FETY REGULATION NO. 3 ...

WORKER HEALTH AND SAFETY ACT · NEW JERSEY

Establishing

THRESHOLD LIMIT VALUES

for

Dusts, Vapors, Fumes, Gases and Mists

Effective December 1, 1967

STATE OF NEW JERSEY
DEPARTMENT OF LABOR & INDUSTRY
BUREAU OF ENGINEERING & SAFETY
Trenton, N. J.

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FOREWORD

This Regulation establishes Threshold Limit Values for various toxic substances which may be present in the atmosphere of the work environment. These values, which are contained in this Regulation, are taken from the Threshold Limit Values for 1966 adopted by the American Conference of Governmental Industrial Hygienists.

The Threshold Limit Values refer to air-borne 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, exposure of an occasional individual at or even below the threshold limit may not prevent discomfort, aggravation of a pre-existing condition, or occupational illness.

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. Exceptions are the substances given in Appendix A and the substances given a "C" listing. The values not given a "C" listing refer to time-weighted average concentrations for a normal workday.

The amount by which these concentrations 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. Enlightened industrial hygiene practice inclines toward controlling exposures below the limit rather than maintenance at the limit.

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 the guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may dominate the basis for others. Limits based on physical irritation should be considered no less binding than those based on physical impairment; growing bodies of evidence indicate that physical irritation may promote and accelerate physical impairment.

Documentation of Threshold Limit Values. A separate companion piece to the TLVs is issued by ACGIH under this title. The publication gives the

pertinent scientific information and data with reference to literature sources, that were used to base each limit. Each documentation also contains a statement defining the type of response against which the limit is safeguarding the worker. For a better understanding of the TLVs it is essential that the Documentation be consulted when the TLVs are being used.

Ceiling vs. *Time-Weighted Average Limits.* Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring air-borne 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 in the magnitude of the threshold limit by an appropriate factor shown in Appendix C. It should be noted that the same factors are used 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 air-borne, 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 these values 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.

"Inert" or Nuisance Particulates. A number of dusts or particulates that occur in the working environment ordinarily produce no specific effects upon prolonged inhalation. Some insoluble substances are classed as inert (e.g. iron

and steel dusts, cement, silicon carbide, titanium dioxide, cellulose); others may be soluble (starch, soluble oils, calcium carbonate) but are of such a low order of activity that in concentrations ordinarily encountered do not cause physiologic impairment; still others may be rapidly eliminated or destroyed by the body (vegetable oils, glycerine, sucrose). In the case of the insoluble substances, there may be some accumulation in the respiratory passages. In the case of the soluble substances, this accumulation will ordinarily be temporary but may interfere to some extent with respiratory processes. Hence, it is desirable to control the concentrations of such particulates in the air breathed by any individual, in keeping with good industrial hygiene practice.

A threshold limit of 15mg/m^3, or 50 mppcf, 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 work day, 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, p^0_2, of 135 mm Hg). Atmospheres deficient in $^0_2$ do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants are listed in Appendix E. Some asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure 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 of 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 work-week more than 50%, might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the threshold limit values.

This Regulation is promulgated by the Commissioner of Labor and Industry of the State of New Jersey under authority vested in him by section 9 of the Worker Health and Safety Act, P. L. 1965, c. 154, N.J.S.A. 34:6A as follows:

> The commissioner shall make and promulgate rules and regulations reasonably necessary to implement the purposes of this act. Such rules and regulations shall have the force and effect of law and shall be enforced in the manner provided in this act. . . .

The same statute provides authority for the commissioner to grant exceptions from the requirements of rules and regulations in accordance with section 23 as follows:

> The commissioner shall have the power and authority to grant exceptions from the literal requirements of rules and regulations promulgated under this act. Such exception shall be granted in any particular case only where it is clearly evident that it is necessary to prevent undue hardship or where existing conditions prevent compliance. In no case shall any exception be granted unless in the opinion of the commissioner reasonable protection of the health and safety of workers and the public will be maintained hereby. An application for an exception shall be filed in writing with the commissioner, setting forth specifically the requirements of the rules and regulations from which an exception is desired and the reason why enforcement of the applicable provisions of the rules and regulations is unreasonable. The commissioner shall grant or deny the exception within 30 days from the date of receipt by him of the application. The commissioner shall maintain a record of all exceptions granted and shall make such record reasonably available for public examination and shall mail a copy of all rulings granting exceptions to the members of the board.

