APPENDIX A

CONCENTRATIONS OF RESPIRABLE COAL MINE DUST AND RESPIRABLE CRYSTALLINE SILICA IN UNDERGROUND AND SURFACE COAL MINES

Table A-1. Number of underground coal mines and samples collected for underground occupations, 1988-92

Type of sample and year collected	Total number of mines in operation*	Inspector samples			Operator samples		
		Number of mines sampled	Number of samples	Number of samples per mine	Number of mines sampled	Number of samples	Number of samples per mine
Coal mine dust:							
1988	1,923	1,299	15,412	11.9	1,679	61,992	36.9
1989	1,766	1,146	13,397	11.7	1,601	59,649	37.3
1990	1,796	1,121	12,193	10.9	1,571	59,296	37.7
1991	1,602	964	11,117	11.5	1,411	56,316	39.9
1992	1,483	1,000	10,057	10.1	1,285	51,429	40.0
Respirable quartz:							
1988	1,923	944	2,882	3.1	327	665	2.0
1989	1,766	841	2,551	3.0	334	638	1.9
1990	1,796	801	2,323	2.9	347	712	2.1
1991	1,602	785	3,920	5.0	334	747	2.2
1992	1,483	875	4,577	5.2	340	748	2.2

*"In operation" indicates that the mine had at least one employee for the specified year.

Table A-2. Number of surface coal mines and samples collected for surface occupations, 1988-92

Type of sample and year collected	Total number of mines in operation*	Inspector samples			Operator samples		
		Number of mines sampled	Number of samples	Number of samples per mine	Number of mines sampled	Number of samples	Number of samples per mine
Coal mine dust:							
1988	2,751	1,386	6,921	5.0	604	5,862	9.7
1989	2,583	1,410	6,917	4.9	577	5,402	9.4
1990	2,524	1,368	6,926	5.1	576	5,160	9.0
1991	2,384	886	4,204	4.7	489	4,473	9.1
1992	2,220	984	4,368	4.4	426	3,747	8.8
Respirable quartz:							
1988	2,751	411	902	2.2	83	126	1.5
1989	2,583	357	648	1.8	79	121	1.5
1990	2,524	356	645	1.8	76	130	1.7
1991	2,384	204	366	1.8	51	76	1.5
1992	2,220	374	703	1.9	56	80	1.4

*"In operation" indicates that the mine had at least one employee for the specified year.

Table A-3. Number of underground coal mines with surface operations* and samples collected for surface occupations, 1988-92

Type of sample and year collected	Total number of mines in operation†	Inspector samples			Operator samples		
		Number of mines sampled	Number of samples	Number of samples per mine	Number of mines sampled	Number of samples	Number of samples per mine
Coal mine dust:							
1988	1,669	210	695	3.3	99	1,003	10.1
1989	1,580	401	878	2.2	87	906	10.4
1990	1,622	468	1,023	2.2	83	774	9.3
1991	1,484	256	564	2.2	81	729	9.0
1992	1,378	257	688	2.7	72	545	7.6
Respirable quartz:							
1988	1,669	31	60	1.9	2	3	1.5
1989	1,580	30	41	1.4	6	8	1.3
1990	1,622	30	46	1.5	2	3	1.5
1991	1,484	21	30	1.4	2	2	1.0
1992	1,378	52	101	1.9	6	8	1.3

*These mines are included in the total number of underground mines reported in Table A-1.
†"In operation" indicates that the mine had at least one employee for the specified year.

Table A–4. Summary of respirable coal mine dust samples collected by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
106 Rock duster	8	2.54	2.19	1.58	3.21	13	38	50	50	50
006 Rock duster	1	2.40	——	2.40	——	0	0	0	0	100
060 Longwall (return face worker)	95	1.95	1.10	1.64	1.92	6	19	42	58	42
044 Shear operator/plow operator, longwall	1,183	1.79	1.19	1.50	1.84	6	25	52	71	29
064 Longwall operator (headgate)	705	1.78	3.22	1.37	1.88	7	30	62	77	23
017 Auger (timberman-return side)	89	1.72	2.79	0.66	4.08	48	63	76	81	19
011 Wireman	1	1.70	——	1.70	——	0	0	0	100	0
055 Jack setter (auger-return side)	75	1.70	2.97	0.62	4.06	51	68	72	77	23
041 Jack setter (longwall)	2,238	1.67	2.27	1.35	1.85	8	30	61	78	22
052 Tailgate operator	105	1.66	1.78	1.00	3.08	26	39	64	72	28
154 Belt cleaner, belt picker	19	1.45	0.95	1.15	2.23	11	42	68	84	16
061 Longwall (return fixed position)	1	1.40	——	1.40	——	0	0	100	100	0
110 Timberman	1	1.40	——	1.40	——	0	0	100	100	0
010 Timberman, propman, jack setter	94	1.39	2.90	0.64	3.22	46	65	82	87	13
038 Cutting machine operator	1,348	1.32	2.23	0.71	3.10	41	60	75	83	17
036 Continuous miner operator	9,990	1.28	1.75	0.84	2.55	31	56	76	85	15

See footnotes at end of table.

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Table A–4 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
048 Roof bolter mounted	337	1.28	0.84	1.05	2.01	16	45	75	88	12
418 Maintenance foreman	14	1.26	3.45	0.34	3.56	86	86	93	93	7
019 Roof bolter mounted (intake)	283	1.22	0.72	1.03	1.88	16	43	77	90	10
035 Continuous miner helper	4,950	1.22	2.16	0.80	2.52	32	58	79	88	12
042 Loading machine helper	33	1.22	1.39	0.76	2.88	36	58	70	91	9
051 Stall driver	25	1.22	0.64	1.07	1.69	12	56	80	88	12
033 Coal drill helper	61	1.19	1.03	0.76	2.93	34	46	72	84	16
423 Surveyor	2	1.15	1.34	0.65	5.27	50	50	50	50	50
014 Roof bolter (twin head-return)	2,474	1.12	1.21	0.79	2.38	32	61	80	88	12
032 Brattice man	54	1.10	0.93	0.80	2.41	31	61	80	89	11
043 Loading machine operator	681	1.10	1.70	0.67	2.74	44	66	81	88	12
018 Auger (timberman-intake side)	72	1.08	1.49	0.49	3.58	53	76	81	85	15
012 Roof bolter (twin head-intake)	2,158	1.04	1.03	0.73	2.40	36	64	83	90	10
047 Roof bolter helper	973	1.04	1.16	0.67	2.72	41	64	81	89	11
046 Roof bolter	6,664	1.03	1.69	0.63	2.70	44	67	83	90	10
070 Auger operator	173	1.01	1.33	0.53	3.17	53	71	81	86	14
071 Auger helper	40	0.83	0.64	0.59	2.54	43	68	90	98	3

