FILE NAME: Asbestos Textile Product Use (ATPU)

DATE: 19фн hŎű

DOC#: ATPUлнм

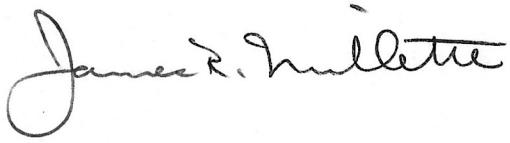
DOCUMENT DESCRIPTION: LyűŜNyl·f /ƨyãdztűl·yű wŜLJƨNű π !ăōŜăűƨă CʎōŜN wŜfŜl·ăŜ 5dzNʎyƎ ¦ăŜ ƨŦ !ăōŜăűƨă /fƨűKʎyƎ

Report of Results: MVA0365

Asbestos Fiber Release During Use of Asbestos Clothing

Prepared by:

MVA, Inc.
5500 Oakbrook Parkway, Suite 200
Norcross, GA 30093



09 October 1992

MVA0365:rpt1009

MVA, Inc.
Excellence in
Microanalysis

5500 Oakbrook Parkway #200
Norcross, Georgia 30093
404-662-8509

Introduction

Asbestos textile clothing; gloves, aprons, jackets and hoods are manufactured from asbestos yarn and usually have high asbestos content (about 85%). Some asbestos textile products are coated or impregnated with polymers, however, there still remains a significant quantity of non-coated fabrics in use. The U.S. Environmental Protection Agency warns that coated asbestos fabrics may release asbestos dust if cut or torn, or for some products, during normal use[1].

Several studies have shown that asbestos fibers are released from asbestos textile materials. Bamber and Butterworth (1970)[2] reported finding fiber levels ranging from 2.37 to 4.45 fibers per cc for air samples collected on an experimentalist wearing an asbestos apron and gauntlets performing activities such as carrying objects, walking and bench work.

Lumley (1971)[3] showed fiber concentrations associated with wearing asbestos cloth fire fighting helmets to exceed 2 fibers/cc.

Gibbs (1975)[4] reported an airborne asbestos levels associated with workers wearing asbestos safety garments at two industrial plants. At a steel plant where men wore asbestos coats, hoods and mittens, concentrations of fibers ranged from 0.3 to 5.0 f/cc. At a second plant which manufactured elemental phosphorus where men wore asbestos coats, leggings and occasionally hoods and gloves, concentrations of fibers ranged from 9.9 to 26.2 fibers/cc.

Asbestos gloves used in sterilization operations in a biological laboratory were the subject of study by Samimi and Williams (1981)[5]. Means of time weighted average concentrations ranged from 0.95 to 11.74 fibers/cc in isolation chamber tests and from 0.07 to 2.93 fibers/cc for breathing zone samples collected in actual laboratory workplaces.

All of the above studies involved measurement of fiber concentrations with an optical microscope following various methods. Gibbs also used scanning electron microscopy. Although none used the current OSHA method, NIOSH 7400, all counted fibers were greater than 5 μm with a 3:1 aspect ratio. Samimi and Williams used the NIOSH method P & CAM 239, the precursor to the NIOSH 7400.

This experiment was designed to measure asbestos fiber release from asbestos gloves and an asbestos apron worn while workers were performing tasks related to those occurring in steel plants; moving fire brick and pieces of metal and handling a steel poking rod. Discussions with the steel workers also indicated that it was a common practice to clap and rub gloves together, especially when they were new or soiled, to get rid of dust that might prevent a good grip. Two short duration tests were conducted to evaluate the asbestos fiber release which might occur with that practice. A test of a non-asbestos aluminized jacket used by the workers while performing the same tasks of moving fire brick and pieces of metal was done for comparison.

Study Site

The experiments were performed in an unused room on the campus of the Georgia Technology Research Institute (GTRI) part of the Georgia Tech University. A controlled containment area with walls, floors and ceilings covered with plastic was installed in the room by a licensed asbestos abatement contractor prior to the studies. The containment was approximately 17' by 10'.

Discussions with steel workers indicated a wide range of ventilation conditions under which the asbestos clothing had been used, from areas of essentially no ventilation to areas where the ventilation levels were high. In some cases, the aire was reportedly very turbulent and capable of stirring dust. This set of experiments were conducted without air movement in the isolation chamber. Subsequent to each test, the chamber was cleaned with a HEPA vacuum and wet wiped with disposable rags. An air filtration unit was used to cleanse the air of particulate. Air samples were collected after each cleaning. All personnel wore respirators and complete protective clothing during the testing and cleanup time periods inside the containment.

