7. REFERENCES

1. Hollett, B., Caplan, P., Cooper, T., and Froehlich, P. In-Depth Survey Report: Control Technology for Asbestos Removal, June 4–July 11, 1985. DHHS, NIOSH Report 1987 (ECTB No. 147-19a). NTIS Publ. No. PB-88-163191

2. Hollett, B., Caplan, P., Cooper, T., and Froehlich, P. In-Depth Survey Report: Control Technology for Asbestos Removal, June 4–July 10, 1985. DHHS, NIOSH Report 1987 (ECTB No. 147-19b). NTIS Publ. No. PB-88-162201

3. Hollett, B., Caplan, P., Cooper, T., and Froehlich, P. In-Depth Survey Report: Control Technology for Asbestos Removal, June 4–July 9, 1985. DHHS, NIOSH Report 1987 (ECTB No. 147-19c). NTIS Publ. No. PB-88-189451

4. Hollett, B., Caplan, P., Cooper, T., and Froehlich, P. In-Depth Survey Report: Control Technology for Asbestos Removal, June 4–July 18, 1985. DHHS, NIOSH Report 1987 (ECTB No. 147-19d). NTIS Publ. No. PB-88-162250

5. NIOSH. 1985. Project Protocol for Control Technology Assessment of Asbestos Removal Processes. August 1985. Unpublished.

6. USEPA. 1972. National Emission Standards for Hazardous Air Pollutants. 40CFR61 Subpart A & B. 38FR8826. April 6, 1973.

7. USEPA. 1972. The Clean Air Act. 42 U.S.C. 7412, 7601(a).

8. USEPA. 1982. Friable Asbestos-Containing Material in Schools: Identification and Notification Rule. 40CFR763. 47FR23360. May 27, 1982.

9. USEPA. 1983. U.S. Environmental Protection Agency. Guidance for Controlling Friable Asbestos-Containing Material in Buildings. Washington, DC. Office of Toxic Substances and Office of Pesticides and Toxic Substances, USEPA. EPA-560/5-83-002.

10. USEPA. 1985. U.S. Environmental Protection Agency. Guidance for Controlling Friable Asbestos-Containing Material in Buildings. Washington, DC. Office of Toxic Substances and Office of Pesticides and Toxic Substances, USEPA. EPA-560/5-85-024.

11. Public Law 99-519. Asbestos Hazard Emergency Response Act of 1986, Sec 2 Amendment to Toxic Substance Control Act, Title II-Asbestos Hazard Emergency Response. Signed October 22, 1986.

12. USEPA. 1984. National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations. 40CFR61, Subpart M. 49FR13661. April 5, 1984.

13. USDOL, OSHA. 1986. Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules. 29CFR1910.1001 and 29CFR1926.58. 51FR22612 (June 20, 1986).

14. NIOSH. 1984. Method 7400. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. Third Ed., Vol 2. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 84-100. (February 15, 1984).

15. Ibid. Revision #1. (May 15, 1985).

16. Ibid. Revision #2. (August 15, 1987).

17. Ibid. Revision #3. (May 15, 1989).

18. Baron, P. and Deye, G. 1990. Electrostatic Effects in Asbestos Sampling I: Experimental Measurements. American Industrial Hygiene Association Journal. 51(2):51-62.

19. USEPA. 1977 (Rev. June 1978). U.S. Environmental Protection Agency. Electron Microscope Measurement of Airborne Asbestos Concentrations. Research Triangle Park, NC. Office of Research and Development, USEPA. EPA-600/2-77-178.

20. NIOSH. 1987. Method 7402. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. Third Ed., Vol 2. March 1987 Revision. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 84-100.

21. Ibid. Revision #2. (August 15, 1989).

22. Gandee, David P. 1983. Report of the Asbestos Detection Program for the Cincinnati Public School District, Cincinnati, OH. Unpublished.

23. NIOSH. 1984. NIOSH testimony to the U.S. Department of Labor: statement of the National Institute for Occupational Safety and Health. Presented at the public hearing on occupational exposure to asbestos, June 21, 1984. NIOSH policy statement. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public health Service. Centers for Disease Control. National Institute for Occupational Safety and Health on the Occupational Safety and Health.

24. NIOSH. 1990. Testimony of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration's Notice of Proposed Rulemaking on Occupational Exposure to Asbestos, Tremolite, Anthrophyllite, and Actinolite, May 9, 1990. NIOSH policy statement. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health.

25. NIOSH. 1976. Criteria for a recommended standard: occupational exposure to asbestos. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 77-169.

26. NIOSH. 1980. Workplace exposure to asbestos: review and recommendations. NIOSH-OSHA Asbestos Work Group. Cincinnati, OH. U.S. Dept. of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 81-103.

27. USDOL, OSHA. 1983. OSHA Safety and Health Standards. 29CFR1910. General Industry, Section 1910.1001 Asbestos. OSHA 2006 Revised March 11,1983.

28. USDOL, OSHA. 1988. Amendment to Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules. 29CFR1910.1001. 53FR35610 (September 14, 1988).

29. USEPA. 1987. Asbestos in Schools Rule. Worker protection rule, Subpart G Revised. 40CFR763. 52FR5618. February 25, 1987.

30. NIOSH. 1977. Method P&CAM 239. National Inst. for Occupational Safety and Health. NIOSH Manual of Analytical Methods. Second Ed., Vol 1. Cincinnati, OH. U.S. Dept. of Health Education and Welfare. DHEW (NIOSH) Publication No. 77-157-A.

31. Chatfield, E. J. 1983. Measurement of Asbestos Fibre Concentrations in Ambient Atmospheres. Ontario, Canada. Ontario Research Foundation.

32. USEPA. 1987. Asbestos-Containing Materials in Schools Final Rule and Notice. 40CFR763. 52FR210/41826. October 30, 1987.

33. USEPA. 1985. Measuring Airborne Asbestos Following an Abatement Action. Research Triangle Park, NC. Environmental Monitoring Systems Laboratory. Washington, DC. Office of Pesticides and Toxic Substances. EPA-600/4-85-049. November 1985.

