

lar conduction defects other than isolated right bundle branch block, angina pectoris, arrhythmia, coronary artery disease), Juxta-articular osteonecrosis.

APPENDIX B—GUIDELINES FOR SCIENTIFIC DIVING

This appendix contains guidelines that will be used in conjunction with § 1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

1. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operations.
2. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and, therefore, are scientists or scientists in training.

[50 FR 1050, Jan. 9, 1985]

Subparts U—Y [Reserved]

Subpart Z—Toxic and Hazardous Substances

AUTHORITY: Secs. 6, 8, Occupational Safety and Health Act (29 U.S.C. 655, 657); Secretary of Labor's Order No. 12-71 (38 FR 8754); 8-76 (41 FR 25050); or 9-86 (48 FR 35736), as applicable; and 29 CFR Part 1911.

Section 1910.1000 Tables Z-1, Z-2, Z-3 also issued under 5 U.S.C. 553.

Section 1910.1000 not issued under 29 CFR Part 1911, except for "Arsenic" and "Cotton Dust" listings in Table Z-1.

Section 1910.1001 also issued under Sec. 107 of Contract Work Hours and Safety Standards Act, 40 U.S.C. 333.

Section 1910.1002 not issued under 29 U.S.C. 655 or 29 CFR Part 1911; also issued under 5 U.S.C. 553.

Sections 1910.1003 through 1910.1018 also issued under 29 U.S.C. 653.

Section 1910.1025 also issued under 29 U.S.C. 653 and 5 U.S.C. 553.

Section 1910.1043 also issued under 5 U.S.C. 551 *et seq.*

Sections 1910.1045 and 1910.1047 also issued under 29 U.S.C. 653.

Sections 1910.1200, 1910.1499 and 1910.1500 also issued under 5 U.S.C. 553.

SOURCE: 39 FR 23502, June 27, 1974, otherwise noted. Redesignated at 45 FR 23072, May 28, 1975.

§ 1910.1000 Air contaminants.

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

(a) Table Z-1:

(1) *Materials with names preceded by "C"—Ceiling Values.* An employee's exposure to any material in table Z-1 the name of which is preceded by "C" (e.g., C Boron trifluoride), shall not exceed the ceiling value given for that material in the table.

(2) *Other materials—8-hour time weighted averages.* An employee's exposure to any material in table Z-1 the name of which is not preceded by "C", in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

(b) Table Z-2: (1) *8-hour time weighted averages.* An employee's exposure to any material listed in table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

(2) *Acceptable ceiling concentrations.* An employee's exposure to a material listed in table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the material in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift".

(3) *Example.* During an 8-hour work shift, an employee may be exposed to a concentration of Benzene above 25 p.p.m. (but never above 50 p.p.m.) only for a maximum period of 10 minutes. Such exposure must be compensated by exposures to concentrations less than 10 p.p.m. so that the cumulative exposure for the entire 8-hour work shift does not exceed a weighted average of 10 p.p.m.

(c) Table Z-3: An employee's exposure to any material listed in table Z-

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any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit for that material in the table.

Computation formulae:

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

$$E = C_1T_1 + C_2T_2 + \dots + C_nT_n \div 8$$

where E is the equivalent exposure for the work shift.

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

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

The value of E shall not exceed the 8-hour time weighted average limit in table Z-1, Z-2, or Z-3 for the material involved.

To illustrate the formula prescribed in paragraph (d)(1)(i) of this section, note that isoamyl acetate has a 4-hour time weighted average limit of 100 p.p.m. (table Z-1). Assume that an employee is subject to the following exposure:

Two hours exposure at 150 p/p
Two hours exposure at 75 p/p
Four hours exposure at 50 p/p

Substituting this information in the formula, we have

$$(2 \times 150 + 2 \times 75 + 4 \times 50) \div 8 = 81.25 \text{ p/p}$$

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

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

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

where:

E is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that contaminant, from table Z-1, Z-2, or Z-3.

The value of E shall not exceed unity (1).

