4.8.4.3

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PLAINTIFF'S EXHIBIT
UC-858

AIA NORTH AMERICA
ASBESTOS INFORMATION ASSOCIATION
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18 November 1976

Mr. R. T. Rinaldi
Executive Officer
California Occupational Safety
& Health Standards Board
1006 4th Street
Sacramento, CA 95814

Re: California State Occupational Safety and Health Standards Board Proposal for Changes in Titles 8 and 24 of the California Administrative Code Relating to the Occupational Use of Asbestos.

Dear Mr. Rinaldi:

The attached information provides an estimate of the numbers of workers exposed, the approximate exposure levels in various industries, and the number of work locations where asbestos is used in the state of California. It is based mainly on a national study carried out for the Asbestos Information Association/North America by an independent contractor, Roy F. Weston, Inc. with appropriate factors applied to relate to California. It is intended to supplement the comments on the above noted subject provided by the AIA on October 22, 1976.

If there are any questions, please let us know. A copy of the complete Weston Report is available on request.

Very truly yours,

Harrison B. Rhodes

Harrison B. Rhodes
Chairman, Standards and Technical Committee

HBR:dal
Enclosures

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# An Estimate of Occupational Exposure to Asbestos in the State of California

Submitted in Response

to the California State

Occupational Safety and Health

Standards Board Proposal for

Changes in Titles 8 and 24 of the

California Administrative Code

Relating to the Occupational

Use of Asbestos

18 November 1976

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1974 rev

## SUMMARY

This report provides an estimate of the number of workers in the State of California that may be exposed, at least occasionally, to airborne asbestos fiber concentrations in excess of 1 fiber/cc time-weighted average. The estimate is based on a report prepared for the Asbestos Information Association/North America by an independent consultant, The Roy H. Weston Company, supplemented by published information on the Construction Industry. The California figures were obtained from the national data by ratio and are summarized in the following table:

| | | Work Locations | Exposed Workers[1] |
|---|---|---|---|
| PRIMARY INDUSTRIES (Produce or use raw asbestos fiber.) | | 16 | 2,014 |
| SECONDARY INDUSTRIES (Use asbestos-containing products manufactured by primary industries.) | Except Construction | 19,840 | 91,200 |
| | Construction | 60,000 | 8,000- 40,000 |
| | | 79,840 | 99,200-131,200 |
| TOTALS (Rounded) | | 80,000 | 100,000-135,000 |
| WORKER AGE DISTRIBUTION | | | |
| Over 40 Years of Age | | - | 43,000- 58,000 |
| Over 45 Years of Age | | - | 34,000- 46,000 |

1. At least occasional exposure to above 1 fiber/cc TWA.

The information presented for the Primary Industries is based on a comprehensive, in-depth survey which included a substantial amount of exposure data. It tended to rely mainly on responses from the larger manufacturers and probably understates both the number of employees and the number of locations.

The Secondary Industries are much more diverse and the information shown had to be estimated from a variety of published sources supplemented by limited survey input. There was a reasonable amount of data on the range of exposures that could occur but very little to define where and how often these levels actually happen in industry. It is important to recognize, therefore, the "... may be exposed, at least occasionally..." qualification that applies to the tabulated figures.

These estimates are provided in good faith as the best information available today to assist the state of California in arriving at a reasonable and realistic occupational asbestos standard. We will be glad to provide more detailed information on the Construction Industry when it becomes available in the first quarter of 1977.

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## INTRODUCTION

The California State Occupational Safety and Health Standards Board is now considering a number of proposed changes in Title 8 of the California Administrative Code covering the occupational use of asbestos and asbestos-containing products. The impact of any changes made will obviously be a direct function of:

1. The number of workers affected.

2. The corresponding levels of exposure.

3. The number of work places affected.

It seemed apparent at the public hearings on this matter held in Los Angeles on October 28, 1976, that the Standards Board had very little factual information available on these three important items. This presentation is intended to provide the relevent data in this area that have been obtained by the Asbestos Information Association/North America (hereinafter the AIA) in connection with the preparation of a response to the current Federal rulemaking on asbestos.

The AIA commissioned an independent contractor, the Roy F. Weston Company, to prepare an in-depth study of the asbestos industry and to assess the technical feasibility and economic impact of changes in the regulations proposed by the Federal government. This study was completed on March 29, 1976, and was on a national basis. It did not include the construction industry which was specifically exempted from the proposed changes. Two studies of the construction industry are now in progress, one by Research Triangle Institute under contract to OSHA and one by Equitable Environmental Health Associates, Inc., who have been engaged by the AIA. Only limited results are available from the latter work since completion is not scheduled until the first quarter of 1977.

The time available does not permit a similar in-depth study of the asbestos industry in the State of California. As an alternative, the pertinent information on the number of workers, number of locations and range of exposure levels has been abstracted on a national basis from the Weston Report. The information available on the Construction Industry, which unfortunately uses approximately 70% of all of the asbestos products manufactured, is not nearly as complete. The number of workers and a rough approximation of the number of work locations have been estimated from the 1972 Census of Construction figures. These have been supplemented by some general observations on exposure levels based on quite limited published data. Finally, the corresponding numbers for the State of California will be estimated from national figures for the United States data by ratio, i.e. the number of manufacturing workers in California divided by the total number of manufacturing workers in the United States.

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This approach is equivalent to the assumption that the distribution of the types of plants using asbestos in California is the same as the national average. While this is obviously not rigorously correct for all segments of the industry, California is a large state with a wide diversity of industry that employs nearly 10% of the work force in the United States. It is our judgement that deviations in detail will average out sufficiently to give a reasonably accurate overall picture. It is, in reality, the overall picture that is most important in assessing the broad impact of various regulatory alternatives.

## METHODOLOGY AND ARRANGEMENT OF PRESENTATION

In order to facilitate the study of the very complex asbestos industry and to provide a workable format to present results, the Weston Company divided the industry into three segments in the manner described below:

"Industry Structure

Asbestos is a widely used inorganic fiber whose properties make it particularly well suited to many applications requiring strength, chemical inertness, mold and mildew resistance, and non-flammability.

