

# Oregon OSHA – Proposed Changes to Occupational Exposure to Respirable Silica in General Industry, Construction, and Maritime

July 2016

Text proposed to be removed is in [~~brackets with line through~~].

Text proposed to be added is in **bold and underline**.

Federal Registers

[March 25, 2016 – Occupational Exposure to Respirable Silica](#)

[May 18, 2016 – corrections to silica](#)

---

## DIVISION 2, GENERAL INDUSTRY

### Division 2/Z, Toxic and Hazardous Substances

437-002-0382 Oregon Rules for Air Contaminants.

An employee's exposure to any substance listed in Oregon Tables Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

(1) Oregon Table Z-1.

(a) Substances with limits preceded by "C" – Ceiling Values. An employee's exposure to any substance in Oregon Table Z-1, the exposure limit of which is preceded by a "C", shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

(b) Other substances – 8-hour Time Weighted Averages. An employee's exposure to any substance in Oregon Table Z-1, the exposure limit of which is not preceded by a "C", shall not exceed the 8-hour Time Weighted Average given for that substance in any 8-hour work shift of a 40-hour work week.

(c) Other Substances – Excursion Limits. Excursions in worker exposure levels may exceed 3 times the PEL-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the PEL-TWA, provided that the PEL-TWA is not exceeded.

(d) Skin Designation. To prevent or reduce skin absorption, an employee's skin exposure to substances listed in Oregon Table Z-1 with an "X" in the Skin Designation column following the substance name shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

(2) Oregon Table Z-2. An employee's exposure to any substance listed in Oregon Table Z-2 shall not exceed the exposure limits specified as follows:

(a) 8-hour time weighted averages. An employee's exposure to any substance listed in Oregon Table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in Oregon Table Z-2.

(b) Acceptable ceiling concentrations. An employee's exposure to a substance listed in Oregon Table Z-2 shall not exceed the acceptable ceiling concentration for the given substance in the table at any time during an 8-hour shift except:

(i) Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. An employee's exposure to a substance listed in Oregon Table Z-2 shall not exceed the acceptable maximum peak above the acceptable ceiling concentration, and shall not exceed the maximum duration for the given substance during an 8-hour shift.

(c) Example.

Oregon Table Z-2					
Substance	8-Hour Time-Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-hour Shift		Skin
			Concentration	Maximum Duration	
Benzene (a) (Z87.4-1969)	10 ppm	25 ppm	50 ppm	10 min.	
Beryllium and beryllium compounds (Z37.17-1970)	2 µg/m <sup>3</sup>	5 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>	30 min.	
Carbon tetrachloride (Z37.19-1967)	10 ppm	25 ppm	200 ppm	5 min. in any 4 hours	

During an 8-hour work shift, an employee exposed to benzene may be exposed to an 8-hour time weighted average (TWA) of 10 ppm. Concentrations of benzene during the 8-hour work shift may not exceed 25 ppm, unless that exposure is no more than 50 ppm and does not exceed 10 minutes during an 8-hour work shift. Such exposures must be compensated by exposures to concentrations below 10 ppm so that the 8-hour time-weighted average is less than 10 ppm.

(d) Skin Designation. To prevent or reduce skin absorption, an employee's skin exposure to substances listed in Oregon Table Z-2 with an "X" in the Skin Designation column following the substance name shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

(3) Oregon Table Z-3. An employee's exposure to any substance listed in Oregon Table Z-3, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in the table.

(4) Computation formulae. The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are included in OAR 437, Division 2/Z, Toxic and Hazardous Substances, in order to determine whether an employee is exposed over the regulatory limit is as follows:

(a)

(i) The cumulative exposure for an 8-hour work shift shall be computed as follows:

$$E = (C_a T_a + C_b T_b + \dots C_n T_n) \div 8$$

Where:

- E is the equivalent exposure for the working shift.
- C is the concentration during any period of time T where the concentration remain constant.
- T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in subpart Z of 29 CFR part 1910 for the substance involved.

(ii) To illustrate the formula prescribed in paragraph (4)(a)(i) of this section, assume that Substance A has an 8-hour time weighted average limit of 100 ppm (Oregon Table Z-1). Assume that an employee is subject to the following exposure:

- Two hours exposure at 150 ppm
- Two hours exposure at 75 ppm
- Four hours exposure at 50 ppm

Substituting this information in the formula, we have

$$[(2 \times 150) + (2 \times 75) + (4 \times 50)] \div 8 = 81.25 \text{ ppm}$$

Since 81.25 ppm is less than 100 ppm, the 8-hour time weighted average limit, the exposure is acceptable.

(b)

(i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

$$E_m = (C_1 \div L_1) + (C_2 \div L_2) + \dots (C_n \div L_n)$$

Where:

- $E_m$  is the equivalent exposure for the mixture.
- C is the concentration of a particular contaminant.
- L is the exposure limit for that substance specified in Subpart Z of 29 CFR Part 1910.

The value of  $E_m$  shall not exceed unity (1).

(ii) To illustrate the formula prescribed in paragraph (4)(b)(i) of this section, consider the following exposures:

Substance	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
B .....	500 ppm	1,000 ppm
C .....	45 ppm	200 ppm
D .....	40 ppm	200 ppm

Substituting in the formula, we have:

$$E_m = (500 \div 1000) + (45 \div 200) + (40 \div 200)$$

$$E_m = 0.500 + 0.225 + 0.200$$

$$E_m = 0.925$$

Since  $E_m$  is less than unity (1), the exposure combination is within acceptable limits.

(5) To achieve compliance with paragraphs (1) through (4) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with 1910.134.

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal Limits.

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Abate	3383-96-8	—	10	
Acetaldehyde	75-07-0	100	180	
Acetic Acid	64-19-7	10	25	
Acetic anhydride	108-24-7	5	20	
Acetone	67-64-1	1,000	2,400	
Acetonitrile	75-05-8	40	70	
2-Acetylaminoflourine	53-96-3	(C)	(See 1910.1003)	
Acetylene	74-86-2	1,000	—	
Acetylene dichloride, see 1,2-Dichloroethylene				
Acetylene tetrabromide	79-27-6	1	14	
Acrolein	107-02-8	0.1	0.25	
Acrylamide	79-06-1	—	0.3	X
Acrylonitrile	107-13-1		(See 1910.1045)	
Aldrin	309-00-2	—	0.25	X
Allyl alcohol	107-18-6	2	5	X
Allyl chloride	107-05-1	1	3	
Allyn glycidyl ether (AGE) .....	106-92-3	5 (C) 10	22 (C) 45	
Allyl propyl disulfide	2179-59-1	2	12	
alpha Alumina Total Dust Respirable Fraction	1344-28-1	— —	10 5	
Aluminum Metal Dust Total Dust Respirable Fraction	7429-90-5	— —	10 5	
Alundum (A1203)		—	10	
4-Aminodiphenyl	92-67-1		(See 1910.1003)	
2-Aminoethanol, see Ethanolamine				
2-Aminopyridine	504-29-0	0.5	2	
Ammonia	7664-41-7	25	18	
Ammonium Chloride Fumes	12125-02-9	—	10	
Ammonium sulfamate Total Dust Respirable Fraction	7773-06-0	— —	10 5	
n-Amyl acetate	628-63-7	100	525	
sec-Amyl acetate	626-38-0	125	650	
Aniline and homologs	62-53-3	5	19	X
Anisidine (o, p-isomers)	29191-52-4		0.5	X
Antimony & Compounds (as Sb)	7440-36-0	—	0.5	
ANTU (alpha Naphthylthiourea)	86-88-4	—	0.3	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Arsenic, Inorganic Compounds (as As)	7440-38-2		0.01 (See 1910.1018)	
Arsenic, Organic Compounds (as As)	7440-38-2	—	0.5	
Arsine	7784-42-1	0.05	0.2	
Asbestos		(See 1910.1001 and 1926.1101)		
Asphalt (petroleum) Fumes	8052-42-4	—	5	
Azinphos-methyl	86-50-1	—	0.2	X
Barium (soluble compounds)	7440-39-3	—	0.5	
Barium Sulfate	7727-43-7			
Total Dust		—	10	
Respirable Fraction		—	5	
Benomyl	17804-35-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Benzene	71-43-2		(See 1910.1028)	
See Oregon Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028 <sup>(d)</sup>				
Benzidine	92-87-5		(See 1910.1003)	
p-Benzoquinone, see Quinone				
Benzoyl peroxide	94-36-0	—	5	
Benzyl chloride	100-44-7	1	5	
Beryllium and Beryllium compounds	7440-41-7		(See Oregon Table Z-2)	
Biphenyl, see Diphenyl				
Bismuth telluride (undoped)	1304-82-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Bismuth telluride (Se-doped)		—	5	
Bisphenol A, see Diglycidyl ether				
Boron oxide	1303-86-2	—	10	
Boron tribromide	10294-33-4	1	10	
Boron trifluoride	7637-07-2	(C) 1	(C) 3	
Bromine	7726-95-6	0.1	0.7	
Bromine pentafluoride	7789-30-2	0.1	0.7	
Bromoform	75-25-2	0.5	5	X
Butadiene (1,3-Butadiene)	106-99-0	1 ppm/5 ppm STEL	(See 1910.1051; 1910.19(l))	
Butane	106-97-8	800	1,900	
Butanethiol, see Butyl mercaptan				
2-Butanone (Methyl Ethyl Ketone)	78-96-3	200	590	
2-Butoxyethanol (Butyl cellosolve)	111-76-2	50	240	X
Butyl acetate (n-Butyl acetate)	123-86-4	150	710	
sec-Butyl acetate	105-46-4	200	950	
tert-Butyl acetate	540-88-5	200	950	
n-Butyl alcohol	71-36-3	100	300	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
sec-Butyl alcohol	78-92-2	150	450	
tert-Butyl alcohol	75-65-0	100	300	
Butyl lactate	138-22-7	1	5	
Butylamine	109-73-9	(C) 5	(C) 15	X
tert-Butyl chromate (as CrO <sub>3</sub> )	1189-85-1	(See 1910.1026) <sup>g</sup>		
n-Butyl glycidyl ether (BGE)	2426-08-6	50	270	
Butyl mercaptan	109-79-5	0.5	1.5	
p-tert-Butyltoluene	98-51-1	10	60	
Cadmium dust and fume (as Cd)	7440-43-9	(See 1910.1027, 1926.1127 and Division 4) 0.005		
Calcium carbonate Total Dust Respirable Fraction	1317-65-3	— —	10 5	
Calcium hydroxide Total Dust Respirable Fraction	1305-62-0	— —	10 5	
Calcium oxide	1305-78-8	—	5	
Calcium silicate Total Dust Respirable Fraction	1344-95-2	— —	10 5	
Calcium sulfate Total Dust Respirable Fraction	7778-18-9	— —	10 5	
Camphor, synthetic	76-22-2	—	2	
Caprolactam (2-Oxonexa-methylenimine)	105-60-2	—	5	
Carbaryl (Sevin®)	63-25-2	—	5	
Carbon black	1333-86-4	—	3.5	
Carbon dioxide	124-38-9	5,000	9,000	
Carbon disulfide	75-15-0		(See Oregon Table Z-2)	
Carbon monoxide	630-08-0	50	55	
Carbon tetrachloride	56-23-5		(See Oregon Table Z-2)	
Cellulose Total Dust Respirable Fraction	9006-34-6	— —	10 5	
Chlordane	57-74-9	—	0.5	X
Chlorinated camphene	8001-35-2	—	0.5	X
Chlorinated diphenyl oxide	55720-99-5	—	0.5	
Chlorine	7782-50-5	(C) 1	(C) 3	
Chlorine dioxide	10049-04-4	0.1	0.3	
Chlorine trifluoride	7790-91-2	(C) 0.1	(C) 0.4	
Chloroacetaldehyde	107-20-0	(C) 1	(C) 3	
α-Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3	
Chlorobenzene	108-90-7	75	350	
o-Chlorobenzylidene malononitrile	2698-41-1	0.05	0.4	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Chlorobromomethane	74-97-5	200	1,050	
2-Chloro-1, 3-butadiene, see beta-Chloroprene				
Chlorodiphenyl (42% Chlorine)	53469-21-9	—	1	X
Chlorodiphenyl (54% Chlorine)	11097-69-1	—	0.5	X
1-Chloro, 2, 3-epoxypropane, see Epichlorhydrin				
2-Chloroethanol, see Ethylene chlorohydrin				
Chloroethylene, see Vinyl Chloride				
Chloroform (Trichloromethane)	67-66-3	(C) 25	(C) 120	
bis-Chloromethyl ether	542-88-1		(See 1910.1003)	
Chloromethyl methyl ether	107-30-2		(See 1910.1003)	
1-Chloro-1-nitropropane	600-25-9	20	100	
Chloropicrin	76-06-2	0.1	0.7	
beta-Chloroprene (2-chloro-1,3-butadiene)	126-99-8	25	90	X
2-Chloro-6-(trichloromethyl) pyridine	1929-82-4			
Total Dust		—	10	
Respirable Fraction		—	5	
Chromic acid and chromates (as CrO <sub>3</sub> )			(See Oregon Table Z-2)	
Chromium (II) compounds (as Cr)	7440-47-3	—	0.5	
Chromium (III) compounds (as Cr)	7440-47-3	—	0.5	
Chromium (VI) compounds		(See 1910.1026)		
Chromium metal & insol. salts (as Cr)	7440-47-3	—	1	
Clopidol	2971-90-6			
Total Dust		—	10	
Respirable Fraction		—	5	
Coal Dust			(See Oregon Table Z-3)	
Coal tar pitch volatiles (Benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65966-93-2	—	0.2 (See 1910.1002)	
Cobalt metal, fume & dust	7440-48-4	—	0.1	
Coke oven emissions			(See 1910.1029)	
Copper fume	7440-50-8	—	0.1	
Dusts and Mists	7440-50-8	—	1	
Corundum (A1203)	1302-74-5	—	10	
Cotton dust			(See 1910.1043)	
Cotton dust (raw)		—	1 <sup>(e)</sup>	
Crag® herbicide (Sesone)	136-78-7			
Total Dust		—	10	
Respirable Fraction		—	5	
Cresol (all isomers)	1319-77-3	5	22	X

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Crotonaldehyde	123-73-9/ 4170-30-3	2	6	
Cumene	98-82-8	50	245	X
Cyanides (as CN)		—	5	X
Cyanogen	460-19-5	10	—	
Cyclohexane	110-82-7	300	1,050	
Cyclohexanol	108-93-0	50	200	
Cyclohexanone	108-94-1	50	200	
Cyclohexene	110-83-8	300	1,015	
Cyclopentadiene	542-92-7	75	200	
2,4-D (Dichlorophenoxyacetic acid)	94-75-7	—	10	
DDT	50-29-3	—	1	X
DDVP, see Dichlorvos				
Decaborane	17702-41-9	0.05	0.3	X
Demeton® (Systox)	8065-48-3	—	0.1	X
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	123-42-2	50	240	
1, 2-Diaminoethane, see Ethylenediamine				
Diazinon	333-41-5	—	0.1	X
Diazomethane	334-88-3	0.2	0.4	
Diborane	19287-45-7	0.1	0.1	
Dibrom®	300-76-5	—	3	
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.001	(See 1910.1044)	
1,2-Dibromoethane, see Ethylene dibromide				
2-N-Dibutylaminoethanol	102-81-8	2	14	X
Dibutyl phosphate	107-66-4	1	5	
Dibutyl phthalate	84-74-2	—	5	
Dichloroacetylene	7572-29-4	(C) 0.1	(C) 0.4	
o-Dichlorobenzene	95-50-1	(C) 50	(C) 300	
p-Dichlorobenzene	106-46-7	75	450	
3,3-Dichlorobenzidine	91-94-1		(See 1910.1003)	X
Dichlorodifluoromethane	75-71-8	1,000	4,950	
1,3-Dichloro-5, 5-dimethyl hydantoin	118-52-5	—	0.2	
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	—	1	X
1, 1-Dichloroethane	75-34-3	100	400	
1, 2-Dichloroethane, see Ethylene dichloride				
1, 2-Dichlorethylene	540-59-0	200	790	
Dichloroethyl Ether	111-44-4	5 (C) 15	30 (C) 90	X
Dichloromethane, see Methylene chloride				
Dichloromonofluoromethane	75-43-4	1,000	4,200	
1, 1-Dichloro-1-nitroethane	594-72-9	(C) 10	(C) 60	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
1, 2-Dichloropropane, see Propylene dichloride				
Dichlorotetrafluoroethane	76-14-2	1,000	7,000	
Dichlorvos (DDVP)	62-73-7	0.1	1	X
Dicyclohexylmethane 4,4'-diisocyanate (hydrogenated MDI, see Oregon Table Z-2 (Diisocyanates))	5124-30-1			
Dicyclopentadienyl iron	102-54-5	—	10	
Total Dust		—	5	
Respirable Fraction				
Dieldrin	60-57-1	—	0.25	X
Diethylamine	109-89-7	25	75	
2-Diethylaminoethanol	100-37-8	10	50	X
Diethylene triamine	111-40-0	(C) 1	(C) 4	X
Diethylether, see Ethyl ether				
Difluorodibromomethane	75-61-6	100	860	
Diglycidyl ether (DGE)	2238-07-5	(C) 0.5	(C) 2.8	
Dihydroxybenzene, see Hydroquinone				
Diisobutyl ketone	108-83-8	25	150	
Diisopropylamine	108-18-9	5	20	X
Dimethoxymethane, see Methylal				
Dimethyl acetamide	127-19-5	10	35	X
Dimethylamine	124-40-3	10	18	
4-Dimethylaminoazobenzene	60-11-7		(See 1910.1003)	
Dimethylaminobenzene, see Xylidene				
Dimethylaniline (N,N-Dimethylaniline)	121-69-7	5	25	X
Dimethylbenzene, see Xylene				
Dimethyl-1,2-dibromo-2, 2-dichloroethyl phosphate	300-76-5	—	3	
Dimethylformamide	68-12-2	10	30	X
2,6-Dimethylheptanone, see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	X
Dimethylphthalate	131-11-3	—	5	
Dimethyl sulfate	77-78-1	1	5	X
Dinitrobenzene (all isomers)			1	X
(ortho)	528-29-0			
(meta)	99-65-0			
(para)	100-25-4			
Dinitro-o-cresol	534-52-1	—	0.2	X
Dinitrotoluene	25321-14-6	—	1.5	X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X
Diphenyl (Biphenyl)	92-52-4	0.2	1	
Diphenylamine	122-39-4	—	10	
Diphenylmethane diisocyanate (MDI), see Oregon Table Z-2 (Diisocyanates)				

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Dipropylene glycol methyl ether	34590-94-8	100	600	X
Diquat	231-36-7	—	0.5	
Di-sec, octyl phthalate (Di-2-ethyl-hexylphthalate)	117-81-7	—	5	
Emery	12415-34-8	—	10	
Total Dust		—	5	
Respirable Fraction		—	5	
Endosulfan (Thiodan®)	115-29-7	—	0.1	X
Endrin	72-20-8	—	0.1	X
Epichlorohydrin	106-89-8	5	19	X
EPN	2104-64-5	—	0.5	X
1,2-Epoxypropane, see Propylene oxide				
2,3-Epoxy-1-propanol, see Glycidol				
Ethane	74-84-0	1,000	—	
Ethanethiol, see Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	
2-Ethoxyethanol (Cellosolve)	110-80-5	100	370	X
2-Ethoxyethylacetate (Cellosolve acetate)	111-15-9	100	540	X
Ethyl acetate	141-78-6	400	1,400	
Ethyl acrylate	140-88-5	25	100	X
Ethyl alcohol (ethanol)	64-17-5	1,000	1,900	
Ethylamine	75-04-7	10	18	
Ethyl amyl ketone (5-methyl-3-heptanone)	541-85-5	25	130	
Ethyl benzene	100-41-4	100	435	
Ethyl bromide	74-96-4	200	890	
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	
Ethyl chloride	75-00-3	1,000	2,600	
Ethyl ether	60-29-7	400	1,200	
Ethyl formate	109-94-4	100	300	
Ethyl mercaptan	75-08-1	0.5	1	
.....		(C) 10	(C) 25	
Ethyl silicate	78-10-4	100	850	
Ethylene	74-85-1	1,000	—	
Ethylene chlorohydrin	107-07-3	5	16	X
Ethylenediamine	107-15-3	10	25	
Ethylene dibromide	106-93-4		(See Oregon Table Z-2)	
Ethylene dichloride	107-06-2		(See Oregon Table Z-2)	
Ethylene glycol particulate		—	10	
Ethylene glycol, Vapor	107-21-1	100	260	
Ethylene glycol dinitrate	628-96-6	(C) 0.2	(C) 1	X
Ethylene glycol methyl acetate (Methyl cellosolve acetate) (2-Methoxy-ethyl acetate)	110-49-6	25	120	X

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Ethylenimine	151-56-4		(See 1910.1003)	
Ethylene oxide	75-21-8	1	(See 1910.1047)	
Ethylidene chloride, see 1, 1-Dichloroethane				
N-Ethylmorpholine	100-74-3	20	94	X
Ferbam	14484-64-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Ferrovandium dust	12604-58-9	—	1	
Fibrous glass, see Glass, Fibrous				
Fluorides (As F)		—	2.5 (See Oregon Table Z-2)	
Fluorine	7782-41-4	0.1	0.2	
Fluorotrichloromethane (Trichlorofluoromethane)	75-69-4	1,000	5,600	
Formaldehyde	50-00-0	0.75	(See 1910.1048)	
Formic acid	64-18-6	5	9	
Furfural	98-01-1	5	20	X
Furfuryl alcohol	98-00-0	5	20	
Gasoline	8006-61-9	—	<sup>(g)</sup>	
Germanium tetrahydride	7782-65-2	0.2	0.6	
Glass, Fibrous or dust		—	10	
Glycerin (mist)	56-81-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Glycidol	556-52-5	50	150	
Glycol momoethyl ether, see 2-Ethoxythanol				
Grain dust (oat, wheat, barley)		—	10	
Graphite natural, respirable	7782-42-5		(See Oregon Table Z-3)	
Graphite (Synthetic)	7782-42-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Guthion®, see Azinphosmethyl				
Gypsum	13397-24-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Hafnium	7440-58-6	—	0.5	
Heptachlor	76-44-8	—	0.5	X
Heptane (n-heptane)	142-82-5	500	2,000	
Hexachlorocyclopentadiene	77-47-4	0.1	1	
Hexachloroethane	67-72-1	1	10	X
Hexachloronaphthalene	1335-87-1	—	0.2	X
Hexafluoroacetone	684-16-2	0.1	0.7	X

