Table 2 .... Recommended Threshold Limit Values[a] (*Continued*)

Substance	Threshold Limit Values ACGIH[a] 1963 ppm[b]	mg/cu m[c]
Naphtha (coal tar)	200	800
Naphtha (petroleum)	500	2,000
β-Naphthylamine	—	A[1]
Nickel carbonyl	0.001	0.007
Nicotine—Skin	—	0.5
Nitric acid	10	25
p-Nitroaniline—Skin	1	6
Nitrobenzene—Skin	1	5
Nitroethane	100	310
Nitrogen dioxide	5	9
*Nitroglycerin—Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
N-Nitrosodimethylamine (Dimethyl-nitrosamine)—Skin	A[3]	—
Nitrotoluene—Skin	5	30
Octane	500	2,350
Osmium tetroxide	—	0.002
Ozone	0.1	0.2
Parathion (O, O, diethyl-O-p-nitrophenyl thiophosphate)—Skin	—	0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene—Skin	—	0.5
Pentachlorophenol—Skin	—	0.5
Pentanone (methyl propyl ketone)	200	700
Pentane	1,000	2,950
Perchloroethylene (tetrachloroethylene)	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Phenol—Skin	5	19
Phenyl glycidyl ether (PGE)	50	310
Phenylhydrazine—Skin	5	22
Phosdrin (2-carbomethoxy-1-methyl vinyl dimethyl phosphate	—	0.1
Phosgene (carbonyl chloride)	1	4
†Phosphine	0.3	0.4
Phosphoric acid	—	1
Phosphorus (yellow)	—	0.1
Phosphorus pentachloride	—	1
Phosphorus pentasulfide	—	1
Phosphorus trichloride	0.5	3
Picric acid—Skin	—	0.1
Platinum (Soluble Salts)	—	0.002
Propyl acetate	200	840
Propyl alcohol (isopropyl alcohol)	400	980
Propyl ether (isopropyl ether)	500	2,100
n-Propyl nitrate	25	110
Propylene dichloride (1,2-dichlsropropane)	75	350
Propylene imine—Skin	25	60
Propylene oxide	100	240
Pyrethrum	—	5
Pyridine	5	15
Quinone	0.1	0.4
Rotenone (commercial)	—	5
Selenium compounds (as Se)	—	0.1
Sodium fluoroacetate (1080)—Skin	—	0.05
Sodium hydroxide	—	2
Stibine	0.1	0.5
Stoddard solvent	500	2,900
Strychnine	—	0.15
Styrene monomer (phenylethylene)	100	420
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	—	1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfuryl fluoride	5	20
TEDP (tetraethyl dithionopyrophosphate)—Skin	—	0.2
Teflon (R) decomposition products	—	A[4]
TEPP (tetraethyl pyrophosphate)—Skin	—	0.05
Tellurium	—	0.1
1,1,2,2,-Tetrachloroethane—Skin	5	35
Tetrahydrofuran	200	590
Tetranitromethane	1	8
Tetryl (2,4,6-trinitrophenylmethylnitramine)—Skin	—	1.5
Thallium (soluble compounds)	—	0.1
Thiran (tetramethyl thiuram disulfide)	—	5
Titanium dioxide	—	15
*Toluene (toluol)	200	750
o-Toluidine—Skin	5	22
*Tolylene-2,4-diisocyanate	0.02	0.14
Trichloroethylene	100	520
Trichloronaphthalene—Skin	—	5
1,1,2-Trichloro 1,2,2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
Trinitrotoluene—Skin	—	1.5
Triorthocresyl phosphate	—	0.1
Triphenyl phosphate	—	3
Turpentine	100	560
Uranium (soluble compounds)	—	0.05
(insoluble compounds)	—	0.25
Vanadium *(V_2O_5 dust)	—	0.5
(V_2O_5 fume)	—	0.1

(*Continued from p. 151*)

In an application such as an ultra clean room, it may be necesssry to know the particle distribution in the air on a *count basis*, in order to arrive at proper filtering for the desired atmosphere. Where such a particle count is required, it is better to use simultaneous air sampling to give both weight and microscopic count, since it is practically impossible to convert weight measurements to a count index. Such factors as particle size, shape, specific gravity, and the characteristics of the sampling equipment are all important and make a mathematical conversion difficult, if not impossible.

For the removal of non-particulate materials which may have toxic, nuisance, corrosive, or undesirable odor properties, it is necessary to use various absorption systems. Many of these will be discussed subsequently under the treatment of *odors* (see Chapter 12).