Many asbestos products pass through several manufacturing and fabrication steps before they reach the consumer. It is logical to expect different exposure levels and control technologies at different steps in the manufacture of any particular product; Weston, therefore, classified the asbestos products industry into three groups:

- Primary Industries: those industries that start the manufacturing process with raw asbestos fiber and modify the fiber to produce an intermediate product (to be further processed or fabricated) or a finished product.

- Secondary Industries: those industries that continue the manufacturing process with an intermediate asbestos product (one in which the fiber has previously been modified in a primary industry), and further process, modify, or fabricate it to produce either another intermediate product (to be further processed or fabricated) or a finished product.

- Consumer Industries: those industries that purchase a finished asbestos-containing product (from a primary or secondary industry), and apply, install, erect, or consume the asbestos-containing product without further physical modification of the product."(1)

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1. Technical Feasibility and Economic Impact of OSHA Proposed Revision to the Asbestos Standard. Roy F. Weston, Environmental Consultants - Designers 29 March 1976.

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The data for the United States has been assembled for each of these three categories and a summary table is provided for each category. The more detailed tabular data from the Weston Report which serves as the basis for these summaries has been assembled for reference in an Appendix section. The summary tables serve as the basis for the estimation of the corresponding employment and exposure figures for the State of California.

## ASBESTOS EXPOSURE - UNITED STATES

### Primary Industries

An overall summary of the quantities of asbestos used and the number of manufacturing locations for the various segments of the primary asbestos industry in the United States is shown in Table 2-1 (see appendix).(2) The figures are based on detailed information supplied by 58% of the industry and account for a usage of about 900,000 tons at 108 manufacturing locations. The miscellaneous category includes, among other things, the manufacture of tape-joint compounds, the distribution of raw asbestos to smaller users, and the use of asbestos in the drilling of oil wells.

For the primary industries a two-part approach was used to assess employee exposure. The number of manufacturing workers in each industry segment together with the frequency of entry or time spent in the work area was determined. A detailed study of the range of exposure for each process step in each industry segment was also carried out. The combination of these two sets of results provides a reasonable estimate of the number of employees involved and the approximate range of potential exposure levels.

The type of worker exposure was divided by Weston into four groups based on frequency in the work environment as shown below:

"The categories of exposure are defined as follows:

1. Continually in Work Environment: those whose normal work station is at a location involving asbestos exposure (production employees).

2. Frequently in Work Environment: those who enter an area of asbestos exposure on a daily basis, but who are not continuously assigned to such a location (maintenance personnel, foremen, supervisors).

3. Occasionally in Work Environment: those exposed to asbestos fiber, but who enter the work area on a less than daily basis (engineers, plant management, specialty maintenance personnel).

4. Never or Very Infrequently in the Work Environment: those employed at the plant, but not in a production area (secretaries, clerks, guards)." (3)

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2. Ibid. Page 2-11
3. Ibid. Page 3-5

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" Employment and exposure levels are presented in Table 3-1. The numbers of employees surveyed were taken directly from the questionnaires, and projected employment levels were based on the segment coverage figures in Table 2-1. Total projected employment in the primary asbestos industries is estimated to be 37,500, which is approximately 0.2 percent of the overall manufacturing work force. Very likely, this estimate is low, because in this survey a higher proportional response was received from larger plants. Small plants tend to be more labor-intensive; larger plants are likely to be more capital-intensive and more efficient. Projected figures, therefore, were based on large facilities and may tend to underestimate total industry employment. (Emphasis added.)

Also, 37,500 represents employment at the plant level, and does (not) generally include corporate staff such as management, administrative, research, engineering, and sales personnel.

The Miscellaneous segment was omitted, because it tended to misrepresent true exposure levels in those plants handling the bulk of asbestos tonnage. Employees in the Miscellaneous segment do not make asbestos products similar to other Primary Industry segments; but, generally use small quantities of asbestos fiber to make an end-product more typical of secondary industries. In most of these plants, a relatively small number of employees handle asbestos; for example, in one plant only 5 of 1,140 employees handle asbestos. Including such a plant in Table 3-1 would tend to indicate a generally lower level of exposure than actually occurs." (4)

" Data provided by industry indicated 66.0 percent of plant personnel exposed on a regular basis (Categories 1, 2, 3), or 24,750 employees. It is our opinion that this estimate is low; it is unlikely that 34.0 percent of employees at the plant level do not enter the work area on a regular basis. We believe that many responding to the questionnaire equated the four categories of exposure with levels of exposure (i.e., TWA fiber count), and, indeed several respondents indicated such. The proposed standard affects all those who are exposed to any levels, even if on an intermittent or non-routine basis. For instance, a clerk may spend virtually all his time in an office, except for fifteen minutes on Friday afternoons, when he delivers the payroll. This employee falls into Category 3, and is affected by certain parts of the proposed standard." (5)

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4. Ibid. Pages 3-2, 3-4.
5. Ibid. Page 3-5.

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Regardless of these reservations by Weston that both the total number and the percentage of workers exposed figures are too low, the sum of categories 1, 2 and 3 will be used as the basis for the California estimates. The other part of the picture, i.e. the levels of asbestos to which these workers may be exposed in the various primary industries are shown in detail by process step in Weston Tables 4-1 through 4-9 (see appendix).(6) Weston's comments on these tables follows:

> "Ranges and
> Typical Data Value Statements
>
> The data reported to Weston on the industry questionnaires, as well as the data from plant visits and telephone contacts, were in the form of ranges of exposure levels or in the form of a single value that represented multiple data points. All data were assumed to be representative of employee exposures under normal production conditions for the processing steps involved. In several instances, however, the data range was extremely broad, indicating questionable sampling or counting procedures, or the inclusion of data collected during the non-routine operations. When such data anomalies were evident, Weston discarded those few anomalous data which appeared questionable. The resultant values are indicated for the segment and for each process step as: "range of fiber count with existing control technology, fibers/cc".
>
> The range of fiber count with existing control technology is further simplified by condensing the range into a single or "typical" value for each processing step. Where sufficient data exist, the typical value is approximated by the average of data points. In some instances, available data were insufficient for calculation of a meaningful average; in such a case, Weston selected a value which, in our judgement, would represent the "typical" value. The resultant values are indicated for the segment and for each process step as: "typical fiber count with existing control technology, fibers/cc". (7)

The overall results for the primary industries needed for the present analysis have been collected in Table A, immediately following. For each industry segment the tons of asbestos used and the number of company locations (Table 2-1), the number of exposed employees (Table 3-1), and the range of TWA levels (Tables 4-1 through 4-9) are shown. The exposure levels are for the overall range for all process steps for each industry segment. This table serves as the basis for the estimation of the primary industries in California.