Prior to promulgation this Regulation was submitted to the New Jersey State Industrial Safety Committee and the Industrial Safety Board in accordance with requirements of the Act cited above.

SECTION 1 — PURPOSE AND SCOPE

1.1 The purpose of this Regulation is to protect the health and safety of workers by establishing Threshold Limit Values for toxic vapors, gases, fumes, mists and dusts which may be present in the work area atmosphere.

1.2 This Regulation is applicable to every place of employment subject to the Worker Health and Safety Act, P. L. 1965, c. 154, N.J.S.A. 34:6A.

SECTION 2 — DEFINITIONS

2.1 *Dust*—solid particles generated by handling, crushing, grinding, rapid impact, detonation and decrepitation of organic or inorganic materials such as rock, ore, metal, coal, wood, grain, etc.

2.2 *Fume*—solid particles generated by condensation from the gaseous state, generally after volatilization from molten metals, etc., and often accompanied by a chemical reaction such as oxidation. Fumes flocculate and sometimes coalesce.

2.3 *Gas*—a normally formless fluid which occupies the space of enclosure and which can be changed to the liquid or solid state by the effect of increased pressure or decreased temperature or both. A gas diffuses.

2.4 *Mist*—suspended liquid droplets generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming and atomizing.

2.5 *Vapor*—the gaseous form of a substance which is normally in the solid or liquid state. A vapor diffuses.

SECTION 3 — GENERAL REQUIREMENTS

3.1 Time-weighted average atmospheric concentrations of dusts, fumes, gases, mists or vapors to which the worker or workers may be exposed for an eight-hour working day shall not exceed the applicable limits presented in Section 5; provided that:

a. When two or more substances are simultaneously present in the atmosphere the time-weighted average atmospheric concentrations shall not exceed those calculated in accordance with Appendix B on mixtures.

b. The atmospheric concentrations of those substances in Section 5 preceded by he letter "C" shall not exceed the Threshold Limit Values at any time.

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SECTION 4 — SAMPLING, TESTING AND ANALYSIS

4.1 Sampling, testing and analysis to determine the atmospheric concentration of dusts, fumes, gases, mists or vapors shall be performed only by technically qualified persons.

4.2 Sampling, testing and analysis shall be done in accordance with accepted and reliable methods.

4.3 Samples of the workroom atmosphere should be taken wherever there may exist hazardous exposure to any toxic dust, fume, gas, mist or vapor.

SECTION 5 — THRESHOLD LIMIT VALUES
(In Alphabetical Order)

Substance	ppm*	Mg/M³**
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene dichloride, see 1, 2 Dicloroethylene		
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
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

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

** Approximate milligrams of particulate per cubic meter of air.

[C] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

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Substance	ppm*	Mg/M3**
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	—	[A]1
p-Benzoquinone, see Quinone		
Benzoyl peroxide	—	5
Benzyl chloride	1	5
Beryllium	—	0.002
†Biphenyl, see Diphenyl		
Boron oxide	—	15
[C] Boron trifluoride	1	3
Bromine	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
†n-Butyl acetate	150.	710.
†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 Cr03)-Skin	—	0.1
n-Butyl glycidyl ether (BGE)	50	270
Butyl mercaptan	10	35
p-tert. Butyltoluene	10	60
†Cadmium (Metal dust and soluble salts)	—	0.2
Cadmium oxide fume	—	0.1
Calcium arsenate	—	1
Calcium oxide	—	5
Camphor	—	2
Carbaryl (Sevin) (R)	—	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

* Parts of vapor or gas per million parts of air plus vapor by volume at 25°C and 760 mm. Hg pressure.
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[A] Numbers. See Appendix A.
[C] Ceiling Value. See Appendix C.
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ppm*	Mg/M3**
—	0.5
0.05	0.2
—	0.2
—	0.5
25	80
—	A1
—	5
1	5
—	0.002
—	15
1	3
0.1	0.7
0.5	5
,000	2,200
200	590
50	240
150.	710.
200	950
200.	950.
100	300
150.	450.
100	300
5	15
—	0.1
50	270
10	35
10	60
—	0.2
—	0.1
—	1
—	5
—	2
—	5
—	3.5
5,000	9,000
20	60
50.	55.
10	65

