

223

EXPOSURE LIMITS FOR AIRBORNE CONTAMINANTS

SAFETY ENGINEERING STANDARD

SS-JED APRIL 1981
THIS PAGE MARCH 1981
STANDARD MARCH 1981

S 2 T
Page 1 of 9

This standard includes requirements of the Occupational Safety and Health Act of 1970 (OSHA) as published in the Federal Register. OSHA information is printed in red.

1. SCOPE

1.1 This standard presents information and data sources on exposure limits of air contaminants to provide criteria for safe Company work environments. Guidance on application of exposure limits is provided.

1.2 The OSHA information presented is a legal requirement in the United States. Local regulations in other countries must be followed.

1.2.1 State and local regulations in the United States are not covered, but must be followed if applicable.

2. SOURCES OF EXPOSURE LIMIT INFORMATION

2.1 OSHA. Permissible Exposure Limits (PELs) from OSHA regulations, Section 1910.1000, Tables Z1, Z2, and Z3 are presented as Tables 1, 2, and 3. These tables are minimum legal requirements in the United States for the substances listed. The OSHA tables were originally based on the 1968 ACGIH TLV tables (see 2.2). OSHA has made some changes to the tables, but has not made all of the changes made by ACGIH.

2.1.1 OSHA Regulated Materials

2.1.1.1 Rules applying to the manufacture, processing, packaging, handling, and storage of these materials are specified in OSHA regulations 1910.1001 through 1910.1046 as listed below.

- 1910.1001 Asbestos
- 1910.1002 Coal tar pitch volatiles
- 1910.1003 4-Nitrophenyl
- 1910.1004 alpha-Naphthylamine
- 1910.1006 Methyl chloromethyl ether
- 1910.1007 3, 3-Dichlorobenzidine (and its salts)
- 1910.1008 bis-Chloromethyl ether
- 1910.1009 beta-Naphthylamine
- 1910.1010 Benzidine
- 1910.1011 4-Aminodiphenyl
- 1910.1012 Ethylenediamine (Ethylenimine)
- 1910.1013 beta-Propiolactone
- 1910.1014 3-Acetylaminofluorene
- 1910.1015 4-Dimethylaminobenzene
- 1910.1016 N-Nitrosodimethylamine
- 1910.1017 Vinyl chloride
- 1910.1018 Inorganic arsenic
- 1910.1023 Lead
- 1910.1028 Benzene

Persons printed in red are from OSHA 1910.1000 through 1910.1046.

- 1910.1029 Coke oven emissions
- 1910.1043 Cotton dust
- 1910.1044 1, 2-Dibromo-3-chloropropane
- 1910.1045 Acrylonitrile
- 1910.1046 Exposure to cotton dust in cotton gins

2.1.1.2 CAUTION. Regulations are frequently subject to litigation. At the time of this revision the benzene and lead regulations and parts of the arsenic regulation were under court review. Consult the Legal Department for latest information.

2.1.1.3 These OSHA regulations specify exact and demanding methodology for sampling, employee notification, training, record keeping, and protective equipment.

2.2 American Conference of Governmental Industrial Hygienists (ACGIH). The ACGIH annually publishes a booklet containing Threshold Limit Values for many chemical substances and physical agents. Copies of the booklet can be obtained from the Chemical Hazards Information Section, ISD, Centre Road Bldg. The updated booklet is usually available in October. ACGIH TLVs should be used where a Du Pont AEL (see 2.3) has not been established and the TLV is either lower than the OSHA PEL or the material is not listed by OSHA.

2.2.1 TLVs are intended to be used only as guidelines toward the establishment of safe working environments.

2.2.2 Du Pont Use of STEL Values. Short-term Exposure Limit (STEL) values are listed as "tentative values" in the ACGIH "Booklet" and may not have been acted upon by the TLV subcommittee of the parent body. STELs should be used as guides. In most cases STELs were derived by multiplying the TLV by an arbitrarily chosen factor ranging from 1.25 to 3.0. STEL values are subject to change or withdrawal. Consultation with Haskell Laboratory is recommended before a significant expenditure is made to meet STEL values.

2.3 Du Pont Sources

2.3.1 Haskell Laboratory has established Acceptable Exposure Limits (AELs) for some chemicals. Information on AELs can be obtained from Haskell Laboratory. Where they have been established, the AELs should be used instead of the ACGIH TLVs. If the AEL is lower than the OSHA PEL the AEL should be used.