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6. Ibid. Pages 4-11, 4-23, 4-34, 4-42, 4-50, 4-58, 4-68, 4-76, 4-86.
7. Ibid. Page 3-6

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TABLE A

U.S.A. - PRIMARY ASBESTOS INDUSTRIES
COMPOSITE SUMMARY OF LOCATIONS, EMPLOYEES, AND EXPOSURE LEVELS

| Industry Segment | % of U.S.[1] Asbestos Usage | Tons[1] Consumed | Plants[1] Covered by Survey | Number[2] of Employees in Working Environment | Number of Employees[3] Never or Very Infrequently in Working Environment | Total[3] Employees | TWA Fiber Count Range with[6] Existing Control Technology: Typical Fibers/cc >5μ | TWA Fiber Count Range with[6] Existing Control Technology: Range Fibers/cc >5μ |
|---|---|---|---|---|---|---|---|---|
| Asbestos Paper | 38.0 | 342,000 | 17 | 1,919 | 2,536 | 4,455 | 0.8 - 1.9 | 0.1 - 2.8 |
| Asbestos Cement Pipe | 16.0 | 144,000 | 13 | 2,116 | 253 | 2,369 | 0.5 - 2.2 | 0.3 - 4.5 |
| Floor Tile | 12.5 | 112,500 | 9 | 4,618 | 2,041 | 6,659 | 0.5 - 1.8 | 0.3 - 4.3 |
| Friction Products | 6.5 | 58,500 | 13 | 6,594 | 710 | 7,304 | 1.0 - 3.3 | 0.2 - 22 |
| Paints, Coatings, & Sealants | 7.5 | 67,500 | 26 | 1,143 | 1,887 | 3,030 | 1.0 - 2.5 | 0.3 - 8.0 |
| Asbestos Cement Sheets | 6.0 | 54,000 | 8 | 794 | 456 | 1,250 | 1.0 - 3.0 | 0.3 - 8.7 |
| Gaskets and Packing | 3.0 | 27,000 | 7 | 1,269 | 4,893 | 6,162 | 0.5 - 2.0 | 1.0 - 2.5 |
| Asbestos Reinforced Plastics | 2.0 | 18,000 | 5 | 1,146 | 1,424 | 2,570 | 0.8 - 2.0 | 0.2 - 3.0 |
| Asbestos Textiles | 1.5 | 13,500 | 5 | 3,071 | 669 | 3,740 | 1.0 - 4.0 | 0.3-10[4] or 2-15[5] |
| TOTALS | 93.0 | 837,000 | 103 | 22,670 | 14,869 | 37,539 | | |

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1. From Table 2-1.
2. From Table 3-1 (1st 3 columns).
3. From Table 3-1. Does not include corporate staff such as administration, research, engineering and sales.
4. Damp process.
5. Dry process.
6. For each Industry segment from Tables 4-1 through 4-9.

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Secondary Industries

The secondary industries encompass those applications that continue the manufacturing process with an intermediate asbestos product and further process, modify, or fabricate it to produce either another intermediate product or a finished product. These industries proved to be very diverse and difficult to characterize with a comprehensive set of statistics. Weston found it necessary to combine data collected from a variety of industry and trade associations, the Census of Manufactures, other government publications, and Dun and Bradstreet with their professional experience to estimate the numbers of employees and workplaces involved. The overall approach shown below was used:

1. The tonnages of the various categories of product, i.e. asbestos paper, floor tile, etc., that were used or further processed by the secondary industries were estimated. In some cases these tonnages were less than the total manufactured by the primary industries because some portion of the products are used directly by the consumer industries.

2. The number of employees in the secondary industries that handle asbestos products was estimated as 240,000 in production and maintenance and 60,000 in administration and management for a total of 300,000. This did not include employees in the brake installation and repair industry which were considered separately and the construction industry which was not covered at all.

3. The 300,000 employees were allocated to the respective product categories in proportion to the amount (tonnage) of asbestos contained in the products in that category used by the secondary industries.

4. The number of establishments was estimated on the assumption of an average of 25 employees per establishment to yield a total of 300,000/25 or 12,000 establishments. These were not allocated by industry segment.

5. Comprehensive employment data for the brake repair industry was obtained from information supplied by the Automotive Parts Rebuilders Association, the 1973 Service Job Analysis Report (Hunter Publishing Co.) and numerous corporations involved with brake repair shops. These data are summarized in Table 5-2(8).

The fiber count data for the products covered are described by the following excerpt from the Weston report:

8. Ibid. Page 5-11.

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## " Existing Fiber Counts

The variety of processing and control techniques employed by the secondary industries and of the raw materials arising from all of the primary industry segments makes the definition of a general range of asbestos exposures meaningless. The data which Weston has acquired indicate a categorization of the secondary industries by raw materials received from the primary industry suppliers. The secondary industries are segmented according to the categories presented for the asbestos primary industries: asbestos paper; asbestos cement pipe; floor tile; friction products; paints, coating and sealants; asbestos cement sheet; gaskets and packing; asbestos-reinforced plastics; and asbestos textiles. Table 5-1 illustrates general ranges of fiber counts in these industries.

- Asbestos paper products are used to produce gasket materials, thermal and electrical insulation, roofing products, etc. Secondary segment products are characterized by slitting, sawing, punching, pressing, converting, and laminating operations. The range of fiber exposure is 1.0 to 3.5 fibers/cc TWA.

- Asbestos cement pipe is manufactured and machined in the primary industries almost exclusively. The next step for this product is the construction (or plant maintenance) industry for installation. This segment's products, when used by the construction industry, are not subject to OSHA's proposed standard.