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Hexamethylene diisocyanate (HDI), see Oregon Table Z-2 (Diisocyanates)	822-06-0			
1,6 Hexamethylene diisocyanate Based Adduct, see Oregon Table Z-2 (Diisocyanates)				
Hexane (n-hexane)	110-54-3	500	1,800	
2-Hexanone	591-78-6	100	410	
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	
sec-Hexyl acetate	108-84-9	50	300	
Hydrazine	302-01-2	1	1.3	X
Hydrogen	1333-74-0	1,000	—	
Hydrogen bromide	10035-10-6	3	10	
Hydrogen chloride	7647-01-0	(C) 5	(C) 7	
Hydrogen cyanide	74-90-8	10	11	X
Hydrogen fluoride (as F)	7664-39-3		(See Oregon Table Z-2)	
Hydrogen peroxide	7722-84-1	1	1.4	
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	
Hydrogen sulfide	7783-06-4		(See Oregon Table Z-2)	
Hydroquinone	123-31-9	—	2	
Indene	95-13-6	10	45	
Indium and compounds (as In)	7440-74-6	—	0.1	
Iodine	7553-56-2	(C) 0.1	(C) 1	
Iron oxide fume	1309-37-1	—	10	
Iron pentacarbonyl	13463-40-6	0.1	0.23	
Iron salts, soluble, as Fe		—	1	
Isoamyl acetate	123-92-2	100	525	
Isoamyl alcohol (primary and secondary)	123-51-3	100	360	
Isobutyl acetate	110-19-0	150	700	
Isobutyl alcohol	78-83-1	100	300	
Isophorone	78-59-1	10	55	
Isophorone diisocyanate (IPDI), see Oregon Table Z-2 (Diisocyanates)	4098-71-9			
Isopropyl acetate	108-21-4	250	950	
Isopropyl alcohol	67-63-0	400	980	
Isopropylamine	75-31-0	5	12	
Isopropyl ether	108-20-3	250	1,050	
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	
Kaolin	1332-58-7	—	10	
		—	5	
Ketene	463-51-4	0.5	0.9	
Lead, inorganic (as Pb)	7439-92-1	(See 1910.1025 & 1926.62) 0.05		
Lead arsenate	7784-40-9	(See 1910.1018)	0.01	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Limestone	1317-65-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Lindane	58-89-9	—	0.5	X
Lithium hydride	7580-67-8	—	0.025	
L.P.G. (Liquified petroleum gas)	68476-85-7	1,000	1,800	
Magnesite	546-93-0			
Total Dust		—	10	
Respirable Fraction		—	5	
Magnesium oxide fume	1309-48-4			
Total Dust		—	10	
Respirable Fraction		—	5	
Malathion	121-75-5	—	10	X
Maleic anhydride	108-31-6	0.25	1	
Manganese Compounds (as Mn)	7439-96-5	—	(C) 5	
Manganese fume (as Mn)	7439-96-5	—	(C) 5	
Marble	1317-65-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Mercury (aryl, inorganic, organo, and vapor) (as Hg)	7439-97-6		(See Oregon Table Z-2)	
Mesityl oxide	141-79-7	25	100	
Methane	74-82-8	1,000	—	
Methanethiol, see Methyl mercaptan				
Methoxychlor	72-43-5			
Total Dust		—	10	
Respirable Fraction		—	5	
2-Methoxyethanol (Methyl Cellosolve)	109-86-4	25	80	X
2-Methoxyethyl acetate (Methyl cellosolve acetate)	110-49-6	25	120	X
Methyl acetate	79-20-9	200	610	
Methyl acetylene (propyne)	74-99-7	1,000	1,650	
Methyl acetylene-propadiene mixture (MAPP)		1,000	1,800	
Methyl acrylate	96-33-3	10	35	X
Methylacrylonitrile	126-98-7	1	3	X
Methylal (dimethoxymethane)	109-87-5	1,000	3,100	
Methyl alcohol (methanol)	67-56-1	200	260	
Methylamine	74-89-5	10	12	
Methyl amyl alcohol, see Methyl isobutyl carbinol				
Methyl (n-amyl) ketone	110-43-0	100	465	
Methyl bromide	74-83-9	15	60	X
.....		(C) 20	(C) 80	
Methyl butyl ketone, see 2-Hexanone				
Methyl cellosolve, see 2 Methoxy ethanol				X
Methyl cellosolve acetate (Ethylene glycol monomethyl ether acetate)	110-49-6	25	120	X

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Methyl Chloride	74-87-3		(See Oregon Table Z-2)	
Methyl Chloroform (1,1,1-Trichloroethane)	71-55-6	350	1,900	
Methyl Chloromethyl ether			(See 1910.1003)	
Methyl 2-cyanoacrylate	137-05-3	2	8	
Methylcyclohexane	108-87-2	500	2,000	
Methylcyclohexanol	25639-42-3	50	235	
o-Methylcyclohexanone	583-60-8	50	230	X
2-Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3	0.1	0.2	X
Methyl demeton	8022-00-2	—	0.5	X
Methyl ethyl ketone (MEK), see 2-Butanone				
Methyl formate	107-31-3	100	250	
Methyl iodide	74-88-4	5	28	X
Methyl isoamyl ketone	110-12-3	100	475	
Methyl isobutyl carbinol	108-11-2	25	100	X
Methyl isobutyl ketone, see Hexone				
Methyl isocyanate	624-83-9	0.02	0.05	X
Methyl mercaptan	74-93-1	0.5	1	
.....		(C) 10	(C) 20	
Methyl methacrylate	80-62-6	100	410	
Methyl parathion	298-00-0	—	0.2	X
Methyl propyl ketone, see 2-Pentanone				
Methyl silicate	681-84-5	(C) 5	(C) 30	
a-Methyl styrene	98-83-9	(C) 100	(C) 480	
Methylene bisphenyl isocyanate (MDI)	101-68-8	(See Oregon Table Z-2 (diisocyanates))		
Methylenedianiline (MDA)		(See 1910.1050 & 1926.60) 0.01		
Methylene Chloride	75-09-2	25	(See 1910.1052)	
Mineral Wool Fiber		—	10	
MOCA	101-14-4		(See 437-002-0346)	
Molybdenum (soluble compounds) (insoluble compounds)	7439-98-7	— —	5 10	
Monomethyl aniline	100-61-8	2	9	X
Monomethyl hydrazine	60-34-4	(C) 0.2	(C) 0.35	X
Morpholine	110-91-8	20	70	X
Naphtha (coal tar)	8030-30-6	100	400	
Naphthalene	91-20-3	10	50	
Naphthalene diisocyanate (NDI), see Oregon Table Z-2 (Diisocyanates)	3173-72-6			
alpha-Naphthylamine	134-32-7		(See 1910.1003)	
beta-Naphthylamine	91-59-8		(See 1910.1003)	
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Nickel, metal and insoluble compounds, as Ni	7440-02-0	—	1	
Nickel, soluble compounds, (as Ni)	7440-02-0	—	1	
Nicotine	54-11-5	0.075	0.5	X
Nitric acid	7697-37-2	2	5	
Nitric oxide	10102-43-9	25	30	
p-Nitroaniline	100-01-6	1	6	X
Nitrobenzene	98-95-3	1	5	X
4-Nitrodiphenyl	92-93-3		(See 1910.1003)	
p-Nitrochlorobenzene	100-00-5	—	1	X
Nitroethane	79-24-3	100	310	
Nitrogen dioxide	10102-44-0	(C) 5	(C) 9	
Nitrogen trifluoride	7783-54-2	10	29	
Nitroglycerin	55-63-0	(C) 0.2	(C) 2	X
Nitromethane	75-52-5	100	250	
1-Nitropropane	108-03-2	25	90	
2-Nitropropane	79-46-9	25	90	
N-Nitrosodimethylamine			(See 1910.1003)	
Nitrotoluene (all isomers)	88-72-2/ 99-08-1/ 99-99-0	5	30	X
Nitrotrichloromethane, see Chloropicrin				
Nitrous oxide	10024-97-5	50	90	
Octachloronaphthalene	2234-13-1	—	0.1	X
Octane	111-65-9	400	1,900	
Oil mist (mineral)	8012-95-1	—	5	
Oil mist, vapor		—	<sup>(g)</sup>	
Osmium tetroxide (as Os)	20816-12-0		0.002	
Oxalic acid	144-62-7	—	1	
Oxygen difluoride	7783-41-7	0.05	0.1	
Ozone	10028-15-6	0.1	0.2	
Parafin wax fume	8002-74-2	—	1	

Paraquat respirable dust	4685-14-7/ 1910-42-5/ 2074-50-2	—	0.5	X
Parathion	56-38-2	—	0.1	X
Particulates not otherwise regulated (PNOR) <sup>(f)</sup>				
Total Dust		—	10	
Respirable Fraction		—	5	
Pentaborane	19624-22-7	0.005	0.01	
Pentachloronaphthalene	1321-64-8	—	0.5	X
Pentachlorophenol	87-86-5	—	0.5	X

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Pentaerythritol	115-77-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Pentane	109-66-0	500	1,500	
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700	
Perchloroethylene (tetrachloroethylene)	127-18-4		(See Oregon Table Z-2)	
Perchloromethyl mercaptan	594-42-3	0.1	0.8	
Perchloryl fluoride	7616-94-6	3	13.5	
Perlite	93763-70-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Petroleum distillates (naphtha) (Rubber Solvent)		500	2,000 <sup>(g)</sup>	
Phenol	108-95-2	5	19	X
Phenothiazine	92-84-2	—	5	X
p-Phenylene diamine	106-50-3	—	0.1	X
Phenyl ether (vapor)	101-84-8	1	7	
Phenyl ether – diphenyl mixture (vapor)	8004-13-5	1	7	
Phenylethylene, see Styrene				
Phenyl glycidyl ether (PGE)	122-60-1	10	60	
Phenylhydrazine	100-63-0	5	22	X
Phenylphosphine	638-21-1	(C) 0.05	(C) 0.25	
Phosdrin (Mevinphos®)	7786-34-7		0.1	X
Phosgene (carbonyl chloride)	75-44-5	0.1	0.4	
Phosphine	7803-51-2	0.3	0.4	
Phosphoric acid	7664-38-2	—	1	
Phosphorus (yellow)	7723-14-0	—	0.1	
Phosphorus pentachloride	10026-13-8	—	1	
Phosphorus pentasulfide	1314-80-3	—	1	
Phosphorus trichloride	7719-12-2	0.5	3	
Phthalic anhydride	85-44-9	2	12	
Picloram	1918-02-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Picric acid	88-89-1	—	0.1	X
Pindone (2-Pivalyl-1, 3-indan-dione)	83-26-1	—	0.1	
Plaster of Paris	26499-65-0			
Total Dust		—	10	
Respirable Fraction		—	5	
Platinum (Soluble Salts) as Pt	7440-06-4	—	0.002	
Polychlorobiphenyls, see Chloro-diphenyls				
Portland Cement	65997-15-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Propane	74-98-6	1,000	1,800	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Beta-Propiolactone	57-57-8		(See 1910.1003)	
Propargyl alcohol	107-19-7	1	—	X
n-Propyl acetate	109-60-4	200	840	
n-Propyl alcohol	71-23-8	200	500	
n-Propyl nitrate	627-13-4	25	110	
Propylene dichloride	78-87-5	75	350	
Propylene glycol monomethyl ether	107-98-2	100	360	
Propylene imine	75-55-8	2	5	X
Propylene oxide	75-56-9	100	240	
Propyne, see Methyl acetylene				
Pyrethrum	8003-34-7	—	5	
Pyridine	110-86-1	5	15	
Quinone	106-51-4	0.1	0.4	
RDX (Cyclonite)	121-82-4	—	1.5	X
Rhodium, Metal fume and dusts, as Rh	7440-16-6	—	0.1	
Soluble salts	7440-16-6	—	0.001	
Ronnel	299-84-3	—	10	
Rosin core solder pyrolysis products (as Formaldehyde)		—	0.1	
Rotenone	83-79-4	—	5	
Rouge				
Total Dust		—	10	
Respirable Fraction		—	5	
Selenium compounds (as Se)	7782-49-2	—	0.2	
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.4	
<b>Silica, crystalline, respirable dust(j)</b>				
<b><u>Cristobalite</u></b>	<b><u>14464-46-1</u></b>			
<b><u>Quartz</u></b>	<b><u>14808-60-7</u></b>	—		
<b><u>Tripoli (as quartz)</u></b>	<b><u>1317-95-9</u></b>			
<b><u>Tridamite</u></b>	<b><u>15468-32-3</u></b>			
Silicon	7440-21-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Silicon carbide	409-21-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Silver, metal and soluble compounds (as Ag)	7440-22-4	—	0.01	
Sodium fluoroacetate	62-74-8	—	0.05	X
Sodium hydroxide	1310-73-2	—	2	
Starch	9005-25-8			
Total Dust		—	10	
Respirable Fraction		—	5	
Stibine	7803-52-3	0.1	0.5	
Stoddard solvent	8052-41-3	200	1,150	
Strychnine	57-24-9	—	0.15	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Styrene	100-42-5		(See Oregon Table Z-2)	
Subtilisins (Proteolytic enzymes) (as 100% pure crystalline enzyme)	1395-21-7	—	(C) 0.0003	
Sucrose	57-50-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Sulfur dioxide	7446-09-5	5	13	
Sulfur hexafluoride	2551-62-4	1,000	6,000	
Sulfuric acid	7664-93-9	—	1	
Sulfur monochloride	10025-67-9	1	6	
Sulfur pentafluoride	5714-22-7	0.025	0.25	
Sulfur tetrafluoride	7783-60-0	0.1	0.4	
Sulfuryl fluoride	2699-79-8	5	20	
Systox, see Demeton®				
2, 4, 5-T	93-76-5	—	10	
Tantalum, metal and oxide dust	7440-25-7	—	5	
TEDP (Sulfotepp)	3689-24-5	—	0.2	X
Tellurium and compounds (as Te)	13494-80-9	—	0.1	
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2	
Temephos	3383-96-8			
Total Dust		—	10	
Respirable Fraction		—	5	
TEPP (Tetraethyl pyrophosphate)	107-49-3	0.004	0.05	X
Terphenyls	26140-60-3	(C) 1	(C) 9	
1, 1, 1, 2-Tetrachloro-2, 2-difluoro-ethane	76-11-9	500	4,170	
1, 1, 2, 2-Tetrachloro-1, 2-difluoro-ethane	76-12-0	500	4,170	
1, 1, 2, 2-Tetrachloroethane	79-34-5	5	35	X
Tetrachloroethylene, see Perchloroethylene				
Tetrachloronaphthalene	1335-88-2	—	2	X
Tetrachloromethane, see Carbon tetrachloride				
Tetraethyl lead (as Pb)	78-0-2	—	.075	X
Tetrahydrofuran	109-99-9	200	590	
Tetramethyl lead (as Pb)	75-74-1	—	0.075	X
Tetramethyl succinonitrile	3333-52-6	0.5	3	X
Tetranitromethane	509-14-8	1	8	
Tetryl (2, 4, 6-trinitro-phenyl-methylnitramine)	479-45-8	—	1.5	X
Thallium (soluble compounds) as Tl	7440-28-0	—	0.1	X
4,4'-Thiobis (6-tert, Butyl-m-cresol)	96-69-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Thiram	137-26-8		(See 437-002-0373) 0.15	
Tin (inorganic compounds, except oxides)				

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
as Sn	7440-31-5	—	2	
Tin (organic compounds)	7440-31-5	—	0.1	
Tin oxide	1332-29-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Titanium dioxide	13463-67-7	—	10	
Toluene (toluol)	108-88-3		(See Oregon Table Z-2)	
Toluene diisocyanate (TDI), See Oregon Table Z-2 (Diisocyanates)	584-84-9			
o-Toluidine	95-53-4	5	22	X
Toxaphene, see Chlorinated camphene				
Tributyl phosphate	126-73-8	—	5	
1, 1, 1-Trichloroethane, see Methyl chloroform				
1, 1, 2-Trichloroethane	79-00-5	10	45	X
Trichloroethylene	79-01-6		(See Oregon Table Z-2)	
Trichloromethane, see Chloroform				
Trichloronaphthalene	1321-65-9	—	5	X
1, 2, 3-Trichloropropane	96-18-4	50	300	
1, 1, 2-Trichloro 1, 2, 2-trifluoro-ethane	76-13-1	1,000	7,600	
Triethylamine	121-44-8	25	100	
Trifluorobromomethane	75-63-8	1,000	6,100	
Trimethyl benzene	25551-13-7	25	120	
2, 4, 6-Trinitrophenol, see Picric acid				
2, 4, 6-Trinitrophenylmethyl-nitramine, see Tetryl				
Trinitrotoluene (TNT)	118-96-7		1.5	X
Triorthocresyl phosphate	78-30-8	—	0.1	
Triphenyl phosphate	115-86-6	—	3	
Tungsten & compounds, as W	7440-33-7			
Soluble		—	1	
Insoluble		—	5	
Turpentine	8006-64-2	100	560	
Uranium (as U)	7440-61-1			
Soluble compounds		—	0.05	
Insoluble compounds		—	0.2	
Vanadium respirable dust (as V <sub>2</sub> O <sub>5</sub> )	1314-62-1	—	(C) 0.5	
Fume (as V <sub>2</sub> O <sub>5</sub> )	1314-62-1	—	(C) 0.05	
Vegetable oil mist				
Total Dust		—	10	
Respirable Fraction		—	5	
Vinyl acetate	108-05-4	10	30	
Vinyl benzene, see Styrene				
Vinyl bromide	593-60-2	250	1,100	
Vinyl chloride	75-01-4		(See 1910.1017)	

Oregon Table Z-1 - Adopted Values (In Alphabetical Order)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Vinyl cyanide, see Acrylonitrile				
Vinyl toluene	25013-15-4	100	480	
Warfarin	81-81-2	—	0.1	
Wood Dust (non-allergenic)		—	10	
Xylene (o-, m-, p-isomers)	1330-20-7	100	435	
Xylidine	1300-73-8	5	25	X
Yttrium	7440-65-5	—	1	
Zinc chloride fume	7646-85-7	—	1	
Zinc oxide	1314-13-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Zinc oxide fume	1314-13-2	—	5	
Zinc stearate	557-05-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Zirconium compounds (as Zr)	7440-67-7	—	5	

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal Limits.

NOTE: PNOR means “particles not otherwise regulated.”

**FOOTNOTES:**

- (a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.
- (b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.
- (c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound, measured as the metal, the CAS number for the metal is given – not CAS numbers for the individual compounds.
- (d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Oregon Table Z-2 apply. See 1910.1028 for specific circumstances.
- (e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.
- (f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Oregon Table Z-3.
- (g) Usually a mixture, in general the aromatic hydrocarbon content will determine which TWA applies.
- (h) If the exposure limit in 1910.1026 is stayed or is otherwise not in effect, the exposure limit is a ceiling of 0.1 mg/m<sup>3</sup>.
- (i) See Table Z-2 for the exposure limit for any operations or sectors where the exposure limit in 1910.1026 is stayed or is otherwise not in effect.
- (j) **See Table Z-3 for the exposure limit for any operations or sectors where the exposure limit in Division 2/Z-Silica is stayed or is otherwise not in effect.**

Oregon Table Z-2					
Substance	8-Hour Time-Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-hour Shift		Skin
			Concentration	Maximum Duration	
Benzene <sup>(a)</sup> (Z87.4-1969)	10 ppm	25 ppm	50 ppm	10 min.	
Beryllium, and beryllium compounds (Z37.29-1970)	2 µg/m <sup>3</sup>	5 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>	30 min.	
Cadmium fume <sup>(b)</sup> (Z37.5-1970)	0.1 mg/m <sup>3</sup>	0.3 mg/m <sup>3</sup>			
Cadmium dust <sup>(b)</sup> (Z37.5-1970)	0.2 mg/m <sup>3</sup>	0.6 mg/m <sup>3</sup>			
Carbon disulfide (Z37.3-1968)	20 ppm	30 ppm	100 ppm	30 min.	X
Carbon tetrachloride (Z37.17-1967)	10 ppm	25 ppm	200 ppm	5 min. in any 4 hrs	
Chromic acid and chromates (Z37.7-1971) (as CrO <sub>3</sub> ) <sup>c</sup>		0.1 mg/m <sup>3</sup>			
Ethylene dibromide (Z37.31-1970)	20 ppm	25 ppm	50 ppm	5 min.	X
Ethylene dichloride (Z37.21-1969)	50 ppm	100 ppm	200 ppm	5 min. in any 3 hrs	
Fluoride as dust (Z37.28-1969)	2.5 mg/m <sup>3</sup>				
Formaldehyde (see 1910.1048)					
Hydrogen fluoride (Z37.28-1969)	3 ppm				
Hydrogen sulfide (Z37.2-1966)		20 ppm	50 ppm	10 min. once, only if no other measurable exposure occurs	
Mercury (Z37.8-1971)	0.05 mg/m <sup>3</sup>	0.1 mg/m <sup>3</sup>			X
Methyl chloride (Z37.18-1969)	100 ppm	200 ppm	300 ppm	5 min. in any 3 hrs	
Organo (alkyl) mercury (Z37.30-1969)	0.001 mg/m <sup>3</sup>	0.01 mg/m <sup>3</sup>			X
Styrene (Z37.15-1969)	100 ppm	200 ppm	600 ppm	5 min. in any 3 hrs	
Tetrachloroethylene (Z37.22-1967)	100 ppm	200 ppm	300 ppm	5 min. in any 3 hrs	
Toluene (Z37.12-1967)	100 ppm	300 ppm	500 ppm	10 min.	
Trichloroethylene (Z37.19-1967)	100 ppm	200 ppm	300 ppm	5 min. in any 2 hrs	

Oregon Table Z-2 (Continued)					
Substance	8-Hour Time-Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-hour Shift		Skin
			Concentration	Maximum Duration	
<b>Diisocyanates</b>					
Dicyclohexylmethane 4,4'-diisocyanate (hydrogenated MDI)	.055 mg/m <sup>3</sup> .005 ppm	0.210 mg/m <sup>3</sup> 0.02 ppm			
Diphenylmethane diisocyanate (MDI)	.050 mg/m <sup>3</sup> .005 ppm	0.200 mg/m <sup>3</sup> 0.02 ppm			
Hexamethylene diisocyanate (HDI)	.035 mg/m <sup>3</sup> .005 ppm	0.140 mg/m <sup>3</sup> 0.02 ppm			
1,6 Hexamethylene diisocyanated Based Adduct (includes HDI-Biuret trimer, and other polymeric forms of HDI, including isocyanurates)	0.5 mg/m <sup>3</sup>	1.0 mg/m <sup>3</sup>			
Isophorone diisocyanate (IPDI)	.045 mg/m <sup>3</sup> .005 ppm	0.180 mg/m <sup>3</sup> 0.02 ppm			
Napthalene diisocyanate (NDI)	.040 mg/m <sup>3</sup> .005 ppm	0.170 mg/m <sup>3</sup> 0.02 ppm			
Toluene diisocyanate (TDI)	.035 mg/m <sup>3</sup> .005 ppm	0.140 mg/m <sup>3</sup> 0.02 ppm			

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal limits.

