washing machine during most of period. (Operator #2)	200	1	6.75	0.5	1	0.03	
M-81	-	Blank	-	-	-	500	2	0.8	-	0.0		
M-97	7/9 & 7/10	10:30A 11:00A	7:25P 7:20P	1025	Outdoor sample. Same location as M-32.	500	2	0.4 1.8	-	0.4		

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TABLE 6 (CONTINUED)

SUMMARY OF AIRBORNE FIBER CONCENTRATIONS - CONSUMER DRYWALL INSTALLATION

Full room

Same as first page

SECOND SANDING AND CLEANUP (8/10/77)

Sample No.	Date	Air Sample On	Air Sample Off	Minutes	Description of Operation	No. of Fields Counted	No. of Filter Sections Used	Airborne Fiber Concentrations: Chrysotile Fibers/100 Fields	Chrysotile Fiber/cc >5u	Possible Amphibole Fibers/100 Fields	Possible Amphibole Fiber/cc >5u
B-17	8/10/77	9:27A	10:01A	34	Personal - Operator #3. Sanding TJC	100	1	~~22.5~~ 24.5	0.5	~~2~~	~~0.04~~
N-86	8/10	10:02A	10:28A	26	Personal - Operator #2. Sanding	100	1	13.5	0.4	~~0~~	~~0~~
P-60	8/10	10:29A	10:46A	17	Personal - Operator #2. Sanding (ceiling).	100	1	~~22~~ 24	0.9	1	~~0.04~~
N-4	8/10	10:48A	11:09A	21	Personal - Operator #2. Sanding (ceiling).	100	1	20.5	0.7	~~0~~	~~0~~
N-7	8/10	11:10A	11:43A	25	Personal - Operator #2. Sanding (ceiling).	100	1	22.5	0.6	~~0~~	~~0~~
B-8	8/10	9:25A	10:00A	35	Personal - Operator #3. Sanding	200	1	8 9.25	0.2	~~0~~	0
B-20	8/10	10:01A	10:30A	29	Personal - Operator #3. Sanding	200	1	~~8.5~~	0.2	~~0.5~~	~~0.01~~
P-65	8/10	10:31A	11:12A	41	Personal - Operator #3. Sanding	100	1	20	0.3	~~0~~	~~0~~
N-8	8/10	11:13A	11:43A	30	Personal - Operator #3. Sanding	100	1	23	0.5	~~0~~	0
N-10	8/10	11:52A	12:13P	21	Personal - Operator #3. During sweep up and vacuuming after sanding.	100	1	~~39.5~~ 36.	1.2	~~0.5~~	~~0.02~~
A-75	8/10	12:47P	4:33P	226	Personal - Operator #3. After final sanding and cleanup. Performing normal household duties including laundering of work clothes used during taping and sanding.	100	1	17	0.05	~~0~~	~~0~~
N-85	8/10	9:24A	12:18P	174	Area. During second sanding and cleanup. Located first floor living room ~6' above floor on mantle of fireplace.	300	3	11	0.02	~~0~~	~~0~~
N-55	8/10	9:27A	10:15A	48	Area. During second sanding of TJC. Located ~6' above floor near center of north wall cellar.	200	2	10.25 ~~9.75~~	0.1	~~0.5~~	~~0.007~~
A-74	8/10	10:17A	11:44A	87	Area. During second sanding of TJC. Located ~6' above floor near center of north wall cellar.	100	1	~~32~~ 31	0.2	~~2~~	~~0.02~~
N-6	8/10	11:52A	12:14P	22	Area. During sweep up and vacuuming after sanding. Located ~6' above floor on north wall.	100	1	15.5	0.5	~~0~~	~~0~~
A-77	8/10	12:19P	5:58P	339	Area. After final sanding and cleanup. Located first floor living room ~6' above floor on mantel of fireplace.	100	1	10.5	0.02	~~0~~	~~0~~
A-71	8/10	12:17P	5:59P	342	Area. After final sanding and cleanup. Located ~6' above floor in north wall of cellar.	100	1	18	0.04	~~0~~	~~0~~

RESIDUAL EXPOSURE AFTER COMPLETION OF INSTALLATION (8/11/77)