Experimental Procedures

Test 1. Two retired steel workers moved various pieces of iron and fire bricks from one side of the containment to the other. One wore a non-asbestos aluminized jacket (#7043) for half the work period of approximately 30 minutes. The other wore the jacket for the second half of the work period. Both wore non-asbestos cloth work gloves.

Test 2. One worker moved various pieces of iron and fire brick while wearing an asbestos apron (#5024) for approximately 30 minutes. The worker wore non-asbestos cloth work gloves.

Test 3. One worker clapped gloves (in good condition) together for 5 minutes. The gloves were identified as pair #5023, later labeled #5023B.

Test 4. Two workers moved various pieces of iron and fire brick while wearing asbestos gloves (pairs #7042 and #5028) for approximately 30 minutes.

Test 5. Two workers handled an iron poking bar while wearing asbestos gloves (pairs #5023A and #5021) for approximately 30 minutes.

Test 6. Two workers moved various pieces of iron and fire brick while wearing asbestos gloves (pairs #5010 and #ABC) and sharing an asbestos apron.

Test 7. One worker clapped gloves which had a tear for 5 minutes. The gloves were identified as pair #7044.

Analytical Methods

Air samples were analyzed by the current standard phase contrast microscopy (PCM) method [6] known as NIOSH 7400. The "A" counting rules were used.

Although the phase contrast microscope enhances the analyst's ability to see fibers over other types of light microscopes, the standard procedure does not involve identification steps which specifically determine how many of the fibers counted are actually asbestos. Because asbestos textile materials are known to contain other types of fibers, some of the samples were analyzed by transmission electron microscopy (TEM) following the NIOSH 7402 preparation procedure.[7] The TEM analysis method identifies asbestos fibers on the basis of morphology, crystal structure and x-ray elemental analysis. All asbestos fibers greater than 0.5 μm were counted. Concentration calculations were also made in which only asbestos fibers longer than 5 μm were counted.

Results

A summary of PCM results from the tests are shown in Table I. All tests showed levels of fibers elevated over the background samples collected after cleaning and before the test. A summary of TEM results are shown in Table II. No asbestos fibers were found during Test #1 where the non-asbestos jacket was tested.

References:

1. U.S. Environmental Protection Agency: Asbestos Waste Management Guidance. EPA-530/SW-85-007. Office of Solid Waste, Washington, DC. (May 1985).

2. Bamber, H.A. and Butterworth, R., Asbestos Hazard from Protective Clothing. Ann. Occup. Hyg. 13:77-80 (1970).

3. Lumley, K.P.S., Asbestos Dust Levels Inside Firefighting Helmets with Chrysotile Asbestos Covers. Ann. Occup. Hyg. 14: 285-286 (1971).

4. Gibbs, G.W., Fiber Release From Asbestos Garments. Ann. Occup. Hyg. 18:143-149 (1975).

5. Samimi, B.S. and Williams, A.M., Occupational Exposure to Asbestos Fibers Resulting From Use of Asbestos Gloves. Am. Ind. Hyg. Assoc. J. 42:870-875 (1981).

6. Carter, J.W., Taylor, D.G., Baron, P.A.; NIOSH 7400. National Institute of Occupational Health Manual of Analytical Methods, p. 7400-1 - 7400-8 (1984).

7. Carter, J.W., Baron,. P.A., Taylor D.G.; NIOSH 7402. National Institute of Occupational Health Manual of Analytical Methods, p. 7402-1 - 7402-7 (1987).

Table I

Summary of Results of Analyses by Phase Contrast Microscopy of Personal Air Samples Collected During Activities with Asbestos and Non-Asbestos Textile Materials

		Mean PCM Value f/cc	Sampling Duration
Test 1	Two workers moving material One aluminized jacket shared	0.13	30 min.
Test 2	One worker moving material One asbestos apron	2.7	30 min.
Test 3	One worker clapping One pair of gloves (good condition)	23.4	5 min.
Test 4	Two workers moving material Two pair of gloves	5.1	30 min.
Test 5	Two workers handling an iron rod Two pair of gloves	3.2	30 min.
Test 6	Two workers moving material Two pair of gloves, one apron shared	1.7	30 min.
Test 7	One worker clapping One pair of gloves (torn)	47.6	5 min.

