

See back page - Silicates - Anteston.

THRESHOLD LIMIT VALUES FOR 1961¹

Adopted at the Twenty-Third Annual Meeting of the American Conference of Governmental Industrial Hygienists, Detroit, April 9-12, 1961

Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. They represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The values listed refer to time-weighted average concentrations for a normal workday. The amount by which these figures may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations even for short periods produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All must be taken into consideration in arriving at a decision as to whether a hazardous situation exists. Special consideration should be given to the application of these values in assessing the health hazards which may be associated with exposure to combinations of two or more substances.

Threshold limits are based on the best available information from industrial experience, from experimental studies, and, when possible, from a combination of the two. These values are based on various criteria of toxic effects or on marked discomfort; thus, they should not be used as a common denominator of toxicity, nor should they be considered as the sole criterion in proving or disproving diagnosis of suspected occupational disease.

These limits are intended for use in the field of industrial hygiene and should be employed by persons trained in this field. They are not intended for use, or for modification for use, in the evaluation or control of community air pollution or air pollution nuisances.

These values are reviewed annually by the Committee on Threshold Limits for changes, revisions, or additions as further information becomes available. The Committee welcomes the suggestion of substances to be added to the list and also comments, references, or reports of experience with these materials.

Recommended Values

Gases and Vapors

Substance	PPM	Approx. Mg. per Cu.M.	Substance	PPM	Approx. Mg. per Cu.M.
Acetaldehyde	200	360	Butyl acetate		
Acetic acid	10	25	(n-butyl acetate)	200	950
Acetic anhydride	5	20	Butyl alcohol (n-butanol)	100	300
Acetone	1000	2400	tert. Butyl alcohol	100	300
Acetylene tetrabromide	1	14	Butylamine	5	15
Acrolein	0.5	1.2	Butyl cellosolve		
Acrylonitrile - skin	20	45	(2-butoxyethanol)	50	240
Allyl alcohol - skin	2	5	p-tert. Butyltoluene	10	60
Allyl chloride	5	15	Carbon dioxide	5000	9000
Allyl propyl disulfide	2	12	Carbon disulfide - skin	20	60
Ammonia	100	70	Carbon monoxide	100	110
Amyl acetate	200	1050	Carbon tetrachloride - skin	25	160
Amyl alcohol (isoamyl alcohol)	100	360	Cellosolve (2-ethoxyethanol)	200	740
Aniline - skin	5	19	Cellosolve acetate		
Arsine	0.05	0.2	(2-ethoxyethyl acetate)	100	540
Benzene (benzol)	25	80	Chlorine	1	3
Benzyl chloride	1	5	Chlorine dioxide	0.1	0.3
Boron trifluoride	1	3	Chlorine trifluoride	0.1	0.4
Bromine	0.1	0.7	Chlorobenzene		
Butadiene (1,3-butadiene)	1000	2200	(monochlorobenzene)	75	350
2-Butanone			Chloroform (trichloromethane)	50	240
(methyl ethyl ketone)	200	590	1-Chloro-1-nitropropane	20	100

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Note: The word "skin" following a compound's name indicates that the liquid compound can penetrate the skin to cause systemic effects.

Gases and Vapors (cont.)