FOOTNOTES:

(a) This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the Benzene Standard, 1910.1028.

(b) This standard applies to any operations on sectors for which the Cadmium Standard, 1910.1027, is stayed or otherwise not in effect.

(c) This standard applies to any operations or sectors for which the exposure limit in the Chromium (VI) standard, 1910.1026, is stayed or is otherwise not in effect.

OREGON TABLE Z-3 - MINERAL DUSTS		
Substance	mppcf (a)	mg/m <sup>3</sup>
<b>Silica:</b>		
<b>Crystalline</b>		
Quartz (respirable).....		0.1 mg/m <sup>3</sup>
Quartz (total dust) .....	.....	$\frac{30 \text{ mg/m}^{3(e)}}{\% \text{SiO}_2 + 2}$
Cristobalite (respirable) Tridymite: Use 1/2 the value calculated from the formulae for quartz.		0.05 mg/m <sup>3</sup>
Amorphous, including natural diatomaceous earth .....	20	$\frac{80 \text{ mg/m}^{3(e)}}{\% \text{SiO}_2}$
<b>Silicates (less than 1% crystalline silica):</b>		
Mica .....	20	
Soapstone.....	20	
Talc (not containing asbestos) .....	20 <sup>(c)</sup>	
Talc (containing asbestos) Use asbestos limit.	20	
Tremolite, asbestiform (see OAR 437, Div. 2/Z, 1910.1001, Asbestos).		
Portland cement.....	50	
Graphite (Natural) .....		5 mg/m <sup>3</sup>
<b>Coal Dust:</b>		
Respirable fraction less than 5% SiO <sub>2</sub> .....		2.4 mg/m <sup>3(e) (f)</sup>
<b>Coal Dust:</b>		
Respirable fraction greater than 5% SiO <sub>2</sub> .....		0.1 mg/m <sup>3(e)</sup>
<b>Inert or Nuisance Dust:</b> <sup>(d)</sup>		
Respirable fraction .....		5 mg/m <sup>3</sup>
Total dust .....		10 mg/m <sup>3</sup>

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal limits.

NOTE: Conversion factors - mppcf x 35.3 = million particles per cubic meter = particles per c.c.

FOOTNOTES:

- (a) Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.
- (b) The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.
- (c) Containing less than 1% quartz; if 1% quartz or more, use quartz limit.

- (d) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by this limit, which is the same as the Particulates Not Otherwise Regulated (PNOR) limit in Oregon Table Z-1.
- (e) Silica sampling methods must conform to OSHA or NIOSH sampling methods for respirable quartz silica.
- (f) The measurements under this note refer to the use of an AEC (now NRC) instrument. If the respirable fraction of coal dust is determined with a MRE the figure corresponding to that of  $2.4 \text{ mg/m}^3$  in the table for coal dust is  $4.5 \text{ mg/m}^3$ .

Stat. Auth.: ORS 654.025(2) and 656.726(4).

Stats. Implemented: ORS 654.001 through 654.295.

Hist: WCB Admin. Order, Safety 3-1975, f. 10/6/75, ef. 11/1/75.

WCB Admin. Order, Safety 6-1978, f. 7/5/78, ef. 7/15/78.

WCD Admin. Order, Safety 12-1979, f. 12/21/79, ef. 3/1/80.

WCB Admin. Order, Safety 2-1980, f. 4/17/80, ef. 8/1/80.

WCB Admin. Order, Safety 1-1982, f. 3/4/82, ef. 5/5/82.

WCB Admin. Order, Safety 6-1983, f. 5/25/83, ef. 5/25/83.

WCB Admin. Order, Safety 21-1984, f. 12/20/84, ef. 1/1/85.

WCD Admin. Order, Safety 4-1986, f. 5/5/86, ef. 5/5/86.

WCB Admin. Order, Safety 5-1986, f. 5/20/86, ef. 6/13/86.

APD Admin. Order, Safety 13-1989, f. 7/17/89, ef. 7/17/89.

OR-OSHA Admin. Order 6-1993, f. 5/17/93, ef. 5/17/93 (temp).

OR-OSHA Admin. Order 17-1993, f. 11/15/93, ef. 11/15/93 (perm).

OR-OSHA Admin. Order 5-1997, f. 4/22/97, ef. 4/22/97.

OR-OSHA Admin. Order 6-1997, f. 5/2/97, ef. 5/2/97.

OR-OSHA Admin. Order 4-2001, f. 2/5/01, ef. 2/5/01.

OR-OSHA Admin. Order 6-2006, f. 8/30/06, ef. 8/30/06.

OR-OSHA Admin. Order 6-2008, f. 5/13/08, ef. 7/1/08.

**OR-OSHA Admin. Order X-2016, f. XX/XX/16, ef. XX/XX/16.**

## Division 2/Z Silica

437-002-1053 Scope and application. This subdivision applies to all occupational exposures to respirable crystalline silica in general industry and construction activities, except for the following:

(1) Exposures that result from the processing of sorptive clays.

(2) Operations where objective data demonstrates that employee exposures to respirable crystalline silica will remain below 25 micrograms per cubic meter of air (25 µg/m<sup>3</sup>) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

437-002-1054 Definitions. For the purposes of this subdivision the following definitions apply:

Action level means a concentration of airborne respirable crystalline silica of 25 µg/m<sup>3</sup>, calculated as an 8-hour TWA.

Competent person means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in this subdivision.

Employee exposure means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator.

High-efficiency particulate air [HEPA] filter means a filter that is at least 99.97 percent efficient in removing monodispersed particles of 0.3 micrometers in diameter.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Permissible exposure limit (PEL) means a concentration of airborne respirable crystalline silica of 50 µg/m<sup>3</sup>, calculated as an 8-hour TWA.

Physician or other licensed health care professional [PLHCP] means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by 437-002-1062.

**Regulated area means an area, demarcated by the employer, where an employee's exposure to airborne concentrations of respirable crystalline silica exceeds, or can reasonably be expected to exceed, the PEL.**

**Respirable crystalline silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality— Particle Size Fraction Definitions for Health-Related Sampling.**

**Specialist means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.**

**437-002-1055 Permissible exposure limit (PEL). Ensure that no employee is exposed to an airborne concentration of respirable crystalline silica in excess of 50 µg/m<sup>3</sup>, calculated as an 8-hour time-weighted average (TWA).**

**437-002-1056 Exposure assessment. This rule requires an evaluation of employee exposure to silica using air monitoring or objective data as described in the performance or scheduled monitoring options.**

- (1) Except for the specific conditions allowed for in 437-002-1057, assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level in accordance with either the performance option in paragraph (2) or the scheduled monitoring option in paragraph (3).**
- (2) Performance option. Assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica.**
- (3) Scheduled monitoring option.**
  - (a) Perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. Where several employees perform the same tasks on the same shift and in the same work area, you may sample a representative fraction of these employees in order to meet this requirement. In representative sampling, sample the employee(s) who are expected to have the highest exposure to respirable crystalline silica.**
  - (b) If initial monitoring indicates that employee exposures are below the action level, you may discontinue monitoring for those employees whose exposures are represented by such monitoring.**

- (c) Where the most recent exposure monitoring indicates that employee exposures are at or above the action level but at or below the PEL, repeat such monitoring within six months of the most recent monitoring.
- (d) Where the most recent exposure monitoring indicates that employee exposures are above the PEL, repeat such monitoring within three months of the most recent monitoring.
- (e) Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the action level, repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken 7 or more days apart, are below the action level, at which time you may discontinue monitoring for those employees whose exposures are represented by such monitoring, except as otherwise provided in paragraph (4).
- (4) Reassessment of exposures. Reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the action level, or when there is any reason to believe that new or additional exposures at or above the action level have occurred.
- (5) Methods of sample analysis. Ensure that all samples taken to satisfy the monitoring requirements of this rule are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with the procedures in Appendix A to this rule.
- (6) Employee notification of assessment results.
  - (a) Individually notify each affected employee in writing of the results of that assessment or post the results in an appropriate location accessible to all affected employees in accordance with the following:
    - (A) Construction employers with a NAICS code of 23XXXX must notify affected employees within 5 working days after receiving any results an exposure assessment in accordance with this rule.
    - (B) All other employers must notify affected employees within 15 working days after receiving any results of an exposure assessment in accordance with this rule.
  - (b) Whenever an exposure assessment indicates that employee exposure is above the PEL, describe in the written notification the corrective action being taken to reduce employee exposure to or below the PEL.
- (7) Observation of monitoring.

- (a) Where air monitoring is performed to comply with the requirements of this rule, provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to respirable crystalline silica.
- (b) When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, provide the observer with protective clothing and equipment at no cost and ensure that the observer uses such clothing and equipment.

## Appendix A

### Methods of Sample Analysis

This appendix specifies the procedures for analyzing air samples for respirable crystalline silica, as well as the quality control procedures that employers must ensure that laboratories use when performing an analysis required under 437-002-1056(5). Employers must ensure that such a laboratory:

1. Evaluates all samples using the procedures specified in one of the following analytical methods: OSHA ID-142; NMAM 7500; NMAM 7602; NMAM 7603; MSHA P-2; or MSHA P-7;
2. Is accredited to ANS/ISO/IEC Standard 17025:2005 with respect to crystalline silica analyses by a body that is compliant with ISO/IEC Standard 17011:2004 for implementation of quality assessment programs;
3. Uses the most current National Institute of Standards and Technology (NIST) or NIST traceable standards for instrument calibration or instrument calibration verification;
4. Implements an internal quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error;
5. Characterizes the sample material by identifying polymorphs of respirable crystalline silica present, identifies the presence of any interfering compounds that might affect the analysis, and makes any corrections necessary in order to obtain accurate sample analysis; and
6. Analyzes quantitatively for crystalline silica only after confirming that the sample matrix is free of uncorrectable analytical interferences, corrects for analytical interferences, and uses a method that meets the following performance specifications:
  - 6.1 Each day that samples are analyzed, performs instrument calibration checks with standards that bracket the sample concentrations;
  - 6.2 Uses five or more calibration standard levels to prepare calibration curves and ensures that standards are distributed through the calibration range in a manner that accurately reflects the underlying calibration curve; and
  - 6.3 Optimizes methods and instruments to obtain a quantitative limit of detection that represents a value no higher than 25 percent of the PEL based on sample air volume.

**437-002-1057 Specified exposure control methods. This rule lists specific tasks and control measures that do not require an exposure assessment and is only applicable to construction and construction like-activities.**

- (1) Fully and properly implement the engineering controls, work practices, and respiratory protection specified for the task on Table 1, unless you assess and limit the exposure of employees to respirable crystalline silica in accordance with 437-002-1056.**
  - (a) When construction employees engage in a task identified on Table 1 of this rule, the exposure assessment in 437-002-1056 is not required when the engineering controls, work practices, and respiratory protection specified are fully and properly implemented for the tasks listed on Table 1 of this rule.**
  - (b) The exposure assessment required by 437-002-1056 is not required when non-construction employees, such as building maintenance personnel, engage in a construction-like task, which when performed:**
    - (A) Is indistinguishable from a construction task listed on Table 1; and**
    - (B) The task will not be performed regularly in the same environment and condition; and**
    - (C) The engineering controls, work practices, and respiratory protection specified are fully and properly implemented for the task on Table 1 of this rule.**
- (2) When using wet methods, apply water at flow rates sufficient to minimize the release of visible dust.**
- (3) For measures that include an enclosed cab or booth, ensure that the enclosed cab or booth:**
  - (a) Is maintained as free as practicable from settled dust;**
  - (b) Has door seals and closing mechanisms that work properly;**
  - (c) Has gaskets and seals that are in good condition and working properly;**
  - (d) Is under positive pressure maintained through continuous delivery of fresh air;**
  - (e) Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0  $\mu\text{m}$  range (e.g., MERV-16 or better); and**
  - (f) Has heating and cooling capabilities.**
- (4) Where an employee performs more than one task in Table 1 during the course of a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks in Table 1 combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified for less than four hours per shift.**

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Stationary masonry saws</u>	<p><u>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p>	<u>None</u>	<u>None</u>
<u>Handheld power saws (any blade diameter)</u>	<p><u>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <ul style="list-style-type: none"> <li>- <u>When used outdoors.</u></li> <li>- <u>When used indoors or in an enclosed area.</u></li> </ul>	<p><u>None</u></p> <p><u>APF 10</u></p>	<p><u>APF 10</u></p> <p><u>APF 10</u></p>
<u>Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)</u>	<p><u>For tasks performed outdoors only:</u></p> <p><u>Use saw equipped with commercially available dust collection system.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p><u>Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.</u></p>	<u>None</u>	<u>None</u>

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Walk-behind saws</u>	<p><u>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <ul style="list-style-type: none"> <li>- <u>When used outdoors.</u></li> <li>- <u>When used indoors or in an enclosed area.</u></li> </ul>	<p><u>None</u></p> <p><u>APF 10</u></p>	<p>-</p> <p><u>None</u></p> <p><u>APF 10</u></p>
<u>Drivable saws</u>	<p><u>For tasks performed outdoors only:</u></p> <p><u>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p>	<p><u>None</u></p>	<p><u>None</u></p>
<u>Rig-mounted core saws or drills</u>	<p><u>Use tool equipped with integrated water delivery system that supplies water to cutting surface.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p>	<p><u>None</u></p>	<p><u>None</u></p>

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Handheld and stand-mounted drills (including impact and rotary hammer drills)</u>	<p><u>Use drill equipped with commercially available shroud or cowling with dust collection system.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p><u>Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.</u></p> <p><u>Use a HEPA-filtered vacuum when cleaning holes.</u></p>	<u>None</u>	<u>None</u>
<u>Dowel drilling rigs for concrete</u>	<p><u>For tasks performed outdoors only:</u></p> <p><u>Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism.</u></p> <p><u>Use a HEPA-filtered vacuum when cleaning holes.</u></p>	<u>APF 10</u>	<u>APF 10</u>
<u>Vehicle-mounted drilling rigs for rock and concrete</u>	<p><u>Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector.</u></p> <p style="text-align: center;"><u>OR</u></p> <p><u>Operate from within an enclosed cab and use water for dust suppression on drill bit.</u></p>	<u>None</u>	<u>None</u>
		<u>None</u>	<u>None</u>

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Jackhammers and handheld powered chipping tools</u>	<u>Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.</u>  – <u>When used outdoors.</u>  – <u>When used indoors or in an enclosed area.</u>  <u>OR</u>  <u>Use tool equipped with commercially available shroud and dust collection system.</u>  <u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u>  <u>Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.</u>  – <u>When used outdoors.</u>  – <u>When used indoors or in an enclosed area.</u>	<u>None</u>  <u>APF 10</u>	<u>APF 10</u>  <u>APF 10</u>
		<u>None</u>  <u>APF 10</u>	<u>APF 10</u>  <u>APF 10</u>

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Handheld grinders for mortar removal (i.e., tuckpointing)</u>	<p><u>Use grinder equipped with commercially available shroud and dust collection system.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p><u>Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.</u></p>	<u>APF 10</u>	<u>APF 25</u>
<u>Handheld grinders for uses other than mortar removal</u>	<p><u>For tasks performed outdoors only:</u></p> <p><u>Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p align="center"><u>OR</u></p>	<u>None</u>	<u>None</u>
-		-	-

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
-	<p><u>Use grinder equipped with commercially available shroud and dust collection system.</u></p> <p><u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p><u>Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.</u></p> <ul style="list-style-type: none"> <li>- <u>When used outdoors.</u></li> <li>- <u>When used indoors or in an enclosed area.</u></li> </ul>	<p><u>None</u></p> <p><u>None</u></p>	<p><u>None</u></p> <p><u>APF 10</u></p>

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Walk-behind milling machines and floor grinders</u>	<u>Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface.</u>	<u>None</u>	<u>None</u>
	<u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u>  <u>OR</u>  <u>Use machine equipped with dust collection system recommended by the manufacturer.</u>  <u>Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.</u>  <u>Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.</u>  <u>When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.</u>	<u>None</u>	<u>None</u>
<u>Small drivable milling machines (less than half-lane)</u>	<u>Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant.</u>  <u>Operate and maintain machine to minimize dust emissions.</u>	<u>None</u>	<u>None</u>

**TABLE 1  
SPECIFIED EXPOSURE CONTROL METHODS  
WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Large drivable milling machines (half-lane and larger)</u>	<u>For cuts of any depth on asphalt only:</u>  <u>Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust.</u>  <u>Operate and maintain machine to minimize dust emissions.</u>	<u>None</u>	<u>None</u>
	<u>For cuts of four inches in depth or less on any substrate:</u>  <u>Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust.</u>  <u>Operate and maintain machine to minimize dust emissions.</u>	<u>None</u>	<u>None</u>
	<u>OR</u>	<u>None</u>	<u>None</u>
	<u>Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant.</u>  <u>Operate and maintain machine to minimize dust emissions.</u>		

**TABLE 1**  
**SPECIFIED EXPOSURE CONTROL METHODS**  
**WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA**

<u>Equipment / Task</u>	<u>Engineering and Work Practice Control Methods</u>	<u>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</u>	
		<u>≤ 4 hours /shift</u>	<u>&gt; 4 hours /shift</u>
<u>Crushing machines</u>	<p><u>Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points).</u></p> <p><u>Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions.</u></p> <p><u>Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.</u></p>	<u>None</u>	<u>None</u>
<u>Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials</u>	<p><u>Operate equipment from within an enclosed cab.</u></p> <p><u>When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.</u></p>	<u>None</u>	<u>None</u>
<u>Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: demolishing, abrading, or fracturing silica-containing materials</u>	<p><u>Apply water and/or dust suppressants as necessary to minimize dust emissions.</u></p> <p style="text-align: center;"><u>OR</u></p> <p><u>When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.</u></p>	<u>None</u>	<u>None</u>

**437-002-1058 Regulated and restricted access areas. This rule applies to fixed site regulated areas and restricted access areas for construction activities.**

**(1) Regulated areas at fixed sites.**

- (a) Establishment. Establish a regulated area wherever an employee's exposure to airborne concentrations of respirable crystalline silica is, or can reasonably be expected to be, in excess of the PEL.**
- (b) Demarcation. Demarcate regulated areas from the rest of the workplace in a manner that minimizes the number of employees exposed to respirable crystalline silica within the regulated area. Post signs at all entrances to regulated areas that bear the following legend.**

**DANGER**  
**RESPIRABLE CRYSTALLINE SILICA**  
**MAY CAUSE CANCER**  
**CAUSES DAMAGE TO LUNGS**  
**WEAR RESPIRATORY PROTECTION IN THIS AREA**  
**AUTHORIZED PERSONNEL ONLY**

**(c) Access. Limit access to regulated areas to:**

- (A) Persons authorized by the employer and required by work duties to be present in the regulated area;**
  - (B) Any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring procedures under 437-002-1056; and**
  - (C) Any person authorized by the Occupational Safety and Health Act or regulations issued under it to be in a regulated area.**
- (d) Provision of respirators. Provide each employee and the employee's designated representative entering a regulated area with an appropriate respirator in accordance with 437-002-1060 and require each employee and the employee's designated representative use the respirator while in a regulated area.**

**(2) Restricted access for construction activities. For employers engaged in construction activities or using the specific exposure control methods in 437-002-1060;**

- (a) Written procedures. Develop and implement written procedures to restrict access to work areas, when necessary, to minimize the number of employees exposed to respirable crystalline silica and their level of exposure, including exposures generated by other employers or sole proprietors. Procedures must be part of the written exposure control plan required by 437-002-1059(2).**
- (b) Competent person. Designate a competent person to ensure the procedures are followed.**

**437-002-1059 Methods of Compliance. This rule describes the engineering and work practice controls you must use.**

- (1) **Engineering and work practice controls. Use engineering and work practice controls to reduce and maintain employee exposure to respirable crystalline silica to or below the PEL, unless the employer can demonstrate that such controls are not feasible. Wherever such feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PEL, use them to reduce employee exposure to the lowest feasible level and supplement them with the use of respiratory protection that complies with the requirements of this subdivision.**
- (2) **Establish and implement a written exposure control plan that contains at least the following elements:**
  - (a) **A description of the tasks in the workplace that involve exposure to respirable crystalline silica;**
  - (b) **A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task; and**
  - (c) **A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica.**
  - (d) **Review and evaluate the effectiveness of the written exposure control plan at least annually and update it as necessary.**
  - (e) **For employees engaged in construction activity or using the specified exposure control methods allowed in 437-002-1057, designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.**
  - (f) **Make the written exposure control plan readily available for examination and copying, upon request, to each employee covered by this subdivision, their designated representatives, the Director of the Oregon Department of Consumer and Business Services, or designee, and the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.**
- (3) **Abrasive blasting. In addition to the requirements of 437-002-1058(1), comply with other Oregon OSHA standards, when applicable, such as OAR 437-002-1910.94 (Ventilation) or 437-003-1926.57 (Ventilation) where abrasive blasting is conducted using crystalline silica containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica.**

**437-002-1060 Respiratory protection. This rule applies to all respirator use.**

- (1) **General. Where respiratory protection is required by this subdivision, provide each employee an appropriate respirator that complies with the requirements of this rule and OAR 437-002-1910.134. Respiratory protection is required:**

- (a) Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;
  - (b) Where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible;
  - (c) During tasks for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL;
  - (d) When specified by an exposure control method in Table 1, as allowed for in 437-002-1057;
  - (e) During periods when the employee is in a regulated area.
- (2) Where respirator use is required by this rule, institute a respiratory protection program in accordance with OAR 437-002-1910.134.

**437-002-1061 Housekeeping. This rule covers housekeeping requirements for all employers covered under the silica rule scope, 437-002-1053.**

- (1) Do not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.
- (2) Do not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:
- (a) The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or
  - (b) No alternative method is feasible.