Table II

TEM Analysis Results of Selected Samples

Laboratory ID	Field No.	Description	Air Volume (liters)	All Asbestos (f/cc)	> 5 µm Asbestos (f/cc)
C4260	3	Experiment 1, Background Area Sample	729.6	< 0.005*	< 0.005*
C4266	9	Experiment 1, Personal	60.8	< 0.07*	< 0.07*
C4281	26	Experiment 2, Personal	58.9	45	27
C4291	36	Experiment 3, Area	53.7	46	10
C4294	39	Experiment 3, Personal	9.5	173	52
C4309	54	Experiment 4, Personal	57	439	23
C4311	56	Experiment 4, Personal	57	80	34
C4322	68	Experiment 5, Personal	60.8	21	6
C4324	70	Experiment 5, Personal	60.8	22	7
C4337	83	Experiment 6, Personal	58.9	25	16
C4339	85	Experiment 6, Personal	58.9	31	15
C4352	98	Experiment 7, Personal	9.5	577	184

*No Asbestos fibers detected. Single fiber detection limits given.

APPENDIX A

Photographs Illustrating the Experimental Procedures



Figure 1. Aluminized jacket being fastened during Test 1.

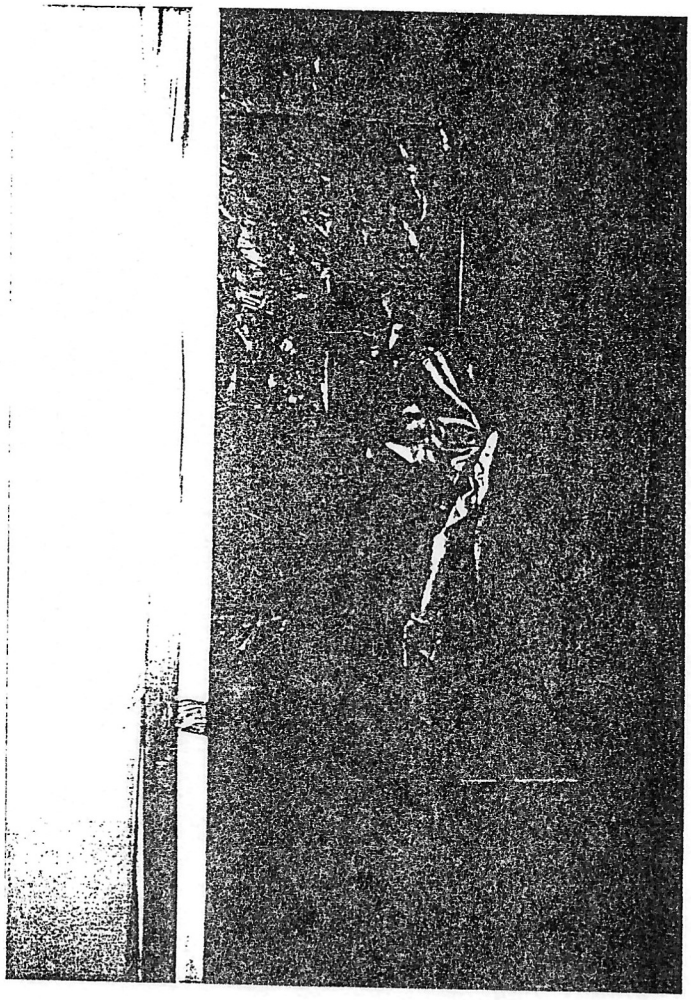


Figure 2. Carrying metal pieces while wearing jacket during Test 1.