- Floor tile is manufactured, cut, and packaged for shipment by the primary industries. The next step for this product is either the construction industry (including builders and remodelers), or homeowners use for installation. Therefore, this segment's products (when used by the construction industry or homeowners) are not subject to OSHA's proposed standard.

- Paints, coatings, and sealants are similar to asbestos cement pipe and floor tile; that is, they are used by the construction industry and home remodeling markets. Thus, this segment's products, when used by the construction industry or homeowners, are not subject to OSHA's proposed standard.

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- Friction products are used to manufacture brake and transmission assemblies for the automotive, truck, heavy machinery, and railroad industries. A wide variety of motion-controlling applications are dependent upon industrial friction components. These secondaries receive the friction products from the primaries and form them into a product which requires drilling, sawing, tapping, grinding, and cutting of the friction products to conform to the product specifications. The range of fiber exposure is 2.5 to 6.5 fibers/cc TWA.

- Asbestos cement sheets are used widely by the secondary industries for molten metal and glass supports and troughs, thermal insulation, building materials, etc. All operations require some machining -- punching, pressing, sawing, drilling, sanding, etc. -- which generates substantial amounts of asbestos-laden dust. The range of fiber exposures is 1.0 to 6.0 fibers/cc TWA.

- Gaskets and packings are used as fluid seals in a variety of devices. They may be impregnated with polymers, latex, and other materials to yield special properties. Gaskets and packings which have been treated with chemicals to further bind the asbestos fibers release less dust than unbound materials when undergoing additional processes such as pressing, punching, and slitting. For gaskets and packings which are received from a primary industry without a binder or as a yarn for making packings in the secondary segment, the range of fiber exposure is 1.0 - 5.0 fibers/cc TWA. Similarly, for those products which had been combined with a binder or impregnated in the primary industry, the range of fiber exposure is 0.2 to 1.5 fibers/cc TWA.

- Asbestos-reinforced plastics are used to make electrical switchboards and a wide variety of molded plastic products requiring a high strength-to-weight ratio. Secondary industries cut, drill, mill, and grind these materials according to product needs. The range of asbestos exposure is 0.5 to 2.0 fibers/cc TWA.

- Asbestos textiles are processed into packing materials, friction products, insulation, and protective clothing by the secondary industries. The textile product as received by the secondary may be bound with a resin which supresses dust evolution in the secondary processing; however, a portion of textile material is received as raw fabric. The secondary industries employ processes such as cutting, stamping, slitting, sawing, braiding, laminating, and sewing according to the specifications of the product. The range of asbestos exposure is 0.5 to 5.0 fibers/cc TWA." (9)

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9. Ibid. Pages 5-4, 5-6, 5-7.


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The foregoing information on the Secondary Industries has been summarized in Table B. This table includes the tonnages of the various categories of asbestos-containing products processed by these industries, the estimated employment (production and total), the estimated total number of employment locations, and the range of TWA fiber levels reported. All of these figures come directly from the Weston Report except the exposure levels in the brake installation and repair industry. The Weston figures for friction materials apply mainly to manufacturing locations where the operations are carried out continuously. In repair shops the operations are intermittant, so TWA values should be considerably lower and are estimated to fall in the range shown. The lower end of the range represents the fairly rare shop where good controls and industrial hygiene practices are in effect while the higher end is more representative of present typical job shop conditions.

It is important to point out that Table B does not include the Construction Industry. This is a critical ingredient in the analysis of occupational asbestos exposure since this industry is the final consumer of about 70% of the asbestos-containing products manufactured in this country. In reality, it is difficult to find a job site of any appreciable size that is not likely to contain asbestos in some shape or form. The number of workers with potential exposure to asbestos may thus be nearly as large as the total of the construction workers shown in the following table from the 1972 Census of Construction Industries published by the United States Department of Commerce.

| | No. of Establishments | Construction Workers | All Employees |
|---|---|---|---|
| Construction Industries (Total) | 430,027 | 3,464,203 | 4,083,465 |
| Special Trade Contractors (Only) | 268,982 | 1,817,126 | 2,106,599 |

Although the definitive studies of this industry will not be available for several months, it seems important that the California Standards Board be aware of the size and nature of this industry and at least of the order of magnitude of the compliance problems it may present. A brief description of the AIA's best estimate of the current exposure situation in this industry is, therefore, provided here.

Much of the present awareness of asbestos health hazards originated from the use of dry asbestos mixed with water as sprayed building insulation and from formed asbestos shapes used to insulate pipes and equipment. These practices have been discontinued for some years. While the insulation already installed is a concern for certain demolition and repair operations, these products are not now a source of exposure for the great majority of the construction workers.

Today the asbestos that is delivered to the construction site is generally either bound or encapsulated or, if dry, has been diluted to a very low level by other ingredients in the product. The rate of fiber release from such products during use will depend upon the amount of asbestos in the product, the nature of the binder, and the amount of energy imparted to the product to break fibers loose. The resulting airborne concentration in the work area will depend on the duration of the operation, the volume and the ventilation of the area into which the fiber is released. Each product used can thus give a

