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PLAINTIFF'S
EXHIBIT

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The Asbestos Exposure of Insulation Workmen

Extensive information has been developed on the mortality experience of insulation workers. It would, thus, be of considerable value to have quantitative information on the asbestos dust levels to which these workers were exposed. Because of the long lapse period between exposure and clinical appearance of disease, the dust estimates of greatest concern are those of 20, 30, 40 or more years ago.

While historical data are scant and fragmentary, insulation work practices have changed relatively little, prior to 1970, either in the U.S. or abroad. Thus, measurements taken prior to 1970 will also provide data of use in assessing earlier exposure.

United States Data

The only early work of note is the 1945 study of Fleischer and his colleagues¹ who reported asbestos dust levels during insulation application in four U.S. shipyards. In this study, dust levels were assessed using a konimeter (an instrument widely used at the time but no longer employed), and both total

ASBESTOS STANDARD TO BE REVIEWED

On December 7, 1971 an Asbestos Standard was promulgated that prohibited workmen's eight-hour average asbestos exposures to exceed 5 fibers per milliliter (f/ml) of air. A milliliter is about a thimbleful of air and only fibers longer than five microns (about 1/25,000 of an inch) are to be counted. This level is mandated to go to 2 f/ml during June, 1976.

Last year, the U.S. Court of Appeals ordered portions of the current U.S. standard to be reviewed by the Department of Labor. Of interest to insulators, the court specifically stated that in those industries where a dust level of 2 f/ml was feasible, it should be implemented before 1976.

Because of this pending review of the standard, a summary of all research on the asbestos exposure of insulation workers has been prepared for submission to the Dept. of Labor by the Insulation Industry Hygiene Research Program. Because of the importance of achieving a safe U.S. Asbestos Standard and the interest of asbestos workers in this goal, we are publishing the full report in this issue.

dust levels and fiber levels were recorded. This study gains importance in that one of the yards studied by Fleischer was resurveyed during 1965 and 1966 by personnel of the Department of Industrial Hygiene, Harvard School of Public Health^{2,3} and a comparison of levels is possible.

During 1964, additional data were published by Marr⁴ on exposure levels

at the Long Beach Naval Shipyard (Local 20, IAHFIAW). However, detailed numerical data on dust concentrations are only given for particles. If fibers were present, but the count revealed less than 1 million particles per cubic foot (mppcf), they were reported only as a trace. Thus, no average fiber concentrations can be derived from this study. (Continued on page 2)

TABLE I

Shipyard asbestos fiber concentrations by Konimeter count—1945, 1965-66

Yard	A fiber conc. MPPCF f/ml		B fiber conc. MPPCF f/ml		C (1945) fiber conc. MPPCF f/ml		C (1965-66) fiber conc. MPPCF f/ml		D fiber conc. MPPCF f/ml	
	MPPCF	f/ml	MPPCF	f/ml	MPPCF	f/ml	MPPCF	f/ml	MPPCF	f/ml
Shop Activity										
No. of men exposed (1945)	84		50		51		—		8	
Layout and cutting	0.35	12.4	0.23	8.1	2.2	78	1.76	62	0.63	22
Sewing and fabrication	0.03	1.1	0.1	3.5	0.62	22	0.27	9.5	0.03	1.1
General room air	0.08	2.8	0.01	0.4	0.8	28	0.3	10.6	0.02	0.7
The following shop activities were done at infrequent intervals and involved only one or, at most, two men:										
Band saw cutting	0.12	4.2	3.0	106	6.19	218	0.7	24.7	—	—
Mixing cement	0.2	7.0	1.7	60	3.1	109	0.23	8.1	0.01	0.4
Scrap grinding	0.47	16.6	—	—	—	—	—	—	—	—
Aboard Ship										
No. of men exposed (1945)	467		700		123		—		160	
Avg. exposure, all activities	0.02	0.7	2.8	98	1.1	39	0.17	6.0	0.03	1.1
Time-Weighted Average Exposure (All fibers visible)	1.1		90		35				1.1	

IIHRP Results Reported

States during the 1960's, over half of the work activities of these men were with materials other than asbestos. Thus, the over eight-hour time-weighted average asbestos exposure was approximately 3 f/ml.

In the research that led to these data, it was reported that peak exposures could be extremely high. It was not uncommon, for example, for two to five-minute concentrations of asbestos to range between 50 f/ml and 100 f/ml during the mixing of cement. This mixing, however, would consume only a few minutes time and be done perhaps once an hour. Thus, exposures measured over that hour, including the mixing, would seldom average over 5 f/ml.

