Guidance Note EH 15/80
from the
Health and Safety
Executive

Threshold Limit Values 1980

Environmental Hygiene 15/80

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Introduction

This guidance note EH 15/80 revises and consolidates previous documents in this series. It reproduces the list of threshold limit values (TLVs) published annually by the American Conference of Governmental Industrial Hygienists (ACGIH) and also lists those substances for which the ACGIH proposes changes to the adopted values or for which it proposes to introduce a value for the first time.

In addition the guidance note gives information on those substances for which different values have been agreed in Great Britain.

All these values give guidance on levels to which exposure to toxic substances should be controlled in order to protect the health of persons employed. These levels form part of the criteria which are used by the Health and Safety Executive in assessing compliance with the Health and Safety at Work etc. Act 1974 and other relevant statutory provisions.

Threshold Limit Values (TLVs)

The evaluation of limits to which exposure to toxic substances should be controlled in order to protect the health of persons employed requires consideration of a number of factors. Further information for individual substances is contained in *Documentation of Threshold Limit Values for Substances in Workroom Air* published by the ACGIH. This gives relevant scientific information, references to the literature sources which were used to arrive at each value and also states the type of response against which the value is intended to protect the worker. Enquiries concerning the availability of this publication should be directed to the Publications Office, American Conference of Governmental Industrial Hygienists, PO Box 1937, Cincinnati, Ohio 45201, USA. Past experience has shown that the documentation for an entry in the 'Notice of Intended Changes' list may not be always immediately available.

The major changes introduced in 1976 (Short Term Exposure Limit (STEL) values and grading of carcinogens) are continued in the 1980 list. The STEL values are derived from a number of sources and users of the list are advised to interpret them cautiously, bearing in mind their limitations as set out in the Preface to the ACGIH list.

In this issue the ACGIH has omitted Appendix D, which had given permissible excursions for Time Weighted Average (TWA) Limits, and all references to it. The remaining Appendices however have not been redesignated to take account of this.

For a better understanding of the use made of TLVs in the provision of healthy working conditions, careful attention should be given to the Preface to the ACGIH list, which explains the underlying philosophy. The following points are of particular importance:

(a) TLVs are not sharp dividing lines between 'safe' and 'dangerous' concentrations (but see special comments for substances with a 'ceiling' (C) limit).

(b) The best working practice is to reduce concentrations of all airborne contaminants as far below the TLV as is reasonably practicable. In the case of substances not quoted in the list or where there are no known toxic effects, exposure should be kept as low as is reasonably practicable*.

(c) The absence of a particular substance from the list does not necessarily indicate that it is 'safe'.

(d) The application of any TLV in relation to particular circumstances should be interpreted by a trained occupational hygienist.

Long hours of work

Threshold limit values are generally based on work schedules involving five shifts of eight hours duration in a working week of 40 hours. Where working times greatly exceed this, the simplest approach in assessing relevant permissible concentrations in the atmosphere would be to make a pro rata reduction in the published TLV, but this method should be used with caution, due account being taken of the properties of the material being handled, the biological half-life within the body and the effect of reduced recovery time.

Notice of intended changes

Attention is particularly drawn to the list of intended changes on page 15. The proposals usually remain on the list for two years to allow time for comment and for the presentation of evidence to the ACGIH. If, after two years, no contradictory evidence has been put forward, the values are normally adopted by the ACGIH at its annual meeting and transferred to the Adopted List.

Control limits

The term TLV should not be confused with that of 'control limit', which is being adopted in Great Britain to indicate those levels of airborne contaminants, averaged over a specified time period, above which personal exposure is considered to be unacceptable and if continued might merit enforcement action. An essential feature of the derivation of control limits is that they are agreed by the Health and Safety Commission after consideration of all the relevant data by the Advisory Committee on Toxic Substances (ACTS), which consists of representatives of the Confederation of British Industry, the Trades Union Congress, the local authority associations and independent experts.

*See Guidance Note EH18, *Toxic substances: a precautionary policy.*

Safe systems of work

The wisdom of ensuring that exposure to any substance is kept as low as is reasonably practicable, whether or not it is known (on present information) to be hazardous, has been shown by the discovery of previously unsuspected and serious long-term health hazards associated with substances which have been used for many years and hitherto had been assumed to be comparatively safe. All substances should be handled with care, whatever their nature, lest future experience shows them to present a hazard which could have been prevented or limited by the application of sensible control measures.

The policy adopted by the Health and Safety Commission* is therefore

(a) that exposure should be kept as low as is reasonably practicable by the application of occupational hygiene principles and techniques appropriate to the route of entry into the body (inhalation, ingestion or absorption through the skin),

(b) that in any case exposure should be kept within the published standards, e.g. TLVs, control limits agreed by the Health and Safety Commission etc, by the application of engineering controls or other suitable control techniques,

(c) and that, where necessary, suitable respiratory and other protective equipment should be provided and used. The provision and use of personal protective equipment should normally be regarded as providing a back-up for other techniques which aim to control the risk at source, rather than as a first line of defence. In certain circumstances however, personal protection may be the only reasonably practicable measure, in which case care must be taken to avoid exposure of others who may be in the vicinity.

Sampling and analysis

Where the atmosphere of a workplace is likely to be contaminated, sampling of the atmosphere and subsequent analysis should be carried out on a periodic basis with a frequency determined by conditions. In Great Britain there are specific legal requirements for the regular measurement of airborne contamination in the Chromium Plating Regulations 1931 (SR and O 1931, No. 455 as amended by SI 1973, No. 9), in the Coal Mines (Respirable Dust) Regulations 1975 (SI 1975, No. 1433 as amended by SI 1976, No. 807) and in the Control of Lead at Work Regulations 1980 (SI 1980, No. 1248).

There are also detailed recommendations on such measurement in *Vinyl Chloride: Code of Practice for Health Precautions* and in the *Code of Practice for Control of Dust from Portable Power Operated Grinding Machines.*

Advice on the sampling of asbestos is given in Guidance Note EH 10†. Details of methods of sampling and analysis of certain substances is given in the series of booklets, *Methods for the Detection of Toxic Substances in Air*, listed on page 23. These are currently being replaced by a new series entitled *Methods for the determination of hazardous substances* (see p 23). Advice may also be obtained from or through inspectors of the Health and Safety Executive.

Where appropriate, the performance of control equipment, such as local exhaust ventilation appliances, should be checked on a regular basis using suitable instruments. Tyndall light beams are particularly useful in the qualitative assessment of the operation of local exhaust equipment used in containing sources of airborne dust. Detailed advice on the legal requirements concerning the safety of the atmosphere of workplaces, which are contained in the Health and Safety at Work etc. Act 1974 (HSW Act), the Factories Act 1961 and various sets of regulations made thereunder, may be obtained from inspectors of the Health and Safety Executive.