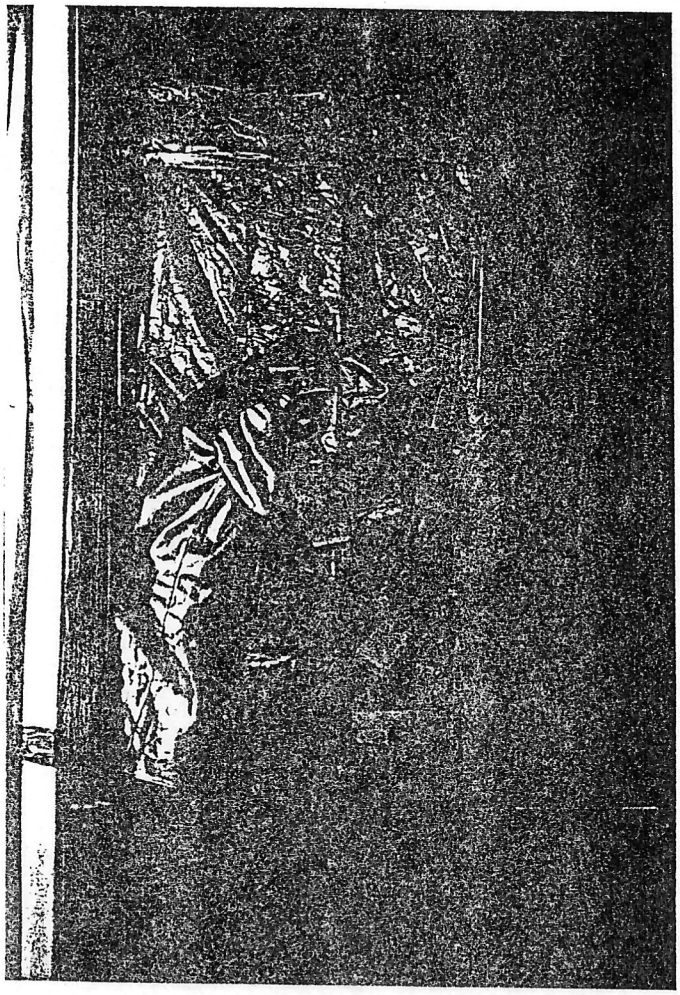


Figure 3. Moving fire brick while wearing jacket during Test 1.



Figure 4. Moving fire brick while wearing an asbestos apron during Test 2.



Figure 5. Moving metal pieces while wearing an asbestos apron during Test 2.



Figure 6. Clapping asbestos gloves together during Test 3.



Figure 7. Ready to move metal pieces and bricks - **Test 4.**



Figure 8. Sweeping - Test 4.

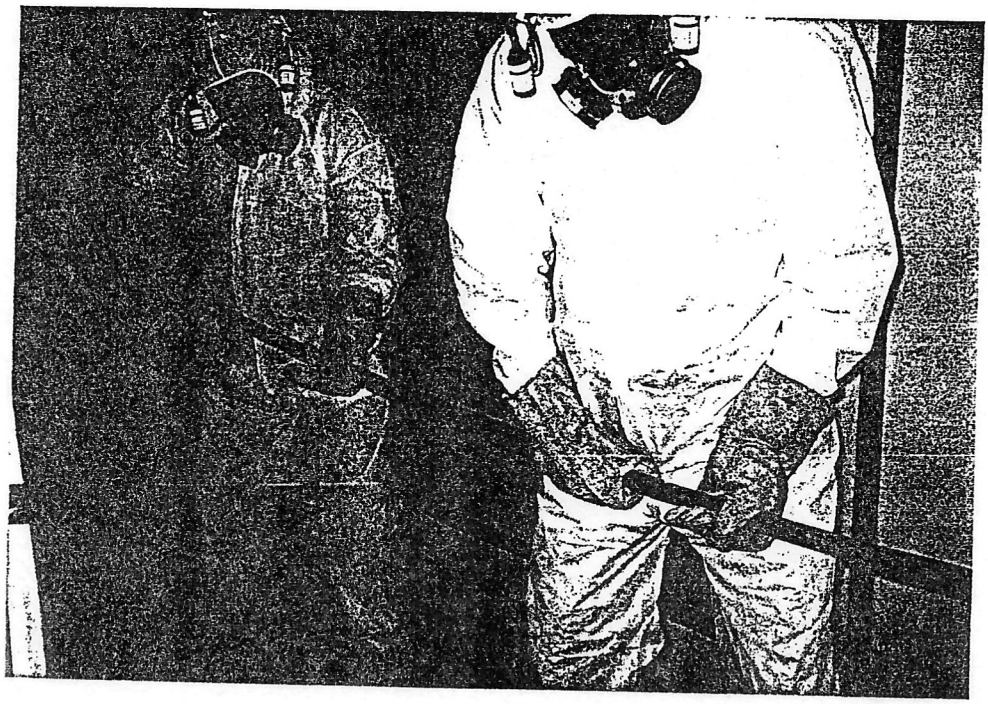


Figure 9. Handling the iron poker - Test 5.



Figure 10. Handling the iron poker - Test 5.



Figure 11. Moving fire brick with gloves and apron - Test 6.



Figure 12. Gloves and apron midpoint through Test 6.

