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WILMINGTON, DELAWARE 19898

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November 5, 1985

PLAINTIFF'S EXHIBIT DUP-2409

Docket Officer
Docket No. H-033C
Room S-6212
U.S. Department of Labor
Third Street and Constitution Avenue, N.W.
Washington, DC 20210

Dear Sir:

On October 16, 1984, E. I. du Pont de Nemours and Company (Du Pont) submitted post-hearing Briefs into the record on the Occupational Safety and Health Administration's proposal to revise 29 CFR 1910.1000 - Asbestos. Included in this brief was a preliminary report of a study on the workplace protection factors for elastomeric and single use respirators during asbestos removal operations. Since that time, Du Pont has completed additional work on the precision of the analytical methods used, identification of the fibers found, and the distribution of fibers on the surface of the filters.

We have also completed work using Transmission Electron Microscopy (TEM) which shows that a small diameter non-asbestos fiber was present in the samples taken with the American Optical R1050 respirator which acted as an interference. This means that the actual workplace protection factors were higher than reported for the American Optical R1050 and may have been comparable to the other respirators studied.

In addition, we inadvertantly did not include Figures 1 and 2 on the distribution of fiber sizes in our original submission, these are attached. Also, we received a request from Ching-sten Bien, from the Office of Technical Support requesting detailed information on the methods and results that we obtained. A listing of the individual sample results in reply to that request is also attached.

Very truly yours,

James T. Williamson
Attorney
Environment Group

JTW:cmk
Att.

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DU 029042

RESPIRATOR WORKPLACE PROTECTION FACTORS FOR ASBESTOS

ADDITIONAL INFORMATION

AIR SAMPLING AND ANALYSIS

Information has been developed to determine the deposition of fibers across the 25mm cellulose ester filters. Sets of six area samples were taken with the probe-closed-face cassette samplers and with open-face cassette samplers during the study for which we have just completed an analysis of fiber density. For analysis the filter was zoned into three concentric and equal areas (outer, middle, inner) and the fiber density was determined in each zone. As is shown in Table I and verified by a repeated measure analysis of variance, there is a slight trend for higher fiber concentrations (5%) nearer the center of the filter for both the probe-closed-face cassettes and the open-face cassettes. The trend does not differ for the two samplers (P=0.05).

As was discussed in our original submission, microscopic analyses were done per NIOSH method P&CAM 239 for asbestos fibers in air with the following modifications. We used the Acetone/Triacetin filter mounting procedure, which is described in NIOSH method 7400. We have found this to be superior to the phthalate mixture method in P&CAM 239 in that it gives better quality slides with very low background fiber counts.

We used the "A" counting rules in NIOSH method 7400 which are identical to the P&CAM 239 counting rules. These include counting all fibers with length to width ratios of greater

than 3 and lengths greater than 5 um. We extended the stopping rules in the NIOSH method to require that a minimum of 500 fields, rather than 100 fields be observed when fewer than 100 fibers were counted. This greatly increased the analysis time for samples, but was required to provide the maximum feasible sensitivity.

The additional information that we are submitting with this document includes the results of a special study to determine the precision of our microscopist's counts over the range of airborne asbestos concentrations encountered in our study. He made six blind counts for each of fourteen filter samples, from which coefficients of variation were calculated. Table II shows the mean coefficients of variation for the samples grouped by airborne asbestos concentration. The number of fields observed is also shown. The coefficient of variation is reduced by increasing the asbestos concentration and by increasing the number of fields observed. It remains at 0.2 down through the 0.001 to 0.01 fiber/ml concentration range. Below 0.001 fiber/ml it increases to 0.4. Ninety-seven percent of the measured asbestos concentrations in our study were above 0.001 fibers/ml.

ADDITIONAL TRANSMISSION ELECTRON MICROSCOPY STUDIES

In our original submission we concluded that the performance of the American Optical R1050 may be lower than 3M 9910 respirator based on estimates of the fifth percentile.