Substances for which additional or alternative standards apply in Great Britain‡

Acrylonitrile

Following advice from the Advisory Committee on Toxic Substances (ACTS) based on consideration of the toxicological and epidemiological evidence, the Health and Safety Commission (HSC) issued a policy statement in 1979 to the effect that acrylonitrile should be regarded as a potential human carcinogen. The policy of the HSC is that exposure should be reduced to a level as low as is reasonably practicable, with the objective of working within a control limit of 2 ppm, 8-hour time-weighted average (TWA), by 1981. In order to allow time to carry out any necessary alterations to plant and operating procedures an interim limit of 4 ppm, 8-hour TWA, was applied in certain circumstances. Any plants which were capable of working within the control limit of 2 ppm, 8-hour TWA, were expected to do so.

Asbestos

Hygiene standards applying in Great Britain are published in Guidance Note EH10†, and are abstracted below.

(a) Exposure to all forms of asbestos dust should be reduced to the minimum that is reasonably practicable; and

(b) In any case, occupational exposure to asbestos dust should never exceed:

for crocidolite	0·2 fibres/ml when measured over any 10-minute period;

*Guidance Note EH18, *Toxic substances: a precautionary policy.* †*Guidance Note EH10, Asbestos: hygiene standards and measurements of airborne dust concentrations*, HMSO. ‡Indicated by a 'double dagger' (‡), in the list of Adopted Values

for other types of asbestos	2 fibres/ml when measurements are averaged over a 4-hour period; short-term exposure should not exceed 12 fibres/ml when measured over any 10-minute period.

Note: Fibres means particles of length greater than 5 μm, a diameter of less than 3 μm and having a length to breadth ratio of at least 3:1, observed by transmitted light under phase contrast conditions at a magnification of approximately 500x.

Benzene

Benzene is listed as a suspect carcinogen at Appendix A, paragraph A2. Epidemiological data however, show that the chronic effects of exposure to benzene are those on the blood-forming tissues leading to disorders of the blood and bone marrow. The condition, known as leukaemia, is a form of cancer. Since the information so far available indicates that such chronic effects usually result from exposure to concentrations significantly in excess of 10 ppm, 8-hour TWA (the listed TLV) it was concluded by the ACTS in the light of current knowledge that a change in the control limit could not be recommended at present. The situation is being kept under review, but benzene should be regarded as a proven human carcinogen, and exposure kept as low as reasonably practicable and in any case within 10 ppm, 8-hour TWA.

Chromium metal and chromium compounds

Many entries for chromium and chromium compounds appear under Adopted Values, Notice of Intended Changes and in the Appendices, and these may cause some confusion. In general, whenever exposure to airborne chromium in the hexavalent state occurs e.g. welding of stainless steels, the preparation and use of chromate solutions and handling of chromate pigments, a TLV of 0.1 mg/m^3 (determined as CrO_3) or 0.05 mg/m^3 (determined as Cr) should be applied in respect of the hexavalent chromium content of the airborne material.

The list of values as applied in Great Britain is as follows:

tert-Butyl chromate — Skin	0.05 mg/m^3 (determined as Cr), ceiling
Chromium metal	0.5 mg/m^3 (determined as Cr), 8-hour TWA
Chromium divalent and trivalent compounds	0.5 mg/m^3 (determined as Cr), 8-hour TWA
Chromium hexavalent compounds	0.05 mg/m^3 (determined as Cr), 8-hour TWA

Cotton dust

The hygiene standard adopted in Great Britain, to be applied to the preparatory stages of spinning raw cotton, up to and including winding and beaming, is 0.5 mg/m^3 of total cotton dust, less fly, 8-hour TWA. Guidance Note EH 25* deals with methods of measurement for cotton dust.

Dust in coal mines

Permitted levels of respirable dust in coal mines are laid down in the Coal Mines (Respirable Dust) Regulations 1975 and the Amendment Regulations of 1978. These limits are the ones which apply in Great Britain.

Lead

An Approved Code of Practice supporting the Control of Lead at Work Regulations 1980, has been published. The 8-hour TWA standards set out in the Code are:
Tetraethyl lead: 0.10 mg/m^3 of air (as Pb)
Lead (except Tetraethyl lead): 0.15 mg/m^3 of air (as Pb)

4,4'-Methylene-bis-(2-chloroaniline)

Following the publication in 1976 of the TLV of 0.02 ppm (220 μg/m^3), 8-hour TWA, further evidence emerged suggesting the need for a lower limit. After consideration of the epidemiological and toxicological data the HSE in 1978 recommended a figure of 50 μg/m^3, 8-hour TWA, and this was first published in the introduction to Guidance Note EH 15/77. The matter was subsequently discussed by the ACTS which decided to endorse the recommendation that a figure of 50 μg/m^3 should be adopted, adding that it must be borne in mind that skin absorption could also be an important route of entry into the body.

Mica and talc

The standard of 10 mg/m^3, 8-hour TWA, of total airborne dust applies to talc and mica, with a qualifying limit of 1 mg/m^3, 8-hour TWA, for the 'respirable' portion. Measurements are based on sampling carried out using a C F Casella size-selective cyclone sampler and the 'respirable' portion, to which the limit of 1 mg/m^3, 8-hour TWA, applies, is defined as that fraction of the dust which passes the cyclone and is collected on the filter membrane.

Other non-siliceous mineral dusts

The value adopted in Great Britain for such dusts containing less than 1% quartz, is 10 mg/m^3 total dust, or 5 mg/m^3 respirable dust.

Perchloroethylene

The ACTS reviewed the available medical and scientific evidence and accepted the view that the existing TLV of

*Guidance Note EH25 *Cotton dust sampling*. HMSO.

100 ppm, 8-hour TWA, provided adequate protection in the light of existing information. Since then the ACGIH has published, in the 'Notice of Intended Changes' (p15) a proposal to lower the TLV to 50 ppm, 8-hour TWA. This will be kept under review.

Pesticides

There are a number of entries for pesticides which appear either under the trade name of a proprietary formulation or under the common chemical name of the active component. It should be noted that in every case the TLV given is that for the active component.

Rubber solvent

This entry refers to the American product. A product by the same name may be found on the market in Great Britain, but the composition may differ from the American product and information on safe handling should be obtained from the suppliers.

Trichloroethylene

Although a TLV of 50 ppm, 8-hour TWA, is proposed in the Notice of Intended Changes (page 15), the ACTS after reviewing the available medical and scientific evidence, recommended retention of the current TLV of 100 ppm, 8-hour TWA, which will continue to apply. The matter, however, is being kept under review.

Vinyl chloride

The standard published in the Code of Practice is a ceiling value of 30 ppm and an 8-hour TWA of 10 ppm, allowing that wherever practicable exposure should be brought as near as possible to zero concentrations (see *Vinyl Chloride: Code of Practice for Health Precautions*). An EEC directive on the control of occupational exposures has been adopted by the Council of Ministers and consideration is being given to any consequential amendments to the Code of Practice which may be necessary. The directive sets a long term limit value of 3 ppm (mean annual value) and this is the standard which is now being applied.