CONFIDENTIAL

1984

REV. III

NOTE - THIS DOCUMENT IS THE PROPERTY OF S. I. DU PONT DE NEMOURS AND COMPANY. THE TECHNICAL INFORMATION HEREON MAY NOT BE USED OR REPRODUCED WITHOUT THE PERMISSION OF DU PONT

SUBCOMMITTEE NO. 48



DUP 0960292

DU 040602

2.3.2 A list, "Industrial Chemicals Designated as Requiring Special Control in Du Pont," is published quarterly by Haskell Laboratory.

2.3.3 A "Carcinogen Synonym List" is published annually by the Corporate Chemicals Information Section, ISD.

3. APPLICATION OF PELs

3.1 Many situations where toxic substances are handled may require detailed review by specialized engineers, industrial hygienists, and toxicologists to obtain the optimum in design controls. When additional information is needed on the toxicity of other materials and the health hazard that may be associated with them, consultation should be made with the Haskell Laboratory for Toxicology and Industrial Medicine.

3.2 Safety precautions in DR176X shall be followed when handling radioactive materials.

4. EXPOSURE LIMITS FOR NONTRADITIONAL WORK SCHEDULES

4.1 Exposure limits apply to the traditional 8-hour workday, 40-hour workweek including such variations as rotating shifts which may involve up to seven consecutive 8-hour workdays. Human data used for setting exposure limits have, in many cases, come from such rotating shifts and at least 20 years of experience with them has shown no special adverse health effects. Exposure limits do not apply to nontraditional schedules such as 10- or 12-hour workdays or a workweek which routinely exceeds 40 hours.

4.2 Reduction Factor Calculations. When non-traditional work schedules are used regularly, an uncertainty exists concerning the effects of greater employee time exposure to chemical agents. Reduced exposure limits should consider the nature of the air contaminant and the increased exposure hours per day, and the decreased hours per day outside the contaminated environment.*

4.2.1 The reduction factor calculations presented in this standard will satisfy OSHA requirements; however, OSHA personnel will use a less restrictive calculation procedure (see reference in 5.1).

4.2.2 In the absence of other guidelines, a reduction factor f is recommended, calculated as follows (see 4.4 for exceptions):

$$f = \left(\frac{8}{h} \right) \left(\frac{34 - h}{16} \right) \quad (1)$$

where

f = Reduction factor for the nontraditional work schedule

h = Hours worked per day

and the reduced exposure limit is

$$L_{NT} = f/L_8 \quad (2)$$

where

L_{NT} = Exposure limit for nontraditional work schedule

L_8 = Exposure limit for 8-hour workday.
e.g. PEL from Table 1

4.2.3 For the case of a 7-day workweek, the reduction factor is based on exposure hours per week and exposure-free hours per week.

$$f = \left(\frac{40}{\Sigma h} \right) \left(\frac{168 - \Sigma h}{128} \right) \quad (3)$$

4.2.4 For work schedules less than 7 to 8 hours per day or 35 hours per week, Equations (1) and (2) are not applicable.

4.2.5 For 24-hour continuous exposure, Equations (1) through (3) are not applicable. Refer to the 90-day continuous exposure limits of the National Academy of Sciences where applicable.**

4.3 CAUTION: The reduction factor calculation is a theoretical estimate with no guarantee that an adequate safety margin is provided. Consult Haskell Laboratory prior to making significant changes in the workplace.

4.4 Exceptions. No adjustment of the exposure limit is necessary for the following:

a. Those substances whose exposure limits are based on short-term effects or rapid elimination.

b. Substances such as lead and mercury which accumulate in the body very slowly. Here, the daily exposure is unimportant as long as the average weekly length of exposure remains at 40 hours.

c. Substances for which a limit is set on the "lowest feasible level" concept.