**437-002-1062 Medical surveillance. This rule describes the medical monitoring requirements of this subdivision.**

- (1) Make medical surveillance available to each employee who:
- (a) Will be occupationally exposed to respirable crystalline silica at or above the action level for 30 or more days per year; or
  - (b) Will be required under this subdivision to use a respirator for 30 or more days per year.

**NOTE: The medical evaluation requirements of the respiratory protection rule, OAR 437-002-1910.134, still apply for employees wearing respiratory protection.**

- (2) Medical surveillance must be provided at no cost to the employee and at a reasonable time and place.
- (3) Ensure that all medical examinations and procedures required by this rule are performed by a PLHCP as defined in 437-002-1054.
- (4) Make an initial (baseline) medical examination available within 30 days after initial assignment, unless the employee has received a medical examination that meets the requirements of this rule within the last three years. The examination must consist of:
- (a) A medical and work history, with emphasis on: Past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history;
  - (b) A physical examination with special emphasis on the respiratory system;
  - (c) A chest X-ray (a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems), interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader;
  - (d) A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) and FEV1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH approved spirometry course;
  - (e) Testing for latent tuberculosis infection; and
  - (f) Any other tests deemed appropriate by the PLHCP.
- (5) Make medical examinations available that include the procedures described in 437-002-1062(4) (except 437-002-1062(4)(e)) at least every three years, or more frequently if recommended by the PLHCP.
- (6) Ensure that the examining PLHCP has a copy of this rule, and provide the PLHCP with the following information:
- (a) A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;
  - (b) The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;
  - (c) A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and
  - (d) Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

- (7) Ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. Ensure the written report contains:
- (a) A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;
  - (b) Any recommended limitations on the employee's use of respirators;
  - (c) Any recommended limitations on the employee's exposure to respirable crystalline silica; and
  - (d) A statement that the employee should be examined by a specialist (pursuant to 437-002-1062(9)) if the chest X-ray provided in accordance with this rule is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.
- (8) Obtain a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion must contain only the following:
- (a) The date of the examination;
  - (b) A statement that the examination has met the requirements of this rule; and
  - (c) Any recommended limitations on the employee's use of respirators.
- (9) If the employee provides written authorization, the written opinion must also contain either or both of the following:
- (a) Any recommended limitations on the employee's exposure to respirable crystalline silica;
  - (b) A statement that the employee should be examined by a specialist (pursuant to 437-002-1062(11)) if the chest X-ray provided in accordance with this rule is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.
- (10) Ensure that each employee receives a copy of the written medical opinion within 30 days of each medical examination performed.
- (11) If the PLHCP's written medical opinion indicates that an employee should be examined by a specialist, make a medical examination by a specialist available within 30 days after receiving the PLHCP's written opinion.
- (a) Ensure that the examining specialist is provided with all of the information that the employer is obligated to provide to the PLHCP in accordance with this rule.
  - (b) Ensure that the specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination. The written report must meet the requirements this rule.

(c) **Obtain a written opinion from the specialist within 30 days of the medical examination. The written opinion must meet the requirements of this rule.**

## Appendix A

### Medical Surveillance Guidelines

#### Introduction

The purpose of this Appendix is to provide medical information and recommendations to aid physicians and other licensed health care professionals (PLHCPs) regarding compliance with the medical surveillance provisions of the respirable crystalline silica standard (437-002-1062). This Appendix is for informational and guidance purposes only and none of the statements in this Appendix should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the standard.

Medical screening and surveillance allow for early identification of exposure-related health effects in individual employee and groups of employees, so that actions can be taken to both avoid further exposure and prevent or address adverse health outcomes. Silica-related diseases can be fatal, encompass a variety of target organs, and may have public health consequences when considering the increased risk of a latent tuberculosis (TB) infection becoming active. Thus, medical surveillance of silica-exposed employees requires that PLHCPs have a thorough knowledge of silica-related health effects.

This Appendix is divided into seven sections. Section 1 reviews silica-related diseases, medical responses, and public health responses. Section 2 outlines the components of the medical surveillance program for employees exposed to silica. Section 3 describes the roles and responsibilities of the PLHCP implementing the program and of other medical specialists and public health professionals. Section 4 provides a discussion of considerations, including confidentiality. Section 5 provides a list of additional resources and Section 6 lists references. Section 7 provides sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization.

#### 1. Recognition of Silica-Related Diseases

1.1. Overview. The term “silica” refers specifically to the compound silicon dioxide (SiO<sub>2</sub>). Silica is a major component of sand, rock, and mineral ores. Exposure to fine (respirable size) particles of crystalline forms of silica is associated with adverse health effects, such as silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), and activation of latent TB infections. Exposure to respirable crystalline silica can occur in industry settings such as foundries, abrasive blasting operations, paint manufacturing, glass and concrete product manufacturing, brick making, china and pottery manufacturing, manufacturing of plumbing fixtures, and many construction activities including highway repair, masonry, concrete work, rock drilling, and tuck-pointing. New uses of silica continue to emerge. These include countertop manufacturing, finishing, and installation (Kramer *et al.* 2012; OSHA 2015) and hydraulic fracturing in the oil and gas industry (OSHA 2012).

Silicosis is an irreversible, often disabling, and sometimes fatal fibrotic lung disease. Progression of silicosis can occur despite removal from further exposure. Diagnosis of silicosis requires a history of exposure to silica and radiologic findings

characteristic of silica exposure. Three different presentations of silicosis (chronic, accelerated, and acute) have been defined. Accelerated and acute silicosis are much less common than chronic silicosis. However, it is critical to recognize all cases of accelerated and acute silicosis because these are life-threatening illnesses and because they are caused by substantial overexposures to respirable crystalline silica.

Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies current high exposure and a very marked breakdown in prevention.

In addition to silicosis, employees exposed to respirable crystalline silica, especially those with accelerated or acute silicosis, are at increased risks of contracting active TB and other infections (ATS 1997; Rees and Murray 2007). Exposure to respirable crystalline silica also increases an employee's risk of developing lung cancer, and the higher the cumulative exposure, the higher the risk (Steenland *et al.* 2001; Steenland and Ward 2014). Symptoms for these diseases and other respirable crystalline silica-related diseases are discussed below.

1.2. Chronic Silicosis. Chronic silicosis is the most common presentation of silicosis and usually occurs after at least 10 years of exposure to respirable crystalline silica. The clinical presentation of chronic silicosis is:

1.2.1. Symptoms—shortness of breath and cough, although employees may not notice any symptoms early in the disease. Constitutional symptoms, such as fever, loss of appetite and fatigue, may indicate other diseases associated with silica exposure, such as TB infection or lung cancer. Employees with these symptoms should immediately receive further evaluation and treatment.

1.2.2. Physical Examination—may be normal or disclose dry rales or rhonchi on lung auscultation.

1.2.3. Spirometry—may be normal or may show only a mild restrictive or obstructive pattern.

1.2.4. Chest X-ray—classic findings are small, rounded opacities in the upper lung fields bilaterally. However, small irregular opacities and opacities in other lung areas can also occur. Rarely, “eggshell calcifications” in the hilar and mediastinal lymph nodes are seen.

1.2.5. Clinical Course—chronic silicosis in most cases is a slowly progressive disease. Under the respirable crystalline silica standard, the PLHCP is to recommend that employees with a 1/0 category X-ray be referred to an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine. The PLHCP and/or Specialist should counsel employees regarding work practices and personal habits that could affect employees' respiratory health.

1.3. Accelerated Silicosis. Accelerated silicosis generally occurs within 5–10 years of exposure and results from high levels of exposure to respirable crystalline silica. The clinical presentation of accelerated silicosis is:

**1.3.1. Symptoms—shortness of breath, cough, and sometimes sputum production. Employees with exposure to respirable crystalline silica, and especially those with accelerated silicosis, are at high risk for activation of TB infections, atypical mycobacterial infections, and fungal superinfections. Constitutional symptoms, such as fever, weight loss, hemoptysis (coughing up blood), and fatigue may herald one of these infections or the onset of lung cancer.**

**1.3.2. Physical Examination—rales, rhonchi, or other abnormal lung findings in relation to illnesses present. Clubbing of the digits, signs of heart failure, and cor pulmonale may be present in severe lung disease.**

**1.3.3. Spirometry—restrictive or mixed restrictive/obstructive pattern.**

**1.3.4. Chest X-ray—small rounded and/or irregular opacities bilaterally. Large opacities and lung abscesses may indicate infections, lung cancer, or progression to complicated silicosis, also termed progressive massive fibrosis.**

**1.3.5. Clinical Course—accelerated silicosis has a rapid, severe course. Under the respirable crystalline silica standard, the PLHCP can recommend referral to a Board Certified Specialist in either Pulmonary Disease or Occupational Medicine, as deemed appropriate, and referral to a Specialist is recommended whenever the diagnosis of accelerated silicosis is being considered.**

**1.4. Acute Silicosis. Acute silicosis is a rare disease caused by inhalation of extremely high levels of respirable crystalline silica particles. The pathology is similar to alveolar proteinosis with lipoproteinaceous material accumulating in the alveoli. Acute silicosis develops rapidly, often, within a few months to less than 2 years of exposure, and is almost always fatal. The clinical presentation of acute silicosis is as follows:**

**1.4.1. Symptoms—sudden, progressive, and severe shortness of breath. Constitutional symptoms are frequently present and include fever, weight loss, fatigue, productive cough, hemoptysis (coughing up blood), and pleuritic chest pain.**

**1.4.2. Physical Examination—dyspnea at rest, cyanosis, decreased breath sounds, inspiratory rales, clubbing of the digits, and fever.**

**1.4.3. Spirometry—restrictive or mixed restrictive/obstructive pattern.**

**1.4.4. Chest X-ray—diffuse haziness of the lungs bilaterally early in the disease. As the disease progresses, the “ground glass” appearance of interstitial fibrosis will appear.**

**1.4.5. Clinical Course—employees with acute silicosis are at especially high risk of TB activation, nontuberculous mycobacterial infections, and fungal superinfections. Acute silicosis is immediately life-threatening. The employee should be urgently referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation and treatment.**

Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies a profoundly high level of silica exposure and may mean that other employees are currently exposed to dangerous levels of silica.

1.5. COPD. COPD, including chronic bronchitis and emphysema, has been documented in silica-exposed employees, including those who do not develop silicosis. Periodic spirometry tests are performed to evaluate each employee for progressive changes consistent with the development of COPD. In addition to evaluating spirometry results of individual employees over time, PLHCPs may want to be aware of general trends in spirometry results for groups of employees from the same workplace to identify possible problems that might exist at that workplace. (See Section 2 of this Appendix on Medical Surveillance for further discussion.) Heart disease may develop secondary to lung diseases such as COPD. A recent study by Liu *et al.* 2014 noted a significant exposure-response trend between cumulative silica exposure and heart disease deaths, primarily due to pulmonary heart disease, such as cor pulmonale.

1.6. Renal and Immune System. Silica exposure has been associated with several types of kidney disease, including glomerulonephritis, nephrotic syndrome, and end stage renal disease requiring dialysis. Silica exposure has also been associated with other autoimmune conditions, including progressive systemic sclerosis, systemic lupus erythematosus, and rheumatoid arthritis. Studies note an association between employees with silicosis and serologic markers for autoimmune diseases, including antinuclear antibodies, rheumatoid factor, and immune complexes (Jalloul and Banks 2007; Shtraichman *et al.* 2015).

1.7. TB and Other Infections. Silica exposed employees with latent TB are 3 to 30 times more likely to develop active pulmonary TB infection (ATS 1997; Rees and Murray 2007). Although respirable crystalline silica exposure does not cause TB infection, individuals with latent TB infection are at increased risk for activation of disease if they have higher levels of respirable crystalline silica exposure, greater profusion of radiographic abnormalities, or a diagnosis of silicosis. Demographic characteristics, such as immigration from some countries, are associated with increased rates of latent TB infection. PLHCPs can review the latest Centers for Disease Control and Prevention (CDC) information on TB incidence rates and high risk populations online (See Section 5 of this Appendix).

Additionally, silica-exposed employees are at increased risk for contracting nontuberculous mycobacterial infections, including *Mycobacterium avium-intracellulare* and *Mycobacterium kansaii*.

1.8. Lung Cancer. The National Toxicology Program has listed respirable crystalline silica as a known human carcinogen since 2000 (NTP 2014). The International Agency for Research on Cancer (2012) has also classified silica as Group 1 (carcinogenic to humans). Several studies have indicated that the risk of lung cancer from exposure to respirable crystalline silica and smoking is greater than additive (Brown 2009; Liu *et al.* 2013). Employees should be counseled on smoking cessation.

## **2. Medical Surveillance**

**PLHCPs who manage silica medical surveillance programs should have a thorough understanding of the many silica-related diseases and health effects outlined in Section 1 of this Appendix. At each clinical encounter, the PLHCP should consider silica-related health outcomes, with particular vigilance for acute and accelerated silicosis.**

**In this Section, the required components of medical surveillance under the respirable crystalline silica standard are reviewed, along with additional guidance and recommendations for PLHCPs performing medical surveillance examinations for silica exposed employees.**

### **2.1. History**

**2.1.1. The respirable crystalline silica standard requires the following: A medical and work history, with emphasis on: Past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of TB; and smoking status and history.**

**2.1.2. Further, the employer must provide the PLHCP with the following information:**

**2.1.2.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;**

**2.1.2.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;**

**2.1.2.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and**

**2.1.2.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.**

**2.1.3. Additional guidance and recommendations: A history is particularly important both in the initial evaluation and in periodic examinations. Information on past and current medical conditions (particularly a history of kidney disease, cardiac disease, connective tissue disease, and other immune diseases), medications, hospitalizations and surgeries may uncover health risks, such as immune suppression, that could put an employee at increased health risk from exposure to silica. This information is important when counseling the employee on risks and safe work practices related to silica exposure.**

### **2.2. Physical Examination**

**2.2.1. The respirable crystalline silica standard requires the following: A physical examination, with special emphasis on the respiratory system. The physical**

examination must be performed at the initial examination and every three years thereafter.

2.2.2. Additional guidance and recommendations: Elements of the physical examination that can assist the PHLCP include: An examination of the cardiac system, an extremity examination (for clubbing, cyanosis, edema, or joint abnormalities), and an examination of other pertinent organ systems identified during the history.

### 2.3. TB Testing

2.3.1. The respirable crystalline silica standard requires the following: Baseline testing for TB on initial examination.

2.3.2. Additional guidance and recommendations:

2.3.2.1. Current CDC guidelines (See Section 5 of this Appendix) should be followed for the application and interpretation of Tuberculin skin tests (TST). The interpretation and documentation of TST reactions should be performed within 48 to 72 hours of administration by trained PLHCPs.

2.3.2.2. PLHCPs may use alternative TB tests, such as interferon-g release assays (IGRAs), if sensitivity and specificity are comparable to TST (Mazurek *et al.* 2010; Slater *et al.* 2013). PLHCPs can consult the current CDC guidelines for acceptable tests for latent TB infection.

2.3.2.3. The silica standard allows the PLHCP to order additional tests or test at a greater frequency than required by the standard, if deemed appropriate. Therefore, PLHCPs might perform periodic (e.g., annual) TB testing as appropriate, based on employees' risk factors. For example, according to the American Thoracic Society (ATS), the diagnosis of silicosis or exposure to silica for 25 years or more are indications for annual TB testing (ATS 1997). PLHCPs should consult the current CDC guidance on risk factors for TB (See Section 5 of this Appendix).

2.3.2.4. Employees with positive TB tests and those with indeterminate test results should be referred to the appropriate agency or specialist, depending on the test results and clinical picture. Agencies, such as local public health departments, or specialists, such as a pulmonary or infectious disease specialist, may be the appropriate referral. Active TB is a nationally notifiable disease. PLHCPs should be aware of the reporting requirements for their region. All States have TB Control Offices that can be contacted for further information. (See Section 5 of this Appendix for links to CDC's TB resources and State TB Control Offices.)

2.3.2.5. The following public health principles are key to TB control in the U.S. (ATS–CDC–IDSA 2005):

(1) Prompt detection and reporting of persons who have contracted active TB;

(2) Prevention of TB spread to close contacts of active TB cases;

**(3) Prevention of active TB in people with latent TB through targeted testing and treatment; and**

**(4) Identification of settings at high risk for TB transmission so that appropriate infection-control measures can be implemented.**

#### **2.4. Pulmonary Function Testing**

**2.4.1. The respirable crystalline silica standard requires the following: Pulmonary function testing must be performed on the initial examination and every three years thereafter. The required pulmonary function test is spirometry and must include forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio. Testing must be administered by a spirometry technician with a current certificate from a National Institute for Occupational Health and Safety (NIOSH)-approved spirometry course.**

**2.4.2. Additional guidance and recommendations: Spirometry provides information about individual respiratory status and can be used to track an employee's respiratory status over time or as a surveillance tool to follow individual and group respiratory function. For quality results, the ATS and the American College of Occupational and Environmental Medicine (ACOEM) recommend use of the third National Health and Nutrition Examination Survey (NHANES III) values, and ATS publishes recommendations for spirometry equipment (Miller *et al.* 2005; Townsend 2011; Redlich *et al.* 2014). OSHA's publication, *Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals*, provides helpful guidance (See Section 5 of this Appendix). Abnormal spirometry results may warrant further clinical evaluation and possible recommendations for limitations on the employee's exposure to respirable crystalline silica.**

#### **2.5. Chest X-ray**

**2.5.1. The respirable crystalline silica standard requires the following: A single posteroanterior (PA) radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems. A chest X-ray must be performed on the initial examination and every three years thereafter. The chest X-ray must be interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader.**

**Chest radiography is necessary to diagnose silicosis, monitor the progression of silicosis, and identify associated conditions such as TB. If the B reading indicates small opacities in a profusion of 1/0 or higher, the employee is to receive a recommendation for referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.**

**2.5.2. Additional guidance and recommendations: Medical imaging has largely transitioned from conventional film-based radiography to digital radiography**

systems. The ILO Guidelines for the Classification of Pneumoconioses has historically provided film-based chest radiography as a referent standard for comparison to individual exams. However, in 2011, the ILO revised the guidelines to include a digital set of referent standards that were derived from the prior film-based standards. To assist in assuring that digitally-acquired radiographs are at least as safe and effective as film radiographs, NIOSH has prepared guidelines, based upon accepted contemporary professional recommendations (See Section 5 of this Appendix). Current research from Laney *et al.* 2011 and Halldin *et al.* 2014 validate the use of the ILO digital referent images. Both studies conclude that the results of pneumoconiosis classification using digital references are comparable to film-based ILO classifications. Current ILO guidance on radiography for pneumoconiosis and B-reading should be reviewed by the PLHCP periodically, as needed, on the ILO or NIOSH Web sites (See Section 5 of this Appendix).

2.6. Other Testing. Under the respirable crystalline silica standards, the PLHCP has the option of ordering additional testing he or she deems appropriate. Additional tests can be ordered on a case-by-case basis depending on individual signs or symptoms and clinical judgment. For example, if an employee reports a history of abnormal kidney function tests, the PLHCP may want to order a baseline renal function tests (e.g., serum creatinine and urinalysis). As indicated above, the PLHCP may order annual TB testing for silica-exposed employees who are at high risk of developing active TB infections. Additional tests that PLHCPs may order based on findings of medical examinations include, but is not limited to, chest computerized tomography (CT) scan for lung cancer or COPD, testing for immunologic diseases, and cardiac testing for pulmonary-related heart disease, such as cor pulmonale.

### 3. Roles and Responsibilities

3.1. PLHCP. The PLHCP designation refers to “an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required” by the respirable crystalline silica standard. The legally permitted scope of practice for the PLHCP is determined by each State. PLHCPs who perform clinical services for a silica medical surveillance program should have a thorough knowledge of respirable crystalline silica-related diseases and symptoms. Suspected cases of silicosis, advanced COPD, or other respiratory conditions causing impairment should be promptly referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

Once the medical surveillance examination is completed, the employer must ensure that the PLHCP explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The written medical report must contain a statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment. In addition, the PLHCP’s written medical report must include any recommended limitations on the employee’s use of respirators, any recommended limitations on the employee’s exposure to respirable crystalline silica,

and a statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational medicine if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate by the PLHCP.

The PLHCP should discuss all findings and test results and any recommendations regarding the employee's health, worksite safety and health practices, and medical referrals for further evaluation, if indicated. In addition, it is suggested that the PLHCP offer to provide the employee with a complete copy of their examination and test results, as some employees may want this information for their own records or to provide to their personal physician or a future PLHCP. Employees are entitled to access their medical records.

Under the respirable crystalline silica standard, the employer must ensure that the PLHCP provides the employer with a written medical opinion within 30 days of the employee examination, and that the employee also gets a copy of the written medical opinion for the employer within 30 days. The PLHCP may choose to directly provide the employee a copy of the written medical opinion. This can be particularly helpful to employees, such as construction employees, who may change employers frequently. The written medical opinion can be used by the employee as proof of up-to-date medical surveillance. The following lists the elements of the written medical report for the employee and written medical opinion for the employer. (Sample forms for the written medical report for the employee, the written medical opinion for the employer, and the written authorization are provided in Section 7 of this Appendix.)

3.1.1. The written medical report for the employee must include the following information:

3.1.1.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.1.1.2. Any recommended limitations upon the employee's use of a respirator;

3.1.1.3. Any recommended limitations on the employee's exposure to respirable crystalline silica; and

3.1.1.4. A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine, where the standard requires or where the PLHCP has determined such a referral is necessary. The standard requires referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for a chest X-ray B reading indicating small opacities in a profusion of 1/0 or higher, or if the PHLCP determines that referral to a Specialist is necessary for other silica-related findings.