In a study submitted into the record by Larry Ortiz and others from Los Alamos, the filter penetration of asbestos for many of the same respirators we studied showed that the high efficiency North, 3M 8710 and Survivair with a dust, mist and fume filter had the penetration of asbestos equal to each other when tested straight from the package. The penetration was less than 0.1% which corresponds to a fit factor of 1000 or more. The American Optical R1050 was reported to have asbestos penetration of 0.6 to 2.8%.

In the Los Alamos study, the difference in penetration between the American Optical R1050 and the other respirators was not seen when these same filters were tested with a small diameter oil mist. The American Optical R1050 shows a much lower penetration of 3 to 9%, the 3M 8710 a higher penetration of 17 to 31%, the Survivair a penetration of 15 to 24%. This was inconsistent with the asbestos penetration results.

American Optical has also sent in information to the docket pointing out inconsistencies in the data. In the American Optical tests, filter penetration of specific portions of the respirator were examined to determine if folds and creases in the filter media were the cause of this unexpected and confusing

result. Their data showed that sodium chloride penetration for the American Optical respirator was less than in the 3M 8710 and did not vary over the surface of the respirator.

Examination of in-mask and lapel filters from our study by transmission electron microscopy and energy dispersive x-ray emission showed that an interference from extraneous fibers was present with the American Optical respirators. These fibers have the same appearance under the light microscope as asbestos, but when examined with energy dispersive x-ray analysis the mineral content matched that of a fibrous glass that forms part of the filter matrix of the respirator.

Thus, the actual performance of the AO-R1050 was likely better than our reported estimate, and may not be significantly lower than the other respirators studied.