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Table A–4 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
037 Cutting machine helper	138	0.99	0.93	0.65	2.70	43	64	82	88	12
109 Supply man	8	0.98	0.32	0.92	1.43	13	50	100	100	0
053 Utility man	1,161	0.96	1.47	0.63	2.55	42	69	86	92	8
008 Mason, stopping builder, ventilation man	47	0.93	0.66	0.67	2.47	36	70	85	87	13
034 Coal drill operator	1,269	0.93	2.33	0.51	2.80	54	75	88	93	7
001 Belt man/conveyor man	157	0.90	1.55	0.50	2.76	57	81	89	92	8
007 Blaster, shotfirer, shooter	220	0.90	1.20	0.48	3.15	53	70	82	90	10
111 Wireman	2	0.90	0.14	0.89	1.17	0	100	100	100	0
040 Headgate operator	822	0.89	0.76	0.67	2.16	40	70	89	95	5
072 Mobile bridge operator	1,425	0.88	1.08	0.54	2.76	51	73	87	92	8
004 Mechanic	692	0.86	3.21	0.50	2.64	53	79	91	95	5
269 Motorman	38	0.86	0.40	0.75	1.84	26	71	95	100	0
462 Fireboss, preshift examiner	4	0.85	0.39	0.78	1.67	25	75	100	100	0
050 Shuttle car operator (on side)	9,125	0.83	1.12	0.56	2.50	48	74	90	94	6
016 Laborer	191	0.80	1.07	0.47	2.78	58	79	87	94	6
054 Scoop car operator	3,701	0.79	1.35	0.49	2.65	56	78	90	94	6

(Continued)

Table A–4 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
073 Shuttle car operator (off side)	4,696	0.77	1.10	0.51	2.52	53	78	91	95	5
013 Cleanup man	34	0.76	0.57	0.52	2.69	50	68	85	100	0
049 Section foreman	1,137	0.74	0.77	0.51	2.46	52	79	91	96	4
156 Rock driller	1	0.70	——	0.70	——	0	100	100	100	0
009 Supply man	32	0.68	0.65	0.43	2.81	56	72	94	97	3
002 Electrician	358	0.63	0.59	0.42	2.55	60	82	93	97	3
031 Shotfire helper, beater	38	0.62	0.53	0.41	2.65	58	79	92	97	3
074 Tractor operator/motorman	785	0.61	0.92	0.40	2.47	67	86	95	97	3
116 Laborer	8	0.61	0.38	0.45	2.66	38	88	100	100	0
146 Roof bolter	2	0.55	0.64	0.32	5.09	50	100	100	100	0
104 Mechanic	5	0.54	0.38	0.42	2.46	60	80	100	100	0
430 Assistant mine foreman/ assistant mine manager	23	0.53	0.78	0.27	3.06	70	83	96	96	4
045 Rockman	6	0.52	0.21	0.47	1.63	67	100	100	100	0
216 Trackman	1	0.50	——	0.50	——	100	100	100	100	0
039 Hand loader	279	0.49	1.17	0.25	2.74	76	90	95	96	4
449 Mine foreman, mine manager	108	0.47	1.32	0.22	2.61	85	94	97	98	2

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Table A–4 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
101 Belt man/conveyor man	2	0.45	0.07	0.45	1.17	100	100	100	100	0
497 Clerk, timekeeper	9	0.40	0.44	0.23	2.99	67	78	100	100	0
495 Safety director	3	0.37	0.38	0.25	2.88	67	100	100	100	0
494 Preparation plant foreman	100	0.35	0.33	0.24	2.31	82	94	100	100	0
489 Outside foreman	77	0.32	0.41	0.22	2.23	88	97	99	99	1
402 Master electrician	2	0.30	0.14	0.28	1.63	100	100	100	100	0
122 Coal dump operator	2	0.25	0.21	0.20	2.67	100	100	100	100	0
496 Union representative	2	0.25	0.21	0.20	2.67	100	100	100	100	0
414 Dust sampler	3	0.23	0.15	0.20	2.00	100	100	100	100	0
456 Engineer	3	0.20	0.17	0.16	2.23	100	100	100	100	0
464 Operator	3	0.20	0.17	0.16	2.23	100	100	100	100	0
481 Superintendent	29	0.19	0.19	0.15	1.84	97	100	100	100	0
404 Master mechanic	2	0.15	0.07	0.14	1.63	100	100	100	100	0
999 Summary for valid occupations	61,697	1.05	1.63	0.67	2.65	41	65	82	90	10

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†Samples with invalid occupation codes (34 samples) and the Part-90 samples (445 samples) are excluded.

Table A–5. Summary of respirable coal mine dust samples collected by mine operators for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
106 Rock duster	6	3.77	3.23	2.16	3.89	33	33	33	33	67
033 Coal drill helper	13	2.12	1.32	1.72	2.04	8	31	38	46	54
003 Electrician helper	1	2.10	——	2.10	——	0	0	0	0	100
060 Longwall (return face worker)	702	1.94	1.31	1.58	1.99	7	22	46	60	40
048 Roof bolter mounted	62	1.70	1.70	1.23	2.16	18	44	69	74	26
044 Shear operator/plow operator, longwall	11,581	1.67	1.17	1.33	2.08	11	30	57	73	27
041 Jack setter (longwall)	1,685	1.66	1.23	1.28	2.17	14	35	59	72	28
040 Headgate operator	89	1.50	0.98	1.19	2.15	15	36	62	79	21
064 Longwall operator (headgate)	145	1.39	0.96	1.11	2.12	14	38	70	85	15
052 Tailgate operator	582	1.34	1.22	0.81	3.12	35	49	65	79	21
050 Shuttle car operator (on side)	567	1.26	1.06	0.87	2.64	30	51	72	82	18
019 Roof bolter mounted (intake)	12	1.23	1.31	0.72	4.34	17	58	92	92	8
002 Electrician	26	1.15	1.31	0.76	2.55	35	73	77	88	12
036 Continuous miner operator	211,266	1.01	1.15	0.62	2.83	44	66	82	89	11
035 Continuous miner helper	482	1.00	0.94	0.65	2.78	41	64	81	89	11
043 Loading machine operator	678	0.94	1.10	0.56	2.85	53	71	82	86	14

See footnotes at end of table.

