File 72

~~JLA~~
~~RLL~~
~~LHS~~
~~JCK~~

Threshold Limit Values of Airborne Contaminants

AND INTENDED CHANGES

Adopted By ACGIH For 1970

AMERICAN CONFERENCE of GOVERNMENTAL INDUSTRIAL HYGIENISTS

PREFACE

THRESHOLD LIMIT VALUES FOR 1970

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit, a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

Simple tests are now available (J. Occup. Med. 9, 537, 1967; Ann. N.Y. Acad. Sci., 151 Art. 2, p. 968, 1968) that may be used to detect those individuals hypersusceptible to a variety of industrial chemicals (respiratory irritants, hemolytic chemicals, organic isocyanates, carbon disulfide). These tests may be used to screen out by appropriate job placement the hyperreactive worker and thus in effect improve this "coverage" of the TLVs.

Threshold limit values refer to time-weighted concentrations for a 7 or 8-hour workday and 40-hour workweek. They should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations. (Exceptions are the substances listed in Appendices A and E and those substances designated with a "C" or Ceiling value, Appendix C.)

Time-weighted averages permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. In some instances it may be permissible to calculate the average concentration for a workweek rather than for a workday. The degree of permissible excursion is related to the magnitude of the threshold limit value of a particular substance as given in Appendix C. The relationship between threshold limit and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which threshold limits 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 factors must be taken into consideration in arriving at decision as to whether a hazardous condition exists.

ernmental

Industrial
on to re-
. Requests
ecretary-

50¢
40¢
30¢
15¢

separate
IH under
scientific
sources
mentation
response
er. For a
that the
ing used.

es of the
directed

Threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

The committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) as a relative index of hazard or toxicity, (2) in the evaluation or control of community air pollution or air pollution nuisances, (3) in estimating the toxic potential of continuous uninterrupted exposures, (4) as proof or disproof of an existing disease or physical conditions, or (5) for adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ.

Ceiling vs Time-Weighted Average Limits. Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose threshold limit is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling "C" limit that should not be exceeded. It is implicit in these definitions that the manner of sampling to determine compliance with the limits for each group must differ; a single brief sample, that is applicable to a "C" limit, is not appropriate to the time-weighted limit; here, a sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

Whereas the ceiling limit places a definite boundary which concentrations should not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are permissible above the listed values. The magnitude of these excursions may be pegged to the magnitude of the threshold limit by an appropriate factor shown in Appendix C. It should be noted that the same factors are used by the Committee in making a judgment whether to include or exclude a substance for a "C" listing.

"Skin" Notation. Listed substances followed by the designation "Skin" refer to the potential contribution to the over-all exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. This attention-calling designation is intended to suggest appropriate measures for the prevention of cutaneous absorption so that the threshold limit is not invalidated.

Mixtures. Special consideration should be given also to the application of the TLVs in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in Appendix B.

Nuisance Dusts. In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics: 1) The architecture of the air spaces remains intact. 2) Collagen (scar tissue) is not formed to a significant extent. 3) The tissue reaction is potentially reversible.

Excessive concentrations of nuisance dusts in the workroom air may seriously reduce visibility (iron oxide), may cause unpleasant deposits in the eyes, ears and nasal passages (Portland Cement dust), or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.

A threshold limit of 10mg/M^3, or 30 mppcf, of total dust < 1% SiO_2, whichever is less, is recommended for substances in these categories and for which no specific threshold limits have been assigned. This limit, for a normal workday, does not apply to brief exposures at higher concentrations. Neither does it apply to those substances which may cause physiologic impairment at lower concentrations but for which a threshold limit has not yet been adopted. Some "inert" particulates are given in Appendix D.

Simple Asphyxiants - "Inert" Gases or Vapors. A number of gases and vapors, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiologic effects. A TLV may not be recommended for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content should be 18 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, pO_2 of 135 mm Hg). Atmospheres deficient in O_2 do not provide adequate warning and most simple asphyxiants are ordorless. Several simple asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant. Specific examples are listed in Appendix E.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude) and the like may place added stress on the body so that the effects from exposure at a threshold limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. Although most threshold limits have built-in safety factors to guard against adverse effects to moderate deviations from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations. For example, continuous work at temperatures above 90°F or over-time extending the workweek more than 25%, might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the threshold limit values.

"Notice of Intent." At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intent." This Notice provides not only an opportunity for comment, but solicits suggestions of substances to be added to the list. The suggestions should be accompanied by substantiating evidence. The list of Intended Changes follows the Adopted Values in the TLV booklet.

As Legislative Code. The Conference recognizes that the TLVs may be adopted in legislative codes and regulations. If so used, the intent of the concepts contained in the Preface should be maintained and provisions should be made to keep the list current. These values are reviewed annually by the Committee on Threshold Limits for revision or additions, as further information becomes available.

Reprint Permission. This publication may be reprinted provided that written permission is obtained from the Secretary-Treasurer of the Conference and that it be published in its entirety.

ADOPTED VALUES
(In Alphabetical Order)

	Substance	ppm[a)]	mg/M³ [b)]
	Abate	--	15
	Acetaldehyde	200	360
	Acetic acid	10	25
	Acetic anhydride	5	20
	Acetone	1,000	2,400
	Acetonitrile	40	70
	Acetylene	E	--
	Acetylene dichloride, see 1, 2-Dichloroethylene	--	--
	Acetylene tetrabromide	1	14
	Acrolein	0.1	0.25
	Acrylamide-Skin	--	0.3
	Acrylonitrile-Skin	20	45
	Aldrin-Skin	--	0.25
	Allyl alcohol-Skin	2	5
	Allyl chloride	1	3
**C	Allyl glycidyl ether (AGE)	10	45
	Allyl propyl disulfide	2	12
	Alundum (Al_2O_3)	--	D
	2-Aminoethanol, see Ethanolamine	--	--
	2-Aminopyridine	0.5	2
**	Ammonia	50	35
	Ammonium sulfamate (Ammate)	--	15
	n-Amyl acetate	100	525
	sec-Amyl acetate	125	650
	Aniline-Skin	5	19
	Anisidine (o, p-isomers)-Skin	--	0.5
	Antimony & compounds (as Sb)	--	0.5
	ANTU (alpha naphthyl thiourea)	--	0.3
	Argon	E	--
	Arsenic & Compounds (as As)	--	0.5
	Arsine	0.05	0.2
	Azinphos-methyl-Skin	--	0.2
	Barium (soluble compounds)	--	0.5
C	Benzene (benzol)-Skin	25	80
	Benzidine-Skin	--	A1
	p-Benzoquinone, see Quinone	--	--
	Benzoyl peroxide	--	5
	Benzyl chloride	1	5
	Beryllium	--	0.002
	Biphenyl, see Diphenyl	--	--
	Bisphenol A, see Diglycidyl ether	--	--
	Boron oxide	--	15
	Boron tribromide	1	10
C	Boron trifluoride	1	3
	Bromine	0.1	0.7
*	Bromine pentafluoride	0.1	0.7
	Bromoform-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

a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm. Hg pressure.
b) Approximate milligrams of particulate per cubic meter of air.