Substance	PPM	Approx. Mg. per Cu.M.	Substance	PPM	Approx. Mg. per Cu.M.
Chloropicrin	0.1	0.7	Hydrogen cyanide - skin	10	11
Chloroprene			Hydrogen fluoride	3	2
(2-chloro-1,3-butadiene)	25	90	Hydrogen peroxide, 90%	1	1.4
Cresol (all isomers) - skin	5	22	Hydrogen selenide	0.05	0.2
Cyclohexane	400	1400	Hydrogen sulfide	20	30
Cyclohexanol	50	200	Iodine	0.1	1
Cyclohexanone	50	200	Isophorone	25	140
Cyclohexene	400	1350	Isopropylamine	5	12
Decaborane - skin	0.05	0.3	Mesityl oxide	25	100
Diacetone alcohol (4-hydroxy- 4-methyl-2-pentanone)	50	240	Methyl acetate	200	610
Diborane	0.1	0.1	Methyl acetylene	1000	1650
o-Dichlorobenzene	50	300	Methyl acrylate - skin	10	35
p-Dichlorobenzene	75	450	Methylal (dimethoxymethane)	1000	3100
Dichlorodifluoromethane	1000	4950	Methyl alcohol (methanol)	200	260
1,1-Dichloroethane	100	400	Methyl bromide - skin	20	80
1,2-Dichloroethane (ethylene dichloride)	100	400	Methyl cellosolve (2-methoxyethanol)	25	80
1,2-Dichloroethylene	200	790	Methyl cellosolve acetate (ethylene glycol monomethyl ether acetate)	25	120
Dichloroethyl ether	15	90	Methyl chloride	100	210
Dichloromonofluoromethane	1000	4200	Methyl chloroform (1,1,1-trichloroethane)	500	2700
1,1-Dichloro-1-nitroethane	10	60	Methylcyclohexane	500	2000
Dichlorotetrafluoroethane	1000	7000	Methylcyclohexanol	100	470
Diethylamine	25	75	Methylcyclohexanone	100	460
Difluorodibromomethane	100	860	Methyl formate	100	250
Diisobutyl ketone	50	290	Methyl isobutyl carbinol (methyl amyl alcohol)	25	100
Dimethylaniline (N-dimethylaniline) - skin	5	25	α-Methyl styrene	100	480
Dimethylformamide	20	60	Methylene chloride (dichloromethane)	500	1750
1,1-Dimethylhydrazine - skin	0.5	1	Monomethyl aniline - skin	2	9
Dimethylsulfate - skin	1	5	Naphtha (coal tar)	200	800
Dipropylene glycol methyl ether	100	600	Naphtha (petroleum)	500	2000
Dioxane (diethylene dioxide)	100	360	Nickel carbonyl	0.001	0.007
Ethyl acetate	400	1400	Nitric acid	10	25
Ethyl acrylate - skin	25	100	p-Nitroaniline - skin	1	6
Ethyl alcohol (ethanol)	1000	1900	Nitrobenzene - skin	1	5
Ethylamine	25	45	Nitroethane	100	310
Ethylbenzene	200	870	Nitrogen dioxide	5	9
Ethyl bromide	200	890	Nitroglycerin	0.5	5
Ethyl chloride	1000	2600	Nitromethane	100	250
Ethyl ether	400	1200	2-Nitropropane	25	90
Ethyl formate	100	300	Nitrotoluene - skin	5	30
Ethyl silicate	100	850	Octane	500	2350
Ethylene chlorohydrin - skin	5	16	Ozone	0.1	0.2
Ethylenediamine	10	30	Pentane	1000	2950
Ethylene dibromide (1,2-dibromoethane)	25	190	Pentanone		
Ethylene imine - skin	5	9	(methyl propyl ketone)	200	700
Ethylene oxide	50	90	Perchloroethylene (tetrachloroethylene)	100	670
Fluorine	0.1	0.2	Phenol - skin	5	19
Fluorotrichloromethane	1000	5600	Phenylhydrazine - skin	5	22
Formaldehyde	5	6	Phosgene (carbonyl chloride)	1	4
Furfural	5	20	Phosphine	0.05	0.07
Furfuryl alcohol	50	200	Phosphorus trichloride	0.5	3
Gasoline	500	2000	Propyl acetate	200	840
Heptane (n-heptane)	500	2000	Propyl alcohol (isopropyl alcohol)	400	980
Hexane (n-hexane)	500	1800	Propyl ether (isopropyl ether)	500	2100
Hexanone (methyl butyl ketone)	100	410	Propylene dichloride (1,2-dichloropropane)	75	350
Hexone (methyl isobutyl ketone)	100	410			
Hydrazine - skin	1	1.3			
Hydrogen bromide	3	10			
Hydrogen chloride	5	7			

Gases and Vapors (cont.)