A-72	8/11/77	8:53A	9:10A	17	Personal (Operator #3). Vacuuming first floor living room, kitchen and den after final sanding and cleanup.	500	4	0.1	0.004	0	0
A-76	8/11	9:12A	5:00P	468	Area. Day following completion of work in basement. Located in kitchen area ~6' above floor.	500	3	0.8	0.001	0	0
Z-4	8/11	9:13A	5:00P	467	Area. Day following completion of work in basement. Located on mantle of fireplace ~6' above floor.	500	4	3.7	0.006	0	0
A-70	8/11	8:45P	5:01P	496	Area. Day following completion of work in basement. Located in stairway of cellar ~7' above cellar floor.	500	3	1.0	0.001	0	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	500	4	2.6	0.004	0	0

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SUMMARY OF AIRBORNE FIBER CONCENTRATIONS
FULL ROOM CONSUMER DRYWALL INSTALLATION

Sample No.	Date	Air Sample On	Air Sample Off	Minutes	Description of Operation	No. of Fields Counted	No. of Filter Sections Used	Airborne Asbestos Fiber Concentration: Fibers/100 Fields	Airborne Asbestos Fiber Concentration: Fiber/cc >5μ	Possible Amphibole: Fibers/100 Fields	Possible Amphibole: Fiber/cc >5μ
COMPLETION OF STUDDING - HANGING DRYWALL - START OF TAPING (8/3/77)											
M-73	8/3/77	8:30A	6:30P	600	Area-Before handling compound. Located in living room 1st floor ~6' above floor on mantel of fireplace.	500	5	3	0.004	0	0
M-52	8/3	8:20A	6:27P	607	Area-Before handling of asbestos. Located in construction area ~6' above floor on north wall ~ center of room.	100	1	63.5	0.08	0	0
B-3	8/3	7:43P	9:10P	87	Personal (Operator #1) Taping joints with ready mix.	100	1	~~25.5~~ 36.	~~0.2~~ 0.3	~~10.5~~	0.08
J-2	8/3	7:46P	9:10P	84	Personal (Operator #2) Taping joints with ready mix.	100	1	~~14~~ 17	0.1	~~1~~	~~0.008~~
COMPLETION OF INSTALLATION AND COVERING OF TAPE (8/4/77)											
M-53	8/4	9:36A	1:48P	252	Personal (Operator #2) Taping joints with ready mix.	200	2	7.25	0.02	~~0~~	~~0~~
M-70	8/4	9:35A	1:48P	253	Area - During taping. Located ~ 6' above floor area near center of north cellar wall.	200	1	5.5	0.02	0	0
APPLICATION OF SECOND COAT OF COMPOUND (8/5/77)											
----- No air samples taken. ----											
FIRST SANDING CLEANUP AND APPLICATION OF FINISH COAT OF COMPOUND (8/6/77)											
M-76	8/6	10:00A	10:44A	44	Personal (Operator #2). Hand sanding. Tape joint compound.	100	1	60 ~~33.5~~	0.9 ~~0.8~~	~~1.5~~	~~0.1~~
M-89	8/6	11:00A	11:28A	28	Personal (Operator #2). Hand sanding. Tape joint compound	100	1	22.5	0.5	1	~~0.02~~
B-14	8/6	11:58A	12:10P	12	Personal (Operator #2). Sweep up after first sanding.	100	1	22 ~~11.5~~	1.3 ~~1.0~~	~~0.5~~	~~0.3~~
M-94	8/8	10:01A	10:47A	46	Personal (Operator #3). Hand sanding. Tape joint compound.	100	1	45.5	0.7	~~2.5~~	~~0.04~~
B-18	8/6	10:55A	11:29A	34	Personal (Operator #3). Hand sanding. Tape joint compound.	100	1	40 ~~34~~	0.8	~~1~~	~~0.1~~
M-75	8/6	11:57A	12:11A	14	Personal (Operator #3). Sweeping up after first sanding.	100	1	15	0.7	0	0
M-71	8/6	9:59A	11:23P	84	Area. During first sanding of tape joint compound. Located ~6' above floor near center of north wall (cellar).	100	1	25.5	0.2	0	0
B-30	8/6	11:57A	12:12P	15	Area - During sweep up after first sanding Located ~6' above floor near center of north wall cellar.	100	1	14.5	0.7	0	0
B-31	8/6	12:39P	4:46P	237	Area. After sanding and sweep up. During final application of tape joint. Located near center of north wall (cellar).	100	1	10	0.03	1	~~0.003~~
B-10	8/6	12:23P	4:39P	256	Area. After sanding and sweep up. During final application of tape joint compound. Located first floor upstairs. Living room on mantle of fireplace.	300	3	10.5	0.01	2	~~0.003~~

