

Threshold Limit Values for 1961

Adopted at the 23rd Annual Meeting of the American Conference of Governmental Industrial Hygienists, Detroit, Michigan, 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	Acrylonitrile—Skin	20	45
Acetic acid	10	25	Allyl alcohol—Skin	2	5
Acetic anhydride	5	20	Allyl chloride	5	15
Acetone	1,000	2,400	Allyl propyl disulfide ...	2	12
Acetylene tetrabromide ..	1	14	Ammonia	100	70
Acrolein	0.5	12	Amyl acetate	200	1,050

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SUBSTANCE	PPM*	Approx. Mg. per Cu. M†	SUBSTANCE	PPM*	Approx. Mg. per Cu. M†
Amyl alcohol (isoamyl alcohol)	100	360	1,2-Dichloroethane (ethylene dichloride) ..	100	400
Aniline—Skin	5	19	1,2-Dichloroethylene	200	790
Argine	0.05	0.2	Dichloroethyl ether	15	90
Benzene (benzol)	25	80	Dichloromono-fluoro- methane	1,000	4,200
Benzyl chloride	1	5	1,1-Dichloro-1- nitroethane	10	60
Boron trifluoride	1	3	Dichlorotetra- fluoroethane	1,000	7,000
Bromine	0.1	0.7	Diethylaniline	25	75
Butadiene (1,3-butadiene) ..	1,000	2,200	Diffuorodibromo- methane	100	360
2-Butanone (methyl ethyl ketone) ..	200	590	Diisobutyl ketone	50	290
Butyl acetate (n-butyl acetate)	200	950	Dimethylaniline (N-di- methylaniline)—Skin ..	5	25
Butyl alcohol (n-butanol) ..	100	300	Dimethylformamide	20	60
tert. Butyl alcohol	100	300	1,1-Dimethylhydrazine— Skin	0.5	1
Butylamine	5	15	Dimethylsulfate—Skin ..	1	5
Butyl cellosolve (2-butoxyethanol)	50	240	Dipropylene glycol methyl ether	100	600
p-tert. Butyltoluene	10	60	Dioxane (1,4-dioxane)	100	360
Carbon dioxide	5,000	9,000	Ethyl acetate	400	1,400
Carbon disulfide—Skin ..	20	60	Ethyl acrylate—Skin ..	25	100
Carbon monoxide	100	110	Ethyl alcohol (ethanol) ..	1,000	1,900
Carbon tetrachloride— Skin	25	160	Ethylamine	25	45
Cellosolve (2-ethoxyethanol)	200	740	Ethylbenzene	200	870
Cellosolve acetate (2-ethoxyethyl acetate) ..	100	540	Ethyl bromide	200	890
Chlorine	1	3	Ethyl chloride	1,000	2,600
Chlorine dioxide	0.1	0.3	Ethyl ether	400	1,200
Chlorine trifluoride	0.1	0.4	Ethyl formate	100	300
Chlorobenzene (monochlorobenzene) ..	75	350	Ethyl silicate	100	850
Chloroform (trichloromethane)	50	240	Ethylene chlorohydrin— Skin	5	16
1-Chloro-1-nitropropane ..	20	100	Ethylene diamine	10	30
Chloropierin	0.1	0.7	Ethylene dibromide (1,2-dibromoethane) ..	25	190
Chloroprene (2-chloro-1,3- butadiene)	25	90	Ethyleneimine—Skin ..	5	9
Cresol (all isomers)—Skin ..	5	22	Ethylene oxide	50	90
Cyclohexane	400	1,400	Fluorine	0.1	0.2
Cyclohexanol	50	200	Fluorotrichloromethane ..	1,000	5,600
Cyclohexanone	50	200	Formaldehyde	5	6
Cyclohexene	400	1,350	Furfural	5	20
Decaborane—Skin	0.05	0.3	Furfuryl alcohol	50	200
Diacetone alcohol (4-hydroxy-4-methyl- 2-pentanone)	50	240	Gasoline	500	2,000
Diborane	0.1	0.1	Heptane (n-heptane)	500	2,000
p-Dichlorobenzene	50	300	Hexane (n-hexane)	500	1,800
p-Dichlorobenzene	75	450	Hexanone (methyl butyl ketone)	100	410
Dichlorodifluoromethane ..	1,000	4,950	Hexone (methyl isobutyl ketone)	100	410
1,1-Dichloroethane	100	400	Hydrazine—Skin	1	13