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Substance	ppm*	Mg/M3**
Chlordane-Skin	—	0.5
Chlorinated camphene, -Skin	—	0.5
Chlorinated diphenyl oxide	—	0.5
†C Chlorine	1.	3.
Chlorine dioxide	0.1	0.3
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
a-Chloroacetophenone (phenacyl-chloride)	0.05	0.3
Chlorobenzene (monochlorobenzene)	75	350
o-Chlorobenzylidene malononitrite (OCBM)	.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 chloride		
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 CrO3)	—	0.1
†Chromium, sol. chromic, chromous salts, as Cr	—	0.5
†Metallic & insol. salts	—	1.
†Coal tar pitch volatiles (benzene soluble fraction) (anthrocene, BaP, phenanthrene, acridine, chrysene, pyrene)	—	0.2
†Cobalt, Metal fume & dust	—	0.1
Copper fume	—	0.1
Dusts and Mists	—	1.0
Cotton dust (raw)	—	1
Crag (R) herbicide	—	15
Cresol (all isomers)-Skin	5	22
Crotonaldehyde	2.	6.
Cumene-Skin	50.	245.
Cyanide (as CN)-Skin	—	5

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

** Approximate milligrams of particulate per cubic meter of air.

C Ceiling Value. See Appendix C.

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Substance	ppm*	Mg/M3**
†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-Skin	—	1
Decaborane-Skin	0.05	0.3
Demeton (R)-Skin	—	0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1, 2 Diaminoethane, see Ethylenediamine		
Diazomethane	0.2	0.4
Diborane	0.1	0.1
†C 1, 2-Dibromo-ethane-Skin	25.	190.
Dibutyl phosphate	1.	5.
Dibutylphthalate	—	5.
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 Methylenechloride		
Dichloromonofluoromethane	1,000	4,200
C 1, 1-Dichloro-1-nitroethane	10	60
1, 2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	7,000
Dieldrin-Skin	—	0.25
Diethylamine	25	75
Diethylamino ethanol-Skin	10.	50.
Diethylether, see Ethyl ether		
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone		
Diisobutyl ketone	50	290
Dimethoxymethane, see Methylal		
Dimethyl acetane-Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene		

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

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Mg/M3**	Substance	ppm*	Mg/M3**
1,050.	Dimethylaniline (N-dimethylaniline)-Skin	5	25
200	Dimethylbenzene, see Xylene		
200	Dimethyl 1, 2-dibromo-2, 2-dichloroethyl phosphate, (Dibrom) (R)	—	3
1,015.	Dimethylformamide-Skin	10	30
200	2, 6 Dimethylheptanone, see Diisobutyl ketone		
10	1, 1-Dimethylhydrazine-Skin	0.5	1
1	†Dimethylphthalate	—	5.
1	Dimethylsulfate-Skin	1	5
0.3	Dinitrobenzene (all isomers)-Skin	—	1
0.1	Dinitro-o-cresol-Skin	—	0.2
	Dinitrotoluene-Skin	—	1.5
240	Dioxane (Diethylene dioxide)-Skin	100	360
	†Diphenyl	0.2	1.
0.4	Dipropylene glycol methyl ether-Skin	100	600
0.1	Di-sec, octyl phthalate (Di-2-ethylhexylphthalate	—	5
190.	Endrin-Skin	—	0.1
5.	Epichlorhydrin-Skin	5	19
5.	EPN-Skin	—	0.5
300	1, 2-Epoxypropane, see Propyleneoxide		
450	2, 3-Epoxy-1-propanol, see Glycidol		
4,950	Ethanethiol, see Ethylmercaptan		
0.2	Ethanolamine	3	6
400	2 Ethoxyethanol-Skin	200	740
200	2 Ethoxyethylacetate (Cellosolve acetate)-Skin	100	540
790	Ethyl acetate	400	1,400
90	Ethyl acrylate-Skin	25	100
	Ethyl alcohol (ethanol)	1,000	1,900
4,200	†Ethylamine	10.	18.
60	Diisopropylamine-Skin	5.	20.
	Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25.	130.
7,000	†C Ethyl benzene	100.	435.
0.25	Ethyl bromide	200	890
75	†Ethyl butyl ketone (3-Heptanone)	50.	230.
50.	Ethyl chloride	1,000	2,600
	Ethyl ether	400	1,200
860	Ethyl formate	100	300
2.8	†C Ethyl mercaptan	10.	25.
	Ethyl silicate	100	850