34. Wilmoth, Roger C. Memo to Hugh Spitzer, Office of Regulatory Support and Scientific Analysis, EPA. Technical Review of Draft of AHERA Regulations. Water Engineering Research Laboratory, ORD, EPA. October 9, 1987.

35. Power, Thomas J. 1986. Filter Blank Contamination in Asbestos Abatement Monitoring Procedures: Proceedings of a Peer Review Workshop. USEPA Water Engineering Research Laboratory. Cincinnati, OH. Contract No. 68-03-3264.

36. Steel, Eric B. and Small, John A. 1985. Accuracy of Transmission Electron Microscopy for the Analysis of Asbestos in Ambient Environments. Analytical Chemistry. 57, 209-213. January 1, 1985.

37. Power, Thomas J. and Cain, William. 1987. Results of Air Sampling from Selected Asbestos Abatement Projects. Presented at the Third Annual NAC Fall Technical Conference and Exposition. Oakland, CA. September 22, 1987.

38. The Glove Bag Technique for Asbestos Removal of Pipe Covering using Safe-T-Strip Glove Bags. Instructor Graham Dewar. Asbeguard Equipment Inc.

39. Nash, Kenneth, V. Pres., W. W. Nash & Sons, Inc. Richmond, VA 23220.

40. Burdett, Garry J. and Rood, Anthony P. 1983. Membrane-Filter, Direct-Transfer Technique for the Analysis of Asbestos Fibers or Other Inorganic Particles by Transmission Electron Microscopy. American Chemical Society, Environmental Science and Technology. 17-11:643-649.

41. USEPA/NIOSH. 1986. A Guide to Respiratory Protection for the Asbestos Abatement Industry. Washington, DC. Office of Pesticides and Toxic Substances Asbestos Action Program. USEPA. EPA-560-OPTS-86-001. April 1986.

APPENDIX A

SUMMARY TABLES FROM REPORTS OF INDIVIDUAL FACILITIES

TABLE A1-1 PERSONAL EXPOSURE MEASUREMENTS DURING PREPARATION AND REMOVAL OF PIPE LAGGING AT FACILITY 1

Exposure is reported as f/cc using NIOSH 7400-B Method

WORKER	TYPE*	ACTIVITY	JUNE 18	JUNE 19	JUNE 20	JUNE 21
# A	TWA		0.25	0.30	0.47	0.17
	ST	REMOVAL			0.38	
	ST	REMOVAL			0.77	
	ST	REMOVAL			1.10	
# B	TWA		**	0.10	0.33	0.12
	ST	PREPARATION		0.03		
	ST	REMOVAL		1.00	0.52	0.34
	ST	REMOVAL			0.14	
# C	TWA		**	0.25	0.49	0.12
	ST	REMOVAL				0.43
	ST	REMOVAL				0.07
# D	TWA		0.21	0.32	0.31	0.15
	ST	PREPARATION		0.03		
	ST	REMOVAL		0.71	1.10	0.25
	ST	REMOVAL		0.92	1.20	
	ST	REMOVAL		0.95		

*   TWA — Sequential, full-shift Time-Weighted-Average
     ST — 15 Minute Short-Term
** In the report for this facility, values of 0.014 and 0.015 for workers B and C respectively are shown. However, subsequent investigation has indicated that values of "below detectable limit" reported by the analytical service should have stated that samples were obscured by too many particulates to be counted.

TABLE A1-2 PERSONAL EXPOSURE MEASUREMENTS DURING PREPARATION AND REMOVAL OF PIPE LAGGING AT FACILITY 2

Exposure is reported as f/cc using NIOSH 7400-B Method (PCM)

WORKER	TYPE*	ACTIVITY	JUNE 25	JUNE 26	JUNE 27	JUNE 28
# A	TWA		0.025	**	**	0.254
	ST	PREPARATION	0.017		0.045	
	ST	REMOVAL		0.188	0.956	0.178
	ST	REMOVAL	1.33	0.667		0.333
# B	TWA		0.339	0.348	**	0.198
	ST	PREPARATION	0.017		0.044	
	ST	REMOVAL	1.38	0.286	***	0.233
	ST	REMOVAL	0.91	0.756		0.400
# C	TWA		0.224	**	0.312	0.350
	ST	PREPARATION	0.025		0.033	
	ST	REMOVAL	0.711	0.457	0.867	0.233
	ST	REMOVAL		0.222		0.688
# D	TWA		**	0.290	**	**
	ST	PREPARATION			0.033	
	ST	REMOVAL	2.91	0.244	0.521	1.93
		REMOVAL		0.250		

* TWA - Time-Weighted-Averages for Preparation and Removal Work
  ST - 15 Minute Short-Term
** The TWA not reported. One of the sequential samples was overloaded with particulates.
***Not counted - sample overloaded with particulates.

TABLE A1-3 PERSONAL EXPOSURE MEASUREMENTS DURING PREPARATION AND REMOVAL OF PIPE LAGGING AT FACILITY 3

Exposure is reported as f/cc using NIOSH 7400-B Method

WORKER	TYPE*	ACTIVITY	JULY 01	JULY 02	JULY 03
# A	TWA		0.345	0.554	0.799
	ST	PREPARATION	0.016		
	ST	REMOVAL	1.0	0.156	0.167
	ST	REMOVAL		2.0	
# B	TWA		0.295	0.560	0.412
	ST	REMOVAL	0.711	0.756	
# C	TWA		0.343	0.663	0.475
	ST	PREPARATION	0.017		
	ST	REMOVAL	0.467	3.18	0.711
	ST	REMOVAL	1.27	0.911	
# D	TWA		0.161	0.639	0.611
	ST	REMOVAL	0.933	2.44	0.622
	ST	REMOVAL		2.78	1.02
	ST	REMOVAL		9.29**	

*   TWA - Sequential, full-shift Time-Weighted-Average
    ST - 15 Minute Short-Term
** The Short-Term sample reported was during an episode of high release.
    A 10-ft. section of lagging separated from the pipe inside the poly.