(ii) To illustrate the formula prescribed in paragraph (d)(2)(i) of this section, consider the following exposures:

Material	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
Acetone (Table Z-1)	500 p/m	1,000 p/m
2-Butanone (Table Z-1)	45 p/m	200 p/m
Toluene (Table Z-2)	40 p/m	200 p/m

Substituting in the formula, we have:

$$E_m = 500 \div 1,000 + 45 \div 200 + 40 \div 200$$

$$E_m = 0.500 + 0.225 + 0.200$$

$$E_m = 0.925$$

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

(e) To achieve compliance with paragraphs (a) through (d) 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.

TABLE Z-1

Substance	p/p ^m	mg./M ³
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene dichloride, see 1, 2-Dichloroethylene		
Acetylene tetrabromide	1	14
Acrolein	0.1	0.25
Acrylamide—Skin		0.3
Aldrin—Skin		0.25
Allyl alcohol—Skin	2	5
Allyl chloride	1	3
C Allylglycidyl ether (AGE)	10	45
Allyl propyl disulfide	2	12
2-Aminoethanol, see Ethanolamine		
2-Aminopyridine	0.5	2
Ammonia	50	35
Ammonium sulfate (Ammate)		15
n-Amyl acetate	100	525
sec-Amyl acetate	125	650
Aniline—Skin	5	19
Anisidine (o, p-isomers)—Skin		0.5
Antimony and compounds (as Sb)		0.5

Substance	p/m*	mg./M*
ANTU (alpha naphthyl thiourea).....		0.3
Arsenic organic compounds (as As).....		0.5
Arsine.....	0.05	0.2
Azophos-methyl—Skin.....		0.2
Barium (soluble compounds).....		0.5
p-Benzquinone, see Quinone.....		
Benzoyl peroxide.....		5
Benzyl chloride.....	1	5
Biphenyl, see Diphenyl.....		
Boron oxide.....		15
C Boron trifluoride.....	1	3
Bromine.....	0.1	0.7
Bromolform—Skin.....	0.5	5
Butadiene (1, 3-butadiene).....	1,000	2,200
Butanethiol, see Butyl mercaptan.....		
2-Butanone.....	200	590
2-Butoxy ethanol (Butyl Cellosolve)—Skin.....	50	240
Butyl acetate (n-butyl acetate).....	150	710
sec-Butyl acetate.....	200	950
tert-Butyl acetate.....	200	950
Butyl alcohol.....	100	300
sec-Butyl alcohol.....	150	450
tert-Butyl alcohol.....	100	300
C Butylamine—Skin.....	5	15
C tert-Butyl chromate (as CrO ₅)—Skin.....		0.1
n-Butyl glycidyl ether (BGE).....	50	270
Butyl mercaptan.....	10	35
p-tert-Butyltoluene.....	10	60
Calcium oxide.....	5	5
Camphor.....		2
Carbaryl (Sevin®).....		5
Carbon black.....		3.5
Carbon dioxide.....	5,000	9,000
Carbon monoxide.....	50	55
Chlordane—Skin.....		0.5
Chlorinated camphene—Skin.....		0.5
Chlorinated diphenyl oxide.....		0.5
C Chlorine.....	1	3
Chlorine dioxide.....	0.1	0.3
C Chlorine trifluoride.....	0.1	0.4
C Chloroacetaldehyde.....	1	3
a-Chloroacetophenone (phenacychloride).....	0.05	0.3
Chlorobenzene (monochlorobenzene).....	75	350
o-Chlorobenzylidene malononitrile (OCBM).....	0.05	0.4
Chlorobromomethane.....	200	1,050
2-Chloro-1,3-butadiene, see Chloroprene.....		
Chlorodiphenyl (42 percent Chlorine)—Skin.....		1
Chlorodiphenyl (54 percent Chlorine)—Skin.....		0.5
1-Chloro, 2,3-epoxypropene, see Epichlorohydrin.....		
2-Chloroethanol, see Ethylene chlorohydrin.....		
Chloroethylene, see Vinyl chloride.....		
C Chloroform (trichloromethane).....	50	240
1-Chloro-1-nitropropane.....	20	100
Chloropicrin.....	0.1	0.7
Chloroprene (2-chloro-1,3-butadiene)—Skin.....	25	90
Chromium, sol. chromic, chromous salts as Cr.....		0.5
Metal and insol. salts.....		0.5