Substances which are prohibited in Great Britain

Manufacture and use of the following substances is prohibited in Great Britain under the Carcinogenic Substances Regulations 1967:

beta-naphthylamine	4-aminodiphenyl
benzidine	4-nitrodiphenyl

also the salts of these substances, and any substance containing any one or more of these compounds, except where present as a by-product of a chemical reaction in any other substance in a total concentration not exceeding 1%. Their importation into the United Kingdom is also prohibited under the Carcinogenic Substances (Prohibition of Importation) Order 1967.

Threshold Limit Values for chemical substances in workroom air adopted by ACGIH for 1980 ©

PREFACE: CHEMICAL CONTAMINANTS

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.

Tests are available (J. Occup. Med. 15: 564, 1973; Ann. N.Y. Acad. Sci., *151, Art. 2:* 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).

Three categories of Threshold Limit Values (TLVs) are specified herein, as follows:

(a) *Threshold Limit Value-Time Weighted Average (TLV-TWA)*—the time-weighted average concentration for a normal 8-hour workday or 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

(b) *Threshold Limit Value-Short Term Exposure Limit (TLV-STEL)*—the maximal concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering from (1) irritation, (2) chronic or irreversible tissue change, or (3) narcosis of sufficient degree to increase accident proneness, impair self rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA also is not exceeded. The STEL should be considered a maximal allowable concentration, or ceiling, not to be exceeded at any time during the 15-minute excursion period. STELs are based on one or more of the following criteria: (1) Adopted TLVs including those with a 'C' or 'ceiling' limit, (2) Pennsylvania Short-Term Limits for Exposure to Airborne Contaminants (Penna. Dept. of Hlth., Chapter 4, Art. 432, Rev. Jan. 25, 1968). (3) OSHA Occupational Safety and Health Standards, 40 FR 23073, May 28, 1975. (4) NIOSH criteria for recommended standards for occupational exposure to specific substances. The TWA-STEL should not be used as an engineering design criterion or considered as an emergency exposure level (EEL).

(c) *Threshold Limit Value-Ceiling (TLV-C)*—the concentration that should not be exceeded even instantaneously.

For some substances, e.g., irritant gases, only one category, the TLV-Ceiling, may be relevant. For other substances, either two or three categories may be relevant, depending upon their physiologic action.

It is important to observe that if any one of these three TLVs is exceeded, a potential hazard from that substance is presumed to exist.

The TLV-TWAs should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations.

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 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 a decision as to whether a hazardous condition exists.

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 amount and nature of the information available for establishing a TLV varies from substance to substance; consequently, the precision of the estimated TLV is also subject to variation and the latest *Documentation* should be consulted in order to assess the extent of the data available for a given substance.

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 nuisances, (3) in estimating the toxic potential of continuous, uninterrupted exposures or other extended work periods, (4) as proof or disproof of an existing disease or physical condition, 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 noncompliance 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. It should be noted that the same factors are used by the Committee in determining the magnitude of the value of the STELs, or 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 overall 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 C.

Nuisance particulates 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, 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 10 mg/m^3, or 30 mppcf, of total dust <1% quartz, or, 5 mg/m^3 respirable dust 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 nuisance particulates are given in Appendix E.

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% 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 odorless. 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 F.

Physical factors It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humid-

ity, 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 overtime 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.

Biologic Limit Values (BLVs) Other means exist and may be necessary for monitoring worker exposure other than reliance on the Threshold Limit Values for industrial air, namely, the Biologic Limit Values. These values represent limiting amounts of substances (or their effects) to which the worker may be exposed without hazard to health or well-being as determined in his tissues and fluids or in his exhaled breath. The biologic measurements on which the BLVs are based can furnish two kinds of information useful in the control of worker exposure: (1) measure of the individual worker's over-all exposure; (2) measure of the worker's individual and characteristic response. Measurements of response furnish a superior estimate of the physiologic status of the worker, and may be made of (a) changes in amount of some critical biochemical constituent, (b) changes in activity of a critical enzyme, (c) changes in some physiologic function. Measurement of exposure may be made by (1) determining in blood, urine, hair, nails, in body tissues and fluids, the amount of substance to which the worker was exposed; (2) determination of the amount of the metabolite(s) of the substance in tissues and fluids; (3) determination of the amount of the substance in the exhaled breath. The biologic limits may be used as an adjunct to the TLVs for air, or in place of them. The BLVs, and their associated procedures for determining compliance with them, should thus be regarded as an effective means of providing health surveillance of the worker.

Unlisted substances Many substances present or handled in industrial processes do not appear on the TLV list. In a number of instances the material is rarely present as a particulate, vapor or other airborne contaminant, and a TLV is not necessary. In other cases sufficient information to warrant development of a TLV, even on a tentative basis, is not available to the Committee. Other substances, of low toxicity, could be included in Appendix E pertaining to nuisance particulates. This list (as well as Appendix F) is not meant to be all inclusive; the substances serve only as examples.
In addition there are some substances of not inconsiderable toxicity, which have been omitted primarily because only a limited number of workers (e.g., employees of a single plant) are known to have potential exposure to possibly harmful concentrations.

'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 Intended Changes'. 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. Values listed in parentheses in the 'Adopted' list are to be used during the period in which a proposed change for that Value is listed in the Notice of Intended Changes.

Legal status The Threshold Limit Values, as issued by ACGIH, are recommendations and should be used as guidelines for good practices. Wherever these values (of whatever year) have been used or included by reference in Federal and/or State statutes and registers, the TLVs do have the force and effects of law.