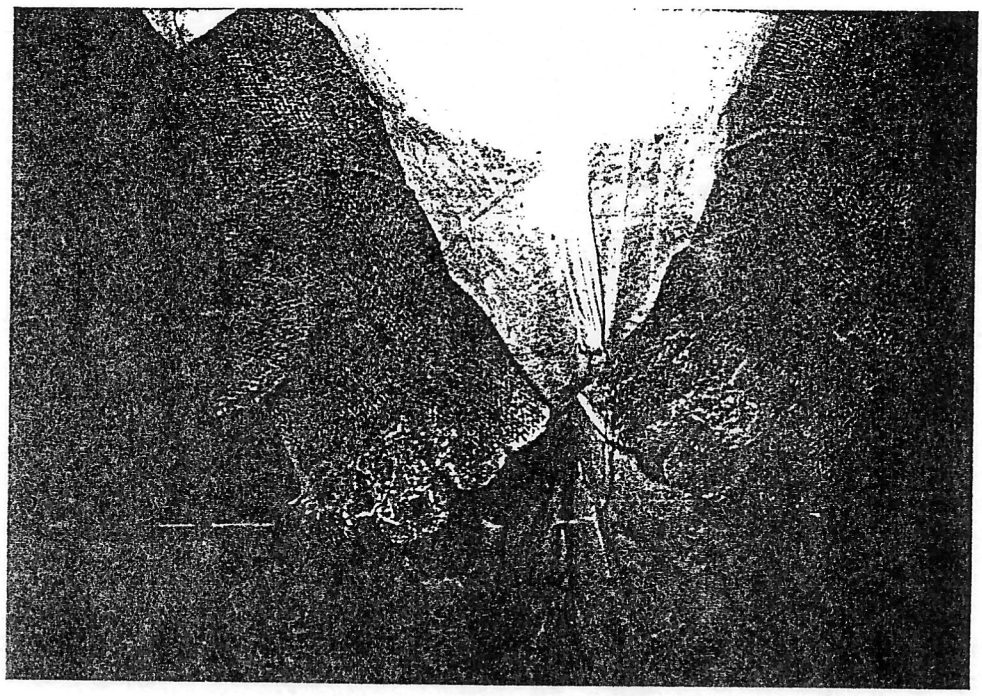


Figure 13. Torn gloves prior to clapping - Test 7.



Figure 14. Clapping gloves together - Test 7.

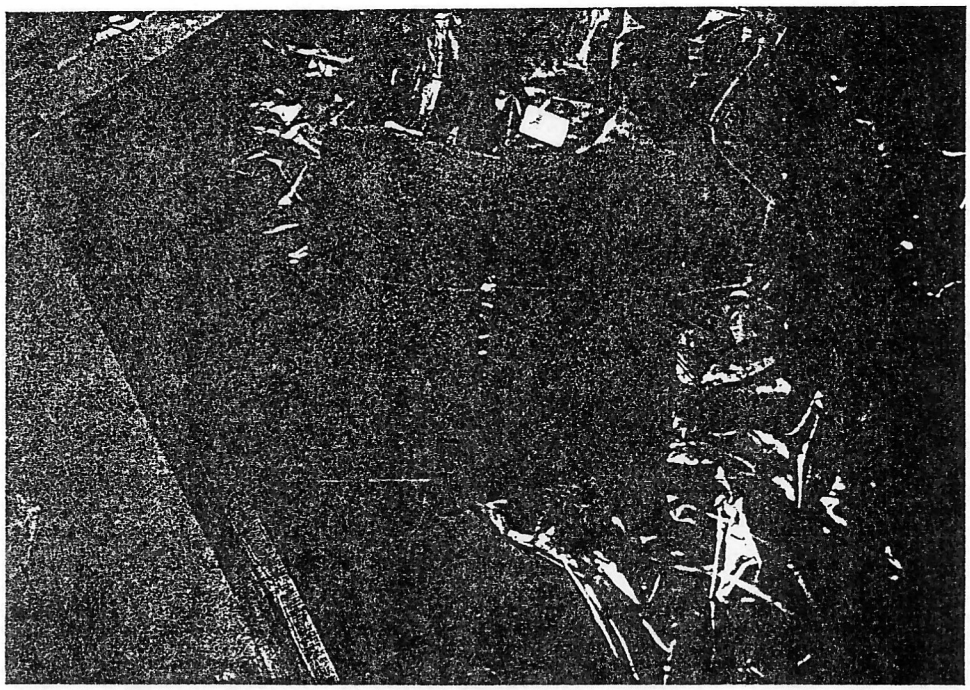


Figure 15. Torn gloves after clapping - Test 7.