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Substance	ppm*	Mg/M³**
Ethylene chlorohydrin-Skin	5	16
Ethylenediamine	10	25
Ethylene dibromide, see 1, 2-Dibromo ethane		
Ethylene dichloride, see 1, 2-Dichloro-ethane		
[C] Ethylene glycol dinitrate-Skin	0.2	1.2
†[C] Ethylene glycol dinitrate &/or nitro-glycerin-Skin	0.02†	0.1†
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
†Ethylene imine-Skin	0.5	1.
Ethylene oxide	50	90
Ethylidine chloride, see 1, 1-Dichloro-ethane		
N-Ethylmorpholine-Skin	20.	94.
Ferbam	—	15
Ferrovanadium dust	—	1
†Fibrous glass	—	5.
Fluoride (as F)	—	2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
[C] Formaldehyde	5	6
Formic acid	5.	9.
Freon 11, see Fluorotrichloromethane		
Freon 12, see Dichlorodifluoromethane		
Freon 13B1, see Trifluoromonobromo-methane		
Freon 21, see Dichloromonofluoro-methane		
Freon 112, see 1, 1, 2, 2-Tetrachloro-1, 2 difluoroethane		
Freon 113, see 1, 1, 2-Trichloro, 1, 2, 2-trifluoroethane		
Freon 114, see Dichlorotetrafluoro-ethane		
Furfural-Skin	5	20
Furfuryl alcohol	50	200
Gasoline	—	A6
Glycidol (2, 3-Epoxy-1-propanol)	50	150
Glycol monoethyl ether, see 2-Ethoxy-ethanol		
†Guthion, see Azinphosmethyl		
Hafnium	—	0.5

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

** Approximate milligrams of particulate per cubic meter of air.

[A] Numbers. See Appendix A.

[C] Ceiling Value. See Appendix C.

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n*	Mg/M3**	Substance	ppm*	Mg/M3**
5	16	Heptachlor-Skin	—	0.5
0	25	Heptane (n-heptane)	500	2,000
		Hexachloroethane-Skin	1	10
		Hexachloronaphthalene-Skin	—	0.2
		Hexane (n-hexane)	500	1,800
		2-Hexanone	100	410
0.2	1.2	Hexone	100	410
		sec-Hexyl acetate	50.	300.
0.02†	0.1†	Hydrazine-Skin	1	1.3
		Hydrogen bromide	3	10
		[c] Hydrogen chloride	5	7
0.5	1.	Hydrogen cyanide-Skin	10	11
50	90	Hydrogen fluoride	3	2
		Hydrogen peroxide, 90%	1	1.4
		Hydrogen selenide	0.05	0.2
20.	94.	Hydrogen sulfide	10	15
—	15	Hydroquinone	—	2
—	1	[c] Iodine	0.1	1
—	5.	†Iron oxide fume	—	10.
—	2.5	Isoamyl acetate	100.	525.
0.1	0.2	Isoamyl alcohol	100	360
00	5,600	Isobutyl acetate	150.	700.
5	6	Isobutyl alcohol	100.	300.
5.	9.	Isophorone	25	140
		Isopropyl acetate	250.	950.
		Isopropyl alcohol	400	980
		Isopropylamine	5	12
		Isopropylether	500	2,100
		Isopropyl glycidyl ether (IGE)	50	240
		Ketene	0.5	0.9
		Lead	—	0.2
		Lead arsenate	—	0.15
		Lindane-Skin	—	0.5
		Lithium hydride	—	0.025
		L.P.G. (Liquified petroleum gas)	1,000	1,800
		Magnesium oxide fume	—	15
5	20	Malathion-Skin	—	15
50	200	Maleic anhydride	0.25	1.
—	A6	[c] Manganese	—	5
50	150	Mercury-Skin	—	0.1
		Mercury (organic compounds)-Skin	—	0.01
		Mesityl oxide	25	100
		Methanethiol, see Methyl mercaptan		
—	0.5	Methoxychlor	—	15

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of air.

ded, but in no case shall the
ıe issued by ACGIH.