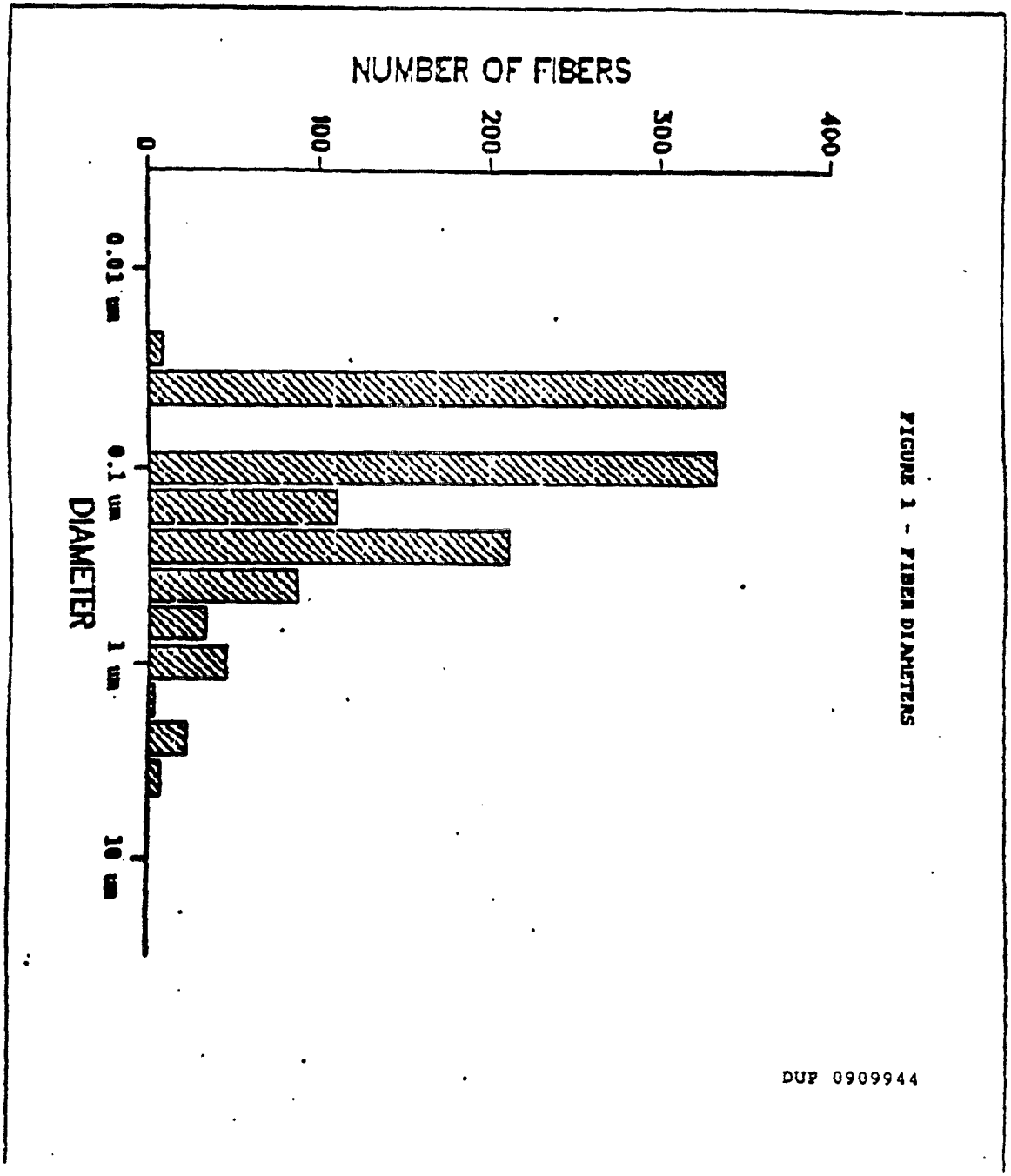

FIGURE 1 - FIBER DIAMETERS

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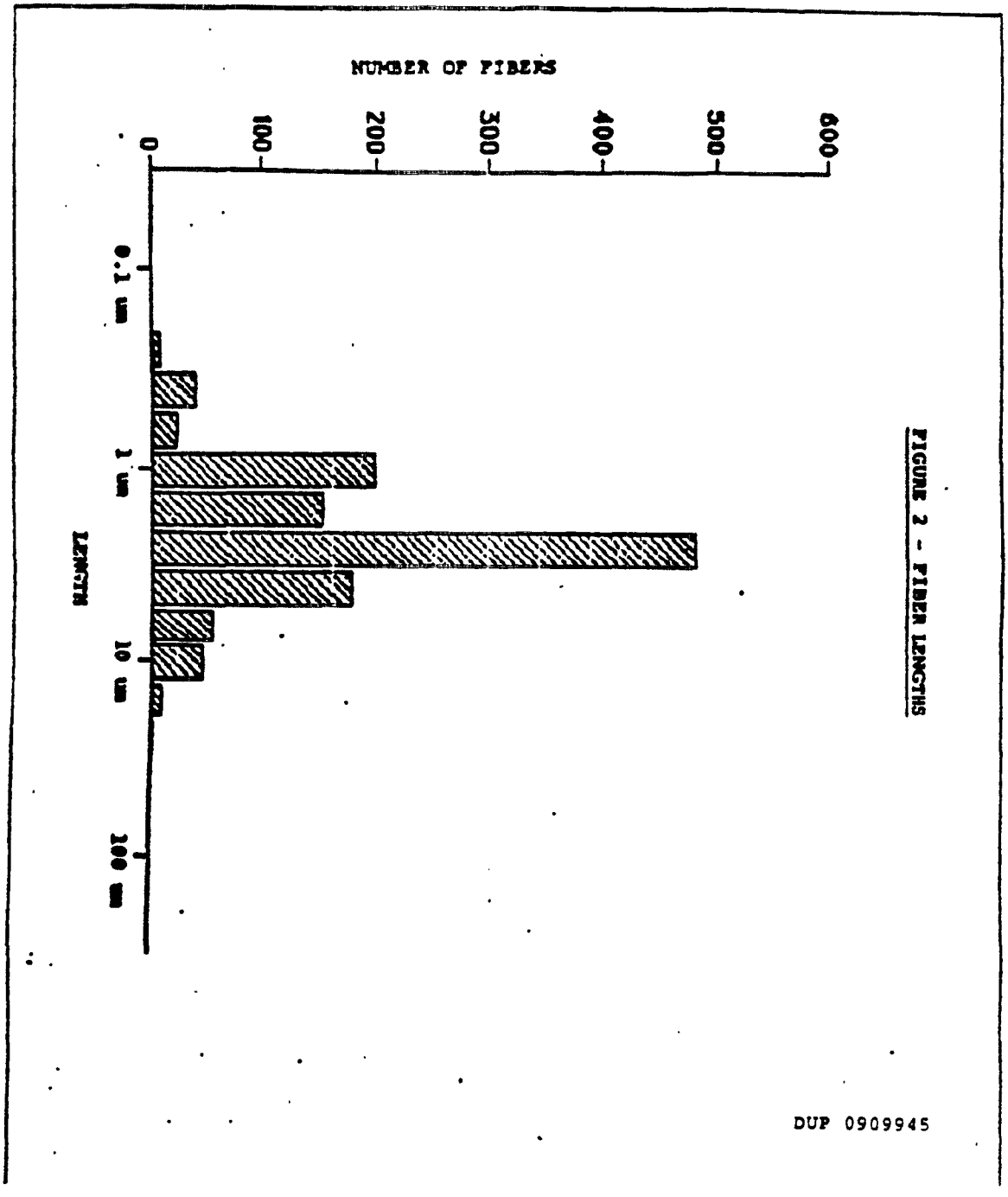