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Table A-5 (Continued). Summary of respirable coal mine dust samples collected by mine operators for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m³)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m³	≤1.0 mg/m³	≤1.5 mg/m³	≤2.0 mg/m³	>2.0 mg/m³
073 Shuttle car operator (off side)	148	0.92	1.04	0.55	2.95	51	70	83	92	8
012 Roof bolter (twin head-intake)	1,267	0.88	1.04	0.55	2.77	50	73	87	92	8
014 Roof bolter (twin head-return)	1,597	0.88	0.87	0.58	2.63	46	73	86	92	8
015 Fan attendant	3	0.87	0.32	0.82	1.54	33	67	100	100	0
046 Roof bolter	3,656	0.85	1.01	0.52	2.80	50	74	88	93	7
101 Belt man/conveyor man	53	0.84	0.52	0.68	2.03	32	74	92	98	2
016 Laborer	49	0.83	0.76	0.55	2.69	49	71	90	92	8
418 Maintenance foreman	31	0.83	0.55	0.61	2.48	29	71	87	97	3
116 Laborer	357	0.81	0.89	0.53	2.56	52	77	88	94	6
018 Auger (timberman-intake side)	10	0.78	0.30	0.72	1.53	40	80	100	100	0
070 Auger operator	2,738	0.76	0.89	0.46	2.74	56	78	90	94	6
104 Mechanic	73	0.75	0.67	0.55	2.24	55	78	90	93	7
038 Cutting machine operator	30,125	0.73	0.92	0.44	2.79	58	79	91	94	6
055 Jack setter (auger-return side)	1,953	0.73	0.60	0.52	2.44	49	77	94	97	3
489 Outside foreman	71	0.73	0.68	0.46	2.85	54	76	89	94	6
054 Scoop car operator	544	0.72	0.82	0.43	2.84	57	79	91	94	6
047 Roof bolter helper	52	0.71	0.62	0.47	2.81	48	81	92	94	6

(Continued)

Table A-5 (Continued). Summary of respirable coal mine dust samples collected by mine operators for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
072 Mobile bridge operator	151	0.71	0.99	0.45	2.57	57	85	93	97	3
430 Assistant mine foreman/ assistant mine manager	14	0.69	0.46	0.53	2.26	57	71	100	100	0
004 Mechanic	53	0.68	0.86	0.41	2.73	70	83	92	92	8
110 Timberman	10	0.68	0.54	0.54	2.02	70	80	90	100	0
122 Coal dump operator	11	0.66	0.54	0.45	2.70	64	64	100	100	0
053 Utility man	65	0.64	0.54	0.43	2.64	60	82	91	98	2
049 Section foreman	77	0.62	0.63	0.38	3.11	60	82	95	96	4
108 Mason stopping builder, ventilation man	36	0.62	0.44	0.50	1.95	64	92	92	100	0
494 Preparation plant foreman	37	0.62	0.67	0.36	3.00	62	73	92	97	3
269 Motorman	82	0.60	0.51	0.42	2.45	60	84	95	99	1
007 Blaster, shotfirer, shooter	22	0.56	0.59	0.35	2.75	68	86	91	95	5
154 Belt cleaner, belt picker	80	0.55	0.55	0.37	2.51	68	86	96	99	1
034 Coal drill operator	6,204	0.54	0.67	0.32	2.73	70	87	95	97	3
017 Auger (timberman-return side)	397	0.53	0.49	0.38	2.35	68	88	97	98	2
013 Cleanup man	1	0.50	——	0.50	——	100	100	100	100	0

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Table A-5 (Continued). Summary of respirable coal mine dust samples collected by mine operators for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m³)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m³	≤1.0 mg/m³	≤1.5 mg/m³	≤2.0 mg/m³	>2.0 mg/m³
449 Mine foreman, mine manager	38	0.50	0.42	0.37	2.25	74	92	97	97	3
074 Tractor operator/motorman	20	0.47	0.27	0.39	1.96	60	100	100	100	0
263 Track foreman	6	0.42	0.22	0.37	1.71	83	100	100	100	0
146 Roof bolter	9	0.39	0.50	0.22	2.81	78	78	100	100	0
109 Supply man	45	0.35	0.33	0.25	2.21	84	96	98	100	0
009 Supply man	5	0.34	0.22	0.30	1.77	80	100	100	100	0
497 Clerk, timekeeper	9	0.33	0.41	0.23	2.21	89	89	100	100	0
102 Electrician	11	0.32	0.32	0.24	2.05	91	91	100	100	0
216 Trackman	5	0.32	0.24	0.26	2.11	80	100	100	100	0
045 Rockman	17	0.28	0.26	0.19	2.34	82	100	100	100	0
037 Cutting machine helper	7	0.26	0.14	0.22	1.87	100	100	100	100	0
001 Belt man/conveyor man	29	0.23	0.23	0.17	2.14	93	100	100	100	0
039 Hand loader	8,844	0.23	0.47	0.15	2.02	94	98	99	99	1
462 Fireboss, pre-shift examiner	13	0.23	0.14	0.19	1.87	100	100	100	100	0
201 Belt man/conveyor man	2	0.15	0.07	0.14	1.63	100	100	100	100	0
414 Dust sampler	6	0.12	0.04	0.11	1.33	100	100	100	100	0
111 Wireman	1	0.10	——	0.10	——	100	100	100	100	0

(Continued)

Table A–5 (Continued). Summary of respirable coal mine dust samples collected by mine operators for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
999 Summary for valid occupations	286,931	0.97	1.12	0.58	2.91	46	68	83	89	11

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.
†The Part-90 samples (1,751 samples) are excluded.