TABLE A1-4 PERSONAL EXPOSURE MEASUREMENTS DURING PREPARATION AND REMOVAL OF PIPE LAGGING AT FACILITY 4

Exposure is reported as f/cc using NIOSH 7400-B Method

WORKER	TYPE*	ACTIVITY	JULY 15	JULY 16	JULY 17
# A	TWA		0.011	0.015	0.009
	ST	PREPARATION	0.015		
	ST	REMOVAL	0.022	0.016	0.016
	ST	REMOVAL			0.017
# B	TWA		0.010	0.013	0.005
	ST	PREPARATION	0.006		
	ST	REMOVAL	0.032	0.065	0.034
# C	TWA		0.003	**	0.008
	ST	PREPARATION	0.002		
	ST	REMOVAL	0.035	0.086	0.017
	ST	REMOVAL		0.20	0.016
# D	TWA		0.013	**	0.010
	ST	PREPARATION	0.016		
	ST	REMOVAL	0.036		0.044

*   TWA — Sequential, full-shift Time-Weighted-Average
   ST — 15 Minute Short-Term
** One of the filters was overloaded with particulates.

TABLE A2-1 PERSONAL SAMPLING RESULTS BY ACTIVITY AT FACILITY 1

PCM Analysis: f/cc using NIOSH 7400-B Method

WORKER	JUNE 18 ROOM B	JUNE 19 ROOM A	JUNE 20 ROOM B	JUNE 21 ROOM C	MEAN	MIN	MAX	ST D*	n*
— — — — — — — — —		PREPARATION FOR PIPE LAGGING REMOVAL		— — — — — — — — —					
A	0.032	0.026			0.029				
B	0.029	0.037			0.033				
C	0.032	0.029			0.030				
D	0.054	0.034			0.044				
PREP AVERAGE	0.037	0.032			0.034	0.026	0.054	0.009	8
— — — — — — — — — — — —		PIPE LAGGING REMOVAL		— — — — — — — — — — — —					
A	0.40				0.40				1
		0.55	0.42		0.48				2
			0.53	0.17	0.35				2
AVG					0.414	0.17	0.55	0.135	5
B	**				0.003				1
		0.12	0.36		0.240				2
			0.30	0.12	0.210				2
AVG					0.225	0.012	0.36	0.107	4
C	**				0.003				1
		0.45	0.55		0.500				2
			0.43	0.12	0.280				2
AVG					0.388	0.012	0.55	0.161	4
D	0.32				0.320				1
		0.64	0.32		0.480				2
			0.29	0.15	0.220				2
AVG					0.344	0.15	0.64	0.161	5
REMOVAL AVERAGE	0.36	0.44	0.40	0.14	0.347	0.012	0.64	0.160	18
AMBIENT	0.002	0.002	0.003	0.002	0.002	0.001	0.003	0.001	8

* ST D — Standard Deviation   n — number of samples
** In the report for this facility, values of 0.003 are shown. However, subsequent investigation has indicated that values of "below detectable limit" reported by the analytical service should have stated that the samples were obscured by too many particulates to be counted.

TABLE A2-2 PERSONAL SAMPLING RESULTS BY ACTIVITY AT FACILITY 2

PCM Analysis: f/cc using NIOSH 7400-B Method

WORKER	JUNE 25 ROOM D	JUNE 26 ROOM D	JUNE 27 ROOM E	JUNE 28 ROOM E	MEAN	MIN	MAX	ST D*	n*
— — — — — — —	— —	PREPARATION FOR PIPE LAGGING REMOVAL	— — — — — — —						
A	0.010		0.022	0.016					
B	0.016		0.054	0.035					
C	0.005		0.022	0.013					
D	0.010		0.022	0.016					
PREP AVERAGE	0.010		0.030		0.020	0.005	0.054	0.015	8
— — — — — — —	— — — — —	PIPE LAGGING REMOVAL	— — — — — — — —						
A	0.043	0.161 **	**		0.102				2
				0.278	0.223				2
				0.169					
AVG				0.223	0.163	0.043	0.278	0.083	4
B	0.606	0.362 0.315	**		0.511				3
				0.060	0.145				2
				0.231					
AVG		0.339		0.145	0.315	0.060	0.606	0.178	5
C	0.522	0.216 **	0.475		0.404				3
				0.323	0.388				2
				0.454					
AVG				0.389	0.398	0.216	0.522	0.112	5
D	**	0.287 0.298	**		0.292				2
			0.354	0.354 **			1		
AVG		0.292			0.313	0.287	0.354	0.029	3
REMOVAL AVERAGE	0.390	0.284	0.475	0.267	0.303	0.043	0.606	0.153	17
AMBIENT	0.001	0.001	0.001	0.001	0.001				8

* ST D = Standard Deviation   n = number of samples
** Filter Overloaded with Particulate - unable to count.

TABLE A2-3 PERSONAL SAMPLING RESULTS BY ACTIVITY AT FACILITY 3

PCM Analysis: f/cc using NIOSH 7400-B Method

WORKER	JULY 01 ROOM F	JULY 02 ROOM G	JULY 03 ROOM G	MEAN	MIN	MAX	ST D*	n*
— — — — — — — — —	PREPARATION FOR PIPE LAGGING REMOVAL		— — — — — — — — — —					
A	0.011							
B	0.008							
C	0.004							
D	0.007							
PREP AVERAGE	0.008			0.008	0.004	0.011	0.003	4
— — — — — — — — — — —	PIPE LAGGING REMOVAL		— — — — — — — — — — —					
A	0.165 1.03	0.260 1.07	0.799					
AVG	0.563	0.554	0.799	0.665	0.165	1.07	0.382	5
B	0.40 0.50	0.263 1.410	0.412					
AVG	0.446	0.837	0.412	0.597	0.263	1.41	0.414	
C	0.505 0.619	0.457 1.10	0.475					
AVG	0.566	0.663	0.475	0.631	0.457	1.10	0.240	5
D	0.241 0.287	0.452 0.951	0.611					
AVG	0.265	0.639	0.611	0.508	0.241	0.951	0.257	5
REMOVAL AVERAGE	0.468	0.745	0.574	0.600	0.165	1.41	0.337	20
AMBIENT	0.001	0.001	0.001	0.001				6