Substance	TWA adopted value ppm	TWA adopted value mg/m³	STEL adopted value ppm	STEL adopted value mg/m³
Acetic acid	10	25	15	37
C Acetic anhydride	5	20	—	—
† Acetone	(1,000)	(2,400)	(1,250)	(3,000)
Acetonitrile	40	70	60	105
Acetylene	S	—	—	—
Acetylene dichloride, see 1,2-Dichloroethylene	200	790	250	1,000
Acetylene tetrabromide	1	15	1.5	20
* Acetylsalicylic acid (Aspirin)	—	5	—	—
Acrolein	0.1	0.25	0.3	0.8
Acrylamide—Skin	—	0.3	—	0.6
†‡ Acrylonitrile—Skin	(A1b)	(A1b)	—	—
Aldrin—Skin	—	0.25	—	0.75
Allyl alcohol—Skin	2	5	4	10
Allyl chloride	1	3	2	6
Allyl glycidyl ether (AGE)—Skin	5	22	10	44
Allyl propyl disulfide	2	12	3	18
Aluminium metal and oxide	—	10	—	20
Aluminium pyro powders	—	5	—	—
Aluminium welding fumes	—	5	—	—
Aluminium, soluble salts	—	2	—	—
Aluminium, alkyls (NOC)§	—	2	—	—
Aluminium oxide (Al_2O_3)	—	E	—	20
‡ *4-Aminodiphenyl*—Skin	—	A1b	—	A1b
2-Aminoethanol, see Ethanolamine	3	8	6	15
2-Aminopyridine	0.5	2	2	4
3-Amino-1, 2, 4-triazole	A2	A2	—	—
Ammonia	25	18	35	27
Ammonium chloride-fume	—	10	—	20
Ammonium sulfamate (Ammate)	—	10	—	20
n-Amyl acetate	100	530	150	800
sec-Amyl acetate	125	670	150	800
* Aniline & homologues—Skin	2	10	5	20
Anisidine (o-, p-isomers)—Skin	0.1	0.5	—	—
Antimony & compounds (as Sb)	—	0.5	—	—
Antimony trioxide handling and use	—	0.5	—	—
* Antimony trioxide production	—	A2	—	—
ANTU (α-Naphthyl thiourea)	—	0.3	—	0.9
Argon	F	—	F	F
* Arsenic & soluble compounds (as As)	—	0.2	—	—
* Arsenic trioxide production	—	A2	—	—
Arsine	0.05	0.2	—	—
*‡ Asbestos, see Mineral dusts	—	A1a	—	A1a
Asphalt (petroleum fumes)	—	5	—	10
Atrazine	—	10	—	—
Azinphos-methyl—Skin	—	0.2	—	0.6
Barium (soluble compounds), (as Ba)	—	0.5	—	—
Baygon (propoxur)	—	0.5	—	2
* Baytex, see Fenthion	—	0.1	—	0.3
Benomyl	—	10	—	15
‡ Benzene	10,A2	30,A2	25,A2	75,A2
†‡ Benzidine production—Skin	—	(A1b)	—	(A1b)
p-Benzoquinone, see Quinone	0.1	0.4	0.3	1.2
Benzoyl peroxide	—	5	—	—
Benzo(a)pyrene	—	A2	—	A2
Benzyl chloride	1	5	—	—
Beryllium	—	0.002,A2	—	—
Biphenyl	0.2	1.5	0.5	4
Bismuth telluride	—	10	—	20
Bismuth telluride, Se-doped	—	5	—	10
Borates, tetra, sodium salts, Anhydrous	—	1	—	—
Decahydrate	—	5	—	—
Pentahydrate	—	1	—	—
Boron oxide	—	10	—	20
Boron tribromide	1	10	3	30
C Boron trifluoride	1	3	—	—
Bromacil	1	10	2	20
Bromine	0.1	0.7	0.3	2
Bromine pentafluoride	0.1	0.7	0.3	2
Bromochloromethane (see chlorobromomethane	200	1,050	250	1,300
Bromoform—Skin	0.5	5	—	—
Butadiene (1, 3-butadiene)	*1,000*	*2,200*	*1,250*	*2,750*
† Butane	(800)	(1,430)	(750)	(1,780)
Butanethiol, see Butyl mercaptan	0.5	1.5	—	—
2-Butanone, see Methylethylketone (MEK)	200	590	300	885
† 2-Butoxyethanol (Butyl cellosolve®)—Skin	(50)	(240)	(150)	(720)
n-Butyl acetate	150	710	200	950
sec-Butyl acetate	200	950	250	1,190
tert-Butyl acetate	200	950	250	1,190
Butyl acrylate	10	55	—	—
C n-Butyl alcohol—Skin	50	150	—	—
† sec-Butyl alcohol	(150)	(455)	—	—
tert-Butyl alcohol	100	300	150	450
C Butylamine—Skin	5	15	—	—
‡C *tert-Butyl chromate (as CrO_3)*—Skin	—	0.1	—	—
† n-Butyl glycidyl ether (BGE)	(50)	(270)	—	—
n-Butyl lactate	5	25	—	—
Butyl mercaptan	0.5	1.5	—	—
* o-sec Butyl phenol —Skin	5	30	—	—
p-tert-Butyltoluene	10	60	20	120
Cadmium, dust & salts (as Cd)	—	*0.05*	—	*0.2*
C Cadmium oxide fume (as Cd)	—	(A2)	—	—
† Cadmium oxide production	—	(A2)	—	—
Calcium carbonate/marble	—	E	—	20
Calcium cyanamide	—	0.5	—	1
Calcium hydroxide	—	5	—	—
Calcium oxide	—	2	—	—
Camphor, synthetic	2	12	3	18
Caprolactam Dust	—	1	—	3
Vapor	5	20	10	40
Captafol (Difolatan®)—Skin	—	0.1	—	—
Captan	—	5	—	15
Carbaryl (Sevin®)	—	5	—	10
Carbofuran (Furadan®)	—	0.1	—	—
Carbon black	—	3.5	—	7
Carbon dioxide	5,000	9,000	15,000	27,000
* Carbon disulfide—Skin	10	30	—	—
Carbon monoxide	50	55	400	440
Carbon tetrabromide	*0.1*	*1.4*	*0.3*	*4*
† Carbon tetrachloride—Skin	(10)	(65)	(20)	(130)
Carbonyl chloride (phosgene)	0.1	0.4	—	—
† Carbonyl fluoride	(5)	(15)	—	—

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See introduction, pp 2 to 5. §Not otherwise classified.

