IV. Analyses of Settled Dust and Dust Counts

There are no established figures for permissible or safe dustiness in pipe covering operations. Dreessen et al (4) in their comprehensive study of asbestosis in the asbestos textile industry suggest 5 million particles of total dust as a threshold for that industry. We should like to point out that the asbestos textile and asbestos pipe covering industries differ widely in their hazards of dust exposure. In textile plants workers usually continue at specific jobs with fairly constant dust exposures for some years, whereas the pipe coverer may rotate between shop and ship and from small to large ship compartments with a wide variation in dust exposure.

In contrast to the textile worker, the pipe coverer's materials differ markedly in their asbestos content, ranging from 85% magnesia (10-15% asbestos) to amosite (95% asbestos). When asbestos cements contain large amounts of diatomaceous earth there is a resultant silicosis hazard as indicated above.

In general we feel that dust counts below 5 million particles per cubic foot by Konimeter indicate good dust control.

Our figures in Table 3 were determined by the Konimeter and not with the impinger instrument which is commonly used in studies of silicosis risks. We used the Konimeter because it is light, easily portable and takes records which can be kept indefinitely. As is indicated in Table 4, the dustiest operations are band saw cutting, cement mixing, and installation on board ship.

TABLE 4. COMPARISON OF DUSTINESS OF VARIOUS OPERATIONS IN EACH SHIPYARD

OPERATION	BOSTON		BROOKLYN		FORE RIVER		NEW YORK SHIP.		PORTSMOUTH	
	MPPCF		MPPCF		MPPCF		MPPCF		MPPCF	
	Total Dust	Asbestos Dust	Total Dust	Asbestos Dust	Total Dust	Asbestos Dust	Total Dust	Asbestos Dust	Total Dust	Asbestos Dust
/out and Cutting	6.1	0.36	4.2	0.23	10.5	0.63	20.5	2.18	7.1	2.3
d Saw Cutting	15.1	0.12	38.5	3.0	--		73.0	6.19	13.1	1.1
ing and Fabrication	4.8	0.03	4.8	0.1	6.0	0.03	11.4	0.62	6.4	0.35
ent Mixing	31.0	0.2	84.0	1.7	32.0	0.01	41.3	3.1	--	
nding	50.0	0.47	--		--		--		--	
eral Room	10.0	0.08	2.4	0.01	6.0	0.02	14.2	0.8	2.0	0.14
Shop Average	30.0	0.25	26.9	1.0	7.6	0.23	32.0	2.6	6.9	1.0
Ship Average	142.0	0.02	128.0	2.8	11.0	0.03	48.2	1.1	11.9	0.3

NOTE: MPPCF = Million particles of dust per cubic foot of air.

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TABLE 3. (Sheet 3) ANALYSES OF SETTLED DUST AND AIR SAMPLES

NOTE: MPPCF = Million particles of dust per cubic foot of air.

OPERATION	Percent less than 10 microns by count	Percent less than 10 microns by count	Percent less than 10 microns by count	Percent less than 10 microns by count	Percent less than 10 microns by count	Percent less than 10 microns by count	Percent less than 10 microns by count	Dust Counts (MPPCF)				
	Percent less than 10 microns by count Asbestos (below 200 microns)	Diatomaceous Earth	Serpentine	Other Fibres (Organic & glass)	Iron oxide (Opaque)	Carbonates and oxides	Others	Number of Samples	Total Dust Range of Counts	Total Dust Average	Asbestos Dust Range of Counts	Asbestos Dust Average	Percent Asbestos (Range)
Boiler Room													
Boston								149	0.2 - 24.6	10.0	0 - 1.4	0.08	.02 - 0.3
Brooklyn								2	1.6 - 3.3	2.4	0 - .01	.01	0 - 0.6
Portsmouth								14	0.8 - 2.7	1.9	.00 - .2	.14	0.2 - 7.6
Pore River								5	3.9 - 10.9	6.0	0 - .05	.02	0 - 0.5
New York Ship.								4	9.0 - 21.6	14.2	0.34-1.7	.8	3.8 - 7.9
board Ship													
Boston								30	65 - 280	142	0 - 0.17	0.02	0 - 0.03
oklyn								15	84.4-192.0	128	1.36-5.21	2.8	1.1 - 3.7
Portsmouth								52	5.4 - 27.0	11.9	0-0.7	0.3	0 - 3.7
Pore River								16	8.0 - 22.1	11.0	0 - 0.21	0.03	0 - 1.0
New York Ship.								15	25.3-89.0	49.2	0.23-2.38	1.10	0.5 - 6.8