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

THRESHOLD LIMIT VALUES FOR 1961

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SUBSTANCE	PPM*	Approx. Mg. per Cu. M. [†]
Hydrogen cyanide—Skin	10	11
Hydrogen fluoride	3	2
Hydrogen peroxide, 90% ..	1	1.4
Hydrogen arsenide	0.05	0.2
Hydrogen sulfide	20	30
Sulfur	0.1	1
Isophorone	25	140
Isopropylamine	5	12
Mesityl oxide	25	100
Methyl acetate	200	610
Methyl acetylene	1,000	1,650
Methyl acrylate—Skin ..	10	35
Methylal (dimethoxymethane) ..	1,000	3,100
Methyl alcohol (methanol)	300	260
Methyl bromide—Skin ..	20	80
Methyl cellosolve (2-methoxyethanol) ...	25	80
Methyl cellosolve acetate (ethylene glycol mono- methyl ether acetate) ..	25	120
Methyl chloride	100	210
Methyl chloroform (1,1,1-trichloroethane) .	500	2,700
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	40
Methylcyclohexanone ...	100	40
Methyl formate	100	150
Methyl isobutyl carbinol (methyl amyl alcohol) ..	25	100
m-Methyl styrene	100	480
Methylene chloride (dichloromethane)	500	1,750
Monomethyl aniline— Skin	2	9
Naphthal (coal tar)	200	800
Naphthal (petroleum)	500	1,000
Nickel carbonyl	0.001	0.007
Nitric acid	10	25
p-Nitroaniline—Skin	1	6
Nitrobenzene—Skin	1	5
Nitroethane	100	310
Nitrogen dioxide	5	9
Nitroglycerin	0.5	5
Nitromethane	100	250
2-Nitropropane	25	90
Nitrotoluene—Skin	5	30
Octane	500	2,350
Ozone	0.1	0.2
Pentane	1,000	2,950

SUBSTANCE	PPM*	Approx. Mg. per Cu. M. [†]
Pentanone (methyl propyl ketone)	200	700
Perchloroethylene (tetrachloroethylene) ..	100	670
Phenol—Skin	5	19
Phenyldiazine—Skin ..	5	22
Phosgene (carbonyl chloride) ...	1	4
Phosphine	0.05	0.07
Phosphorus trichloride ..	0.5	3
Propyl acetate	200	840
Propyl alcohol (isopropyl alcohol) ...	400	980
Propyl ether (isopropyl ether)	500	2,100
Propylene dichloride (1,2-dichloropropane) ..	75	350
Propylene imine—Skin ..	25	60
Propylene oxide	100	240
Pyridine	5	15
Quinone	0.1	0.4
Stibine	0.1	0.5
Stockard solvent	500	2,900
Styrene monomer (phenylethylene)	100	420
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfur monochloride ...	1	6
Sulfur pentafluoride	0.025	0.25
1,1,2,2-Tetrachloro- ethane—Skin	5	35
Tetrahydrofuran	200	590
Tetramethoxymethane	1	8
Toluene (toluol)	200	750
m-Toluidine—Skin	5	22
Tolylene-2,4- diisocyanate	0.025	0.145
Trichloroethylene	100	520
Triethylamine	25	100
Trifluoromono- bromomethane	1,000	6,100
Turpentine	100	560
Vinyl chloride (chloroethylene)	500	1,300
Vinyl toluene	100	480
Xylene (xylol)	200	870
Xylidine—Skin	5	25

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

† Approximate milligrams per cubic meter of air.