FIGURE 2 - FIBER LENGTHS

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DuPONT ASBESTOS RESPIRATOR STUDY

TABLE I

Distribution of Fibers on the Filter Surface

CASSETTE TYPE	MEAN FIBERS PER FIELD		
	OUTER ZONE	MIDDLE ZONE	INNER ZONE
OPEN- FACE	10.2	10.3	10.7
CLOSED- FACE with Probe	9.2	9.4	9.6

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DuPONT ASBESTOS RESPIRATOR STUDY

TABLE II

Percision at Various Concentrations of Asbestos

COEFFICIENT OF VARIATION	CONCENTRATION (FIBERS/ ML)	NUMBER OF FIELDS OBSERVED
0.4	<0.001	500
0.2	0.001 - 0.01	500
0.1	0.01 - 0.1	500
0.2	0.1 - 3.0	20 - 100

Respirator Workplace Protection Factors for Asbestos - Raw Data

Respirator/Size	Sample #	Workplace Protection Factor	Site	Subject	Date
1050	7021/7022	75	1	3	05/02/84
1050	7070/7071	974	1	3	05/03/84
1050	7006/7007	9.67	1	4	05/02/84
1050	7063/7064	52.5	1	4	05/03/84
1050	6951/6952	38.0	1	5	05/03/84
1050	7008/7009	26.0	1	6	05/02/84
1050	7061/7062	27.7	1	6	05/03/84
8710	7041/7042	401	1	1	05/03/84
8710	7047/7048	1560	1	1	05/03/84
8710	6905/6906	420	1	2	05/01/84
8710	7033/7034	1030	1	2	05/02/84
8710	7004/7005	1020	1	3	05/01/84
8710	7027/7028	1760	1	3	05/02/84
8710	7023/7024	195	1	4	05/02/84
8710	6901/6902	1520	1	5	05/01/84
8710	7067/7068	3180	1	5	05/03/84
8710	6903/6904	107	1	6	05/01/84
8710	7025/7026	1070	1	6	05/02/84
8710	7547/7548	107	2	9	07/19/84
8710	7462/7463	7.39	2	10	07/20/84
8710	7626/7527	431	2	11	07/20/84
8710	7563/7564	61.3	2	13	07/20/84
8710	7435/7436	15.2	2	14	07/17/84
8710	7448/7449	309	2	16	07/18/84
8710	7504/7505	178	2	17	07/17/85
9910	7076/7077	1270	1	1	05/04/84
9910	7012/7013	711	1	3	05/02/84
9910	7053/7054	3680	1	3	05/03/84
9910	7017/7018	546	1	4	05/02/84
9910	7072/7073	5580	1	4	05/04/84
9910	6907/6908	2380	1	5	05/02/84
9910	7015/7016	3000	1	6	05/02/84
9910	7506/7507	630	2	7	07/17/84
9910	7414/7415	154	2	9	07/20/84
9910	7412/7413	284	2	10	07/20/84
9910	7403/7404	150	2	12	07/17/84
9910	7444/7445	168	2	14	07/17/84
9910	7430/7431	106	2	16	07/18/84
9910	7442/7443	94.2	2	17	07/17/84
NH-H-M	7074/7075	3140	1	1	05/04/84
NH-H-M	7039/7040	1880	1	3	05/02/84
NH-H-L	7043/7044	12.2	1	4	05/03/84
NH-H-M	7078/7079	2050	1	5	05/04/84

