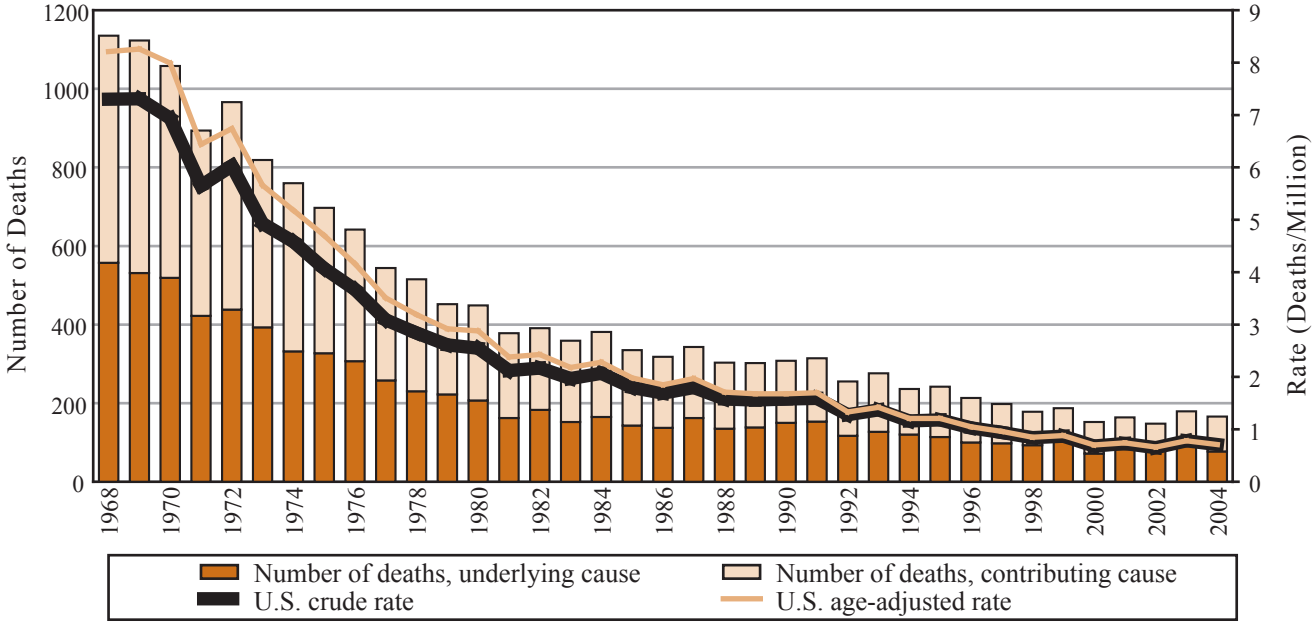
Section 3

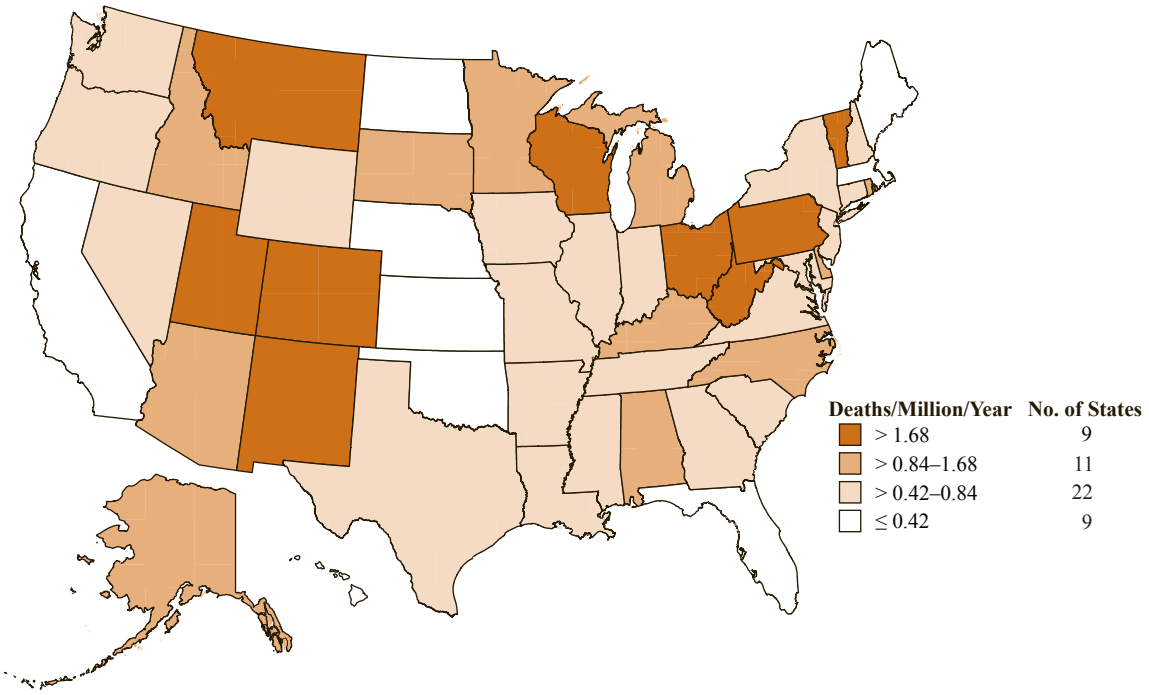
Silicosis and Related Exposures

Figure 3-1. Silicosis: Number of deaths, crude and age-adjusted death rates, U.S. residents age 15 and over, 1968–2004



NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Figure 3-2. Silicosis: Age-adjusted death rates by state, U.S. residents age 15 and over, 1995–2004



NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Table 3-1. Silicosis: Number of deaths by sex, race, age, and median age at death, U.S. residents age 15 and over, 1995–2004

Year	No. of Deaths	Underlying Cause (%)	Sex		Race			Age Group (yrs)								Median Age (yrs)
			Male	Female	White	Black	Other	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85+	
1995	242	47.1	232	10	198	42	2	-	-	2	8	28	70	98	36	76
1996	213	46.9	207	6	185	26	2	-	1	2	7	25	54	83	41	76
1997	198	49.5	189	9	163	32	3	-	-	4	7	26	67	58	36	74
1998	178	52.2	174	4	158	18	2	-	-	5	9	17	47	68	32	76
1999	187	55.1	181	6	154	30	3	-	-	3	9	21	58	61	35	75
2000	152	47.4	144	8	128	23	1	-	2	3	3	16	35	64	29	77
2001	164	50.6	159	5	137	26	1	-	-	1	5	25	46	55	32	75
2002	148	60.8	138	10	124	21	3	-	-	5	8	17	41	51	26	75
2003	179	57.0	168	11	152	25	2	1	1	4	8	13	52	56	44	77
2004	166	46.4	160	6	137	29	-	-	-	3	7	24	44	58	30	75
TOTAL	**1,827**	**51.0**	**1,752**	**75**	**1,536**	**272**	**19**	**1**	**4**	**32**	**71**	**212**	**514**	**652**	**341**	**76**

- indicates no deaths listed.
NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-2. Silicosis: Death rates (per million population) by race and sex, U.S. residents age 15 and over, 1995–2004

		White		Black		Other	
Year	**Overall**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
			Crude Death Rate				
1995	1.18	2.27	0.09	3.59	0.15	0.49	-
1996	1.03	2.12	0.07	2.29	-	0.46	-
1997	0.94	1.82	0.09	2.68	0.07	0.68	-
1998	0.84	1.80	0.03	1.44	0.07	0.44	-
1999	0.87	1.72	0.05	2.42	0.07	0.64	-
2000	0.68	1.34	0.09	1.85	-	0.18	-
2001	0.73	1.47	0.04	1.98	0.07	0.17	-
2002	0.65	1.26	0.08	1.55	0.07	0.34	0.16
2003	0.78	1.52	0.11	1.91	-	0.32	-
2004	0.71	1.40	0.06	2.17	-	-	-
1995–2004	**0.82**	**1.64**	**0.07**	**2.13**	**0.05**	**0.33**	**0.02**
			Age-Adjusted Death Rate				
1995	1.21	2.73	0.07	6.60	0.21	0.72	-
1996	1.05	2.59	0.05	3.86	-	1.00	-
1997	0.96	2.14	0.08	4.57	0.10	1.10	-
1998	0.85	2.10	0.03	2.44	0.07	0.84	-
1999	0.88	1.97	0.04	3.93	0.07	1.25	-
2000	0.70	1.59	0.07	3.42	-	0.19	-
2001	0.74	1.69	0.04	3.70	0.07	0.40	-
2002	0.66	1.45	0.07	2.87	0.08	0.57	0.17
2003	0.78	1.78	0.10	3.13	-	0.51	-
2004	0.71	1.56	0.05	3.70	-	-	-
1995–2004	**0.84**	**1.92**	**0.06**	**3.79**	**0.06**	**0.60**	**0.02**

- indicates no deaths listed.
NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Table 3-3. Silicosis: Years of potential life lost to age 65 and to life expectancy by race and sex, U.S. residents age 15 and over, 1995–2004

Year	White		Black		Other		Total
	Male	Female	Male	Female	Male	Female	
	Years of Potential Life Lost to Age 65						
1995	220	5	65	15	5	-	310
1996	240	-	60	-	15	-	315
1997	225	35	75	-	-	-	335
1998	260	5	55	25	-	-	345
1999	180	-	110	25	-	-	315
2000	210	5	40	-	15	-	270
2001	170	10	30	15	-	-	225
2002	225	55	35	5	5	5	330
2003	215	30	95	-	25	-	365
2004	215	-	85	-	-	-	300
TOTAL	**2,160**	**145**	**650**	**85**	**65**	**5**	**3,110**
	Years of Potential Life Lost to Life Expectancy						
1995	1,995	100	405	37	35	-	2,572
1996	1,881	57	301	-	36	-	2,275
1997	1,758	132	371	9	43	-	2,313
1998	1,737	39	204	38	23	-	2,041
1999	1,643	41	385	37	35	-	2,141
2000	1,318	97	257	-	30	-	1,702
2001	1,509	63	267	29	9	-	1,877
2002	1,411	153	214	22	31	22	1,853
2003	1,584	166	351	-	49	-	2,150
2004	1,598	57	387	-	-	-	2,042
TOTAL	**16,434**	**905**	**3,142**	**172**	**291**	**22**	**20,966**

- indicates no deaths listed.
NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-4. Silicosis: Number of deaths by state, U.S. residents age 15 and over, 1995–2004

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Alabama	4	3	1	8	4	2	1	3	4	2	**32**
Alaska	-	1	-	-	-	1	-	-	-	-	**2**
Arizona	6	3	3	3	4	1	3	3	8	2	**36**
Arkansas	3	1	2	2	3	2	-	1	1	1	**16**
California	14	13	5	4	6	8	9	4	6	7	**76**
Colorado	9	10	7	6	7	4	3	7	10	5	**68**
Connecticut	2	3	1	4	1	1	3	1	2	-	**18**
Delaware	1	1	1	-	1	1	-	-	-	1	**6**
District of Columbia	1	-	1	-	-	-	-	1	-	-	**3**
Florida	6	5	6	6	5	1	3	7	7	6	**52**
Georgia	6	4	4	3	2	2	1	-	3	3	**28**
Hawaii	-	-	-	-	-	-	-	1	-	-	**1**
Idaho	2	3	2	1	-	-	3	-	2	2	**15**
Illinois	5	7	8	7	5	5	8	4	7	2	**58**
Indiana	1	2	5	5	5	8	4	3	3	2	**38**
Iowa	2	1	4	4	1	1	4	-	-	-	**17**
Kansas	3	-	1	1	1	-	-	-	-	1	**7**
Kentucky	5	3	4	5	2	6	4	3	2	3	**37**
Louisiana	2	2	2	1	5	1	4	4	3	1	**25**
Maine	-	1	-	-	1	-	-	1	1	-	**4**
Maryland	2	4	1	3	5	2	-	6	1	3	**27**
Massachusetts	2	2	5	3	1	2	3	1	-	-	**19**
Michigan	12	16	5	9	6	8	4	4	4	9	**77**
Minnesota	6	6	5	-	4	3	6	1	3	7	**41**
Mississippi	1	1	3	1	2	1	1	2	3	3	**18**
Missouri	6	3	5	3	3	2	2	3	1	4	**32**
Montana	2	2	1	1	2	2	2	1	1	-	**14**
Nebraska	-	1	-	-	1	-	-	-	1	-	**3**
Nevada	2	-	1	-	-	1	-	1	-	2	**7**
New Hampshire	-	-	2	-	-	-	-	-	1	1	**4**
New Jersey	3	3	4	4	3	3	5	2	6	3	**36**
New Mexico	4	1	5	2	2	1	2	3	3	2	**25**
New York	9	10	6	8	8	9	4	10	4	10	**78**
North Carolina	12	6	9	5	6	6	5	1	4	6	**60**
North Dakota	-	1	-	-	-	-	-	-	-	-	**1**
Ohio	20	16	12	16	23	15	15	14	17	12	**160**
Oklahoma	-	-	1	-	5	1	1	-	1	1	**10**
Oregon	2	2	-	1	5	2	3	1	1	5	**22**
Pennsylvania	43	38	33	24	20	20	24	18	21	16	**257**
Rhode Island	-	2	3	-	2	-	1	-	2	3	**13**
South Carolina	-	3	2	1	2	3	5	-	1	1	**18**
South Dakota	-	1	1	-	1	2	-	1	1	-	**7**
Tennessee	2	2	3	5	3	-	4	2	4	4	**29**
Texas	11	9	11	8	12	6	8	14	15	12	**106**
Utah	4	-	3	3	1	2	6	4	2	1	**26**
Vermont	-	1	2	2	1	1	1	-	1	1	**10**
Virginia	3	2	3	6	1	4	4	1	5	7	**36**
Washington	2	2	2	4	3	2	1	2	3	2	**23**
West Virginia	8	6	6	5	6	4	1	6	4	1	**47**
Wisconsin	14	10	6	4	6	6	6	7	8	12	**79**
Wyoming	-	-	1	-	-	-	-	-	2	-	**3**
TOTAL	**242**	**213**	**198**	**178**	**187**	**152**	**164**	**148**	**179**	**166**	**1,827**

- indicates no deaths listed. NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes. SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-5. Silicosis: Number of deaths, death rates (per million population), and years of potential life lost (YPLL) by state, U.S. residents age 15 and over, 1995–2004

