

Table 5-11 (page 1 of 4). Selected pneumoconiotic agents: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979-1999

Agent	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Aluminum Oxide Fume and Dust - MSHA																					
GM (mg/m ³)	0.115	0.025	0.017	0.010	0.017	0.017	0.020	0.019	0.031	0.032	0.025	0.030	0.022	0.028	0.009	0.011	0.011	0.006	0.008	0.005	0.002
No. of samples	145	152	170	85	148	160	177	121	139	112	133	182	143	120	140	241	206	765	227	67	101
% > PEL	0.0	0.0	0.6	1.2	0.0	0.0	0.0	0.0	0.7	1.8	0.0	1.6	0.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum Oxide and Alpha Aluminum - OSHA																					
GM (mg/m ³)	0.209	1.16	0.196	1.235	0.396	0.035	0.007	0.016	0.004	0.034	0.031	0.050	0.003	0.019	0.013	0.035	0.049	0.031	0.002	0.008	0.022
No. of samples	22	15	6	27	11	70	96	28	24	50	47	41	44	16	42	41	35	13	145	85	65
% > PEL	18.2	0.0	0.0	18.5	18.2	0.0	4.2	3.6	0.0	2.0	2.1	0.0	0.0	0.0	2.4	0.0	5.7	7.7	0.0	0.0	0.0
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Antimony and Compounds - OSHA																					
GM (mg/m ³)	0.013	0.010	0.016	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.009	0.008	0.009	0.009	0.009	0.007	0.008	0.009	0.010	0.009
No. of samples	96	213	145	158	104	714	756	640	910	901	650	915	733	672	561	432	502	411	557	370	346
% > PEL	5.2	0.9	4.8	1.9	0.0	0.6	0.8	0.3	0.8	0.3	0.5	0.3	0.8	0.3	0.5	0.2	1.0	0.7	0.2	2.4	0.6
% > REL	5.2	0.9	4.8	1.9	0.0	0.6	0.8	0.3	0.8	0.3	0.5	0.3	0.8	0.3	0.5	0.2	1.0	0.7	0.2	2.4	0.6
Beryllium Fume and Dust - MSHA																					
GM (µg/m ³)	0.334	0.164	0.176	0.183	0.189	0.161	0.164	0.215	0.172	0.189	0.166	0.160	0.169	0.159	0.150	0.152	0.152	0.153	0.162	0.166	0.169
No. of samples	65	53	83	72	171	155	168	81	81	97	75	64	48	39	107	217	183	582	113	44	88
% > PEL	13.8	0.0	1.2	4.2	2.9	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

See footnotes at end of table.

Table 5-11 (page 2 of 4). Selected pneumoconiotic agents: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979-1999

Agent	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Beryllium and Compounds - OSHA																					
GM (µg/m ³)	0.043	0.079	0.037	0.031	0.044	0.031	0.035	0.026	0.034	0.039	0.031	0.033	0.032	0.031	0.034	0.029	0.027	0.029	0.029	0.027	0.032
No. of samples	31	71	110	151	102	698	683	579	864	991	711	911	707	676	595	452	408	349	558	372	410
% > PEL	6.5	7.0	2.7	0.7	2.9	1.4	2.9	0.3	1.9	1.2	0.8	1.4	0.3	0.6	1.3	0.4	0.0	0.9	0.5	0.8	1.2
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Black - OSHA																					
GM (µg/m ³)	0.460	1.53	1.38	1.01	1.14	1.16	1.71	0.976	0.692	0.659	0.716	1.05	0.712	0.556	0.686	0.705	0.918	0.513	0.798	0.620	0.325
No. of samples	16	30	30	29	29	26	29	28	22	27	20	27	17	32	28	18	39	21	35	26	23
% > PEL	0.0	20.0	16.7	10.3	10.3	23.1	24.1	10.7	13.6	3.7	15.0	18.5	17.6	6.3	7.1	11.1	10.3	14.3	17.1	7.7	0.0
% > REL	0.0	20.0	16.7	10.3	10.3	23.1	24.1	10.7	13.6	3.7	15.0	18.5	17.6	6.3	7.1	11.1	10.3	14.3	17.1	7.7	0.0
Cobalt Fume and Dust - MSHA																					
GM (µg/m ³)	1.20	26.0	1.44	-	0.485	0.313	0.382	0.426	0.410	0.389	0.366	0.375	0.367	0.393	0.286	0.329	0.306	0.270	0.309	0.287	0.308
No. of samples	2	3	4	0	111	124	123	55	89	60	102	105	72	41	105	212	187	580	102	45	90
% > PEL	100.0	33.3	0.0	-	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.2	0.0	0.0	0.0
% > REL	100.0	33.3	0.0	-	1.8	0.0	0.8	0.0	0.0	0.0	0.0	1.0	1.4	0.0	0.0	1.9	0.0	0.2	1.0	0.0	0.0
Cobalt, Metal, Fume and Dust - OSHA																					
GM (µg/m ³)	4.32	7.41	5.74	6.19	7.52	3.19	3.83	3.59	3.07	3.10	2.61	3.60	4.01	3.29	2.96	2.53	2.96	1.87	1.84	2.13	1.97
No. of samples	51	71	168	288	222	829	785	809	990	1069	760	987	836	823	653	512	595	582	748	511	476
% > PEL	3.9	4.2	3.6	8.3	13.1	2.5	3.3	3.6	2.7	3.5	2.1	5.3	6.1	3.9	1.1	0.8	3.5	1.0	1.6	1.6	0.0
% > REL	5.9	12.7	6.5	14.2	15.8	4.0	5.6	4.9	4.4	5.1	2.1	5.3	6.1	3.9	3.5	1.8	5.0	2.6	2.8	2.2	0.0

See footnotes at end of table.