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Respirator Workplace Protection Factors for Asbestos - Raw Data

Respirator/Size	Sample #	Workplace Protection Factor	Site	Subject	Date
NH-H-L	6944/6945	2450	1	6	05/03/84
NH-H-M	7520/7521	19.9	2	7	07/18/84
NH-H-M	7558/7559	396	2	8	07/20/84
NH-H-M	7531/7532	260	2	9	07/19/84
NH-H-M	7545/7546	110	2	10	07/19/84
NH-H-M	7410/7411	353	2	11	07/20/84
NH-H-M	7406/7407	35.7	2	14	07/18/84
NH-H-M	7424/7425	74.4	2	15	07/18/84
NH-H-M	7454/7455	1030	2	16	07/18/84
NH-H-M	7522/7523	59.9	2	17	07/18/84
MC-F-L	7029/7030	4220	1	2	05/02/84
MC-H-L	7010/7011	775	1	2	05/02/84
SV-F-M	7065/7066	1092	1	1	05/03/84
SV-F-L	7057/7058	46.6	1	4	05/03/84
SV-F-L	7082/7083	88.4	1	4	05/04/84
SV-F-L	6926/6927	4070	1	4	05/03/84
SV-F-M	6942/6943	1040	1	5	05/03/84
SV-F-L	7059/7060	369	1	6	05/03/84
SV-F-L	6924/6925	1770	1	6	05/03/84
SV-F-M	7405/7441	136	2	7	07/18/84
SV-F-M	7422/7423	14.7	2	8	07/17/84
SV-F-M	7464/7465	24.2	2	9	07/20/84
SV-F-M	7553/7554	190	2	10	07/19/84
SV-F-M	7541/7542	>1120	2	11	07/19/84
SV-F-M	7428/7429	483	2	13	07/19/84
SV-F-M	7528/7529	45.5	2	14	07/18/84
SV-F-M	7543/7544	45.2	2	16	07/19/84
SV-F-M	7524/7525	73.7	2	17	07/18/84
SV-H-L	7051/7052	12.2	1	4	05/03/84
SV-H-L	7035/7036	85.2	1	4	05/02/84
SV-H-M	6928/6929	7860	1	5	05/03/84
SV-H-L	7055/7056	27.9	1	6	05/03/84
SV-H-L	7037/7038	222	1	6	05/02/84
SV-H-M	7401/7402	64.6	2	7	07/17/84
SV-H-M	7420/7421	114	2	8	07/17/84
SV-H-M	7533/7534	135	2	10	07/19/84
SV-H-M	7456/7457	155	2	11	07/19/84
SV-H-M	7426/7427	122	2	13	07/18/84
SV-H-M	7408/7409	41.9	2	14	07/18/84
SV-H-M	7432/7512	31.8	2	15	07/18/84
SV-H-M	7458/7459	223	2	16	07/19/84
SV-H-M	7439/7440	162	2	17	07/18/84
SCBA-M	7565/7566	404	2	8	07/20/84
SCBA-M	7560/7561	877	2	13	07/20/84