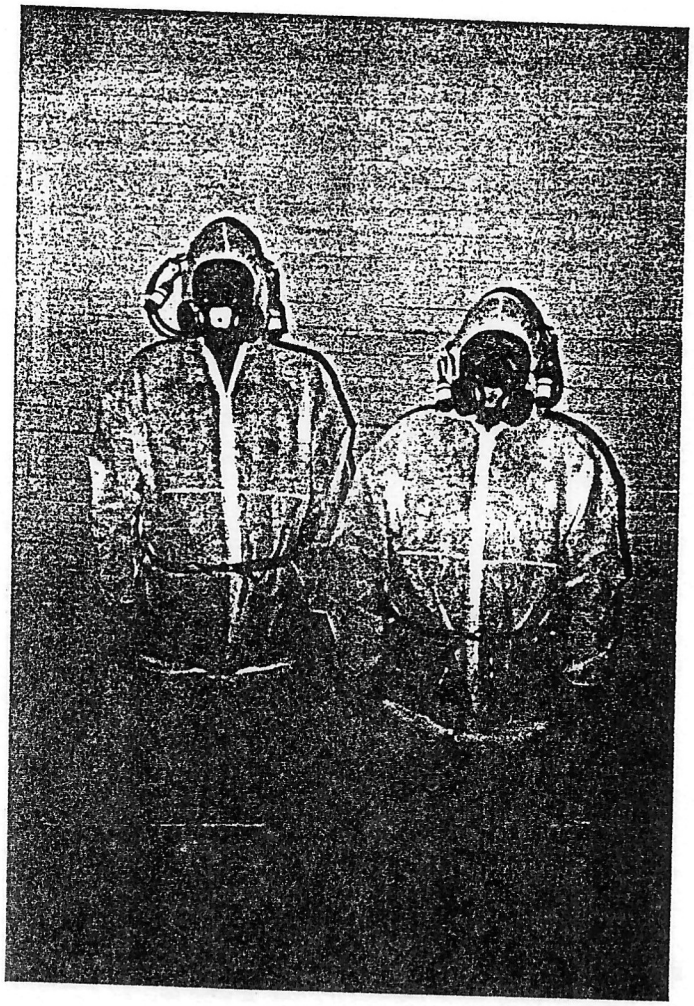


Figure 16. Workers wearing protective gear and air monitors - front view.

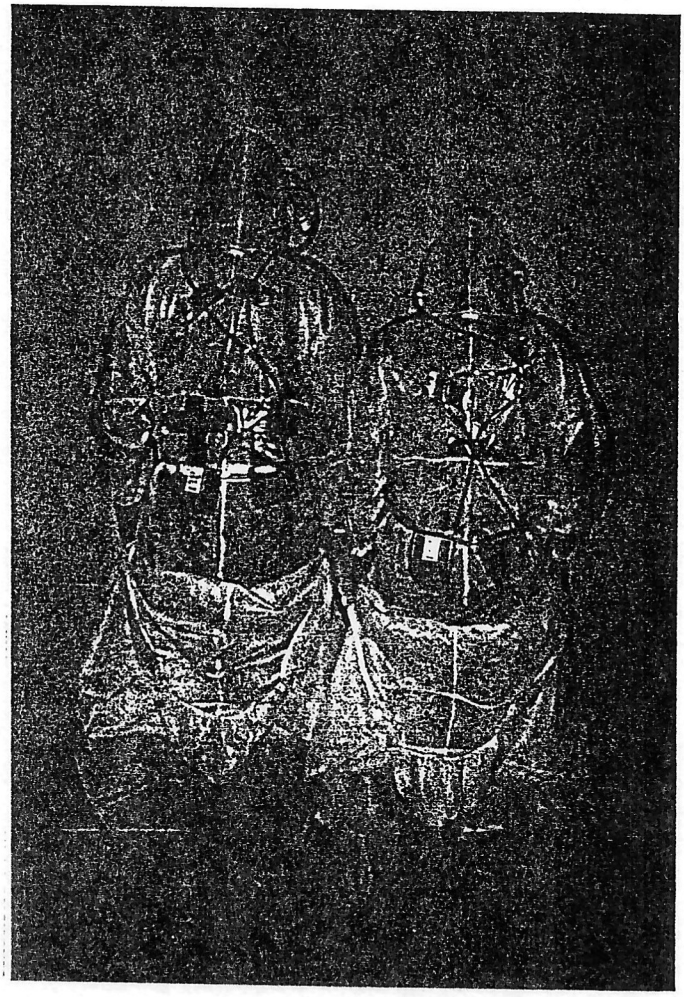


Figure 17. Workers wearing protective gear and air monitors - back view.