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TABLE VIII

AIRBORNE ASBESTOS FIBER CONCENTRATIONS - SPARYING OF FIBRATED ROOF COATINGS( )

Date	Binder	Approximate(2) Wt. % Asbestos	Spray Gun Type	Airborne Asbestos Concentration (Fibers/cc >5μ) Background	Total	Asbestos
9/25/74	Cutback Asphalt	7.7	Air Supported	0.020	0.023	0.003
			Air Supported	0.020	0.026	0.006
10/9/74	Cutback Asphalt	7.7	Air Supported	0.038	0.110	0.072
			Air Supported	0.038	0.065	0.027
12/10/74	Asphalt Emulsion	2.8	Air Supported	0.15	0.16	0.01
			Air Supported	0.15	0.17	0.02
5/19/76	Asphalt Emulsion	2.8	Air Supported	0.5	0.8	0.3

( ) Data from response by the Flintkote Company to "Changes in the National Emission Standards for Hazardous Air Pollutants (40 CFR, Part 61) proposed by the EPA (42 CFR No. 41, p. 12122, March 2, 1977)

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TABLE IX

AIRBORNE ASBESTOS FIBER CONCENTRATIONS
TEAR-OFF AND APPLICATION OF BUILTUP ROOFING( )

Date	Location	Operation	Airborne Asbestos Concentration (Fibers/cc >5μ)
3/14/74	Wisconsin	New Application	0.2 - 0.6
4/10/74	Indiana	Tear-off	0.1 - 0.4
5/21/74	Pennsylvania	Tear-off and Replace	0.0 - 0.2
7/25/74	Indiana	Tear-off and Replace	0.1 - 0.3
11/20/74	Colorado	New Application	0.1 - 0.2
12/16/75	Colorado	New Application	<0.1
8/16/76	Indiana	Tear-off and Replace	0.0
8/16/76	Indiana	New Application	0.0

( ) Data from response by the Johns-Manville Corporation to "Changes in the National Emission Standards for Hazardous Air Pollutants (40 CFR, Part 61) proposed by the EPA (42 CFR No. 41, p. 12122, March 2, 1977)

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Rhodes
Thurber products sheet
as 2 pages - 8½ x 11

TABLE B X

AIRBORNE ASBESTOS FIBER CONCENTRATIONS - and TABLE
SPRAYING OF HIGH PERFORMANCE INDUSTRIAL COATINGS

Sample Designation	Commercial Application	Date	Binder	Approximate Wt. % Asbestos (1)	Spray Gun Type	Operation	Sample Time (Min.)	Airborne Asbestos Concentration (Fibers/cc
A. Filled Epoxy								75μ)
K-3	Ship coating.	10/2/74	Epoxy primer	1.5	Airless	Operator spraying outside & under a ship.	33	0.2
K-10	"	"	"	1.5	"	"	8	0.2
M Epoxy - Coal Tar								
M-45	Coating dry dock	10/1/74	Epoxy, Coal-tar, solvent	1	Airless	Operator spraying side of dry dock from suspended platform.	11	0.2
M-1	"	"	"	1	"	Operator spraying side of dry dock from fixed scaffold.	38	0
K-3	Coating pipe interiors.	"	"	1	Air-supported wand.	Operator spraying interior of 3", 6" and 12" diameter pipe.	37	0.1
B Chemical-Resistant Polyester								
J-21	Fiber-glass pipe manufacture. (Mandrel coating)	8/13/74	Chemical resistant resin.	1.4	Airless	Operator adjacent to automatic spray machine coating 28' mandrels.	23	0.1
M-26	"	"	"	1.4	"	Operator wiping mandrels. In area near spraying.	14	0.4
J-5	Below water line ship coating	10/3/74	"	0.7	Air-supported wand.	Roll-out tank. In spray area about 1/4 of time.	65	0.4
J-7	" "		"	0.7	"	Operator spray: the ship hull in drydock.	41	0.4
M-28	" "			0.7	"	" "	23	0.0
C. Vinyl and Alkyd Resins								
M-7	Painting building exterior.	10/6/74	Alkyd resin.	6%	Airless gun.	Operator spraying building exterior wall.	9	0
M-35	"	"	"	6%	"	"	5	0.0
J-11	Painting building interior.	3/8/77	Vinyl (acrylic) resin.	1.1	Airless gun.	Operator spraying interior walls.	23	0.030.0
J-7	"	"	"	1.1	"	"	23	0.06 0.0
J-87	Painting building exterior.	"	"	1.1	"	Operator spraying exterior walls.	16	0.00 0.00
F-48	"	"	"	1.1	"	"	16	0.0 0.0
D. Latex Based (Maintenance)								
M-5	Wall and Roof Spray.	10/4/74	Vinyl latex	3.7	Air supported.	Operator spraying vertical wall panel.	15	0.0
J-3	"	"	"	2.8	"	"	12	0.2
M-43	Roof Spray.	9/30/74	Acrylic latex.	0.7	Airless	Operator spraying downward onto a large roof.	28	0.0
M-49	"	"	"	0.7	"	"	14	0.0