* Smith, R. E., and Boren, R. A., "Occupational Exposure Limits for Novel Work Schedules," *Amer Ind Hygiene Assoc J*, 467 (June 1973)

** "Airborne Contaminants in Spacecraft," Report of the Panel on Air Standards for Manned Space Flight, Space Science Board, National Academy of Sciences, Washington, DC, 86 pages (October 1969)



DUP 0960293

DU 040603

CONFIDENTIAL

REV. III 10/81

4.5 Examples

4.5.1 For carbon monoxide exposure during a 10-hour workday, 4 days per week where $L_g = 50$ ppm, the L_{NT} is calculated using Equations (1) and (2):

$$f = \left(\frac{8}{10} \right) \left(\frac{24 - 10}{16} \right) = 0.7$$

$$L_{NT} = (0.7) (50) = 35 \text{ ppm}$$

4.5.2 For methanol exposure during a 12-hour workday, 5 days per week where $L_g = 200$ ppm, the L_{NT} is calculated using Equations (1) and (2):

$$f = \left(\frac{8}{12} \right) \left(\frac{24 - 12}{16} \right) = 0.5$$

$$L_{NT} = (0.5) (200) = 100 \text{ ppm}$$

4.5.3 For methanol exposure during an 8-hour workday, 7 days per week where the $L_g = 200$ ppm, the L_{NT} is calculated using Equations (2) and (3):

$$f = \left(\frac{40}{8 \times 7} \right) \left(\frac{168 - (8 \times 7)}{128} \right) = 0.625$$

$$L_{NT} = (0.625) (200) = 125 \text{ ppm}$$

This calculation does not apply to normal rotating shift schedules. See 4.1.

5. OTHER REFERENCES

5.1 Employment Safety and Health Guide No. 419 May 24, 1979 "OSHA Industrial Hygiene Field Operations Manual."

This manual does not have the authority of a regulation. Its purpose is to guide OSHA industrial hygiene compliance officers. Du Pont disagrees with many important statements of fact and interpretations given in the manual. The manual should not be used as guidance in Du Pont but may be useful for determining how an OSHA compliance officer is likely to handle a situation.

Source: Commerce Clearing House, Inc. 4025 W Peterson Avenue, Chicago, IL 60646

5.2 "NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS"

DHEW (NIOSH) Publication No. 78-210.

This is a useful concise compilation of information on chemicals, including chemical and physical properties, permissible exposure limits, respirator selection, health hazards, etc. The book contains a number of errors. In addition, it defines "immediately dangerous to life and health" as the "maximum level from which one could escape within 30 minutes without any escape impairing symptoms or any irreversible health effects." The conventional definition (see ANSI Z39.2, 1980) is "any atmosphere that poses an immediate hazard to life or produces immediate irreversible effects on health that will be debilitating." In keeping with its definition the Guide's IDLH values are lower than those which correspond to the ANSI definition. This book may be useful but any information should be checked using a primary source.

CONFIDENTIAL

Footnotes for Table 1:

- Parts per million by volume 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 (the footnote "c" is used to avoid confusion with ceiling value notations)
- An atmospheric concentration of not more than 0.02 ppm, or personal protection may be necessary to avoid headache

Partials printed in red are from OSHA 1916.1028.



DUP 0960294

DU 040604

REV. III 1984

TABLE 1 - OSHA TABLE Z - 1

Materials with Names Preceded by "C" - Ceiling Values If the name of the material in Table 1 is preceded by a "C," the value in the table is a ceiling value. An employee's exposure to a material shall at no time exceed the ceiling value.

Other Materials – 8-Hour Time-Weighted Average: If the name of the material in Table 1 is not preceded by a "C," the value in the table is an 8-hour time-weighted average. An employee's exposure to a material in any 8-hour work shift of a 40-hour week are not exceed the 8-hour time-weighted average.