** See Notice of Intended Changes
Capital letters refer to Appendices.

	Substance	ppm[a)]	mg/M[3 b)]
	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_3) - Skin .	--	0.1
	n-Butyl glycidyl ether (BGE).........	50	270
*	Butyl mercaptan	0.5	1.5
	p-tert-Butyltoluene	10	60
	Cadmium (Metal dust and soluble salts)	--	0.2
*C	Cadmium oxide fume (as Cd)	--	0.1
	Calcium carbonate	--	D
	Calcium arsenate	--	1
	Calcium oxide	--	5
**	Camphor (Synthetic)	2	--
	Carbaryl (Sevin ®)	--	5
	Carbon black	--	3.5
	Carbon dioxide	5,000	9,000
	Carbon disulfide-Skin	20	60
	Carbon monoxide	50	55
	Carbon tetrachloride-Skin	10	65
	Cellulose (paper fiber)	--	D
	Chlordane-Skin	--	0.5
	Chlorinated camphene-Skin	--	0.5
	Chlorinated diphenyl oxide	--	0.5
*	Chlorine	1	3
	Chlorine dioxide	0.1	0.3
C	Chlorine trifluoride	0.1	0.4
C	Chloroacetaldehyde	1	3
	α-Chloroacetophenone (phenacyl-chloride)	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% Chlorine) - Skin .	--	1
	Chlorodiphenyl (54% Chlorine) - Skin .	--	0.5
	1-Chloro, 2, 3-epoxypropane, see Epichlorhydrin	--	--
	2-Chloroethanol, see Ethylene chlorohydrin	--	--
	Chloroethylene, see Vinyl choride ...	--	--
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
	Chromic acid and chromates (as CrO_3)	--	0.1
	Chromium, sol. chromic, chromous salts as Cr	--	0.5
	Metal & insol. salts	--	1
	Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene)	--	0.2

* 1970 Addition
** *See Notice of Intended Changes*

Substance	ppm[a)]	mg/M^{3} [b)]
Cobalt, metal fume & dust	--	0.1
Copper fume	--	0.1
Dusts and Mists	--	1
Corundum (Al_2O_3)	--	D
Cotton dust (raw)	--	1
Crag® herbicide	--	15
Cresol (all isomers) - Skin	5	22
Crotonaldehyde	2	6
Cumene-Skin	50	245
Cyanide (as CN)-Skin	--	5
* Cyanogen	10	--
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclopentadiene	75	200
2, 4-D	--	10
DDT-Skin	--	1
DDVP, see Dichlorvos	--	--
Decaborane-Skin	0.05	0.3
Demeton® -Skin	--	0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1, 2-Diaminoethane, see Ethylene-diamine	--	--
Diazomethane	0.2	0.4
Diborane	0.1	0.1
C 1, 2-Dibromoethane (ethylene dibromide)-Skin	25	190
Dibutyl phosphate	1	5
Dibutylphthalate	--	5
*C Dichloroacetylene	0.1	0.4
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorodifluoromethane	1,000	4,950
1, 3-Dichloro-5, 5-dimethyl hydantoin	--	0.2
1, 1-Dichloroethane	100	400
1, 2-Dichloroethane	50	200
1, 2-Dichloroethylene	200	790
C Dichloroethyl ether-Skin	15	90
Dichloromethane, see Methylene-chloride	--	--
Dichloromonofluoromethane	1,000	4,200
C 1, 1-Dichloro-1-nitroethane	10	60
1, 2-Dichloropropane, see Pro-pylenedichloride	--	--
Dichlorotetrafluoroethane	1,000	7,000
Dichlorvos (DDVP)-Skin	--	1
Dieldrin-Skin	--	0.25
Diethylamine	25	75
Diethylamino ethanol-Skin	10	50
**C Diethylene triamine-Skin	10	42
Diethylether, see Ethyl ether	--	--
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone .	--	--
Diisobutyl ketone	50	290
Diisopropylamine-Skin	5	20

* 1970 Addition
** See Notice of Intended Changes

mg/M3 b)
0.1
0.1
1
D
1
15
22
6
245
5
--
1,050
200
200
1,015
200
10
1
--
0.3
0.1
240
--
0.4
0.1
190
5
5
0.4
300
450
4,950
0.2
400
200
790
90
--
4,200
60
--
7,000
1
0.25
75
50
42
--
860
2.8
--
290
20

Substance	ppm a)	mg/M3 b)
Dimethoxymethane, see Methylal	--	--
Dimethyl acetamide-Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene .	--	--
Dimethylaniline (N-dimethylaniline)-Skin	5	25
Dimethylbenzene, see Xylene	--	--
Dimethyl 1, 2-dibromo-2, 2-dichloroethyl phosphate, (Dibrom) ...	--	3
Dimethylformamide-Skin	10	30
2, 6-Dimethylheptanone, see Diisobutyl ketone	--	--
1, 1-Dimethylhydrazine-Skin	0.5	1
Dimethylphthalate	--	5
Dimethylsulfate-Skin	1	5
Dinitrobenzene (all isomers)-Skin	--	1
Dinitro-o-cresol-Skin	--	0.2
Dinitrotoluene-Skin	--	1.5
Dioxane (Diethylene dioxide)-Skin	100	360
Diphenyl	0.2	1
Diphenyl amine	--	10
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI)	--	--
Dipropylene glycol methyl ether-Skin .	100	600
Di-sec, octyl phthalate (Di-2-ethylhexylphthalate)..............	--	5
Emery	--	D
* Endosulfan (Thiodan ®)-Skin	--	0.1
Endrin-Skin	--	0.1
Epichlorhydrin-Skin	5	19
EPN-Skin	--	0.5
1, 2-Epoxypropane, see Propylene-oxide	--	--
2, 3-Epoxy-1-propanol, see Glycidol .	--	--
Ethane	E	--
Ethanethiol, see Ethylmercaptan	--	--
Ethanolamine	3	6
2-Ethoxyethanol-Skin	200	740
2-Ethoxyethylacetate (Cellosolve acetate)-Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate-Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
Ethyl mercaptan	0.5	1
Ethyl silicate	100	850
Ethylene	E	--
Ethylene chlorohydrin-Skin	5	16