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

** Approximate milligrams of particulate per cubic meter of air.

[c] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

Substance	ppm*	Mg/M³**
2-Methoxyethanol, see Methyl cellosolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate-Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methyl amyl alcohol, see Methyl isobutyl carbinol		
[C] Methyl bromide-Skin	20	80
Methyl butyl ketone, see 2-Hexanone		
Methyl cellosolve-Skin	25	80
Methyl cellosolve acetate-Skin	25	120
[C] Methyl chloride	100	210
Methyl chloroform	350	1,900
Methylamine	10.	12.
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
o-Methylcyclohexanone-Skin	100	460
Methyl ethyl ketone (MEK), see 2-Butanone		
Methyl formate	100	250
Methyl iodine-Skin	5.	28.
Methyl isobutyl carbinol-Skin	25	100
Methyl isobutyl ketone, see Hexone		
Methyl isocyanate-Skin	0.02	0.05
Methyl (n-amyl) ketone (2-Heptanone)	100.	465.
[C] Methyl mercaptan	10	20
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone		
[C] ∝ 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.
Naphtha (petroleum)	500	2,000
Naphthalene	10	50

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

** Approximate milligrams of particulate per cubic meter of air.

[C] Ceiling Value. See Appendix C.

Mg/M3**	Substance	ppm*	Mg/M3**
	β-Naphthylamine	—	A2
	Nickel carbonyl	0.001	0.007
610	Nickel, metal and soluble compounds	—	1
1,650	Nicotine-Skin	—	0.5
	Nitric acid	2	5
1,800	†Nitric oxide	25.	30.
35	p-Nitroaniline-Skin	1	6
3,100	Nitrobenzene-Skin	1	5
260	p-Nitrochloro-benzene-Skin	—	1
	Nitroethane	100	310
	[C]Nitrogen dioxide	5	9
80	Nitrogen trifluoride	10	29
	[C]Nitroglycerin- + EGDN-Skin	0.2	2
80	Nitromethane	100	250
120	1-Nitropropane	25	90
210	2-Nitropropane	25	90
1,900	N-Nitrosodimethyl-amine (Di-methyl-nitrosoamine)-Skin	—	A3
12.			
2,000	Nitrotoluene-Skin	5	30
470	Nitrotrichloromethane, see Chloro-picrin		
460			
	†Octachloronaphthalene-Skin	—	0.1
	Octane	500	2,350
250	Oil mist (mineral)	—	5
28.	Osmium tetroxide	—	0.002
100	†Oxalic acid	—	1.
	Oxygen difluoride	0.05	0.1
02 0.05	Ozone	0.1	0.2
	Parathion-Skin	—	0.1
465.	†Parquat-Skin	—	0.5
20	Pentaborane	0.005	0.01
410	Pentachloronaphthalene-Skin	—	0.5
	Pentachlorophenol-Skin	—	0.5
480	Pentane	1,000	2,950
	2-Pentanone	200	700
02 0.2	Perchloroethylene	100	670
	Perchloromethyl mercaptan	0.1	0.8
1,740	Perchloryl fluoride	3	13.5
5	Phenol-Skin	5	19
15	p-Phenylene diamine-Skin	—	0.1
9	†Phenyl ether (vapor)	1.	7.
2 0.35	†Phenyl ether-Biphenyl mixture (vapor)	1.	7.
70	Phenylethylene, see Styrene		
400.	†Phenyl glycidyl ether (PGE)	10.	62.
2,000			
50			

volume at 25°C and 760

ir.

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

** Approximate milligrams of particulate per cubic meter of air.

[A] Numbers. See Appendix A.

[C] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

Substance	ppm*	Mg/M³**
Phenylhydrazine-Skin	5	22
Phosdrin (Mevinphos) (R)-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
Platinum (Soluble Salts)	—	0.002
Polytetrafluoroethylene decomposition products	—	A[4]
Propane	1,000	1,800
Propyl alcohol	200.	450
Propyne, see Methylacetylene		
β-Propiolactone	—	A[5]
n-Propyl acetate	200	840
n-Propyl nitrate	25	110
Propylene dichloride	75	350
†Propylene imine-Skin	2.	5.
Propylene oxide	100	240
Pyrethrum	—	5
Pyridine	5	15
Quinone	0.1	0.4
Rhodium, Metal fume and dusts	—	0.1
Soluble salts	—	0.001
Ronnel	—	15.
Rotenone (commercial)	—	5
Selenium compounds (as Se)	—	0.2
Selenium hexafluoride	0.05	0.4
Silver, metal and soluble compounds	—	0.01
Sodium fluoroacetate (1080)-Skin	—	0.05
Sodium hydroxide	—	2
Stibine	0.1	0.5
Stoddard solvent	500	2,900
Strychnine	—	0.15
[C] Styrene monomer (phenylethylene)	100	420
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	1,000	6,000
Sulfur monochloride	1	6