Substance	ppm ^{a)}	mg kg ⁻¹ b)	Substance	ppm ^{a)}	mg kg ⁻¹ b)
Acetaldehyde	200	360	Calcium oxide		5
Acetic acid	10	25	Camphor		2
Acetic anhydride	5	20	Carbaryl (Sevin)		5
Acetone	1,000	2,400	Carbon black		3.5
Acetonitrile	40	70	Carbon dioxide	5,000	9,000
Acetylene dichloride, see 1,2-Dichloroethylene			Carbon monoxide	50	55
Acetylene tetrabromide	1	14	Chlordane - Skin		0.5
Acrolein	0.1	0.25	Chlorinated camphene - Skin		0.5
Acrylamide - Skin		0.3	Chlorinated diphenyl oxide		0.5
Aldrin - Skin		0.25	C Chlorine	1	3
Allyl alcohol - Skin	2	5	Chlorine dioxide	0.1	0.3
Allyl chloride	1	3	C Chlorine trifluoride	0.1	0.4
C Allylglycidyl ether (AGE)	10	45	C Chloroacetaldehyde	1	3
Allyl propyl disulfide	2	12	o-Chloroacetophenone (phenacylchloride)	0.05	0.3
2-Aminoethanol, see Ethanolamine			Chlorobenzene (monochlorobenzene)	75	360
2-Aminopyridine	0.5	2	o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4
Ammonia	50	35	Chlorobromomethane	200	1,050
Ammonium sulfamate (Ammate)		15	2-Chloro-1,3-butadiene, see Chloroprene		
n-Amyl acetate	100	525	Chlorodiphenyl (42 percent Chlorine) - Skin		1
iso-Amyl acetate	125	650	Chlorodiphenyl (54 percent Chlorine) - Skin		0.5
Aniline - Skin	5	19	1-Chloro-2,3-epoxypropane, see Epichlorohydrin		
Anilidine (o, p-isomers) - Skin		0.5	2-Chloroethanol, see Ethylene chlorohydrin		
Antimony and compounds (as Sb)		0.5	Chloroethylene, see Vinyl chloride		
ANTU (alpha naphthyl thiourea)		0.3	C Chloroform (trichloromethane)	50	240
Azine	0.05	0.2	1-Chloro-1-nitropropane	20	100
Azinphos-methyl - Skin		0.2	Chloroplatin	0.1	0.7
Barium (soluble compounds)		0.5	Chloroprene (2-chloro-1,3-butadiene) - Skin	25	90
p-Benzquinone, see Quinone			Chromium, incl. chromic, chromous salts as Cr		0.5
Benzoyl peroxide		5	Metal and insol salts		1
Benzyl chloride	1	5	Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene		0.2
Biphenyl, see Diphenyl			Cobalt, metal fume and dust		0.1
Boron oxide		15	Copper fume		0.1
C Boron trifluoride	1	3	Dusts and Mists		1
Bromine	0.1	0.7	Cotton dust (raw)		1
Bromoform - Skin	0.5	5	Crag herbicide		15
Butadiene (1,3-butadiene)	1,000	2,200	Cresol (all isomers) - Skin	5	22
Butanethiol, see Butyl mercaptan			Crotonaldehyde	2	6
2-Butanone	200	660	Cumene - Skin	50	245
2-Butoxy ethanol (Butyl Cellosolve) - Skin	50	240	Cyanide (as CN) - Skin		5
Butyl acetate (n-butyl acetate)	150	710	Cyclohexane	300	1,050
sec-Butyl acetate	200	950	Cyclohexanol	50	200
tert-Butyl acetate	200	960	Cyclohexanone	50	200
Butyl alcohol	100	300			
sec-Butyl alcohol	150	460			
tert-Butyl alcohol	100	300			
C Butylamine - Skin	5	15			
C tert-Butyl chromate (as CrO ₃) - Skin		0.1			
n-Butyl glycidyl ether (BGE)	50	270			
Butyl mercaptan	10	35			
p-tert-Butyltoluene	10	50			

See page 3 for instructions
Partners awarded in red are from OSHA 1910.1000

42-2562-200 Page 51

Super

DUP 0960295

CONFIDENTIAL

1.1

This Page Rev March 1981

EXPOSURE LIMITS FOR
AIRBORNE CONTAMINANTS

S 2 T

Page 5

TABLE 1 - OSHA TABLE 2-1 (CONTD)