Table A–6. Summary of respirable coal mine dust samples collected by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
320 Cage attendant/cager	3	1.40	1.68	0.64	5.80	33	67	67	67	33
384 Driller, highwall operator	2,696	1.32	2.97	0.62	3.29	48	67	78	84	16
325 Diester table operator	60	1.29	1.79	0.73	3.05	32	55	80	90	10
347 Froth cell operator	97	1.29	1.48	0.95	2.30	21	49	75	88	12
388 Scalper-screen operator	273	1.20	2.54	0.58	3.28	50	67	77	85	15
334 Coal drill operator	63	1.14	1.73	0.55	3.35	52	73	83	86	14
379 Dryer operator	151	1.13	5.48	0.46	2.88	53	78	92	97	3
380 Fine coal plant operator	555	1.13	1.19	0.79	2.48	29	57	79	91	9
319 Welder, (shop) blacksmith	187	1.04	1.52	0.49	3.44	52	69	82	85	15
317 Rodman	1	1.00	——	1.00	——	0	100	100	100	0
329 Vacuum filter operator	38	0.93	0.51	0.76	2.10	26	58	92	95	5
313 Cleanup man	442	0.88	1.19	0.54	2.79	46	72	87	93	7
306 Welder (non-shop)	132	0.78	1.37	0.38	3.24	60	79	89	92	8
301 Conveyor operator	98	0.74	2.77	0.26	3.12	79	93	96	96	4
374 Cleaning plant operator	857	0.74	1.96	0.42	2.75	59	82	93	96	4
316 Laborer, blacksmith	1,269	0.72	1.32	0.36	3.09	64	80	90	94	6
330 Face worker-shaft/slope sinking	5	0.72	0.60	0.51	2.84	40	80	80	100	0

See footnotes at end of table.

(Continued)

Table A–6 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	<2.0 mg/m^3	>2.0 mg/m^3
356 Rock driller	62	0.67	0.72	0.43	2.61	65	84	89	92	8
383 Driller, highwall helper	117	0.62	0.84	0.36	2.75	68	85	94	95	5
314 Coal sampler	295	0.61	1.27	0.36	2.60	67	86	95	97	3
357 Washer operator	233	0.61	0.54	0.42	2.55	58	82	96	99	1
324 Backhoe operator	264	0.60	4.83	0.20	2.46	88	96	98	99	1
392 Tipple operator	1,358	0.59	0.95	0.32	2.84	70	85	92	96	4
394 Carpenter	4	0.58	0.40	0.42	2.82	50	100	100	100	0
341 Beltman/conveyor man	197	0.56	0.79	0.32	2.73	73	85	93	97	3
340 Boom operator	18	0.55	0.64	0.29	3.28	61	83	94	94	6
386 Refuse truck driver	2,893	0.55	0.80	0.37	2.45	69	88	96	98	2
307 Blaster, shotfirer, shooter	199	0.53	0.61	0.35	2.44	70	89	96	97	3
345 Crusher attendant	226	0.53	1.28	0.28	2.63	76	92	95	97	3
352 Steel worker	3	0.53	0.29	0.46	2.06	33	100	100	100	0
328 Utility man	682	0.51	0.90	0.28	2.71	76	89	95	97	3
302 Electrician	449	0.48	0.49	0.31	2.53	71	91	96	98	2
390 Silo operator	23	0.48	0.35	0.35	2.42	61	96	100	100	0
304 Mechanic	1,337	0.47	0.76	0.27	2.68	75	90	96	98	2

(Continued)

Table A–6 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
381 Hoist operator helper	3	0.47	0.35	0.34	2.98	67	100	100	100	0
368 Bulldozer operator	5,761	0.46	0.73	0.29	2.49	77	91	97	98	2
327 Pumper	21	0.45	0.44	0.29	2.71	67	95	95	100	0
323 Transit man	3	0.43	0.58	0.22	3.99	67	67	100	100	0
358 Water circuit operator	10	0.41	0.32	0.31	2.29	80	100	100	100	0
369 Motorman	31	0.41	0.46	0.24	2.70	77	84	97	100	0
371 Auger helper	268	0.40	1.05	0.24	2.31	85	96	98	99	1
305 Mechanic helper	45	0.39	0.63	0.23	2.59	82	93	98	98	2
308 Mason	11	0.39	0.25	0.30	2.24	82	100	100	100	0
310 Pan scraper operator	699	0.39	0.77	0.23	2.43	86	94	97	98	2
370 Auger operator	336	0.39	0.59	0.25	2.35	84	94	97	98	2
376 Coal truck driver	655	0.39	0.67	0.26	2.35	83	93	98	99	1
354 Sweeper operator	16	0.38	0.53	0.22	2.61	88	88	94	94	6
344 Car shake-out operator	19	0.37	0.24	0.29	2.09	74	100	100	100	0
391 Stripping shovel operator	160	0.36	0.47	0.23	2.35	86	96	98	98	2
318 Greaser, oiler	448	0.35	0.34	0.24	2.33	83	96	98	100	0
366 Waterboy	6	0.35	0.25	0.28	2.07	83	100	100	100	0

(Continued)

Table A-6 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
398 Groundman	56	0.35	0.41	0.23	2.35	80	96	98	98	2
375 Road grader operator	378	0.34	0.79	0.22	2.26	88	97	99	100	0
382 Highlift operator	6,714	0.34	0.79	0.22	2.29	86	96	99	99	1
342 Bit sharpener	4	0.33	0.21	0.27	2.19	100	100	100	100	0
349 Rotary dump operator	16	0.33	0.19	0.27	1.97	94	100	100	100	0
343 Car trimmer/car loader	235	0.32	0.47	0.20	2.32	89	94	96	98	2
373 Car dropper	288	0.32	0.39	0.22	2.30	84	95	99	99	1
395 Water truck operator	68	0.30	0.27	0.22	2.08	91	97	99	100	0
396 Watchman	3	0.30	0.10	0.29	1.42	100	100	100	100	0
303 Electrician helper	7	0.29	0.25	0.20	2.45	86	100	100	100	0
393 Weighman	179	0.27	0.26	0.19	2.15	89	97	100	100	0
365 Dispatcher	7	0.26	0.14	0.22	1.87	100	100	100	100	0
367 Coal shovel operator	188	0.26	0.46	0.17	2.19	91	98	99	99	1
348 Machinist	58	0.25	0.25	0.18	2.12	95	97	100	100	0
372 Barge attendant	152	0.25	0.34	0.17	2.30	93	98	99	99	1
387 Rotary bucket excavator operator	51	0.25	0.22	0.19	2.03	96	98	100	100	0
326 Forklift operator	55	0.24	0.19	0.19	1.96	96	98	100	100	0

(Continued)