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

** Approximate milligrams of particulate per cubic meter of air.

[A] Numbers. See Appendix A.

[C] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

*	Mg/M³**	Substance	ppm*	Mg/M³**
	22	Sulfur pentafluoride	0.025	0.25
	0.1	Sulfuryl fluoride	5	20
.1	0.4	Systox, see Demeton		
.3	0.4	2, 4, 5 T	—	10
	1	Tantalum	—	5
	0.1	TEDP-Skin	—	0.2
	1	Teflon (R) decomposition products	—	A[4]
	1	Tellurium	—	0.1
.5	3	†Tellurium hexafluoride	0.02	0.2
	12	TEPP-Skin	—	0.05
	0.1	†[C] Terphenyls	1.	9.4
	0.1	1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane	500	4,170
	0.002	1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	500	4,170
	A[4]	1, 1, 2, 2-Tetrachloroethane-Skin	5	35
	1,800	Tetrachloroethylene, see Perchloroethylene		
.	450	Tetrachloromethane, see Carbon tetrachloride		
	A[5]	†Tetrachloronaphthalene-Skin	—	2.
	840	Tetraethyl lead (as Pb)-Skin	—	0.075
	110	Tetrahydrofuran	200	590
	350	†Tetramethyl lead (TML) (as lead)-Skin	—	0.075
	5.	†Tetramethyl succinonitrile-Skin	0.5	3.
	240	Tetranitromethane	1	8
	5	Tetryl (2, 4, 6-trinitrophenylmethylnitramine)-Skin	—	1.5
	15	Thallium (soluble compounds)-Skin	—	0.1
.1	0.4	Thiram	—	5
	0.1	Tin (inorganic cmpds, except oxide)	—	2
	0.001	Tin (organic cmpds)	—	0.1
	15.	Titanium dioxide	—	15
	5	Toluene (toluol)	200	750
	0.2	[C] Toluene-2, 4-diisocyanate	0.02	0.14
.05	0.4	o-Toluidine-Skin	5	22
	0.01	Toxaphene, see Chlorinated camphene		
	0.05	†Tremolite	5 mppcf	—
	2	†Tributyl phosphate	—	5.
.1	0.5	†1, 1, 2-Trichloroethane-Skin	10.	45.
	2,900	1, 1, 1-Trichloroethane, see Methyl chloroform		
	0.15	Trichloroethylene	100	535
	420			
	13			
	6,000			
	6,000			
	6			

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ssued by ACGIH.

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

** Approximate milligrams of particulate per cubic meter of air.

[A] Numbers. See Appendix A.

[C] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

Substance	ppm*	Mg/M3**
Trichloromethane, see Chloroform		
Trichloronaphthalene-Skin	—	5
1, 2, 3-Trichloropropane	50	300
1, 1, 2-Trichloro 1, 2, 2-trifluorethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
2, 4, 6-Trinitrophenol, see Picric acid		
2, 4, 6-Trinitrophenylmethylnitramine, see Tetryl		
Trinitrotoluene-Skin	—	1.5
Triorthocresyl phosphate	—	0.1
Triphenyl phosphate	—	3
Turpentine	100	560
Uranium (soluble compounds)	—	0.05
(insoluble compounds)	—	0.25
[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	100.	435.
Xylidine-Skin	5	25
Yttrium	—	1
†Zinc chloride	—	1.
Zinc oxide fume	—	5
Zirconium compounds (as Zr)	—	5

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

** Approximate milligrams of particulate per cubic meter of air.

[C] Ceiling Value. See Appendix C.

† Tentative, not a binding limit, conformity is recommended, but in no case shall the limit exceed the most recent previous unqualified value issued by ACGIH.