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TABLE B

U.S.A. - SECONDARY ASBESTOS INDUSTRIES
COMPOSITE SUMMARY OF LOCATIONS, EMPLOYEES, AND EXPOSURE LEVELS

| Primary Industry Segments | | | Secondary Industries | | | | | |
|---|---|---|---|---|---|---|---|---|
| Industry Segment | Annual Tons of Asbestos Used | % of Asbestos Used | Annual Tons of Asbestos Used | % of Asbestos Used | Estimated Employment[4] Production | Estimated Employment[4] Total | Estimated No. of Locations[7] | Range of Reported TWA Fiber Levels (Fibers/cc >5μ) |
| Asbestos Paper | 342,000 | 38.0 | 342,000 | 66.0 | 158,400 | 198,000 | - | 1.0 - 3.5 |
| Asbestos Cement Pipe | 144,000 | 16.0 | - | - | - | - | - | Not applicable [8] |
| Floor Tile | 122,500 | 12.5 | - | - | - | - | - | Not applicable [8] |
| Friction Products | 58,500 | 6.5 | 58,500 | 11.5 | 27,600[6]<br>900,000 | 34,500[6]<br>1,970,000[5] | | 2.5 - 6.5<br>0.1 - 2.0[9] |
| Paints, Coatings, & Sealants | 67,500 | 7.5 | - | - | - | - | - | Not applicable [8] |
| Asbestos Cement Sheets | 54,000 | 6.0 | 40,500 | 8.0 | 19,200 | 24,000 | - | 1.0 - 6.0 |
| Gaskets and Packings | 27,000 | 3.0 | 27,000 | 5.0 | 12,000 | 15,000 | - | 0.2 - 5.0 |
| Asbestos Reinforced Plastics | 18,000 | 2.0 | 18,000 | 3.5 | 8,400 | 10,500 | - | 0.5 - 2.0 |
| Asbestos Textiles | 13,500 | 1.5 | 13,500 | 2.5 | 6,000 | 7,500 | - | 0.5 - 5.0 |
| Miscellaneous | 63,000 | 7.0 | 18,000 | 3.5 | 8,400 | 10,500 | - | - |
| TOTALS | 900,000[1] | 100.0 | 517,500[2] | 100.0[3] | 1,140,000 | 2,270,000 | 248,000[7] | |

Footnotes:
1. Based upon Table 2-1.
2. Estimate of tons of asbestos contained in primary industry products which are processed by secondary industries.
3. These percentages were used to allocate the 300,000 workers by industry segment.
4. Approximately 80 percent of total employment is defined as production workers.
5. Brake repair industry. See Table 5-2.
6. Secondary industries in Friction Products segment excluding Brake Service/Repair.
7. Calculated as 25 employees per location plus brake repair.
8. Included under the Construction Industry.
9. Industry estimate.

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wide range of airborne asbestos concentrations depending on where and how it is used. Different products, however, may give quite different concentration ranges.

The levels of exposure that can occur in construction can be illustrated in terms of the various types of products involved. The installation of asbestos-cement sheet when extensive cutting is required probably represents the high end of the range. Values from several fibers per cc to thirty or more fibers per cc have been reported. The sanding of tape-joint compounds, mixing of spray stucco, and the cutting and grinding of reinforced plastics falls in an intermediate range. These operations tend to occur for limited time periods. Although there is some disagreement regarding exposure levels, partially because there are difficult samples to count accurately, TWA values of several tenths of a fiber/cc up to perhaps 3-5 fibers/cc appear to be representative of normal commercial operations. On the low end of the range are products like vinyl asbestos tile, roll flooring, roofing paper, paints, caulks and sealants. With these materials it is generally difficult to demonstrate exposure levels that are significantly different from background.

The asbestos concentrations just described refer to the source, i.e. the immediate vicinity of the operation generating the dust. There will be a decreasing gradation in exposure as the distance from the source increases. Exposure will also be less on days when asbestos is not being used. Qualitatively four "classes" of exposure can be identified.

1. Workers who regularly install asbestos-containing products. There will be almost daily exposure to these workers at different parts of the same construction site or on different sites.

2. Workers who do not themselves use asbestos but who happen to be scheduled to work in the immediate vicinity of the installation of asbestos products during the time they are being installed. This exposure level will be similar to that of the workers using the asbestos but will generally occur for a considerably lesser number of days per year.

3. Workers who pass through the area occasionally while asbestos-containing materials are being used.

4. Workers who are on the site while asbestos is handled but are at distant locations, those who are on the site on other days, or who subsequently pass occasionally through an area where asbestos has been used.

This rather orderly progression is complicated by the fact that more than one asbestos-containing product is often used on the same site and that, during clean-up, short but possibly fairly high exposures can occur to whoever happens to be in the vicinity. The difficulty in accurately characterizing exposure in the construction industry is obvious. The numbers of construction workers potentially exposed that was given previously can, however, be combined with the approximate exposure levels and exposure patterns just described to make a rough estimate of the exposure situation in the construction industry. If the criteria of "exposure" is defined as exposure to even a single fiber as would be

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the case for a strict interpretation of the present federal regulations, virtually all of the 3,464,203 construction workers would be covered and would need at least an annual physical examination. It does not alter the situation particularly to change the interpretation to include only exposures that are above the background level because the analytical procedures are very inaccurate at such low levels. The distinction cannot be made with any degree of reliability.

Changing the criterion to cover only an exposure of a 1 fiber/cc TWA for even a single day out of the year would obviously make a sharp reduction in the number involved. A range of 500,000-2,000,000 workers is estimated for this definition of exposure. A further change to a requirement of regular exposure to a 1 fiber/cc TWA would tend to limit the coverage to the portion of the Special Trade Contractors who work with the asbestos-containing materials plus employees of other contractors who are regularly assigned to work in the same areas. A range of 100,000 to 500,000 workers is estimated to be covered by this much more limited criterion.

The number of work locations is also obviously large and difficult to determine accurately. The Census reference cited defines a "construction establishment" as "...a relatively permanent office or place of business at which or from which the usual business activities related to construction are conducted". Note that it is the business office not the construction site. If each establishment did business on only two jobs per year almost 900,000 job sites would result. There are over a million housing starts annually most of which use some kind of asbestos containing product. The figure of a million and a quarter working locations covered to some extent by the asbestos regulations seems a reasonable and conservative estimate.

For more the restricted exposure criteria of "occasionally above 1 fiber/cc TWA" the number of locations would not drop appreciably since housing sites tend to contain some asbestos and represent a major portion of the work location. Significant exposures can result during clean up here. A figure of 1,000,000 locations is thus estimated for this approximate exposure level. The same situation is largely true for "regular exposure above 1 fiber/cc TWA". Although the number of exposed workers is down considerably the special crafts concerned work at a substantial number of sites each year. Accordingly, a figure of 750,000 sites has been estimated here. The estimates just described have been summarized in Table C.