State	No. of Deaths	Rank	Death Rate				YPLL to Life Expectancy			
			Crude	Rank	Age-Adjusted	Rank	Total	Rank	YPLL/death	Rank
Alabama	32	19	0.91	18	0.90	19	464	15	14.5	12
Alaska	2	49	0.43	41	1.27	12	15	50	7.4	49
Arizona	36	16	0.91	18	0.90	19	439	18	12.2	31
Arkansas	16	34	0.76	23	0.72	28	348	24	21.7	2
California	76	7	0.29	48	0.33	46	972	5	12.8	24
Colorado	68	8	2.01	4	2.59	2	813	8	12.0	34
Connecticut	18	30	0.67	28	0.61	34	236	33	13.1	19
Delaware	6	43	0.96	16	0.98	18	65	44	10.8	41
District of Columbia	3	46	0.63	33	0.67	31	60	45	19.8	3
Florida	52	11	0.40	43	0.32	48	672	11	12.9	21
Georgia	28	22	0.44	40	0.57	37	328	28	11.7	37
Hawaii	1	50	0.10	51	0.10	51	22	48	22.0	1
Idaho	15	35	1.51	11	1.63	10	154	35	10.3	45
Illinois	58	10	0.60	34	0.62	33	807	9	13.9	14
Indiana	38	14	0.80	22	0.81	22	569	13	15.0	9
Iowa	17	33	0.73	25	0.61	34	177	34	10.4	44
Kansas	7	40	0.33	47	0.33	46	90	40	12.9	21
Kentucky	37	15	1.14	13	1.18	13	510	14	13.8	16
Louisiana	25	25	0.72	26	0.76	26	384	22	15.3	8
Maine	4	44	0.38	44	0.35	44	46	46	11.6	39
Maryland	27	23	0.65	30	0.72	28	331	27	12.3	29
Massachusetts	19	29	0.37	45	0.36	43	239	32	12.6	27
Michigan	77	6	0.99	15	1.01	16	951	6	12.3	29
Minnesota	41	13	1.05	14	1.05	14	413	21	10.1	47
Mississippi	18	30	0.81	20	0.82	21	333	26	18.5	4
Missouri	32	19	0.72	26	0.68	30	423	20	13.2	18
Montana	14	36	1.94	5	1.84	7	128	38	9.2	48
Nebraska	3	46	0.22	49	0.18	49	21	49	7.1	50
Nevada	7	40	0.45	39	0.54	38	76	42	10.9	40
New Hampshire	4	44	0.41	42	0.42	42	66	43	16.5	6
New Jersey	36	16	0.54	36	0.52	40	440	17	12.2	31
New Mexico	25	25	1.78	7	1.90	6	351	23	14.0	13
New York	78	5	0.52	37	0.51	41	937	7	12.0	34
North Carolina	60	9	0.94	17	1.00	17	766	10	12.8	24
North Dakota	1	50	0.19	50	0.13	50	6	51	6.1	51
Ohio	160	2	1.78	7	1.72	9	2,013	2	12.6	27
Oklahoma	10	38	0.37	45	0.35	44	130	37	13.0	20
Oregon	22	28	0.81	20	0.79	24	257	31	11.7	37
Pennsylvania	257	1	2.60	2	2.15	4	2,765	1	10.8	41
Rhode Island	13	37	1.53	10	1.33	11	137	36	10.6	43
South Carolina	18	30	0.56	35	0.58	36	268	30	14.9	10
South Dakota	7	40	1.18	12	1.02	15	84	41	12.0	34
Tennessee	29	21	0.64	31	0.66	32	456	16	15.7	7
Texas	106	3	0.66	29	0.78	25	1,787	3	16.9	5
Utah	26	24	1.57	9	2.17	3	334	25	12.8	24
Vermont	10	38	2.03	3	2.02	5	103	39	10.3	45
Virginia	36	16	0.64	31	0.73	27	436	19	12.1	33
Washington	23	27	0.49	38	0.54	38	308	29	13.4	17
West Virginia	47	12	3.17	1	2.78	1	653	12	13.9	14
Wisconsin	79	4	1.86	6	1.80	8	1,022	4	12.9	21
Wyoming	3	46	0.76	23	0.80	23	44	47	14.7	11

NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Table 3-6. Silicosis: Most frequently recorded industries on death certificate, U.S. residents age 15 and over, selected states and years, 1990–1999

CIC	Industry	Number of Deaths	Percent
060	Construction	118	13.4
040	Metal mining	86	9.8
041	Coal mining	69	7.8
270	Blast furnaces, steelworks, rolling and finishing mills	51	5.8
271	Iron and steel foundries	49	5.6
050	Nonmetallic mining and quarrying, except fuel	48	5.5
262	Miscellaneous nonmetallic mineral and stone products	44	5.0
392	Not specified manufacturing industries	33	3.8
331	Machinery, except electrical, n.e.c.	23	2.6
252	Structural clay products	20	2.3
	All other industries	317	36.0
	Industry not reported	23	2.6
	TOTAL	**881**	**100.0**

CIC - Census Industry Code n.e.c. - not elsewhere classified
NOTE: The comparable number of silicosis deaths in the entire United States for this same time period was 2,407. Percentages may not total to 100% due to rounding. See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, ICD codes, industry and occupation codes, and list of selected states and years.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-7. Silicosis: Most frequently recorded occupations on death certificate, U.S. residents age 15 and over, selected states and years, 1990–1999

COC	Occupation	Number of Deaths	Percent
616	Mining machine operators	138	15.7
889	Laborers, except construction	84	9.5
019	Managers and administrators, n.e.c.	34	3.9
633	Supervisors, production occupations	32	3.6
453	Janitors and cleaners	30	3.4
779	Machine operators, not specified	30	3.4
869	Construction laborers	26	3.0
719	Molding and casting machine operators	25	2.8
804	Truck drivers	20	2.3
243	Supervisors and proprietors, sales occupations	18	2.0
	All other occupations	422	47.9
	Occupation not reported	22	2.5
	TOTAL	**881**	**100.0**

COC - Census Occupation Code n.e.c. - not elsewhere classified
NOTE: The comparable number of silicosis deaths in the entire United States for this same time period was 2,407. Percentages may not total to 100% due to rounding. See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, ICD codes, industry and occupation codes, and list of selected states and years.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-8. Silicosis: Proportionate mortality ratio (PMR) adjusted for age, sex, and race by usual industry, U.S. residents age 15 and over, selected states and years, 1990–1999

CIC	Industry	Number of Deaths	PMR	95% Confidence Interval	
				LCL	UCL
040	Metal mining	86	41.7	33.6	51.8
262	Miscellaneous nonmetallic mineral and stone products	44	30.7	22.2	41.2
261	Pottery and related products	17	29.3	17.0	46.9
050	Nonmetallic mining and quarrying, except fuel	48	29.2	21.5	38.8
271	Iron and steel foundries	49	21.6	16.0	28.5
252	Structural clay products	20	19.7	12.0	30.4
041	Coal mining	69	6.2	4.8	7.9
300	Miscellaneous fabricated metal products	18	5.7	3.4	9.0
251	Cement, concrete, gypsum, and plaster products	8	4.2	1.8	8.3
280	Other primary metal industries	9	3.5	1.6	6.6
270	Blast furnaces, steelworks, rolling and finishing mills	51	3.2	2.4	4.2
682	Miscellaneous retail stores	7	3.2	1.3	6.5
250	Glass and glass products	10	3.0	1.4	5.5
331	Machinery, except electrical, n.e.c.	23	2.5	1.6	3.7
392	Not specified manufacturing industries	33	1.6	1.1	2.2
060	Construction	118	1.3	1.1	1.5

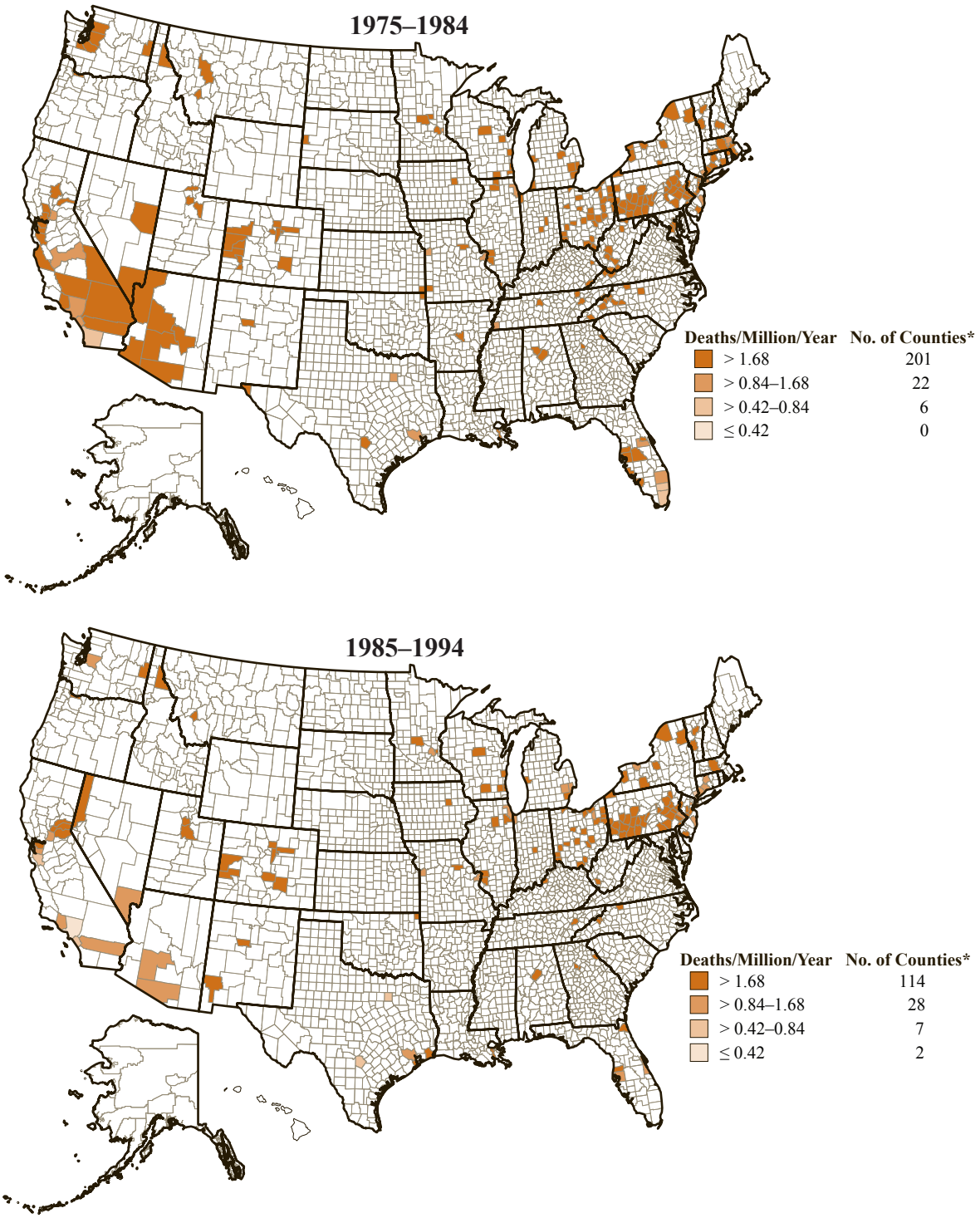
CIC - Census Industry Code n.e.c. - not elsewhere classified LCL - lower confidence limit UCL - upper confidence limit
NOTE: The total number of deaths with silicosis reported was 881 in these same selected states and years, and the comparable number of silicosis deaths in the entire United States for this same time period was 2,407. See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, ICD codes, industry and occupation codes, and list of selected states and years.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Table 3-9. Silicosis: Proportionate mortality ratio (PMR) adjusted for age, sex, and race by usual occupation, U.S. residents age 15 and over, selected states and years, 1990–1999

COC	Occupation	Number of Deaths	PMR	95% Confidence Interval LCL	95% Confidence Interval UCL
725	Miscellaneous metal and plastic processing machine operators	10	92.6	44.5	170.3
787	Hand molding, casting, and forming occupations	8	41.9	18.1	82.5
675	Hand molders and shapers, except jewelers	14	38.9	21.2	65.2
768	Crushing and grinding machine operators	17	33.0	19.2	52.9
719	Molding and casting machine operators	25	19.3	12.5	28.5
617	Mining occupations, n.e.c.	8	15.8	6.8	31.2
616	Mining machine operators	138	13.1	11.0	15.5
613	Supervisors, extractive occupations	7	12.9	5.2	26.5
599	Construction trades, n.e.c.	8	6.8	2.9	13.3
766	Furnace, kiln, and oven operators, except food	11	5.2	2.6	9.4
709	Grinding, abrading, buffing, and polishing machine operators	7	4.5	1.8	9.3
849	Crane and tower operators	9	3.9	1.8	7.3
544	Millwrights	8	3.5	1.5	6.9
779	Machine operators, not specified	30	2.9	2.0	4.2
844	Operating engineers	15	2.3	1.3	3.8
889	Laborers, except construction	84	2.2	1.8	2.7
579	Painters, construction and maintenance	14	2.2	1.2	3.6
633	Supervisors, production occupations	32	1.8	1.2	2.5
869	Construction laborers	26	1.6	1.0	2.3