Table A-6 (Continued). Summary of respirable coal mine dust samples collected by MSHA inspectors for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
351 Scoop operator	12	0.24	0.18	0.20	1.89	92	100	100	100	0
362 Brakeman	12	0.24	0.20	0.19	2.08	92	100	100	100	0
322 Coal strip operator	8	0.23	0.15	0.18	1.99	100	100	100	100	0
360 Shopman repair cars	3	0.23	0.15	0.20	2.00	100	100	100	100	0
309 Supply man	93	0.22	0.22	0.17	1.99	95	99	100	100	0
378 Dragline operator, crane operator	474	0.22	0.50	0.16	1.90	97	99	100	100	0
331 Clam operator	4	0.20	0.14	0.17	1.94	100	100	100	100	0
350 Shuttle car operator	1	0.20	——	0.20	——	100	100	100	100	0
321 Hoist engineer/operator	62	0.19	0.13	0.15	1.78	98	100	100	100	0
385 Lampman	24	0.19	0.13	0.16	1.82	100	100	100	100	0
312 Belt vulcanizer	3	0.17	0.12	0.14	1.89	100	100	100	100	0
397 Yard engine operator	11	0.17	0.13	0.15	1.77	100	100	100	100	0
333 Coal drill helper	2	0.15	0.07	0.14	1.63	100	100	100	100	0
999 Summary for valid occupations	32,947	0.56	1.38	0.30	2.73	74	88	94	96	4

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†Samples with invalid occupation codes (8 samples) and the Part-90 samples (229 samples) are excluded.

Table A-7. Summary of respirable coal mine dust samples collected by mine operators for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
319 Welder, (shop) blacksmith	56	1.19	2.23	0.43	3.90	64	73	80	86	14
347 Froth cell operator	307	1.10	0.63	0.90	2.01	24	52	82	90	10
388 Scalper-screen operator	662	1.07	1.12	0.66	2.94	39	60	80	87	13
390 Silo operator	31	1.03	0.75	0.78	2.35	19	55	87	94	6
329 Vacuum filter operator	91	1.00	0.74	0.79	2.12	26	56	89	95	5
306 Welder (non-shop)	208	0.97	1.43	0.52	3.05	54	70	84	89	11
379 Dryer operator	191	0.95	0.77	0.63	2.75	37	64	81	90	10
380 Fine coal plant operator	1,609	0.94	0.75	0.68	2.38	36	63	86	93	7
391 Stripping shovel operator	45	0.89	1.28	0.48	2.98	58	78	84	89	11
325 Diester table operator	136	0.87	0.52	0.69	2.12	33	66	91	99	1
316 Laborer, blacksmith	2,155	0.85	0.84	0.55	2.74	47	69	87	92	8
344 Car shake-out operator	4	0.85	0.39	0.79	1.54	25	75	100	100	0
384 Driller, highwall operator	5,688	0.84	1.84	0.41	3.14	62	78	88	91	9
305 Mechanic helper	12	0.83	0.59	0.63	2.38	42	58	92	92	8
313 Cleanup man	1,107	0.83	1.52	0.53	2.64	48	73	88	95	5
357 Washer operator	317	0.83	0.58	0.60	2.44	38	69	91	95	5
374 Cleaning plant operator	1,120	0.81	0.63	0.59	2.42	41	71	91	95	5

See footnotes at end of table.

(Continued)

Table A-7 (Continued). Summary of respirable coal mine dust samples collected by mine operators for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
302 Electrician	350	0.79	0.95	0.45	2.88	56	73	87	93	7
304 Mechanic	1,272	0.79	0.82	0.51	2.71	47	76	90	94	6
356 Rock driller	75	0.75	0.75	0.48	2.65	57	77	91	93	7
392 Tipple operator	1,406	0.73	0.87	0.44	2.77	56	78	91	94	6
328 Utility man	365	0.68	0.76	0.41	2.77	60	77	92	96	4
345 Crusher attendant	146	0.67	0.66	0.43	2.66	59	78	92	95	5
370 Auger operator	53	0.61	0.67	0.40	2.47	66	83	94	94	6
314 Coal sampler	329	0.58	0.50	0.41	2.40	59	88	96	98	2
301 Conveyor operator	34	0.57	0.41	0.43	2.27	56	88	97	100	0
334 Coal drill operator	194	0.57	0.83	0.32	2.75	73	89	93	93	7
398 Groundman	14	0.56	0.87	0.28	3.12	71	93	93	93	7
373 Car dropper	201	0.55	0.57	0.35	2.62	64	86	94	99	1
326 Forklift operator	7	0.54	0.40	0.46	1.81	57	86	100	100	0
383 Driller, highwall helper	397	0.54	0.82	0.30	2.78	74	87	94	95	5
386 Refuse truck driver	1,826	0.54	1.20	0.32	2.64	70	89	95	97	3
307 Blaster, shotfirer, shooter	158	0.50	0.50	0.35	2.46	72	92	97	97	3
376 Coal truck driver	295	0.48	0.92	0.31	2.42	77	93	98	99	1

(Continued)

Table A–7 (Continued). Summary of respirable coal mine dust samples collected by mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
382 Highlift operator	1,492	0.48	1.47	0.27	2.56	78	91	96	98	2
324 Backhoe operator	41	0.47	0.41	0.31	2.64	68	88	100	100	0
368 Bulldozer operator	3,993	0.47	0.65	0.28	2.62	75	90	96	97	3
318 Greaser, oiler	246	0.46	0.42	0.31	2.44	74	90	98	100	0
310 Pan scraper operator	390	0.43	0.63	0.26	2.56	79	93	96	98	2
341 Beltman/conveyor man	111	0.40	0.34	0.29	2.29	77	95	99	100	0
372 Barge attendant	9	0.40	0.43	0.25	2.71	78	89	100	100	0
343 Car trimmer/car loader	77	0.39	0.41	0.26	2.41	83	91	99	99	1
367 Coal shovel operator	36	0.39	0.29	0.30	2.22	72	94	100	100	0
354 Sweeper operator	21	0.38	0.30	0.28	2.27	81	95	100	100	0
375 Road grader operator	74	0.38	0.37	0.26	2.37	80	93	99	100	0
395 Water truck operator	31	0.38	0.30	0.30	2.06	81	97	100	100	0
371 Auger helper	31	0.34	0.36	0.22	2.41	84	94	97	100	0
348 Machinist	7	0.33	0.21	0.27	2.08	86	100	100	100	0
321 Hoist engineer/operator	11	0.22	0.13	0.19	1.69	100	100	100	100	0
378 Dragline operator, crane operator	76	0.22	0.21	0.17	1.96	93	99	100	100	0

(Continued)

Table A–7 (Continued). Summary of respirable coal mine dust samples collected by mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
303 Electrician helper	16	0.21	0.17	0.16	1.96	94	100	100	100	0
385 Lampman	76	0.21	0.19	0.17	1.86	95	100	100	100	0
365 Dispatcher	13	0.19	0.13	0.16	1.74	100	100	100	100	0
387 Rotary bucket excavator operator	7	0.19	0.11	0.16	1.69	100	100	100	100	0
309 Supply man	25	0.18	0.13	0.16	1.65	96	100	100	100	0
394 Carpenter	5	0.16	0.13	0.13	1.86	100	100	100	100	0
999 Summary for valid occupations	27,649	0.71	1.19	0.41	2.85	60	79	91	94	6

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†The Part-90 samples (952 samples) are excluded.