Substance	ppm ^{a)}	mg/M ³ ^{b)}	Substance	ppm ^{a)}	mg/M ³ ^{b)}
Cyclohexene	300	1,015	Dioxane (Diethylene dioxide) - Skin	100	360
Cyclopentadiene	75	200	Diphenyl	0.2	1
2,4-D		10	Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI))		
DDT - Skin		1	Dipropylene glycol methyl ether - Skin	100	600
DDVP - Skin		1	Di-sec, octyl phthalate (Di-2-ethylhexylphthalate)		5
Decaborane - Skin	0.05	0.3	Endrin - Skin		0.1
Demeton - Skin		0.1	Epichlorohydrin - Skin	5	19
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240	EPN - Skin		0.5
1,2-diaminoethane, see Ethylenediamine			1,2-Epoxypropane, see Propyleneoxide		
Diazomethane	0.2	0.4	2,3-Epoxy-1-propanol, see Glycidol		
Diborane	0.1	0.1	Ethanethiol, see Ethylmercaptan		
Dibutyl Phosphate	1	5	Ethanolamine	3	6
Dibutylphthalate		5	2-Ethoxyethanol - Skin	200	740
C o-Dichlorobenzene	50	300	2-Ethoxyethylacetate (Cellulose acetate) - Skin	100	540
p-Dichlorobenzene	75	450	Ethyl acetate	400	1,400
Dichlorodifluoromethane	1,000	4,950	Ethyl acrylate - Skin	25	100
1,3-Dichloro-5,5-dimethylhydantoin		0.2	Ethyl alcohol (ethanol)	1,000	1,800
1,1-Dichloroethane	100	400	Ethylamine	10	18
1,2-Dichloroethylene	200	790	Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
C Dichloroethyl ether - Skin	15	60	Ethyl benzene	100	435
Dichloromethane, see Methylenechloride			Ethyl bromide	200	880
Dichloromono-fluoromethane	1,000	4,200	Ethyl butyl ketone (3-Heptanone)	50	230
C 1,1-Dichloro-1-nitroethane	10	60	Ethyl chloride	1,000	2,800
1,2-Dichloropropane, see Propylenedichloride			Ethyl ether	400	1,200
Tetrafluoromethane	1,000	7,000	Ethyl formate	100	300
Dieldrin - Skin		0.25	C Ethyl mercaptan	10	25
Diethylamine	25	75	Ethyl silicate	100	850
Diethylamine ethanol - Skin	10	50	Ethylene chlorohydrin - Skin	5	16
Diethylether, see Ethyl ether			Ethylenediamine	10	25
Difluorodibromomethane	100	880	C Ethylene glycol dinitrate and/or Nitroglycerin - Skin	0.2	1
C Diglycidyl ether (DGE)	0.5	2.8	Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
Dihydroxybenzene, see Hydroquinone			Ethylene mine - Skin	0.5	1
Diisobutyl ketone	30	280	Ethylene oxide	50	90
Diisopropylamine - Skin	5	20	Ethylidene chloride, see 1,1-Dichloroethane		
Dimethoxymethane, see Methylal			N-Ethylmorpholine - Skin	20	84
Dimethyl acetamide - Skin	10	35	Perbam		15
Dimethylamine	10	16	Ferrocenium dust		1
Dimethylaminobenzene, see Xylene			Fluoride (as F)		2.5
Dimethylaniline (N-dimethylaniline) - Skin	5	25	Fluorine	0.1	0.2
Dimethylbenzene, see Xylene			Fluorotrichloromethane	1,000	5,800
Dimethyl 1,3-dibromo-2,2-dichloroethyl phosphate, (Olebram)		3	Formic acid	5	9
Dimethylformamide - Skin	10	30	Furfural - Skin	5	20
2,6-Dimethylheptanone, see Diisobutyl ketone			Furfuryl alcohol	30	200
1,1-Dimethylhydrazine - Skin	0.5	1	Glycidol (2,3-Epoxy-1-propanol)	50	150
Dimethylphthalate		5	Glycol monomethyl ether, see 2-Ethoxyethanol		
Dimethylsiloxane - Skin	1	5	Guthion, see Azinphosmethyl		
Dinitrobenzene (all isomers) - Skin		1			
Dinitro-o-cresol - Skin		0.2			
Dinitrotoluene - Skin		1.5			

See page 3 for footnotes
Persons printed in red are from OSHA 1010.1000.

(Cont'd on Page 6)

DUP 0960296

DU 040606

EXPOSURE LIMITS FOR
AIRBORNE CONTAMINANTS

Page 6

This Page Rev March 1981

228

TABLE 1 - OSHA TABLE Z-1 (CONTD)