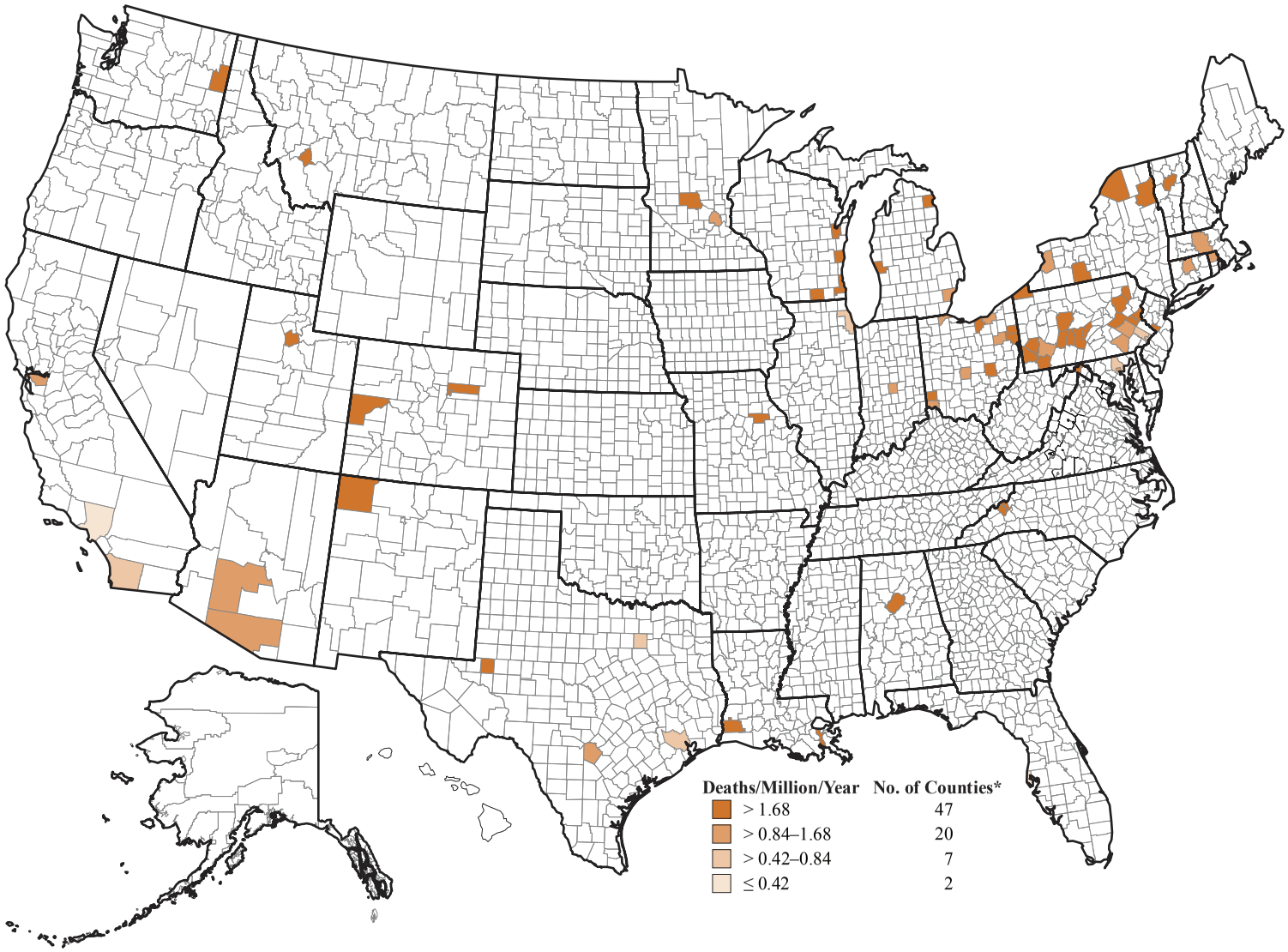
COC - Census Occupation Code n.e.c. - not elsewhere classified LCL - lower confidence limit UCL - upper confidence limit
NOTE: The total number of deaths with silicosis reported was 881 in these same selected states and years, and the comparable number of silicosis deaths in the entire United States for this same time period was 2,407. See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, ICD codes, industry and occupation codes, and list of selected states and years.
SOURCE: National Center for Health Statistics multiple cause-of-death data.

Figure 3-3a. Silicosis: Age-adjusted death rates by county, U.S. residents age 15 and over, 1975–1984 and 1985–1994



*Age-adjusted rates have not been calculated for counties having less than 5 deaths with the disease of interest or for unincorporated counties (see Appendix H).
NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Figure 3-3b. Silicosis: Age-adjusted death rates by county, U.S. residents age 15 and over, 1995–2004



*Age-adjusted rates have not been calculated for counties having less than 5 deaths with the disease of interest or for unincorporated counties (see Appendix H).
NOTE: See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Table 3-10. Silicosis: Counties with highest age-adjusted death rates (per million population), U.S. residents age 15 and over, 1995–2004

County	State	Age-Adjusted Rate	Crude Rate	Number of Deaths	% Female
Morgan County	West Virginia	35.8	49.0	6	16.7
Yancey County	North Carolina	29.9	41.0	6	0.0
Mitchell County	North Carolina	28.7	38.5	5	0.0
Huntingdon County	Pennsylvania	22.1	23.9	9	0.0
Audrain County	Missouri	21.1	29.0	6	0.0
St. Lawrence County	New York	19.3	18.7	17	0.0
Silver Bow County	Montana	18.9	25.0	7	0.0
Alpena County	Michigan	15.2	19.7	5	0.0
Washington County	Vermont	13.6	14.8	7	0.0
Muskegon County	Michigan	13.4	13.6	18	0.0
Schuylkill County	Pennsylvania	13.2	20.0	25	0.0
Essex County	New York	13.2	15.7	5	0.0
Stearns County	Minnesota	12.3	10.3	11	9.1
Mifflin County	Pennsylvania	12.1	16.2	6	0.0
Mesa County	Colorado	11.0	13.0	12	0.0
San Juan County	New Mexico	10.3	8.3	7	0.0
Columbiana County	Ohio	8.8	10.0	9	0.0
Sheboygan County	Wisconsin	8.0	8.9	8	0.0
Clearfield County	Pennsylvania	7.8	10.3	7	0.0
Blair County	Pennsylvania	6.7	8.5	9	0.0
Steuben County	New York	6.7	7.7	6	0.0
Muskingum County	Ohio	6.6	7.5	5	0.0
Ector County	Texas	5.7	5.5	5	0.0
Cambria County	Pennsylvania	5.2	7.9	10	0.0
Brown County	Wisconsin	5.2	4.5	8	0.0
Luzerne County	Pennsylvania	4.9	7.9	21	0.0
Racine County	Wisconsin	4.8	4.8	7	0.0
Rock County	Wisconsin	4.3	4.2	5	0.0
Mahoning County	Ohio	4.2	5.3	11	0.0
Calcasieu Parish	Louisiana	3.8	3.5	5	0.0
Fayette County	Pennsylvania	3.7	5.0	6	0.0
Lorain County	Ohio	3.7	3.6	8	0.0
Milwaukee County	Wisconsin	3.0	2.9	21	0.0
Mercer County	New Jersey	2.9	2.9	8	50.0
Butler County	Ohio	2.8	2.3	6	0.0
Northampton County	Pennsylvania	2.7	3.2	7	0.0
Washington County	Pennsylvania	2.6	3.6	6	0.0
Adams County	Colorado	2.5	1.8	5	20.0
Allegheny County	Pennsylvania	2.4	3.2	34	0.0
Erie County	Pennsylvania	2.3	2.7	6	0.0
Salt Lake County	Utah	2.2	1.5	10	0.0
Spokane County	Washington	1.9	1.8	6	0.0
Denver County	Colorado	1.8	1.6	7	0.0
Jefferson County	Alabama	1.8	1.9	10	0.0
Jefferson Parish	Louisiana	1.8	1.7	6	0.0
Lackawanna County	Pennsylvania	1.7	2.9	5	0.0
Lehigh County	Pennsylvania	1.7	2.0	5	0.0
Stark County	Ohio	1.6	2.0	6	16.7
Franklin County	Ohio	1.6	1.3	11	18.2
Hartford County	Connecticut	1.5	1.8	12	0.0
Overall United States		**0.8**	**0.8**	**1,827**	**4.1**

NOTE: Only counties with at least 5 deaths from the disease of interest are included. See selected limitations for general cautions regarding inferences based on small numbers of deaths, and see appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause-of-death data. Population estimates from U.S. Census Bureau.

Table 3-11. Silicosis: Estimated number of discharges from short-stay non-federal hospitals, 1970–2004

Year	Number of Discharges
1970	6,000
1971	7,000
1972	6,000
1973	5,000
1974	4,000
1975	4,000
1976	5,000
1977	4,000
1978	2,000
1979	3,000
1980	1,000
1981	2,000
1982	3,000
1983	2,000
1984	2,000
1985	3,000
1986	3,000
1987	3,000
1988	3,000
1989	2,000
1990	3,000
1991	4,000
1992	3,000
1993	1,000
1994	3,000
1995	3,000
1996	4,000
1997	3,000
1998	1,000
1999	1,000
2000	1,000
2001	300
2002	2,000
2003	1,000
2004	1,000

NOTE: Number of discharges has been rounded. The National Center for Health Statistics recommends that, in statistical comparisons, estimates of less than 5,000 not be used and that estimates of 5,000 to 10,000 be used with caution. See appendices for source description and methods.
SOURCE: National Center for Health Statistics National Hospital Discharge Survey.

Table 3-12a. Silicosis: Number of cases by ascertainment source—Michigan, New Jersey, Ohio, 1993–2002

	Michigan		New Jersey		Ohio		Total	
Source	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Healthcare provider report	108	23.2	2	1.5	13	4.7	123	14.0
Hospital data	312	67.1	127	94.1	234	83.9	673	76.6
Death certificate data	10	2.2	2	1.5	9	3.2	21	2.4
Workers' compensation	35	7.5	-	-	19	6.8	54	6.1
Other	-	-	4	3.0	4	1.4	8	1.0
TOTAL	**465**	**100.0**	**135**	**100.0**	**279**	**100.0**	**879**	**100.0**

- indicates no cases reported.
NOTE: Percentages may not sum to 100% due to rounding. Hospital data may include reporting by hospital of inpatient hospitalization and reporting by hospital record review. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of September 2006, reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante, D Schill, and K McGreevy (New Jersey); and E Socie and A Migliozzi (Ohio).

Table 3-12b. Silicosis: Number of cases by ascertainment source—California, 2000–2002

Source	No.	%
Healthcare provider report	7	5.2
Hospital data	127	94.8
TOTAL	**134**	**100.0**

NOTE: Percentages may not sum to 100% due to rounding. Hospital data may include reporting by hospital of inpatient hospitalization and reporting by hospital record review. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of December 2006, reported by R Harrison and F Reinisch.

Table 3-13a. Silicosis: Number of cases by duration of occupational exposure to silica—Michigan, New Jersey, Ohio, 1993–2002

Years of Employment in Jobs with Potential Silica Exposure	Michigan		New Jersey		Ohio		Total	
	No.	%	No.	%	No.	%	No.	%
< 10 years	24	5.2	15	11.1	18	6.5	57	6.5
10–19 years	68	14.6	32	23.7	52	18.6	152	17.3
20–29 years	145	31.2	30	22.2	66	23.7	241	27.4
30–39 years	149	32.0	26	19.3	56	20.1	231	26.3
≥ 40 years	46	9.9	16	11.9	23	8.2	85	9.7
Unknown number of years	33	7.1	16	11.9	64	22.9	113	12.9
TOTAL	**465**	**100.0**	**135**	**100.0**	**279**	**100.0**	**879**	**100.0**

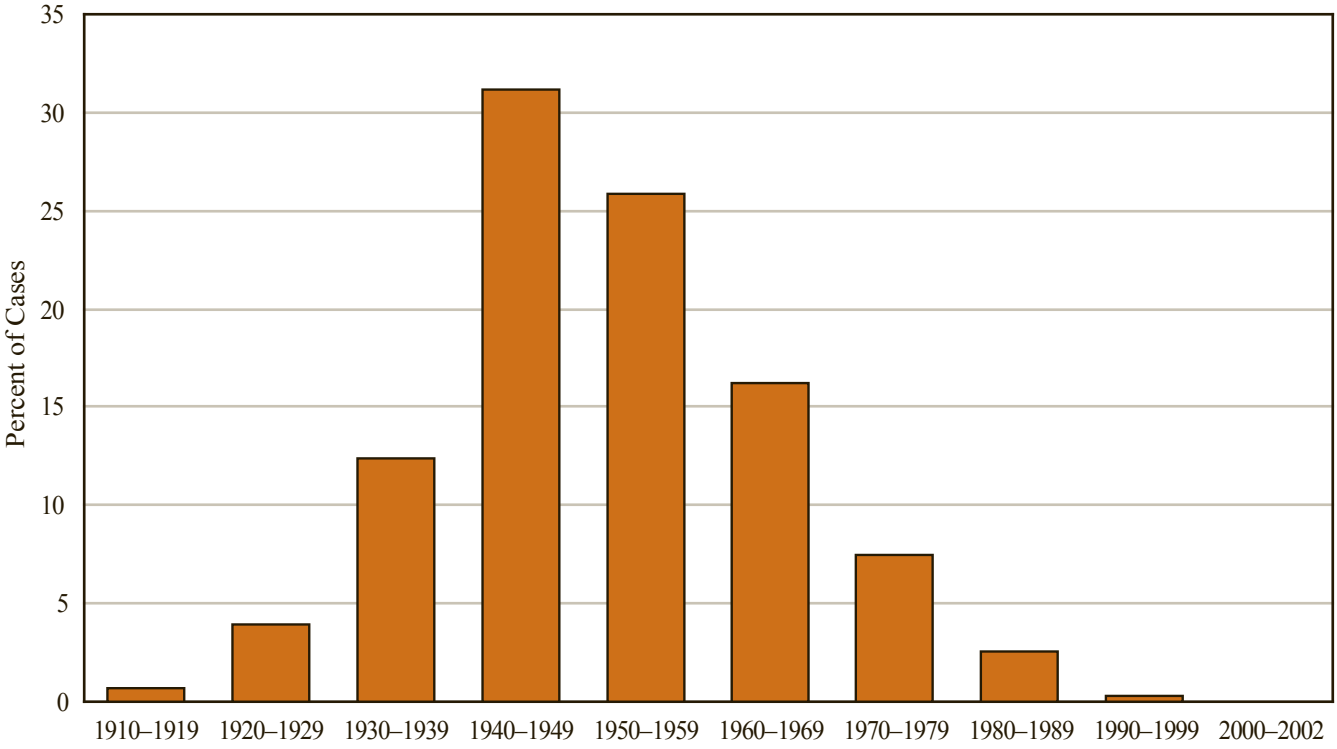
NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of September 2006, reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante, D Schill, and K McGreevy (New Jersey); and E Socie and A Migliozzi (Ohio).

Table 3-13b. Silicosis: Number of cases by duration of occupational exposure to silica—California, 2000–2002

Years of Employment in Jobs with Potential Silica Exposure	No.	%
< 10 years	9	6.7
10–19 years	18	13.4
20–29 years	24	17.9
30–39 years	15	11.2
≥ 40 years	18	13.4
Unknown number of years	50	37.3
TOTAL	**134**	**100.0**

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of December 2006, reported by R Harrison and F Reinisch.

Figure 3-4. Silicosis: Decade of first exposure for 734 cases—Michigan, New Jersey, Ohio, 1993–2002



NOTE: Cases with unknown or missing date of first exposure are excluded.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of September 2006, reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante, D Schill, and K McGreevy (New Jersey); and E Socie and A Migliozzi (Ohio).