Substance	PPM	Approx. Mg. per Cu. M.	Substance	PPM	Approx. Mg. per Cu. M.
Propylene imine - skin	25	60	Tetrahydrofuran	200	590
Propylene oxide	100	240	Tetranitromethane	1	8
Pyridine	5	15	Toluene (toluol)	200	750
Quinone	0.1	0.4	o-Toluidine - skin	5	22
Stibine	0.1	0.5	Tolylene-2,4-diisocyanate	0.02*	0.14*
Stoddard solvent	500	2900	Trichloroethylene	100	520
Styrene monomer (phenylethylene)	100	420	Triethylamine	25	100
Sulfur dioxide	5	13	Trifluoromonobromomethane	1000	6100
Sulfur hexafluoride	1000	6000	Turpentine	100	560
Sulfur monochloride	1	6	Vinyl chloride	500	1300
Sulfur pentafluoride	0.025	0.25	(chloroethylene)	100	480
1,1,2,2-Tetrachloro- ethane - skin	5	35	Vinyl toluene	200	870
			Xylene (xylol)	5	25
			Xylidine - skin		

* Probably sufficiently low to protect against primary sensitization, but may not protect persons specifically sensitized.

Dusts, Fumes and Mists

Substance	Mg. per Cu. M.	Substance	Mg. per Cu. M.
Aldrin (1,2,3,4,10,10-hexachloro-1,4, 4a,5,8,8a-hexahydro-1,4,5,8-di- methanonaphthalene) - skin	0.25	Lindane (hexachlorocyclohexane, gamma isomer)	0.5
Ammate (ammonium sulfamate)	15	Lithium hydride	0.025
Antimony	0.5	Magnesium oxide fume	15
ANTU (alpha-naphthyl-thiourea)	0.3	Malathion (O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate) - skin	15
Arsenic	0.5	Manganese	5
Barium (soluble compounds)	0.5	Mercury	0.1
Beryllium	0.002	Mercury (organic compounds) - skin	0.01
Cadmium oxide fume	0.1	Methoxychlor (2,2-di-p-methoxyphenyl-1, 1,1-trichloroethane)	15
Calcium arsenate	0.1	Molybdenum	
Chlordane (1,2,4,5,6,7,8,8-octa- chloro-3a,4,7,7a-tetra-hydro-4, 7-methanoindane)	2	(soluble compounds)	5
Chlorinated camphene, 60%	0.5	(insoluble compounds)	15
Chlorinated diphenyl oxide	0.5	Nicotine - skin	0.5
Chlorodiphenyl (42% chlorine) - skin	1	Parathion (O,O-diethyl-O-p-nitrophenyl thiophosphate) - skin	0.1
Chlorodiphenyl (54% chlorine) - skin	0.5	Pentachloronaphthalene - skin	0.5
Chromic acid and chromates (as CrO ₃)	0.1	Pentachlorophenol - skin	0.5
Crag herbicide (sodium 2-(2,4-dichloro- phenoxy) ethanol hydrogen sulfate)	15	Phosphoric acid	1
Cyanide (as CN) - skin	5	Phosphorus (yellow)	0.1
2,4-D (2,4-dichlorophenoxyacetic acid)	10	Phosphorus pentachloride	1
DDT (2,2-bis (p-chlorophenyl)-1,1,1- trichloroethane)	1	Phosphorus pentasulfide	1
Dieldrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro- 1,4,5,8-dimethanonaphthalene) - skin	0.25	Picric acid - skin	0.1
Dinitrobenzene - skin	1	Pyrethrum	2
Dinitrotoluene - skin	1.5	Rotenone	5
Dinitro-o-cresol - skin	0.2	Selenium compounds (as Se)	0.1
EPN (O-ethyl O-p-nitrophenyl thiono- benzenephosphonate) - skin	0.5	Sodium fluoroacetate (1080) - skin	0.1
Ferbam (ferric dimethyl dithiocarbamate)	15	Sodium hydroxide	2
Ferrovandium dust	1	Strychnine	0.15
Fluoride	2.5	Sulfuric acid	1
Hydroquinone	2	TEDP (tetraethyl dithionopyro- phosphate) - skin	0.2
Iron oxide fume	15	TEPP (tetraethyl pyrophosphate) - skin	0.05
Lead	0.2	Tellurium	0.1
Lead arsenate	0.15	Tetryl (2,4,6-trinitrophenylmethyl- nitramine) - skin	1.5
		Thallium (soluble compounds)	0.1
		Thiram (tetramethyl thiuram disulfide)	5
		Titanium dioxide	15

Dusts, Fumes and Mists (cont.)