3.1.2. The PLHCP's written medical opinion for the employer must include only the following information:

**3.1.2.1. The date of the examination;**

**3.1.2.2. A statement that the examination has met the requirements of this section; and**

**3.1.2.3. Any recommended limitations on the employee's use of respirators.**

**3.1.2.4. If the employee provides the PLHCP with written authorization, the written opinion for the employer shall also contain either or both of the following:**

**(1) Any recommended limitations on the employee's exposure to respirable crystalline silica; and**

**(2) A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate.**

**3.1.2.5. In addition to the above referral for abnormal chest X-ray, the PLHCP may refer an employee to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for other findings of concern during the medical surveillance examination if these findings are potentially related to silica exposure.**

**3.1.2.6. Although the respirable crystalline silica standard requires the employer to ensure that the PLHCP explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the PLHCP has explained the results of the medical examination to the employee.**

**3.2. Medical Specialists. The silica standard requires that all employees with chest X-ray B readings of 1/0 or higher be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine. If the employee has given written authorization for the employer to be informed, then the employer shall make available a medical examination by a Specialist within 30 days after receiving the PLHCP's written medical opinion.**

**3.2.1. The employer must provide the following information to the Board Certified Specialist in Pulmonary Disease or Occupational Medicine:**

**3.2.1.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;**

**3.2.1.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;**

**3.2.1.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and**

**3.2.1.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.**

**3.2.2. The PLHCP should make certain that, with written authorization from the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has any other pertinent medical and occupational information necessary for the specialist's evaluation of the employee's condition.**

**3.2.3. Once the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has evaluated the employee, the employer must ensure that the Specialist explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The employer must also ensure that the Specialist provides the employer with a written medical opinion within 30 days of the employee examination. (Sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization are provided in Section 7 of this Appendix.)**

**3.2.4. The Specialist's written medical report for the employee must include the following information:**

**3.2.4.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;**

**3.2.4.2. Any recommended limitations upon the employee's use of a respirator; and**

**3.2.4.3. Any recommended limitations on the employee's exposure to respirable crystalline silica.**

**3.2.5. The Specialist's written medical opinion for the employer must include the following information:**

**3.2.5.1. The date of the examination; and**

**3.2.5.2. Any recommended limitations on the employee's use of respirators.**

**3.2.5.3. If the employee provides the Board Certified Specialist in Pulmonary Disease or Occupational Medicine with written authorization, the written medical opinion for the employer shall also contain any recommended limitations on the employee's exposure to respirable crystalline silica.**

**3.2.5.4. Although the respirable crystalline silica standard requires the employer to ensure that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the Specialist has explained the results of the medical examination to the employee.**

3.2.6. After evaluating the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine should provide feedback to the PLHCP as appropriate, depending on the reason for the referral. OSHA believes that because the PLHCP has the primary relationship with the employer and employee, the Specialist may want to communicate his or her findings to the PLHCP and have the PLHCP simply update the original medical report for the employee and medical opinion for the employer. This is permitted under the standard, so long as all requirements and time deadlines are met.

3.3. Public Health Professionals. PLHCPs might refer employees or consult with public health professionals as a result of silica medical surveillance. For instance, if individual cases of active TB are identified, public health professionals from state or local health departments may assist in diagnosis and treatment of individual cases and may evaluate other potentially affected persons, including coworkers. Because silica-exposed employees are at increased risk of progression from latent to active TB, treatment of latent infection is recommended. The diagnosis of active TB, acute or accelerated silicosis, or other silica-related diseases and infections should serve as sentinel events suggesting high levels of exposure to silica and may require consultation with the appropriate public health agencies to investigate potentially similarly exposed coworkers to assess for disease clusters. These agencies include local or state health departments or OSHA. In addition, NIOSH can provide assistance upon request through their Health Hazard Evaluation program. (See Section 5 of this Appendix)

#### 4. Confidentiality and Other Considerations

The information that is provided from the PLHCP to the employee and employer under the medical surveillance section of OSHA's respirable crystalline silica standard differs from that of medical surveillance requirements in previous OSHA standards. The standard requires two separate written communications, a written medical report for the employee and a written medical opinion for the employer. The confidentiality requirements for the written medical opinion are more stringent than in past standards. For example, the information the PLHCP can (and must) include in his or her written medical opinion for the employer is limited to: The date of the examination, a statement that the examination has met the requirements of this section, and any recommended limitations on the employee's use of respirators. If the employee provides written authorization for the disclosure of any limitations on the employee's exposure to respirable crystalline silica, then the PLHCP can (and must) include that information in the written medical opinion for the employer as well. Likewise, with the employee's written authorization, the PLHCP can (and must) disclose the PLHCP's referral recommendation (if any) as part of the written medical opinion for the employer.

However, the opinion to the employer must not include information regarding recommended limitations on the employee's exposure to respirable crystalline silica or any referral recommendations without the employee's written authorization. The standard also places limitations on the information that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine can provide to the employer without the employee's written authorization. The Specialist's written medical opinion for the employer, like the PLHCP's opinion, is limited to (and must contain): The date of the

examination and any recommended limitations on the employee's use of respirators. If the employee provides written authorization, the written medical opinion can (and must) also contain any limitations on the employee's exposure to respirable crystalline silica.

The PLHCP should discuss the implication of signing or not signing the authorization with the employee (in a manner and language that he or she understands) so that the employee can make an informed decision regarding the written authorization and its consequences. The discussion should include the risk of ongoing silica exposure, personal risk factors, risk of disease progression, and possible health and economic consequences. For instance, written authorization is required for a PLHCP to advise an employer that an employee should be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation of an abnormal chest X-ray (B-reading 1/0 or greater). If an employee does not sign an authorization, then the employer will not know and cannot facilitate the referral to a Specialist and is not required to pay for the Specialist's examination. In the rare case where an employee is diagnosed with acute or accelerated silicosis, co-workers are likely to be at significant risk of developing those diseases as a result of inadequate controls in the workplace. In this case, the PLHCP and/or Specialist should explain this concern to the affected employee and make a determined effort to obtain written authorization from the employee so that the PLHCP and/or Specialist can contact the employer.

Finally, without written authorization from the employee, the PLHCP and/or Board Certified Specialist in Pulmonary Disease or Occupational Medicine cannot provide feedback to an employer regarding control of workplace silica exposure, at least in relation to an individual employee. However, the regulation does not prohibit a PLHCP and/or Specialist from providing an employer with general recommendations regarding exposure controls and prevention programs in relation to silica exposure and silica-related illnesses, based on the information that the PLHCP receives from the employer such as employees' duties and exposure levels.

Recommendations may include increased frequency of medical surveillance examinations, additional medical surveillance components, engineering and work practice controls, exposure monitoring and personal protective equipment. For instance, more frequent medical surveillance examinations may be a recommendation to employers for employees who do abrasive blasting with silica because of the high exposures associated with that operation.

ACOEM's Code of Ethics and discussion is a good resource to guide PLHCPs regarding the issues discussed in this section (See Section 5 of this Appendix).

## 5. Resources

5.1. American College of Occupational and Environmental Medicine (ACOEM): ACOEM Code of Ethics.

Accessed at: <http://www.acoem.org/codeofconduct.aspx>

Raymond, L.W. and Wintermeyer, S. (2006) ACOEM evidenced-based statement on medical surveillance of silica-exposed workers: Medical surveillance of workers exposed to crystalline silica. *J Occup Environ Med*, 48, 95–101.

**5.2. Center for Disease Control and Prevention (CDC)**

**Tuberculosis Web page: <http://www.cdc.gov/tb/default.htm>**

**State TB Control Offices Web page: <http://www.cdc.gov/tb/links/tboffices.htm>**

**Tuberculosis Laws and Policies Web page:**

**<http://www.cdc.gov/tb/programs/laws/default.htm>**

**CDC. (2013). Latent Tuberculosis Infection: A Guide for Primary Health Care Providers.**

**Accessed at: <http://www.cdc.gov/tb/publications/ltbi/pdf/targetedltbi.pdf>**

**5.3. International Labour Organization International Labour Office (ILO). (2011) Guidelines for the use of the ILO International Classification of Radiographs of Pneumoconioses, Revised edition 2011.**

**Occupational Safety and Health Series No. 22:**

**[http://www.ilo.org/safework/info/publications/WCMS\\_168260/lang-en/index.htm](http://www.ilo.org/safework/info/publications/WCMS_168260/lang-en/index.htm)**

**5.4. National Institute of Occupational Safety and Health (NIOSH)**

**NIOSH B Reader Program Web page. (Information on interpretation of X-rays for silicosis and a list of certified B readers).**

**Accessed at: <http://www.cdc.gov/niosh/topics/chestradiography/breader-info.html>**

**NIOSH Guideline (2011). Application of Digital Radiography for the Detection and Classification of Pneumoconiosis. NIOSH publication number 2011-198.**

**Accessed at: <http://www.cdc.gov/niosh/docs/2011-198/>.**

**NIOSH Hazard Review (2002), Health Effects of Occupational Exposure to Respirable Crystalline Silica. NIOSH publication number 2002-129:**

**Accessed at <http://www.cdc.gov/niosh/docs/2002-129/>**

**NIOSH Health Hazard Evaluations Programs. (Information on the NIOSH Health Hazard Evaluation (HHE) program, how to request an HHE and how to look up an HHE report). Accessed at: <http://www.cdc.gov/niosh/hhe/>**

**5.5. National Industrial Sand Association: Occupational Health Program for Exposure to Crystalline Silica in the Industrial Sand Industry. National Industrial Sand Association, 2nd ed. 2010.**

**Can be ordered at: <http://www.sand.org/silicaoccupational-health-program>**

**5.6. Occupational Safety and Health Administration (OSHA)**

**Contacting OSHA: [http://www.osha.gov/html/Feed\\_Back.html](http://www.osha.gov/html/Feed_Back.html)**

**OSHA's Clinicians Web page. (OSHA resources, regulations and links to help clinicians navigate OSHA's Web site and aid clinicians in caring for workers.)**

**Accessed at: <http://www.osha.gov/dts/oom/clinicians/index.html>**

**OSHA's Safety and Health Topics Web page on Silica.**

**Accessed at: <http://www.osha.gov/dsq/topics/silicacrystalline/index.html>**

OSHA (2013). Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals.(OSHA 3637–03 2013).

Accessed at: <http://www.osha.gov/Publications/OSHA3637.pdf>

OSHA/NIOSH (2011). Spirometry: OSHA/NIOSH Spirometry InfoSheet (OSHA 3415–1–11). (Provides guidance to employers).

Accessed at <http://www.osha.gov/Publications/osha3415.pdf>

OSHA/NIOSH (2011) Spirometry: OSHA/NIOSH Spirometry Worker Info. (OSHA 3418–3–11).

Accessed at <http://www.osha.gov/Publications/osha3418.pdf>

### 5.7. Other

Steenland, K. and Ward E. (2014). Silica: A lung carcinogen. *CA Cancer J Clin*, 64, 63–69. (This article reviews not only silica and lung cancer but also all the known silica-related health effects. Further, the authors provide guidance to clinicians on medical surveillance of silica-exposed workers and worker counselling on safety practices to minimize silica exposure.)

### 6. References

American Thoracic Society (ATS). Medical Section of the American Lung Association (1997). Adverse effects of crystalline silica exposure. *Am J Respir Crit Care Med*, 155, 761–765.

American Thoracic Society (ATS), Centers for Disease Control (CDC), Infectious Diseases Society of America (IDSA) (2005).

Controlling Tuberculosis in the United States. *Morbidity and Mortality Weekly Report (MMWR)*, 54(RR12), 1–81.

Accessed at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5412a1.htm>.

Brown, T. (2009). Silica exposure, smoking, silicosis and lung cancer—complex interactions. *Occupational Medicine*, 59, 89–95.

Halldin, C.N., Petsonk, E.L., and Laney, A.S. (2014). Validation of the International Labour Office digitized standard images for recognition and classification of radiographs of pneumoconiosis. *Acad Radiol*, 21, 305–311.

International Agency for Research on Cancer.

(2012). Monographs on the evaluation of carcinogenic risks to humans: Arsenic, Metals, Fibers, and Dusts Silica Dust, Crystalline, in the Form of Quartz or Cristobalite. A Review of Human Carcinogens. Volume 100 C. Geneva, Switzerland: World Health Organization.

Jalloul, A.S. and Banks D.E. (2007). Chapter 23. The health effects of silica exposure. In: Rom, W.N. and Markowitz, S.B. (Eds).

*Environmental and Occupational Medicine*, 4th edition. Lippincott, Williams and Wilkins, Philadelphia, 365–387.

Kramer, M.R., Blanc, P.D., Fireman, E., Amital, A., Guber, A., Rahman, N.A., and Shitrit, D. (2012). Artificial stone silicosis: Disease resurgence among artificial stone workers. *Chest*, 142, 419– 424.

Laney, A.S., Petsonk, E.L., and Attfield, M.D. (2011). Intramodality and intermodality comparisons of storage phosphor computed radiography and conventional film-screen radiography in the recognition of small pneumonconiotic opacities. *Chest*, 140, 1574–1580.

Liu, Y., Steenland, K., Rong, Y., Hnizdo, E., Huang, X., Zhang, H., Shi, T., Sun, Y., Wu, T., and Chen, W. (2013). Exposure response analysis and risk assessment for lung cancer in relationship to silica exposure: A 44-year cohort study of 34,018 workers. *Am J Epi*, 178, 1424– 1433.

Liu, Y., Rong, Y., Steenland, K., Christiani, D.C., Huang, X., Wu, T., and Chen, W. (2014). Long-term exposure to crystalline silica and risk of heart disease mortality. *Epidemiology*, 25, 689–696.

Mazurek, G.H., Jereb, J., Vernon, A., LoBue, P., Goldberg, S., Castro, K. (2010). Updated guidelines for using interferon gamma release assays to detect *Mycobacterium tuberculosis* infection— United States. *Morbidity and Mortality Weekly Report (MMWR)*, 59(RR05), 1–25.

Miller, M.R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., Crapo, R., Enright, P., van der Grinten, C.P., Gustafsson, P., Jensen, R., Johnson, D.C., MacIntyre, N., McKay, R., Navajas, D., Pedersen, O.F., Pellegrino, R., Viegi, G., and Wanger, J. (2005). American Thoracic Society/European Respiratory Society (ATS/ERS) Task Force: Standardisation of Spirometry. *Eur Respir J*, 26, 319–338.

National Toxicology Program (NTP) (2014). Report on Carcinogens, Thirteenth Edition. Silica, Crystalline (respirable Size). Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. <http://ntp.niehs.nih.gov/ntp/roc/content/profiles/silica.pdf>.

Occupational Safety and Health Administration/National Institute for Occupational Safety and Health (OSHA/NIOSH) (2012). Hazard Alert. Worker exposure to silica during hydraulic fracturing.

Occupational Safety and Health Administration/National Institute for Occupational Safety and Health (OSHA/ NIOSH) (2015). Hazard alert. Worker exposure to silica during countertop manufacturing, finishing, and installation. (OSHA–HA–3768–2015).

Redlich, C.A., Tarlo, S.M., Hankinson, J.L., Townsend, M.C, Eschenbacher, W.L., Von Essen, S.G., Sigsgaard, T., Weissman, D.N. (2014). Official American Thoracic Society technical standards: Spirometry in the occupational setting. *Am J Respir Crit Care Med*; 189, 984–994.

Rees, D. and Murray, J. (2007). Silica, silicosis and tuberculosis. *Int J Tuberc Lung Dis*, 11(5), 474–484.

Shtraichman, O., Blanc, P.D., Ollech, J.E., Fridel, L., Fuks, L., Fireman, E., and Kramer, M.R. (2015). Outbreak of autoimmune disease in silicosis linked to artificial stone. *Occup Med*, 65, 444–450.

Slater, M.L., Welland, G., Pai, M., Parsonnet, J., and Banaei, N. (2013). Challenges with QuantiFERON–TB gold assay for largescale, routine screening of U.S. healthcare workers. *Am J Respir Crit Care Med*, 188, 1005–1010.

Steenland, K., Mannetje, A., Boffetta, P., Stayner, L., Attfield, M., Chen, J., Dosemeci, M., DeKlerk, N., Hnizdo, E., Koskela, R., and Checkoway, H. (2001). International Agency for Research on Cancer. Pooled exposure-response analyses and risk assessment for lung cancer in 10 cohorts of silica-exposed workers: An IARC multicentre study. *Cancer Causes Control*, 12(9):773–84.

Steenland, K. and Ward E. (2014). Silica: A lung carcinogen. *CA Cancer J Clin*, 64, 63–69.

Townsend, M.C. ACOEM Guidance Statement. (2011). Spirometry in the occupational health setting—2011 Update. *J Occup Environ Med*, 53, 569–584.

## 7. Sample Forms

Three sample forms are provided. The first is a sample written medical report for the employee. The second is a sample written medical opinion for the employer. And the third is a sample written authorization form that employees sign to clarify what information the employee is authorizing to be released to the employer.





**AUTHORIZATION FOR CRYSTALLINE SILICA OPINION TO EMPLOYER**

**This medical examination for exposure to crystalline silica could reveal a medical condition that results in recommendations for (1) limitations on respirator use, (2) limitations on exposure to crystalline silica, or (3) examination by a specialist in pulmonary disease or occupational medicine. Recommended limitations on respirator use will be included in the written opinion to the employer. If you want your employer to know about limitations on crystalline silica exposure or recommendations for a specialist examination, you will need to give authorization for the written opinion to the employer to include one or both of those recommendations.**

**I hereby authorize the opinion to the employer to contain the following information, if relevant (please check all that apply):**

**Recommendations for limitations on crystalline silica exposure**

**Recommendation for a specialist examination**

**OR**

**I do not authorize the opinion to the employer to contain anything other than recommended limitations on respirator use.**

**Please read and initial:**

**I understand that if I do not authorize my employer to receive the recommendation for specialist examination, the employer will not be responsible for arranging and covering costs of a specialist examination.**

\_\_\_\_\_  
**Name (printed)**

\_\_\_\_\_  
**Signature**

\_\_\_\_\_  
**Date**

**437-002-1063 Communication of respirable crystalline silica hazards to employees.**

- (1) Include respirable crystalline silica in the program established to comply with the hazard communication standard (HCS) (OAR 437-002-1910.1200). Ensure that each employee has access to labels on containers of crystalline silica and safety data sheets, and is trained in accordance with the provisions of HCS and this subdivision. Ensure that at least the following hazards are addressed:**
  - (a) Cancer**
  - (b) Lung effects**
  - (c) Immune system effects**
  - (d) Kidney effects**
  
- (2) Ensure that each employee covered by this subdivision can demonstrate knowledge and understanding of at least the following:**
  - (a) The health hazards associated with exposure to respirable crystalline silica;**
  - (b) Specific tasks in the workplace that could result in exposure to respirable crystalline silica;**
  - (c) Specific measures the employer has implemented to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used;**
  - (d) The contents of this subdivision;**
  - (e) The purpose and a description of the medical surveillance program required by 437-002-1062; and**
  - (f) When a competent person is required, the identity of the designated competent person.**
  
- (3) Make a copy of 437-002-1053 through 437-002-1065 readily available without cost to each employee covered by these rules.**

**437-002-1064 Recordkeeping.**

- (1) Air monitoring data.**
  - (a) Make and maintain an accurate record of all exposure measurements taken to assess employee exposure to respirable crystalline silica, as prescribed in 437-002-1056.**
  - (b) This record must include at least the following information:**
    - (A) The date of measurement for each sample taken;**
    - (B) The task monitored;**
    - (C) Sampling and analytical methods used;**
    - (D) Number, duration, and results of samples taken;**
    - (E) Identity of the laboratory that performed the analysis;**

- (F) Type of personal protective equipment, such as respirators, worn by the employees monitored; and
  - (G) Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.
- (c) Ensure that exposure records are maintained and made available in accordance with OAR 437-002-1910.1020.

(2) Objective data.

- (a) Make and maintain an accurate record of all objective data relied upon to comply with the requirements of this subdivision.
- (b) This record must include at least the following information:
  - (A) The crystalline silica-containing material in question;
  - (B) The source of the objective data;
  - (C) The testing protocol and results of testing;
  - (D) A description of the process, task, or activity on which the objective data were based; and
  - (E) Other data relevant to the process, task, activity, material, or exposures on which the objective data were based.
- (c) Ensure that objective data are maintained and made available in accordance with OAR 4374-002-1910.1020.

(3) Medical surveillance.

- (a) Make and maintain an accurate record for each employee covered by medical surveillance under 437-002-1062.
- (b) The record must include the following information about the employee:
  - (A) Name and social security number;
  - (B) A copy of the PLHCPs' and specialists' written medical opinions;
  - (C) A copy of the information provided to the PLHCPs and specialists.
- (c) Ensure that medical records are maintained and made available in accordance with 437-002-1910.1020.

437-002-1065 Dates.

- (1) This rule is effective September 25, 2016.

- (2) Construction employers with a NAICS code of 23XXXX must comply with this subdivision by June 23, 2017, except for the sample analysis requirements of 437-002-1056(5), which must be complied with by June 23, 2018.
- (3) All other employers must comply with this subdivision by June 23, 2018, except as provided for below:
- (a) For all employees exposed to respirable crystalline silica above the PEL for 30 days or more per year, you must comply with the medical surveillance requirements in 437-002-1062 by June 23, 2018.
- (b) For all employees exposed to respirable crystalline silica above the action level for 30 or more days per year, you must comply with the medical surveillance requirements in 437-002-1062 by June 23, 2020.

## DIVISION 3, CONSTRUCTION

### Division 3/Z, Toxic and Hazardous Substances

437-003-1000 Oregon Rules for Air Contaminants. An employee's exposure to any substance listed in Oregon Tables Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

(1) Oregon Table Z-1.

(a) Substances with limits preceded by "C" – Ceiling Values. An employee's exposure to any substance in Oregon Table Z-1, the exposure limit of which is preceded by a "C", shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

(b) Other substances – 8-hour Time Weighted Averages. An employee's exposure to any substance in Oregon Table Z-1, the exposure limit of which is not preceded by a "C", shall not exceed the 8-hour Time Weighted Average given for that substance in any 8-hour work shift of a 40-hour work week.

(c) Other Substances – Excursion Limits. Excursions in worker exposure levels may exceed 3 times the PEL-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the PEL-TWA, provided that the PEL-TWA is not exceeded.

(d) Skin Designation. To prevent or reduce skin absorption, an employee's skin exposure to substances listed in Oregon Table Z-1 with an "X" in the Skin Designation column following the substance name shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

(2) Oregon Table Z-2. An employee's exposure to any substance listed in Oregon Table Z-2 shall not exceed the exposure limits specified as follows:

(a) 8-hour time weighted averages. An employee's exposure to any substance listed in Oregon Table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in Oregon Table Z-2.

(b) Acceptable ceiling concentrations. An employee's exposure to a substance listed in Oregon Table Z-2 shall not exceed the acceptable ceiling concentration for the given substance in the table at any time during an 8-hour shift except:

(i) Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. An employee's exposure to a substance listed in Oregon Table Z-2 shall not exceed the acceptable maximum peak above the acceptable ceiling concentration, and shall not exceed the maximum duration for the given substance during an 8-hour shift.