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(1) Based on total formulation as sprayed.

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TABLE XI

AIRBORNE ASBESTOS FIBER COUNTS - SPRAYING OF LAMINATING RESIN

Sample Designation	Commercial Application	Date	Binder	Approximate Wt. % Asbestos (1)	Spray Gun Type	Operation	Sample Time (Min.)	Airborne Asbestos Concentration (Fibers/cc >5μ)
69	Boat Manufacture	12/7/72	General pupose polyester resin	0.5	Air-supported chopper	Operator spraying resin and chopped fiberglass.	24	0.6
L-13	Boat Manufacture	10/31/74	General purpose polyester resin	0.5	Air-supported chopper	Operator spraying resin and chopped fiberglass.	16	0.1
N-28	" "	"	"	"	"	"	5	0.4
N-30	" "	"	"	"	"	"	4	0.4
N-34	Boat Manufacture	10/8/75	General purpose polyester resin	0.5	Airless	Operator-spraying resin only. No fiberglass.	55	0.0
N-40	" "	"	"	"	"	"	53	0.03
I-12	" "	"	"	"	"	"	35	0.1

(1) Based on total formulation as sprayed.

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TABLE 12

AIRBORNE ASBESTOS FIBER COUNTS-

GRINDING AND SANDING OF POLYESTER RESIN-BASED SYSTEMS CONTAINING ASBESTOS

Sample signation	Commercial Application	Date	Asbestos Type	Asbestos Approx. Wt. %	Operation	Sample Time (Min.)	Airborne Asbestos Fiber Concentration (Fibers/cc >5u)
THERMOSET RESIN (Polyester)							
29-82-3	Fabrication of reinforced fiberglass pipe.	2/27/73	RG-144	2-3	Operator pulls pipe along line. Saws off end with circular saw.	19	0.1
29-82-4	"	"	"	2-3	Same operation as 1929-82-3.	49	0.1
29-82-5	"	"	"	2-3	Operator removing end of pipe with scarfing machine.	45	0.04
13	"	8/13/74	RG-244	1.4	Operator shaping end of pipe with bell & spigot machine.	16	0.3
6	"	"	"	1.4	Operator cutting off pipe end and light grinding on exterior surface.	17	0.2
26	Fabrication of FRP tanks and pipe.	8/13/74	RG-244	1.5	Operator grinding inside of 13' I.D. x 26' tank.	16	0.4
8	"	"	"	1.5	Continuation of same operation as 1-26.	5	0.3
39	"	"	"	1.5	Operator grinding edges of miscellaneous small parts.	25	0.3
15	"	"	No Asbestos	0	Operator sanding inside of 26" I.D. x 15 pipe.	4	4.3
12	"	"	"	0	Continuation of same operations as 1-15.	4	2.6
29-84-4	Production of artificial bricks.	3/8/73	RG-244	2.0	Operator cutting with sabre saw.	44	0.1
29-84-5	"	"	"	2.0	Operator trimming with sabre saw.	39	0.2
20	Production of fiberglass boats.	11/26/74	RG-244	0.5	Operator grinding inside of boat hull.	11	0.0
25	"	"	"	0.5	Operator grinding.	4	0.0
VINYL LATEX RESIN							
33	Sanding of vinyl latex paint.	3/8/77		1.1	Operator hand sanding overhead panel.	12	0.3
43	"	"		1.1	"	11	0.06
35	"	"		1.1	Operator hand sanding wall panel.	16	0.18
4	"	"		1.1	"	16	0.0

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