Substance	p/mf	mg. per liter
Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene		
Cobalt, metal fume and dust		
Copper fume		
Dusts and Mists		
Cotton dust (raw)		
Crag® herbicide		
Cresol (all isomers)—Skin	5	
Crotonaldehyde	2	
Cumene—Skin	50	
Cyanide (as CN)—Skin		
Cyclohexane	300	
Cyclohexanol	50	
Cyclohexanone	50	
Cyclohexene	300	
Cyclopentadiene	75	
2,4-D		
DDT—Skin		
DDVP—Skin		
Decaborane—Skin	0.05	
Demeton®—Skin		
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	
1,2-diaminoethane, see Ethylenediamine		
Diazomethane	0.2	
Diborane	0.1	
Dibutyl phosphate	1	
Dibutylphthalate		
O, o-Dichlorobenzene	50	
p-Dichlorobenzene	75	
Dichlorodifluoromethane	1,000	
1,3-Dichloro-5,5-dimethyl hydantoin		
1,1-Dichloroethane	100	
1,2-Dichloroethylene	200	
C Dichloroethyl ether—Skin	15	
Dichloromethane, see Methylene chloride		
Dichloromonofluoromethane	1,000	
C, 1,1-Dichloro-1-nitroethane	10	
1,2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	
Dieldrin—Skin		
Diethylamine	25	
Diethylamino ethanol—Skin	10	
Diethylether, see Ethyl ether		
Difluorodibromomethane	100	
C Diglycidyl ether (DGE)	0.5	
Dihydroxybenzene, see Hydroquinone		
Disobutyl ketone	50	
Disopropylamine—Skin	5	
Dimethoxymethane, see Methylal		
Dimethyl acetamide—Skin	10	
Dimethylamine	10	
Dimethylaminobenzene, see Xylidene		
Dimethylaniline (N-dimethylaniline)—Skin	5	
Dimethylbenzene, see Xylene		
Dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate, (Dibrom)	10	
Dimethylformamide—Skin	10	
2,6-Dimethylheptanone, see Diisobutyl ketone		
1,1-Dimethylhydrazine—Skin	0.5	

Substance	p/m*	mg./m.
acetic acid—Skin	1	
acetic anhydride (all isomers)—		
do		0.
acetic anhydride—Skin		1.
acetic anhydride—Skin		
acetic anhydride (Diethylene dioxide)—		
do	100	36
do	0.2	
acetic anhydride desiccant		
acetic anhydride desiccant isocyan-		
do		
acetic anhydride glycol methyl ether—		
do	100	60
acetic anhydride phenyl acetate (Di-2-eth-		
do)		
do—Skin		0.
acetic anhydride—Skin	5	1.
acetic anhydride—Skin		0.
acetic anhydride, see Propylene-		
do		
acetic anhydride, see Glycol-		
do		
acetic anhydride, see Ethylmercaptan		
acetic anhydride	3	
acetic anhydride—Skin	200	74
acetic anhydride (Cello-solve		
do)—Skin	100	54
do	400	1,40
do	25	10
do	1,000	1,90
do	10	1
acetic anhydride (5-methyl-		
do)	25	13
acetic anhydride	100	43
acetic anhydride	200	89
acetic anhydride (3-Heptanone)	50	23
acetic anhydride	1,000	2,60
acetic anhydride	400	1,20
acetic anhydride	100	30
acetic anhydride	10	2
acetic anhydride	100	85
acetic anhydride—Skin	5	1
acetic anhydride	10	2
acetic anhydride glycol dinitrate and/or		
do)	0.2	
acetic anhydride monomethyl ether		
do, see Methyl cellosolve		
do		
acetic anhydride—Skin	0.5	
acetic anhydride, see 1,1-Dich-		
do)		
acetic anhydride—Skin	20	9
acetic anhydride		
acetic anhydride dust		
acetic anhydride (as F)		2
acetic anhydride	0.1	0
acetic anhydride	1,000	5,60
acetic anhydride	5	
acetic anhydride—Skin	5	
acetic anhydride	50	20
acetic anhydride (2,3-Epoxy-1-propanol)	50	13
acetic anhydride monomethyl ether, see 2-		
do)		
acetic anhydride, see Azinphosmethyl		
acetic anhydride		
acetic anhydride—Skin		0
acetic anhydride (n-heptane)	500	2,00
acetic anhydride—Skin	1	