(c) Example.

Oregon Table Z-2				
Substance	8-Hour Time-Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-hour Shift	
			Concentration	Maximum Duration
Benzene (a) (Z87.4-1969)	10 ppm	25 ppm	50 ppm	10 min.
Beryllium and beryllium compounds (Z37.17-1970)	2 µg/m <sup>3</sup>	5 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>	30 min.
Carbon tetrachloride (Z37.19-1967)	10 ppm	25 ppm	200 ppm	5 min. in any 4 hours

During an 8-hour work shift, an employee exposed to benzene may be exposed to an 8-hour time weighted average (TWA) of 10 ppm. Concentrations of benzene during the 8-hour work shift may not exceed 25 ppm, unless that exposure is no more than 50 ppm and does not exceed 10 minutes during an 8-hour work shift. Such exposures must be compensated by exposures to concentrations below 10 ppm so that the 8-hour time-weighted average is less than 10 ppm.

(3) Oregon Table Z-3. An employee's exposure to any substance listed in Oregon Table Z-3, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in the table.

(4) Computation formulae. The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are included in OAR 437, Division 2/Z, Toxic and Hazardous Substances, in order to determine whether an employee is exposed over the regulatory limit is as follows:

(a)

(i) The cumulative exposure for an 8-hour work shift shall be computed as follows:

$$E = (C_a T_a + C_b T_b + \dots C_n T_n) \div 8$$

Where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remain constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in subpart Z of 29 CFR part 1910 for the substance involved.

(ii) To illustrate the formula prescribed in paragraph (4)(a)(i) of this section, assume that Substance A has an 8-hour time weighted average limit of 100 ppm (Oregon Table Z-1). Assume that an employee is subject to the following exposure:

Two hours exposure at 150 ppm

Two hours exposure at 75 ppm

Four hours exposure at 50 ppm

Substituting this information in the formula, we have

$$[(2 \times 150) + (2 \times 75) + (4 \times 50)] \div 8 = 81.25 \text{ ppm}$$

Since 81.25 ppm is less than 100 ppm, the 8-hour time weighted average limit, the exposure is acceptable.

(b)

(i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

$$E_m = (C_1 \div L_1) + (C_2 \div L_2) + \dots (C_n \div L_n)$$

Where:

$E_m$  is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that substance specified in Subpart Z of 29 CFR Part 1910.

The value of  $E_m$  shall not exceed unity (1).

(ii) To illustrate the formula prescribed in paragraph (4)(b)(i) of this section, consider the following exposures:

Substance	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
B .....	..... 500 ppm	..... 1,000 ppm
C .....	..... 45 ppm	..... 200 ppm
D .....	..... 40 ppm	..... 200 ppm

Substituting in the formula, we have:

$$E_m = (500 \div 1000) + (45 \div 200) + (40 \div 200)$$

$$E_m = 0.500 + 0.225 + 0.200$$

$$E_m = 0.925$$

Since  $E_m$  is less than unity (1), the exposure combination is within acceptable limits.

(5) To achieve compliance with paragraphs (1) through (4) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with 1910.134.

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Abate	3383-96-8	—	10	
Acetaldehyde	75-07-0	100	180	
Acetic Acid	64-19-7	10	25	
Acetic anhydride	108-24-7	5	20	
Acetone	67-64-1	1,000	2,400	
Acetonitrile	75-05-8	40	70	
2-Acetylaminoflourine	53-96-3		(See 1910.1003)	
Acetylene	74-86-2	1,000	—	
Acetylene dichloride, see 1,2-Dichloro-ethylene				
Acetylene tetrabromide	79-27-6	1	14	
Acrolein	107-02-8	0.1	0.25	
Acrylamide	79-06-1	—	0.3	X
Acrylonitrile	107-13-1		(See 1910.1045)	X
Aldrin	309-00-2	—	0.25	X
Allyl alcohol	107-18-6	2	5	X
Allyl chloride	107-05-1	1	3	
Allyl glycidyl ether (AGE)	106-92-3	5 (C) 10	22 (C) 45	
Allyl propyl disulfide	2179-59-1	2	12	
alpha Alumina Total Dust Respirable Fraction	1344-28-1	— —	10 5	
Aluminum Metal Dust Total Dust Respirable Fraction	7429-90-5	— —	10 5	
Alundum (A1203)		—	10	
4-Aminodiphenyl	92-67-1		(See 1910.1003)	
2-Aminoethanol, see Ethanolamine				
2-Aminopyride	504-29-0	0.5	2	
Ammonia	7664-41-7	25	18	
Ammonium Chloride Fumes	12125-02-9	—	10	
Ammonium sulfamate Total Dust Respirable Fraction	7773-06-0	— —	10 5	
n-Amyl acetate	628-63-7	100	525	
sec-Amyl Acetate	626-38-0	125	650	
Aniline and homologs	62-53-3	5	19	X
Anisidine (o, p-isomers)	29191-52-4	0.1	0.5	X
Antimony & Compounds (as Sb)	7440-36-0	—	0.5	
ANTU (alpha naphthyl-thiourea)	86-88-4	—	0.3	
Arsenic Inorganic Compounds (as As)	7440-38-2		(See 1910.1018) 0.01	
Arsenic Organic Compounds (as As)	7440-38-2	—	0.5	
Arsine	7784-42-1	0.05	0.2	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Asbestos		(See 1910.1001 and 1926.1101)		
Asphalt (petroleum) Fumes	8052-42-4	—	5	
Azinphos-methyl	86-50-1	—	0.2	X
Barium (soluble compounds)	7440-39-3	—	0.5	
Barium Sulfate	7727-43-7	—	10	
Total Dust		—	5	
Respirable Fraction		—	5	
Benomyl	17804-35-2	—	10	
Total Dust		—	5	
Respirable Fraction		—	5	
Benzene	71-43-2		(See 1910.1028)	
See Oregon Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028 <sup>(d)</sup>				
Benidine	92-87-5		(See 1910.1003)	
p-Benzoquinone, see Quinone				
Benzoyl peroxide	94-36-0	—	5	
Benzyl chloride	100-44-7	1	5	
Beryllium and Beryllium compounds	7440-41-7		(See Oregon Table Z-2)	
Biphenyl, see Diphenyl				
Bismuth telluride (undoped)	1304-82-1	—	10	
Total Dust		—	5	
Respirable Fraction		—	5	
Bismuth telluride (Se-doped)		—	5	
Bisphenol A, see Diglycidyl ether				
Boron oxide	1303-86-2	—	10	
Boron tribromide	10294-33-4	1	10	
Boron trifluoride	7637-07-2	(C) 1	(C) 3	
Bromine	7726-95-6	0.1	0.7	
Bromine pentafluoride	7789-30-2	0.1	0.7	
Bromoform	75-25-2	0.5	5	X
Butadiene (1,3-Butadiene)	106-99-0	1 ppm/5 ppm STEL	(See 1910.1051; 1910.19(l))	
Butane	106-97-8	800	1,900	
Butanethiol, see Butyl mercaptan				
2-Butanone (Methyl Ethyl Ketone)	78-93-3	200	590	
2-Butoxyethanol (Butyl cellosolve)	111-76-2	50	240	X
Butyl acetate (n-Butyl acetate)	123-86-4	150	710	
sec-Butyl acetate	105-46-4	200	950	
tert-Butyl acetate	540-88-5	200	950	
n-Butyl alcohol	71-36-3	100	300	
sec-Butyl alcohol	78-92-2	150	450	
tert-Butyl alcohol	75-65-0	100	300	
Butyl lactate	138-22-7	1	5	
Butylamine	109-73-9	(C) 5	(C) 15	X

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
tert-Butyl chromate (as CrO <sub>3</sub> )	1189-85-1	(See 1926.126) <sup>(h)</sup>		
n-Butyl glycidyl ether (BGE)	2426-08-6	50	270	
Butyl mercaptan	109-79-5	0.5	1.5	
p-tert-Butyltoluene	98-51-1	10	60	
Cadmium dust and fume (as Cd)	7440-43-9	(See 1910.1027, 1926.1127 and Division 4) 0.005		
Calcium carbonate Total Dust Respirable Fraction	1317-65-3	— —	10 5	
Calcium hydroxide Total Dust Respirable Fraction	1305-62-0	— —	10 5	
Calcium oxide	1305-78-8	—	5	
Calcium silicate Total Dust Respirable Fraction	1344-95-2	— —	10 5	
Calcium sulfate Total Dust Respirable Fraction	7778-18-9	— —	10 5	
Camphor, synthetic	76-22-2	—	2	
Caprolactam (2-Oxonexa-methylenimine)	105-60-2	—	5	
Carbaryl (Sevin®)	63-25-2	—	5	
Carbon black	1333-86-4	—	3.5	
Carbon dioxide	124-38-9	5,000	9,000	
Carbon disulfide	75-15-0		(See Oregon Table Z-2)	
Carbon monoxide	630-08-0	50	55	
Carbon tetrachloride	56-23-5		(See Oregon Table Z-2)	
Cellulose Total Dust Respirable Fraction	9006-34-6	— —	10 5	
Chlordane	57-74-9	—	0.5	X
Chlorinated camphene	8001-35-2	—	0.5	X
Chlorinated diphenyl oxide	55720-99-5	—	0.5	
Chlorine	7782-50-5	(C) 1	(C) 3	
Chlorine dioxide	10049-04-4	0.1	0.3	
Chlorine trifluoride	7790-91-2	(C) 0.1	(C) 0.4	
Chloroacetaldehyde	107-20-0	(C) 1	(C) 3	
α-Chloroacetophenone (phenacyl chloride)	532-27-4	0.05	0.3	
Chlorobenzene	108-90-7	75	350	
o-Chlorobenzylidene malononitrile	2698-41-1	0.05	0.4	
Chlorobromomethane	74-97-5	200	1,050	
2-Chloro-1, 3-butadiene, see beta-Chloroprene				
Chlorodiphenyl (42% Chlorine)	53469-21-9	—	1	X
Chlorodiphenyl (54% Chlorine)	11097-69-1	—	0.5	X
1-Chloro, 2, 3-epoxypropane, see				

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Epichlorhydrin				
2-Chloroethanol, see Ethylene Chlorohydrin				
Chloroethylene, see Vinyl Chloride				
Chloroform (trichloromethane)	67-66-3	(C) 25	(C) 120	
bis-Chloromethyl ether	542-88-1		(See 1910.1003)	
Chloromethyl methyl ether	107-30-2		(See 1910.1003)	
1-Chloro-1-nitropropane	600-25-9	20	100	
Chloropicrin	76-06-2	0.1	0.7	
Beta-Chloroprene (2-chloro-1,3-butadiene)	126-99-8	25	90	X
2-Chloro-6-(trichloromethyl) pyridine	1929-82-4		10	
Total Dust		—	5	
Respirable Fraction		—	5	
Chromic acid and chromates (as CrO <sub>3</sub> )			(See Oregon Table Z-2)	
Chromium (II) compounds (as Cr)	7440-47-3	—	0.5	
Chromium (III) compounds (as Cr)	7440-47-3	—	0.5	
Chromium (VI) compounds		(See 1926.1126) <sup>(i)</sup>		
Chromium metal & insol. salts	7440-47-3	—	1	
Clopidol	2971-90-6			
Total Dust		—	10	
Respirable Fraction		—	5	
Coal Dust			(See Oregon Table Z-3)	
Coal tar pitch volatiles (Benzene soluble fraction) anthracene, BaP, phenanthracene, acridine, chrysene, pyrene	65966-93-2	—	0.2 (See 1910.1002)	
Cobalt metal, fume & dust	7440-48-4	—	0.1	
Coke oven emissions			(See 1910.1029)	
Copper fume	7440-50-8	—	0.1	
Dusts and Mists	7440-50-8	—	1	
Corundum (A1203)	1302-74-5	—	10	
Cotton dust			(See 1910.1043)	
Cotton dust (raw)		—	1 <sup>(e)</sup>	
Crag® herbicide (Sesone)	136-78-7			
Total Dust		—	10	
Respirable Fraction		—	5	
Cresol (all isomers)	1319-77-3	5	22	X
Crotonaldehyde	123-73-9/ 4170-30-3	2	6	
Cumene	98-82-8	50	245	X
Cyanide (as CN)		—	5	X
Cyanogen	460-19-5	10	—	
Cyclohexane	110-82-7	300	1,050	
Cyclohexanol	108-93-0	50	200	
Cyclohexanone	108-94-1	50	200	
Cyclohexene	110-83-8	300	1,015	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Cyclopentadiene	542-92-7	75	200	
2,4-D (Dichlorophenoxyacetic acid)	94-75-7	—	10	
DDT	50-29-3	—	1	X
DDVP, see Dichlorvos				
Decaborane	17702-41-9	0.05	0.3	X
Demeton® (Systox)	8065-48-3	—	0.1	X
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	123-42-2	50	240	
1, 2-Diaminoethane, see Ethylenediamine				
Diazinon	333-41-5	—	0.1	X
Diazomethane	334-88-3	0.2	0.4	
Diborane	19287-45-7	0.1	0.1	
Dibrom®	300-76-5	—	3	
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.001	(See 1910.1044)	
1,2-Dibromoethane, see Ethylene dibromide				
2-N-Dibutylaminoethanol	102-81-8	2	14	X
Dibutyl phosphate	107-66-4	1	5	
Dibutyl phthalate	84-74-2	—	5	
Dichloroacetylene	7572-29-4	(C) 0.1	(C) 0.4	
o-Dichlorobenzene	95-50-1	(C) 50	(C) 300	
p-Dichlorobenzene	106-46-7	75	450	
3,3-Dichlorobenzidine	91-94-1		(See 1910.1003)	X
Dichlorodifluoromethane	75-71-8	1,000	4,950	
1,3-Dichloro-5, 5-dimethyl hydantoin	118-52-5	—	0.2	
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	—	1	X
1, 1-Dichloroethane	75-34-3	100	400	
1, 2-Dichloroethane, see Ethylene dichloride				
1, 2-Dichlorethylene	540-59-0	200	790	
Dichloroethyl Ether	111-44-4	5 (C) 15	30 (C) 90	X X
Dichloromethane, see Methylenechloride				
Dichloromonofluoromethane	75-43-4	1,000	4,200	
1, 1-Dichloro-1-nitroethane	594-72-9	(C) 10	(C) 60	
1, 2-Dichloropropane, see Propylene dichloride				
Dichlorotetrafluoroethane	76-14-2	1,000	7,000	
Dichlorvos (DDVP)	62-73-7	0.1	1	X
Dicyclohexylmethane 4,4'-diisocyanate (hydrogenated MDI, see Oregon Table Z-2 (Diisocyanates))	5124-30-1			
Dicyclopentadienyl iron Total Dust Respirable Fraction	102-54-5	— —	10 5	
Dieldrin	60-57-1	—	0.25	X
Diethylamine	109-89-7	25	75	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
2-Diethylaminoethanol	100-37-8	10	50	X
Diethylene triamine	111-40-0	(C) 1	(C) 4	X
Diethylether, see Ethyl ether				
Difluorodibromomethane	75-61-6	100	860	
Diglycidyl ether (DGE)	2238-07-5	(C) 0.5	(C) 2.8	
Dihydroxybenzene, see Hydroquinone				
Diisobutyl ketone	108-83-8	25	150	
Diisopropylamine	108-18-9	5	20	X
Dimethoxymethane, see Methylal				
Dimethyl acetamide	127-19-5	10	35	X
Dimethylamine	124-40-3	10	18	
4-Dimethylaminoazobenzene	60-11-7		(See 1910.1003)	
Dimethylaminobenzene, see Xylidene				
Dimethylaniline (N,N-Dimethylaniline)	121-69-7	5	25	X
Dimethylbenzene, see Xylene				
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	300-76-5	—	3	
Dimethylformamide	68-12-2	10	30	X
2,6-Dimethylheptanone, see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	X
Dimethylphthalate	131-11-3	—	5	
Dimethyl sulfate	77-78-1	1	5	X
Dinitrobenzene (all isomers)	528-29-0/ 99-65-0/ 100-25-4			
Dinitro-o-cresol	534-52-1	—	0.2	X
Dinitrotoluene	25321-14-6	—	1.5	X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X
Diphenyl (Biphenyl)	92-52-4	0.2	1	
Diphenylamine	122-39-4	—	10	
Diphenylmethane diisocyanate (MDI), see Oregon Table Z-2 (Diisocyanates)				
Dipropylene glycol methyl ether	34590-94-8	100	600	X
Diquat	231-36-7	—	0.5	
Di-sec, octyl phthalate (Di-2-ethyl-hexyl-phthalate)	117-81-7	—	5	
Emery	12415-34-8			
Total Dust		—	10	
Respirable Fraction		—	5	
Endosulfan (Thiodan®)	115-29-7	—	0.1	X
Endrin	72-20-8	—	0.1	X
Epichlorohydrin	106-89-8	5	19	X
EPN	2104-64-5	—	0.5	X
1,2-Epoxypropane, see Propylene oxide				

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
2,3-Epoxy-1-propanol, see Glycidol				
Ethane	74-84-0	1,000	—	
Ethanethiol, see Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	
2-Ethoxyethanol (Cellosolve)	110-80-5	100	370	
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	X
Ethyl acetate	141-78-6	400	1,400	
Ethyl acrylate	140-88-5	25	100	X
Ethyl alcohol (ethanol)	64-17-5	1,000	1,900	
Ethylamine	75-04-7	10	18	
Ethyl amyl ketone (5-methyl-3-heptanone)	541-85-5	25	130	
Ethyl benzene	100-41-4	100	435	
Ethyl bromide	74-96-4	200	890	
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	
Ethyl chloride	75-00-3	1,000	2,600	
Ethyl ether	60-29-7	400	1,200	
Ethyl formate	109-94-4	100	300	
Ethyl mercaptan	75-08-1	0.5 (C) 10	1 (C) 25	
Ethyl silicate	78-10-4	100	850	
Ethylene	74-85-1	1,000	—	
Ethylene chlorohydrin	107-07-3	5	16	X
Ethylenediamine	107-15-3	10	25	
Ethylene dibromide	106-93-4		(See Oregon Table Z-2)	
Ethylene dichloride	107-06-2		(See Oregon Table Z-2)	
Ethylene glycol particulate		—	10	
Ethylene glycol, Vapor	107-21-1	100	260	
Ethylene glycol dinitrate	628-96-6	(C) 0.2	(C) 1	X
Ethylene glycol methyl acetate (Methyl cellosolve acetate) (2-Methoxy-ethyl acetate)	110-49-6	25	120	
Ethylenimine	151-56-4		(See 1910.1003)	
Ethylene oxide	75-21-8		(See 1910.1047)	
Ethylidene chloride, see 1,1-Dichloroethane				
N-Ethylmorpholine	100-74-3	20	94	X
Ferbam	14484-64-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Ferrovandium dust	12604-58-9	—	1	
Fibrous glass, see Glass, Fibrous				
Fluorides (As F)		—	2.5 (See Oregon Table Z-2)	
Fluorine	7782-41-4	0.1	0.2	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Fluorotrichloromethane (Trichlorofluoromethane)	75-69-4	1,000	5,600	
Formaldehyde	50-00-0	0.75	(See 1910.1048)	
Formic acid	64-18-6	5	9	
Furfural	98-01-1	5	20	X
Furfuryl alcohol	98-00-0	5	20	
Gasoline	8006-61-9	—	<sup>(g)</sup>	
Germanium tetrahydride	7782-65-2	0.2	0.6	
Glass, Fibrous or dust		—	10	
Glycerin (mist)	56-81-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Glycidol	556-52-5	50	150	
Glycol monoethyl ether, see 2-Ethoxyethanol				
Grain dust (oat, wheat, barley)		—	10	
Graphite natural, respirable	7782-42-5		(See Oregon Table Z-3)	
Graphite (Synthetic)	7782-42-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Guthion®, see Azinphosmethyl				
Gypsum	13397-24-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Hafnium	7440-58-6	—	0.5	
Heptachlor	76-44-8	—	0.5	X
Heptane (n-heptane)	142-82-5	500	2,000	
Hexachlorocyclopentadiene	77-47-4	0.1	1	
Hexachloroethane	67-72-1	1	10	X
Hexachloronaphthalene	1335-87-1	—	0.2	X
Hexafluoroacetone	684-16-2	0.1	0.7	X
Hexamethylene diisocyanate (HDI), see Oregon Table Z-2 (Diisocyanates)	822-06-01			
1,6 Hexamethylene diisocyanate Based Adduct, see Oregon Table Z-2 (Diisocyanates)				
Hexane (n-hexane)	110-54-3	500	1,800	
2-Hexanone	591-78-6	100	410	
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	
sec-Hexyl acetate	108-84-9	50	300	
Hydrazine	302-01-2	1	1.3	X
Hydrogen	1333-74-0	1,000	—	
Hydrogen bromide	10035-10-6	3	10	
Hydrogen chloride	7647-01-0	(C) 5	(C) 7	
Hydrogen cyanide	74-90-8	10	11	X
Hydrogen fluoride (as F)	7664-39-3		(See Oregon Table Z-2)	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Hydrogen peroxide	7722-84-1	1	1.4	
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	
Hydrogen sulfide	7783-06-4		(See Oregon Table Z-2)	
Hydroquinone	123-31-9	—	2	
Indene	95-13-6	10	45	
Indium and compounds (as In)	7440-74-6	—	0.1	
Iodine	7553-56-2	(C) 0.1	(C) 1	
Iron oxide fume	1309-37-1	—	10	
Iron pentacarbonyl	13463-40-6	0.1	.23	
Iron salts, soluble, as Fe		—	1	
Isoamyl acetate	123-92-2	100	525	
Isoamyl alcohol (primary and secondary)	123-51-3	100	360	
Isobutyl acetate	110-19-0	150	700	
Isobutyl alcohol	78-83-1	100	300	
Isophorone	78-59-1	10	55	
Isophorone diisocyanate (IPDI), see Oregon Table Z-2 (Diisocyanates)	4098-71-9			
Isopropyl acetate	108-21-4	250	950	
Isopropyl alcohol	67-63-0	400	980	
Isopropylamine	75-31-0	5	12	
Isopropyl ether	108-20-3	250	1,050	
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	
Kaolin	1332-58-7			
Total Dust		—	10	
Respirable Fraction		—	5	
Ketene	463-51-4	0.5	0.9	
Lead, inorganic (as Pb)	7439-92-1	(See 1910.1025 & 1926.62)		
Lead arsenate	7784-40-9	(See 1910.1018)	0.01	
Limestone	1317-65-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Lindane	58-89-9	—	0.5	X
Lithium hydride	7580-67-8	—	0.025	
L.P.G. (Liquified petroleum gas)	68476-85-7	1,000	1,800	
Magnesite	546-93-0			
Total Dust		—	10	
Respirable Fraction		—	5	
Magnesium oxide fume	1309-48-4			
Total Dust		—	10	
Respirable Fraction		—	5	
Malathion	121-75-5	—	10	X
Maleic anhydride	108-31-6	0.25	1	
Manganese Compounds (as Mn)	7439-96-5	—	(C) 5	
Manganese fume (as Mn)	7439-96-5	—	(C) 5	
Marble	1317-65-3			