* ST D - Standard Deviation   n - number of samples

TABLE A2-4   PERSONAL SAMPLING RESULTS BY ACTIVITY AT FACILITY 4

PCM Analysis: f/cc using NIOSH 7400-B Method

WORKER	JULY 15	JULY 16	JULY 17	MEAN	MIN	MAX	ST D*	n*
	ROOM H	ROOM I	ROOM J					

— — — — — — — — — PREPARATION FOR PIPE LAGGING REMOVAL — — — — — — — — — —

WORKER	JULY 15	JULY 16	JULY 17	MEAN	MIN	MAX	ST D*	n*
A	0.005							
B	0.006							
C	0.002							
D	0.010							
PREP AVERAGE	0.006			0.006	0.002	0.010	0.003	4

— — — — — — — — — — — PIPE LAGGING REMOVAL — — — — — — — — — — — — —

WORKER	JULY 15	JULY 16	JULY 17	MEAN	MIN	MAX	ST D*	n*
A	0.018	0.015	0.002					
			0.023					
AVG	0.018	0.015	0.012	0.015	0.002	0.023	0.008	4
B	0.015	0.013	0.005****					
AVG	0.015	0.013	0.005	0.011	0.005	0.015	0.004	3
C	0.005	**	0.004					
			0.017					
AVG	0.005		0.010	0.009	0.004	0.017	0.006	3
D	0.017	***	0.010****	0.014				
AVG	0.017		0.010	0.014	0.010	0.017	0.003	2
REMOVAL AVERAGE	0.014	0.014	0.010	0.012	0.002	0.023	0.012	12
AMBIENT	0.001	0.001	0.001	0.001				

*   ST D — Standard Deviation   n — number of samples
**   Filter overloaded with particulate; unable to count.
*** Worker not on job today.
**** Only half shift sample; worker on another job first half of day.

TABLE A3-1   AREA SAMPLING RESULTS PREPARATION FOR PIPE LAGGING REMOVAL
AT FACILITY 1

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JUNE 18 ROOM B		JUNE 19 ROOM A		MEAN	MIN	MAX	ST D*	n*
	PCM f/cc	TEM as/cc	PCM f/cc	TEM as/cc					
PCM ANALYSIS									
NEAR WORKERS	0.030				0.030	0.023	0.040	0.007	4
			0.019		0.019	0.009	0.029	0.014	2
AVERAGE					0.026	0.009	0.040	0.010	6
TEM ANALYSIS	(No Data)								
				0.590	0.590	0.540	0.640	0.069	2
AVERAGE				0.590	0.590	0.540	0.640	0.069	2
ROOM (BACKGROUND)									
PCM ANALYSIS	0.019				0.019	0.018	0.019	0.001	2
			0.013		0.013	0.009	0.017	0.005	2
AVERAGE					0.016	0.009	0.019	0.005	4
TEM ANALYSIS		0.870			0.870	0.574	1.200	0.410	2
				0.670	0.670	0.390	0.960	0.400	2
AVERAGE					0.780	0.390	1.200	0.370	4
HALL (BACKGROUND)									
PCM ANALYSIS	0.048				0.048	0.044	0.053	0.007	2
			0.070		0.070	0.043	0.096	0.037	2
AVERAGE					0.059	0.043	0.096	0.025	4
TEM ANALYSIS		0.499			0.499	0.450	0.550	0.073	2
				0.650	0.650	0.645	0.655	0.006	2
AVERAGE					0.575	0.450	0.655	0.096	4
OUTDOOR AMBIENT									
PCM ANALYSIS	0.002								2
			0.002						2

* f/cc = fibers/cc   as/cc = asbestos structures/cc
  ST D = Standard Deviation   n = number of samples

TABLE A3-2   AREA SAMPLING RESULTS PREPARATION FOR PIPE LAGGING REMOVAL AT FACILITY 2

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JUNE 25 ROOM D PCM f/cc	JUNE 25 ROOM D TEM as/cc	JUNE 27 ROOM E PCM f/cc	JUNE 27 ROOM E TEM as/cc	MEAN	MIN	MAX	ST D*	n*
NEAR WORKERS									
PCM ANALYSIS	0.013				0.012	0.011	0.014	0.002	2
			0.023		0.023	0.023	0.023	0.000	2
AVERAGE					0.018	0.011	0.023	0.005	4
TEM ANALYSIS				1.633	1.633	1.215	2.051	0.418	2
AVERAGE					1.633	1.215	2.051	0.418	2
ROOM (BACKGROUND)									
PCM ANALYSIS	0.015				0.014	0.013	0.016	0.002	2
			0.016		0.015	0.012	0.019	0.005	2
AVERAGE					0.015	0.012	0.019	0.003	4
TEM ANALYSIS		0.370			0.370	0.350	0.390	0.020	2
				1.269	1.269	1.210	1.328	0.059	2
AVERAGE					0.820	0.350	1.328	0.451	4
HALL (BACKGROUND)									
PCM ANALYSIS	0.007				0.007	0.006	0.008	0.001	2
			0.045		0.045	0.024	0.065	0.029	2
AVERAGE					0.026	0.006	0.065	0.024	4
TEM ANALYSIS									
		0.585			0.085	0.575	0.594	0.009	2
				2.061	2.061	1.598	2.525	0.463	2
AVERAGE					1.323	0.575	2.525	0.807	4
OUTDOOR AMBIENT									
PCM ANALYSIS	0.001				0.001	0.001	0.001	0.000	2
			0.001		0.001	0.001	0.001	0.000	2

* f/cc - fibers/cc   as/cc - asbestos structures/cc
  ST D - Standard Deviation   n - number of samples