	Substance	TWA (Notice of Intended Changes) ppm	TWA (Notice of Intended Changes) mg/m³	STEL (Notice of Intended Changes) ppm	STEL (Notice of Intended Changes) mg/m³
	Catechol (Pyrocatechol)	5	20	—	—
	Cellulose (paper fiber)	—	6	—	20
	Cesium hydroxide	—	2	—	—
	Chlordane—Skin	—	0.5	—	2
	Chlorinated camphene—Skin	—	0.5	—	1
	Chlorinated diphenyl oxide	—	0.5	—	2
	Chlorine	1	3	3	9
	Chlorine dioxide	0.1	0.3	0.3	0.9
C	Chlorine trifluoride	0.1	0.4	—	—
C	Chloroacetaldehyde	1	3	—	—
	α-Chloroacetophenone (Phenacyl chloride)	0.05	0.3	—	—
*	Chloroacetyl chloride	0.05	0.2	—	—
	Chlorobenzene (Monochlorobenzene)	75	350	—	—
†	o-Chlorobenzylidene malononitrile—Skin	(0.05)	(0.4)	—	—
	Chlorobromomethane	200	1,050	250	1,300
*	2-Chloro-1, 3-butadiene, see β-Chloroprene—Skin	10	35	—	—
	Chlorodifluoromethane	1,000	3,500	1,250	4,375
	Chlorodiphenyl (42% Chlorine)—Skin	—	1	—	2
	Chlorodiphenyl (54% Chlorine)—Skin	—	0.5	—	1
*	1-Chloro-2, 3-epoxypropane (Epichlorohydrin)—Skin	2	8	5	20
C	2-Chloroethanol (Ethylene chlorohydrin)—Skin	1	3	—	—
*‡	Chloroethylene see Vinyl chloride	5,A1a	—	—	—
	Chloroform (Trichloromethane)	10,A2	50,A2	50	225
	bis-Chloromethyl ether	0.001	A1a	—	A1a
†	1-Chloro-1-nitropropane	(20)	(100)	—	—
	Chloropicrin	0.1	0.7	0.3	2
*	β-Chloroprene—Skin	10	36	—	—
	o-Chlorostyrene	50	285	75	430
	o-Chlorotoluene—Skin	50	250	75	375
	2-Chloro-6-(trichloromethyl) pyridine (N-Serve ®)	—	10	—	20
	Chlorpyrifos (Dursban ®)—Skin	—	0.2	—	0.6
‡‡	Chromates, certain insoluble forms	—(0.05,A1a)		—	(A1a)
‡‡	Chromic acid and Chromates (as Cr)	—	(0.05)	—	—
	Chromite ore processing (chromate) (as Cr)	—	0.05,A1a	—	—
‡	Chromium, Sol. chromic, chromous salts (as Cr)	—	0.5	—	—
	Clopidol (Coyden ®)	—	10	—	20
	Coal tar pitch volatiles (as Benzene solubles)	—	0.2,A1a	—	A1a
†	Cobalt metal, dust and fume (as Co)	—	(0.1)	—	—
	Copper fume	—	0.2	—	—
	Dusts & mists (as Cu)	—	1	—	2
	Corundum (Al_2O_3)	—	‡	—	‡
‡	Cotton dust, raw	—	0.2[NN]	—	0.6
	Crag ® herbicide, see Sodium 2, 4-dichlorophenoxy ethyl sulphate	—	10	—	20
	Cresol, all isomers—Skin	5	22	—	—
	Crotonaldehyde	2	6	6	18
	Cumate ®	—	5	—	20
	Cumene—Skin	50	245	75	365
	Cyanamide	—	2	—	—
	Cyanides (as CN)—Skin	—	5	—	—
	Cyanogen	10	20	—	—
*C	Cyanogen chloride	0.3	0.6	—	—
	Cyclohexane	300	1,050	375	1,300
	Cyclohexanol	50	200	—	—
†	Cyclohexanone	(50)	(200)	—	—
	Cyclohexene	300	1,015	—	—
	Cyclohexylamine—Skin	10	40	—	—
	Cyclonite—Skin	—	1.5	—	3
	Cyclopentadiene	75	200	150	400
	2, 4-D (2,4-Dichlorophenoxy acetic acid)	—	10	—	20
	DDT (Dichlorodiphenyl-trichloroethane)	—	1	—	3
	DDVP, see Dichlorvos—Skin	0.1	1	0.3	3
	Decaborane—Skin	0.05	0.3	0.15	0.9
	Demeton ®—Skin	0.01	0.1	0.03	0.3
	Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240	75	360
	1, 2-Diaminoethane, see Ethylenediamine	10	25	—	—
	Diazinon—Skin	—	0.1	—	0.3
	Diazomethane	0.2	0.4	—	—
	Diborane	0.1	0.1	—	—
†	1, 2-Dibromoethane see Ethylene dibromide—Skin	(A1b)	(A1b)	—	—
	Dibrom ®	—	3	—	6
	2-n-Dibutylaminoethanol—Skin	2	14	4	28
	Dibutyl phosphate	1	5	2	10
	Dibutyl phthalate	—	5	—	10
C	Dichloroacetylene	0.1	0.4	—	—
C	o-Dichlorobenzene	50	300	—	—
	p-Dichlorobenzene	75	450	110	675
	3, 3'-Dichlorobenzidine—Skin	—	A2	—	A2
	Dichlorodifluoromethane	1,000	4,950	1,250	6,200
	1, 3-Dichloro-5, 5-dimethyl hydantoin	—	0.2	—	0.4
	1, 1-Dichloroethane	200	810	250	1,010
*	1, 2-Dichloroethane, see Ethylene dichloride	10	40	15	60
	1, 2-Dichloroethylene	200	790	250	1,000
	Dichloroethyl ether—Skin	5	30	10	60
*	Dichlorofluoromethane	10	40	—	—
†	Dichloromethane, see Methylene chloride	(200)	(700)	(250)	(870)
C	1, 1-Dichloro-1-nitroethane	10	60	—	—
	1, 2-Dichloropropane, see Propylene dichloride	75	350	110	510
*	Dichloropropene—Skin	1	5	10	50
*	2, 2-Dichloropropionic acid	1	6	—	—
	Dichlorotetrafluoroethane	1,000	7,000	1,250	8,750
	Dichlorvos (DDVP)—Skin	0.1	1	0.3	3
	Dicrotophos (Bidrin ®)—Skin	—	0.25	—	—
	Dicyclopentadiene	5	30	—	—
	Dicyclopentadienyl iron	—	10	—	20
	Dieldrin—Skin	—	0.25	—	0.75
†	Diethylamine	(25)	(75)	—	—
	Diethylaminoethanol—Skin	10	50	—	—
	Diethylene triamine—Skin	1	4	—	—
	Diethyl ether, see Ethyl ether	400	1,200	500	1,500
	Diethyl phthalate	—	5	—	10
	Difluorodibromomethane	100	860	150	1,290
†C	Diglycidyl ether (DGE)	(0.5)	(3)	—	—
	Dihydroxybenzene, see Hydroquinone	—	2	—	4
	Diisobutyl ketone	25	150	—	—
	Diisopropylamine—Skin	5	20	—	—

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes ‡See Introduction, pp 2 to 3. §Not otherwise classified.