Substance	p/m*	mg / M **
Hexachloronaphthalene—Skin		0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone (Methyl isobutyl ketone)	100	410
sec-Hexyl acetate	50	300
Hydrazine—Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide—Skin	10	11
Hydrogen peroxide (90%)	1	1.4
Hydrogen selenide	0.05	0.2
Hydroquinone		2
C Iodine	0.1	1
Iron oxide fume		10
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	950
Isopropyl alcohol	400	980
Isopropylamine	5	12
Isopropylether	500	2,100
Isopropyl glycidyl ether (IGE)	50	243
Ketene	0.5	0.9
Lindane—Skin		0.5
Lithium hydride		0.025
L.P.G. (liquefied petroleum gas)	1,000	1,800
Magnesium oxide fume		15
Malathion—Skin		15
Maleic anhydride	0.25	1
C Manganese	5	5
Mesityl oxide	25	100
Methanethiol, see Methyl mercap- tan		
Methoxychlor		15
2-Methoxyethanol, see Methyl cel- losolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mix- ture (MAPP)	1,000	1,800
Methyl acrylate—Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol		
Methyl (n-amyyl) ketone (2- Hep- lanone)	100	465
C Methyl bromide—Skin	20	80
Methyl butyl ketone, see 2- Hex- anone		
Methyl cellosolve—Skin	25	80
Methyl cellosolve acetate—Skin	25	120
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
o-Methylcyclohexanone—Skin	100	460
Methyl ethyl ketone (MEK), see 2- Butanone		
Methyl formate	100	250
Methyl iodide—Skin	5	28
Mesityl isobutyl carbinol—Skin	25	100
Methyl isobutyl ketone, see Hexone		
Methyl isocyanate—Skin	0.02	0.05
C Methyl mercaptan	10	20
Methyl methacrylate	100	410

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TABLE Z-1—Continued

Substance	p/m ²	mg./M ²
Methyl propyl ketone, see 2- Pentanone		
C# Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Molybdenum:		
Soluble compounds		5
Insoluble compounds		15
Monomethyl aniline—Skin	2	9
C Monomethyl hydrazine— Skin	0.2	0.35
Morpholine—Skin	20	70
Naphtha (coal tar)	100	400
Naphthalene	10	50
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble cmpds, as Ni		1
Nicotine—Skin		0.5
Nitric acid	2	5
Nitric oxide	25	30
p-Nitroaniline—Skin	1	6
Nitrobenzene—Skin	1	5
p-Nitrochlorobenzene—Skin	1	1
Nitroethane	100	310
C Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
C Nitroglycerin—Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
Nitrotoluene—Skin	5	30
Nitrotrichloromethane, see Chloroform		
Octachloronaphthalene—Skin		0.1
Octane	500	2,350
Gil mist, mineral		5
Osmium tetroxide		0.002
Oxalic acid		1
Oxygen difluoride	0.05	0.1
Ozone	0.1	0.2
Paraquat—Skin		0.5
Parathion—Skin		0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene—Skin		0.5
Pentachlorophenol—Skin		0.5
Pentane	1,000	2,950
2-Pentanone	200	700
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Petroleum distillates (naphtha)	500	2,000
Phenol—Skin	5	19
p-Phenylenediamine—Skin		0.1
Phenyl ether (vapor)	1	7
Phenyl ether-biphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenyl glycidyl ether (PGE)	10	60
Phenylhydrazine—Skin	5	22
Phosdrin (Mevinphos®)— Skin		0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.1
Phosphoric acid		1
Phosphorus (yellow)		0.1
Phosphorus pentachloride		1
Phosphorus pentasulfide		1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
Picric acid—Skin		0.1
Privat® (2-Privatyl-1,3- indandione)		0.1
Platinum (Soluble salts) as Pt		0.002
Propane	1,000	1,800