* 1970 Addition
** See Notice of Intended Changes

E— Asphyxiants

Substance	ppm[a)]	mg/M^3 [b)]
o-Methylcyclohexanone-Skin	100	460
Methyl ethyl ketone (MEK), see 2-Butanone	--	--
Methyl formate	100	250
Methyl iodide - Skin	5	28
Methyl isobutyl carbinol-Skin	25	100
Methyl isobutyl ketone, see Hexone...	--	--
Methyl isocyanate - Skin	0.02	0.05
* Methyl mercaptan	0.5	1
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone	--	--
C Methyl silicate	5	30
C α Methyl styrene..................	100	480
C Methylene bisphenyl isocyanate (MDI).	0.02	0.2
Methylene chloride (dichloromethane).	500	1,740
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
β-Naphthylamine	--	A^1
Neon	E	--
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
Nitroethane	100	310
Nitrogen..........................	E	--
Nitrogen dioxide...................	5	9
Nitrogen trifluoride	10	29
Nitroglycerin-Skin.................	0.2	2
Nitromethane	100	250
1-Nitropropane.....................	25	90
2-Nitropropane.....................	25	90
N-Nitrosodimethylamine (dimethyl-nitrosoamine)-Skin	--	A^1
Nitrotoluene-Skin..................	5	30
Nitrotrichloromethane, see Chloropicrin	--	--
Nitrous oxide	E	--
Octachloronaphthalene-Skin	--	0.1
* Octane............................	400	1,900
* Oil mist, particulate..............	--	5[h]
* Oil mist, vapor	i) A^3	--
Osmium tetroxide	--	0.002
Oxalic acid	--	1
Oxygen difluoride..................	0.05	0.1
Ozone	0.1	0.2
Paraquat-Skin......................	--	0.5

h) As sampled by method that does not collect vapor.

i) According to analytically determined composition.

* 1970 Addition

** See Notice of Intended Changes

LAM 027436

ABS-009280

	ppm a)	mg/M3 b)
	100	460
	--	--
	100	250
	5	28
	25	100
	--	--
	0.02	0.05
	0.5	1
	100	410
e	--	--
	5	30
	100	480
	0.02	0.2
	500	1,740
	--	5
	--	15
	2	9
	0.2	0.35
	20	70
	100	400
	10	50
	--	A^1
	E	--
	0.001	0.007
Ni	--	1
	--	0.5
	2	5
	25	30
	1	6
	1	5
	--	1
	100	310
	E	--
	5	9
	10	29
	0.2	2
	100	250
	25	90
	25	90
	--	A^1
	5	30
	--	--
	E	--
	--	0.1
	400	1,900
	--	5h
	i) A^3	--
	--	0.002
	--	1
	0.05	0.1
	0.1	0.2
	--	0.5

apor.

.ition.

Substance	ppm a)	mg/M3 b)
Parathion-Skin	--	0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene-Skin	--	0.5
Pentachlorophenol-Skin	--	0.5
Pentaerythritol	--	D
* Pentane	500	1,500
2-Pentanone	200	700
Perchloroethylene	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
* Petroleum Distillates (naphtha)	i) A^3	--
Phenol-Skin	5	19
p-Phenylene diamine-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	0.4
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
Pival®(2-Pivalyl-1, 3-indandione)	--	0.1
Plaster of Paris	--	D
Platinum (Soluble Salts) as Pt	--	0.002
Polytetrafluoroethylene decomposition products	--	A^2
Propane	E	--
β Propiolactone	--	A^1
Propargyl alcohol-Skin	1	--
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride	75	350
Propylene imine-Skin	2	5
Propylene oxide	100	240
Propyne, see Methylacetylene	--	--
Pyrethrum	--	5
Pyridine	5	15
Quinone	0.1	0.4
RDX-Skin	--	1.5
Rhodium, Metal fume and dusts, as Rh	--	0.1
Soluble salts	--	0.001
Ronnel	--	10
Rotenone (commercial)	--	5
Rouge	--	D
Selenium compounds (as Se)	--	0.2
Selenium hexafluoride	0.05	0.4
Silicon carbide	--	D

i) According to analytically determined composition.

Capital letters refer to Appendices.

* 1970 Addition
** See Notice of Intended Changes

LAM 027437

ABS-009281

Substance	ppm[a)]	mg/M³ [b)]
Silver, metal and soluble compounds .	--	0.01
Sodium fluoroacetate (1080)-Skin	--	0.05
Sodium hydroxide	--	2
Stibine	0.1	0.5
Starch	--	D
* Stoddard solvent	200	1,150
Strychnine	--	0.15
**C Styrene monomer (phenylethylene) ...	100	420
Sucrose	--	D
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
Systox, see Demeton ®	--	--
2, 4, 5 T	--	10
Tantalum	--	5
TEDP-Skin	--	0.2
Teflon ® decomposition products	--	A2
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
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	500	4,170
1, 1, 2, 2-Tetrachloroethane-Skin ...	5	35
Tetrachloroethylene, see Perchloroethylene	--	--
Tetrachloromethane, see Carbon tetrachloride	--	--
Tetrachloronaphthalene-Skin	--	2
Tetraethyl lead (as Pb)-Skin	--	0.100 j)
Tetrahydrofuran	200	590
Tetramethyl lead (as Pb)-Skin	--	0.150 j)
Tetramethyl succinonitrile-Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2, 4, 6-trinitrophenylmethylnitramine)-Skin	--	1.5
Thallium (soluble compounds)-Skin as Tl	--	0.1
Thiram	--	5
Tin (inorganic cmpds, except SnH_4 and SnO_2)	--	2
Tin (organic cmpds)	--	0.1
Tin oxide	--	D
Titanium dioxide	--	D
Toluene (toluol)	200	750
C Toluene-2, 4-diisocyanate	0.02	0.14
o-Toluidine-Skin	5	22
Toxaphene, see Chlorinated camphene	--	--
Tributyl phosphate	--	5
1, 1, 1-Trichloroethane, see Methyl chloroform	--	--
1, 1, 2-Trichloroethane-Skin	10	45

j) For control of general room air, biologic monitoring is essential for personnel control.

