TABLE I

CEMENT PIPE PLANTS
NUMBER OF PLANTS = 7

INDIVIDUAL SAMPLES BY OPERATION AND SAMPLE SIZE

OPERATION	HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND LOWEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	LOWEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT
Warehousing & Mixing	7.0	2	0	5.6	2	0	0.2	3	P	0.2	4	Q
Pipe Forming	3.7	6	0	3.4	3	N	0.1	6	0	0.0	6	AA
Curing	2.6	3	0	2.1	15	BB	0.1	4	Z	0.0	6	P
Pipe Finishing	4.6	10	Z	4.0	5	Q	0.0	6	N	0.0	10	Z
Coupling Finishing	13.4	7	Z	10.5	7	Z	0.0	16	P	0.0	21	AA
Epoxy	4.7	1	N	2.1	6	BB	0.3	5	Z	0.2	6	BB
Packing	6.1	1	Q	2.5	7	Z	0.1	13	AA	0.0	13	AA
Miscellaneous	1.7	9	Z	1.4	9	P	0.1	9	P	0.0	9	Z

1 - All samples expressed as fibers >5μ/cc counted by the standard method recommended in this document. (Latest Available NIOSH Data Collected during the Years 1969 through 1970).

TABLE II

ASBESTOS CEMENT PIPE PLANTS

NUMBER OF PLANTS = 7

MEANS BY OPERATION AND SAMPLE SIZE ( )

OPERATION	HIGHEST	PLANT	SECOND HIGHEST	PLANT	SECOND LOWEST	PLANT	LOWEST	PLANT
Warehousing & Mixing	6.3 (2)	O	2.7 (4)	N	0.7 (5)	AA	0.4 (3)	P
Pipe Forming	2.2 (3)	N	1.8 (4)	Z	0.5 (6)	AA	0.3 (4)	P
Curing	2.0 (3)	O	0.9 (15)	BB	0.4 (4)	Z	0.3 (6)	P
Pipe Finishing	1.7 (10)	Z	1.3 (5)	Q	0.6 (9)	AA	0.5 (6)	N
Coupling Finishing	5.3 (7)	Z	3.8 (4)	O	0.6 (21)	AA	0.5 (16)	P
Epoxy	4.7 (1)	N	1.1 (6)	BB	0.6 (6)	P	0.3 (1)	AA
Packing	6.1 (1)	Q	1.1 (7)	Z	0.7 (6)	BB	0.4 (13)	AA
Miscellaneous	0.5 (9)	Z	0.5 (6)	BB	0.4 (9)	P	0.2 (3)	Q

1 - All samples expressed as fibers >5u/cc counted by the standard method recommended in this document. (Latest Available NIOSH Data collected during the years 1969 through 1970).

TABLE III

ASBESTOS FRICTION
NUMBER OF PLANTS = 5

INDIVIDUAL SAMPLES BY OPERATION AND SAMPLE SIZE

OPERATION	HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	LOWEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT
Mixing, Coating & Extruding	32.4	16	S	18.4	16	S	0.1	7	M	0.1	7	M
Forming	16.2	3	U	9.2	4	S	0.3	6	H	0.1	6	H
Hot Pressing	7.3	5	S	6.0	5	S	0.2	7	H	0.1	7	H
Baking	7.4	5	S	7.3	5	S	0.5	2	M	0.1	2	H
Grinding & Sanding	20.5	8	T	16.6	16	S	0.1	10	H	0.1	10	H
Cutting & Drilling	14.4	22	S	14.4	22	S	0.4	12	H	0.1	7	M
Bonding & Riveting	8.7	4	H	1.5	4	H	0.2	1	T	0.1	1	M
Inspection & Packing	11.1	4	S	9.9	13	H	0.1	13	H	0.1	13	H
Miscellaneous	6.4	9	H	6.4	9	H	0.1	5	T	0.1	9	H

1 - All samples expressed as fibers >5μ/cc counted by the standard method recommended in this document. (Latest available NIOSH Data collected during the years 1968 through 1971).

TABLE IV

ASBESTOS FRICTION PLANTS

NUMBER OF PLANTS = 5

MEANS BY OPERATION WITH SAMPLE SIZE ( )

OPERATION	HIGHEST	PLANT	2nd HIGHEST	PLANT	2nd LOWEST	PLANT	LOWEST	PLANT
Mixing, Coating & Extruding	11.0 (16)	S	5.3 (2)	H	4.3 (2)	U	1.9 (7)	M
Forming	6.0 (3)	U	3.6 (4)	S	0.5 (2)	T	0.5 (6)	H
Hot Pressing	4.9 (5)	S	1.5 (2)	U	1.4 (4)	M	0.7 (7)	H
Baking	5.4 (5)	S	3.7 (1)	U	0.6 (2)	M	0.4 (2)	H
Grinding & Sanding	6.3 (4)	U	5.2 (16)	S	2.7 (7)	M	1.1 (10)	H
Cutting & Drilling	14.4 (1)	U	7.7 (22)	S	0.9 (7)	T	0.6 (7)	M
Bonding & Riveting	2.8 (4)	H			0.2 (1)	T	0.1 (1)	M
Inspection & Packing	5.1 (4)	S	3.7 (3)	U	1.0 (4)	M	0.9 (7)	T
Miscellaneous	2.2 (9)	H	1.4 (1)	M	0.8 (3)	U	0.5 (5)	T

1 - All samples expressed as fibers $>5\mu$/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1968 through 1971).