Table 3-14a. Silicosis: Primary industries associated with silica exposure of silicosis cases—Michigan, New Jersey, Ohio, 1993–2002

	Michigan		New Jersey		Ohio		Total	
Industry (SIC)	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Agriculture, forestry, and fishing (01)	**1**	**0.2**	**1**	**0.7**	**-**	**-**	**2**	**0.2**
Mining	**13**	**2.8**	**20**	**14.8**	**17**	**6.1**	**50**	**5.7**
Mining and quarry of nonmetal minerals except fuel (14)	3	0.6	16	11.9	12	4.3	31	3.5
Metal mining (10)	9	1.9	3	2.2	-	-	12	1.4
All others within this division	1	0.2	1	0.7	5	1.8	7	0.8
Construction	**42**	**9.0**	**24**	**17.8**	**15**	**5.4**	**81**	**9.2**
Construction, special trade contractors (17)	34	7.3	12	8.9	11	3.9	57	6.5
Heavy construction other than building construction (16)	3	0.6	12	8.9	3	1.1	18	2.0
Building construction – general contractors and operative builders (15)	5	1.1	-	-	1	0.4	6	0.7
Manufacturing*	**393**	**84.5**	**85**	**63.0**	**239**	**85.7**	**717**	**81.6**
Primary metal industries (33)	340	73.1	17	12.6	121	43.4	478	54.4
Stone, clay, glass, and concrete products (32)	17	3.7	48	35.6	66	23.7	131	14.9
Fabricated metal products except machinery and transportation equipment (34)	6	1.3	5	3.7	20	7.2	31	3.5
Transportation equipment (37)	16	3.4	4	3.0	4	1.4	24	2.7
Industrial and commercial machinery and computer equipment (35)	5	1.1	1	0.7	16	5.7	22	2.5
Chemicals and allied products (28)	1	0.2	4	3.0	5	1.8	10	1.1
Electronic and other electrical equipment and components, except Computer Equipment (36)	2	0.4	1	0.7	3	1.1	6	0.7
Miscellaneous manufacturing industries (39)	6	1.3	-	-	-	-	6	0.7
Rubber and miscellaneous plastics products (30)	-	-	3	2.2	2	0.7	5	0.6
All others within this division	-	-	2	1.4	2	0.8	4	0.4
Transportation (40, 42, 49)	**2**	**0.4**	**2**	**1.5**	**-**	**-**	**4**	**0.5**
Wholesale trade (50)	**1**	**0.2**	**-**	**-**	**1**	**0.4**	**2**	**0.2**
Retail trade (59)	**1**	**0.2**	**1**	**0.7**	**-**	**-**	**2**	**0.2**
Finance, insurance, and real estate (65)	**-**	**-**	**-**	**-**	**1**	**0.4**	**1**	**0.1**
Services (75, 76, 80, 86)	**6**	**1.3**	**1**	**0.7**	**3**	**1.1**	**10**	**1.1**
Public administration (92, 95, 96, 97)	**3**	**0.6**	**1**	**0.7**	**1**	**0.4**	**5**	**0.6**
Unclassifiable (99)	**3**	**0.6**	**-**	**-**	**2**	**0.7**	**5**	**0.6**
TOTAL	**465**	**100.0**	**135**	**100.0**	**279**	**100.0**	**879**	**100.0**

- indicates no cases reported. SIC - Standard Industrial Classification

* Manufacturing includes the following SIC codes for cases less than 5 cases: 22, 29, 38.

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.

SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of September 2006, reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante, Schill, and K McGreevy (New Jersey); and E Socie and A Migliozzi (Ohio).

Table 3-14b. Silicosis: Primary industries associated with silica exposure of silicosis cases—California, 2000–2002

Industry (SIC)	No.	%
Agriculture, forestry, and fishing (01, 02)	**3**	**2.4**
Mining	**29**	**22.8**
Metal mining (10)	15	11.8
Mining and quarry of nonmetal minerals except fuel (14)	13	10.2
All others within this division	1	0.8
Construction	**18**	**14.2**
Construction, special trade contractors (17)	13	10.2
Heavy construction, other than building (16)	5	3.9
Manufacturing	**36**	**28.3**
Stone, clay, glass, and concrete products (32)	17	13.4
Primary metal industries (33)	7	5.5
Transportation equipment (37)	5	3.9
All others within this division	7	2.0
Transportation (40, 46)	**3**	**2.4**
Retail trade (52)	**1**	**0.8**
Services (73, 80, 82, 86, 87)	**6**	**4.7**
Public administration (97)	**3**	**2.4**
Unclassifiable (99)	**28**	**22.0**
TOTAL	**134**	**100.0**

SIC - Standard Industrial Classification
NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of December 2006, reported by R Harrison and F Reinisch.

Table 3-15a (page 1 of 2). Silicosis: Primary occupations associated with silica exposure of silicosis cases—Michigan, New Jersey, Ohio, 1993–2002

	Michigan		New Jersey		Ohio		Total	
Occupation (COC)	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Managerial and professional specialty	**3**	**0.6**	**3**	**2.2**	**2**	**0.7**	**8**	**0.9**
Technical, sales, and administrative	**3**	**0.6**	**3**	**2.2**	**1**	**0.4**	**7**	**0.8**
Service occupations	**5**	**1.1**	**-**	**-**	**2**	**0.7**	**7**	**0.8**
Farming, forestry and fishing	**1**	**0.2**	**1**	**0.7**	**-**	**-**	**2**	**0.2**
Precision production, craft, and repair	**113**	**24.3**	**40**	**29.6**	**47**	**16.8**	**200**	**22.8**
Supervisors, production (628)	15	3.2	5	3.7	7	2.5	27	3.1
Hand molders and shapers, except jewelers (675)	23	4.9	2	1.5	2	0.7	27	3.1
Construction trades, n.e.c. (599)	16	3.4	3	2.2	7	2.5	26	3.0
Brickmasons and stonemasons (563)	11	2.4	4	3.0	7	2.5	22	2.5
Mining machine operators (616)	5	1.1	5	3.7	2	0.7	12	1.4
Millwrights (544)	6	1.3	-	-	1	0.4	7	0.8
Concrete/terrazzo finishers (588)	6	1.3	-	-	1	0.4	7	0.8
Mining occupations, n.e.c. (617)	1	0.2	2	1.5	4	1.4	7	0.8
Industrial machinery repairers (518)	1	0.2	3	2.2	2	0.7	6	0.7
Electricians (575)	3	0.6	2	1.5	-	-	5	0.6
Dental lab, medical appliance technicians (678)	4	0.9	-	-	1	0.4	5	0.6
All others within this grouping	22	4.7	14	10.4	13	4.7	4.9	5.6
Operators, fabricators, and laborers	**278**	**59.8**	**86**	**63.7**	**217**	**77.8**	**581**	**66.1**
Laborers, except construction (889)	98	21.1	20	14.8	52	18.6	170	19.3
Molding and casting machine operators (719)	55	11.8	2	1.5	24	8.6	81	9.2
Grinding, abrading, buffing, and polishing machine operators (709)	25	5.4	1	0.7	21	7.5	47	5.3
Crushing and grinding machine operators (768)	10	2.2	6	4.4	22	7.9	38	4.3
Miscellaneous metal and plastic processing machine operators (725)	9	1.9	4	3.0	21	7.5	34	3.9
Furnace, kiln, and oven operators, excluding food (766)	14	3.0	2	1.5	14	5.0	30	3.4
Miscellaneous machine operators, n.e.c. (777)	7	1.5	3	2.2	13	4.7	23	2.6
Hand molding, casting, and forming occupations (787)	3	0.6	10	7.4	8	2.9	21	2.4
Construction laborers (869)	4	0.9	11	8.1	3	1.1	18	2.0
Machine operators, not specified (779)	4	0.9	4	3.0	8	2.9	16	1.8
Miscellaneous hand working occupations (795)	14	3.0	-	-	-	-	14	1.6
Crane and tower operators (849)	6	1.3	1	0.7	3	1.1	10	1.1
Production inspectors, checkers, and examiners (796)	3	0.6	2	1.5	4	1.4	9	1.0

See footnotes at end of table.

Table 3-15a (page 2 of 2). Silicosis: Primary occupations associated with silica exposure of silicosis cases—Michigan, New Jersey, Ohio, 1993–2002

	Michigan		New Jersey		Ohio		Total	
Occupation (COC)	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Operators, fabricators, and laborers (cont.)	**278**	**59.8**	**86**	**63.7**	**217**	**77.8**	**581**	**66.1**
Painting, paint spray machinery operators (759)	-	-	6	4.4	2	0.7	8	0.9
Welders and cutters (783)	3	0.6	2	1.5	3	1.1	8	0.9
Mixing, blending machine operators (756)	2	0.4	2	1.5	3	1.1	7	0.8
Operating engineers (844)	3	0.6	2	1.5	1	0.4	6	0.7
Industrial truck, tractor equipment operators (856)	2	0.4	-	-	3	1.1	5	0.6
All others within this grouping	16	3.4	8	5.9	12	4.3	36	4.1
Unclassifiable and miscellaneous unemployed	**62**	**13.3**	**2**	**1.5**	**10**	**3.6**	**74**	**8.4**
TOTAL	**465**	**100.0**	**135**	**100.0**	**279**	**100.0**	**879**	**100.0**

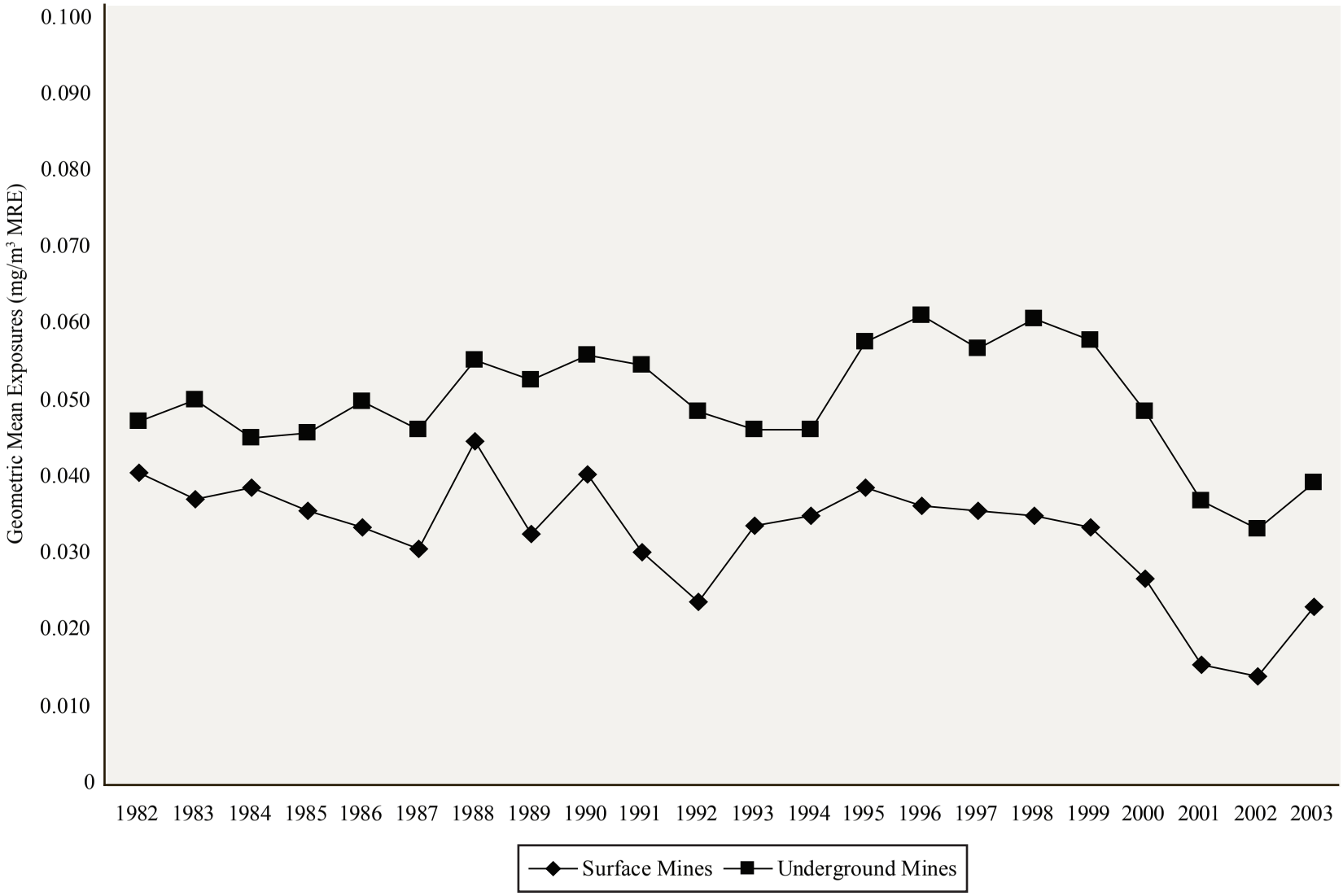
- indicates no cases reported. COC - Census Occupational Code n.e.c. - not elsewhere classified
NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of September 2006, reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante, D Schill, and K McGreevy (New Jersey); and E Socie and A Migliozzi (Ohio).

Table 3-15b. Silicosis: Primary occupations associated with silica exposure of silicosis cases—California, 2000–2002

Occupation (COC)	**No.**	**%**
Managerial and professional specialty	**6**	**4.5**
Technical, sales, and administrative	**2**	**1.5**
Farming, forestry and fishing	**3**	**2.2**
Precision production, craft, and repair	**53**	**39.6**
Mining machine operators (616)	14	10.4
Brickmasons and stonemasons (563)	5	3.7
All others within this grouping	34	25.4
Operators, fabricators, and laborers	**42**	**31.3**
Laborers, except construction (889)	7	5.2
Construction laborers (869)	5	3.7
All others within this grouping	30	22.4
Unclassifiable and miscellaneous unemployed	**28**	**20.9**
TOTAL	**134**	**100.0**

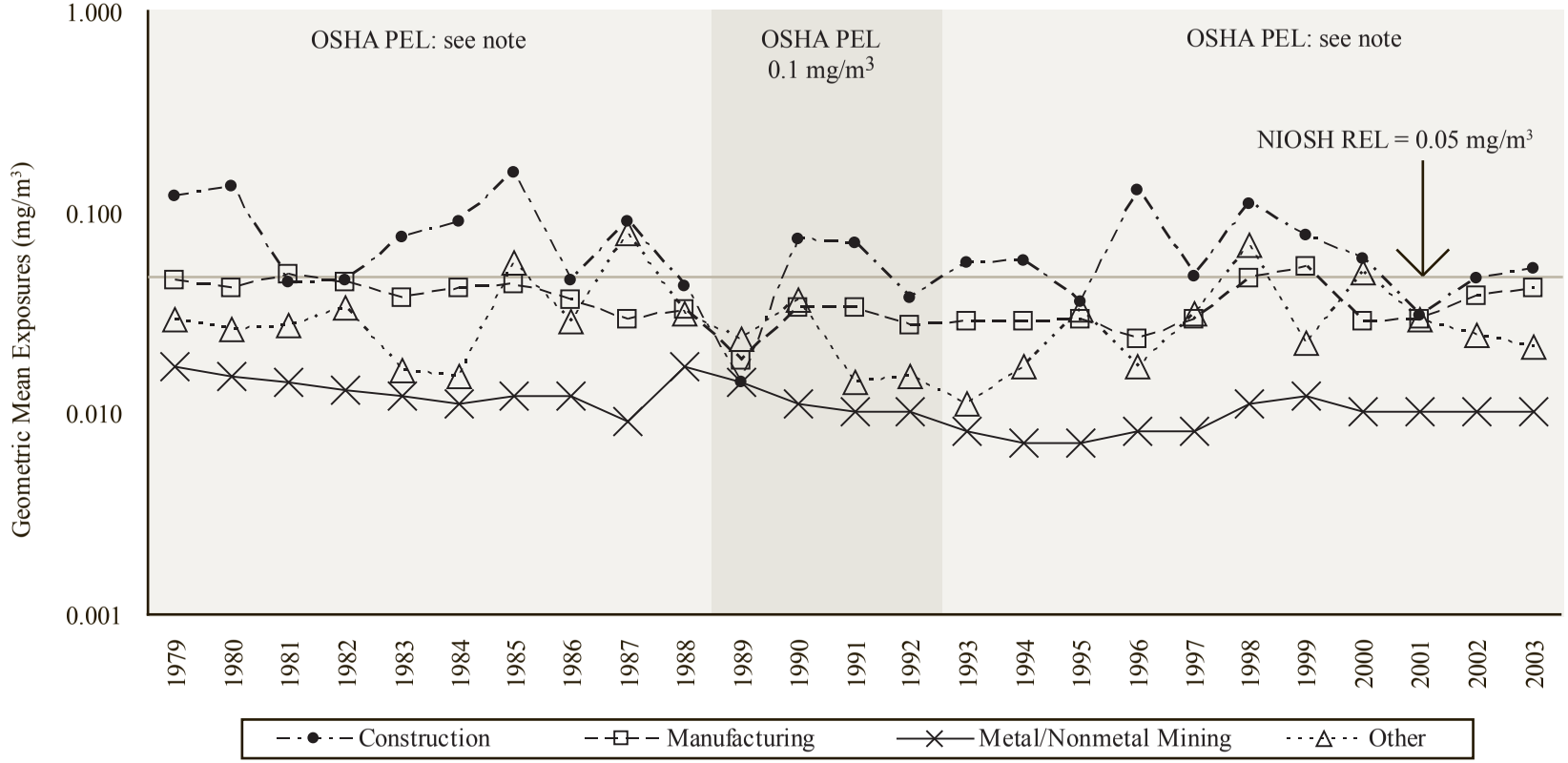
COC - 1990 Census Occupational Code
NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.
SOURCE: Provisional Sentinel Event Notification Systems for Occupational Risks surveillance data as of December 2006, reported by R Harrison and F Reinisch.