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Total Dust		—	10	
Respirable Fraction		—	5	
Mercury (aryl, inorganic, organo, and vapor) (as Hg)	7439-97-6		(See Oregon Table Z-2)	
Mesityl oxide	141-79-7	25	100	
Methane	74-82-8	1,000	—	
Methanethiol, see Methyl mercaptan				
Methoxychlor	72-43-5			
Total Dust		—	10	
Respirable Fraction		—	5	
2-Methoxyethanol (Methyl Cellosolve)	109-86-4	25	80	X
2-Methoxyethyl acetate (Methyl cellosolve acetate)	110-49-6	25	120	X
Methyl acetate	79-20-9	200	610	
Methyl acetylene (propyne)	74-99-7	1,000	1,650	
Methyl acetylene-propadiene mixture (MAPP)		1,000	1,800	
Methyl acrylate	96-33-3	10	35	X
Methylacrylonitrile	126-98-7	1	3	X
Methylal (dimethoxy-methane)	109-87-5	1,000	3,100	
Methyl alcohol (methanol)	67-56-1	200	260	
Methylamine	74-89-5	10	12	
Methyl amyl alcohol, see Methyl isobutyl carbinol				
Methyl (n-amyl) ketone	110-43-0	100	465	
Methyl bromide	74-83-9	15 (C) 20	60 (C) 80	X
Methyl butyl ketone, see 2-Hexanone				
Methyl cellosolve, see 2 Methoxy ethanol				X
Methyl cellosolve acetate (Ethylene glycol monomethyl ether acetate)	110-49-6	25	120	X
Methyl Chloride	74-87-3		(See Oregon Table Z-2)	
Methyl Chloroform (1,1,1-Trichloroethane)	71-55-6	350	1,900	
Methyl Chloromethyl ether			(See 1910.1003)	
Methyl 2-cyanoacrylate	137-05-3	2	8	
Methylcyclohexane	108-87-2	500	2,000	
Methycyclohexanol	25639-42-3	50	235	
o-Methylcyclohexanone	583-60-8	50	230	X
2-Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3	0.1	0.2	X
Methyl demeton	8022-00-2	—	0.5	X
Methyl ethyl ketone (MEK), see 2-Butanone				
Methyl formate	107-31-3	100	250	
Methyl iodide	74-88-4	5	28	X
Methyl isoamyl ketone	110-12-3	100	475	
Methyl isobutyl carbinol	108-11-2	25	100	X

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Methyl isobutyl ketone, see Hexone				
Methyl isocyanate	624-83-9	0.02	0.05	X
Methyl mercaptan	74-93-1	0.5 (C) 10	1 (C) 20	
Methyl methacrylate	80-62-6	100	410	
Methyl parathion	298-00-0	—	0.2	X
Methyl propyl ketone, see 2-Pentanone				
Methyl silicate	681-84-5	(C) 5	(C) 30	
a-Methyl styrene	98-83-9	(C) 100	(C) 480	
Methylene bisphenyl isocyanate (MDI)	101-68-8	(See Oregon Table Z-2 (diisocyanates))		
Methylenedianiline (MDA)		(See 1910.1050 & 1926.60) 0.01		
Methylene Chloride	75-09-2	25	(See 1910.1052)	
Mineral Wool Fiber		—	10	
MOCA	101-14-4		(See 437-002-0346)	
Molybdenum (soluble compounds) (insoluble compounds)	7439-98-7	— —	5 10	
Monomethyl aniline	100-61-8	2	9	X
Monomethyl hydrazine	60-34-4	(C) 0.2	(C) 0.35	X
Morpholine	110-91-8	20	70	X
Naphtha (coal tar)	8030-30-6	100	400	
Naphthalene	91-20-3	10	50	
Naphthalene diisocyanate (NDI), see Oregon Table Z-2 (Diisocyanates)	3173-72-6			
Alpha naphthylamine	134-32-7		(See 1910.1003)	
B-Naphthylamine	91-59-8		(See 1910.1003)	
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	
Nickel, metal and insoluble compounds, as Ni	7440-02-0	—	1	
Nickel, soluble compounds, (as Ni)	7440-02-0	—	1	
Nicotine	54-11-5	0.075	0.5	X
Nitric acid	7697-37-2	2	5	
Nitric oxide	10102-43-9	25	30	
p-Nitroaniline	100-01-6	1	6	
Nitrobenzene	98-95-3	1	5	X
4-Nitrodiphenyl	92-93-3		(See 1910.1003)	
p-Nitrochlorobenzene	100-00-5	—	1	X
Nitroethane	79-24-3	100	310	
Nitrogen dioxide	10102-44-0	(C) 5	(C) 9	
Nitrogen trifluoride	7783-54-2	10	29	
Nitroglycerin	55-63-0	(C) 0.2	(C) 2	X
Nitromethane	75-52-5	100	250	
1-Nitropropane	108-03-2	25	90	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
2-Nitropropane	79-46-9	25	90	
N-Nitrosodimethylamine			(See 1910.1003)	
Nitrotoluene (all isomers)	88-72-2/ 99-08-1/ 99-99-0	5	30	X
Nitrotrichloromethane, see Chloropicrin				
Nitrous oxide	10024-97-2	50	90	
Octachloronaphthalene	2234-13-1	—	0.1	X
Octane	111-65-9	400	1,900	
Oil mist (mineral)	8012-95-1	—	5	
Oil mist, vapor		—	<sup>(g)</sup>	
Osmium tetroxide (as Os)	20816-12-0		0.002	
Oxalic acid	144-62-7	—	1	
Oxygen difluoride	7783-41-7	0.05	0.1	
Ozone	10028-15-6	0.1	0.2	
Parafin wax fume	8002-74-2	—	1	
Paraquat respirable dust	4685-14-7/ 1910-42-5/ 2074-50-2	—	0.5	X
Parathion	56-38-2	—	0.1	X
Particulates not otherwise regulated (PNOR) <sup>(h)</sup>				
Total Dust		—	10	
Respirable Fraction		—	5	
Pentaborane	19624-22-7	0.005	0.01	
Pentachloronaphthalene	1321-64-8	—	0.5	X
Pentachlorophenol	87-86-5	—	0.5	X
Pentaerythritol	115-77-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Pentane	109-66-0	500	1,500	
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700	
Perchloroethylene (tetrachloroethylene)	127-18-4		(See Oregon Table Z-2)	
Perchloromethyl mercaptan	594-42-3	0.1	0.8	
Perchloryl fluoride	7616-94-6	3	13.5	
Perlite	93763-70-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Petroleum distillates (naphtha) (Rubber Solvent)		500	2,000 <sup>(g)</sup>	
Phenol	108-95-2	5	19	X
Phenothiazine	92-84-2	—	5	X
p-Phenylene diamine	106-50-3	—	0.1	X
Phenyl ether (vapor)	101-84-8	1	7	
Phenyl ether - biphenyl mixture (vapor)	8004-13-5	1	7	
Phenylethylene, see Styrene				

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Phenyl glycidyl ether (PGE)	122-60-1	10	60	
Phenyldiazine	100-63-0	5	22	X
Phenylphosphine	638-21-1	(C) 0.05	(C) 0.25	
Phosdrin (Mevinphos®)	7786-34-7		0.1	X
Phosgene (carbonyl chloride)	75-44-5	0.1	0.4	
Phosphine	7803-51-2	0.3	0.4	
Phosphoric acid	7664-38-2	—	1	
Phosphorus (yellow)	7723-14-0	—	0.1	
Phosphorus pentachloride	10026-13-8	—	1	
Phosphorus pentasulfide	1314-80-3	—	1	
Phosphorus trichloride	7719-12-2	0.5	3	
Phthalic anhydride	85-44-9	2	12	
Picloram	1918-02-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Picric acid	88-89-1	—	0.1	X
Pindone (2-Pivalyl-1, 3-indandione)	83-26-1	—	0.1	
Plaster of Paris	26499-65-0			
Total Dust		—	10	
Respirable Fraction		—	5	
Platinum (Soluble Salts) as Pt	7440-06-4	—	0.002	
Polychlorobiphenyls, see Chlorodiphenyls				
Portland Cement	65997-15-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Propane	74-98-6	1,000	1,800	
Beta-Propiolactone	57-57-8		(See 1910.1003)	
Propargyl alcohol	107-19-7	1	—	X
n-Propyl acetate	109-60-4	200	840	
n-Propyl alcohol	71-23-8	200	500	
n-Propyl nitrate	627-13-4	25	110	
Propylene dichloride	78-87-5	75	350	
Propylene glycol monomethyl ether	107-98-2	100	360	
Propylene imine	75-55-8	2	5	X
Propylene oxide	75-56-9	100	240	
Propyne, see Methyl acetylene				
Pyrethrum	8003-34-7	—	5	
Pyridine	110-86-1	5	15	
Quinone	106-51-4	0.1	0.4	
RDX (Cyclonite)	121-82-4	—	1.5	X
Rhodium, Metal fume and dusts, as Rh	7440-16-6	—	0.1	
Soluble salts	7440-16-6	—	0.001	
Ronnel	299-84-3	—	10	
Rosin core solder pyrolysis Products (as Formaldehyde)		—	0.1	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Rotenone	83-79-4	—	5	
Rouge				
Total Dust		—	10	
Respirable Fraction		—	5	
Selenium compounds (as Se)	7782-49-2	—	0.2	
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.4	
Silica, <u>crystalline, respirable dust(j)</u>			{(See Oregon Table Z-3)} (See Division 2/Z Silica)	
<u>Cristobalite</u>	<u>14464-46-1</u>	—		
<u>Quartz</u>	<u>14808-60-7</u>			
<u>Tripoli (as quartz)</u>	<u>1317-95-9</u>			
<u>Tridamite</u>	<u>15468-32-3</u>			
Silicon	7440-21-3			
Total Dust		—	10	
Respirable Fraction		—	5	
Silicon carbide	409-21-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Silver, metal and soluble compounds (as Ag)	7440-22-4	—	0.01	
Sodium fluoroacetate	62-74-8	—	0.05	X
Sodium hydroxide	1310-73-2	—	2	
Starch	9005-25-8			
Total Dust		—	10	
Respirable Fraction		—	5	
Stibine	7803-52-3	0.1	0.5	
Stoddard solvent	8052-41-3	200	1,150	
Strychnine	57-24-9	—	0.15	
Styrene	100-42-5		(See Oregon Table Z-2)	
Subtilisins (Proteolytic enzymes) (as 100% pure crystalline enzyme)	1395-21-7	—	(C) 0.0003	
Sucrose	57-50-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Sulfur dioxide	7446-09-5	5	13	
Sulfur hexafluoride	2551-62-4	1,000	6,000	
Sulfuric acid	7664-93-9	—	1	
Sulfur monochloride	10025-67-9	1	6	
Sulfur pentafluoride	5714-22-7	0.025	0.25	
Sulfur tetrafluoride	7783-60-0	0.1	0.4	
Sulfuryl fluoride	2699-79-8	5	20	
Systox, see Demeton®				
2, 4, 5-T	93-76-5	—	10	
Tantalum, metal and oxide dust	7440-25-7	—	5	
TEDP (Sulfotepp)	3689-24-5	—	0.2	X
Tellurium and compounds (as Te)	13494-80-9	—	0.1	
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2	
Temephos	3383-96-8			
Total Dust		—	10	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Respirable Fraction		—	5	
TEPP (Tetraethyl pyrophosphate)	107-49-3	0.004	0.05	X
Terphenyls	26140-60-3	(C) 1	(C) 9	
1, 1, 1, 2-Tetrachloro-2,2-difluoroethane	76-11-9	500	4,170	
1, 1, 2, 2-Tetrachloro-1,2-difluoroethane	76-12-0	500	4,170	
1, 1, 2, 2-Tetrachloroethane	79-34-5	5	35	X
Tetrachloroethylene, see Perchloroethylene				
Tetrachloronaphthalene	1335-88-2	—	2	X
Tetrachloromethane, see Carbon tetrachloride				
Tetraethyl lead (as Pb)	78-00-2	—	0.075	X
Tetrahydrofuran	109-99-9	200	590	
Tetramethyl lead (as Pb)	75-74-1	—	0.075	X
Tetramethyl succinonitrile	3333-52-6	0.5	3	X
Tetranitromethane	509-14-8	1	8	
Tetryl (2, 4, 6-trinitro-phenyl-methyl-nitramine)	479-45-8	—	1.5	X
Thallium (soluble compounds) as Tl	7440-28-0	—	0.1	X
4,4'-Thiobis (6-tert, Butyl-m-cresol)	96-69-5			
Total Dust		—	10	
Respirable Fraction		—	5	
Thiram	137-26-8		(See 437-002-0373) 0.15	
Tin (inorganic compounds, except oxides) as Sn	7440-31-5	—	2	
Tin (organic compounds)	7440-31-5	—	0.1	
Tin oxide	1332-29-2			
Total Dust		—	10	
Respirable Fraction		—	5	
Titanium dioxide	13463-67-7	—	10	
Toluene (toluol)	108-88-3		(See Oregon Table Z-2)	
Toluene diisocyanate (TDI), See Oregon Table Z-2 (Diisocyanates)	584-84-9			
o-Toluidine	95-53-4	5	22	X
Toxaphene, see Chlorinated camphene				
Tributyl phosphate	126-73-8	—	5	
1, 1, 1-Trichloroethane, see Methyl chloroform				
1, 1, 2-Trichloroethane	79-00-5	10	45	X
Trichloroethylene	79-01-6		(See Oregon Table Z-2)	
Trichloromethane, see Chloroform				
Trichloronaphthalene	1321-65-9	—	5	X
1, 2, 3-Trichloropropane	96-18-4	50	300	
1, 1, 2-Trichloro 1, 2, 2-trifluoroethane	76-13-1	1,000	7,600	
Triethylamine	121-44-8	25	100	

OREGON TABLE Z-1 - ADOPTED VALUES (IN ALPHABETICAL ORDER)				
Substance	CAS No. <sup>(c)</sup>	ppm <sup>(a)</sup>	mg/m <sup>3</sup> <sup>(b)</sup>	Skin
Trifluorobromomethane	75-63-8	1,000	6,100	
Trimethyl benzene	25551-13-7	25	120	
2, 4, 6-Trinitrophenol, see Picric acid				
2, 4, 6-Trinitrophenylmethyl-nitramine, see Tetryl				
Trinitrotoluene (TNT)	118-96-7		1.5	X
Triorthocresyl phosphate	78-30-8	—	0.1	
Triphenyl phosphate	115-86-6	—	3	
Tungsten & compounds, as W	7440-33-7			
Soluble		—	1	
Insoluble		—	5	
Turpentine	8006-64-2	100	560	
Uranium (as U)	7440-61-1			
Soluble compounds		—	0.05	
Insoluble compounds		—	0.2	
Vanadium respirable dust				
(as V <sub>2</sub> O <sub>5</sub> )	1314-62-1	—	(C) 0.5	
Fume (as V <sub>2</sub> O <sub>5</sub> )	1314-62-1	—	(C) 0.05	
Vegetable oil mist				
Total Dust		—	10	
Respirable Fraction		—	5	
Vinyl acetate	108-05-4	10	30	
Vinyl benzene, see Styrene				
Vinyl bromide	593-60-2	250	1,100	
Vinyl chloride	75-01-4		(See 1910.1017)	
Vinyl cyanide, see Acrylonitrile				
Vinyl toluene	25013-15-4	100	480	
Warfarin	81-81-2	—	0.1	
Wood Dust (non-allergenic)		—	10	
Xylene (o-, m-, p-isomers)	1330-20-7	100	435	
Xylidine	1300-73-8	5	25	X
Yttrim	7440-65-5	—	1	
Zinc chloride fume	7646-85-7	—	1	
Zinc oxide	1314-13-2			
Total Dust		—	10	
Respirable Fraction		—	5	

Zinc oxide fume	1314-13-2	—	5	
Zinc stearate	557-05-1			
Total Dust		—	10	
Respirable Fraction		—	5	
Zirconium compounds (as Zr)	7440-67-7	—	5	

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal Limits.

NOTE: PNOR means "particles not otherwise regulated."

FOOTNOTES:

- (a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.
- (b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.
- (c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound, measured as the metal, the CAS number for the metal is given – not CAS numbers for the individual compounds.
- (d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Oregon Table Z-2 apply. See 1910.1028 for specific circumstances.
- (e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.
- (f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Oregon Table Z-3.
- (g) Usually a mixture, in general the aromatic hydrocarbon content will determine which TWA applies.
- (h) If the exposure limit in 1926.1126 is stayed or is otherwise not in effect, the exposure limit is a ceiling of 0.1 mg/m<sup>3</sup>.
- (i) If the exposure limit in 1926.1126 is stayed or is otherwise not in effect, the exposure limit is 0.1 mg/m<sup>3</sup> (as CrO<sub>3</sub>) as an 8-hour TWA.

**(j) See Table Z-3 for the exposure limit for any operations or sectors where the exposure limit in Division 2/Z-Silica is stayed or is otherwise not in effect.**

**OREGON TABLE Z-2**

Substance	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-Hour Shift		Skin
			Concentration	Maximum Duration	
Benzene (a) (Z87.4-1969)	10 ppm	25 ppm	50 ppm	10 min.	
Beryllium, and beryllium compounds (Z37.29-1970)	2 µg/m <sup>3</sup>	5 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>	30 min.	
Cadmium fume (b) (Z37.5-1970)	0.1 mg/m <sup>3</sup>	0.3 mg/m <sup>3</sup>			
Cadmium dust (b) (Z37.5-1970)	0.2 mg/m <sup>3</sup>	0.6 mg/m <sup>3</sup>			
Carbon disulfide (Z37.3-1968)	20 ppm	30 ppm	100 ppm	30 min.	X
Carbon tetrachloride (Z37.17-1967)	10 ppm	25 ppm	200 ppm	5 min. in any 4 hrs	
Chromic acid and chromates (Z37.7-1971) (as CrO <sub>3</sub> ) <sup>c</sup>		0.1 mg/m <sup>3</sup>			
Ethylene dibromide (Z37.31-1970)	20 ppm	30 ppm	50 ppm	5 min.	X
Ethylene dichloride (Z37.21-1969)	50 ppm	100 ppm	200 ppm	5 min. in any 3 hrs	
Fluoride as dust (Z37.28-1969)	2.5 mg/m <sup>3</sup>				
Formaldehyde (see 1910.1048)					
Hydrogen fluoride (Z37.28-1969)	3 ppm				
Hydrogen sulfide (Z37.2-1966)		20 ppm	50 ppm	10 min. once, only if no other measureable exposure occurs	
Mercury (Z37.8-1971)	0.05 mg/m <sup>3</sup>	0.1 mg/m <sup>3</sup>			X
Methyl chloride (Z37.18-1969)	100 ppm	200 ppm	300 ppm	5 min. in any 3 hrs	
Organo (alkyl) mercury (Z37.30-1969)	0.001 mg/m <sup>3</sup>	0.01 mg/m <sup>3</sup>			X
Styrene (Z37.15-1969)	100 ppm	200 ppm	600 ppm	5 min. in any 3 hrs	
Tetrachloroethylene (Z37.22-1967)	100 ppm	200 ppm	300 ppm	5 min. in any 3 hrs	
Toluene (Z37.12-1967)	100 ppm	300 ppm	500 ppm	10 min.	
Trichloroethylene (Z37.19-1967)	100 ppm	200 ppm	300 ppm	5 min. in any 2 hrs	

OREGON TABLE Z-2 (Continued)				
Substance	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-Hour Shift	
			Concentration	Maximum Duration
Diisocyanates				
Dicyclohexylmethane 4,4'-diisocyanate (hydrogenated MDI)	.055 mg/m <sup>3</sup> .005 ppm	.210 mg/m <sup>3</sup> .02 ppm		
Diphenylmethane diisocyanate (MDI)	.050 mg/m <sup>3</sup> .005 ppm	.200 mg/m <sup>3</sup> .02 ppm		
Hexamethylene diisocyanate (HDI)	.035 mg/m <sup>3</sup> .005 ppm	.140 mg/m <sup>3</sup> .02 ppm		
1,6 Hexamethylene diisocyanated Based Adduct (includes HDI-Biuret trimer, and other polymeric forms of HDI, including isocyanurates)	0.5 mg/m <sup>3</sup>	1.0 mg/m <sup>3</sup>		
Isophorone diisocyanate (IPDI)	.045 mg/m <sup>3</sup> .005 ppm	.180 mg/m <sup>3</sup> .02 ppm		
Napthalene diisocyanate (NDI)	.040 mg/m <sup>3</sup> .005 ppm	.170 mg/m <sup>3</sup> .02 ppm		
Toluene diisocyanate (TDI)	.035 mg/m <sup>3</sup> .005 ppm	.140 mg/m <sup>3</sup> .02 ppm		

NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal limits.

FOOTNOTES:

(d) This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the Benzene Standard, 1910.1028.

(e) This standard applies to any operations on sectors for which the Cadmium Standard, 1910.1027, is stayed or otherwise not in effect.

(f) This standard applies to any operations or sectors for which the exposure limit in the Chromium (VI) standard, 1926.1126, is stayed or is otherwise not in effect.