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DU 029052

Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Lapel (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
1050							
7021	I	0.0833	100	318	131	1.88	70
7022	L	6.24	130	20	36	0.51	70
7070	L	6.52	132	20	35	1.03	33
7071	I	0.00669	6	500	62	1.88	33
7006	I	1.02	122	41	101	1.88	54
7007	L	9.85	159.5	20	28	0.51	54
7063	I	0.194	107.5	240	80	1.88	43
7064	L	10.18	129.5	20	22	0.51	43
6951	I	0.0925	103	220	175	1.94	91
6952	L	3.52	203.5	20	100	1.05	91
7008	I	0.333	102	104	102	1.86	55
7009	L	8.65	140	20	28	0.51	55
7061	I	0.353	103	120	84	1.84	46
7062	L	9.77	130	20	23	0.51	46
8710							
7041	I	0.0117	13.5	500	80	1.84	44
7042	L	4.68	130	20	48	1.03	44
7047	I	0.00601	4	500	46	1.83	25
7048	L	9.36	151.5	20	28	1.05	25
6905	I	0.00576	12	500	144	1.89	77
6906	L	2.42	196	20	140	1.84	77
7033	I	0.00720	10	500	96	1.86	52
7034	L	7.42	111.5	20	26	0.50	52
7004	I	0.00348	7	500	139	1.81	77
7005	L	3.54	286.5	20	140	1.84	77
7027	I	0.00358	6	500	116	1.89	62
7028	L	6.30	116.5	20	32	0.51	62
7023	I	0.0497	80.5	500	112	1.89	60
7024	L	9.68	173.5	20	31	0.52	60

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DU 029053

Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Lapel (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
6901	L	2.91	236	20	140	1.84	77
6902	I	0.00192	4	500	144	1.89	77
7067	I	0.00131	2	500	106	1.94	55
7068	L	4.15	144	20	60	1.05	55
6903	I	0.0299	60	500	139	1.81	77
6904	L	3.20	255.5	20	138	1.80	77
7025	I	0.00826	13.5	500	113	1.86	61
7026	L	8.87	159	20	31	0.51	61
7547	I	0.00958	12.5	500	90.3	2.1	43
7548	L	1.02	121	100	40.9	0.95	43
7462	I	0.0188	31.5	1000	57.9	1.93	30
7463	L	0.139	206	900	57.9	1.93	30
7526	I	0.00136	2	500	101.4	1.95	52
7527	L	0.586	116	70	97.8	1.88	52
7563	I	0.0123	9	500	50.7	1.95	26
7564	L	0.754	110.5	100	50.7	1.95	26
7435	L	0.0928	202	1000	75.5	0.98	77
7436	I	0.00614	13	500	146	1.90	77
7448	I	0.00186	2	500	74.1	1.95	38
7449	L	0.575	101	82	74.1	1.95	38
7504	L	0.00772	11.5	500	103	1.98	52
7505	I	1.37	143	70	51.5	0.99	52
~~9910~~ 7076	I	0.00548	8	500	101	1.89	54
7077	L	6.98	109	20	27	0.51	54
7012	I	0.00593	9	500	105	1.89	56
7013	L	4.21	106	30	29	0.51	56
7053	I	0.00105	2	500	132	1.79	74
7054	L	3.86	181	20	81	1.1	74