Table A-8. Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
003 Electrician helper	2	0.23	0.32	0.06	18.93	50	50	50
017 Auger (timberman-return side)	15	0.19	0.34	0.06	4.97	53	80	20
055 Jack setter (auger-return side)	22	0.16	0.26	0.05	6.70	45	64	36
269 Motorman	9	0.16	0.16	0.09	3.82	44	56	44
046 Roof bolter	2,862	0.12	0.17	0.07	3.17	41	64	36
010 Timberman, propman, jack setter	10	0.10	0.10	0.07	2.67	30	80	20
012 Roof bolter (twin head-intake)	894	0.10	0.15	0.06	3.23	47	71	29
036 Continuous miner operator	5,464	0.10	0.22	0.04	4.10	56	75	25
047 Roof bolter helper	136	0.10	0.11	0.07	2.63	46	71	29
014 Roof bolter (twin head-return)	1,311	0.09	0.15	0.05	3.57	51	70	30
035 Continuous miner helper	527	0.08	0.17	0.04	3.41	60	81	19
060 Longwall (return face worker)	44	0.08	0.07	0.06	2.47	41	77	23
102 Electrician	1	0.08	——	0.08	——	0	100	0
116 Laborer	1	0.08	——	0.08	——	0	100	0
008 Mason, stopping builder, ventilation man	7	0.07	0.06	0.05	2.42	43	71	29

See footnotes at end of table.

(Continued)

Table A-8 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
052 Tailgate operator	30	0.07	0.09	0.03	5.31	63	70	30
074 Tractor operator/motorman	51	0.07	0.21	0.03	3.11	76	92	8
001 Belt man/conveyor man	17	0.06	0.07	0.02	5.01	65	82	18
032 Brattice man	3	0.06	0.07	0.02	13.17	67	67	33
041 Jack setter (longwall)	451	0.06	0.08	0.03	3.30	67	85	15
044 Shear operator/plow operator, longwall	633	0.06	0.09	0.03	4.09	67	82	18
048 Roof bolter mounted	180	0.06	0.10	0.03	4.67	70	86	14
054 Scoop car operator	338	0.06	0.11	0.03	2.88	72	88	12
073 Shuttle car operator (off side)	385	0.06	0.10	0.03	3.38	76	88	12
019 Roof bolter mounted (intake)	147	0.05	0.11	0.02	4.18	82	91	9
031 Shotfire helper, beater	6	0.05	0.03	0.04	1.95	83	100	0
034 Coal drill operator	206	0.05	0.10	0.02	4.02	82	91	9
038 Cutting machine operator	640	0.05	0.11	0.02	4.58	81	91	9
043 Loading machine operator	87	0.05	0.16	0.01	4.82	90	94	6
050 Shuttle car operator (on side)	743	0.05	0.10	0.03	3.48	73	87	13
064 Longwall operator (headgate)	162	0.05	0.05	0.03	2.87	72	88	12
070 Auger operator	49	0.05	0.08	0.02	4.72	82	88	12

(Continued)

Table A-8 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
072 Mobile bridge operator	127	0.05	0.05	0.03	3.18	69	90	10
109 Supply man	3	0.05	0.04	0.02	11.93	33	100	0
430 Assistant mine foreman/ assistant mine manager	2	0.05	0.05	0.03	5.09	50	100	0
016 Laborer	26	0.04	0.05	0.02	3.64	77	88	12
039 Hand loader	38	0.04	0.06	0.01	6.30	71	84	16
053 Utility man	130	0.04	0.06	0.02	3.82	73	90	10
002 Electrician	34	0.03	0.03	0.01	4.01	85	97	3
004 Mechanic	63	0.03	0.06	0.02	3.59	89	94	6
006 Rock duster	1	0.03	——	0.03	——	100	100	0
015 Fan attendant	2	0.03	0.03	0.02	3.61	100	100	0
033 Coal drill helper	8	0.03	0.04	0.02	2.50	88	88	13
049 Section foreman	164	0.03	0.04	0.02	3.61	86	93	7
051 Stall driver	1	0.03	——	0.03	——	100	100	0
110 Timberman	2	0.03	0.02	0.03	2.20	100	100	0
418 Maintenance foreman	1	0.03	——	0.03	——	100	100	0
423 Surveyor	1	0.03	——	0.03	——	100	100	0

(Continued)

Table A–8 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
449 Mine foreman, mine manager	9	0.03	0.06	0.01	7.20	89	89	11
007 Blaster, shotfirer, shooter	15	0.02	0.02	0.02	2.13	87	100	0
013 Cleanup man	7	0.02	0.02	0.01	5.17	100	100	0
018 Auger (timberman-intake side)	4	0.02	0.02	0.01	5.44	100	100	0
037 Cutting machine helper	10	0.02	0.02	0.02	1.88	90	100	0
040 Headgate operator	131	0.02	0.04	0.01	3.65	91	98	2
042 Loading machine helper	8	0.02	0.02	0.01	2.64	88	100	0
005 Mechanic helper	1	0.01	——	0.01	——	100	100	0
009 Supply man	6	0.01	0.01	0.01	4.74	100	100	0
071 Auger helper	1	0.01	——	0.01	——	100	100	0
101 Belt man/conveyor man	2	0.01	0.01	0.01	2.11	100	100	0
154 Belt cleaner, belt picker	4	0.01	0.01	0.01	3.78	100	100	0
494 Preparation plant foreman	6	0.01	0.01	0.01	2.95	100	100	0
999 Summary for valid occupations	16,240	0.09	0.17	0.04	3.92	58	76	24

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†Samples with invalid occupation codes (14 samples) and the Part-90 samples (69 samples) are excluded.

‡Equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.

§MSHA PEL.