TABLE Z-1—Continued

Substance	p/mr
n-Propyl acetate.....	200
n-Propyl alcohol.....	200
n-Propyl nitrate.....	25
Propylene dichloride.....	75
Propylene imine—Skin.....	2
Propylene oxide.....	100
Propyne, see Methylacetylene.....	
Pyrethrum.....	
Pyridine.....	5
Quinone.....	0.1
Rhodium, Metal fume and dusts, as Rh.....	
Soluble salts.....	
Ronnel.....	
Rotenone (commercial).....	
Selenium compounds (as Se).....	
Selenium hexafluoride.....	0.05
Silver, metal and soluble com- pounds.....	
Sodium fluoroacetate (1080)— Skin.....	
Sodium hydroxide.....	
Stibine.....	0.1
Stoddard solvent.....	500
Strychnine.....	
Sulfur dioxide.....	5
Sulfur hexafluoride.....	1,000
Sulfuric acid.....	
Sulfur monochloride.....	1
Sulfur pentafluoride.....	0.025
Sulfuryl fluoride.....	5
Systox, see Demeton® 2,4,5T.....	
Tantalum.....	
TEDP—Skin.....	
Tellurium.....	
Tellurium hexafluoride.....	0.02
TEPP—Skin.....	
C Terphenyls.....	1
1,1,1,2-Tetrachloro-2,2- difluoroethane.....	500
1,1,2,2-Tetrachloro-1,2- difluoroethane.....	500
1,1,2,2-Tetrachloroethane—Skin.....	5
Tetrachloromethane, see Carbon tetrachloride.....	
Tetrachloronaphthalene—Skin.....	
Tetraethyl lead (as Pb)—Skin.....	
Tetrahydrofuran.....	200
Tetramethyl lead (as Pb)—Skin.....	
Tetramethyl succinonitrile—Skin.....	0.5
Tetranitromethane.....	1
Tetryl (2,4,6-trinitrophenyl methyl- nitramine)—Skin.....	
Thallium (soluble compounds)— Skin as Tl.....	
Thiram.....	
Tin (inorganic cmpds, except oxides).....	
Tin (organic cmpds).....	
C Toluene-2,4-diisocyanate.....	0.02
o-Toluidine—Skin.....	5
Toxaphene, see Chlorinated cam- phene.....	
Tributyl phosphate.....	
1,1,1-Trichloroethane, see Methyl chloroform.....	
1,1,2-Trichloroethane—Skin.....	10
Titaniumdioxide.....	
Tnchloromethane, see Chloroform.....	

TABLE Z-1—Continued

Substance	p/m*	mg./M**
acrylonitrile—Skin.....		9
1,1-dichloropropane.....	50	300
1,1-dichloro-2,2-trifluoroethane.....	1,000	7,800
acetone.....	25	100
tetrachlorobromomethane.....	1,000	6,100
alkylmercaptols, see Mercaptols		
alkylmercaptoethylmethyl-nitrate.....		
arsenic, see Tetra-		
bisphenol-A—Skin.....		1.
bisphenol-C phosphate.....		0.
bisphenol-F phosphate.....		2.
benzene.....	100	560
benzene (soluble compounds).....		0.01
benzene (insoluble compounds).....		0.2
B. dust:		
B.D. dust.....		0.0
B.D. fume.....		0.
butadiene, see Styrene		
cyanide, see Acrylonitrile		

TABLE 2-1—Continued

Substance	p/m ^a	mg/M ^b
Vinyl toluene	100	480
Warfarni		0.1
Xylene (xytol)	100	435
Xylidine—Skin	5	25
Yttrium		1
Zinc chloride fume		1
Zinc oxide fume		5
Zirconium compounds (as Zr)		5

*Parts of vapor or gas per million parts of contaminated air by volume at 25° C. and 760 mm. Hg pressure.

*Approximate milligrams of particulate per cubic meter of air.

(No footnote "c" is used to avoid confusion with ceiling value notations.)

*An atmospheric concentration of not more than 0.02 p.p.m., or personal protection may be necessary to avoid headache.

*This 8 hour time weighted average is for respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. This time weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and ginning.