* 1970 Addition
** See Notice of Intended Changes

Substance	ppm[a)]	mg/M³ [b)]
Trichloroethylene	100	535
Trichloromethane, see Chloroform	--	--
Trichloronaphthalene-Skin	--	5
1, 2, 3-Trichloropropane	50	300
1, 1, 2-Trichloro 1, 2, 2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
* Trimethyl benzene	25	120
2, 4, 6-Trinitrophenol, see Picric acid	--	--
2, 4, 6-Trinitrophenylmethylnitramine, see Tetryl	--	--
Trinitrotoluene-Skin	--	1.5
Triorthocresyl phosphate	--	0.1
Triphenyl phosphate	--	3
Tungsten & compounds, as W		
Soluble	--	1
Insoluble	--	5
Turpentine	100	560
Uranium (natural) sol. & insol. compounds as U	--	0.2
C Vanadium (V_2O_5 dust)	--	0.5
(V_2O_5 fume)	--	0.1
Vinyl benzene, see Styrene	--	--
**C Vinyl chloride	500	1,300
Vinylcyanide, see Acrylonitrile	--	--
Vinyl toluene	100	480
Warfarin	--	0.1
Xylene (xylol)	100	435
Xylidine-Skin	5	25
Yttrium	--	1
Zinc chloride fume	--	1
Zinc oxide fume	--	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 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.

* 1970 Addition
** See Notice of Intended Changes

MINERAL DUSTS

Substance	m.p.p.c.f.[e]
SILICA	
Crystalline	
** Quartz, Threshold Limit calculated from the formula	$\frac{250^{f)}}{\%SiO_2+5}$
** Cristobalite " " "	
Amorphous, including natural diatomaceous earth	20
SILICATES (less than 1% crystalline silica)	
** Asbestos, all types	5
Mica	20
Portland Cement	50
Soapstone	20
Talc (non-asbestiform)................	20
Talc (fibrous), use asbestos limit......	--
Tremolite, see asbestos	--
Graphite (natural)	15
** "Inert" or Nuisance Particulates see Appendix D	50 (or 15 mg/M^3 whichever is the smaller) of total dust < 1% SiO_2

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

LAM 027440

e) Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

f) The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

** See Notice of Intended Changes for Mineral Dusts.

ABS-009284

NOTICE OF INTENDED CHANGES
(for 1970)

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least two years. During this time, the previously Adopted Limit will remain in effect. If, after two years no evidence comes to light that questions the appropriateness of the values herein, the values will be placed in the "Adopted" list. Documentation is available for each of these substances.

MERCURY ***(all forms except alkyl) ...... 0.05 mg/M³***

Substance	ppm	mg/M³
2-Acetylaminofluorene-Skin	--	A[1]
+ Allyl glycidyl ether	5	22
4-Aminodiphenyl-Skin	--	A[1]
+ Ammonia	25	18
+ Ammonium chloride fume	--	10
Asphalt (petroleum) fumes	--	5
+ Butyl lactate	1	5
+ Camphor (synthetic)	2	12
+ Diazinon-Skin	--	0.1
+ 2-N Dibutylamino ethanol-Skin	2	14
Dichlorobenzidine-Skin	--	A[1]
+ Diethylene triamine-Skin	1	4
4-Dimethylaminoazobenzene	--	A[1]
Fibrous glass	g) --	D
+ C Formaldehyde	2	3
+ Iron pentacarbonyl	0.01	0.08
+ Mercury (Alkyl compounds) - Skin	--	0.01
+ Methyl chloride	100	210
Methyl 2-cyanoacrylate	2	8
+ Methylcylopentadienyl manganese tricarbonyl (as Mn)	0.1	0.2
Methyl demeton-Skin	--	0.5
Methyl parathion-Skin	--	0.2
Phenothiazine-Skin	--	5
+ Rosin Core Solder, pyrolysis products	--	0.1 (as aldehyde)
Styrene	100	420
+ C Subtilisins (Proteolytic enzymes)	--	0.0003 (as 100% pure crystalline enzyme)
+ Vanadium (V_2O_5 Fume) as V	--	0.05
Vinyl acetate	10	30
+ Vinyl chloride	200	770
+ Wood dust (non allergenic)	--	5

\+ 1970 Revision or Addition
Capital letters refer to Appendices
g) < 5-7 μ Diameter. No TLV for coarse fibrous glass has yet been set.

st
's counted
etermined
hods have

NOTICE OF INTENDED CHANGES (Cont'd)
MINERAL DUSTS

SUBSTANCE	TLV
+ Asbestos (All types)	5 fibers/ml > 5 μ in length[k]
+ Coal dust (bituminous)	2 mg/m^3 (respirable dust)[m]
Cristobalite	Use one-half the value calculated from the count or mass formulae for quartz.
+ 'Inert' or Nuisance Particulates	10 mg/M^3 or 30 mppcf (whichever is the smaller) of total dust < 1% SiO_2[n]
+ Quartz	TLV in mppcf: $\frac{300}{\%SiO_2+10}$ TLV for respirable dust in mg/m^3: $\frac{10\ mg/M^3}{\%\ \text{Respirable quartz} + 2}$[p] TLV for "total dust", respirable and nonrespirable: $\frac{30\ mg/M^3}{\%\ \text{quartz} + 3}$
Silica, fused	Use quartz formulae
Tridymite	Use one-half the value calculated from formulae for quartz.

\+ 1970 Revision or Addition

k) As determined by the membrane filter method at 430 X magnification phase contrast illumination. Concentrations > 5 fibers/ml, but not to exceed 10, may be permitted for 15-minute periods each hour up to five times daily.

m) "Respirable" dust as defined by the British Medical Research Council Criteria (1) and as sampled by a device producing equivalent results (2).

(1) Hatch, T.E. and Gross, P., Pulmonary Deposition and Rentention of Inhaled Aerosols, p. 149. Academic Press, New York, New York, 1964.

(2) Interim Guide for Respirable Mass Sampling, AIHA Aerosol Technology Committee, AIHA J. 31, 2, 1970, p. 133.

n) This automatically reduces all particulate substances in Adopted list with TLV of 15 mg/M^3 to 10 mg/M^3.

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

Aerodynamic Diameter (μ) (unit density sphere)	% passing selector
≤ 2	90
2.5	75
3.5	50
5.0	25
10	0

APPENDIX A

A1 Because of the high incidence of cancer, either in man or in animals, no exposure or contact by any route, respiratory, oral or skin should be permitted for the compounds:

2-Acetylaminofluorene	beta-Naphthylamine
4-Aminodiphenyl	4-Nitrodiphenyl
Benzidine & its salts	N-Nitrosodimethylamine
Dichlorobenzidine	beta-Propiolactone
4-Dimethylaminoazobenzene	

Because of the extremely high incidence of bladder tumors in workers handling beta-naphthylamine and the potential carcinogenic activity of the other compounds, the State of Pennsylvania prohibits the manufacture, use and other activities that involve human exposure without express approval by the Department of Health.