Table 2 .... Recommended Threshold Limit Values[a] (*Concluded*)

Substance	ppm[b]	mg/cu m[c]
Vinyl chloride (chloroethylene)	500	1,300
Vinyl toluene	100	480
Warfarin (3-[acetonylbenzyl]-4-hydroxycoumarin)	—	0.1
Yttrium	—	5
*Xylene (xylol)	200	870
Xylidine—Skin	5	25
Zinc oxide fumes	—	5
Zirconium compounds (as Zr)	—	5

Radioactivity: For permissible concentrations of radioisotopes in air, see U. S. Department of Commerce, National Bureau of Standards, Handbook 69, *Maximum Permissible Body Burdens and Maximum 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 Dusts

Substance	mppcf[d]
*SILICA	
Crystalline	
Quarts, Threshold Limit calculated from the formula	250 / %SiO_2+5
Cristobalite, Threshold Limit calculated from the formula	
Amorphous, including natural diatomaceous earth	20
SILICATES (less than 1% crystalline silica)	
Asbestos	5
Mica	20
Soapstone	20
Talc	20
Portland Cement	50
Miscellaneous (less than 1% crystalline silica)	50

Note: The percent 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.

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

Tentative Values

Substance	ppm[b]	mg/cu m[c]
*tert. Butyl chromate (as CrO_3)	—	0.1
†Calcium oxide	—	5
Camphor	—	2
†Copper Fume	—	0.1
Dusts and Mists	—	1.0

Tentative Values (Concluded)

Substance	ppm[b]	mg/cu m[c]
DDVP (O, O-Dimethyl-2,2-dichlorovinyl phosphate)	—	1
†Demeton (R) (Systox)	—	0.1
Endrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octa hydro, 1,4-endo-5,8-dimethanonaphthalene)—Skin	—	0.1
Epichlorohydrin	5	19
Ethanolamine	3	6
†Graphite	—	15 mppcf
†Hafnium	—	0.5
Heptachlor (1,4,5,6,7,8,8a-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene)	—	0.5
†Methylamine	25	31
†Methyl Methacrylate	100	410
*†Methylene bis phenylisocyanate	0.02	0.2
†Mineral Wool (Fiberglas)	—	2
†Naphthalene	10	50
Oil (mineral)	—	5
†β-Propiolactone	—	A[5]
†Silver	—	0.05
†Tantalum	—	5
†1,1,1,2,-Tetrachloro-2,2,-difluoroethane	1,000	8,340
†1,1,2,2-Tetrachloro-1,2-difluoroethane	500	4,170
†Tetraethyl lead—Skin	—	0.075
†Tin (inorganic compounds)	—	2
(organic compounds as Sn) —Skin	—	0.1

Appendix A

A[1] *Benzidine.* Because of high incidence of bladder tumors in man, any exposure, including skin, is extremely hazardous.

A[2] *β-Naphthylamine.* Because of the extremely high incidence of bladder tumors in workers handling this compound, and the inability to control exposures, β-naphthylamine has been prohibited from manufacture, use and other activities that involve human contact by the State of Pennsylvania.

A[3] *N-Nitrosodimethylamine.* Because of extremely high toxicity and presumed carcinogenic potential of this compound, contact by all routes should not be permitted.

A[4] *Teflon® decomposition products.* At least one identified component of Teflon® decomposition products is extremely toxic, but, in the absence of more complete toxicity information and suitable analytical methods, a definite threshold limit value is not recommended at this time; but air concentrations should be minimal.

A[5] *β-Propiolactone.* Because of high acute toxicity and demonstrated skin tumor production in animals, contact by any route should be avoided.

[a] ACGIH = American Conference of Governmental Industrial Hygienists. Reprinted by permission of the ACGIH Committee on Threshold Limits.
[b] Parts of vapor or gas per million parts of air by volume at 25 C and 760 mm. Hg pressure.
[c] Approximate milligrams of particulate per cubic meter of air.
[d] Millions of particles per cubic foot of air, based on impinger samples counted by light field techniques.
† 1963 Revision. * Ceiling listing.

It is obvious that the continued pollution of the atmosphere by gases from combustion equipment, and by uncleaned waste gases from commercial and industrial establishments, is placing a severe burden, not only upon the engineer who must select air ventilation supply equipment, but also upon the population as a whole.

In recent years, several disasters and dramatic air pollution incidents have caused increased concern. In these instances, the combination of polluted air and unfavorable meteorological and topographical conditions have resulted in severe exposures for large numbers of the population. The Meuse Valley fog disaster of 1930 in Belgium, the Donora, Pennsylvania smog of 1948, and the London smog of 1952, are classic examples in the history of air pollution. In these instances it is