TABLE V

ASBESTOS CEMENT SHINGLE, MILL BOARD AND GASKET
NUMBER OF PLANTS = 3

INDIVIDUAL SAMPLES BY OPERATION AND SAMPLE SIZE

OPERATION	HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT
Warehousing	1.4	3	R	0.4	3	R	0.2	3	R	0.1	1	V
Mixing	16.6	15	R	9.5	6	W	0.5	6	W	0.3	15	R
Forming	6.4	18	R	3.7	3	W	0.1	18	R	0.0	18	R
Curing	2.5	2	R	1.6	2	V	0.4	[illegible]	W	0.2	2	R
Finishing	5.4	17	R	4.4	17	R	0.1	7	V	0.1	7	W
Packing	3.8	4	R	1.1	2	W	0.2	[illegible]	W	0.1	4	R
Miscellaneous	1.4	2	W	1.2	4	R	0.9	2	W	0.6	4	R

1 - All samples expressed as fibers >5μ/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1970).

TABLE VI

'ASBESTOS CEMENT SHINGLE, MILLBOARD AND GASKET
NUMBER OF PLANTS = 3
MEANS BY OPERATION AND SAMPLE SIZE ( )

OPERATION	HIGHEST	PLANT	2nd HIGHEST	PLANT	2nd LOWEST	PLANT	LOWEST	PLANT
Warehousing	0.7 (3)	R					0.1 (1)	V
Mixing	4.4 (6)	W	3.8 (15)	R			1.8 (1)	V
Forming	2.6 (3)	W	1.3 (18)	R			0.9 (6)	V
Curing	1.5 (2)	V	1.4 (2)	R			0.4 (1)	W
Finishing	1.9 (17)	R	1.5 (2)	W			1.0 (7)	V
Packing	1.2 (4)	R	0.7 (2)	W			0.5 (2)	V
Miscellaneous	1.2 (2)	W	1.0 (4)	R			0.9 (1)	V

1 - All samples expressed as fibers $>5\mu$/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1970).

TABLE VII

ASBESTOS PAPER, PACKING, AND ASPHALT PRODUCTS

INDIVIDUAL SAMPLES BY OPERATIONS AND SAMPLE SIZE*

PRODUCT AREA	INDIVIDUAL HIGH	OPERATION	INDIVIDUAL LOW	OPERATION
Asbestos Paper	10.9	Asbestos Mixing	0.0	Wood Mixing Paper Making
Asbestos Packing	18.9	Weaving	0.1	Braiding Mixing & Calender Forming Cutting & Trimming
Asbestos Asphalt Products	16.3	Dry Mixing	0.0	Dry Mixing Wet Mixing Forming Finishing Inspection & Packing

* IN THESE THREE ASBESTOS PRODUCT AREAS, INSUFFICIENT DATA PREVENTS TABULATING ENVIRONMENTAL LEVELS INTO HIGHEST AND LOWEST INDIVIDUAL SAMPLE CATEGORIES BY OPERATION. BASED ON A SMALL NUMBER OF PLANTS FOR EACH PRODUCT AREA, ONLY THE HIGH, LOW FOR INDIVIDUAL SAMPLES WERE DETERMINED.

1 - All samples expressed as fibers > 5μ/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1970).

TABLE VIII

ASBESTOS PAPER, PACKING AND ASPHALT PRODUCTS

MEANS BY OPERATIONS AND SAMPLE SIZE*

PRODUCT AREA	HIGH MEAN	OPERATION	LOW MEAN	OPERATION
Asbestos Paper	3.4	Asbestos Mixing	0.7	Miscellaneous
Asbestos Packing	13.6	Weaving	0.2	Mixing & Calender
Asbestos Asphalt Products	2.4	Dry Mixing	0.2	Forming Finishing

*IN THESE THREE ASBESTOS PRODUCT AREAS, INSUFFICIENT DATA PREVENTS TABULATING ENVIRONMENTAL LEVELS INTO HIGHESTS, LOWEST MEAN CATEGORIES BY OPERATION. BASED ON A SMALL NUMBER OF PLANTS FOR EACH PRODUCT AREA, ONLY THE HIGH MEAN AND LOW MEAN WERE DETERMINED.

1 - All samples expressed as fibers $> 5\mu$/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1970).