TABLE Z-2

Material	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptance ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration
barium (Z37.40-1969).....	10 p.p.m.	25 p.p.m.	50 p.p.m.	10 minutes.
barium and beryllium compounds (Z37.29-1970).....	2 µg./M ³	5 µg./M ³	25 µg./M ³	30 minutes.
calcium lime (Z37.5-1970).....	0.1 mg./M ³	0.3 mg./M ³		
calcium dust (Z37.5-1970).....	0.2 mg./M ³	0.6 mg./M ³		
carbon disulfide (Z37.3-1968).....	20 p.p.m.	30 p.p.m.	100 p.p.m.	30 minutes.
carbon tetrachloride (Z37.17-1967).....	10 p.p.m.	25 p.p.m.	200 p.p.m.	5 minutes in any 4 hours.
chromic acid and chromates (Z37.7-1971).....		1 mg./10M ³		
ethylene dibromide (Z37.31-1973).....	20 p.p.m.	30 p.p.m.	50 p.p.m.	5 minutes.
ethylene dichloride (Z37.21-1969).....	50 p.p.m.	100 p.p.m.	200 p.p.m.	5 minutes in any 3 hours.
formaldehyde (Z37.16-1967).....	3 p.p.m.	5 p.p.m.	10 p.p.m.	30 minutes.
hydrogen fluoride (Z37.28-1969).....	3 p.p.m.			
hydrogen sulfide (Z37.2-1966).....		20 p.p.m.	50 p.p.m.	10 minutes once only if no other measurable exposure occurs.
fluoride as dust (Z37.28-1969).....	2.5 mg./M ³			
mercury (Z37.8-1971).....		1 mg./10M ³		
methyl chloride (Z37.18-1969).....	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 3 hours.
ethylene chloride (Z37.23-1969).....	500 p.p.m.	1,000 p.p.m.	2,000 p.p.m.	5 minutes in any 2 hours.
inorganic (alkyl) mercury (Z37.30-1969).....	0.01 mg./M ³	0.04 mg./M ³		
styrene (Z37.15-1969).....	100 p.p.m.	200 p.p.m.	600 p.p.m.	5 minutes in any 3 hours.
tetrachloroethylene (Z37.22-1967).....	do	do	300 p.p.m.	5 minutes in any 3 hours.
toluene (Z37.12-1967).....	200 p.p.m.	300 p.p.m.	500 p.p.m.	10 minutes.
trichloroethylene (Z37.19-1967).....	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 2 hours.

TABLE Z-3—MINERAL DUSTS

Substance	Mppcf*	Mg/M ³
Silica:		
Crystalline:		
Quartz (respirable).....	250 [†]	10mg/M ³ =
	%SiO ₂ + 5	%SiO ₂ + 2
Quartz (total dust).....		30mg/M ³
		%SiO ₂ + 2
Cristobalite: Use 1/2 the value calculated from the count or mass formulae for quartz.		
Tridymite: Use 1/2 the value calculated from the formulae for quartz.		
Amorphous, including natural diatomaceous earth.....	20	80mg/M ³
		%SiO ₂
Silicates (less than 1% crystalline silica):		
Mica.....	20	
Soapstone.....	20	
Talc (non-asbestos-form).....	20*	
Talc (fibrous). Use asbestos limit.		
Tremolite (see talc, fibrous).....	50	
Portland cement.....	15	
Graphite (natural).....		
Coal dust (respirable fraction less than 5% SiO ₂).....		2.4mg/M ³ or
		10mg/M ³
For more than 5% SiO ₂		%SiO ₂ + 2
Inert or Nuisance Dust:		
Respirable fraction.....	15	5mg/M ³
Total dust.....	50	15mg/M ³

NOTE: Conversion factors—mppcf × 35.3 = million particles per cubic meter = particles per c.c.

* Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

† The percentage of crystalline silica in the formula is the amount determined from air-borne samples, except in those instances in which other methods have been shown to be applicable.

* Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

* Containing <1% quartz; if 1% quartz, use quartz limit.

Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90
2.5	75
3.5	50
5.0	25
10	0

The measurements under this note refer to the use of an AEC instrument. The respirable fraction of coal dust is determined with a MRE; the figure corresponding to that of 2.4 Mg/M³ in the table for coal dust is 4.5 Mg/M³.