Peak High, Average Low

Similar experiences were subsequently reported by Cooper⁸ at Lyon who stated that, "Peak concentrations may be high for brief periods, while time-weighted averages are often deceptively low."

In a continuation of the work of the Department of Industrial Hygiene of Harvard University in assessing asbestos exposure in Naval Shipyards, Ferris *et al*⁹ reported on the results obtained by J. Lynch and W. Burgess from 81

shipyard asbestos air samples taken during 1969. Using fiber counting techniques they determined a mean asbestos concentration of 0.3 f/ml in land fabrication shops and 2.9 f/ml in ship-board installation work.

3 f/ml Exposure

Three research programs in the United States point to the conclusion that the time-weighted average exposure of insulators between 1965 and 1969 was *less than 3 fibers longer than five microns per milliliter*.

We have direct information on asbestos fiber concentrations, measured using the currently prescribed analysis procedures, during recent years only. Insulation materials have changed from earlier years. Fibrous glass has found extensive use while work with cork is seldom seen today. Moreover, changes in the asbestos composition of insulation products have taken place. Pipe covering and insulation block may have had twice the asbestos content in past years as exists today.

During this period, however, work practices were virtually identical to those of past years and during the period of those measurements, few controls of significance were in use.

TABLE III

Asbestos concentrations during various work practices

Type of Work	Measured Fiber Concentration (f/ml) (greater than 5 microns)	Percentage of Time Practice Occurs When Asbestos is Used	Column One times Column Two
Mixing and Applying Cement and Cloth Covering to Insulation Material			
Good Ventilation	2.5	17.5	44
Poor Ventilation	4.6	17.5	81
Cutting and Applying Insulation Block or Sections of Pipe Covering			
Good Ventilation	5.2	20	104
Poor Ventilation	11.5	20	230
Pre-Fabrication work including Cutting Materials for later use	7.6	10	76
			535

Time-weighted average = $535/85 = 6.3$ f/ml

The above practices, which occupy 85% of the work time in asbestos insulation work, give rise to a time-weighted average exposure of 6.3 f/ml. As the majority of the other activities of insulation work (supervision, collection of materials, movement and installation of equipment, etc.) are relatively clean, the overall exposure may be lower. (In U.S., sweeping and dusty cleanup are done by members of the Laborers Union.)

In a review of work activities in commercial and industrial construction, it was found that little removal of insulation was conducted and asbestos spray applications were very rarely undertaken by insulators. (Asbestos workers applied spray insulations only to powerhouse turbines.) It is estimated that less than two or three percent of nonmarine insulation work by members of the Asbestos Workers Union is in these continuously dusty operations. Even if average exposures here were 50 f/ml and the men wore no respirators, their overall average exposure would be increased only to 7 f/ml when working with asbestos.

Insulators Still Exposed to Asbestos

While much of new insulation material contains no asbestos, pipe-coverers may still be exposed to high asbestos concentrations during removal and demolition. In such work, safe procedures and personal protective equipment must be used. Thus, obtaining an effective and safe Asbestos Standard remains of paramount importance.

Thus, dust concentrations measured under these conditions have relevance for the estimate of levels of past years.

Considering the possible doubling of asbestos content of insulation materials and considering that workers may have used asbestos materials more often in the past than now, the data from these three studies would suggest that the upper limit on insulators' exposures in the United States during past years would be about 10 f/ml.

British Data

At the Devonport Naval Dockyard in Plymouth, England, extensive measurements of asbestos dust concentrations during the application and removal of insulation aboard ship have been reported by Harries.¹⁰ These are listed in Table 4. During the application of insulation material, fiber concentrations from 2.1 to 22.4 f/ml were found, not unlike those found in U.S. studies.

However, during the removal of pipe and machinery insulation, mean dust concentration in various compartments ranged from 88 to 257 f/ml, and in the removal of sprayed crocidolite asbestos, fiber concentrations ranged from 20 to 500 f/ml, with short-term breathing zone samples showing concentrations exceeding 1000 f/ml. Moreover, the spread of asbestos from the site of removal can be extensive. Concentrations of 30 f/ml were found at hatchway openings to decks from the area of crocidolite stripping.

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High Dust During Ripout

Additionally, short-term fiber concentrations measured during the variety of specific application and removal techniques are reported. High levels, exceeding 200 f/ml, occurred while mixing asbestos cement. The cleaning of debris (155 f/ml) and the sawing (55 f/ml), fitting (43 f/ml), or removing (52 f/ml) of calcium silicate sections also produced high dust concentrations.

A subsequent publication by Harries¹¹ of long-term area sampling in var-