TABLE IX

ASBESTOS INSULATION PLANTS
NUMBER OF PLANTS = 5

INDIVIDUAL SAMPLES BY OPERATION AND SAMPLE SIZE

OPERATION	HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT
Mixing	188.9	11	X	169.7	11	X	0.4	3	DD	0.2	7	R
Forming	134.4	39	X	111.2	39	X	0.0	10	R	0.0	10	R
Curing	23.5	5	X	19.9	5	X	1.5	1	DD	0.1	1	CC
Finishing	208.4	26	X	97.3	26	X	0.1	4	CC	0.1	11	R
Inspection & Packing	92.3	15	X	73.6	15	X	0.1	11	R	0.0	11	CC
Miscellaneous	42.3	24	X	37.5	24	X	0.1	4	CC	0.1	4	CC

1 - All samples expressed as fibers >5μ/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1971).

TABLE X

ASBESTOS INSULATION PLANTS

NUMBER OF PLANTS = 5

MEANS BY OPERATION AND SAMPLE SIZE ( )

OPERATION	HIGHEST	PLANT	2nd HIGHEST	PLANT	2nd LOWEST	PLANT	LOWEST	PLANT
Mixing	74.4 (11)	X	46.3 (7)	Y	4.1 (7)	R	1.7 (2)	CC
Forming	50.6 (39)	X	25.2 (32)	Y	0.7 (10)	R	0.2 (7)	CC
Curing	14.4 (5)	X			1.5 (1)	DD	0.1 (1)	CC
Finishing	39.5 (26)	X	15.0 (17)	Y	1.0 (11)	R	0.9 (4)	CC
Inspection & Packing	22.8 (15)	X	11.0 (19)	Y	0.5 (1)	R	0.3 (11)	CC
Miscellaneous	16.6 (24)	X	2.7 (5)	Y	2.6 (4)	DD	0.2 (4)	CC

1 - All samples expressed as fibers >5μ/cc counted by the standard method recommended in this document. (Latest available NIOSH data collected during the years 1966 through 1971).

TABLE XI

LATEST SURVEY RESULTS

ASBESTOS TEXTILE
NUMBER OF PLANTS = 8

INDIVIDUAL SAMPLES BY OPERATION AND THE SAMPLE SIZE INDIVIDUAL SAMPLE WAS TAKEN FROM

FIBERS/cc 5u

OPERATION	HIGHEST INDIVIDUAL SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND HIGHEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	SECOND LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT	LOWEST INDIVID. SAMPLE	SAMPLE SIZE FROM WHICH INDIVIDUAL SAMPLE DRAWN	PLANT
Fiber Preparation	120.3	12	B	40.9	4	A	1.4	9	K	0.4	9	K
Carding	143.9	30	B	72.2	30	B	0.7	22	K	0.4	40	J
Spinning	40.9	36	K	28.7	43	B	1.0	36	K	0.4	43	B
Twisting	31.1	7	A	25.3	8	K	0.5	8	K	0.2	8	G
Winding	18.4	24	B	17.9	40	K	0.1	40	K	0.0	40	K
Weaving	123.2	57	B	38.5	25	A	0.1	50	K	0.1	50	K
Rope, Wick, Braid & Cord	11.0	3	D	10.3	3	D	0.1	4	K	0.1	3	D
Finishing	5.6	3	G	3.8	28	B	0.2	28	B	0.1	28	B
Miscellaneous	37.0	2	A	22.7	2	A	0.1	45	K	0.1	45	K

TABLE XII

LATEST SURVEY RESULTS

ASBESTOS TEXTILE PLANTS

NUMBER OF PLANTS = 8

MEANS BY OPERATION WITH SAMPLE SIZE ( )
FIBERS/CC >5u

OPERATION	HIGHEST	PLANT	SECOND HIGHEST	PLANT	SECOND LOWEST	PLANT	LOWEST	PLANT
Fiber Preparation	22.3 (4)	A	20.3 (12)	B	7.6 (9)	K	7.4 (5)	J
Carding	27.3 (10)	A	26.4 (30)	B	7.1 (22)	K	6.1 (14)	G
Spinning	12.5 (36)	K	10.9 (11)	A	5.8 (11)	C	3.7 (2)	J
Twisting	14.5 (7)	A	10.7 (19)	B	4.8 (4)	C	3.2 (8)	G
Winding	9.7 (12)	A	5.9 (24)	B	2.8 (10)	J	2.0 (5)	G
Weaving	12.4 (25)	A	10.0 (16)	J	2.5 (11)	C	1.1 (3)	E
Rope, Wick, Braid & Cord	7.1 (3)	D	3.5 (2)	J	2.6 (4)	A	1.3 (4)	K
Miscellaneous	29.9 (2)	A	9.7 (2)	G	2.5 (4)	J	0.2 (2)	E
Finishing	2.5 (3)	G	1.8 (2)	C	1.3 (28)	B	0.1 (5)	E