Substances	ppm ^{a)}	mg/m ³ ^{b)}	Substances	ppm ^{a)}	mg/m ³ ^{b)}
Helium		0.5	o-Methylcyclohexanone - Skin	100	480
Heptachlor - Skin		0.5	Methyl ethyl ketone (MEK), see 2-Butanone		
Heptane (n-heptane)	500	2,000	Methyl formate	100	250
Hexachloroethane - Skin	1	10	Methyl iodide - Skin	5	28
Hexachloronaphthalene - Skin		0.2	Methyl isobutyl carbinol - Skin	25	100
Hexane (n-hexane)	500	1,800	Methyl isobutyl ketone, see Hexane		
2-Hexanone	100	410	Methyl isocyanate - Skin	0.02	0.05
Hexone (Methyl isobutyl ketone)	100	410	C Methyl mercaptan	10	20
sec-Hexyl acetate	50	300	Methyl methacrylate	100	410
Hydrazine - Skin	1	1.3	Methyl propyl ketone, see 2- Pentanone		
Hydrogen bromide	3	10	C α Methyl styrene	100	480
C Hydrogen chloride	5	7	C Methylene Bisphenyl isocyanate (MDI)	0.02	0.2
Hydrogen cyanide - Skin	10	11	Molybdenum:		
Hydrogen peroxide (50%)	1	1.4	Soluble compounds		5
Hydrogen selenide	0.05	0.2	Insoluble compounds		15
Hydroquinone		2	Monomethyl aniline - Skin	2	8
C Iodine	0.1	1	C Monomethyl hydrazine - Skin	0.2	0.35
Iron oxide fume		10	Morpholine - Skin	20	70
Isamyl acetate	100	525	Naphtha (coaltar)	100	400
Isamyl alcohol	100	380	Naphthalene	10	50
Isobutyl acetate	150	700	Nickel carbonyl	0.001	0.007
Isobutyl alcohol	100	300	Nickel, metal and soluble compounds, as Ni		1
Isophorone	25	140	Nicotine - Skin		0.5
Isopropyl acetate	250	850	Nitric acid	2	5
Isopropyl alcohol	400	980	Nitric oxide	25	30
Isopropylamine	5	12	p-Nitroaniline - Skin	1	5
Isopropylether	500	2,100	Nitrobenzene - Skin	1	5
Isopropyl glycidyl ether (IGE)	50	240	p-Nitrochlorobenzene - Skin		1
Ketene	0.5	0.8	Nitroethane	100	310
Lindane - Skin		0.5	C Nitrogen dioxide	5	5
Lithium hydride		0.025	Nitrogen trifluoride	10	29
L.P.G. (liquefied petroleum gas)	1,000	1,800	C Nitroglycerin - Skin	0.2	2
Magnesium oxide fume		15	Nitromethane	100	250
Malathion - Skin		15	1-Nitropropane	25	90
Malic anhydride	0.25	1	2-Nitropropane	25	90
C Manganese	25	5	Nitrotoluene - Skin	5	30
Methyl acetate		100	Nitrotrichloromethane, see Chloropicrin		
Methacrylonitrile		15	Octachloronaphthalene - Skin		0.1
2-Methoxyethanol, see Methyl cellosolve			Octane	500	2,380
Methyl acetate	300	810	Oil mist, mineral		5
Methyl acetylene (propyne)	1,000	1,850	Organic Arsenic compounds (as As)		0.5
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800	Osmium tetroxide		0.002
Methyl acrylate - Skin	10	35	Oxalic acid		1
Methylal (dimethoxymethane)	1,000	3,100	Oxygen difluoride	0.05	0.1
Methyl alcohol (methanol)	300	280	Ozone	0.1	0.2
Methylamine	10	12	Paraquat - Skin		0.5
Methyl amyl alcohol, see Methyl isobutyl carbinol			Parathion - Skin		0.1
Methyl (n-amy) ketone (2- Hexanone)	100	485	Pentaborane	0.005	0.01
C Methyl bromide - Skin	20	80	Pentachloronaphthalene - Skin		0.5
Methyl butyl ketone, see 2- Hexanone			Pentachlorophenol - Skin		0.5
Methyl cellosolve - Skin	25	80	Pentene	1,000	2,950
Methyl cellosolve acetate - Skin	25	120	2-Pentanone	300	700
Methyl chloroform	350	1,900	Perchloromethyl mercaptan	0.1	0.8
Methylcyclohexane	500	2,000	Perchloryl fluoride	3	13.5
Methylcyclohexanol	100	470	Petroleum distillates (naphtha)	500	2,000
			Phenol - Skin	5	19

See page 3 for footnotes
Portions printed in red are from OSHA 1910.1000

(Cont'd on Page 7)

CONFIDENTIAL

DUP 0960297

DU 040607

CONFIDENTIAL

EXPOSURE LIMITS FOR
AIRBORNE CONTAMINANTS

S 2 T

This Page Rev March 1981

Page 7

TABLE 1 - OSHA TABLE Z-1 (CONTD FROM PAGE 6)