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DU 029054

Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Lapel (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
7017	I	0.0163	30	500	127	1.89	68
7018	L	8.92	180.5	20	35	0.52	68
7072	I	0.00136	2	500	102	1.84	56
7073	L	7.57	127	20	29	0.51	56
6907	I	0.00201	3	500	103	1.89	55
6908	L	4.78	114	25	33	0.55	55
7015	I	0.00340	6	500	122	1.86	66
7016	L	10.2	200.5	20	34	0.51	66
7506	I	0.00414	7	500	117	1.98	59
7507	L	2.61	173.5	20	115	1.95	59
7414	L	2.09	127.5	50	42.1	1.45	29
7415	I	0.0136	16.5	1000	42.1	1.45	29
7412	I	0.00822	5	500	42.1	1.45	29
7413	L	2.34	119.5	42	42.1	1.45	29
7403	I	0.00709	13	500	127	1.95	65
7404	L	1.06	117	60	63.7	0.98	65
7444	I	0.00209	5	500	166	1.95	85
7445	L	0.351	106.5	130	80.8	0.95	85
7430	I	0.0115	13	500	78.0	1.95	40
7431	L	1.22	165	60	78.0	1.95	40
7442	I	0.00530	10	500	131	1.95	67
7443	L	0.499	101	110	63.7	0.95	67
NH-H							
7074	I	0.00243	4	500	114	1.89	61
7075	L	4.26	114.5	30	31	0.51	61
7039	I	0.00314	4	500	88	1.89	47
7040	L	5.91	123	30	24	0.51	47
7043	I	0.609	107.5	50	122	1.84	67
7044	L	7.43	146	20	34	0.51	67
7078	I	0.00201	3	500	103	1.89	55
7079	L	4.14	143.5	20	60	1.1	55
6944	I	0.00427	5	500	81	1.84	44
6945	L	10.5	133	20	22	0.51	44

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Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Label (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
7520	I	0.0167	37	1000	77.2	1.93	40
7521	L	0.333	209	280	78.0	1.95	40
7558	I	0.00444	5	500	78.0	1.95	40
7559	L	1.76	158.5	40	78.0	1.95	40
7531	I	0.00254	3	500	81.9	2.10	39
7532	L	0.661	120.5	170	37.1	0.95	39
7545	I	0.00532	6	500	78.0	1.95	40
7546	L	0.587	107.5	160	39.6	0.99	40
7410	I	0.00254	3	500	81.9	1.95	42
7411	L	0.897	127.5	60	81.9	1.95	42
7406	I	0.0152	24	500	109	1.95	56
7407	L	0.542	133.5	80	106	1.90	56
7424	I	0.00459	5	500	75.3	1.93	39
7425	L	0.341	123	170	73.3	1.88	39
7454	I	<0.000322	<0.5	500	107	1.95	55
7455	L	0.337	104.5	100	107	1.95	55
7522	I	0.00644	6	500	64.4	1.95	33
7523	L	0.386	115	160	64.4	1.95	33
MC-F							
7029	I	0.00180	3	500	115	1.86	62
7030	L	7.61	136.5	20	31	0.50	62
MC-H							
7010	I	0.00964	14.5	500	104	1.86	56
7011	L	7.47	121	20	28	0.50	56
SV-F							
7065	I	0.00843	10	500	82	1.84	45
7066	L	9.21	122.5	20	23	0.51	45
7057	L	7.73	152	20	34	1.03	32
7058	I	0.166	115	400	60	1.89	32
7082	I	0.0364	59.5	500	113	1.84	62
7083	L	3.22	115.5	40	31	0.5	62

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Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Lapel (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
6926	I	0.00194	3	500	107	1.89	57
6927	L	7.90	132.5	20	29	0.51	57
6942	I	0.00381	7.5	500	136	1.94	71
6943	L	3.96	162.5	20	71	1.00	71
7059	I	0.0221	16	500	50	1.79	28
7060	L	8.17	137	20	29	1.03	28
6924	I	0.00466	7	500	104	1.84	57
6925	L	8.23	138	20	29	0.51	57
7405	L	0.609	103	40	146	1.95	80
7441	I	0.00449	10	500	154	1.93	80
7422	I	0.0273	170.5	1000	216	1.98	109
7423	L	0.401	244.5	100	213	1.95	109
7464	I	0.00551	9	1000	56.6	1.95	29
7465	L	0.134	218	1000	56.6	1.95	29
7553	I	0.00182	2	500	76.0	2.00	38
7554	L	0.346	144.5	400	36.1	0.95	38
7541	I	<0.000503	<0.5	500	69.6	1.88	37
7542	L	0.561	114	200	35.2	0.95	37
7428	I	0.000895	1	500	77.1	1.88	41
7429	L	0.432	214.5	215	80.0	1.95	41
7528	I	0.0113	13	500	79.8	1.90	42
7529	L	0.514	101	83	81.9	1.95	42
7543	I	0.00748	8	500	74.0	2.00	37
7544	L	0.338	103	300	35.15	0.95	37
7524	I	0.0119	16.5	500	95.6	1.95	49
7525	L	0.877	157.5	65	95.6	1.95	49
SV-H							
7051	I	0.506	120	100	82	1.99	44
7052	L	6.20	172	20	48	1.10	44
7035	I	0.0752	105.5	500	97	1.89	52
7036	L	6.40	100	20	27	0.52	52