TABLE XIII

ASBESTOS CONCENTRATION* BY OPERATION
FOR INSULATION WORKERS

Marine Construction Repair	No. of Samples	Actual Arithemetic Means	Recalculated Mean***	Previous Time-Weighted Average***	Recalculated Time-Weighted Average***
Prefabrication	7	30.4	8.7		
Application	25	6.2	2.6		
Mixing	19	21.2	6.4		
General	18	0.6	0.6	9.2	1.8
Tear Out	14	31.5	8.3		
Finishing	19	0.3	0.3		
Light and Heavy Industrial Construction					
Prefabrication	23	10.1	6.6		
Application	36	3.1	2.4		
Mixing	17	4.7	2.9	4.2	2.2
General	19	1.6	1.1		
Tear Out	10	12.8	7.1		
Finishing	16	0.9	0.9		

* Fibers/ml > 5μ in length
** Summarized from data
*** Personal communication, March 1970 from Balzer & Cooper[4].

TABLE XIV

ASBESTOS CONCENTRATION BY OPERATION*, 1969

Work practice	Environmental conditions	Average asbestos fiber levels: Personal Samples Fibers/ml	Area Samples Fibers/ml	Area Samples Distance from Source
#1 Asbestos cement	High ceiling room. Louvre venting	2.4	.45	2'
#2 Asbestos cement	Low ceiling room. Poor ventilation	2.6	-	-
#3 Asbestos cement	Access tunnel	6.1	-	-
#4 Asbestos cement	Power house. Low Ceiling, poor ventilation	3.9	2.5	3-5'
Cutting calcium silicate, block, pipe #1	Table and hand saws, in power house - open	1.2	-	-
Cutting calcium silicate, block & pipe #2	Same - in industrial building. Good ventilation.	4.1	-	-
Cutting calcium silicate block & pipe	Apartment house boiler room. No ventilation. Work 3"-18" from breathing zone.	11.5	-	-
Cutting calcium silicate block & pipe #4	Limited ventilation	9.4	1.6	3-4'
Spraying insulation	Turbines in power plant - very high ceiling, good ventilation.	47.7	19.5	3'
			28.0	6'

Fibers/ml $>5\mu$ in length

Notes:
1. Conditions usually variable: Cement mixed dry - applied wet; rapid changes in local ventilation; composition of material may vary; number of men on job may vary.
2. Average of counts (excluding spray insulation): ≥ 5 fibers/ml = 64.5%; 5-12 fibers/ml = 25.5%; >12 fibers/ml = 10.0%.
3. Information prepared by Reitze, Nicholson, and Holaday.(5)

TABLE XV

ASBESTOS PLANT Z - CEMENT PIPE

PERSONAL SAMPLES - SECULAR TRENDS

MEANS BY OPERATION AND SAMPLE SIZE

OPERATION	1967 MEAN	1967 No. OF SAMPLES	1971 MEAN	1971 NO. OF SAMPLES
Warehousing & Mixing	6.2	4	2.3	2
Pipe Forming	2.1	15	1.8	4
Curing	1.3	8	0.4	4
Pipe Finishing	5.0	6	1.7	10
Coupling Finishing	12.8	9	5.3	7
Epoxy	2.6	2	0.9	5
Packing	1.7	6	1.1	7
Miscellaneous			0.5	9

1 - All samples expressed as fibers $>5\mu$/cc by the standard method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XVI

ASBESTOS PLANT S - FRICTION

PERSONAL SAMPLES - SECULAR TRENDS

MEANS BY OPERATION WITH SAMPLE SIZE

OPERATION	1966 MEAN	1966 NO. OF SAMPLES	1969 MEAN	1969 NO. OF SAMPLES	1971 MEAN	1971 NO. OF SAMPLES
Mixing, Coating & Extruding	7.5	24	8.0	6	11.0	16
Forming	5.7	7	0.5	3	3.6	4
Hot Pressing	13.1	15	1.8	3	4.9	5
Baking	9.1	1	2.6	4	5.4	5
Grinding & Sanding	10.8	34	4.7	10	5.2	16
Cutting & Drilling	11.0	31	2.8	8	7.7	22
Bonding & Riveting						
Inspection & Packing	9.6	21	1.9	5	5.1	4
Miscellaneous Friction	6.7	6	1.8	10		

1 - All samples expressed as fibers >5 μ/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XVII

ASBESTOS CEMENT SHINGLE, MILLBOARD AND GASKET

PERSONAL SAMPLES - SECULAR TRENDS

MEANS BY OPERATION AND SAMPLE SIZE

PLANT W

OPERATION	1967 MEAN	1967 NO. OF SAMPLES	1970 MEAN	1970 NO. OF SAMPLES
Warehousing	8.9	4		
Mixing	8.3	14	4.4	6
Forming	1.8	36	2.6	3
Curing			0.4	1
Finishing	4.3	35	1.5	7
Packing	2.5	22	0.7	2
Miscellaneous	2.3	13	1.2	2