TABLE A3-3 AREA SAMPLING RESULTS PREPARATION FOR PIPE LAGGING REMOVAL AT FACILITY 3

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

	JULY 1 ROOM F						
	PCM f/cc	TEM as/cc					
SAMPLING SITE			MEAN	MIN	MAX	ST D*	n*
NEAR WORKERS							
PCM ANALYSIS	0.004		0.003	0.003	0.004	0.000	2
(TEM ANALYSIS NOT COMPLETED)							
ROOM (BACKGROUND)							
PCM ANALYSIS	0.006		0.007	0.004	0.009	0.003	2
(TEM ANALYSIS NOT COMPLETED)							
HALL (BACKGROUND)							
PCM ANALYSIS	0.005		0.005	0.002	0.009	0.003	2
(TEM ANALYSIS NOT COMPLETED)							
OUTDOOR AMBIENT							
PCM ANALYSIS	0.001						2

* f/cc — fibers/cc   as/cc — asbestos structures/cc
ST D — Standard Deviation   n — number of samples

TABLE A3-4 AREA SAMPLING RESULTS PREPARATION FOR PIPE LAGGING REMOVAL AT FACILITY 4

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JULY 15 ROOM H PCM f/cc	TEM as/cc	MEAN	MIN	MAX	ST D*	n*
NEAR WORKERS							
PCM ANALYSIS	0.008						
	0.006						
AVERAGE	0.007		0.006				2
(TEM ANALYSIS NOT COMPLETED)							
ROOM (BACKGROUND)							
PCM ANALYSIS	0.003						
	0.013						
AVERAGE	0.008		0.008	0.003	0.013		2
(TEM ANALYSIS NOT COMPLETED)							
HALL (BACKGROUND)							
PCM ANALYSIS	0.001						
	0.001						
AVERAGE	0.001		0.001				2
(TEM ANALYSIS NOT COMPLETED)							
OUTDOOR AMBIENT							
PCM ANALYSIS	0.001		0.001				2

*   f/cc — fibers/cc   as/cc — asbestos structures/cc
ST D — Standard Deviation   n — number of samples

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JUNE 18 ROOM B PCM f/cc	n	TEM as/cc	n	JUNE 19 ROOM A PCM f/cc	n	TEM as/cc	n	JUNE 20 ROOM A/ROOM C PCM f/cc	n	TEM as/cc	n	JUNE 21 ROOM C PCM f/cc	n	TEM as/cc	n	MEAN	MIN	MAX	ST D
NEAR WORKERS																				
PCM ANALYSIS	0.36	2															0.36	0.31	0.41	0.074
					0.47	2			0.35	2							0.41	0.29	0.49	0.086
									0.19	2			0.11	2			0.15	0.10	0.20	0.048
AVERAGE																	0.30	0.10	0.49	0.140
TEM ANALYSIS			3.1	2													3.1	1.7	4.5	2.0
							2.4	2			3.5	2					2.9	1.9	4.5	1.1
											1.1	2			1.4	2	1.3	0.78	1.8	0.45
AVERAGE																	1.500	0.780	4.500	1.600
ROOM (BACKGROUND)																				
PCM ANALYSIS	0.41	2															0.41	0.38	0.44	0.040
					0.47	2											0.47	0.34	0.59	0.140
									0.21	2										
									0.31	2			0.11	2			0.16	0.09	0.23	0.062
AVERAGE																	0.30	0.09	0.59	0.140
TEM ANALYSIS			2.1	2													2.1	2.0	2.1	0.06
							1.7	2			2.7	2					1.5	0.16	3.0	1.50
											1.1	2			0.94	2	1.0	0.84	1.1	0.11
AVERAGE																	1.7	0.16	3.0	0.71
AREA AVERAGE	0.39	4	2.6	4	0.47	4	2.0	4	0.27	8	2.1	8	0.11	4	1.17	2				
HALL (BACKGROUND)																				
PCM ANALYSIS	0.05	2															0.048	0.044	0.053	0.007
					0.07	2			0.13	2							0.100	0.043	0.140	0.042
									0.006	2			0.008	2			0.007	0.006	0.009	0.001
AVERAGE																	0.052	0.043	0.096	0.049
TEM ANALYSIS			0.5	2													0.50	0.45	0.55	0.07
							0.65	2			1.3	2					0.98	0.65	1.5	0.41
											0.51	2			0.26	2	0.39	0.23	0.62	0.17
AVERAGE																	0.63	0.23	1.50	0.375
OUTDOOR AMBIENT																				
PCM ANALYSIS	0.002	2			0.002	2			0.003	2			0.002	2			0.002	0.001	0.003	0.001

*f/cc = fibers/cc   as/cc = asbestos structures/cc   ST D = Standard Deviation   n = number of samples

TABLE A4-2 AREA SAMPLING RESULTS PIPE LAGGING REMOVAL AT FACILITY 2

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JUNE 25 ROOM D PCM f/cc	n*	TEM as/cc	n	JUNE 26 ROOM D PCM f/cc	n	TEM as/cc	n	JUNE 27 ROOM D PCM f/cc	n	TEM as/cc	n	JUNE 28 ROOM E PCM f/cc	n	TEM as/cc	n	MEAN	MIN	MAX	ST D*	n
NEAR WORKERS																					
PCM ANALYSIS	0.52	2			0.15	4			0.38	2							0.30	0.09	0.58	0.17	8
													0.17	4			0.17	0.05	0.33	0.10	4
AVERAGE																	0.26	0.05	0.58	0.16	12
TEM ANALYSIS			2.53	2			1.17	2			2.37	2					2.02	0.83	3.76	1.00	6
															2.60	4	2.6	1.20	5.02	1.46	4
AVERAGE																	2.25	0.83	5.02	1.24	10
ROOM (BACKGROUND)																					
PCM ANALYSIS	0.61	2			0.17	4			0.03	1							0.30	0.03	0.77	0.22	8
													0.18	4			0.18	0.09	0.34	0.10	4
AVERAGE																	0.26	0.03	0.77	0.20	12
TEM ANALYSIS			3.24	2			2.17	4			1.55	2					2.28	1.33	3.22	0.77	8
															2.93	4	2.93	1.20	4.51	1.27	4
AVERAGE																	2.49	1.20	4.51	1.01	12
AREA AVERAGE	0.57	4	2.88	4	0.16	8	1.83	6	0.27	3	1.96	4	0.18	8	2.76	8					
HALL (BACKGROUND)																					
PCM ANALYSIS	0.35	2			0.13	4			0.01	2							0.16	0.01	0.43	0.16	8
													0.02	4			0.02	0.00	0.04	0.01	4
AVERAGE																	0.11	0.00	0.43	0.14	12
TEM ANALYSIS			1.56	2			2.27	4			1.03	2					1.78	0.60	2.51	0.65	8
															1.3	4	1.3	0.46	2.35	0.83	4
AVERAGE																	1.62	0.46	2.51	0.75	12
OUTDOOR AMBIENT																					
PCM ANALYSIS	0.001	2			0.001	2			0.001	2			0.001	2			0.001	0.001	0.001	0.000	8