DUP 0909954

Respirator Workplace Protection Factors for Asbestos - Raw Data

Sample #	In-Mask (I) Or Lapel (L)	Fibers/mL	# Fibers	# Fields	Liters	LPM	Minutes
6928	I	0.000474	1	500	146	1.94	76
6929	L	3.73	174.5	20	81	1.03	76
7055	I	0.275	113	200	71	1.79	40
7056	L	7.68	186.5	20	42	1.03	40
7037	I	0.0311	45	500	100	1.86	54
7038	L	6.92	112	20	28	0.51	54
7401	I	0.00957	20	500	154	1.93	80
7402	L	0.618	126	90	78.4	0.98	80
7420	I	0.00855	26.5	500	214	1.95	110
7421	L	0.974	121.5	40	108	0.98	110
7533	I	0.00682	7.5	500	76.1	1.95	39
7534	L	0.918	102.5	100	38.6	0.99	39
7456	I	0.00449	5	500	77.1	1.88	41
7457	L	0.698	107.5	130	39.0	0.95	41
7426	I	0.00388	4	500	71.4	1.88	38
7427	L	0.474	101.5	100	74.1	1.95	38
7408	I	0.0106	12	500	78.0	1.95	40
7409	L	0.444	101.5	104	76.0	1.90	40
7432	I	0.0175	19	500	75.1	1.93	39
7512	L	0.557	118	100	73.3	1.88	39
7458	L	0.374	126.5	300	39.0	0.95	41
7459	I	0.00168	2	500	82.0	2.00	41
7439	I	0.00331	7	500	146	1.95	75
7440	L	0.538	113.5	50	146	1.95	75
SCBA							
7565	I	0.00272	2	500	50.7	1.95	26
7566	L	1.10	129	80	50.7	1.95	26
7560	I	0.00177	2	500	78.0	1.95	40
7561	L	1.55	140	40	78.0	1.95	40

DUP 0909955

DU 029058

Supplementary Information/Abbreviation Key

Filter Area = 415 mm^2
Microscope Field Area = 0.0120 mm^2
Site 1 = Ceiling Removal Operation
Site 2 = Pipe Insulation Removal Operation

Respirators

S = Small Size
M = Medium Size
L = Large Size
1050 = American Optical® R-1050 Disposable (One Size)
8710 = 3M 8710 Disposable (One Size)
9910 = 3M 9910 Disposable (One Size)
MC-F = Mine Safety Appliance Co. Comfo II® with Dust, Fume and Mist Filters, neoprene Facepiece (S,M and L Sizes)
MC-H = Mine Safety Appliance Co. Comfo II® with High Efficiency Filters, neoprene Facepiece (S,M and L Sizes)
NH-H = North 7700 With High Efficiency Particulate Filters, Silicone Rubber Facepiece (S,M and L Sizes)
SV-F = Survivair® 2000 With Dust, Fume and Mist Filters, Silicone Rubber Facepiece (S,M and L Sizes)
SV-H = Survivair® 2000 With High Efficiency Particulate Filters, Silicone Rubber Facepiece (S,M and L Sizes)
SCBA = Scott Air Pak Self Contained Breathing Apparatus - Pressure Demand Mode-Full Facepiece

DUP 0909956

DU 029059