1 - All samples expressed as fibers $>5\,\mu$/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XVIII

ASBESTOS, INSULATION PLANT X

PERSONAL SAMPLES - SECULAR TRENDS

THERMAL PIPE

MEANS BY OPERATION WITH SAMPLE SIZE

OPERATION	1967 MEAN	1967 NO. OF SAMPLES	1970 MEAN	1970 NO. OF SAMPLES	1971 MEAN	1971 NO. OF SAMPLES
Mixing	163.0	5	36.2	3	74.4	11
Forming	33.3	18	25.7	3	50.6	39
Curing	2.5	1	31.0	1	14.4	5
Finishing	44.6	3	34.8	4	39.5	26
Inspection & Packing	16.7	7	17.9	3	22.8	15
Miscellaneous			13.8	2	16.6	24
Office Worker						

1 - All samples expressed as fibers >5 μ/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XIX

ASBESTOS, INSULATION PLANT Y

PERSONAL SAMPLES - SECULAR TRENDS

THERMAL PIPE

MEANS BY OPERATION WITH SAMPLE SIZE

OPERATION	1967 MEAN	1967 NO. OF SAMPLES	1970 MEAN	1970 NO. OF SAMPLES	1971 MEAN	1971 NO. OF SAMPLES
Mixing	107.0	3	27.7	2	46.3	7
Forming	98.9	12	24.1	13	25.2	32
Curing						
Finishing	32.2	4	16.8	2	15.0	17
Inspection & Packing	13.3	2	13.0	8	11.0	19
Miscellaneous			21.0	14	2.7	5

1 - All samples expressed as fibers >5 μ/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XX

ASBESTOS TEXTILE PLANT A

PERSONAL SAMPLES - SECULAR TRENDS

MEANS BY OPERATION WITH SAMPLE SIZE

OPERATION	1964 MEAN	1964 NO. OF SAMPLES	1966 MEAN	1966 NO. OF SAMPLES	1970 MEAN	1970 NO. OF SAMPLES
Fiber preparation	13.6	6	9.6	4	22.3	4
Carding	14.5	4	52.2	7	27.3	10
Spinning	11.8	2	15.3	9	10.9	11
Twisting	5.4	7	9.2	8	14.5	7
Winding	9.5	5	13.8	4	9.7	12
Weaving	5.6	11	17.7	15	12.4	25
Rope, Wick, Braid & Cord	0.2	6	6.9	2	2.6	4
Finishing	5.7	2	7.5	1	29.9	2
Miscellaneous						

1 - All samples expressed as fibers >5 μ/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XXI

ASBESTOS TEXTILE PLANT J

PERSONAL SAMPLES - SECULAR TRENDS

MEANS BY OPERATION WITH SAMPLE SIZE

OPERATION	1965 MEAN	1965 NO. OF SAMPLES	1967 MEAN	1967 NO. OF SAMPLES	1971 MEAN	1971 NO. OF SAMPLES
Fiber preparation	6.4	7	15.7	5	7.4	5
Carding	8.1	17	12.6	11	7.8	40
Spinning	7.9	14	27.4	11	3.7	2
Twisting	7.3	20	17.7	9	6.9	35
Winding			3.4	3	2.8	10
Weaving	5.6	47	6.8	12	10.0	16
Rope, Wick, Braid & Cord					3.5	2
Miscellaneous					2.5	4

1 - All samples expressed as fibers >5 μ/cc by the Standard Method recommended in this document.

2 - Information prepared from NIOSH data.

TABLE XXII

ASBESTOS CEMENT PIPE
PERCENT OF SAMPLES LESS THAN OR EQUAL TO 2 FIBERS/CC,
5 FIBERS/CC AND 10 FIBERS/CC LONGER THAN 5u IN LENGTH,
BY PLANT AND OPERATION
( ) = NO. OF SAMPLES
REPRESENTS FIBERS LONGER THAN 5u

OPERATION	PLANT N			PLANT O			PLANT P			PLANT Q			PLANT Z			PLANT AA			PLANT BB		
	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10
Warehousing & Mixing	25	100 (4)	100	0	0 (2)	100	100	100 (3)	100	100	100 (4)	100	50	100 (2)	100	100	100 (5)	100	80	100 (5)	100
Pipe Forming	33	100 (3)	100	33	100 (6)	100	100	100 (4)	100	100	100 (2)	100	75	100 (4)	100	100	100 (6)	100	100	100 (10)	100
Curing	100	100 (3)	100	67	100 (3)	100	100	100 (6)	100	100	100 (1)	100	100	100 (4)	100	100	100 (5)	100	93	100 (15)	100
Pipe Finishing	100	100 (6)	100	100	100 (4)	100	100	100 (6)	100	80	100 (5)	100	70	100 (10)	100	100	100 (9)	100	100	100 (9)	100
Coupling Finishing	100	100 (4)	100	25	50 (4)	100	100	100 (16)	100	80	100 (5)	100	43	57 (7)	71	100	100 (21)	100	90	100 (10)	100
Epoxy	0	100 (1)	100	100	100 (1)	100	100	100 (6)	100	-	-	-	100	100 (5)	100	100	100 (1)	100	83	100 (6)	100
Packing	100	100 (4)	100	100	100 (1)	100	-	-	-	0	0 (1)	100	86	100 (7)	100	100	100 (13)	100	100	100 (6)	100
Miscellaneous	-	-	-	-	-	-	100	100 (9)	100	100	100 (3)	100	100	100 (9)	100	100	100 (8)	100	100	100 (6)	100