Substance	TWA (Notice) ppm	TWA (Notice) mg/m³	STEL (Notice) ppm	STEL (Notice) mg/m³
Dimethoxymethane, see Methylal	1,000	3,100	1,250	3,875
Dimethyl acetamide—Skin	10	35	15	50
Dimethylamine	10	18	—	—
Dimethylaminobenzene, see Xylidine—Skin	5	25	10	50
Dimethylaniline (N, N-Dimethylaniline)—Skin	5	25	10	50
Dimethylbenzene, see Xylene—Skin	100	435	150	650
Dimethylcarbamyl chloride	A2	A2	—	—
Dimethyl-1, 2-dibromo-2-dichloroethyl phosphate, see Dibrom [9]	—	3	—	6
Dimethylformamide—Skin	10	30	20	60
2, 6-Dimethyl-4-heptanone, see Diisobutyl ketone	25	150	—	—
1,1-Dimethylhydrazine—Skin	0.5,A2	1,A2	1,A2	2,A2
Dimethylphthalate	—	5	—	10
C Dimethyl sulphate—Skin	0.1,A2	0.5,A2	—	—
Dinitrobenzene (all isomers)—Skin	0.15	1	0.5	3
Dinitro-o-cresol—Skin	—	0.2	—	0.6
3, 5-Dinitro-o-toluamide (Zoalene [9])	—	5	—	10
Dinitrotoluene—Skin	—	1.5	—	5
† Dioxane, tech. grade—Skin	(50)	(180)	—	—
Dioxathion (Delnav [9]) Skin	—	0.2	—	—
Diphenyl, see Biphenyl	0.2	1.5	0.6	4
Diphenylamine	—	10	—	20
C Diphenylmethane diisocyanate, see Methylene bisphenyl diisocyanate (MDI)	0.02	0.2	—	—
Dipropylene glycol methyl ether—Skin	100	600	150	900
Diquat	—	0.5	—	1
Di-sec-octyl phthalate (Di-2-ethylhexyl phthalate)	—	5	—	10
Disulfuram	—	2	—	5
Disulfoton (Disyston [9])	0.1	—	—	0.3
2, 6-Di-tert-butyl-p-cresol	—	10	—	20
Diuron	—	10	—	—
* Divinyl benzene	10	50	—	—
Dyfonate [9]—Skin	—	0.1	—	—
Emery	—	E	—	20
Endosulfan (Thiodan [9])—Skin	—	0.1	—	0.3
Endrin—Skin	—	0.1	—	0.3
* Epichlorohydrin—Skin	2	8	5	20
EPN—Skin	—	0.5	—	2
† 1, 2-Epoxypropane, see Propylene oxide	(100)	(240)	(150)	(360)
† 2, 3-Epoxy-1-propanol, see Glycidol	(50)	(150)	(75)	(225)
Ethane	F	—	F	—
Ethanethiol, see Ethyl mercaptan	0.5	1	2	3
Ethanolamine	3	8	6	15
Ethion (Nialate [9])—Skin	—	0.4	—	—
† 2-Ethoxyethanol—Skin	(100)	(370)	(150)	(560)
† *2-Ethoxyethyl acetate* (Cellosolve acetate)—Skin	(100)	(540)	(150)	(810)
Ethyl acetate	400	1,400	—	—
† Ethyl acrylate—Skin	(25)	(100)	—	—
Ethyl alcohol (Ethanol)	1,000	1,900	—	—
Ethylamine	10	18	—	—
Ethyl amyl ketone (5-Methyl-3-heptanone)	25	130	—	—
Ethyl benzene	100	435	125	545
Ethyl bromide	200	890	250	1,110
Ethyl butyl ketone (3-Heptanone)	50	220	75	345
Ethyl chloride	1,000	2,600	1,250	3,250
Ethylene	F	—	F	—
C Ethylene chlorohydrin—Skin	1	3	—	—
Ethylene diamine	10	25	—	—
† *Ethylene dibromide*	(A1b)	(A1b)	—	—
* Ethylene dichloride, see 1, 2-Dichloroethane	10	40	15	60
Ethylene glycol, Particulate	—	10	—	20
† Vapor	(100)	(250)	(125)	(325)
†C Ethylene glycol dinitrate and/or Nitroglycerin—Skin	(0.2)	(2)	—	—
Ethylene glycol methyl ether acetate (Methyl cellosolve [9] acetate)—Skin	25	120	35	170
† *Ethylene oxide*	*(50)*	*(90)*	*(75)*	*(135)*
Ethylenimine—Skin	0.5	1	—	—
Ethyl ether	400	1,200	500	1,500
Ethyl formate	100	300	150	450
Ethylidene chloride, see 1, 1-Dichloroethane	200	810	250	1010
C Ethylidene norbornene	5	25	—	—
Ethyl mercaptan	0.5	1	2	3
† N-Ethylmorpholine—Skin	(20)	(95)	—	—
Ethyl silicate	10	85	30	255
Fensulfothion (Dasanit)	—	0.1	—	—
Fenthion	—	0.1	—	0.3
Ferbam	—	*10*	—	*20*
Ferrovanadium dust	—	1	—	3
Fluoride (as F)	—	2.5	—	—
Fluorine	1	2	2	4
† Fluorotrichloromethane, see Trichlorofluoromethane	(1,000)	(5,600)	(1,250)	(7,000)
C Formaldehyde	2	3	—	—
Formamide	20	30	30	45
Formic acid	5	9	—	—
† Furfural—Skin	(5)	(20)	(15)	(60)
† Furfuryl alcohol—Skin	(5)	(20)	(10)	(40)
† Gasoline	—	(B2)	—	(B2)
Germanium tetrahydride	*0.2*	*0.6*	*0.6*	*1.8*
Glass, fibrous or dust[18]	—	10	—	—
C Glutaraldehyde	0.2	0.7	—	—
Glycerin mist	—	E	—	E
† Glycidol (2, 3-Epoxy-1-propanol)	(50)	(150)	(75)	(225)
† Glycol monoethyl ether, see 2-Ethoxyethanol—Skin	(100)	(370)	(150)	(560)
Graphite (Synthetic)	—	E	—	—
Guthion [9], see Azinphos-methyl—Skin	—	0.2	—	0.6
Gypsum	—	E	—	20
Hafnium	—	*0.5*	—	*1.5*
Helium	F	—	F	—
Heptachlor—Skin	—	0.5	—	2
Heptane (n-Heptane)	400	1,600	500	2,000
† Hexachlorobutadiene	(A2)	(A2)	—	—
Hexachlorocyclopentadiene	0.01	0.1	0.03	0.3
† Hexachloroethane—Skin	(1)	(10)	(3)	(30)
Hexachloronaphthalene—Skin	—	0.2	—	0.6
Hexafluoroacetone	0.1	0.7	0.3	2
† Hexane (n-hexane)	(100)	(360)	(125)	(450)
Hexamethyl phosphoramide—Skin	A2	A2	—	—