APPENDIX B

Phase Contrast Microscopy (PCM) Data

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 1
Jacket

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
1	BKG, IWA	3/100	729.6	3.5	<0.004	0.004
2	BKG, IWA	7/100	729.6	8.2	<0.004	0.004
3	BKG, IWA	3/100	729.6	3.5	<0.004	0.004
4	BKG, IWA	2.5/100	729.6	2.9	<0.004	0.004
5	BKG, IWA	3.5/100	729.6	4.1	<0.004	0.004
6	Area, IWA	22/100 (Heavy Loaded)	343.4	25.9	0.028	0.009
7	Area, IWA	16/100	343.4	18.8	0.020	0.009
8	Bill Gaumer	(Pump Failed)				
9	Bill Gaumer	22.5/100	60.8	26.5	0.164	0.052
10	Ed Dodd	(Pump Failed)				
11	Ed Dodd	13.5/100	60.8	15.9	0.097	0.052
12	Blank, OWA	0.5/100	0	0.6	N/A	N/A
13	Area, OWA	0/100	311.2	0.0	<0.010	0.010
14	Area, OWA	3/100	246.8	3.5	0.013	0.013
15	Area, OWA	1/100	386.3	1.2	<0.008	0.008

OWA - Outside Work Area
IWA - Inside Work Area
N/A - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 2
Apron

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
16	BKG, IWA	1/100	611.6	1.2	<0.005	0.005
17	BKG, IWA	2/100	611.6	2.3	<0.005	0.005
18	BKG, IWA	2/100	611.6	2.3	<0.005	0.005
19	BKG, IWA	2/100	611.6	2.3	<0.005	0.005
20	BKG, IWA	1.5/100	611.6	1.7	<0.005	0.005
21	Area, IWA	105.5/20	332.6	621.3	0.144	0.010
22	Area, IWA	113.5/20	332.6	668.4	0.155	0.010
25	Ed Dodd	(Pump Failed)				
26	Ed Dodd	104.5/30	58.9	410.3	2.682	0.054
27	Blank	0/100	0	0.0	N/A	N/A
28	Area, OWA	1/100	321.9	1.2	<0.010	0.010
29	Area. OWA	12.5/100	311.2	14.7	0.018	0.010
30	Area, OWA	0/100	182.4	0.0	<0.017	0.017

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 3
Glove Banging or Clapping

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
31	BKG, IWA	4/100	536.5	4.7	<0.006	0.006
32	BKG, IWA	5.5/100	536.5	6.5	<0.006	0.006
33	BKG, IWA	3.5/100	536.5	4.1	<0.006	0.006
34	BKG, IWA	1.5/100	536.5	1.8	<0.006	0.006
35	BKG, IWA	5.5/100	536.5	6.5	<0.006	0.006
36	Area, IWA	191/20	53.7	1124.9	8.040	0.059
37	Area, IWA	299/20	53.7	1726.3	12.352	0.058
38	Bill Gaumer	(Pump Failed)				
39	Bill Gaumer	126/25	9.5	582.0	23.4	0.328
40	Blank	3/100	0.0	3.5	N/A	N/A
41	Area, OWA	0/100	53.7	0.0	<0.059	0.059
42	Area. OWA	0/100	53.7	0.0	<0.059	0.059
43	J. Millette	(Pump Failed)				
44	Area, OWA	3.5/100	193.1	4.1	<0.016	0.016

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 4
Gloves

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
45	BKG, IWA	6.5/100	643.8	7.7	<0.005	0.005
46	BKG, IWA	8/100	643.8	9.4	<0.005	0.005
47	BKG, IWA	2/100	643.8	2.3	<0.005	0.005
48	BKG, IWA	3/100	643.8	3.5	<0.005	0.005
49	BKG, IWA	5.5/100	643.8	6.5	<0.005	0.005
50	Area, IWA	Not Analyzed (Overloaded)	321.9	-	-	0.010
51	Area, IWA	Not Analyzed (Overloaded)	321.9	-	-	0.010
52	Blank	4/100	0	4.7	N/A	N/A
53	Bill Gaumer	143/20 (Heavy Loaded)	84	842.2	3.839	0.038
54	Bill Gaumer	118.5/20 (Heavy Loaded)	57	697.9	4.685	0.056
55	Ed Dodd	148.5/20	84	874.6	3.987	0.038
56	Ed Dodd	113.5/25 (Heavy Loaded)	57	524.2	3.541	0.047
58	Area, OWA	4/100	321.9	4.7	<0.010	0.010
59	Area, OWA	2/100	257.5	2.4	<0.010	0.012