Table A-9. Summary of respirable crystalline silica samples collected by coal mine operators for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
019 Roof bolter mounted (intake)	2	0.32	0.45	0.03	95.89	50	50	50
040 Headgate operator	1	0.19	——	0.19	——	0	0	100
060 Longwall (return face worker)	6	0.18	0.11	0.16	1.86	0	33	67
047 Roof bolter helper	3	0.17	0.27	0.02	22.22	67	67	33
072 Mobile bridge operator	6	0.16	0.20	0.07	4.32	33	67	33
036 Continuous miner operator	2,298	0.12	0.35	0.04	5.17	53	69	31
044 Shear operator/plow operator, longwall	104	0.12	0.14	0.07	3.43	41	64	36
004 Mechanic	2	0.10	0.13	0.05	7.48	50	50	50
041 Jack setter (longwall)	21	0.10	0.10	0.05	4.06	48	57	43
014 Roof bolter (twin head-return)	241	0.09	0.14	0.04	4.94	55	70	30
046 Roof bolter	468	0.09	0.18	0.03	5.13	61	79	21
052 Tailgate operator	4	0.09	0.06	0.07	2.15	50	50	50
012 Roof bolter (twin head-intake)	175	0.08	0.14	0.03	5.79	62	78	22
035 Continuous miner helper	18	0.08	0.20	0.01	8.52	67	89	11
054 Scoop car operator	7	0.08	0.14	0.03	4.57	71	86	14

See footnotes at end of table.

(Continued)

Table A–9 (Continued). Summary of respirable crystalline silica samples collected by coal mine operators for underground occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
070 Auger operator	12	0.08	0.13	0.02	6.65	67	83	17
055 Jack setter (auger-return side)	8	0.06	0.05	0.03	5.03	63	88	13
269 Motorman	2	0.06	0.01	0.05	1.14	50	100	0
016 Laborer	1	0.05	——	0.05	——	100	100	0
034 Coal drill operator	16	0.05	0.09	0.02	5.87	75	88	13
039 Hand loader	1	0.05	——	0.05	——	100	100	0
050 Shuttle car operator (on side)	25	0.05	0.06	0.03	3.74	72	88	12
038 Cutting machine operator	62	0.04	0.06	0.01	4.99	85	94	6
073 Shuttle car operator (off side)	10	0.04	0.04	0.02	5.32	80	90	10
017 Auger (timberman-return side)	7	0.03	0.02	0.02	2.05	100	100	0
043 Loading machine operator	3	0.03	0.02	0.01	8.35	100	100	0
146 Roof bolter	1	0.03	——	0.03	——	100	100	0
064 Longwall operator (headgate)	3	0.02	0.02	0.01	7.34	100	100	0
489 Outside foreman	1	0.02	——	0.02	——	100	100	0
048 Roof bolter mounted	4	0.01	0.01	0.00	5.80	100	100	0
049 Section foreman	2	0.00	0.00	0.00	1.00	100	100	0

(Continued)

Table A-9 (Continued). Summary of respirable crystalline silica samples collected by coal mine operators for underground occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
999 Summary for valid occupations	3,514	0.11	0.29	0.04	5.21	56	72	28

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†Samples with invalid occupation codes (5 samples) and the Part-90 samples (2 samples) are excluded.

‡0.058 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.

§MSHA PEL.

Table A-10. Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
383 Driller, highwall helper	20	0.48	0.82	0.21	3.40	20	30	70
356 Rock driller	8	0.36	0.61	0.05	17.49	38	38	63
384 Driller, highwall operator	548	0.35	0.64	0.15	3.91	19	33	67
330 Face worker-shaft/slope sinking	2	0.25	0.10	0.25	1.47	0	0	100
368 Bulldozer operator	586	0.17	0.25	0.06	5.62	40	55	45
334 Coal drill operator	13	0.16	0.19	0.07	5.20	38	54	46
310 Pan scraper operator	55	0.14	0.21	0.06	5.19	42	56	44
307 Blaster, shotfirer, shooter	24	0.12	0.18	0.07	3.23	38	58	42
390 Silo operator	3	0.12	0.17	0.05	5.74	67	67	33
301 Conveyor operator	6	0.11	0.17	0.06	2.60	83	83	17
366 Waterboy	1	0.09	——	0.09	——	0	100	0
376 Coal truck driver	44	0.08	0.22	0.02	6.19	68	82	18
386 Refuse truck driver	374	0.07	0.09	0.03	4.15	59	81	19
398 Groundman	4	0.05	0.03	0.02	7.88	50	100	0
340 Boom operator	6	0.04	0.06	0.01	7.51	83	83	17
344 Car shake-out operator	2	0.04	0.05	0.03	4.28	50	100	0

See footnotes at end of table.

(Continued)

Table A–10 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
345 Crusher attendant	24	0.04	0.11	0.01	4.94	96	96	4
370 Auger operator	17	0.04	0.06	0.01	6.06	71	82	18
375 Road grader operator	18	0.04	0.04	0.02	4.17	72	89	11
382 Highlift operator	373	0.04	0.08	0.01	5.14	82	93	7
314 Coal sampler	38	0.03	0.04	0.01	5.13	87	92	8
326 Forklift operator	2	0.03	0.05	0.01	19.48	50	100	0
328 Utility man	49	0.03	0.04	0.01	4.09	90	94	6
341 Beltman/conveyor man	16	0.03	0.05	0.02	3.91	94	94	6
391 Stripping shovel operator	4	0.03	0.03	0.03	2.23	75	100	0
313 Cleanup man	107	0.02	0.03	0.01	4.47	93	94	6
316 Laborer, blacksmith	196	0.02	0.09	0.01	4.91	95	97	3
318 Greaser, oiler	37	0.02	0.04	0.01	5.33	89	95	5
320 Cage attendant/cager	1	0.02	——	0.02	——	100	100	0
324 Backhoe operator	10	0.02	0.03	0.01	5.50	90	100	0
329 Vacuum filter operator	10	0.02	0.03	0.01	4.30	90	100	0
343 Car trimmer/car loader	5	0.02	0.02	0.01	4.24	100	100	0

(Continued)