f/cc = fibers/cc   as/cc = asbestos structures/cc   n = number of samples   ST D = Standard Deviation

TABLE A4-3   AREA SAMPLING RESULTS PIPE LAGGING REMOVAL AT FACILITY 3

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JULY 01 ROOM F PCM f/cc	n*	TEM as/cc	n	JULY 02 ROOM G PCM f/cc	n	TEM as/cc	n	JULY 03 ROOM G PCM f/cc	n	TEM as/cc	n	MEAN	MIN	MAX	ST D*	n
NEAR WORKERS																	
PCM ANALYSIS	0.434	2																
	0.473	2			0.445	2			0.616	2								
					0.800	2												
AVERAGE	0.453	4			0.623	4			0.616	2			0.583	0.002	0.956	0.31	8
(TEM ANALYSIS NOT COMPLETED)				2				4				2					8
ROOM (BACKGROUND)																	
PCM ANALYSIS	0.423	2																
	0.443	2			0.467	2			0.546	2								
					0.789	2												
AVERAGE	0.436	4			0.628	4			0.546	2			0.546	0.258	0.816	0.19	8
(TEM ANALYSIS NOT COMPLETED)				2				4				2					8
AREA AVERAGE	0.444	8			0.625	8			0.581	4			0.565	0.002	0.956	0.24	20
HALL (BACKGROUND)																	
PCM ANALYSIS	0.012	2			0.001	2			0.300	2								
					0.451	2												
AVERAGE	0.012	2			0.226	4			0.300	2			0.155	0.001	0.458	0.23	8
(TEM ANALYSIS NOT COMPLETED)				2				4				2					8
OUTDOOR AMBIENT																	
PCM ANALYSIS	0.001	2			0.001	2			0.001	2			0.001				6

* f/cc = fibers/cc   as/cc = asbestos structures/cc   n = number of samples   ST D = Standard Deviation

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

SAMPLING SITE	JULY 15 ROOM H PCM f/cc	n*	TEM as/cc	n	JULY 16 ROOM I PCM f/cc	n	TEM as/cc	n	JULY 17 ROOM J PCM f/cc	n	TEM as/cc	n	MEAN	MIN	MAX	ST D*	n
NEAR WORKERS																	
PCM ANALYSIS	0.007	2			0.013	1**			0.003	2							
									0.006	2							
AVERAGE	0.007	2			0.013	1			0.004	4			0.006	0.001	0.013	0.004	7
(TEM ANALYSIS NOT COMPLETED)																	
ROOM (BACKGROUND)																	
PCM ANALYSIS	0.007	2			0.032	2***			0.004	2							
									0.013	2							
AVERAGE	0.007	2			0.032	2			0.009	4			0.012	0.002	0.051	0.016	8
(TEM ANALYSIS NOT COMPLETED)																	
AREA AVERAGE	0.007	4			0.026	3			0.006	8							
HALL (BACKGROUND)																	
PCM ANALYSIS	0.002	2			0.002	2			0.001	2							
									0.004	2							
AVERAGE	0.002	2			0.002	2			0.002	4			0.002	0.001	0.004	0.001	8
(TEM ANALYSIS NOT COMPLETED)																	
OUTDOOR AMBIENT																	
PCM ANALYSIS	0.001	2			0.001	2			0.001	2			0.001				6

* f/cc = fibers/cc as/cc = asbestos structures/cc n = number of samples ST D = Standard Deviation

** The other filter sample of this pair was overloaded with particulates; unable to count.

*** One of the paired samples was overloaded with particulates; unable to count. However, a 20 min short
   term area sample which measured 0.051 f/cc was included in this average .

TABLE A5-1   MEAN ASBESTOS STRUCTURE AND ASBESTOS FIBER CONCENTRATIONS AT FACILITY 1

Analysis by TEM using EPA Provisional Method

Sample	Structures/m^3	Fibers/m^3
Pre-Removal		
Nonaggressive	77,000	65,000
Aggressive	167,000	139,000
Post-Removal		
Nonaggressive	148,000	140,000
Aggressive	385,000	294,000

TABLE A5-2   MEAN ASBESTOS STRUCTURE AND ASBESTOS FIBER CONCENTRATIONS AT FACILITY 2

Analysis by TEM using EPA Provisional Method

Sample	Structures/m^3	Fibers/m^3
Pre-Removal		
Nonaggressive	85,700	73,800
Aggressive	119,000	113,000
Post-Removal		
Nonaggressive	260,000	232,000
Aggressive	283,000	217,000

TABLE A5-3 MEAN ASBESTOS STRUCTURE AND ASBESTOS FIBER CONCENTRATIONS AT FACILITY 3

Analysis by TEM using EPA Provisional Method

Sample	Structures/m^3	Fibers/m^3
Pre Removal		
Nonaggressive	N/C	N/C
Aggressive	130,000	80,000
Post Removal		
Nonaggressive	N/C	N/C
Aggressive	130,000	110,000

N/C - Analysis not completed.

TABLE A5-4 MEAN ASBESTOS STRUCTURE AND ASBESTOS FIBER CONCENTRATIONS AT FACILITY 4

Analysis by TEM using EPA Provisional Method

Sample	Structures/m^3	Fibers/m^3
Pre Removal		
Nonaggressive	N/C	N/C
Aggressive	270,000	200,000
Post Removal		
Nonaggressive	N/C	N/C
Aggressive	80,000	62,000

N/C - Analysis not completed.