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Substance	TWA concentration ppm	TWA concentration mg/m³	STEL concentration ppm	STEL concentration mg/m³
† 2-Hexanone, see Methyl n-butyl ketone—Skin	(25)	(100)	(40)	(165)
† Hexone, see Methyl isobutyl ketone—Skin	(100)	(410)	(125)	(510)
sec-Hexyl acetate	50	300	—	—
C Hexylene glycol	25	125	—	—
Hydrazine—Skin	0.1,A2	0.1,A2	—	—
Hydrogen	F	—	F	—
Hydrogenated terphenyls	0.5	5	—	—
Hydrogen bromide	3	10	—	—
C Hydrogen chloride	5	7	—	—
*C Hydrogen cyanide—Skin	10	10	—	—
Hydrogen fluoride (as F)	3	2.5	6	5
Hydrogen peroxide	1	1.5	2	3
Hydrogen selenide (as Se)	0.05	0.2	—	—
Hydrogen sulfide	10	14	15	21
Hydroquinone	—	2	—	4
* 2-Hydroxypropyl acrylate—Skin	0.5	3	—	—
Indene	10	45	15	70
Indium & Compounds (as In)	—	0.1	—	0.3
C Iodine	0.1	1	—	—
Iodoform	0.6	10	1	20
Iron oxide fume (Fe_2O_3) (as Fe)	83	5	—	10
† Iron pentacarbonyl (as Fe)	(0.01)	(0.08)	—	—
Iron salts, soluble (as Fe)	—	1	—	2
Isoamyl acetate	100	525	125	650
Isoamyl alcohol	100	360	125	450
Isobutyl acetate	150	700	187	875
Isobutyl alcohol	50	150	75	225
C Isophorone	5	25	—	—
Isophorone diisocyanate—Skin	0.01	0.09	—	—
Isopropyl acetate	250	950	310	1,185
Isopropyl alcohol—Skin	400	980	500	1,225
Isopropylamine	5	12	10	24
* N-isopropyl aniline—Skin	2	10	5	20
Isopropyl ether	250	1,050	310	1,320
Isopropyl glycidyl ether (IGE)	50	240	75	360
Kaolin	—	E	—	20
Ketene	0.5	0.9	1.5	3
Lead, inorg., fumes & dusts (as Pb)	—	0.15	—	0.45
‡ Lead arsenate (as ^{Pb})	—	(0.15)	—	(0.45)
‡ Lead chromate (as Cr)	—	0.05,A2	—	—
Limestone	—	E	—	20
Lindane—Skin	—	0.5	—	1.5
Lithium hydride	—	0.025	—	—
LPG (liquefied petroleum gas)	1,000	1,800	1,250	2,250
Magnesite	—	E	—	20
Magnesium oxide fume (as Mg)	—	10	—	—
Malathion—Skin	—	10	—	—
Maleic anhydride	0.25	1	—	—
C Manganese & compounds (as Mn)	—	5	—	—
Manganese fume (as Mn)	—	1	—	3
Manganese cyclopentadienyl tricarbonyl (as Mn)—Skin	—	0.1	—	0.3
Manganese tetroxide	—	1	—	—
Marble/calcium carbonate	—	E	—	20
Mercury (Alkyl compounds)—Skin (as Hg)	—	0.01	—	0.03
† Mercury (All forms except alkyl) (as Hg)	—	(0.05)	—	(0.15)
† Mesityl oxide	(25)	(100)	—	—
Methane	F	—	F	—
Methanethiol, see Methyl mercaptan	0.5	1	—	—
Methomyl [Lannate ®]—Skin	—	2.5	—	—
Methoxychlor	—	10	—	—
2-Methoxyethanol—Skin (Methyl cellosolve ®)	25	80	35	120
Methyl acetate	200	610	250	760
Methyl acetylene (propyne)	1,000	1,650	1,250	2,040
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800	1,250	2,250
Methyl acrylate—Skin	10	35	—	—
Methyl acrylonitrile—Skin	1	3	2	6
Methylal (dimethoxymethane)	1,000	3,100	1,250	3,875
Methyl alcohol (methanol)—Skin	200	260	250	310
Methylamine	10	12	—	—
Methyl amyl alcohol, see Methyl isobutyl carbinol—Skin	25	100	40	160
† Methyl n-amyl ketone (2-Heptanone)	(100)	(465)	(150)	(710)
† Methyl bromide—Skin	(15)	(60)	—	—
† Methyl butyl ketone, —Skin	(25)	(100)	(40)	(165)
Methyl cellosolve ®—Skin, see 2-Methoxyethanol	25	80	35	120
Methyl cellosolve ® acetate—Skin, see Ethylene glycol monomethyl ether acetate	25	120	35	170
† Methyl chloride	(100)	(210)	(125)	(260)
Methyl chloroform (1, 1, 1-Trichloroethane)	350	1,900	450	2,450
Methyl 2-cyanoacrylate	2	8	4	16
Methylcyclohexane	400	1,600	500	2,000
Methylcyclohexanol	50	235	75	350
o-Methylcyclohexanone—Skin	50	230	75	345
Methylcyclopentadienyl manganese tricarbonyl (as Mn)—Skin	—	0.2	—	0.6
Methyl demeton—Skin	—	0.5	—	1.5
C Methylene bisphenyl diisocyanate (MDI)	0.02	0.2	—	—
‡ 4, 4'-Methylene bis (2-chloraniline), MbOCA—Skin	0.02,A2	0.22,A2	—	—
C Methylene bis (4-cyclohexylisocyanate)	0.01	0.11	—	—
† Methylene chloride (dichloromethane)	(200)	(700)	(250)	(870)
* 4,4' Methylene dianiline	0.1	0.8	0.5	4
Methyl ethyl ketone (MEK)	200	590	300	885
C Methyl ethyl ketone peroxide	0.2	1.5	—	—
Methyl formate	100	250	150	375
C Methyl hydrazine—Skin	0.2,A2	0.35,A2	—	—
† Methyl iodide—Skin	(5)	(28)	(10)	(56)
† Methyl isoamyl ketone	(100)	(475)	(150)	(710)
Methyl isobutyl carbinol—Skin	25	100	40	160
† Methyl isobutyl ketone—Skin	(100)	(410)	(125)	(510)
Methyl isocyanate—Skin	0.02	0.05	—	—
Methyl mercaptan	0.5	1	—	—
Methyl methacrylate	100	410	125	510
Methyl parathion—Skin	—	0.2	—	0.6
Methyl propyl ketone	200	700	250	875
†C Methyl silicate	(5)	(30)	—	—