Consumer Industries

The "Consumer Industries" were defined previously as those industries that purchase a finished asbestos-containing product, and apply, install, erect or consume the asbestos-containing product without further physical modification of the product. Under this definition exposure levels would generally be down in the range that would be difficult to distinguish from background. As might be expected, detailed characterization of these industries was very difficult and Weston relied mainly on the National Input/Output Table and the Census of Manufactures to arrive at the following estimate of workers and locations continuously involved with asbestos-containing products:(10)

| | |
|---|---|
| Employees | 11,800,000 |
| Establishments | 140,000 |

10. Ibid. Page

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TABLE C

PRELIMINARY ESTIMATE-ASBESTOS EXPOSURE
IN THE CONSTRUCTION INDUSTRY IN THE UNITED STATES

| Approximate Exposure Level | Number of Workers | Number of Work Sites |
|---|---|---|
| Any exposure to a single fiber, or Any exposure above background. | 3,500,000+ | 1,250,000 |
| Occasionally above 1 fiber/cc TWA | 500,000-2,000,000 | 1,000,000 |
| Regularly above 1 fiber/cc TWA | 100,000-500,000 | 750,000 |

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ASBESTOS EXPOSURE - CALIFORNIA

The information in Tables A, B, and C has been used to estimate the corresponding exposures for the State of California. This estimate requires two adjustments from the national figures:

1. A ratio for the number of workers in California compared to the total number of workers in the United States.

2. An estimate of the proportion of the workers in the U.S. totals shown where exposure exceeds a time-weighted average of 1 fiber/cc >5μ.

The ratio needed was obtained from the data on manufacturing employment in the 1972 Census of Manufactures shown below. For simplicity a value of 0.08 was selected. This number is in accord with the "10% of the U.S." figure commonly quoted for California.

| | All Employees | Production Workers |
|---|---|---|
| California | 1,546,000 | 1,020,000 |
| United States | 19,029,000 | 13,529,000 |
| Ratio $\frac{(Calif.)}{(U.S.)}$ | 0.081 | 0.075 |

Use 0.08

At their meeting on October 28, 1976, the California Standards Board adopted a 1 fiber/cc >5μ TWA cut-off level for monitoring and medical examinations. No requirement that such exposure should occur for any minimum number of days per year was included so a worker who is exposed to this level for even a single day would be covered.

Examination of Tables A and B indicates that the 1 fiber/cc TWA level could be exceeded in the work area at least occasionally for all of the industries considered. Accordingly, the categories "Number of Workers in Working Environment" from Table A and "Production" employees from Table B have been used as the basis for the California calculations. These categories cover a substantially lower number of workers than the totals in the respective industries and their use is intended to provide a conservative estimate. Since a place of employment must be counted regardless of the number of workers exposed, the total U.S. figures have been used as the calculation basis.

For the Construction Industry, Table C, the exposure levels are less well defined. In view of this uncertainty and in an attempt to avoid overestimating the figures for "Regularly above 1 fiber/cc TWA" will be used as the basis for the California estimate.

The relevant U.S. figures and the corresponding values for California calculated via the 0.08 factor are summarized in Table D. In the Primary Industry group, the U.S. numbers did not include the manufacture of tape joint compounds or the mining and milling of asbestos. California is unique in that it has three asbestos production operations. Approximately five tape joint compound manufacturers in the state use asbestos. Some figures to include these have been added. Weston noted in their report that the survey method

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tended to miss the smaller primary industry operations. It is suspected that the actual number of primary industry locations in the State of California is several times larger than the 16 estimated.

Table D shows quite clearly, however, that the exposures in the primary industries are heavily outweighed by those in the secondary industries, particularly those for brake repairs and construction. Obviously, these numbers could shift widely depending on a better definition of actual exposure levels but they do represent the best estimate that can be supplied at this time. It should also be noted the number of locations for construction exceeds the number of workers exposed because it is characteristic of this industry that a worker is employed at a multiplicity of locations each year.

It should be noted that Table D does not include the Consumer Industry category since exposures here are generally expected to be well below 1 fiber/cc. It is relevant to point out, however, that the Standards Board will be required to promulgate reporting requirements for asbestos in accordance with the Gregorio Bill (S.B. 1678) that was passed during the 1976 legislature session. The definition of "use" in this bill is so broad that, unless the Standards Board decides otherwise, all of the consumer industries would be required to report. Based on the Weston estimate of 140,000 establishments in this category, 11,000 California locations in addition to those shown above would be required to report.

As a final point, California is considering a sputum cytology requirement for workers older than 40-45 years. The Statistical Abstracts of the United States provides the following age distribution for the male U.S. Labor Force.

| Age | % of Labor Force(1) |
|---|---|
| 16-19 | 9.1 |
| 20-24 | 14.2 |
| 25-34 | 24.4 |
| 35-44 | 18.5 |
| 45-54 | 18.3 |
| 55-64 | 12.2 |
| 65 and over | 3.3 |
| | 100.0 |

(1) Based on 57.3 million male workers in 1974.

Based on these percentages and the lowest estimate of 100,000 workers exposed to a 1 fiber/cc TWA level shown in Table D, sputum cytology would encompass 43,000 workers older than 40 or 34,000 workers older than 45. Addition of a requirement of 10 years of exposure would obviously reduce these numbers to some extent. The available exposure data is too limited to make an estimate of this reduction.

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TABLE D

STATE OF CALIFORNIA
ESTIMATE OF EXPOSURE LOCATIONS AND EMPLOYEES EXPOSED(1)

| | UNITED STATES | | CALIFORNIA | |
|---|---|---|---|---|
| | Locations | Exposed Workers | Locations | Exposed Workers |
| PRIMARY INDUSTRIES(2) | 103 | 22,670 | 8<br>3 Mines(2)<br>5 TJC Mfg.(2)<br>16 | 1814<br>150<br>50<br>2014 |
| SECONDARY INDUSTRIES | | | | |
| Except Construction | 248,000 | 1,140,000 | 19,840 | 91,200 |
| Construction(3) | 750,000 | 100,000-500,000 | 60,000 | 8,000-40,000 |
| Subtotals | 998,000 | 1,240,000-1,640,000 | 79,840 | 99,200-131,200 |
| OVERALL TOTALS (ROUNDED) | 1,000,000 | 1,300,000-1,600,000 | 80,000 | 100,000-135,000 |

1. Includes only those workers where there is a reasonable possibility that exposures will exceed 1 fiber/cc TWA.
2. U.S. numbers do not include the "Miscellaneous" Industry Segment category. Additional figures shown are specific for California.
3. Based on estimate for regular exposure to 1 fiber/cc or more.