TABLE A6-1 COMPARISON OF MEAN PRE- AND POST-REMOVAL AREA SAMPLING AT FACILITY 1

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

LOCATION	JUNE 14 PRE-REMOVAL SAMPLES							JULY 9 POST-REMOVAL SAMPLES						
	NIOSH PCM AND TEM				EPA TEM ANALYSIS**			NIOSH PCM AND TEM				EPA TEM ANALYSIS**		
	f/cc	n	as/cc	n	as/cc Total	>5 um long	n	f/cc	n	as/cc	n	as/cc Total	>5 um long	n
NONAGGRESSIVE SAMPLING METHOD														
ROOM A	0.002	6	0.001	1	0.089	0.009	3	0.003	6	0.003	1	0.065	0.005	3
ROOM B	0.006	6	0.000	1	0.065	0.005	3	0.007	6	0.028	1	0.230	0.005	3
OUTSIDE ROOM A	None Taken							0.003	1	0.065	1			
OUTDOOR AMBIENT	0.001	2	0.003	2				0.001	2***	0.006	2***			
AGGRESSIVE SAMPLING METHOD														
ROOM A	0.015	6	0.028	1	0.140	0.009	3	0.017	6	0.110	1	0.260	0.013	3
ROOM B	0.021	6	0.160	1	0.190	0.027	3	0.035	6	1.400	1	0.558	0.071	3
OUTSIDE ROOM A	None Taken							0.005	1	0.220	1			
OUTDOOR AMBIENT	None Taken							0.001	2***	0.006	2***			

* f/cc = fibers/cc as/cc = asbestos structures/cc n = number of samples
** Sample volumes are approximately 1,500 liters. The lower limit of detection (LOD) is 0.010 as/cc. Analyses reported "below the LOD" are entered at half of the LOD = 0.005 as/cc.
*** These two samples were collected for a double shift; therefore, volumes = 3,000 liters.

TABLE A6-2 COMPARISON OF MEAN PRE- AND POST-REMOVAL AREA SAMPLING AT FACILITY 2

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

LOCATION	JUNE 12 PRE-REMOVAL SAMPLES							JULY 11 POST-REMOVAL SAMPLES						
	NIOSH PCM AND TEM				EPA TEM ANALYSIS**			NIOSH PCM AND TEM				EPA TEM ANALYSIS**		
	f/cc	n*	as/cc	n	as/cc Total	>5 um long	n	f/cc	n	as/cc	n	as/cc Total	>5 um long	n
NONAGGRESSIVE SAMPLING METHOD														
ROOM D	0.001	6			0.114	0.005	3	0.001	6			0.353	0.005	3
ROOM E	0.002	6			0.056	0.005	3	0.002	6			0.166	0.005	3
OUTSIDE HALL								0.002	2					
OUTDOOR AMBIENT			0.002	2***						0.002	2***			
AGGRESSIVE SAMPLING METHOD														
ROOM D	0.002	6			0.054	0.005	3	0.008	6			0.356	0.038	3
ROOM E	0.016	6			0.184	0.005	3	0.037	6			0.209	0.008	3
OUTSIDE HALL								0.005	2					
OUTDOOR AMBIENT	0.001	2	0.002	2***				0.001	4	0.01	2***			

* f/cc = fibers/cc as/cc = asbestos structures/cc n = number of samples
** These sample volumes are approximately 1,500 liters. The lower limit of detection (LOD) is 0.010 as/cc. Analyses reported below the LOD are entered at half of the LOD = 0.005 as/cc.
*** These are 25-mm cellulose ester filter samples analyzed by NIOSH 7402 method, March, 1987 revision. The Lower Limit of Detection for a 2500 l sample is about 0.002 as/cc.

TABLE A6-3 COMPARISON OF MEAN PRE- AND POST-REMOVAL AREA SAMPLING AT FACILITY 3

Analysis: PCM using NIOSH 7400-B Method (f/cc)*
TEM using EPA Provisional Method (as/cc)*

| | JUNE 13 PRE-REMOVAL SAMPLES | | | | | | JULY 10 POST-REMOVAL SAMPLES | | | | | | |
| | NIOSH PCM AND TEM | | | | EPA TEM ANALYSIS** as/cc | | | NIOSH PCM AND TEM | | | | EPA TEM ANALYSIS** as/cc | | |
LOCATION	f/cc	n*	as/cc	n	Total	>5 um long	n	f/cc	n	as/cc	n	Total	>5 um long	n
								NONAGGRESSIVE SAMPLING METHOD						
ROOM F	0.002	6	N/C		N/C	N/C	3	0.001	6	N/C		N/C	N/C	3
ROOM G	0.003	6	N/C		N/C*	N/C	3	0.001	6	N/C		N/C	N/C	3
HALL ROOM F								0.001	2	N/C				
HALL ROOM G								0.001	2	N/C				
								AGGRESSIVE SAMPLING METHOD						
ROOM F	0.008	5	N/C		0.06	0.012	3	0.020	6	N/C		0.10	0.006	3
ROOM G	0.075	6	N/C		0.20	0.037	3	0.002	6	N/C		0.15	0.007	3
HALL ROOM F								0.003	1	N/C				
HALL ROOM G								0.000	1	N/C				
OUTDOOR AMBIENT	0.002	2	0.002	2***				0.000	2	0.002	2***			

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*   f/cc = fibers/cc   as/cc = asbestos structures/cc   n = number of samples
    N/C - Analysis not completed
** These sample volumes are approximately 1,500 liters. The lower limit of detection (LOD) is
    0.010 as/cc. Analyses reported below the LOD are entered at half of the LOD (0.005 as/cc).
*** These samples were collected on 25mm cellulose ester filters and analyzed by NIOSH Method 7402, March
    1987 revision.