Table A-10 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
351 Scoop operator	1	0.02	——	0.02	——	100	100	0
357 Washer operator	42	0.02	0.05	0.01	4.42	95	95	5
367 Coal shovel operator	6	0.02	0.03	0.01	4.17	83	100	0
371 Auger helper	11	0.02	0.02	0.01	4.19	100	100	0
380 Fine coal plant operator	171	0.02	0.03	0.01	4.42	96	98	2
388 Scalper-screen operator	82	0.02	0.03	0.01	5.45	90	98	2
302 Electrician	36	0.01	0.02	0.00	4.33	97	100	0
304 Mechanic	123	0.01	0.02	0.01	4.51	93	98	2
306 Welder (non-shop)	17	0.01	0.01	0.00	3.62	100	100	0
309 Supply man	1	0.01	——	0.01	——	100	100	0
319 Welder, (shop) blacksmith	21	0.01	0.03	0.00	4.49	95	95	5
325 Diester table operator	18	0.01	0.01	0.01	3.45	100	100	0
327 Pumper	2	0.01	0.01	0.00	5.09	100	100	0
347 Froth cell operator	40	0.01	0.01	0.01	3.51	100	100	0
372 Barge attendant	3	0.01	0.01	0.01	5.18	100	100	0
373 Car dropper	18	0.01	0.01	0.00	3.30	100	100	0

(Continued)

Table A-10 (Continued). Summary of respirable crystalline silica samples collected by MSHA coal mine inspectors for surface occupations, 1988-92*

MSHA code and occupation	Number of samples†	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3‡	≤0.100 mg/m^3§	>0.100 mg/m^3
374 Cleaning plant operator	135	0.01	0.02	0.00	4.05	97	99	1
378 Dragline operator, crane operator	8	0.01	0.01	0.01	3.06	100	100	0
379 Dryer operator	27	0.01	0.01	0.00	3.27	100	100	0
392 Tipple operator	166	0.01	0.02	0.00	4.21	98	99	1
394 Carpenter	1	0.01	——	0.01	——	100	100	0
395 Water truck operator	2	0.01	0.00	0.01	1.14	100	100	0
305 Mechanic helper	3	0.00	0.01	0.00	3.78	100	100	0
348 Machinist	1	0.00	——	0.00	——	100	100	0
369 Motorman	1	0.00	——	0.00	——	100	100	0
393 Weighman	4	0.00	0.01	0.00	3.54	100	100	0
999 Summary for valid occupations	3,543	0.11	0.31	0.02	7.28	66	76	24

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.
†Samples with invalid occupation codes (2 samples) and the Part-90 samples (10 samples) are excluded.
‡0.058 mg/m^3 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.
§MSHA PEL.

Table A–11. Summary of respirable crystalline silica samples collected by coal mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3†	≤0.100 mg/m^3‡	>0.100 mg/m^3
383 Driller, highwall helper	11	0.51	0.49	0.24	4.46	18	36	64
384 Driller, highwall operator	196	0.24	0.42	0.09	4.82	29	49	51
356 Rock driller	6	0.15	0.24	0.05	5.74	50	67	33
368 Bulldozer operator	126	0.14	0.16	0.06	4.81	40	56	44
324 Backhoe operator	3	0.10	0.05	0.09	1.63	0	67	33
375 Road grader operator	2	0.09	0.01	0.09	1.12	0	50	50
307 Blaster, shotfirer, shooter	9	0.08	0.05	0.05	5.04	22	56	44
310 Pan scraper operator	13	0.08	0.15	0.04	2.70	69	92	8
318 Greaser, oiler	8	0.08	0.10	0.03	6.32	50	75	25
313 Cleanup man	9	0.07	0.08	0.03	5.04	67	67	33
376 Coal truck driver	11	0.06	0.05	0.02	7.94	45	82	18
382 Highlift operator	20	0.06	0.06	0.03	4.63	60	75	25
386 Refuse truck driver	85	0.05	0.15	0.02	5.09	71	82	18
334 Coal drill operator	3	0.04	0.02	0.03	1.69	100	100	0
304 Mechanic	3	0.03	0.03	0.02	2.74	100	100	0
316 Laborer, blacksmith	5	0.03	0.02	0.03	1.92	100	100	0

See footnotes at end of table.

(Continued)

Table A–11 (Continued). Summary of respirable crystalline silica samples collected by coal mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3†	≤0.100 mg/m^3‡	>0.100 mg/m^3
398 Groundman	2	0.03	0.02	0.03	2.39	100	100	0
341 Beltman/conveyor man	4	0.02	0.01	0.02	1.77	100	100	0
345 Crusher attendant	3	0.02	0.02	0.01	2.90	100	100	0
370 Auger operator	1	0.02	——	0.02	——	100	100	0
388 Scalper-screen operator	3	0.02	0.02	0.00	8.79	100	100	0
392 Tipple operator	4	0.02	0.02	0.01	4.78	100	100	0
301 Conveyor operator	3	0.01	0.01	0.01	1.84	100	100	0
314 Coal sampler	1	0.01	——	0.01	——	100	100	0
328 Utility man	5	0.01	0.01	0.01	2.05	100	100	0
344 Car shake-out operator	1	0.01	——	0.01	——	100	100	0
354 Sweeper operator	2	0.01	0.02	0.01	9.98	100	100	0
357 Washer operator	4	0.01	0.01	0.01	1.49	100	100	0
380 Fine coal plant operator	10	0.01	0.01	0.00	4.11	100	100	0
390 Silo operator	1	0.01	——	0.01	——	100	100	0
391 Stripping shovel operator	1	0.01	——	0.01	——	100	100	0
302 Electrician	1	0.00	——	0.00	——	100	100	0

(Continued)

Table A–11 (Continued). Summary of respirable crystalline silica samples collected by coal mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3†	≤0.100 mg/m^3‡	>0.100 mg/m^3
340 Boom operator	1	0.00	——	0.00	——	100	100	0
999 Summary for valid occupations	557	0.15	0.29	0.05	5.65	48	64	36

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†0.058 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.

‡MSHA PEL.

Table A–12. Summary of respirable coal mine dust area samples collected in coal mines, 1988–92*

Type of sample	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
Inspector	16,194	0.61	1.35	0.3	3.13	69	83	92	95	5
Operator	71,837	0.66	1.05	0.39	2.78	64	82	92	95	5

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

Table A–13. Summary of respirable crystalline silica area samples collected in coal mines, 1988–92*

Type of sample	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3†	≤0.100 mg/m^3‡	>0.100 mg/m^3
Inspector	2,244	0.08	0.13	0.04	4.24	61	78	22
Operator	1,783	0.09	0.15	0.04	4.22	56	76	24

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.
†0.058 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.
‡MSHA PEL.