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# APPENDIX

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Table 2-1

Asbestos Fiber Usage and Percent of Coverage
of Each Industry Segment

| | Industry Segment | % of U.S. Asbestos Usage | Tons Consumed | Tons Represented by Survey | % of Coverage | Companies Responding to Survey | Plants Covered by Survey |
|---|---|---|---|---|---|---|---|
| 1 | Asbestos Paper | 38.0 | 342,000 | 182,000 | 53 | 12 | 17 |
| 2 | Asbestos Cement Pipe | 16.0 | 144,000 | 144,000 | 100 | 4 | 13 |
| 3 | Floor Tile | 12.5 | 112,500 | 43,400 | 39 | 5 | 9 |
| 4 | Friction Products | 6.5 | 58,500 | 35,100 | 60 | 12 | 13 |
| 5 | Paints, Coatings and Sealants | 7.5 | 67,500 | 20,500 | 30 | 16 | 26 |
| 6 | Asbestos Cement Sheet | 6.0 | 54,000 | 48,000 | 89 | 6 | 8 |
| 7 | Gaskets and Packing | 3.0 | 27,000 | 11,000 | 41 | 7 | 7 |
| 8 | Asbestos-Reinforced Plastics | 2.0 | 18,000 | 9,900 | 55 | 5 | 5 |
| 9 | Asbestos Textiles | 1.5 | 13,500 | 12,900 | 96 | 3 | 5 |
| 10 | Miscellaneous | 7.0 | 63,000 | 20,000 | 32 | 4 | 5 |
| | Total | 100.0 | 900,000 | 526,800 | 58 | | 108 |



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Table 3-1

Number of Employees at Various Exposure Levels
Primary Asbestos Industries

| Industry Segment | Continually in the Work Environment | | Frequently in the Work Environment | | Occasionally in the Work Environment | | Never or Only Very Infrequently in the Work Environment | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surveyed | Total in Segment | Surveyed | Total in Segment | Surveyed | Total in Segment | Surveyed | Total in Segment | Surveyed | Total in Segment |
| 1. Asbestos Paper | 608 | 1,147 | 285 | 538 | 124 | 234 | 1,344 | 2,536 | 2,361 | 4,455 |
| 2. Asbestos Cement Pipe | 1,643 | 1,643 | 350 | 350 | 123 | 123 | 253 | 253 | 2,369 | 2,369 |
| 3. Floor Tile | 1,137 | 2,915 | 269 | 759 | 368 | 944 | 796 | 2,041 | 2,570 | 6,659 |
| 4. Friction Products | 2,937 | 4,895 | 607 | 1,012 | 412 | 687 | 426 | 710 | 4,382 | 7,304 |
| 5. Paints, Coatings and Sealants | 106 | 353 | 130 | 433 | 107 | 357 | 566 | 1,887 | 909 | 3,030 |
| 6. Asbestos Cement Sheet | 550 | 618 | 117 | 131 | 40 | 45 | 406 | 456 | 1,113 | 1,250 |
| 7. Gaskets & Packings | 259 | 632 | 120 | 293 | 141 | 344 | 2,006 | 4,893 | 2,526 | 6,162 |
| 8. Asbestos-Reinforced Plastics | 467 | 849 | 112 | 204 | 51 | 93 | 783 | 1,424 | 1,413 | 2,570 |
| 9. Asbestos Textiles | 2,296 | 2,392 | 329 | 343 | 323 | 336 | 642 | 669 | 3,590 | 3,740 |
| TOTALS | 10,003 | 15,444 | 2,319 | 4,063 | 1,689 | 3,163 | 7,222 | 14,869 | 21,233 | 37,539 |
| Percent By Exposed Category | ~~47.1~~ | | ~~10.9~~ | | 8.0 | | 34.0 | | ~~100.0~~ | |
| Corrected | 41.14 | | 10.82 | | 8.43 | | 39.61 | | 100.00 | |



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Table 4-1

Time-Weighted Average Fiber Counts
Asbestos Paper

| | Process Step | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 1.9 | 0.3 - 2.8 |
| 3 | Stock Preparation | 1.2 | 0.1 - 2.7 |
| 4 | Papermaking | 0.75 | 0.25 - 1.0 |
| 5 | Dryer | 0.75 | 0.5 - 1.5 |
| 6 | Slit and Calendering | 1.0 | 0.1 - 1.6 |
| 7 | Rewind | 1.0 | 0.5 - 1.5 |

Data Base: Data collected from plants consuming 182,000 tons of asbestos annually, or 53 percent of the Asbestos Paper Segment.

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Table 4-2

Time-Weighted Average Fiber Counts
Asbestos Cement Pipe

| | Process Step | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Fiber Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 1.5 | 0.5 - 3.5 |
| 3 | Dry Mix | 1.8 | 0.8 - 3.0 |
| 4 | Wet Mix | 1.2 | 0.8 - 3.0 |
| 5 | Pipe Formation | 0.75 | 0.5 - 1.1 |
| 6 | Cure | 0.5 | - |
| 7 | Finishing (Lathes) | 2.0 | 0.6 - 4.5 |
| 8 | Coupling Cutoff & Machining | 1.75 | 1.0 - 2.25 |
| 9 | Fittings & Specialties | 1.9 | 1.5 - 2.1 |
| 10 | Rework Saw & Crushing | 2.2 | 2.0 - 2.9 |

Data Base: Data collected from plants consuming 144,000 tons of asbestos annually, or 100 percent of the Asbestos Cement Pipe Segment

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Table 4-3

Time-Weighted Average Fiber Counts
Floor Tile

| | Process Step | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 1.5 | 0.9 - 4.3 |
| 3 | Blending | 1.75 | 0.9 - 4.3 |
| 4 | Banbury Mixer | 1.5 | 0.8 - 4.3 |
| 5 | Milling | 0.75 | - |
| 6 | Calendering | 0.75 | - |
| 7 | Embossing | 0.75 | - |
| 8 | Cutting | 0.75 | - |
| 9 | Inspection | 0.75 | - |
| 10 | Packing | 0.5 | - |
| 11 | Scrap & Rework | 0.5 | - |

Data Base: Data collected from plants consuming 43,400 tons of asbestos annually, or 39 percent of the Floor Tile Segment.