TABLE 3. (Sheet 2) ANALYSES OF SETTLED DUST AND AIR SAMPLES

OPERATION	Percent less than 10 microns by count	Asbestos (below 200 microns)	Percent less than 10 microns by count: Diatomaceous Earth	Serpentine	Other Fibres (Organic & glass)	Iron Oxide (Opaque)	Carbonates and oxides	Others	Dust Counts (MPPCF): Number of Samples	Total Dust: Range of Counts	Total Dust: Average	Asbestos Dust: Range of Counts	Asbestos Dust: Average	Percent Asbestos (Range)
NOTE: = Million particles st per cubic foot of														
& Prep. of Boots & Jackets														
(Sewing asbestos cloth)	98	12	tr	9	tr	42	21	16	3	3.3-6.9	4.8	0.0-0.4	0.1	0-6.4
(Stuffing with Amosite)	98	8	8	11	tr	38	20	15	1	2.1	2.1	0	0	0
tsmouth	98	6	tr	5	tr	42	26	21	12	2.7-8.2	5.4	.2-.5	.35	6-7
e River	98	6	6	8	tr	38	28	14	5	3.9-10.9	6.0	0 -.05	.03	0-0.5
York Ship.	95	26	6	11	3	28	12	14	2	10.5-12.3	11.4	.45-.79	.62	3.7-7.4
ston									2	3.5-5.1	4.8	.01-.05	0.03	0.3-1.0
room														
tsmouth (Stockroom)	98	10	8	5	tr	31	27	19						
(Issue Room)	98	4	2	6	tr	45	28	15						
er	95	15	8	7	tr	26	32	12						
t Mixing														
ston									16	6.4-90 ≠	31 ≠	0 - 0.52	0.2	0 - 0.7
ooklyn									2	67 - 100 ≠	84 ≠	1.6-1.7	1.7	1.4 - 2.8
re River (On board ship)									5	19.6-40.0	32	0 - .02	.01	0 - .001
w York Ship.									2	33.8-43.7	41.3	1.6 - 4.7	3.1	4.7 - 10.0
ding Scrap Materials														
ston	98	8	20	16	1	10	33	12	15	9.4 - 100 ≠	50 ≠	0 - 1.6	.47	0 - 2.6

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TABLE 3. ANALYSES OF SETTLED DUST AND AIR SAMPLES

NOTE:
MPPCF = Million particles of dust per cubic foot of air.

OPERATION	Percent less than 10 microns by count	Asbestos (below 200 microns)	Percent less than 10 microns by count						Dust Counts (MPPCF)					
										Total Dust		Asbestos Dust		
			Diatomaceous Earth	Serpentine	Other Fibres (Organic & glass)	Iron oxide (Opaque)	Carbonates and oxides	Others	Number of samples	Range of Counts	Average	Range of Counts	Average	Percent Asbestos (Range)
Layout and Cutting														
Boston	96	16	6	12	6	24	26	10	2	3.5 - 8.7	6.1	0.21 - 0.50	0.35	5.7 - 6.
Brooklyn	88	10	8	12	tr	40	18	12	7	1.6 - 6.8	4.2	0.01 - 0.54	0.23	0.6 - 7.
Portsmouth	98	9	tr	9	tr	38	28	16	64	0.8 - 10.7	7.1	0.06 - 1.0	2.3	7.5 - 5
Fore River	95	26	5	8	tr	29	21	10	5	6.5 - 16.5	10.9	0.09 - 1.10	0.53	1.4 - 6.
Same as remarks of table	96	10	42	6	tr	18	14	10						
New York Ship.	95	30	5	10	tr	26	14	16	4	17.1 - 25.2	20.6	1.13 - 4.30	2.18	6.6 - 1
Cutting with Band saw														
Boston									2	11.0 - 19.2	15.1	0.10 - 0.14	0.12	0.7 - 0.
Brooklyn	98	9	7	8	tr	48	16	12	2	32.4 - 46.6	39.5	2.8 - 3.2	3.0	6.8 - 8.
Portsmouth	98	4	5	8	tr	8	61	24	24	1.2 - 30.0	13.1	0 - 2.5	1.1	0 - 4.
New York Ship	98	9	63	2	tr	10	4	12	3	18.2 - 100 ≠	73 ≠	.9 - 12.8	6.19	4.3 - 1
Molding Operations														
New York Ship	98	8	66	3	tr	7	6	10						
Fore River	96	4	9	7	tr	48	10	12						

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V. Medical Findings

The incidence of asbestosis among pipe coverers as determined by chest x-ray is given in Table 5. The relation between years of exposure and percent asbestosis is included in Table 6.