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

Dusts, Fumes, and Mists

SUBSTANCE	Mg. per Cu. Ft.	SUBSTANCE	Mg. per Cu. Ft.
Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanonaphthalene)—Skin	0.25	Molybdenum (soluble compounds)	5
Ammonia (ammonium sulfamate)	15	(insoluble compounds)	15
Antimony	0.5	Nicotinic—Skin	0.5
ANTU (alpha-naphthyl-thiourea)	0.3	Parathion (O,O-diethyl-O-p-nitrophenyl thiophosphate)—Skin	0.1
Arsenic	0.5	Pentachloronaphthalene—Skin	0.5
Barium (soluble compounds)	0.5	Pentachlorophenol—Skin	0.5
Beryllium	0.002	Phosphoric acid	1
Cadmium oxide fume	0.1	Phosphorus (yellow)	0.1
Calcium arsenate	0.1	Phosphorus pentachloride	1
Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane) 2		Phosphorus pentasulfide	1
Chlorinated camphene, 60%	0.5	Picric acid—Skin	0.1
Chlorinated diphenyl oxide	0.5	Pyrethrum	2
Chlorodiphenyl (42% chlorine)—Skin 1		Rotenone	5
Chlorodiphenyl (54% chlorine)—Skin 0.5		Selenium compounds (as Se)	0.1
Chromic acid and chromates (as CrO ₃) 0.1		Sodium fluoroacetate (1050)—Skin ...	0.1
Crag herbicide (sodium 2-[2,4-dichlorophenoxy] ethanol hydrogen sulfate) .15		Sodium hydroxide	2
Cyanide (as CN)—Skin	5	Strychnine	0.15
2,4-D (2,4-dichlorophenoxyacetic acid) 10		Sulfuric acid	1
DDT (2,2-bis [p-chlorophenyl]-1,1,1-trichloroethane)	1	TEDP (tetraethyl dithionopyrophosphate)—Skin	0.2
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	TEPP (tetraethyl pyrophosphate)—Skin	0.05
Dinitrobenzene—Skin	1	Tellurium	0.1
Dinitrotoluene—Skin	1.5	Tetryl (2,4,6-trinitrophenylmethyl nitramine)—Skin	1.5
Dinitro-p-cresol—Skin	0.2	Thallium (soluble compounds)	0.1
EPN (O-ethyl O-p-nitrophenyl diionobenzenephosphonate)—Skin ...	0.5	Thiram (tetramethyl thiuram disulfide) 5	
Ferbam (ferric dimethyl dithiocarbamate)	15	Titanium dioxide	15
Ferrovanadium dust	1	Trichloronaphthalene—Skin	5
Fluoride	2.5	Trinitrotoluene—Skin	1.5
Hydroquinone	2	Uranium (soluble compounds)	0.05
Iron oxide fume	15	(insoluble compounds)	0.25
Lead	0.2	Vanadium (V ₂ O ₅ dust)	0.5
Lead arsenate	0.15	(V ₂ O ₅ fume)	0.1
Lindane (hexachlorocyclohexane, gamma isomer)	0.5	Warfarin (3-[alpha-acetylbenzyl]-hydroxycoumarin)	0.5
Lithium hydride	0.025	Yttrium	5
Magnesium oxide fume	15	Zinc oxide fume	15
Malathion (O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate)—Skin	15	Zirconium compounds (as Zr)	5
Manganese	5		
Mercury	0.1		
Mercury (organic compounds)—Skin .	0.01		
Methoxychlor (2,2-di-p-methoxyphenyl-1,1,1-trichloroethane)	15		

1 Milligrams of dust, fume, or mist per cubic meter of air.

Radioactivity: For permissible concentrations of radionuclides in air, see U.S. Department of Commerce, National Bureau of Standards, Handbook 62, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," June 3, 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.

SUBSTANCE

Silica

Quartz
High (a)
Medium
Low (b)
Cristobalite
Amorphous
Silicates
Asbestos
Mica
Portland C.

SUBSTANCE

Acetonitrile
Allyl glyce
(AGE)
Boron oxide
tert. But
(as CrO₃)
n-Butyl
(BGE)
Butyl me
Chloroac.
Chlorobn
DDVP
2,2-Di
phate)
Diglycidyl
Dimethyl
Endrin
achloro
5,6,7,8-t
endo, e
naphth.
Ethanol
Ethyl me
Glycidol
Heptach
heptach
tetrahy
indene)

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Mineral and Non-Metallic Inorganic Dusts

SUBSTANCE	M.P.P.C.F.†	SUBSTANCE	M.P.P.C.F.†
Silica		Soapstone	20
Quartz		Talc	20
High (above 50% free silica)	5	Miscellaneous:	
Medium (5 to 50% free silica) ...	20	Aluminum Oxide	50
Low (below 5% free silica)	50	Calcite	50
Cristobalite (above 5%)	5	Dolomite	50
Amorphous	20	Limestone	50
Silicates		Marble	50
Asbestos	5	Silicon Carbide	50
Mica	20	Other inert dusts	50
Portland Cement	50		

† Millions of particles per cubic foot of air based on isoprene samples counted by light-field techniques.

TENTATIVE VALUES

SUBSTANCE	P.P.M.‡	Approx. Mg. per Cu. M.±	SUBSTANCE	P.P.M.‡	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	1,050	Phenyl glycidyl ether (PGE)	50	310
DDVP (O,O-Dimethyl- 2,2-Dichlorodivinyl phos- phate)		1	Phosdrin (2-carbomethoxy- 1-methyl vinyl dimethyl phosphate)		0.1
Diglycidyl ether (DGE) .	10	55	n-Propyl nitrate	25	110
Dimethyl acetamide	10	35	Systox		0.2
Endrin (1,2,3,4,10,10-hex- achloro-6,7-epoxy-1,4,4a, 5,6,7,8,8a-octa hydro-1,4- endo, endo-5,6-dimethano- naphthalene)		0.25	2,4,5T (2,4,5-trichloro- phenoxy acetic acid) ..		10
Ethanol amine	0.5	1	Teflon decomposition products (as F)		0.05
Ethyl mercaptan	250	640	1,2,3-Trichloropropane ...	50	300
Glycidol	50	150	1,1,2-Trichloro-1,2,2- trifluoroethane	1,000	7,600
Heptachlor (1,4,5,6,7,8,8- heptachloro-3a,4,7,7a- tetrahydro-4,7-methano- indene)		0.25	Tetrithiocresyl phosphate .		0.1
			Triphenyl phosphate		3

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

± Approximate milligrams per cubic meter of air.

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