A2 **Polytetrafluoroethylene* decomposition products.** Thermal decomposition of the fluorocarbon chain in air leads to the formation of oxidized products containing carbon, fluorine and oxygen. Because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluoride to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimal.

A3 **Gasoline and/or Petroleum Distillates.** The composition of these materials varies greatly and thus a single TLV for all types of these materials is no longer applicable. In general, the aromatic hydrocarbon content will determine what TLV applies. Consequently the content of benzene, other aromatics and additives should be determined to arrive at the appropriate TLV (Elkins, et al. A.I.H.A.J. 24, 99, 1963).

* Trade Names: Algoflōn, Fluon, Halon, Teflon, Tetran

APPENDIX B

B.1 THRESHOLD LIMIT VALUES FOR MIXTURES

When two or more hazardous substances are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \text{-----} \frac{C_n}{T_n}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit, (See Example 1A.a.).

Exceptions to the above rule may be made when there is good reason to believe that the chief effects of the different harmful substances are not in fact additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit ordinarily is exceeded only when at least one member of the series $\left(\frac{C_1}{T_1} + \text{or} + \frac{C_2}{T_2} \text{ etc.}\right)$ itself has a value exceeding unity, (See Example 1A.b.).

Antagonistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or antagonistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristically emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc., (Example 2.)

THRESHOLD LIMIT VALUES FOR MIXTURES
EXAMPLES

1A. General case, where air is analyzed for each component

a. Additive effects. (note: It is essential that the atmosphere be analyzed both qualitatively and quantitatively for each component present, in order to evaluate compliance or noncompliance with this calculated TLV.)

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \cdots\cdots = 1$$

Example No. 1: Air contains 5 ppm of carbon tetrachloride (TLV = 10 ppm) 20 ppm of ethylene dichloride (TLV = 50 ppm) and 10 ppm of ethylene dibromide (TLV = 25 ppm)

Atmospheric concentration of mixture =

5 + 20 + 10 = 35 ppm of mixture

$$\frac{5}{10} + \frac{20}{50} + \frac{10}{25} = \frac{25 + 20 + 20}{50} = 1.3$$

Threshold Limit is exceeded. Furthermore, the TLV of this mixture may be calculated by reducing the total fraction to 1.0; i.e.

$$\text{TLV of mixture} = \frac{35}{1.3} = 27 \text{ ppm}$$

Example No. 2: Air contains 200 ppm of hexane (TLV = 500 ppm) 100 ppm of methylene chloride (TLV = 500 ppm) and 20 ppm of perchlorethylene (TLV = 100 ppm)

Atmospheric concentration of mixture =

200 + 100 + 20 = 320 ppm of mixture

$$\frac{200}{500} + \frac{100}{500} + \frac{20}{100} = \frac{200 + 100 + 100}{500} = \frac{400}{500} = 0.8$$

Threshold Limit is not exceeded. The TLV of this mixture $= \frac{320}{0.8} = 400$ ppm

1B. Special case when the source of contaminant is a liquid mixture and the atmospheric composition is assumed to be similar to that of the original material; e.g. on a time weighted average exposure basis, all of the liquid (solvent) mixture eventually evaporates.

a. Additive effects (approximate solution)

1. The percent composition (by weight) of the liquid mixture is known, the TLVs of the constituents must be listed in mg/M^3.

(NOTE: In order to evaluate compliance with this TLV, field sampling instruments should be calibrated, in the laboratory, for response to this specific quantitative and qualitative air-vapor mixture, and also to fractional concentrations of this mixture; e.g., 1/2 the TLV; 1/10 the TLV; 2 X the TLV; 10 X the TLV; etc.)

$$\text{TLV of mixture} = \frac{1}{\frac{f_a}{TLV_a} + \frac{f_b}{TLV_b} + \frac{f_c}{TLV_c} + \cdots\cdots \frac{f_n}{TLV_n}}$$

Example No. 1: Liquid solvent contains (by weight) 50% heptane (TLV = 2000 mg/M^3) 30% methylene chloride (TLV = 1740 mg/M^3) 20% perchlorethylene (TLV = 670 mg/M^3)

$$\text{TLV of mixture} = \frac{1}{\frac{0.5}{2000}+\frac{0.3}{1740}+\frac{0.2}{670}} = \frac{1}{.00025+.00017+.0003}$$

$$= \frac{1}{.00072} = 1390 \ mg/M^3$$

Of this mixture: 50% or 695 mg/M^3 is heptane, 30% or 417 mg/M^3 is methylene chloride and 20% or 278 mg/M^3 is perchlorethylene

These values can be converted to ppm as follows:

heptane: 2000 mg/M^3 = 500 ppm
1 mg/M^3 = 0.25 ppm
695 mg/M^3 = 174 ppm

methylene chloride: 1740 mg/M^3 = 500 ppm
1 mg/M^3 = 0.287 ppm
417 mg/M^3 = 119 ppm

ontaminant is a
composition is
riginal material;
osure basis, all
ally evaporates.

ion)

weight) of the
TLVs of the
ng/M3.

liance with this
nents should be
y, for response
and qualitative
fractional con-
; e.g., 1/2 the
TLV; 10 X the

$+ \ldots\ldots \frac{f_n}{TLV_n}$

by weight) 50%
3) 30% methylene
/M3) 20% per-
ng/M3)

$\frac{1}{5+.00017+.0003}$

eptane, 30% or
e chloride and
erchlorethylene

ows:

m

pm

perchlorethylene: 670 mg/M^3 = 100 ppm
1 mg/M^3 = 0.15 ppm
278 mg/M^3 = 42 ppm

The TLV of this mixture = 174 + 119 + 42 = 335 ppm.

1B.b. General Exact Solution for Mixtures of N Components With Additive Effects and Different Vapor Pressures.