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 5
Iron Poking Rod

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
60	BKG, IWA	7.5/100	536.5	8.8	0.006	0.006
61	BKG, IWA	3/100	536.5	3.5	<0.006	0.006
62	BKG, IWA	3.5/100	536.5	4.04	<0.006	0.006
63	BKG, IWA	3/100	536.5	3.5	<0.006	0.006
64	BKG, IWA	7.5/100	536.5	8.8	<0.006	0.006
65	Area, IWA	337.5/20 (Heavy Loaded)	343.4	1987.6	2.229	0.009
66	Area, IWA	305/20 (Heavy Loaded)	343.4	1796.2	2.014	0.009
67	Ed Dodd	112.5/20	89.6	649.5	2.791	0.347
68	Ed Dodd	113.5/20	60.8	655.3	4.150	0.051
69	Bill Gaumer	110/20	89.6	635.1	2.729	0.347
70	Bill Gaumer	108/24	60.8	579.6	3.290	0.0511
71	Blank	0/100	0.0	0.0	N/A	N/A
72	Area, OWA	3.5/100	321.9	4.1	<0.010	0.010
73	Area, OWA	5/100	321.9	5.9	<0.010	0.010
74	Area, OWA	0/100	321.9	0.0	<0.010	0.010

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 6
Gloves and Apron

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
75	BKG, IWA	8/100	600.9	9.4	0.005	0.005
76	BKG, IWA	4.5/100	600.9	5.3	<0.005	0.005
77	BKG, IWA	7.5/100(R)	600.9	8.8	<0.005	0.005
78	BKG, IWA	3/100	600.9	3.5	<0.005	0.005
79	BKG, IWA	2/100	600.9	2.4	<0.005	0.005
80	Area, IWA	100/76 (Heavy Loaded)	332.6	157.9	0.175	0.009
81	Area, IWA	124/100 (Heavy Loaded)	332.6	143.2	0.164	0.009
82	Ed Dodd	107.5/40 (Heavy Loaded)	86.8	310.3	1.371	0.036
83	Ed Dodd	101/42 (Heavy Loaded)	58.9	277.7	1.790	0.053
84	Bill Gaumer	100/32	86.8	360.9	1.596	0.036
85	Bill Gaumer	100.5/37	58.9	313.7	2.043	0.053
86	Blank	1/100	0	0.0	N/A	N/A
87	Area, OWA	1.5/100	332.6	1.7	<0.010	0.009
88	Area, OWA	12/100	321.9	13.9	0.015	0.009
89	Area, OWA	0/100	461.4	0.0	<0.007	0.007

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable

Summary of Phase Contrast Microscopy Results
Asbestos Clothing Experiment

Experiment 7
Banging Gloves II

Sample #	Type	Fibers/Field	Volume	Fibers/mm^2	Fibers/cc	LOD
90	BKG, IWA	9/100	482.9	10.3	<0.006	0.006
91	BKG, IWA	10/100	482.9	11.5	0.008	0.007
92	BKG, IWA	3.5/100	482.9	4.04	<0.006	0.006
93	BKG, IWA	6/100	482.9	6.9	<0.006	0.006
94	BKG, IWA	1.5/100	482.9	1.7	<0.006	0.006
95	Area, IWA	199/20	53.7	1149.0	8.217	0.058
96	Area, IWA	186/20 (Heavy Loaded)	53.7	1073.9	7.679	0.058
97	Bill Gaumer	240/20 (Heavy Loaded)	14	1385.7	38.029	0.222
98	Bill Gaumer	256.5/20	9.5	1480.9	59.904	0.328
99	J. Millette	282.5/20 (Heavy Loaded)	14	1631.1	44.778	0.222
100	Blank	2.5/100	0	2.9	N/A	N/A
101	Area, OWA	4.5/100	53.7	5.7	<0.064	0.064
102	Area, OWA	0.5/100	53.7	0.6	<0.064	0.064
103	Area, OWA	1.5/100	332.6	1.9	<0.010	0.010

OWA - Outside Work Area
IWA - Inside Work Area
NA - Not Applicable