Table 5-11 (page 3 of 4). Selected pneumoconiotic agents: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979-1999

Agent	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Iron Oxide Fume - MSHA																					
GM (mg/m ³)	0.430	0.480	0.333	0.394	0.210	0.279	0.301	0.238	0.214	0.327	0.282	0.198	0.199	0.198	0.097	0.109	0.110	0.062	0.059	0.130	0.027
No. of samples	155	155	226	119	152	182	211	171	181	136	163	213	177	136	136	200	173	381	155	59	40
% > PEL	1.9	0.6	0.9	2.5	1.3	1.6	0.5	0.6	1.1	0.7	2.5	2.3	1.1	1.5	1.5	3.0	0.0	1.0	0.0	0.0	0.0
% > REL	3.2	5.2	2.2	4.2	4.6	3.3	4.7	2.3	5.0	3.7	5.5	5.2	3.4	5.9	4.4	4.0	2.9	3.4	2.6	0.0	0.0
Iron Oxide Fume - OSHA																					
GM (mg/m ³)	1.33	1.10	0.974	0.924	0.514	0.421	0.456	0.356	0.245	0.277	0.502	0.360	0.264	0.261	0.280	0.301	0.406	0.238	0.315	0.333	0.279
No. of samples	575	901	1204	1347	1303	1315	1759	1586	1540	1818	1674	1760	1338	1258	1146	925	859	968	986	833	668
% > PEL	6.3	5.4	5.7	5.3	3.4	3.2	4.3	1.3	2.4	2.7	5.0	3.4	2.5	2.0	1.9	3.7	2.9	3.9	2.7	3.4	1.8
% > REL	18.3	16.5	17.1	13.8	9.7	10.7	12.5	6.6	6.9	8.0	13.4	10.1	6.3	6.1	5.9	7.4	6.8	6.9	5.5	7.9	5.5
Talc, Nonfibrous, < 1% quartz - MSHA																					
GM (mppcf)	7.98	5.39	3.93	5.97	1.70	2.08	2.87	4.75	5.41	4.90	5.66	8.11	3.41	2.55	6.50	-	-	26.0	3.00	-	-
No. of samples	56	35	61	33	68	22	14	29	18	30	24	9	6	13	11	0	0	5	1	0	0
% > PEL	14.3	8.6	4.9	6.1	7.4	9.1	7.1	3.4	11.1	6.7	8.3	33.3	0.0	0.0	18.2	-	-	40.0	0.0	-	-
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin, inorganic compounds except oxide, as Sn - OSHA																					
GM (µg/m ³)	6.76	5.84	8.66	5.25	8.64	4.88	5.03	10.4	6.70	5.80	4.94	5.02	7.32	7.36	10.8	4.58	11.3	3.60	9.25	4.22	4.40
No. of samples	124	130	63	46	27	57	99	62	69	88	46	182	111	79	51	75	52	125	37	66	45
% > PEL	1.6	0.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0
% > REL	1.6	0.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0

See footnotes at end of table.

Table 5-11 (page 4 of 4). Selected pneumoconiotic agents: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979-1999

Agent	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Titanium Dioxide Fume and Dust - MSHA																					
GM (µg/m³)	1.48	4.11	6.49	2.57	3.70	2.42	3.43	3.22	4.95	7.22	7.27	4.24	6.48	3.73	1.29	1.37	1.06	0.677	0.822	1.55	0.488
No. of samples	111	56	116	97	124	129	145	100	123	104	106	145	108	55	119	215	188	578	128	49	86
% > PEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding Fumes (total particulate) - MSHA																					
GM (mg/m³)	2.39	1.59	1.07	0.931	0.907	0.931	1.57	1.34	1.98	1.77	1.53	0.169	1.95	0.070	1.00	-	-	-	-	-	-
No. of samples	165	175	212	117	94	47	79	45	31	44	20	5	2	1	1	0	0	0	0	0	0
% > PEL	13.3	9.1	4.7	2.6	3.2	4.3	11.4	0.0	16.1	6.8	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding Fumes (total particulate) - OSHA																					
GM (mg/m³)	7.05	3.34	3.05	2.33	2.75	4.12	2.75	1.09	2.36	2.12	3.55	2.18	1.67	2.22	1.79	1.46	1.20	1.00	0.978	1.20	0.975
No. of samples	7	35	35	128	48	27	38	32	146	33	230	435	629	585	457	261	230	480	216	304	203
% > PEL	-	-	-	-	-	-	-	-	-	-	52.5	34.7	25.4	24.4	36.8	-	-	-	-	-	-
% > REL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- indicates incalculable field
 PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m³ - milligrams per cubic meter µg/m³ - micrograms per cubic meter
 mppcf - millions of particles per cubic foot

NOTE: Pneumoconiotic agents with at least 300 total samples in MSHA or OSHA are presented. From March 1, 1989 to March 22, 1993, the OSHA PELs in force differed from those employed before and after those dates. NIOSH has designated beryllium and titanium dioxide as potential occupational carcinogens, and recommends reducing exposures to as low as feasible. The % > REL cannot be calculated for talc because the REL is in units of mg/m³, but MSHA samples and analyzes for talc using units of millions of particles per cubic foot (mppcf). For welding fumes - OSHA, the % > PEL is based on fewer samples than the number reported for the years 1989 and 1993 because OSHA adopted a PEL for welding fumes that was enforced from March 1, 1989 through March 22, 1993. Samples collected in 1989 before March 1, or in 1993 after March 23 are not compared to a PEL. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal mine data. Occupational Safety and Health Administration (OSHA) Integrated Management Information System.