Figure 3-5a. Respirable quartz: Geometric mean exposures in coal mining, MSHA inspector and mine operator samples, 1982–2003



PEL - permissible exposure limit REL - recommended exposure limit mg/m^3 - milligrams per cubic meter MRE - Mining Research Establishment
MSHA - Mine Safety and Health Administration
NOTE: The MSHA PEL is 2 mg/m^3 MRE for respirable dust containing less than or equal to 5 percent quartz. The PEL is adjusted using the formula [(10 mg/m^3 MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. See appendices for source description, methods, and agents.
SOURCE: MSHA coal mine inspector and mine operator quartz data.

Figure 3-5b. Respirable quartz: Geometric mean exposures by major industry division, MSHA and OSHA samples, 1979–2003



PEL - permissible exposure limit REL - recommended exposure limit mg/m^3 - milligrams per cubic meter MSHA - Mine Safety and Health Administration
OSHA - Occupational Safety and Health Administration
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m^3) / (% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m^3 for respirable quartz. For metal/nonmetal mining, the MSHA PEL is [(10 mg/m^3) / (% quartz+2)] for respirable dust containing at least 1 percent quartz. See appendices for source description, methods, and agents.
SOURCE: MSHA metal/nonmetal data. OSHA Integrated Management Information System.

Table 3-16a. Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits in coal mining, MSHA inspector and mine operator samples, 1982–2003

	Underground Mines			Surface Mines		
Year	GM (mg/m^3 MRE)	No. of Samples	% > PEL*	GM (mg/m^3 MRE)	No. of Samples	% > PEL*
1982	0.047	2,144	36.7	0.040	538	46.1
1983	0.050	3,972	38.5	0.037	990	44.2
1984	0.045	3,622	39.3	0.038	991	44.4
1985	0.045	3,500	35.3	0.035	742	41.5
1986	0.050	3,354	38.2	0.033	867	38.1
1987	0.046	3,279	36.3	0.030	728	33.4
1988	0.055	3,584	35.3	0.044	968	37.0
1989	0.052	3,210	37.1	0.032	699	35.2
1990	0.056	3,079	34.7	0.040	680	37.1
1991	0.054	4,647	33.8	0.030	410	27.8
1992	0.048	6,493	28.2	0.023	1,308	21.6
1993	0.046	5,556	25.4	0.033	1,228	29.8
1994	0.046	5,591	27.0	0.035	1,208	30.5
1995	0.057	5,802	31.1	0.038	1,369	26.5
1996	0.061	3,996	31.3	0.036	1,485	21.0
1997	0.056	5,573	29.1	0.035	1,921	20.4
1998	0.060	7,361	28.5	0.035	1,913	20.4
1999	0.057	9,291	26.6	0.033	2,121	18.6
2000	0.048	9,105	21.4	0.026	1,951	15.7
2001	0.037	12,328	15.5	0.015	4,763	6.2
2002	0.033	9,951	13.2	0.014	3,748	5.7
2003	0.039	5,909	15.4	0.023	1,156	11.2

- incalculable SIC - Standard Industrial Classification PEL - permissible exposure limit REL - recommended exposure limit
GM - geometric mean mg/m^3 - milligrams per cubic meter MRE - Mining Research Establishment
MSHA - Mine Safety and Health Administration
* Samples selected based on the respirable dust level and MSHA PEL (2 mg/m^3 MRE or adjusted PEL).
NOTE: The MSHA PEL is 2 mg/m^3 MRE for respirable dust containing less than or equal to 5 percent quartz. The PEL is adjusted using the formula [(10 mg/m^3 MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. See appendices for source description, methods, and agents.
SOURCE: MSHA coal mine inspector and mine operator quartz data.

Table 3-16b. Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by major industry division, MSHA and OSHA samples, 1979–2003

OSHA PEL (mg/m^3)	Year	Construction (SIC 15–17)				Manufacturing (SIC 20–39)				Metal/Nonmetal Mining (SIC 10, 14)				Other (SIC 1–9, 13, 40–99)			
		GM (mg/m^3)	No. of Samples	% > PEL	% > REL	GM (mg/m^3)	No. of Samples	% > PEL	% > REL	GM (mg/m^3)	No. of Samples	% > PEL*	% > REL	GM (mg/m^3)	No. of Samples	% > PEL	% > REL
See note	**1979**	0.118	27	55.6	63.0	0.045	763	30.0	49.0	0.017	9,038	11.7	17.3	0.029	36	13.9	36.1
	1980	0.133	71	59.2	67.6	0.041	1,394	30.8	47.5	0.015	6,001	11.2	17.7	0.026	36	16.7	22.2
	1981	0.044	26	38.5	50.0	0.048	1,269	33.2	50.9	0.014	6,299	11.7	17.8	0.027	15	13.3	26.7
	1982	0.045	36	27.8	44.4	0.044	1,298	30.5	48.7	0.013	2,553	11.1	16.8	0.033	15	20.0	26.7
	1983	0.074	56	41.1	64.3	0.037	1,067	26.9	42.4	0.012	6,048	10.5	16.5	0.016	30	10.0	20.0
	1984	0.089	43	44.2	51.2	0.041	863	32.3	47.5	0.011	7,118	10.2	15.4	0.015	43	14.0	23.3
	1985	0.156	57	59.6	64.9	0.043	1,144	33.6	48.9	0.012	6,002	10.3	15.4	0.055	26	38.5	57.7
	1986	0.045	35	34.3	37.1	0.036	719	26.7	39.5	0.012	6,625	10.3	16.5	0.028	40	27.5	37.5
	1987	0.089	39	51.3	64.1	0.029	804	24.9	36.6	0.009	6,069	7.8	11.5	0.077	79	50.6	58.2
	1988	0.042	44	38.6	43.2	0.032	720	28.9	40.4	0.017	7,062	17.8	26.7	0.031	75	30.7	38.7
0.1	**1989**	0.014	16	12.5	18.8	0.018	644	14.0	25.0	0.014	8,307	14.7	22.1	0.023	70	22.9	28.6
	1990	0.073	41	31.7	48.8	0.033	808	21.9	40.1	0.011	10,512	11.1	16.7	0.036	43	27.9	37.2
	1991	0.069	44	31.8	40.9	0.033	757	21.3	39.8	0.010	12,495	9.4	14.2	0.014	51	3.9	21.6
	1992	0.037	65	23.1	35.4	0.027	720	14.4	33.1	0.010	12,244	9.2	14.7	0.015	43	7.0	11.6
See note	**1993**	0.055	30	33.3	56.7	0.028	525	18.1	31.6	0.008	10,382	7.3	11.3	0.011	34	2.9	8.8
	1994	0.057	21	38.1	61.9	0.028	439	23.5	35.8	0.007	15,940	5.6	8.6	0.017	55	9.1	12.7
	1995	0.035	36	25.0	27.8	0.029	410	23.9	36.3	0.007	12,594	5.5	8.4	0.032	43	27.9	30.2
	1996	0.126	67	49.3	62.7	0.023	435	18.6	26.0	0.008	16,251	6.2	9.2	0.017	48	10.4	16.7
	1997	0.047	109	33.0	46.8	0.029	536	22.9	34.7	0.008	7,855	6.4	10.2	0.031	38	15.8	23.7
	1998	0.109	143	51.7	62.9	0.046	678	36.0	50.1	0.011	4,488	6.6	12.7	0.068	28	32.1	60.7
	1999	0.076	171	48.5	59.1	0.053	665	36.2	54.7	0.012	4,883	8.0	15.9	0.022	52	21.2	25.0
	2000	0.058	131	40.5	48.1	0.028	422	19.0	31.3	0.010	8,406	5.7	10.8	0.049	24	33.3	33.3
	2001	0.030	136	25.7	36.0	0.029	346	21.7	31.5	0.010	6,133	6.8	13.6	0.029	35	11.4	22.9
	2002	0.046	133	24.1	41.4	0.038	290	26.6	38.3	0.010	7,463	5.6	11.7	0.024	40	17.5	30.0
	2003	0.052	96	35.4	43.8	0.041	328	30.5	41.2	0.010	8,932	6.1	11.7	0.021	34	14.7	23.5

SIC - Standard Industrial Classification PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m^3 - milligrams per cubic meter
MSHA - Mine Safety and Health Administration OSHA - Occupational Safety and Health Administration
*For metal/nonmetal mining, the MSHA PEL is [(10 mg/m^3) / (% quartz+2)] for respirable dust containing at least 1 percent quartz.
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m^3) / (% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m^3 for respirable quartz. The NIOSH REL is 0.05 mg/m^3. See appendices for source description, methods, and agents.
SOURCE: MSHA metal/nonmetal mine data. OSHA Integrated Management Information System.

Table 3-17 (page 1 of 2). Respirable quartz: Number of samples, geometric mean exposures, and percent exceeding designated occupational exposure limits by industry, MSHA inspector and mine operator and OSHA samples, 1993–2003

CIC	Industry	Number of Samples	GM (mg/m^3)	% > PEL	% > REL
892	Miscellaneous professional and related services	10	0.679	60.0	60.0
311	Farm machinery and equipment	32	0.059	50.0	59.4
271	Iron and steel foundries	1,625	0.049	33.9	50.0
060	Construction	1,073	0.059	37.9	49.7
331	Machinery, except electrical, n.e.c.	182	0.045	35.7	49.5
282	Fabricated structural metal products	126	0.073	37.3	47.6
530	Machinery, equipment, and supplies	19	0.051	21.1	47.4
360	Ship and boat building and repairing	13	0.098	46.2	46.2
751	Automotive repair and related services	24	0.068	41.7	45.8
262	Miscellaneous nonmetallic mineral and stone products	581	0.041	28.6	45.4
252	Structural clay products	245	0.038	29.8	45.3
261	Pottery and related products	157	0.043	26.1	45.2
041	Coal mining	103,326	0.040	21.1†	‡
211	Other rubber products, and plastics footwear and belting	41	0.027	26.8	41.5
351	Motor vehicles and motor vehicle equipment	98	0.030	30.6	38.8
300	Miscellaneous fabricated metal products	207	0.039	28.0	36.2
502	Lumber and construction materials	42	0.035	19.0	33.3
312	Construction and material handling machines	29	0.034	20.7	31.0
250	Glass and glass products	73	0.018	17.8	28.8
191	Agricultural chemicals	21	0.023	14.3	28.6
280	Other primary metal industries	213	0.024	19.2	27.7
251	Cement, concrete, gypsum, and plaster products	550	0.022	17.8	26.7
231	Sawmills, planning mills, and millwork	19	0.025	26.3	26.3
760	Miscellaneous repair services	29	0.023	17.2	24.1
371	Scientific and controlling instruments	13	0.017	15.4	23.1
682	Miscellaneous retail stores	13	0.020	15.4	23.1
212	Miscellaneous plastics products	57	0.016	8.8	22.8
190	Paints, varnishes, and related products	27	0.016	14.8	22.2
372	Medical, dental, optical instruments and supplies	18	0.014	16.7	22.2

See footnotes at end of table.

Table 3-17 (page 2 of 2). Respirable quartz: Number of samples, geometric mean exposures, and percent exceeding designated occupational exposure limits by industry, MSHA inspector and mine operator and OSHA samples, 1993–2003

CIC	Industry	Number of Samples	GM (mg/m^3)	% > PEL	% > REL
391	Miscellaneous manufacturing industries	74	0.020	10.8	21.6
471	Sanitary services	33	0.023	12.1	21.2
272	Primary aluminum industries	194	0.019	11.9	21.1
180	Plastics, synthetics, and resins	20	0.014	10.0	20.0
531	Scrap and waste materials	20	0.018	10.0	20.0
990	Industry not reported	71	0.011	11.3	19.7
241	Miscellaneous wood products	21	0.016	4.8	19.0
192	Industrial and miscellaneous chemicals	103	0.019	12.6	18.4
040	Metal mining	6,590	0.012	10.2	16.9
232	Wood buildings and mobile homes	12	0.016	16.7	16.7
411	Warehousing and storage	13	0.017	15.4	15.4
201	Miscellaneous petroleum and coal products	54	0.013	9.3	14.8
270	Blast furnaces, steelworks, rolling and finishing mill	32	0.016	9.4	12.5
291	Metal forgings and stampings	24	0.016	8.3	12.5
050	Nonmetallic mining and quarrying, except fuel	96,694	0.008	5.9	10.1
320	Metalworking machinery	35	0.010	5.7	8.6
580	Lumber and building material retailing	12	0.010	0.0	8.3
281	Cutlery, handtools, and general hardware	14	0.011	7.1	7.1
410	Trucking service	14	0.010	0.0	7.1
342	Electrical machinery, equipment, and supplies, n.e.c.	32	0.010	3.1	6.3
	All other industries*	324	0.016	10.8	16.4
	TOTAL	**213,249**	**0.019**	**14.1**	**27.2**

CIC - Census Industry Code PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean
mg/m^3 - milligrams per cubic meter MRE - Mining Research Establishment n.e.c. - not elsewhere classified
MSHA - Mine Safety and Health Administration OSHA - Occupational Safety and Health Administration
* includes industries with no samples exceeding the REL or industries with less than 10 samples.
† Geometric mean reported in mg/m^3 MRE. Samples selected based on the respirable dust level and MSHA PEL (2 mg/m^3 MRE or adjusted PEL).
‡ The MSHA respirable coal mine quartz exposure data and the NISOH REL for respirable quartz cannot be compared to each other because they are based on difference sampling criteria.
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m^3) /(% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m^3 for respirable quartz. For coal mining, the MSHA PEL is 2 mg/m^3 MRE for respirable dust containing less than or equal to 5 percent quartz. The PEL is adjusted using the formula [(10 mg/m^3 MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz; for metal/nonmetal mining, the MSHA PEL is [(10 mg/m^3) / (% quartz + 2)] for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m^3. See appendices forsource description, methods, and industry codes.
SOURCE: MSHA metal/nonmetal and coal mine inspector and mine operator quartz data. OSHA Integrated Management Information System.