[39 FR 23502, June 27, 1974. Redesignated and amended at 40 FR 23072, May 28, 1975; 42 FR 22525, May 3, 1977; 43 FR 2600, Jan. 17, 1978; 43 FR 5963, Feb. 10, 1978; 43 FR 13563, Mar. 31, 1978; 43 FR 19624, May 5,

1978; 43 FR 27394, June 23, 1978; 43 FR 45809, Oct. 3, 1978; 43 FR 53007, Nov. 1978; 43 FR 57602, Dec. 8, 1978; 43 FR 32022, June 19, 1981; 49 FR 25798, June 1984; 50 FR 51173, Dec. 13, 1985; 51 FR 41477, Nov. 17, 1986]

§ 1910.1001 Asbestos, tremolite, phyllite, and actinolite.

(a) **Scope and application.** This section applies to all occupational exposures to asbestos, tremolite, phyllite, and actinolite, in all activities covered by the Occupational Safety and Health Act, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to construction work as defined in 29 CFR 1910.12(b). [Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58.]

(b) **Definitions.** "Action level" means an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals of 0.2 fiber per cubic centimeter (f/cc) of air calculated as an eight (8)-hour time-weighted average.

"Asbestos" includes chrysotile, crocidolite, tremolite, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and altered.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Authorized person" means any person authorized by the employer and required by work duties to be present in regulated areas.

"Director" means the Director of the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Employee exposure" means the exposure to airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals that would occur if the employee were not using respiratory protective equipment.

"Fiber" means a particulate form of asbestos, tremolite, anthophyllite, actinolite, 5 micrometers or longer

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with a length-to-diameter ratio of at least 3 to 1.

"High-efficiency particulate air (HEPA) filter" means a filter capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter aerosol-disperse particles.

"Regulated area" means an area established by the employer to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed, or can reasonably be expected to exceed, the permissible exposure limit.

"Tremolite, anthophyllite, or actinolite" means the non-asbestos form of these minerals, and any of these minerals that have been chemically treated and/or altered.

(c) **Permissible exposure limit (PEL).**

The employer shall ensure that no employee is exposed to an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of 0.2 fiber per cubic centimeter of air as an eight (8)-hour time-weighted average (TWA) as determined by the method prescribed in Appendix A of this section, or by an equivalent method.

(d) **Exposure monitoring.**—(1) General.

(i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA of each employee.

(ii) Representative 8-hour TWA employee exposures shall be determined on the basis of one or more samples representing full-shift exposures for each shift for each employee in each job classification in each work area.

(2) **Initial monitoring.** (i) Each employer who has a workplace or work operation covered by this standard, except as provided for in paragraphs (d)(2)(ii) and (d)(2)(iii) of this section, shall perform initial monitoring of employees who are, or may reasonably be expected to be exposed to airborne concentrations at or above the action level.

(ii) Where the employer has monitored after December 20, 1985, and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring

results to satisfy the requirements of paragraph (d)(2)(i) of this section.

(iii) Where the employer has relied upon objective data that demonstrates that asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is not capable of being released in airborne concentrations at or above the action level under the expected conditions of processing, use, or handling, then no initial monitoring is required.

(3) **Monitoring frequency (periodic monitoring) and patterns.** After the initial determinations required by paragraph (d)(2)(i) of this section, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than six months for employees whose exposures may reasonably be foreseen to exceed the action level.

(4) **Changes in monitoring frequency.** If either the initial or the periodic monitoring required by paragraphs (d)(2) and (d)(3) of this section statistically indicates that employee exposures are below the action level, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(5) **Additional monitoring.** Notwithstanding the provisions of paragraphs (d)(2)(ii) and (d)(4) of this section, the employer shall institute the exposure monitoring required under paragraphs (d)(2)(i) and (d)(3) of this section whenever there has been a change in the production, process, control equipment, personnel or work practices that may result in new or additional exposures above the action level or when the employer has any reason to suspect that a change may result in new or additional exposures above the action level.

(6) **Method of monitoring.** (i) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be personal samples collected following the procedures specified in Appendix A.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be evaluated using the OSHA Reference Method (ORM) specified in