(1) $\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots\ldots + \frac{C_n}{T_n} = 1;$

(2) $C_1 + C_2 + \ldots\ldots + C_n = T;$

(2.1) $\frac{C_1}{T} + \frac{C_2}{T} + \ldots\ldots + \frac{C_n}{T} = 1.$

By the Law of Partial Pressures,

(3) $C_1 = ap_1,$

and by Raoult's Law,

(4) $p_1 = F_1 p_1^{o}.$

Combine (3) and (4) to obtain

(5) $C_1 = aF_1 p_1^{o}.$

Combining (1), (2,1) and (5), we obtain

(6) $$\frac{F_1 p_1^o}{T} + \frac{F_2 p_2^o}{T} + \ldots\ldots + \frac{F_n p_n^o}{T} = \frac{F_1 p_1^o}{T_1} + \frac{F_2 p_2^o}{T_2} + \ldots\ldots + \frac{F_n p_n^o}{T_n}$$

and solving for T,

(6.1) $$T = \frac{F_1 p_1^o + F_2 p_2^o + \ldots\ldots + F_n p_n^o}{\frac{F_1 p_1^o}{T_1} + \frac{F_2 p_2^o}{T_2} + \ldots\ldots + \frac{F_n p_n^o}{T_n}}$$

or

(6.2) $$T = \frac{\sum_{i=1}^{i=n} F_1 p_1^o}{\sum_{i=1}^{i=n} \frac{F_1 p_1^o}{T_1}}$$

T = Threshold Limit Value in ppm.
C = Vapor concentration in ppm.
p = Vapor pressure of component in solution.
p^o = Vapor pressure of pure component.
F = Mol fraction of component in solution.
a = A constant of proportionality.

Subscripts 1, 2, . . . n relate the above quantities to components 1, 2, . . . n, respectively.

Subscript i refers to an arbitrary component from 1 to n.

Absence of subscript relates the quantity to the mixture.

1B. c. Solution to be applied when there is a reservoir of the solvent mixture whose composition does not change appreciably by evaporation.

Exact Arithmetic Solution of Specific Mixture

	Mol. wt.	Density	TLV	p^o at 25°C	Mol fraction in half-and-half solution by volume
Trichloro-ethylene (1)	131.4	1.46g/ml	100	73mm Hg	0.527
Methylchlo-roform (2)	133.42	1.33g/ml	350	125mm Hg	0.473

$$F_1p_1^o = (0.527)\ (73) = 38.2$$

$$F_2p_2^o = (0.473)\ (125) = 59.2$$

$$TLV = \frac{38.2 + 59.2}{\frac{38.2}{100} + \frac{59.2}{350}} = \frac{(97.4)\quad(350)}{133.8 + 59.2} = \frac{(97.4)\quad(350)}{193.0} = 177$$

TLV = 177 ppm (Note difference in TLV when account is taken of vapor pressure and mol fraction in comparison with above sample where such account is not taken.)

2. A mixture of one part of (1) parathion (TLV, 0.1) and two parts of (2) EPN (TLV, 0.5).

$$\frac{C_1}{0.1} + \frac{C_2}{0.5} = \frac{C_m}{T_m} \qquad C_2 = 2C_1$$

olution.
t.
tion.

/e quantities to

omponent from

tity to the mix-

a reservoir of
does not change

Mixture

	Mol fraction in half-and-half solution by volume
Hg	0.527
Hg	0.473

$\frac{)7.4)\ (350)}{193.0} = 177$

when account is
. and mol fraction
/e sample where
.)

'LV, 0.1) and two

$$C_m = 3C_1$$

$$\frac{C_1}{0.1} + \frac{2C_1}{0.5} = \frac{3C_1}{T_m}$$

$$\frac{7C_1}{0.5} = \frac{3C_1}{T_m}$$

$$T_m = \frac{1.5}{7} = 0.21 \text{ mg/M}^3$$

1C. TLV for Mixtures of Mineral Dusts.

For mixtures of biologically active mineral dusts the general formula for mixtures may be used.

For a mixture containing 80% talc and 20% quartz, the TLV for 100% of the mixture is given by:

$$\text{TLV} = \frac{1}{\frac{0.8}{20} + \frac{0.2}{2.5}} = 8.4 \text{ mppcf}$$

Essentially the same result will be obtained if the limit of the more (most) toxic component is used provided the effects are additive. In the above example the limit for 20% quartz is 10 mppcf.

For another mixture of 25% quartz, 25% amorphous silica and 50% talc:

$$\text{TLV} = \frac{1}{\frac{0.25}{2.5} + \frac{0.25}{20} + \frac{0.5}{20}} = 7.3 \text{ mppcf}$$

The limit for 25% quartz approximates 8 mppcf.

APPENDIX C

PERMISSIBLE EXCURSIONS FOR TIME-WEIGHTED AVERAGE (TWA) LIMITS

The Excursion TLV Factor in the Table automatically defines the magnitude of the permissible excursion above the limit for those substances not given a "C" designation; i.e., the TWA limits. Examples in the Table show that nitrobenzene, the TLV for which is 1 ppm, should never be allowed to exceed 3 ppm. Similarly, carbon tetrachloride, TLV 10 ppm, should never be allowed to exceed 20 ppm. By contrast, those substances with a "C" designation are not subject to the excursion factor and must be kept below the TLV.

These limiting excursions are to be considered to provide a 'rule-of-thumb' guidance for listed substances generally, and may not provide the most appropriate excursion for a particular substance. Efforts are being made to develop such specific excursions, when indicated to be significantly different from that recommended by the present excursion factors.

Substance	TLV	Excursion Factor	Max. Conc. Permitted for short time
Nitrobenzene	1 ppm	3	3 ppm
Carbon tetrachloride	10 ppm	2	20 ppm
Carbon monoxide	50 ppm	1.5	75 ppm
Acetone	1000 ppm	1.25	1250 ppm
Boron trifluoride	C 1 ppm	-	1 ppm
Butylamine	C 5 ppm	-	5 ppm
Styrene monomer	C 100 ppm	-	100 ppm

For all substances:

TLV = 0 - 1	(ppm or mg/m^3),	Excursion	Factor	= 3
TLV = 1 - 10	"	"	"	= 2
TLV = 10 - 100	"	"	"	= 1.5
TLV = 100 - 1000	"	"	"	= 1.25

BASIS FOR ASSIGNING LIMITING "C" VALUES

By definition in the Preface, a listed value bearing a "C" designation refers to a 'ceiling' value that should not be exceeded; all values should fluctuate below the listed value. This, in effect, makes the "C" designation a maximal allowable concentration (MAC). In general, the bases for assign-

E-WEIGHTED

automatically de-
xcursion above the
' designation; i.e.,
how that nitroben-
d never be allowed
ıchloride, TLV 10
ppm. By contrast,
are not subject to
ıt below the TLV.