Table 3-18 (page 1 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits in coal mining by MSHA coal mine district and state, MSHA inspector and mine operator samples, 1982–2003

	All years		1982–1988			1989–1992			1993–2003		
MSHA Coal Mine District	No. of Samples	(GM mg/m^3 MRE)	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*
District 1 (Anthracite coal mining regions in Pennsylvania)	**2,185**	**0.017**	**299**	**0.021**	**38.8**	**171**	**0.021**	**37.4**	**1,715**	**0.017**	**17.4**
District 2 (Bituminous coal mining regions in Pennsylvania)	**16,941**	**0.035**	**3,843**	**0.042**	**33.7**	**2,207**	**0.039**	**23.2**	**10,891**	**0.032**	**14.7**
District 3	**15,753**	**0.031**	**3,680**	**0.031**	**27.7**	**1,684**	**0.037**	**20.7**	**10,389**	**0.030**	**14.2**
Maryland	1,108	0.034	120	0.056	40.0	45	0.037	4.4	943	0.032	12.8
Ohio	5,356	0.034	1,871	0.038	32.2	719	0.036	21.7	2,766	0.031	14.6
Northern West Virginia	9,289	0.029	1,689	0.024	21.8	920	0.038	20.7	6,680	0.029	14.2
District 4 (Southern West Virginia)	**27,718**	**0.053**	**6,802**	**0.051**	**39.1**	**3,900**	**0.055**	**35.8**	**17,016**	**0.053**	**27.5**
District 5 (Virginia)	**17,991**	**0.051**	**4,264**	**0.056**	**44.3**	**2,795**	**0.057**	**36.6**	**10,932**	**0.048**	**22.0**
District 6 (Eastern Kentucky)	**21,839**	**0.050**	**2,706**	**0.050**	**39.8**	**2,529**	**0.066**	**41.2**	**16,604**	**0.048**	**24.3**
District 7	**21,732**	**0.050**	**2,729**	**0.067**	**49.0**	**3,008**	**0.056**	**36.4**	**15,995**	**0.046**	**23.5**
Northern Georgia	0	-	0	-	-	0	-	-	0	-	-
Central Kentucky	19,421	0.050	2,232	0.069	50.2	2,486	0.058	37.2	14,703	0.046	23.4
North Carolina	0	-	0	-	-	0	-	-	0	-	-
South Carolina	0	-	0	-	-	0	-	-	0	-	-
Tennessee	2,311	0.048	497	0.057	43.3	522	0.050	32.6	1,292	0.045	23.6
District 8	**9,722**	**0.041**	**2,004**	**0.046**	**33.5**	**1,414**	**0.040**	**19.9**	**6,304**	**0.040**	**22.3**
Illinois	7,913	0.040	1,616	0.046	32.3	1,262	0.039	18.8	5,035	0.038	20.4
Indiana	1,717	0.049	330	0.051	37.9	140	0.053	30.7	1,247	0.048	30.0
Iowa	54	0.024	39	0.023	38.5	9	0.027	22.2	6	0.022	0
Michigan	0	-	0	-	-	0	-	-	0	-	-
Minnesota	0	-	0	-	-	0	-	-	0	-	-
Northern Missouri	38	0.052	19	0.075	47.4	3	0.031	-	16	0.036	31.3
Wisconsin	0	-	0	-	-	0	-	-	0	-	-

See footnotes at end of table.

Table 3-18 (page 2 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits in coal mining by MSHA coal mine district and state, MSHA inspector and mine operator samples, 1982–2003

	All years		1982–1988			1989–1992			1993–2003		
MSHA Coal Mine District	No. of Samples	(GM mg/m^3 MRE)	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*
District 9	**7,043**	**0.029**	**1,296**	**0.038**	**40.4**	**1,210**	**0.028**	**32.6**	**4,537**	**0.027**	**16.1**
Alaska	13	0.019	10	0.014	10.0	2	0.051	50.0	1	0.056	0
Arizona	50	0.045	6	0.023	33.3	10	0.050	40.0	34	0.049	14.7
Arkansas	19	0.043	6	0.120	66.7	1	0.009	100.0	12	0.029	16.7
California	1	0.025	0	-	-	0	-	-	1	0.025	0
Colorado	2,227	0.031	424	0.039	42.9	380	0.030	34.2	1,423	0.030	16.0
Hawaii	0	-	0	-	-	0	-	-	0	-	-
Idaho	0	-	0	-	-	0	-	-	0	-	-
Kansas	32	0.044	8	0.120	75.0	7	0.027	0	17	0.034	5.9
Louisiana	27	0.008	0	-	-	2	0.038	0	25	0.007	-
Southern Missouri	59	0.038	14	0.096	57.1	4	0.077	25.0	41	0.026	9.8
Montana	136	0.027	34	0.036	38.2	11	0.048	54.5	91	0.022	20.9
Nebraska	0	-	0	-	-	0	-	-	0	-	-
Nevada	0	-	0	-	-	0	-	-	0	-	-
New Mexico	425	0.034	113	0.050	35.4	42	0.052	38.1	270	0.027	12.6
North Dakota	57	0.009	27	0.011	11.1	14	0.008	14.3	16	0.009	6.3
Oklahoma	423	0.057	149	0.118	61.1	62	0.065	38.7	212	0.033	17.9
Oregon	0	-	0	-	-	0	-	-	0	-	-
Texas	162	0.027	48	0.095	56.3	24	0.015	25.0	90	0.016	13.3
Utah	2,667	0.027	292	0.029	34.9	549	0.025	32.1	1,826	0.027	16.4
Washington	23	0.027	2	0.017	0	9	0.019	0	12	0.038	16.7
Wyoming	722	0.020	163	0.016	27.6	93	0.019	29.0	466	0.021	18.2

See footnotes at end of table.

Table 3-18 (page 3 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits in coal mining by MSHA coal mine district and state, MSHA inspector and mine operator samples, 1982–2003

	All years		1982–1988			1989–1992			1993–2003		
MSHA Coal Mine District	No. of Samples	(GM mg/m^3 MRE)	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*	No. of Samples	(GM mg/m^3 MRE)	% > PEL*
District 10 (Western Kentucky)	**6,973**	**0.022**	**1,137**	**0.020**	**25.7**	**904**	**0.022**	**18.1**	**4,932**	**0.022**	**12.4**
District 11	**5,234**	**0.041**	**519**	**0.053**	**36.8**	**704**	**0.058**	**33.0**	**4,011**	**0.038**	**18.8**
Alabama	5,234	0.041	519	0.053	36.8	704	0.058	33.0	4,011	0.038	18.8
Florida	0	-	0	-	-	0	-	-	0	-	-
Central and Southern Georgia	0	-	0	-	-	0	-	-	0	-	-
Mississippi	0	-	0	-	-	0	-	-	0	-	-
Puerto Rico	0	-	0	-	-	0	-	-	0	-	-
Virgin Islands	0	-	0	-	-	0	-	-	0	-	-
TOTAL	**153,131**	**0.042**	**29,279**	**0.046**	**37.8**	**20,526**	**0.047**	**31.9**	**103,326**	**0.040**	**21.1**

- indicates incalculable field. PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m^3 - milligrams per cubic meter
MRE - Mining Research Establishment MSHA - Mine Safety and Health Administration
* Samples selected based on the respirable dust level and MSHA PEL (2 mg/m^3 MRE or adjusted PEL).
NOTE: The MSHA PEL is 2 mg/m^3 MRE for respirable dust containing less than or equal to 5 percent quartz. The PEL is adjusted using the formula [(10 mg/m^3 MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. See appendices for source description and methods.
SOURCE: MSHA coal mine inspector and mine operator quartz data.

Table 3-19 (page 1 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA metal/nonmetal mine district and state, MSHA samples, 1979–2003

MSHA Metal/Nonmetal Mine District	All years		1979–1988				1989–1992				1993–2003			
	No. of Samples	GM (mg/m^3)	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL
Northeast	**33,331**	**0.011**	**8,979**	**0.016**	**12.4**	**19.4**	**6,060**	**0.011**	**9.9**	**16.1**	**18,292**	**0.009**	**6.2**	**11.4**
Connecticut	904	0.012	285	0.027	26.3	38.2	156	0.013	13.5	23.1	463	0.007	1.7	5.6
Delaware	114	0.005	17	0.006	0.0	0.0	33	0.005	0.0	3.0	64	0.004	3.1	0.0
District of Columbia	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Maine	940	0.012	199	0.025	16.6	24.6	169	0.009	3.0	7.7	572	0.011	5.4	12.1
Maryland	1,736	0.008	518	0.009	4.2	8.1	314	0.007	2.9	7.0	904	0.008	2.8	5.9
Massachusetts	1,669	0.013	476	0.026	17.4	28.6	250	0.010	9.6	16.0	943	0.009	5.1	10.5
New Hampshire	738	0.012	131	0.029	15.3	33.6	133	0.010	7.5	16.5	474	0.010	5.7	13.5
New Jersey	2,780	0.012	992	0.021	17.5	27.5	623	0.012	12.4	20.1	1,165	0.008	4.2	8.8
New York	7,618	0.010	1,875	0.014	11.4	17.0	1,649	0.009	6.2	11.8	4,094	0.009	5.2	9.9
Pennsylvania	7,918	0.012	2,324	0.014	9.3	15.2	1,212	0.014	13.8	20.5	4,382	0.011	7.6	13.2
Rhode Island	262	0.016	57	0.030	22.8	36.8	35	0.014	8.6	25.7	170	0.014	12.4	20.6
Vermont	1,859	0.016	372	0.020	22.3	31.5	334	0.013	19.2	26.3	1,153	0.016	16.7	28.9
Virginia	5,012	0.009	1,126	0.011	6.6	12.0	808	0.009	8.5	13.2	3,078	0.008	4.0	7.5
West Virginia	1,781	0.014	607	0.018	17.6	24.4	344	0.015	13.7	19.8	830	0.010	7.0	11.6
Southeast	**43,316**	**0.008**	**13,902**	**0.010**	**7.5**	**12.4**	**9,250**	**0.008**	**8.2**	**12.8**	**20,164**	**0.007**	**4.9**	**8.6**
Alabama	3,736	0.007	1,034	0.007	4.2	6.6	876	0.007	8.0	11.9	1,826	0.007	5.5	8.8
Florida	3,938	0.005	830	0.006	3.7	7.1	827	0.005	2.2	5.0	2,281	0.004	1.8	2.7
Georgia	6,815	0.010	2,464	0.015	11.1	19.6	1,567	0.010	10.6	15.3	2,784	0.008	6.3	9.8
Kentucky	2,905	0.008	943	0.009	7.5	10.4	480	0.008	9.4	11.0	1,482	0.007	4.4	6.1
Mississippi	2,058	0.007	273	0.007	4.4	6.6	476	0.007	5.5	8.2	1,309	0.008	5.8	9.8
North Carolina	9,183	0.008	3,347	0.010	6.5	11.4	2,166	0.008	6.7	11.1	3,670	0.007	4.6	8.6
Puerto Rico	1,380	0.005	586	0.004	0.9	0.2	29	0.007	3.4	10.3	765	0.005	3.1	3.4
South Carolina	4,549	0.010	1,054	0.017	17.3	27.6	1,130	0.010	9.7	16.1	2,365	0.007	3.8	8.7
Tennessee	8,663	0.009	3,327	0.009	6.4	9.9	1,698	0.010	10.5	16.3	3,638	0.009	6.9	12.8
Virgin Islands	89	0.006	44	0.004	0.0	0.0	1	0.010	0.0	0.0	44	0.010	2.3	6.8
North Central	**40,993**	**0.010**	**12,515**	**0.011**	**9.3**	**13.8**	**8,549**	**0.011**	**10.8**	**15.8**	**19,929**	**0.009**	**5.4**	**9.6**
Illinois	7,193	0.011	2,796	0.014	16.4	21.0	1,387	0.011	13.0	19.3	3,010	0.008	5.2	9.6
Indiana	4,440	0.007	1,174	0.007	2.9	3.3	917	0.007	4.5	6.0	2,349	0.007	3.1	5.4
Iowa	2,498	0.006	675	0.007	4.9	5.0	570	0.006	5.3	4.9	1,253	0.006	2.6	4.2
Michigan	5,746	0.011	1,397	0.012	8.4	15.3	1,459	0.014	14.3	19.9	2,890	0.010	6.8	11.7
Minnesota	7,915	0.010	3,402	0.010	5.7	10.6	1,475	0.012	10.5	17.0	3,038	0.009	5.5	10.1
Ohio	7,638	0.010	1,361	0.013	13.2	19.2	1,710	0.010	9.1	14.4	4,567	0.009	6.3	11.1
Wisconsin	5,563	0.011	1,710	0.012	8.9	13.3	1,031	0.013	15.1	20.5	2,822	0.009	5.7	10.7

See footnotes at end of table.