ım*	Mg/M³**
—	5
50	300
00	7,600
25	100
00	6,100
—	1.5
—	0.1
—	3
00	560
—	0.05
—	0.25
—	0.5
—	0.1
500	1,300
100	480
—	0.1
100.	435.
5	25
—	1
—	1.
—	5
—	5

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RESPIRABLE DUSTS EVALUATED BY COUNT

Substance	m.p.p.c.f.*
SILICA	
Crystalline	
Quartz, Threshold Limit calculated from the formula	250 **
Cristobalite " " "	$\frac{250}{\%SiO_2 + 5}$
Amorphous, including natural diatomaceous earth	20
SILICATES (less than 1% crystalline silica)	
Asbestos	5
Mica	20
Soapstone	20
Talc	20
Portland Cement	50
GRAPHITE (natural)	15
"Inert" or Nuisance Particulates see Appendix D	50 (or 15 mg/m³ whichever is the smaller)

Conversion factors

mppcf $\times$ 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-field technics.

** 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.

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 any route should not be permitted.

A[4] 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 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.

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

A[6] GASOLINE. The composition of gasoline varies greatly and thus a single TLV for all types of gasoline 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: Algoflon, Fluon, Halon, Teflon, Tetran.

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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 additives. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots . \frac{Cn}{Tn}$$

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 $\frac{(C_1}{T_1}$ or $\frac{C_2}{T_2}$ etc.) 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

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots \frac{C_N}{T_N} = 1$$

Air contains 5 ppm of carbon tetrachloride (TLV, 10), 20 ppm of ethylene dichloride (TLV, 50) and 10 ppm of ethylene dibromide, (TLV, 25).

$$\frac{5}{10} + \frac{20}{50} + \frac{10}{25} = \frac{65}{50} = 1.3$$

Threshold limit is exceeded.

b. INDEPENDENT EFFECTS

Air contains 0.15 mg/m^3 of lead (TLV, 0.2) and 0.7 mg/m^3 of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.20} = 0.75; \qquad \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

1B. Special case when source of contaminant is a mixture and atmospheric composition is assumed similar to that of original material, i.e. vapor pressure of each component is the same at the observed temperature.

a. ADDITIVE EFFECTS, approximate solution.

1. A mixture of equal parts (1) trichloroethylene (TLV, 100), and (2) methyl chloroform (TLV, 350).

$\frac{C_1}{100} + \frac{C_2}{350} = \frac{Cm}{Tm}$ Solution applicable to "spot" solvent mixture usage, where all or nearly all, solvent evaporates.

$$C_1 = C_2 = \frac{1}{2} Cm$$

$$\frac{C_1}{100} + \frac{C_1}{350} = \frac{2C_1}{Tm}$$

$$\frac{7C_1}{700} + \frac{2C_1}{700} = \frac{2C_1}{Tm}$$

$$Tm = 700 \times \frac{2}{9} = 155 \text{ ppm}$$

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

$$(1)\quad \frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots + \frac{C_N}{T_N} = 1;$$

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

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

By the Law of Partial Pressures,

$$(3)\quad C_1 = ap_1,$$

And by Raoult's Law,

$$(4)\quad p_1 = F_1\, p_1^{\circ}.$$

Combine (3) and (4) to obtain

$$(5)\quad C_1 = aF_1p_1^{\circ}.$$

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

$$(6)\quad \frac{F_1\, p_1^{\circ}}{T} + \frac{F_2\, p_2^{\circ}}{T} + \ldots + \frac{F_N p_N^{\circ}}{T} = \frac{F_1p_1^{\circ}}{T_1} + \frac{F_2p_2^{\circ}}{T_2} + \ldots + \frac{F_N p_N^{\circ}}{T_N}$$

and solving for T,

$$(6.1)\quad T = \frac{F_1p_1^{\circ} + F_2p_2^{\circ} + \ldots + F_N p_N^{\circ}}{\frac{F_1p_1^{\circ}}{T_1} + \frac{F_2p_2^{\circ}}{T_2} + \ldots + \frac{F_N p_N^{\circ}}{T_N}}$$

or

$$(6.2)\quad T = \frac{\sum_{i=1}^{i=n} F_1p_1^{\circ}}{\sum_{i=1}^{i=n} \frac{F_1p_1^{\circ}}{T_1}}$$

T = Threshold Limit Value in ppm.
C = Vapor concentration in ppm.
p = Vapor pressure of component in solution.
p° = 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.