- Not Applicable

TABLE XXIII

ASBESTOS FRICTION PLANTS
PERCENT OF SAMPLES LESS THAN OR EQUAL TO 2 FIBERS/CC,
5 FIBERS/CC, AND 10 FIBERS/CC LONGER THAN 5μ
BY PLANT AND OPERATION
( ) = NUMBER OF SAMPLES

OPERATION	PLANT H			PLANT M			PLANT S			PLANT T			PLANT U		
	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10
Mixing, Coating & Extruding	0	50 (2)	100	71	86 (7)	100	13	19 (16)	44	-	-	-	0	50 (2)	100
Forming	100	100 (6)	100	-	-	-	75	75 (4)	100	100	100 (2)	100	67	67 (3)	67
Hot Pressing	100	100 (7)	100	50	100 (4)	100	0	40 (5)	100	-	-	-	100	100 (2)	100
Baking	100	100 (2)	100	100	100 (2)	100	0	40 (5)	100	100	100 (2)	100	0	100 (1)	100
Grinding & Sanding	90	100 (10)	100	57	86 (7)	100	13	56 (16)	94	88	88 (8)	88	0	25 (4)	100
Cutting & Drilling	50	75 (12)	83	100	100 (7)	100	5	32 (22)	64	86	100 (7)	100	0	0 (1)	0
Bonding & Riveting	75	75 (4)	100	100	100 (1)	100	-	-	-	100	100 (1)	100	-	-	-
Inspecting & Packing	54	69 (13)	100	100	100 (4)	100	50	50 (4)	75	86	100 (7)	100	0	67 (3)	100
Miscellaneous	67	78 (9)	100	100	100 (1)	100	-	-	-	100	100 (5)	100	100	100 (3)	100

- Not applicable

TABLE XXIV

ASBESTOS CEMENT SHINGLE, MILLBOARD AND GASKET
PERCENT OF SAMPLES LESS THAN OR EQUAL TO 2 FIBERS/CC,
5 FIBERS/CC, AND 10 FIBERS/CC LONGER THAN 5μ
BY PLANT AND OPERATION
( ) = NUMBER OF SAMPLES

	PLANT R			PLANT U			PLANT W		
OPERATION	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10
Warehousing	100	100 (3)	100	100	100 (1)	100	-	-	-
Mixing	53	67 (15)	93	67	100 (3)	100	50	67 (6)	100
Forming	83	94 (18)	100	100	100 (6)	100	33	100 (3)	100
Curing	50	100 (2)	100	100	100 (2)	100	100	100 (1)	100
Finishing	71	94 (17)	100	86	100 (7)	100	71	100 (7)	100
Packing	75	100 (4)	100	100	100 (2)	100	100	100 (2)	100
Miscellaneous	100	100 (4)	100	100	100 (1)	100	100	100 (2)	100

- Not Applicable

TABLE XXV

ASBESTOS INSULATION PLANTS
PERCENT OF SAMPLES LESS THAN OR EQUAL TO 2 FIBERS/CC,
5 FIBERS/CC, AND 10 FIBERS/CC LONGER THAN 5μ
BY PLANT AND OPERATION
( ) = NUMBER OF SAMPLES

OPERATION	PLANT R			PLANT X			PLANT Y			PLANT CC			PLANT DD		
	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10	%≤2	%≤5	%≤10
Mixing	57	71 (7)	86	0	0 (11)	18	0	0 (7)	0	100	100 (2)	100	67	67 (3)	67
Forming	90	90 (10)	100	0	0 (39)	15	0	9 (32)	13	100	100 (7)	100	100	100 (5)	100
Curing	-	-	-	0	0 (5)	40	-	-	-	100	100 (1)	100	100	100 (1)	100
Finishing	82	100 (11)	100	8	12 (26)	15	6	6 (17)	29	100	100 (4)	100	40	100 (5)	100
Inspection & Packing	100	100 (1)	100	13	27 (15)	40	0	16 (19)	63	100	100 (11)	100	63	100 (8)	100
Miscellaneous	-	-	-	21	46 (24)	54	40	100 (5)	100	100	100 (4)	100	50	100 (4)	100