Table 3-19 (page 2 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA metal/nonmetal mine district and state, MSHA samples, 1979–2003

MSHA Metal/Nonmetal Mine District	All years		1979–1988				1989–1992				1993–2003			
	No. of Samples	GM (mg/m^3)	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL
South Central	**36,806**	**0.009**	**7,465**	**0.013**	**13.0**	**17.6**	**9,403**	**0.010**	**9.5**	**13.7**	**19,938**	**0.007**	**5.4**	**8.4**
Arkansas	2,805	0.014	544	0.039	31.6	45.8	660	0.018	16.7	28.5	1,601	0.009	8.2	14.7
Louisiana	3,019	0.006	279	0.008	7.2	11.8	716	0.005	4.2	6.3	2,024	0.006	3.9	6.9
Missouri	9,055	0.010	2,347	0.013	13.0	16.4	2,008	0.011	11.6	15.1	4,700	0.008	5.2	8.4
New Mexico	4,338	0.013	1,013	0.015	14.4	19.7	1,059	0.015	13.2	21.1	2,266	0.012	11.8	16.7
Oklahoma	5,512	0.009	1,570	0.011	9.9	13.2	1,340	0.011	10.9	16.6	2,602	0.008	4.5	8.9
Texas	12,077	0.007	1,712	0.011	10.0	14.1	3,620	0.007	6.4	8.4	6,745	0.006	3.4	4.2
Rocky Mountain	**34,698**	**0.015**	**15,364**	**0.017**	**14.5**	**22.2**	**5,927**	**0.017**	**16.7**	**26.2**	**13,407**	**0.013**	**11.2**	**18.2**
Arizona	5,644	0.017	2,380	0.023	18.0	27.1	717	0.019	18.8	29.0	2,547	0.012	10.2	16.8
Colorado	6,528	0.016	3,459	0.014	12.6	19.9	1,168	0.019	17.4	27.6	1,901	0.018	12.6	23.3
Kansas	2,970	0.011	1,280	0.013	12.4	14.1	542	0.011	9.8	12.5	1,148	0.009	7.1	8.6
Montana	3,334	0.014	1,370	0.012	10.4	15.3	667	0.023	22.5	33.7	1,297	0.013	12.1	20.9
Nebraska	861	0.006	53	0.006	5.7	5.7	254	0.006	2.8	4.7	554	0.006	3.1	3.8
Nevada	4,114	0.020	1,224	0.025	24.5	33.7	1,032	0.021	20.4	31.8	1,858	0.017	15.3	25.0
North Dakota	582	0.011	194	0.014	12.9	18.6	72	0.009	1.4	11.1	316	0.010	5.7	12.3
South Dakota	2,688	0.015	1,597	0.019	13.2	23.0	281	0.013	9.3	16.0	810	0.011	9.6	15.3
Utah	4,744	0.016	2,083	0.015	12.6	20.0	889	0.020	18.2	30.4	1,772	0.015	11.5	21.9
Wyoming	3,233	0.015	1,724	0.021	15.1	26.4	305	0.013	13.8	21.0	1,204	0.010	14.1	13.6
Western	**20,556**	**0.010**	**4,590**	**0.016**	**13.5**	**20.7**	**4,369**	**0.013**	**12.1**	**19.1**	**11,597**	**0.008**	**5.4**	**9.1**
Alaska	450	0.014	88	0.025	21.6	28.4	33	0.054	24.2	39.4	329	0.011	6.4	14.6
California	9,059	0.013	2,326	0.018	15.3	23.3	2,425	0.014	12.0	21.0	4,308	0.010	7.0	11.2
Hawaii	320	0.004	11	0.005	0.0	0.0	57	0.005	3.5	1.8	252	0.004	1.2	0.8
Idaho	3,238	0.015	912	0.022	15.9	26.1	534	0.017	17.0	27.2	1,792	0.011	8.0	15.9
Oregon	3,464	0.005	413	0.007	4.1	6.3	698	0.007	7.4	8.0	2,353	0.005	1.9	1.8
Washington	4,025	0.008	840	0.011	10.1	13.8	622	0.011	13.3	17.8	2,563	0.007	4.6	7.5
TOTAL	**209,700**	**0.010**	**62,815**	**0.013**	**11.4**	**17.3**	**43,558**	**0.011**	**10.8**	**16.5**	**103,327**	**0.009**	**6.2**	**10.6**

- indicates incalculable field. PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m^3 - milligrams per cubic meter
MSHA - Mine Safety and Health Administration
NOTE: For metal/nonmetal mining, the MSHA PEL is [(10 mg/m^3) / (% quartz+2)] for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m^3. See appendices for source description and methods.
SOURCE: MSHA metal/nonmetal mine data.

Table 3-20 (page 1 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979–2003

	All years		1979–1988 OSHA PEL: see note				1989–1992 OSHA PEL=0.1 mg/m^3				1993–2003 OSHA PEL: see note			
OSHA Region	No. of Samples	GM (mg/m^3)	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL
Region 1	**1,692**	**0.029**	**1,006**	**0.032**	**25.2**	**39.2**	**187**	**0.017**	**9.6**	**21.9**	**499**	**0.028**	**22.8**	**34.7**
Connecticut	514	0.021	354	0.026	18.6	32.8	56	0.014	3.6	16.1	104	0.015	8.7	20.2
Maine	39	0.019	21	0.029	33.3	38.1	1	0.007	0.0	0.0	17	0.012	5.9	11.8
Massachusetts	601	0.038	300	0.040	31.0	45.3	77	0.025	16.9	29.9	224	0.041	29.9	44.2
New Hampshire	298	0.024	143	0.033	23.8	39.9	41	0.015	7.3	22.0	114	0.018	15.8	23.7
Rhode Island	240	0.039	188	0.036	28.7	41.0	12	0.007	0.0	0.0	40	0.096	47.5	60.0
Vermont	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Region 2	**2,075**	**0.038**	**1,001**	**0.040**	**31.6**	**46.4**	**300**	**0.029**	**17.7**	**36.7**	**774**	**0.039**	**31.7**	**43.9**
New Jersey	584	0.033	318	0.035	29.6	41.8	138	0.038	18.8	45.7	128	0.025	21.9	26.6
New York	1,476	0.040	681	0.042	32.3	48.3	158	0.024	17.1	29.7	637	0.044	33.9	47.7
Puerto Rico	11	0.027	2	0.914	100.0	100.0	3	0.007	0.0	0.0	6	0.016	16.7	33.3
Virgin Islands	4	0.007	0	-	-	-	1	0.007	0.0	0.0	3	0.007	0.0	0.0
Region 3	**2,846**	**0.047**	**1,994**	**0.047**	**30.1**	**49.3**	**304**	**0.034**	**23.7**	**39.8**	**548**	**0.054**	**36.1**	**51.5**
Delaware	23	0.019	17	0.014	5.9	11.8	0	-	-	-	6	0.044	33.3	33.3
District of Columbia	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Maryland	247	0.032	127	0.032	28.3	36.2	62	0.035	35.5	50.0	58	0.030	20.7	29.3
Pennsylvania	2,061	0.049	1,394	0.049	29.4	51.7	220	0.033	20.5	37.3	447	0.057	38.0	53.2
Virginia	280	0.041	252	0.038	26.6	40.1	3	0.041	0.0	33.3	25	0.084	28.0	76.0
West Virginia	235	0.061	204	0.062	42.2	55.9	19	0.049	26.3	36.8	12	0.057	58.3	50.0
Region 4	**3,223**	**0.031**	**1,501**	**0.036**	**29.0**	**42.0**	**524**	**0.030**	**20.8**	**35.3**	**1,198**	**0.026**	**19.5**	**31.8**
Alabama	663	0.029	354	0.033	30.2	42.1	167	0.043	26.3	50.3	142	0.014	8.5	15.5
Florida	121	0.038	59	0.034	28.8	37.3	22	0.027	22.7	27.3	40	0.054	42.5	50.0
Georgia	750	0.040	477	0.041	32.9	47.4	96	0.022	15.6	26.0	177	0.049	22.6	42.4
Kentucky	359	0.029	155	0.045	33.5	45.2	62	0.046	29.0	41.9	142	0.015	13.4	16.2
Mississippi	114	0.047	75	0.046	33.3	49.3	22	0.030	13.6	22.7	17	0.096	41.2	64.7
North Carolina	587	0.027	157	0.026	12.1	26.1	27	0.026	18.5	29.6	403	0.027	21.3	33.3
South Carolina	230	0.022	66	0.018	21.2	22.7	68	0.019	16.2	25.0	96	0.030	21.9	32.3
Tennessee	399	0.029	158	0.041	28.5	44.9	60	0.019	13.3	23.3	181	0.025	17.7	35.9

See footnotes at end of table.

Table 3-20 (page 2 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979–2003

	All years		1979–1988 OSHA PEL: see note				1989–1992 OSHA PEL=0.1 mg/m^3				1993–2003 OSHA PEL: see note			
OSHA Region	No. of Samples	GM (mg/m^3)	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL
Region 5	**6,233**	**0.037**	**2,863**	**0.048**	**34.9**	**52.5**	**1,251**	**0.028**	**16.4**	**35.3**	**2,119**	**0.032**	**25.6**	**36.7**
Illinois	1,188	0.039	546	0.043	33.5	47.4	191	0.031	18.3	35.6	451	0.039	28.8	39.5
Indiana	503	0.030	262	0.037	31.3	45.0	79	0.019	8.9	25.3	162	0.027	27.2	35.2
Michigan	915	0.015	29	0.013	0.0	3.4	264	0.012	2.7	12.1	622	0.016	9.0	18.2
Minnesota	75	0.059	60	0.067	50.0	65.0	9	0.029	0.0	44.4	6	0.047	33.3	33.3
Ohio	1,995	0.043	1,219	0.046	32.1	49.9	366	0.031	18.6	34.7	410	0.048	31.7	44.4
Wisconsin	1,557	0.055	747	0.061	41.9	64.1	342	0.050	25.7	55.8	468	0.049	38.5	52.6
Region 6	**1,294**	**0.041**	**887**	**0.036**	**30.0**	**41.5**	**172**	**0.037**	**29.1**	**43.6**	**235**	**0.075**	**40.4**	**50.2**
Arkansas	124	0.031	96	0.023	24.0	32.3	15	0.089	66.7	66.7	13	0.072	53.8	53.8
Louisiana	97	0.074	68	0.056	41.2	64.7	11	0.032	27.3	36.4	18	0.336	44.4	66.7
New Mexico	27	0.071	11	0.041	54.5	54.5	1	0.007	0.0	0.0	15	0.124	80.0	80.0
Oklahoma	233	0.040	154	0.034	20.1	37.7	10	0.044	30.0	50.0	69	0.058	33.3	49.3
Texas	813	0.039	558	0.037	31.9	41.0	135	0.034	25.2	41.5	120	0.065	37.5	44.2
Region 7	**1,256**	**0.036**	**742**	**0.036**	**26.7**	**39.8**	**236**	**0.022**	**12.3**	**27.1**	**278**	**0.052**	**35.3**	**47.1**
Iowa	592	0.032	336	0.031	22.6	32.7	119	0.021	12.6	28.6	137	0.050	40.9	48.9
Kansas	250	0.051	97	0.041	34.0	42.3	51	0.030	17.6	27.5	102	0.079	36.3	56.9
Missouri	333	0.036	242	0.048	31.4	50.4	62	0.019	8.1	22.6	29	0.013	6.9	6.9
Nebraska	81	0.027	67	0.023	19.4	32.8	4	0.033	0.0	50.0	10	0.068	30.0	40.0
Region 8	**868**	**0.040**	**511**	**0.031**	**23.5**	**34.8**	**122**	**0.032**	**25.4**	**39.3**	**235**	**0.075**	**40.9**	**55.7**
Colorado	541	0.031	328	0.026	20.4	30.2	74	0.025	17.6	32.4	139	0.055	33.8	51.8
Montana	78	0.059	64	0.044	25.0	35.9	11	0.250	72.7	81.8	3	0.141	66.7	66.7
North Dakota	108	0.082	56	0.041	23.2	50.0	2	0.069	50.0	50.0	50	0.183	64.0	72.0
South Dakota	73	0.055	27	0.033	33.3	44.4	10	0.102	70.0	70.0	36	0.068	36.1	47.2
Utah	62	0.044	31	0.085	48.4	48.4	25	0.017	8.0	28.0	6	0.076	33.3	66.7
Wyoming	6	0.025	5	0.022	0.0	20.0	0	-	-	-	1	0.046	0.0	0.0

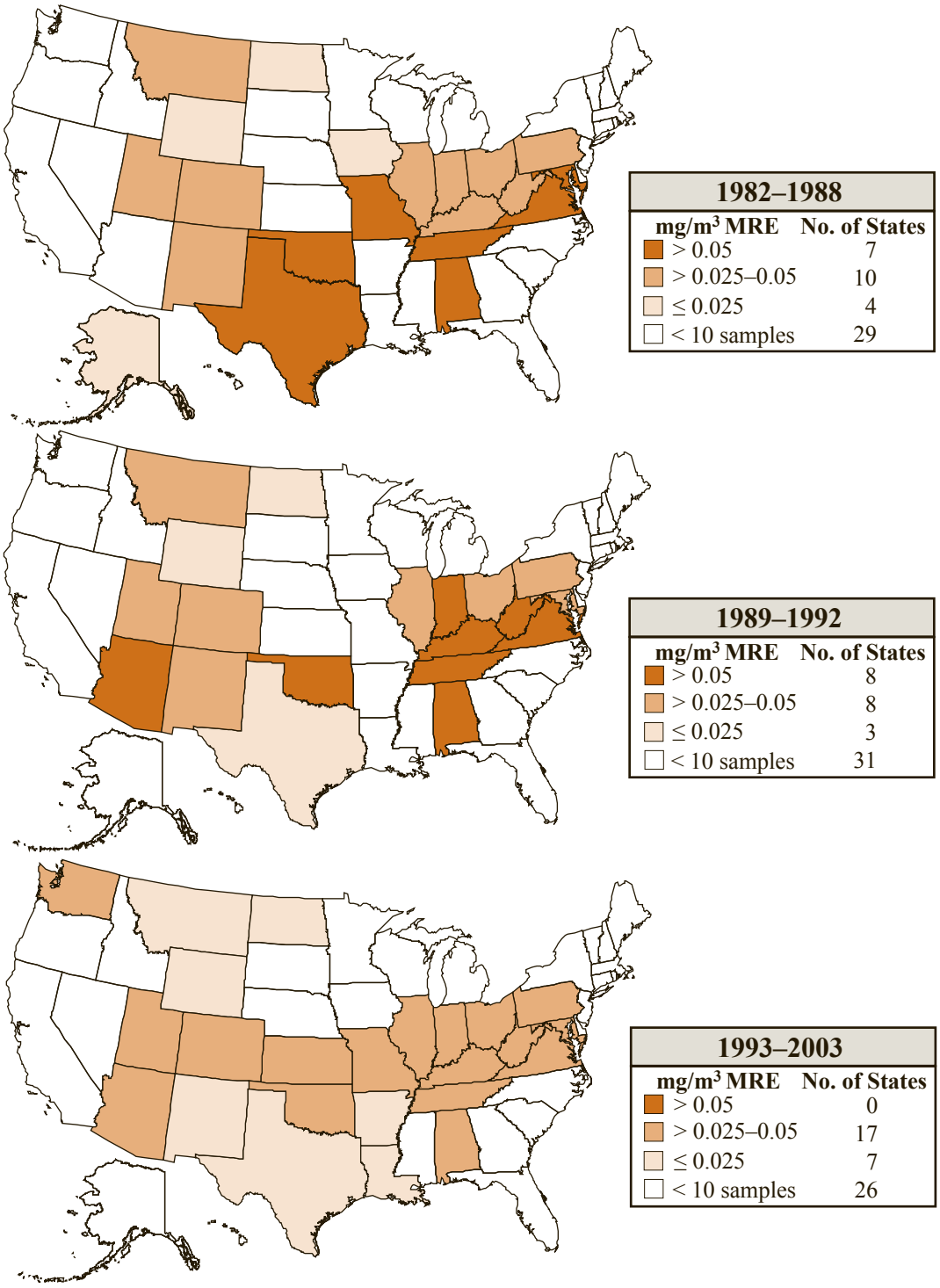
See footnotes at end of table.