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	T	p°at 25°C	Mol fraction in half-and half solution by volume.
Trichloroethylene (1)	131.4	1.46 g/ml	100	73mm Hg	0.527
Methylchloroform (2)	133.42	1.33 g/ml	350	125mm Hg	0.473

$$F_1p_1^\circ = (0.527)\ (\ 73) = 38.2$$
$$F_2p_2^\circ = (0.473)\ (125) = 59.2$$

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

T = 177 ppm (Note difference in T.L.V. when account is taken of vapor pressure and mol fraction in comparison with above example 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).

$$\frac{C_1}{0.1} + \frac{C_2}{0.5} = \frac{Cm;\ C_2 = 2C_1}{Tm}$$
$$Cm = 3C_1$$
$$\frac{C_1}{0.1} + \frac{2C_1}{0.5} = \frac{3C_1}{Tm}$$
$$\frac{7C_1}{0.5} = \frac{3C_1}{Tm}$$
$$Tm = \frac{1.5}{7} = 0.21\ mg/m_3$$

1C. T. L. V. for Mixtures of Mineral Dusts.

For mixtures of biologically active mineral dusts the general formula for mixtures may be used. With the exception of asbestos, pure minerals are assigned TLV of 2. 5, 20 or 50.

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

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

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:

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

The limit for 25% quartz approximates 8 mppcf.

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T.L.V. RANGE ppm* or mg/m³	T. Fa
0 to 1	
1 + to 10	
10 + to 100	1
100 + to 1000	1

* Whichever unit is

Appendix C

BASES FOR ASSIGNING LIMITING "C" VALUES

By definition in the Preface, a listed value bearing a "C" designation refers to 'ceiling' value that should not be exceeded; all values should fluctuate below the listed value. In general the bases for assigning 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.

In order to decide whether a substance is a candidate for a "C" listing, some guidelines must be formulated on the permissive fluctuation above the limit in terms of the seriousness of the response in the categories a, b, c, given above. For this the factors given in the table below have been used by the Committee. For both technical and practical reasons, the factors have been pegged to the concentration in an inverse manner. It will be noted that as the magnitude of the T. L. V. increases a correspondingly decreased range of fluctuation is permitted; not to decrease the factor for T. L. V. s of increasing magnitude would permit exposures to large absolute quantities, an undesirable condition, a condition that is minimized at low T. L. V. s. Moreover, larger factors at the lower T. L. V. s are consistent with the difficulties in analyzing and controlling trace quantities.

T.L.V. RANGE ppm* or mg/m³	Test T.L.V. Factor	Examples
0 to 1	3	Toluene diisocyanate-T. L. V., 0.02 ppm. if permitted to rise above 0.06 ppm may result in sensitization in a single subsequent exposure. "C" listing recommended on category b.
1 + to 10	2	Manganese-T.L.V., 5mg/m³, contains little or no safety factor. All values should fluctuate below 5mg/m³. "C" listing recommended on category b.
10 + to 100	1.5	Methyl styrene-T. L. V. 100 if encountered at levels of 150 ppm will prove intensely irritating. "C" listing recommended on category a.
100 + to 1000	1.25	Methyl chloroform-T. L. V. 350ppm, at 438 ppm for periods not exceeding 15 minutes is not expected to result in untoward effects relating to category c. No "C" listing recommended.

* Whichever unit is applicable.

PERMISSIBLE EXCURSIONS FOR TIME-WEIGHTED AVERAGE (TWA) LIMITS

As stated in the preface, the same factors may be used as guides for reasonable excursions above the limit for substances to which the time-weighted average applies. The time-weighted average implies that each excursion above the limit is compensated by a comparable excursion below the limit. Thus, a value of 6-ppm HF is permissible for periods not exceeding 15 minutes, provided an equivalent decrease below the limit of 3-ppm obtains.

Appendix D

Some "Inert" or Nuisance Particulates*

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

* When toxic impurities are not present.

Appendix E

Some Simple Asphyxiants — "Inert" Gases and Vapors.

Acetylene
Argon
Ethane
Ethylene
Helium
Hydrogen
Methane
Neon
Nitrogen
Nitrous Oxide