OREGON TABLE Z-3 – MINERAL DUSTS		
Substance	mppcf <sup>(a)</sup>	mg/m <sup>3</sup>
<b>Silica:</b>		
<b>Crystalline</b>		
Quartz (respirable) .....		0.1 mg/m <sup>3</sup>
Quartz (total dust) .....		30 mg/m <sup>3</sup>
Cristobalite (respirable)		%SiO <sub>2</sub> + 2
Tridymite: Use 1/2 the value calculated from the formulae for quartz.		0.05 mg/m <sup>3</sup>
Amorphous, including natural diatomaceous earth .....	20	80 mg/m <sup>3</sup>
		%SiO <sub>2</sub>
<b>Silicates (less than 1% crystalline silica):</b>		
Mica .....	20	
Soapstone .....	20	
Talc (not containing asbestos) .....	20 <sup>(c)</sup>	
Talc (containing asbestos) Use asbestos limit.	20	
Tremolite, asbestiform (see OAR 437, Div. 2/Z, 1910.1001, Asbestos).		
Portland cement .....	50	
Graphite (Natural) .....		5 mg/m <sup>3</sup>
<b>Coal Dust:</b>		
Respirable fraction less than 5% SiO <sub>2</sub> .....		2.4 mg/m <sup>3</sup> <sup>(e)</sup> <sup>(f)</sup>
<b>Coal Dust:</b>		
Respirable fraction greater than 5% SiO <sub>2</sub> .....		0.1 mg/m <sup>3</sup> <sup>(e)</sup>
<b>Inert or Nuisance Dust: <sup>(d)</sup></b>		
Respirable fraction .....		5 mg/m <sup>3</sup>
Total dust .....		10 mg/m <sup>3</sup>
NOTE: Bold print identifies substances for which the Oregon Permissible Exposure Limits (PELs) are different than the federal limits.		
NOTE: Conversion factors - mppcf x 35.3 = million particles per cubic meter = particles per c.c.		
FOOTNOTES:		
(a) Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.		
(b) The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.		
(c) Containing less than 1% quartz; if 1% quartz or more, use quartz limit.		
(d) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by this limit, which is the same as the Particulates Not Otherwise Regulated (PNOR) limit in Oregon Table Z-1.		
(e) Silica sampling methods must conform to OSHA or NIOSH sampling methods for respirable quartz silica.		
(f) The measurements under this note refer to the use of an AEC (now NRC) instrument. If the respirable fraction of coal dust is determined with a MRE the figure corresponding to that of 2.4 mg/m <sup>3</sup> in the table for coal dust is 4.5 mg/m <sup>3</sup> .		

Stat. Auth.: ORS 654.025(2) and 656.726(4).  
Stats. Implemented: ORS 654.001 through 654.295.  
Hist: WCB Admin. Order, Safety 3-1975, f. 10/6/75, ef. 11/1/75.  
WCB Admin. Order, Safety 6-1978, f. 7/5/78, ef. 7/15/78.  
WCD Admin. Order, Safety 12-1979, f. 12/21/79, ef. 3/1/80.  
WCB Admin. Order, Safety 2-1980, f. 4/17/80, ef. 8/1/80.  
WCB Admin. Order, Safety 1-1982, f. 3/4/82, ef. 5/5/82.  
WCB Admin. Order, Safety 6-1983, f. 5/25/83, ef. 5/25/83.  
WCB Admin. Order, Safety 21-1984, f. 12/20/84, ef. 1/1/85.  
WCD Admin. Order, Safety 4-1986, f. 5/5/86, ef. 5/5/86.  
WCB Admin. Order, Safety 5-1986, f. 5/20/86, ef. 6/13/86.  
APD Admin. Order 13-1989, f. 7/17/89, ef. 7/17/89.  
OR-OSHA Admin. Order 6-1997, f. 5/2/97, ef. 5/2/97.  
OR-OSHA Admin. Order 6-2006, f. 8/30/06, ef. 8/30/06.  
OR-OSHA Admin. Order 6-2008, f. 5/13/08, ef. 7/1/08.  
**OR-OSHA Admin. Order X-2016, f. XX/XX/16, ef. XX/XX/16.**

## DIVISION 5, MARITIME ACTIVITIES

### Part 1915 – Occupational Safety and Health Standards For Shipyard Employment

437-005-0001

Adoption by Reference. In addition to, and not in lieu of, any other safety and health codes contained in OAR Chapter 437, the Department adopts by reference the following federal regulations printed as part of the Code of Federal Regulations, 29 CFR 1915, in the Federal Register:

(1) Subdivision A

(a) 29 CFR 1915.1. Purpose and authority, published 4/20/82, Federal Register (FR) vol. 47, p. 16984.

(b) 29 CFR 1915.2. Scope and application, published 4/20/82, FR vol. 47, p. 16984.

(c) 29 CFR 1915.3. Responsibility, published 4/20/82, FR vol. 47, p. 16984.

(d) 29 CFR 1915.4. Definitions, published 7/3/02, FR vol. 67, no. 128, p. 44541.

(e) 29 CFR 1915.5. Incorporation by reference, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.

(f) 29 CFR 1915.6. Commercial diving operations, published 4/20/82, FR vol. 47, p. 16984.

(g) 29 CFR 1915.7. Competent person, published 7/25/94, FR vol. 59, p. 37856.

(h) 29 CFR 1915.9. Compliance duties owed to each employee, published 12/12/08, FR vol. 73, no. 240, pp. 75568-75589.

(2) Subdivision B

(a) 29 CFR 1915.11. Scope, application and definitions applicable to this Subpart, published 7/25/94, FR vol. 59, p. 37857.

(b) 29 CFR 1915.12. Precautions before entering confined and enclosed spaces and other dangerous atmospheres, published 3/16/95, FR vol. 60, no. 51, p. 14218.

(c) 29 CFR 1915.13. Cleaning and other cold work, published 7/25/94, FR vol. 59, p. 37859.

(d) 29 CFR 1915.14. Hot work, published 7/3/02, FR vol. 67, no. 128, p. 44541.

(e) 29 CFR 1915.15. Maintenance of safe conditions, published 6/22/12, FR vol. 77, no. 121, p. 37587.

(f) 29 CFR 1915.16. Warning signs and labels, published 7/25/94, FR vol. 59, p. 37861.

Appendix A to Subpart B published 6/8/11, Federal Register, vol. 76, no. 110, p. 33590.

Appendix B to Subpart B published 7/25/94, FR vol. 59, p. 37816.

(3) Subdivision C

(a) 29 CFR 1915.31. Scope & application of subdivision, published 4/20/82, FR vol. 47, p. 16984.

(b) 29 CFR 1915.32. Toxic cleaning solvents, published 5/24/96, FR vol. 61, no. 102, p. 26351.

(c) 29 CFR 1915.33. Chemical paint & preservative remover, published 5/24/96, FR vol. 61, no. 102, p. 26351.

(d) 29 CFR 1915.34. Mechanical paint removers, published 5/24/96, FR vol. 61, no. 102, p. 26351.

(e) 29 CFR 1915.35. Painting, published 7/3/02, FR vol. 67, no. 128, p. 44541.

(f) 29 CFR 1915.36. Flammable liquids, published 4/20/82, FR vol. 47, p. 16984.

(4) Subdivision D

(a) 29 CFR 1915.51. Ventilation & protection in welding, cutting and heating, published 7/3/02, FR vol. 67, no. 128, p. 44541.

(b) 29 CFR 1915.52. Fire prevention. REMOVED 9/15/04, FR vol. 69, p. 55667.

- (c) 29 CFR 1915.53. Welding, cutting and heating of hollow metal containers & structure not covered by 1915.12, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (d) 29 CFR 1915.55. Gas welding & cutting, published 4/20/82, FR vol. 47, p. 16984.
- (e) 29 CFR 1915.56. Arc welding and cutting, published 4/20/82, FR vol. 47, p. 16984.
- (f) 29 CFR 1915.57. Uses of fissionable material in ship repairing and shipbuilding, published 4/20/82, FR vol. 47, p. 16984.
- (5) Subdivision E
  - (a) 29 CFR 1915.71. Scaffolds or staging, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (b) 29 CFR 1915.72. Ladders, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (c) 29 CFR 1915.73. Guarding of deck openings and edges, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (d) 29 CFR 1915.74. Access to vessels, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (e) 29 CFR 1915.75. Access to and guarding of dry docks and marine railways, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (f) 29 CFR 1915.76. Access to cargo spaces and confined spaces, published 4/20/82, FR vol. 47, p. 16984.
  - (g) 29 CFR 1915.77. Working surfaces, published amended 7/3/02, FR vol. 67, no. 128, p. 44541.
- (6) Subdivision F
  - (a) 29 CFR 1915.80 Scope, application, definitions and effective dates, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (b) 29 CFR 1915.81 Housekeeping, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (c) 29 CFR 1915.82 Lighting, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (d) 29 CFR 1915.83 Utilities, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (e) 29 CFR 1915.84 Working alone, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (f) 29 CFR 1915.85 Vessel radar and communication systems, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (g) 29 CFR 1915.86 Lifeboats, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (h) 29 CFR 1915.87 Medical services and first aid, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (i) 29 CFR 1915.88 Sanitation, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (j) 29 CFR 1915.89 Control of hazardous energy (lockout/tagout), published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (k) 29 CFR 1915.90 Safety color code for marking physical hazards, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (l) 29 CFR 1915.91. Accident prevention signs and tags, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (m) 29 CFR 1915.92. Retention of DOT markings, placards, and labels, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (n) 29 CFR 1915.93. Motor vehicle safety equipment, operation, and maintenance, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (o) 29 CFR 1915.94. Servicing of multi-piece and single-piece rim wheels, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
- (7) Subdivision G
  - (a) 29 CFR 1915.111. Inspection, published 4/20/ 82, FR vol. 47, p. 16984.
  - (b) 29 CFR 1915.112. Ropes, chains and slings, published 6/8/11, Federal Register, vol. 76, no. 110, p. 33590.
  - (c) 29 CFR 1915.113. Shackles and hooks, published 6/8/11, Federal Register, vol. 76, no. 110, p. 33590.

- (d) 29 CFR 1915.114. Chain falls and pull-lifts, published 4/20/82, FR vol. 47, p. 16984.
- (e) 29 CFR 1915.115. Hoisting and hauling equipment, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (f) 29 CFR 1915.116. Use of gear, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (g) 29 CFR 1915.117. Qualifications of operators, published 4/20/82, FR vol. 47, p. 16984.
- (h) 29 CFR 1915.118. Tables, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (8) Subdivision H
  - (a) 29 CFR 1915.131. General precautions, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (b) 29 CFR 1915.132. Portable electric tools, published 4/20/82, FR vol. 47, p. 16984.
  - (c) 29 CFR 1915.133. Hand tools, published 4/20/ 82, FR vol. 47, p. 16984.
  - (d) 29 CFR 1915.134. Abrasive wheels, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (e) 29 CFR 1915.135. Powder actuated fastening tools, published 5/24/96, FR vol. 61, no. 102, p. 26351.
  - (f) 29 CFR 1915.136. Internal combustion engines other than ship's equipment, published 4/20/82, FR vol. 47, p. 16984.
- (9) Subdivision I
  - (a) 29 CFR 1915.151. Scope, application and definitions, published 5/24/96, FR vol. 61, no. 102, p. 26352.
  - (b) 29 CFR 1915.152. General requirements, published 6/8/11, Federal Register, vol. 76, no. 110, p. 33590.
  - (c) 29 CFR 1915.153. Eye and face protection, published 9/9/09, FR vol. 74, no. 173, pp. 46350-46361.
  - (d) 29 CFR 1915.154. Respiratory protection, published 5/24/96, FR vol. 61, no. 102, p. 26354.
  - (e) 29 CFR 1915.155. Head protection, published 6/22/12, FR vol. 77, no. 121, p. 37587.
  - (f) 29 CFR 1915.156. Foot protection, published 9/9/09, FR vol. 74, no. 173, pp. 46350-46361.
  - (g) 29 CFR 1915.157. Hand and body protection, published 5/24/96, FR vol. 61, no. 102, p. 26354.
  - (h) 29 CFR 1915.158. Lifesaving equipment, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (i) 29 CFR 1915.159. Personal fall arrest systems (PFAS), published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (j) 29 CFR 1915.160. Positioning device systems, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- Appendix A to Subpart I, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- Appendix B to Subpart I, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (10) Subdivision J
  - (a) 29 CFR 1915.161. Scope and application of subdivision, published 4/20/ 82, FR vol. 47, p. 16984.
  - (b) 29 CFR 1915.162. Ship's boilers, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (c) 29 CFR 1915.163. Ship's piping systems, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (d) 29 CFR 1915.164. Ship's propulsion machinery, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.
  - (e) 29 CFR 1915.165. Ship's decking machinery, published 7/3/02, FR vol. 67, no. 128, p. 44541.
- (11) Subdivision K
  - (a) 29 CFR 1915.171. Scope and application of subdivision, published 4/20/ 82, FR vol. 47, p. 16984.
  - (b) 29 CFR 1915.172. Portable air receiver and other unfired pressure vessels, published 7/3/02, FR vol. 67, no. 128, p. 44541.
  - (c) 29 CFR 1915.173. Drums and containers, published 4/20/82, FR vol. 47, p. 16984.

(12) Subdivision L

(a) 29 CFR 1915.181. Electrical circuits and distribution boards, published 5/2/11, Federal Register vol. 76, no. 84, p. 24576.

(13) Subdivisions M-O (Reserved)

(14) Subdivision P

(a) 29 CFR 1915.501. General provisions, published 9/15/04, FR vol. 69, p. 55667.

(b) 29 CFR 1915.502. Fire safety plan, published 9/15/04, FR vol. 69, p. 55667.

(c) 29 CFR 1915.503. Precautions for hot work, published 9/15/04, FR vol. 69, p. 55667.

(d) 29 CFR 1915.504. Fire watches, published 9/15/04, FR vol. 69, p. 55667.

(e) 29 CFR 1915.505. Fire response, published 10/17/06, FR vol. 71, no. 200, p. 60843.

(f) 29 CFR 1915.506. Hazards of fixed extinguishing systems on board vessels and vessel sections, published 9/15/04, FR vol. 69, p. 55667.

(g) 29 CFR 1915.507. Land-side fire protection systems, published 10/17/06, FR vol. 71, no. 200, p. 60843.

(h) 29 CFR 1915.508. Training, published 9/15/04, FR vol. 69, p. 55667.

(i) 29 CFR 1915.509. Definitions applicable to this subpart, published 9/15/04, FR vol. 69, p. 55667.

Appendix A to Subpart P, published 9/15/04, FR vol. 69, p. 55667.

(15) Subdivision Q-Y (Reserved)

(16) Subdivision Z

(a) 29 CFR 1915.1000. Air Contaminants, published ~~[12/27/11, FR vol. 76, no. 248, p. 80735]~~ **3/25/16, FR vol. 81, no. 58, p. 26386; 5/18/16, FR vol. 81, no. 96, p. 31167.**

(b) 29 CFR 1915.1001. Asbestos, published 2/8/13, FR vol. 78, no. 27, p. 9311.

Appendix A to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix B to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix C to 1915.1001, published 6/8/11, Federal Register, vol. 76, no. 110, p. 33590.

Appendix D to 1915.1001, published 8/10/94, FR vol. 59, p. 40964.

Appendix E to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix F to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix G to 1915.1001, published 8/10/94, FR vol. 59, p. 40964.

Appendix H to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix I to 1915.1001, published 8/10/94, FR vol. 59, p. 40964.

Appendix J to 1915.1001, published 8/10/94, FR vol. 59, p. 40964.

Appendix K to 1915.1001, published 6/29/95, FR vol. 60, p. 33972.

Appendix L to 1915.1001, published 8/23/96, FR vol. 61, p. 43454.

(c) 29 CFR 1915.1002. Coal tar pitch volatiles; interpretation of term, published 6/20/96, FR vol. 61, p. 31427.

(d) 29 CFR 1915.1003. 13 Carcinogens (4-Nitrobiphenyl, etc.), published 6/20/96, FR vol. 61, p. 31427.

(e) 29 CFR 1915.1004. alpha-Naphthylamine, published 6/20/96, FR vol. 61, p. 31427.

(f) 29 CFR 1915.1005. (Reserved)

(g) 29 CFR 1915.1006. Methyl chloromethyl ether, published 6/20/96, FR vol. 61, p. 31427.

(h) 29 CFR 1915.1007. 3,3'Dichlorobenzidene (and its salts), published 6/20/96, FR vol. 61, p. 31427.

(i) 29 CFR 1915.1008. bis-Chloromethyl ether, published 6/20/96, FR vol. 61, p. 31427.

(j) 29 CFR 1915.1009. beta-Naphthylamine, published 6/20/96, FR vol. 61, p. 31427.

(k) 29 CFR 1915.1010. Benzidine, published 6/20/96, FR vol. 61, p. 31427.

(l) 29 CFR 1915.1011. 4-Aminodiphenyl, published 6/20/96, FR vol. 61, p. 31427.

(m) 29 CFR 1915.1012. Ethyleneimine, published 6/20/96, FR vol. 61, p. 31427.

(n) 29 CFR 1915.1013. beta-Propiolactone, published 6/20/96, FR vol. 61, p. 31427.

(o) 29 CFR 1915.1014. 2-Acetylaminofluorene, published 6/20/96, FR vol. 61, p. 31427.

- (p) 29 CFR 1915.1015. 4-Dimethylaminoazobenzene, published 6/20/96, FR vol. 61, p. 31427.
- (q) 29 CFR 1915.1016. N-Nitrosodimethylamine, published 6/20/96, FR vol. 61, p. 31427.
- (r) 29 CFR 1915.1017. Vinyl chloride, published 6/20/96, FR vol. 61, p. 31427.
- (s) 29 CFR 1915.1018. Inorganic arsenic, published 6/20/96, FR vol. 61, p. 31427.
- (t) 29 CFR 1915.1020 Access to employee exposure and medical records, published 6/20/96, FR vol. 61, p. 31427.
- (u) 29 CFR 1915.1025. Lead, published 6/20/96, FR vol. 61, p. 31427.
- (v) 29 CFR 1915.1026 Chromium (VI), published 3/26/12, FR vol. 77, no. 58, p. 17574.
- (w) 29 CFR 1915.1027. Cadmium, published 6/20/96, FR vol. 61, p. 31427.
- (x) 29 CFR 1915.1028. Benzene, published 6/20/96, FR vol. 61, p. 31427.
- (y) 29 CFR 1915.1030. Bloodborne pathogens, published 6/20/96, FR vol. 61, p. 31427.
- (z) 29 CFR 1915.1044. 1,2 dibromo-3-chloropropane, published 6/20/96, FR vol. 61, p. 31427.
- (aa) 29 CFR 1915.1045. Acrylonitrile, published 6/20/96, FR vol. 61, p. 31427.
- (bb) 29 CFR 1915.1047. Ethylene oxide, published 6/20/96, FR vol. 61, p. 31427.
- (cc) 29 CFR 1915.1048. Formaldehyde, published 6/20/96, FR vol. 61, p. 31427.
- (dd) 29 CFR 1915.1050. Methylenedianiline, published 6/20/96, FR vol. 61, p. 31427.
- (ee) 29 CFR 1915.1052 Methylene Chloride, published 1/10/97, Federal Register, vol. 62, no. 7, p. 1619.

**(ff) 29 CFR 1915.1053 Respirable Crystalline Silica, published 3/25/16, Federal Register, vol. 81, no. 58, p. 16286.**

(~~ff~~gg) 29 CFR 1915.1120 Access to employee exposure and medical records has been redesignated to §1915.1020.

(Note: 29 CFR 1915.99, Hazard Communication was redesignated as 1915.1200 on 7/1/93, FR vol. 58, no. 125, p. 35514.)

(~~gg~~hh) 29 CFR 1915.1200. Hazard communication, published 6/20/96, FR vol. 61, p. 31427.

(~~hh~~ii) 29 CFR 1915.1450. Occupational exposure to hazardous chemicals in laboratories, published 6/20/96, FR vol. 61, p. 31427.

Stat. Auth.: ORS 654.025(2) and 656.726(4).

Stats. Implemented: ORS 654.001 to 654.295.

Hist: OR-OSHA Admin. Order 9-1992, f. 9/24/92, ef. 11/1/92.

OR-OSHA Admin. Order 1-1993, f. 1/22/93, ef. 1/22/93.

OR-OSHA Admin. Order 19-1993, f. 12/29/93, ef. 12/29/93.

OR-OSHA Admin. Order 4-1994, f. 8/4/94, ef. 8/4/94.

OR-OSHA Admin. Order 1-1995, f. 1/19/95, ef. 1/19/95.

OR-OSHA Admin. Order 2-1995, f. 1/25/95, ef. 1/25/95.

OR-OSHA Admin. Order 4-1995, f. 3/29/95, ef. 3/29/95.

OR-OSHA Admin. Order 5-1995, f. 4/6/95, ef. 4/6/95.

OR-OSHA Admin. Order 8-1995, f. 8/25/95, ef. 8/25/95.

OR-OSHA Admin. Order 5-1996, f. 11/29/96, ef. 18/29/96.

OR-OSHA Admin. Order 6-1996, f. 11/29/96, ef. 11/29/96.

OR-OSHA Admin. Order 3-1997, f. 3/28/97, ef. 3/28/97.

OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.

OR-OSHA Admin. Order 6-1997, f. 5/2/97, ef. 5/2/97.

OR-OSHA Admin. Order 7-1998, f. 12/28/98, ef. 12/28/98.

OR-OSHA Admin. Order 4-2001, f. 2/5/01, ef. 2/5/01.

OR-OSHA Admin. Order 4-2003, f. 5/6/03, ef. 5/6/03.

OR-OSHA Admin. Order 8-2004, f. 12/30/04, ef. 12/30/04.

OR-OSHA Admin. Order 1-2005, f. 4/12/05, ef. 4/12/05.

OR-OSHA Admin. Order 4-2006, f. 7/24/06, ef. 7/24/06.

OR-OSHA Admin. Order 6-2006, f. 8/30/06, ef. 8/30/06.

OR-OSHA Admin. Order 10-2006, f. 11/30/06, ef. 11/30/06.

OR-OSHA Admin. Order 1-2007, f. 1/9/07, ef. 1/16/07.

OR-OSHA Admin. Order 5-2008, f. 5/1/08, ef. 5/15/08.

OR-OSHA Admin. Order 5-2009, f. 5/29/09, ef. 5/29/09.

OR-OSHA Admin. Order 2-2010, f. 2/25/10, ef. 2/25/10.

OR-OSHA Admin. Order 3-2010, f. 6/10/10, ef. 6/15/10.  
OR-OSHA Admin. Order 3-2011, f. 11/1/11, ef. 11/1/11.  
OR-OSHA Admin. Order 4-2011, f. 12/8/11, ef. 12/8/11.  
OR-OSHA Admin. Order 1-2012, f. 4/10/12, ef. 4/10/12.  
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.  
OR-OSHA Admin. Order 7-2012, f. 12/14/12, ef. 12/14/12.  
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.  
**OR-OSHA Admin. Order X-2016, XX/XX/16, ef. XX/XX/16.**