Table 3-20 (page 3 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979–2003

	All years		1979–1988 OSHA PEL: see note				1989–1992 OSHA PEL=0.1 mg/m^3				1993–2003 OSHA PEL: see note			
OSHA Region	No. of Samples	GM (mg/m^3)	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL	No. of Samples	GM (mg/m^3)	% > PEL	% > REL
Region 9	**523**	**0.039**	**246**	**0.058**	**44.3**	**55.3**	**119**	**0.020**	**19.3**	**21.8**	**158**	**0.035**	**28.5**	**39.9**
American Samoa	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Arizona	76	0.052	29	0.055	41.4	58.6	10	0.010	0.0	10.0	37	0.078	51.4	62.2
California	283	0.024	119	0.025	22.7	35.3	61	0.014	6.6	9.8	103	0.031	22.3	35.9
Guam	1	0.007	1	0.007	0.0	0.0	0	-	-	-	0	-	-	-
Hawaii	10	0.008	5	0.008	0.0	0.0	0	-	-	-	5	0.007	0.0	0.0
Nevada	153	0.097	92	0.205	76.1	83.7	48	0.035	39.6	39.6	13	0.021	23.1	23.1
Region 10	**769**	**0.038**	**130**	**0.046**	**33.1**	**40.8**	**87**	**0.034**	**21.8**	**32.2**	**552**	**0.037**	**25.2**	**38.6**
Alaska	7	0.100	2	0.150	50.0	50.0	5	0.085	60.0	80.0	0	-	-	-
Idaho	42	0.041	18	0.055	50.0	55.6	21	0.040	14.3	42.9	3	0.007	0.0	0.0
Oregon	348	0.025	107	0.046	30.8	39.3	5	0.009	0.0	0.0	236	0.019	18.2	24.2
Washington	372	0.055	3	0.007	0.0	0.0	56	0.033	23.2	26.8	313	0.061	30.7	49.8
TOTAL	**20,779**	**0.037**	**10,881**	**0.041**	**30.7**	**46.0**	**3,302**	**0.028**	**18.4**	**34.5**	**6,596**	**0.036**	**27.4**	**39.6**

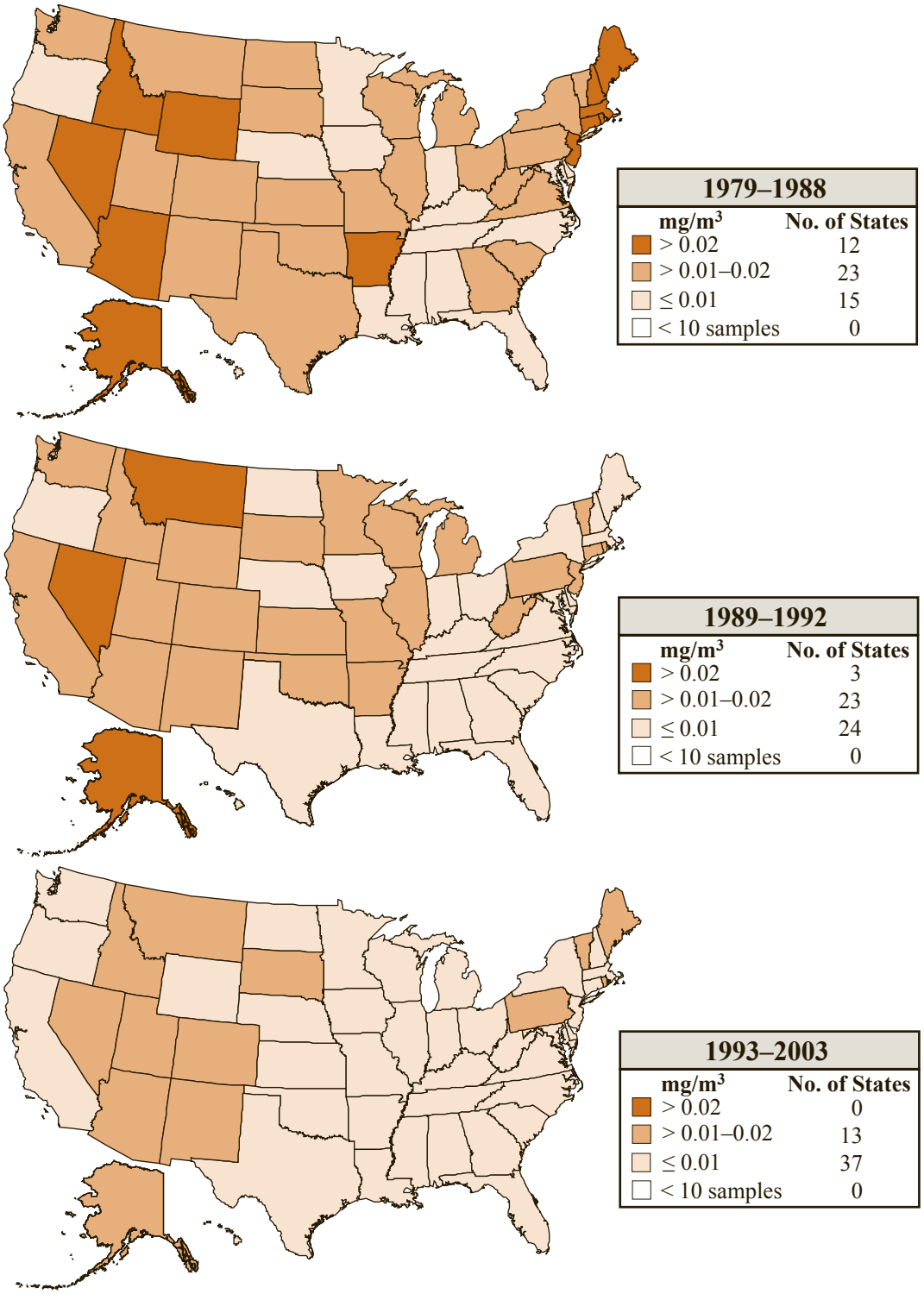
- indicates incalculable field. PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m^3 - milligrams per cubic meter
OSHA - Occupational Safety and Health Administration
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m^3) /(% quartz + 2)] for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m^3 for respirable quartz. The NIOSH REL is 0.05mg/m^3. See appendices for source description and mehtods.
SOURCE: OSHA Integrated Management Information System.

Figure 3-6. Respirable quartz: Geometric mean coal mining exposures by state, MSHA inspector and mine operator samples, 1982–2003



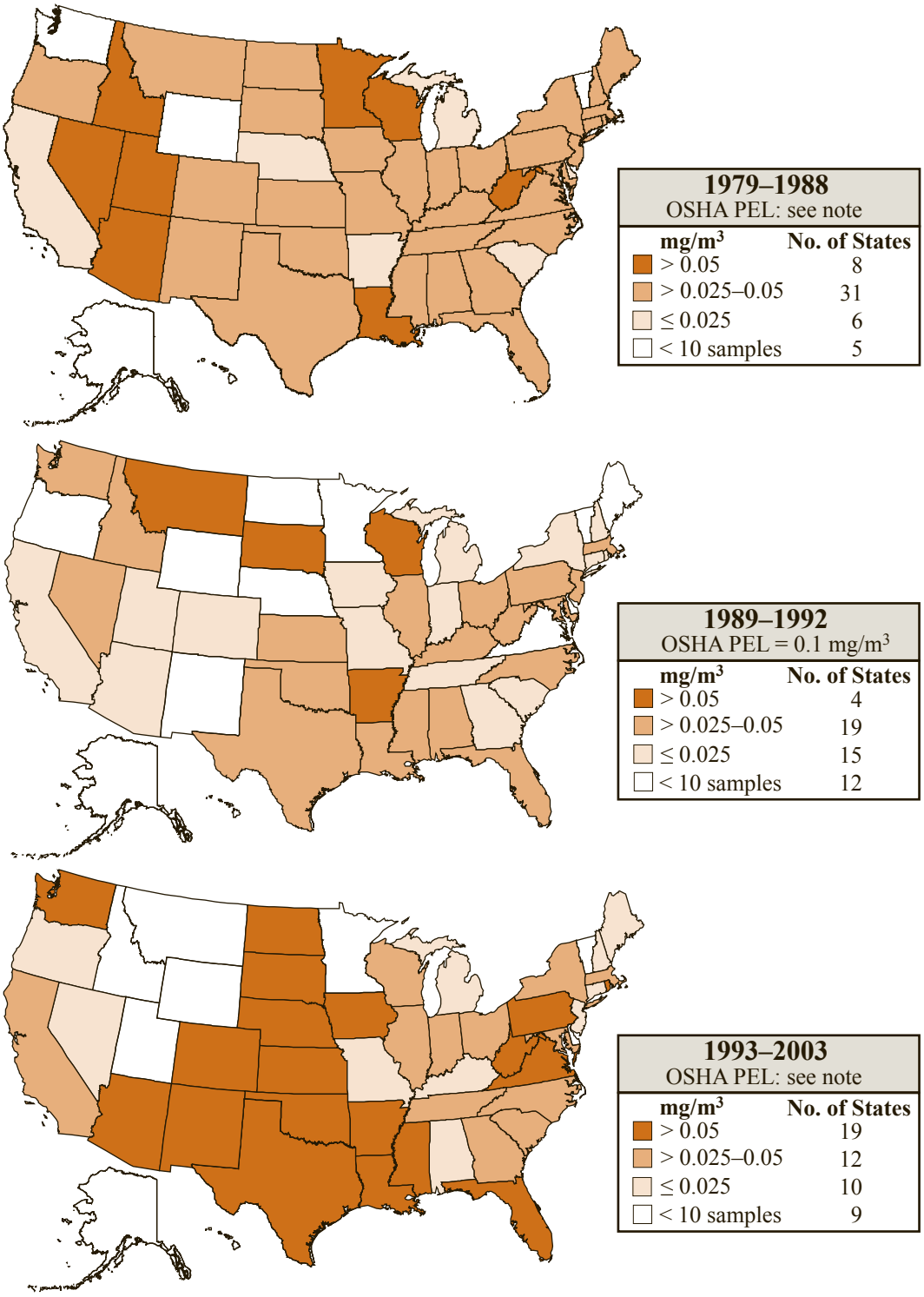
mg/m^3 - milligrams per cubic meter MRE - Mining Research Establishment
MSHA - Mine Safety and Health Administration
NOTE: See appendices for source description, methods, and agents.
SOURCE: MSHA coal mine inspector and operator quartz data.

Figure 3-7. Respirable quartz: Geometric mean metal/nonmetal mining exposures by state, MSHA samples, 1979–2003



mg/m^3 - milligrams per cubic meter MSHA - Mine Safety and Health Administration
NOTE: See appendices for source description, methods, and agents.
SOURCE: MSHA metal/nonmetal mine data.

Figure 3-8. Respirable quartz: Geometric mean exposures by state, OSHA samples, 1979–2003



PEL - permissible exposure limit mg/m^3 - milligrams per cubic meter OSHA - Occupational Safety and Health Administration

NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m^3) /(% quartz + 2)] for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m^3 for respirable quartz. See appendices for source description, methods, and agents.

SOURCE: OSHA Integrated Management Information System.

Table 3-21. Respirable cristobalite: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979–2003

OSHA PEL (mg/m^3)	Year	Cristobalite, respirable - MSHA				Cristobalite, respirable - OSHA			
		GM (mg/m^3)	No. of Samples	% > PEL	% > REL	GM (mg/m^3)	No. of Samples	% > PEL	% > REL
See note	**1979**	0.056	12	58.3	50.0	0.030	34	14.7	14.7
	1980	0.050	53	54.7	43.4	0.020	193	0.0	0.0
	1981	0.032	21	42.9	28.6	0.022	101	3.0	3.0
	1982	0.060	5	100.0	60.0	0.022	84	4.8	4.8
	1983	0.039	34	44.1	23.5	0.027	26	7.7	7.7
	1984	0.036	26	23.1	15.4	0.020	68	1.5	1.5
	1985	0.025	23	26.1	13.0	0.025	116	9.5	8.6
	1986	0.026	10	10.0	10.0	0.021	78	2.6	2.6
	1987	0.032	14	14.3	14.3	0.020	72	1.4	1.4
	1988	0.028	22	31.8	22.7	0.019	82	1.2	1.2
0.05	**1989**	0.033	28	28.6	21.4	0.020	127	1.6	1.6
	1990	0.038	19	52.6	36.8	0.020	124	4.0	4.0
	1991	0.029	13	46.2	30.8	0.023	73	6.8	6.8
	1992	0.021	22	9.1	0.0	0.020	179	1.7	1.7
See note	**1993**	0.032	23	30.4	26.1	0.021	82	3.7	3.7
	1994	0.066	12	66.7	50.0	0.028	66	15.2	15.2
	1995	0.033	3	0.0	0.0	0.023	54	11.1	11.1
	1996	0.020	12	8.3	8.3	0.022	45	4.4	4.4
	1997	0.030	7	28.6	28.6	0.020	84	4.8	3.6
	1998	0.015	5	0.0	0.0	0.019	32	0.0	0.0
	1999	0.010	1	0.0	0.0	0.021	54	7.4	7.4
	2000	0.031	8	50.0	50.0	0.025	60	13.3	13.3
	2001	0.020	1	0.0	0.0	0.027	40	15.0	15.0
	2002	0.000	0	-	-	0.024	25	4.0	4.0
	2003	0.036	10	20.0	20.0	0.027	50	10.0	10.0

- indicates incalculable field. PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean
mg/m^3 - milligrams per cubic meter MSHA - Mine Safety and Health Administration OSHA - Occupational Safety and Health Administration
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(5 mg/m^3) / (% cristobalite + 2)], for respirable dust containing at least 1 percent cristobalite. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.05 mg/m^3 for respirable cristobalite. For metal/nonmetal mining, the MSHA PEL is [(5 mg/m^3) / (% cristobalite + 2)] for respirable dust containing at least 1 percent cristobalite. The NIOSH REL is 0.05 mg/m^3. See appendices for source description and methods.
SOURCE: MSHA metal/nonmetal mine data. OSHA Integrated Management Information System.