TABLE A6-4 COMPARISON OF MEAN PRE- AND POST-REMOVAL AREA SAMPLING AT FACILITY 4

Analysis: PCM using NIOSH 7400-B Method (f/cc)*;
TEM using EPA Provisional Method (as/cc)*

| | JULY 12 PRE REMOVAL SAMPLES | | | | | | JULY 18 POST REMOVAL SAMPLES | | | | | | |
| | NIOSH PCM AND TEM | | | | EPA TEM ANALYSIS** as/cc | | | NIOSH PCM AND TEM | | | | EPA TEM ANALYSIS** as/cc | | |
LOCATION	f/cc	n*	as/cc	n	Total	>5 um long	n	f/cc	n	as/cc	n	Total	>5 um long	n
								NONAGGRESSIVE SAMPLING METHOD						
ROOM H	0.001	6	N/C		N/C	N/C	3	0.001	6	N/C		N/C	N/C	3
ROOM I	0.002	6	N/C*		N/C	N/C	3	0.001	6	N/C		N/C	N/C	3
HALL ROOM H	0.001	1	N/C					0.001	1	N/C				
HALL ROOM I	0.001	1	N/C					0.003	1	N/C				
								AGGRESSIVE SAMPLING METHOD						
ROOM H	0.004	6	N/C		0.24	0.012	3	0.002	6	N/C		0.07	0.007	3
ROOM I	0.010	6	N/C		0.30	0.014	3	0.003	6	N/C		0.09	0.021	3
HALL ROOM H	0.001	1	N/C					0.001	1	N/C				
HALL ROOM I	0.026	1	N/C					0.000	1	N/C				
OUTDOOR AMBIENT	0.001	2	0.001	2***				0.001	2	0.001	2***			

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*   f/cc = fibers/cc   as/cc = asbestos structures/cc   n = number of samples
    N/C - Analysis not completed for these samples
** These sample volumes are approximately 1,500 liters. The TEM lower limit of detection (LOD) is
    0.010 as/cc. Analyses reported below the LOD are entered at half of the LOD (0.005 as/cc).
*** These ambient samples were collected on 25mm cellulose ester filters and analyzed by NIOSH method 7402
    March 1987 revision. The lower limit of detection for a 3000 1 sample is about 0.002 as/cc. None
    detected values are reported here at half the LOD.

TABLE A7-1 EVALUATION OF WORK PRACTICES AT FACILITY 1

	6/18/85	6/19/85	6/20/85	6/21/85
Date	6/18/85	6/19/85	6/20/85	6/21/85
Time	AM / PM	AM / PM	AM / PM	AM / PM
Site	ROOM B	ROOM A	<-----ROOM C----->	

TASK	WORK PRACTICE RATING#			
Prepare Pipe	A / -	A / -	- / -	- / -
Install Bag	P / -	P / -	- / -	A / -
Wet Pipe Lagging	P / P	- / P	A / A	A / P
Remove Lagging (use of bag)	P / P	- / P	P / A	A / A
Move Bag	- / P	- / P	P / A	G / A
Remove Bag	- / A	- / A	A / A	G / P
Clean Pipe	- / A	- / A	A / A	A / A
Decontaminate Room	- / A	- / -	A / A	A / A
Number of Bags Used	(5)	(12)	(13)	

SUBJECTIVE RATING VALUES: P - POOR   A - AVERAGE   G - GOOD

TABLE A7-2 EVALUATION OF WORK PRACTICES AT FACILITY 2

	6/25/85	6/26/85	6/27/85	6/28/85
Date	6/25/85	6/26/85	6/27/85	6/28/85
Time	AM / PM	AM / PM	AM / PM	AM / PM
Site	<-----ROOM D----->		<-----ROOM E----->	

TASK	WORK PRACTICE RATING#			
Prepare Pipe	G / -	- / -	- / A	- / -
Install Bag	A / -	A / -	- / G	G / -
Wet Pipe Lagging	- / A	A / A	A / -	A / A
Remove Lagging (use of bag)	- / A	A / A	A / -	A / G
Move Bag	- / A	A / A	A / -	A / G
Remove Bag	- / A	G / G	G / -	A / G
Clean Pipe	- / A	A / A	A / -	A / A
Decontaminate Room	- / G	- / G	- / -	- / G
Number of Bags Removed	0 / 3	4 / 2	7 / 0	4 / 0

SUBJECTIVE RATING VALUES: P - POOR   A - AVERAGE   G - GOOD

TABLE A7-3   EVALUATION OF WORK PRACTICES AT FACILITY 3

	Date	7/1/85	7/2/85	7/3/85
	Time	AM / PM	AM / PM	AM / PM
	Site	<----ROOM F--->/<---ROOM G--->		

TASK	WORK PRACTICE RATING#		
Prepare Pipe	A / -	- / -	- / -
Install Bag	G / -	A / -	A / G
Wet Pipe Lagging	- / A	A / A	A / -
Remove Lagging (use of bag)	- / A	A / A	G / -
Move Bag	- / G	- / G	G / A
Remove Bag	- / A	G / A	A / -
Clean Pipe	- / A	G / G	A / -
Decontaminate Room	- / A	G / G	G / -
Number of Bags Removed	0 / 3	6 / 3	3 / 0

\# SUBJECTIVE RATING VALUES: P — POOR   A — AVERAGE   G — GOOD

TABLE A7-4   EVALUATION OF WORK PRACTICES AT FACILITY 4

	Date	7/15/85	7/16/85	7/17/85
	Time	AM / PM	AM / PM	AM / PM
	Site	ROOM H	ROOM I	ROOM J

TASK	WORK PRACTICE RATING#		
Prepare Pipe	A / -	- / -	- / -
Install Bag	G / -	- / -	- / -
Wet Pipe Lagging	A / A	A / -	G / G
Remove Lagging (use of bag)	G / A	A / -	A / A
Move Bag	G / G	A / -	G / A
Remove Bag	G / G	G / -	A / A
Clean Pipe	G / G	A / -	G / G
Decontaminate Room	- / G	A / -	- / G
Number of Bags Removed	(6)	(6)	(8)

\# SUBJECTIVE RATING VALUES: P — POOR   A — AVERAGE   G — GOOD