- Not applicable

TABLE XXVI

ASBESTOS TEXTILE PLANTS
PERCENT OF SAMPLES LESS THAN OR EQUAL TO 2 FIBERS/CC,
5 FIBERS/CC, AND 10 FIBERS/CC LONGER THAN 5u
BY PLANT AND OPERATION
( ) = NUMBER OF SAMPLES

OPERATION	PLANT A			PLANT B			PLANT C			PLANT D			PLANT E			PLANT G			PLANT J			PLANT K		
	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10	%_2	%_5	%_10
Fiber Preparation	0	0 (4)	25	0	17 (12)	58	0	0 (3)	33	0	0 (3)	33	-	-	-	0	0 (2)	50	20	40 (5)	80	22	44 (9)	67
Carding	0	0 (10)	10	0	7 (30)	40	0	0 (4)	75	20	40 (10)	60	-	-	-	14	57 (14)	71	13	38 (40)	80	23	36 (22)	77
Spinning	0	9 (11)	36	5	26 (43)	77	0	36 (11)	91	0	13 (16)	44	-	-	-	0	33 (6)	100	0	100 (2)	100	3	14 (36)	42
Twisting	0	0 (7)	29	0	11 (19)	58	0	75 (4)	100	13	50 (8)	75	-	-	-	38	75 (8)	100	6	26 (35)	89	25	38 (8)	50
Winding	8	33 (12)	50	25	54 (24)	83	0	60 (5)	100	43	71 (7)	86	-	-	-	60	100 (5)	100	40	90 (10)	100	40	53 (40)	78
Weaving	4	16 (25)	44	16	58 (57)	86	36	100 (11)	100	8	33 (24)	88	67	100 (3)	100	8	50 (12)	100	0	25 (16)	56	26	76 (50)	96
Rope, Wick, Braid & Cord	50	75 (4)	100	40	100 (5)	100	-	-	-	33	33 (3)	33	-	-	-	-	-	-	0	100 (2)	100	75	100 (4)	100
Miscellaneous	0	0 (2)	0	33	67 (3)	100	-	-	-	0	50 (6)	83	100	100 (2)	100	0	50 (3)	50	50	100 (4)	100	80	91 (45)	100
Finishing	-	-	-	82	100 (28)	100	50	100 (2)	100	-	-	-	100	100 (5)	100	67	67 (2)	100	-	-	-	63	100 (8)	94

- Not Applicable

TABLE XXVII

Duration of employment and known exposure to Asbestos and the development of X-ray findings of Asbestosis in 232 employees of an Asbestos Insulation Factory, employed sometime in 1941-1945 and examined in 1969-1970.

DURATION OF EMPLOYMENT	TOTAL	X-RAY ASBESTOSIS 0	+ -	1+	2+	3+
1 DAY OR LESS	7	3	0	4	0	0
1 - 7 DAYS	13	4	3	5	1	0
1 - 4 WKS	15	5	3	6	1	0
1 - 3 MOS	35	6	5	23	1	0
3 - 6 MOS	35	8	3	19	5	0
6 - 12 MOS	31	5	3	15	5	3
1 - 2 YRS	48	7	5	25	8	3
2 - 5 YRS	36	3	8	16	6	3
5 - 14 YRS	12	1	0	5	4	2
	232					

ALL EMPLOYEES INCLUDED. EXPOSURES VARIED FROM "NONE" (OFFICE) THROUGH THAT OF MANAGEMENT, ENGINEERING AND SHIPPING, TO THAT OF PRODUCTION EMPLOYEES.

1 - Personal Communication Dr. Irving Selikoff, January, 1971.

TABLE XXVIII

Lapsed period from onset of exposure in 344 deaths among employees of an asbestos insulation factory, employed at some time in 1941-1945 and followed to 1970.

	Years from Onset							
Cause of Death	0-4	5-9	10-14	15-19	20-24	25+		TOTAL
Lung cancer	0	3	8	14	16	18	=	59
Mesothelioma	0	0	0	0	2	2	=	4
G. I. cancer	1	1	6	3	4	3	=	18
Asbestosis	0	2	1	8	8	5	=	24
All other cancer	1	3	9	7	6	5	=	31
All other causes	26	28	30	52	42	30	=	208
TOTAL	28	37	54	84	78	63	=	344

1 - Personal communication Dr. Irving Selikoff, January, 1971.