Substance	Mg. per Cu.M.	Substance	Mg. per Cu.M.
Trichloronaphthalene - skin	5	Warfarin (3-(α -acetonilylsyl)-	
Trinitrotoluene - skin	1.5	4-hydroxycoumarin)	0.5
Uranium		Yttrium	5
(soluble compounds)	0.05	Zinc oxide fume	15
(insoluble compounds)	0.25	Zirconium compounds (as Zr)	5
Vanadium			
(V ₂ O ₅ dust)	0.5		
(V ₂ O ₅ fume)	0.1		

Radioactivity: For permissible concentrations of radionuclides in air, see U. S. Department of Commerce, National Bureau of Standards, Handbook 69, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure", June 5, 1959. Also, see U. S. Department of Commerce, National Bureau of Standards, Handbook 59, "Permissible Dose from External Sources of Ionizing Radiation", September 24, 1954, and addendum of April 15, 1958.

Mineral and Non-Metallic Inorganic Dusts

Substance	MPPCF	Substance	MPPCF
Silica		Miscellaneous:	
Quartz		Aluminum Oxide	50
high (above 50% free silica)	5	Calcite	50
medium (5 to 50% free silica)	20	Dolomite	50
low (below 5% free silica)	50	Limestone	50
Cristobalite (above 5%)	5	Marble	50
Amorphous	20	Silicon Carbide	50
Silicates		Other Inert Dusts	50
<u>Asbestos</u>	<u>5</u>		
Mica	20		
Portland Cement	50		
Soapstone	20		
Talc	20		

Tentative Values

Substance	PPM	Approx. Mg. per Cu.M.	Substance	PPM	Approx. Mg. per Cu. M.
Acetonitrile	40	70	sec-Hexyl acetate	100	590
Allyl glycidyl ether (AGE)	10	45	Isopropyl glycidyl ether (IGE)	50	240
Boron oxide		15	Ketene	0.5	0.9
tert. Butyl chromate (as CrO ₃)		0.1	Methyl mercaptan	50	100
n-Butyl glycidyl ether (BGE)	50	270	1-Nitropropane	25	90
Butyl mercaptan	10	35	Pentaborane	0.005	0.01
Chloroacetaldehyde	1	3	Perchloromethyl mercaptan	0.1	0.8
Chlorobromomethane	200	1050	Phenyl glycidyl ether (PGE)	50	310
DDVP (O, O-Dimethyl-2, 2-			Phosdrin (2-carbomethoxy-1-		
Dichlorodivinyi phosphate)		1	methyl vinyl dimethyl phos-		
Diglycidyl ether (DGE)	10	55	phate)		0.1
Dimethyl acetamide	10	35	n-Propyl nitrate	25	110
Endrin (1, 2, 3, 4, 10, 10-hexa-			Systox		0.2
chloro-6, 7-epoxy-1, 4, 4a,			2, 4, 5T (2, 4, 5-trichloro-		
5, 6, 7, 8, 8a-octa hydro-1,			phenoxy acetic acid)		10
4-endo, endo-5, 8-dimeth-			Teflon decomposition		
anonaphthalene)		0.25	products (as F)		0.05
Ethanol amine	0.5	1	1, 2, 3-Trichloropropane	50	300
Ethyl mercaptan	250	640	1, 1, 2-Trichloro-1, 2, 2-tri-		
Glycidol	50	150	fluoroethane	1000	7600
Heptachlor (1, 4, 5, 6, 7, 8, 8-hep-			Triorthocresyl phosphate		0.1
tachloro-3a, 4, 7, 7a-tetrahydro-			Triphenyl phosphate		3
4, 7-methanoindene)		0.25			

(Signed): William L. Ball Herbert E. Stokinger Hervey B. Elkins William F. Reindollar
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