Substance	ppm ^(a)	mg/m ³ ^(b)	Substance	ppm ^(a)	mg/m ³ ^(b)
p-Phenylenediamine - Skin		0.1	1,1,2,2-Tetrachloro-1,2-difluoroethane	500	4,170
Phenyl ether (vapor)	1	7	1,1,2,2-Tetrachloroethane - Skin	5	35
Phenyl ether-biphenyl mixture (vapor)	1	7	Tetrachloromethane, see Carbon tetrachloride		
Phenylethylene, see Styrene			Tetrachloronaphthalene - Skin		2
Phenyl glycidyl ether (PGE)	10	60	Tetraethyl lead (as Pb) - Skin		0.075
Phenyldiazine - Skin	5	22	Tetrahydrofuran	200	590
Phosdrin (Mevinphos) - Skin		0.1	Tetramethyl lead (as Pb) - Skin		0.075
Phosgene (carbonyl chloride)	0.1	0.4	Tetramethyl succinonitrile - Skin	0.5	3
Phosphine	0.3	0.4	Tetranitromethane	1	8
Phosphoric acid		1	Tetryl (2,4,6-trinitrophenyl-methylnitramine) - Skin		1.5
Phosphorus (yellow)		0.1	Thallium (soluble compounds) - Skin as Tl		0.1
Phosphorus pentachloride		1	Thiram		5
Phosphorus pentasulfide		1	Tin (inorganic compounds, except oxides)		2
Phosphorus trichloride	0.5	3	Tin (organic compounds)		0.1
Phthalic anhydride	2	12	C-Toluene-2,4-diisocyanate	0.02	0.14
Picric acid - Skin		0.1	o-Toluidine - Skin	5	22
Pival (2-Pivalyl-1,3-indandione)		0.1	Taxaphene, see Chlorinated camphene		
Platinum (Soluble Salts) as Pt		0.002	Tributyl phosphate		5
Propane	1,000	1,800	1,1,1-Trichloroethane see Methyl chloroform		
n-Propyl acetate	200	840	1,1,2-Trichloroethane - Skin	10	45
Propyl alcohol	200	500	Titanium dioxide		15
n-Propyl nitrate	25	110	Trichloromethane, see Chloroform		
Propylene dichloride	75	350	Trichloronaphthalene - Skin		5
Propylene imine - Skin	2	5	1,2,3-Trichloropropane	50	300
Propylene oxide	100	240	1,1,2-Trichloro-1,2,2-trifluoroethane	1,000	7,800
Propyne, see Methylacetylene			Triethylamine	25	100
Pyrethrum		5	Trifluoromonomeromethane	1,000	8,100
Pyridine	5	15	2,4,6-Trinitrophenol, see Picric acid		
Quinone	0.1	0.4	2,4,6-Trinitrophenylmethyl-nitramine, see Tetryl		
Rhodium, Metal fume and dusts, as Rh		0.1	Trinitrotoluene - Skin		1.5
Soluble salts		0.001	Trionthocresyl phosphate		0.1
Ronnel		15	Triphenyl phosphate	100	560
Rotenone (commercial)		5	Turpentine		
Selenium compounds (as Se)		0.2	Uranium (soluble compounds)		0.05
Selenium hexafluoride	0.05	0.4	Uranium (insoluble compounds)		0.25
Silver, metal and soluble compounds		0.01	C Vanadium:		
Sodium fluoracetate (1080) - Skin		0.05	V ₂ O ₅ dust		0.5
Sodium hydroxide		2	V ₂ O ₅ fume		0.1
Stibine	0.1	0.5	Vinyl Benzene, see Styrene		
Standard solvent	500	2,900	Vinylcyanide, see Acrylonitrile		
Strychnine		0.15	Vinyl toluene	100	480
Sulfur dioxide	5	13	Warfarin		0.1
Sulfur hexafluoride	1,000	6,000	Xylene (xytol)	100	435
Sulfuric acid		1	Xylidine - Skin	5	25
Sulfur monochloride	1	5	Yttrium		1
Sulfur pentachloride	0.025	0.25	Zinc chloride fume		1
Sulfuryl fluoride	5	30	Zinc oxide fume		5
Sylox, see Dimetox			Zirconium compounds (as Zr)		5
2,4,5T		10			
Tantalum		5			
TBOP - Skin		0.2			
Tellurium		0.1			
Tellurium hexafluoride	0.02	0.2			
TEPP - Skin		0.05			
C Terphenyls	1	9			
1,1,1,2-Tetrachloro-2,2-difluoroethane	500	4,170			

See page 3 for footnotes.
Persons printed in red are from OSHA 1910.1000.