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Table 4-4

Time-Weighted Average Fiber Counts
Friction Products

| | Process Step | Fiber Count With Existing Control Technology | |
|---|---|---|---|
| | | Typical fibers/cc | Range fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25-2.5 |
| 2 | Fiber Introduction & Storage | 2.5 | 0.4 -4.6 |
| 3 | Mixing | 2.3 | 0.2 -8.0 |
| 4 | Forming or Rolling | 3.3 | 0.5 - 22.0 |
| 5 | Curing | 1.5 | 0.5 -3.5 |
| 6 | Finishing | 2.0 | 0.6 -7.4 |
| 7 | Adjustment & Printing | 1.0 | 0.7 -1.0 |
| 8 | Inspection | 2.0 | 0.1 -15.0 |
| 9 | Packaging | 1.5 | 1.0 -2.0 |

Data Base: Data collected from plants consuming 35,100 tons of asbestos, or 60 percent of the Friction Products Segment.

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Table 4-5

Time-Weighted Average Fiber Counts
Paints, Coatings, and Sealants

| | Process Step | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 2.5 | 1.5 - 8.0 |
| 3 | Mixing Compounding | - | - |
| 4 | Packaging | - | - |

Data Base: Data collected from plants consuming 20,500 tons of asbestos, or 30 percent of the Paints, Coatings, and Sealants Segment.

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Table 4-6

Time-Weighted Average Fiber Counts
Asbestos Cement Sheet

| | Process Step | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 2.3 | 0.3 - 8.7 |
| 3 | Dry Mix | 2.5 | 1.1 - 8.4 |
| 4 | Wet Mix | 1.25 | - |
| 5 | Sheet Formation | 2.0 | 1.6 - 3.5 |
| 6 | Dry/Cure | 1.9 | 1.3 - 2.5 |
| 7 | Cut/Trim | 2.5 | 0.6 - 6.7 |
| 8 | Sand | 3.0 | 0.9 - 8.0 |
| 9 | Finishing & Fabrication | 1.8 | 0.9 - 3.6 |

Data Base: Data collected from plants consuming 48,000 tons of asbestos, or 89 percent of the Asbestos Cement Sheet Segment.

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Table 4-7

Existing Fiber Counts

| Operation | TWA Range Fibers/cc |
|---|---|
| Fiber Introduction | 0.5 - 2.5 |
| Mixing | 0.014 - 1.0 |
| Braiding and Twisting | --- |
| Sheet Formation | --- |
| Cutting | --- |
| Packaging | --- |

For the basic gasket and packing processes, fiber exposure levels in the fiber introduction area are of the most concern. Where mixing is accomplished with a wetted compound, fiber evolution is low. Data for fiber levels in the braiding, sheet formation, cutting, and packaging steps were not received in sufficient quantity to estimate employee exposure since these companies surveyed felt that they are complying with the existing standards and to the 2.0 fibers/cc TWA level for July 1976.

Table 4-8

Time-Weighted Average Fiber Counts
Asbestos-Reinforced Plastics

| Process Step | | Fiber Count with Existing Control Technology | |
|---|---|---|---|
| | | Typical Fibers/cc | Range Fibers/cc |
| 1 | Fiber Receiving & Storage | 1.0 | 0.25 - 2.5 |
| 2 | Fiber Introduction | 2.0 | 0.5 - 3.0 |
| 3 | Dry Blending | 1.0 | 0.2 - 1.5 |
| 4 | Resin Formation | 0.75 | 0.5 - 1.5 |
| 5 | Kneading, Rolling, Etc. | 1.0 | 0.25 - 1.5 |
| 6 | Cure | 0.75 | 0.2 - 1.5 |
| 7 | Finishing | 1.0 | 0.5 - 1.5 |

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Table 4-9

Time-Weighted Average Fiber Counts
Asbestos Textiles

| | Process Step | Fiber Count with Existing Control Technology | | |
|---|---|---|---|---|
| | | Typical Fibers/cc | Damp Fibers/cc | Dry Fibers/cc |
| 1 | Receiving & Storage | 1.0 | 0.25 - 2.5 | |
| 2 | Fiber Introduction | 4.0 | 2.0 - 10.0 | 2.0 - 10.0 |
| 3 | Mixing & Blending | 4.0 | N/A | 2.0 - 10.0 |
| 4 | Carding | 4.0 | N/A | 2.0 - 10.0 |
| 5 | Spinning | 4.0 | 2.0 - 10.0 | 2.0 - 15.0 |
| 6 | Twisting | 4.0 | 4.0 - 10.0 | No Data |
| 7 | Weaving | 3.0 | 1.0 - 4.0 | No Data |
| 8 | Braiding | 3.0 | 2.0 - 5.0 | No Data |

(1) Data are estimates from pilot equipment
N/A - Not Applicable

Data Base: Data collected from Conventional Plants Consuming 12,900 tons of asbestos, or 96 percent Asbestos Textile Segment.





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TABLE 5-2

ECONOMIC IMPACT FOR BRAKE SERVICE/REPAIR SECTORS - SECONDARY INDUSTRIES

| | Service Stations | Independent Repair Shops | New Car/Truck Dealer Shops | Self-Service Fleet Shops | Totals |
|---|---|---|---|---|---|
| Employee continuously exposed | 340,000 | 190,000 | 145,000 | 225,000 | 900,000 |
| Employee occasionally or infrequently exposed | 325,000 | 470,000 | 140,000 | 135,000 | 1,070,000 |
| Total employees exposed | 665,000 | 660,000 | 285,000 | 360,000 | 1,970,000 |
| Total establishments in U.S. | 194,000 | 108,000 | 39,000 | 21,000 | 362,000 |
| Establishments involved in Brake Service/Repair | 136,000 | 70,000 | 25,000 | 15,000 | 246,000 |



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