.sidered to provide
ıstances generally,
te excursion for a
.de to develop such
significantly dif-
ent excursion fac-

:sion tor	Max. Conc. Permitted for short time
	3 ppm
	20 ppm
5	75 ppm
25	1250 ppm
	1 ppm
	5 ppm
	100 ppm

Factor = 3
" = 2
" = 1.5
" = 1.25

"C" VALUES

alue bearing a "C"
that should not be
ow the listed value.
n a maximal allow-
e bases for assign-

ing or not assigning a "C" value rest on whether excursions of concentration above a proposed limit for periods up to 15 minutes may result in a) intolerable irritation, b) chronic, or irreversible tissue change, or c) narcosis of sufficient degree to increase accident proneness, impair self-rescue or materially reduce work efficiency.

APPENDIX D

Some "Inert" or Nuisance Particulates [q)]

Alundum (Al_2O_3)	Kaolin
Calcium carbonate	Limestone
Cellulose (paper fiber)	Magnesite
Portland Cement	Marble
Corundum (Al_2O_3)	Pentaerythritol
Emery	Plaster of Paris
Glycerine Mist	Rouge
Graphite (synthetic)	Silicon Carbide
Gypsum	Starch
Vegetable oil mists (except castor, cashew nut, or similar irritant oils)	Sucrose
	Tin Oxide
	Titanium Dioxide

q) When toxic impurities are not present, e.g. quartz $<1\%$.

APPENDIX E

Some Simple Asphyxiants - "Inert" Gases and Vapors

Acetylene	Hydrogen
Argon	Methane
~~Ethane~~	Neon
Ethylene	Nitrogen
Helium	Nitrous Oxide
	Propane

1970 TLV COMMITTEE MEMBERS

Paul E. Caplan	Harold N. MacFarland, Ph. D.
Hervey B. Elkins, Ph. D.	Frederick T. McDermott
W. G. Fredrick, Sc. D.	E. Mastromatteo, M. D.
Bernard Grabois, P. E.	Col. Walter W. Melvin, Jr., M.D.
Paul Gross, M. D.	Ralph G. Smith, Ph. D.
Wayland J. Hayes, Jr., M. D.	Mitchell R. Zavon, M. D.
John W. Knauber	

Herbert E. Stokinger, Ph. D., Chairman
William D. Wagner, Recording Sec'y

SM-32 (REV. 5-78)

Shell Oil Company
Interoffice Memorandum

SEPTEMBER 30, 1986

ENVIRONMENTAL AND OCCUPATIONAL HYGIENE	
DATE 10-3-86	NAME J. C. Gillespie
	Return Document to File
X	Record Copy in File
	Information Copy
Record Copy in ECB Sate	
Copy: AF Schmit, BT Wagger	
Circulate:	

FROM: SR. INDUSTRIAL HYGIENIST, HEALTH & SAFETY, MFG. & TECH.

TO: SEE ATTACHED DISTRIBUTION LIST

SUBJECT: SUPPLEMENTAL ASBESTOS COMPLIANCE INFORMATION

The attached information was copied from a 1985 EPA document on managing asbestos abatement projects. You may find it of value in addressing the contractor selection issue for major asbestos projects.

P. J. Snyder

P. J. Snyder

PJS:bjd

Attachment.

cc: A. D. Ditmar
G. L. Greene
J. L. Rivard

LAM 027452

ABS-009296

BT8627304

DISTRIBUTION LIST

ANACORTES REFINERY
MANAGER, HEALTH, SAFETY AND ENVIRONMENT

DEER PARK MANUFACTURING COMPLEX
SUPERINTENDENT, HEALTH, SAFETY AND ENVIRONMENTAL
MANAGER, HEALTH AND SAFETY

GEISMAR PLANT
MANAGER, HEALTH, SAFETY AND ENVIRONMENT

MARIETTA PLANT
MANAGER, HEALTH, SAFETY AND ENVIRONMENT

MARTINEZ MANUFACTURING COMPLEX
MANAGER, HEALTH AND SAFETY

NORCO MANUFACTURING COMPLEX
MANAGER, HEALTH, SAFETY AND MEDICAL

ODESSA REFINERY
MANAGER, HEALTH, SAFETY AND ENVIRONMENTAL

TAFT PLANT
SAFETY AND TRAINING REPRESENTATIVE

WILMINGTON MANUFACTURING COMPLEX
MANAGER, HEALTH, SAFETY AND ENVIRONMENTAL

WOODBURY PLANT
MANAGER, HEALTH, SAFETY AND ENVIRONMENT

WOOD RIVER MANUFACTURING COMPLEX
MANAGER, SAFETY AND INDUSTRIAL HYGIENE

LAM 027453

GUIDANCE FOR CONTROLLING ASBESTOS-CONTAINING MATERIALS IN BUILDINGS

1985 EDITION

Exposure Evaluation Division
Office of Toxic Substances
Office of Pesticides and Toxic Substances
U.S. Environmental Protection Agency
Washington, D.C. 20460

LAM 027454

ABS-009298

Appendix K. Checklist for Determining Contractor Qualifications

a. Contractors shall demonstrate reliability in performance of general contracting activities through the submission of a list of references of persons who can attest to the quality of work performed by the contractor.

b. Contractors must demonstrate ability to perform asbestos abatement activities by submitting evidence of the successful completion of training courses covering asbestos abatement. At a minimum, the contractor shall furnish proof that employees have had instruction on the dangers of asbestos exposure, on respirator use, decontamination, and OSHA regulations.

c. Contractors must be able to demonstrate prior experience in performing previous abatement projects through the submission of a list of prior contracts, including: the names, addresses, and telephone numbers of building owners for whom the projects were performed. In rare circumstances inexperienced contractors may be qualified if they can demonstrate exceptional qualifications in the other contractor standards.

d. Additional evidence of successful completion of prior abatement projects should be demonstrated by contractors through the submission of air monitoring data, if any, taken during and after completion of previous projects in accordance with 29 CFR 1910.1001 (e).

e. Contractors must possess written standard operating procedures and employee protection plans which include specific reference to OSHA medical monitoring and respirator training programs. In addition, the contractor must be prepared to make available for viewing at the job site a copy of OSHA regulations at 29 CFR 1910.1001 governing asbestos controls, and Environmental Protection Agency regulations at 40 CFR Part 61, Subpart M, (NESHAPS) governing asbestos stripping work practices, and disposal of asbestos waste.

f. In those States which have contractor certification programs, contractors must possess State certifications for the performance of asbestos abatement projects.

g. Contractors must be able to provide a description of any asbestos abatement projects which have been prematurely terminated, including the circumstances surrounding the termination.

h. Contractors must provide a list of any contractual penalties which the contractor has paid for breach or noncompliance with contract specifications, such as overruns of completion time or liquidated damages.

i. Any citations levied against the contractor by any Federal, State, or local government agencies for violations related to asbestos abatement, shall be identified by contractors, including the name or location of the project, the date(s), and how the allegations were resolved.

j. Contractors must submit a description detailing all legal proceedings, lawsuits or claims which have been filed or levied against the contractor or any of his past or present employees for asbestos-related activities.

k. Contractors must supply a list of equipment that they have available for asbestos work. This should include negative air machines, type "C" supplied air systems, scaffolding, decontamination facilities, disposable clothing, etc.