DUP 0960298

DU 040608

EXPOSURE LIMITS FOR
AIRBORNE CONTAMINANTS

This Page Rev March 1981

230

TABLE 2 - OSHA TABLE 2-2

Material	8-Hour Time Weighted Average	Acceptable Ceiling Concentration*	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift.	
			Concentration	Maximum Duration
Benzene (Z37.4 - 1968)**	10 ppm	25 ppm	50 ppm	10 minutes
Beryllium and beryllium compounds (Z37.29 - 1970)	2 $\mu\text{g}/\text{M}^3$	5 $\mu\text{g}/\text{M}^3$	25 $\mu\text{g}/\text{M}^3$	30 minutes
Cadmium dust (Z37.5 - 1970)	0.2 mg/ M^3	0.6 mg/ M^3		
Cadmium fume (Z37.5 - 1970)	0.1 mg/ M^3	0.3 mg/ M^3		
Carbon disulfide (Z37.3 - 1968)	20 ppm	30 ppm	100 ppm	30 minutes
Carbon tetrachloride (Z37.17 - 1967)	10 ppm	25 ppm	200 ppm	5 minutes in any 4 hours.
Chromic acid and chromates (Z37.7 - 1971)		1 mg/ 10M^3		
Ethylene dibromide (Z37.31 - 1970)	20 ppm	30 ppm	80 ppm	5 minutes.
Ethylene dichloride (Z37.21 - 1968)	50 ppm	100 ppm	200 ppm	5 minutes in any 3 hours.
Fluoride as dust (Z37.28 - 1968)	2.5 mg/ M^3			
Formaldehyde (Z37.16 - 1967)	3 ppm	5 ppm	10 ppm	30 minutes.
Hydrogen fluoride (Z37.26 - 1968)	3 ppm			
Hydrogen sulfide (Z37.2 - 1965)		20 ppm	80 ppm	10 minutes once only if no other measurable exposure occurs.
Mercury (Z37.8 - 1971)		1 mg/ 10M^3		
Methyl Chloride (Z37.18 - 1968)	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Methylene Chloride (Z37.23 - 1968)	500 ppm	1,000 ppm	2,000 ppm	5 minutes in any 2 hours.
Organic alkyl mercury (Z37.30 - 1968)	0.01 mg/ M^3	0.04 mg/ M^3		
Styrene (Z37.15 - 1968)	100 ppm	200 ppm	800 ppm	5 minutes in any 3 hours.
Tetrachloroethylene (Z37.22 - 1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Toluene (Z37.12 - 1967)	200 ppm	300 ppm	300 ppm	10 minutes.
Trichloroethylene (Z37.19 - 1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 2 hours.

* The "acceptable ceiling concentration" shall not be exceeded during an 8-hour shift except for the time period indicated and the concentration allowed under "acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift."

** Occupational exposures to benzene are subject to the requirements of Section 1910.1023 except as specifically exempted by Section 1910.1023(a)(2). Exposures exempted by Section 1910.1023(a)(2) are covered by this Section 1910.1023.

CONFIDENTIAL

Portions printed in red are from OSHA 1910.1023.



DUP 0960299

H.I.

DU 040609

EXPOSURE LIMITS FOR AIRBORNE CONTAMINANTS

S 2 T

This Page Rev March 1981

Page 9

TABLE 3 - OSHA TABLE Z-3

Substance	Mineral Dusts	
	8-Hour Time-Weighted Averages	
	Mppcf*	Mg/m ³
Silica:		
Crystalline:		
Quartz (respirable)	250**	10 mg/M ³ †
	%SiO ₂ + 5	%SiO ₂ + 2
Quartz (total dust)		30 mg/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	80 mg/M ³
		%SiO ₂
Silicates (less than 1% crys- talline silica):		
Mica	20	
Soapstone	20	
Talc (non-asbestos - form)	30††	
Talc (fibrous). Use asbestos limit		
Tremolite (see talc, fibrous)		
Portland cement	30	
Graphite (natural)	15	
Coal dust (respirable fraction less than 5% SiO ₂)		2.4 mg/M ³
		or
For more than 5% SiO ₂		10 mg/M ³
		%SiO ₂ + 2
Inert or Nuisance Dust:		
Respirable fraction	15	5 mg/M ³
Total dust	30	15 mg/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-bead 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

CONFIDENTIAL

Portions printed in red are from OSHA 1910.1000.



DUP 0960300

DU 040610