Due to frequent turnover of shipyard workers and the length of time required to x-ray a large number of workers, the number x-rayed may not equal the number of pipe coverers. At New York Ship. x-rays were examined of men who have left the yard while at Brooklyn a few pipe coverers were not x-rayed. At Boston the 48 x-rayed out of 551 were all older men working in the shop.

Some of these pipe coverers have had pre-shipyard experience in the asbestos industry, but the tables are based solely on shipyard exposure. At New York Ship., for example, the Asbestos Shop estimated that about one-third of their pipe coverers had worked with asbestos before coming to the yard.

The one case of advanced asbestosis at New York Ship had worked in the asbestos industry for 23 years before coming to work in the yard. At Fore River the two cases of moderate asbestosis had worked 22 years and 30 years at pipe covering in their yard.

All of the x-ray films used in the above data were first read by roentgenologists of the Medical Department at the Navy Yards, by Dr. Locke at New York Ship., and by Drs. Fred Manley and J. E. Moriarity at Fore River. In addition all of these films were examined by one of the authors (W. E. F.). Dr. W. C. Dreessen, U.S.P.H.S. was kind enough to examine the three positive plates and he agreed on the diagnosis.

Since only three workers out of the 1074 x-rayed had asbestosis, and each of the three had been a pipe coverer for more than 20 years, it would appear that asbestos pipe covering is a relatively safe occupation. However it must be remembered that these men rotated among the various operations of pipe covering and were not continually exposed to high concentrations of asbestos dust as found in band saw cutting and cement mixing. The suggestions made in Section I relative to exhaust ventilation and respiratory protection are therefore of value despite this low incidence of asbestosis.

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TABLE 5. INCIDENCE OF ASBESTOSIS AMONG PIPE COVERERS

SHIPYARD	Number of Pipe Coverers	Number X-rayed	Number of Cases of Asbestosis		
			Minimal	Moderate	Advanced
Boston	551	48	0	0	0
Brooklyn	750	662	0	0	0
Fore River	168	168	0	2	0
New York Ship.	174	196	0	0	1
Totals	1663	1074	0	2	1

NOTE: X-rays from the Portsmouth Navy Yard were not available.

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TABLE 6. RELATIONSHIP BETWEEN LENGTH OF EXPOSURE AND INCIDENCE OF ASBESTOSIS

SHIPYARD		Years in Pipe Covering Industry			
		0 - 2	2 - 5	5 - 10	10 Plus
Boston	(Exposed	24	13	8	3
	(Affected	0	0	0	0
	(Percentage	0%	0%	0%	0%
Brooklyn	(Exposed	225	435	67	22
	(Affected	0	0	0	0
	(Percentage	0%	0%	0%	0%
Fore River	(Exposed	28	118	5	9
	(Affected	0	0	0	2
	(Percentage	0%	0%	0%	22%
New York Ship	(Exposed	0	105	45	17
	(Affected	0	0	0	1
	(Percentage	0%	0%	0%	6%

VI. Summary and Conclusions

1. The data in Tables 3 and 4 indicate that band saw cutting, cement mixing and installation on board ship are the dustiest operations.

2. The above 3 operations should be equipped with exhaust ventilation to keep the total dust concentration low. Such dust control will greatly facilitate good housekeeping in pipe covering operations.

3. The incidence of asbestosis found was low - 0.29% (3 cases out of 1074 x-rayed). Since each of these 3 men had worked at asbestos pipe covering in shipyards for more than 20 years, it may be concluded that such pipe covering is not a dangerous occupation.

4. The excellent exhaust ventilation supplied to the layout and cutting table at Brooklyn decreased markedly the dustiness of this operation.

5. Since water repellent amosite cannot be wetted, exhaust ventilation should be supplied during laying out and cutting of this material.

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