LAM 027455

ABS-009299

In most cases, the in-house maintenance staff will not have enough time to master asbestos abatement methods for surfacing materials—removal, enclosure, and encapsulation. However, some school districts with many buildings containing surfacing ACM have formed asbestos abatement teams whose sole responsibility is control of ACM. These in-house teams can thoroughly learn the requirements and methods of asbestos abatement. With this training and knowledge of the buildings, an in-house team may be the most effective. More typically, however, an outside contractor specializing in asbestos abatement is hired for specific abatement projects.

Building maintenance workers accustomed to repairing equipment with insulation are frequently trained to undertake abatement actions involving pipe and boiler insulation. However, outside contractors are typically hired to remove extensive amounts of insulation or to remove both pipe and insulation.

6.2 Selecting a Contractor

Selecting a competent contractor is the first step toward successful abatement. EPA's experience with asbestos abatement and comments from technical advisors suggest that many contractors cannot properly conduct abatement projects. Several contractors, awarded jobs based on responsive and reasonable cost bids, proved unable or unwilling to follow contract specifications. Suggestions to help building owners avoid these situations are as follows:

- Assign the technical advisor who will monitor the abatement work to assist in writing job specifications and selecting the contractor. The advisor should not be employed by an abatement contractor.
- Require evidence of prospective contractors' experience and/or training in asbestos abatement.
- Check references, including other building owners for whom contractors have worked. (See Appendix K for an example checklist of contractor qualifications.)
- Ask for detailed written descriptions of how bidders will satisfy the project specifications.
- Interview bidders regarding their work, worker protection, and site containment plans. A statement that the contractor will comply with all EPA, OSHA, and state regulations is not sufficient. Ask bidders for copies of their standard operating procedures and employee protection plans, specifically their OSHA medical monitoring and respirator training program. The interview is invaluable for evaluating each contractor's capabilities and understanding of the problem.
- Obtain documentation of each contractor's fiscal qualifications, including financial performance, assets, liabilities, legal judgments, and insurance.
- Be sure that the contractor selected has adequate liability insurance. Some forms of insurance may not provide enough long-term protection against inadequate abatement work. The building owner's attorney and insurance advisor should determine if coverage is adequate.
- Be specific about what constitutes successful job completion. A thorough visual inspection to insure adequate cleaning is an absolute necessity. Air monitoring is also recommended (see Section 6.4). The person carrying out the air monitoring should not be employed by the abatement contractor.
- Require evidence of worker certification or have the contractor conduct an on-site training program for workers.

- Encourage bidding competition, since prices can vary greatly. Multiple bids are desired, but too many can confuse the selection process. Remember that successful abatement, not cost minimization, is the goal.

- If possible, avoid contracting for abatement work during the summer. Many school projects are conducted during that season, taxing the limited number of competent contractors.

Appendix L contains a list of organizations that have prepared model contract specifications for asbestos removal. Together with the above suggestions, these models can serve as the basis for writing specifications tailored to individual projects. Remember that EPA's RAC can provide additional information and suggestions.

6.3 Managing the Work

As in all construction jobs, the program manager or the manager's representative (frequently the technical advisor) should visit the abatement work site often (no less than four times per day) to insure that all plans and procedures are properly implemented. The work site monitor should:

- Be sure the workers follow specifications;

- Confirm compliance with worker protection requirements; and

- Assure that the containment barriers around the work site are properly constructed and maintained.

By carefully monitoring the abatement work, the asbestos program manager can correct errors quickly. Work site inspections are most effective if the manager can refer to a detailed workplan containing specific work practices. Where work does not follow specifications, the project should be stopped immediately. The abatement contractor, the asbestos program manager, and the work site monitor (if different from the program manager) should then identify the problems and take steps to correct them.

The need for worker protection (protective clothing, respirators, and change facilities) was discussed in Section 5.1. Although contractors are responsible for their employees, a building owner's concern for the safety of everyone in the building extends to the abatement workers.

Work area containment is essential for all types of abatement and for both surfacing material and pipe and boiler insulation. Once abatement begins, all persons not directly involved in the work should be barred from the area. The work site monitor should make sure plastic barriers are in place (see Section 5.1) and that warning signs are posted at least 20 ft. in front of the work site entrance.

If abatement activity is limited to repair or minor removal of pipe and boiler insulation, containment bags will probably be used (see Section 5.2). The monitor should inspect the construction and use of the bags. Warning signs should be posted outside the work site.

The monitor should also check the air lock at the entrance to the work site. If a negative pressure system is not used, the air lock (and the entire containment system) should be airtight. If a negative pressure system is used (as recommended), the air lock must allow air from the building to enter the work site to replace the contaminated air that is filtered and exhausted outside. When inspecting the work in progress, the monitor's specific checklist will depend on the type of abatement. Abatement inspection for surfacing materials and pipe and boiler insulation should be based on guidelines and precautions described in Chapter 5 (Sections 5.1 and 5.2, respectively).

Work site inspections greatly increase an abatement project's likelihood of success. The importance of doing the job right the first time cannot be over-emphasized. Tests must be performed when the work is

Appendix L. Guide Specifications for Abatement Projects

The following organizations have developed contract specifications that can be used as a guide for abatement projects:

Association of the Wall/Ceiling Industries—International, Inc.
Guide Specifications for the Abatement of Asbestos Release from Spray- or Trowel-Applied Materials in Buildings and Other Structures. December 1981. The Foundation of the Wall and Ceiling Industry, 25 K Street, N.E., Washington, DC 20002 USA.

Maryland State Department of Health and Mental Hygiene
Recommended Contract Specifications for Asbestos Abatement Projects.

Federal Construction Guide Specifications (FCGS): 02085. Asbestos Abatement Procedures.

GSA Guide Specifications PBS (PCD): 02085. Asbestos Abatement Procedures.

LAM 027458

ABS-009302