TABLE XXIX

SUMMARY OF 4 CASE HISTORIES OF EXPOSURE TO
ASBESTOS AND SUBSEQUENT DEVELOPMENT OF MESOTHELIOMA

Race	W	W	W	W
Sex	M	F	M	F
Occupational History				
Before asbestos exposure	None	Student	None	None
Asbestos exposure				
Duration of exposure	Unknown	6 weeks	3 years	Unknown - at least several yrs
Type of Work	Engineer	Pipe Insulation	Neighborhood exposure	Family exposure
After asbestos exposure	Unknown	Housewife	Bookkeeper-floor manager	Housewife
Type of asbestos	Chrysotile-amosite-crocidolite	Chrysotile-amosite	Chrysotile-amosite	Amosite
Respirator protection	None	None	NA	NA
Mesothelioma History				
Age at death	74	41	30	52
Site	Peritoneal & Pleural	Right Pleural	Pleural	Left Pleural
Histological diagnosis	Biphasic	(Biphasic) epithelial & fibrous	Biphasic Pleomorphic	- [1]
Lapsed period since exposure	25 years	21 years	19 years	Unknown
Duration of illness	13 weeks	5 weeks	1 year	2 years
Concurrent asbestosis	Pleural Calcification	Grade I by X-Ray	None	None by X-Ray
Smoking history	0	40	20	NA
Duration of smoking history (years)	-	24	5 years Stopped in 1965	-

1 - Personal communication Dr. Irving Selikoff - January, 1971.

TABLE XXX

Observed and Expected Deaths Through December 31, 1969 by Cause and Dust Exposure Score, for 291 Males who Worked Primarily in Non-Asbestos Production and Maintenance Service Jobs and for 1464 Males who Worked Primarily in Asbestos Production and Maintenance-Service Jobs and Retired During 1941-1967, Showing Standardized Mortality Ratios (SMR's)

Accumulative exposure to asbestos in million parts per cubic foot years (mppcfyr)

Cause of Death and International List Number	Limited Exposure			< 125			125-250			250-500		
	Obs.	Exp.	SMR	Obs.	Exp.	SMR	Obs.	Exp.	SMR	Obs.	Exp.	SMR
All Causes	114	129.9	87.8	365	344.8	105.8	162	139.8	115.9	184	156.7	117.4*
All Cancer (140-205)	22	22.3	98.6	74	56.3	131.4*	23	23.6	97.4	52	26.4	197.1*
Digestive System (150-159)	9	8.2	109.8	27	21.9	123.3	5	8.9	56.2	19	10.0	190.0*
Lung, Bronchus, Trachea & Pleura (162-163)	8	4.8	166.7	18	10.7	168.2	11	4.9	224.5*	16	5.4	296.3*
All Other Cancer	5	9.3	53.8	29	23.7	122.4	7	9.8	71.4	17	11.0	90.9
Cerebral Vascular Lesions (330-334)	15	14.8	101.4	31	41.4	74.3	14	16.2	86.4	15	18.2	82.4
All Heart Disease (400-443)	46	60.8	75.6	168	161.2	104.2	72	65.5	109.9	75	73.3	102.3
Coronary Heart Disease (420)	39	48.9	80.1	129	124.8	103.4	59	52.2	113.0	55	57.8	95.2
All Other Heart Disease	7	12.1	57.8	39	36.4	107.1	13	13.3	97.7	20	15.5	129.0
Diseases of the Respiratory System (470-527)	10	7.7	129.9	26	19.0	162.5*	11	80	137.5	17	8.9	191.0*
Pneumoconiosis & Pulmonary Fibrosis (523-525)	5	-	-	8	-	-	3	-	-	8	-	-
All Other Causes	22	24.5	89.8	66	66.6	99.1	42	26.5	158.5*	25	29.9	83.6

* SMR significantly different from 100 at 5% level.

Source: A Study of the Dose-Response Relationship Between Asbestos Dust and Lung Cancer by Philip Enterline, Pierre DeCoufle and Vivian Henderson (Unpublished Manuscript)

TABLE XXX (continued)

Cause of Death and International List Number	500-750			>750								
	Obs.	Exp.	SMR	Obs.	Exp.	SMR	Obs.	Exp.	SMR	Obs.	Exp.	SMR
All Causes	77	50.2	153.4*	34	26.2	129.8						
All Cancer (140-205)	18	8.7	206.9*	9	4.5	200.0						
Digestive System (150-159)	6	3.3	181.8	2	1.7	117.6						
Lung, Bronchus, Trachea & Pleura (162-163)	9	1.8	500.0*	5	0.9	555.6						
All Other Cancer	3	3.6	83.3	2	1.9	105.3						
Cerebral Vascular Lesions (330-334)	5	5.6	89.3	3	3.0	100.0						
All Heart Disease (400-443)	36	23.5	153.2*	11	12.3	89.4						
Coronary Heart Disease (420)	24	13.8	127.6	8	9.9	80.8						
All Other Heart Disease	12	4.7	255.3*	3	2.4	125.0						
Diseases of the Respiratory System (470-527)	11	2.8	392.8*	9	1.5	600.0*						
Pneumoconiosis & Pulmonary Fibrosis (523,525)	8	-	-	5	-	-						
All Other Causes	7	9.6	72.9	2	4.9	40.8						

*SMR significantly different from 100 at 5% level.

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