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Substance	TWA Applied to Limits ppm	TWA Applied to Limits mg/m³	STEL Ceiling Values ppm	STEL Ceiling Values mg/m³
†C α-Methyl styrene	(100)	(480)	—	—
Molybdenum (as Mo)				
Soluble compounds	—	5	—	10
Insoluble compounds	—	10	—	20
Monocrotophos (Azodrin®)	—	0.25	—	—
† Monomethyl aniline—Skin	(2)	(9)	(4)	(18)
Morpholine—Skin	20	70	30	105
Naphthalene	10	50	15	75
‡ β-Naphthylamine	—	A1b	—	A1b
Neon	F	—	F	—
Nickel carbonyl (as Ni)	0.05	0.35	—	—
Nickel metal	—	1	—	—
Nickel, soluble compounds (as Ni)	—	0.1	—	0.3
Nickel sulfide roasting, fume and dust (as Ni)	—	1,A1a	—	—
Nicotine—Skin	—	0.5	—	1.5
Nitric acid	2	5	4	10
Nitric oxide	25	30	35	45
p-Nitroaniline—Skin	1	6	2	12
Nitrobenzene—Skin	1	5	2	10
p-Nitrochlorobenzene—Skin	—	1	—	2
‡ 4-Nitrodiphenyl	—	A1b	—	A1b
Nitroethane	100	310	150	465
†C Nitrogen dioxide	(5)	(9)	—	—
Nitrogen trifluoride	10	30	15	45
†C Nitroglycerin—Skin	(0.2)	(2)	—	—
Nitromethane	100	250	150	375
† 1-Nitropropane	(25)	(90)	(35)	(135)
*C 2-Nitropropane	25A2	90A2	—	—
n-Nitrosodimethylamine (dimethylnitrosoamine) —Skin	—	A2	—	A2
† Nitrotoluene—Skin	(5)	(30)	(10)	(60)
Nitrotrichloromethane, see Chloropicrin	0.1	0.7	0.3	2
Nonane	200	1,050	250	1,307
Octachloronaphthalene —Skin	—	0.1	—	0.3
Octane	300	1,450	375	1,800
Oil mist, mineral	—	5[M]	—	10
Osmium tetroxide (as Os)	0.0002	0.002	0.0006	0.006
Oxalic acid	—	1	—	2
Oxygen difluoride	0.05	0.1	0.15	0.3
Ozone	0.1	0.2	0.3	0.6
Paraffin wax fume	—	2	—	6
Paraquat, respirable sizes	—	0.1	—	—
Parathion—Skin	—	0.1	—	0.3
Particulate polycyclic aromatic hydrocarbons (PPAH) see Coal tar pitch volatiles	—0.2,	A1a	—	A1a
Pentaborane	0.005	0.01	0.015	0.03
Pentachloronaphthalene	—	0.5	—	2
Pentachlorophenol—Skin	—	0.5	—	1.5
Pentaerythritol	—	E	—	20
Pentane	600	1,800	750	2,250
2-Pentanone, see Methyl propyl ketone	200	700	250	875
† Perchloroethylene—Skin	(100)	(670)	(150)	(1,000)
Perchloromethyl mercaptan	0.1	(0.8	—	—
Perchloryl fluoride	3	14	6	28
Phenol—Skin	5	19	10	38
Phenothiazine—Skin	—	5	—	10
N-Phenyl-beta-naphthylamine	A2	A2	—	—
p-Phenylene diamine—Skin	—	0.1	—	—
Phenyl ether (vapor)	1	7	2	14
† Phenyl ether-Diphenyl mixture (vapor)	(1)	(7)	(2)	(14)
† Phenylethylene, see Styrene monomer	(100)	(420)	(125)	(525)
Phenyl glycidyl ether (PGE)	10	60	15	90
Phenylhydrazine—Skin	5	20	10	45
Phenyl mercaptan	0.5	2	—	—
C Phenylphosphine	0.05	0.25	—	—
Phorate (Thimet®)—Skin	—	0.05	—	0.2
Phosdrin (Mevinphos®) —Skin	0.01	0.1	0.03	0.3
Phosgene (carbonyl chloride)	0.1	0.4	—	—
Phosphine	0.3	0.4	1	1
Phosphoric acid	—	1	—	3
Phosphorous (yellow)	—	0.1	—	0.3
* Phosphorus pentachloride	0.1	1	—	—
Phosphorus pentasulfide	—	1	—	3
† Phosphorus trichloride	(0.5)	(3)	—	—
Phthalic anhydride	1	6	4	24
m-Phthalodinitrile	—	5	—	—
Picloram (Tordon®)	—	10	—	20
Picric acid—Skin	—	0.1	—	0.3
Piva® (2-Pivalyl-1, 3-indandione)	—	0.1	—	0.3
Plaster of Paris	—	E	—	20
Platinum (Soluble salts) (as Pt)	—	0.002	—	—
Polychlorobiphenyls, see Chlorodiphenyls—Skin	—	—	—	—
Polytetrafluoroethylene decomposition products	—	B1	—	B1
C Potassium hydroxide	—	2	—	—
Propane	F	—	F	—
Propargyl alcohol—Skin	1	2	3	6
† β-Propiolactone	—	(A2)	—	(A2)
* Propionic acid	10	30	15	45
n-Propyl acetate	200	840	250	1,050
Propyl alcohol—Skin	200	500	250	625
n-Propyl nitrate	25	105	40	170
Propylene	F	—	F	—
Propylene dichloride (1, 2-Dichloropropane)	75	350	110	510
†C Propylene glycol dinitrate —Skin	(0.2)	(2)	—	—
Propylene glycol monomethyl ether	100	360	150	540
‡ Propylene imine—Skin	(2)	(5)	—	—
† Propylene oxide	(100)	(240)	(150)	(360)
Propyne, see Methyl acetylene	1,000	1,650	1,250	2,040
Pyrethrum	—	5	—	10
Pyridine	5	15	10	30
Quinone	0.1	0.4	0.3	1.2
RDX® see Cyclonite —Skin	—	1.5	—	3
Resorcinol	10	45	20	90
† Rhodium, metal fume and dusts (as Rh)	—	(0.1)	—	(0.3)
Soluble salts (as Rh)	—	(0.001)	—	(0.003)
Ronnel	—	10	—	—
Rosin core solder pyrolysis products (as formaldehyde)	—	0.1	—	0.3
Rotenone (commercial)	—	5	—	10
Rouge	—	E	—	20
‡ Rubber solvent (Naphtha)	400	1,600	—	—
Selenium compounds (as Se)	—	0.2	—	—
Selenium hexafluoride (as Se)	0.05	0.2	—	—
Sevin® (see Carbaryl)	—	5	—	10
† Silane (see Silicon tetrahydride)	0.5	0.7	1	1.5
Silicon	—	E	—	20
Silicon carbide	—	E	—	20
† Silicon tetrahydride (Silane)	(0.5)	(0.7)	(1)	(1.5)

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Substance	TWA concentration ppm	TWA concentration mg/m³	STEL concentration ppm	STEL concentration mg/m³
* Silver, metal	—	0.1	—	—
† Silver, soluble compounds (as Ag)	—	(0.01)	—	(0.03)
C Sodium azide	0.1	0.3	—	—
* Sodium bisulfite	—	5	—	—
Sodium 2, 4, 5-trichlorophenoxyethyl sulfate	—	10	—	20
Sodium fluoroacetate (1080)—Skin	—	0.05	—	0.15
C Sodium hydroxide	—	2	—	—
* Sodium metabisulfite	—	5	—	—
Starch	—	5	—	20
Stibine	0.1	0.5	0.3	1.5
† Stoddard solvent	(100)	(575)	(125)	(720)
Strychnine	—	0.15	—	0.45
† Styrene monomer (Phenylethylene)	(100)	(420)	(125)	(525)
C Subtilisins (Proteolytic enzymes as 100% pure crystalline enzyme)	—	0.00060[mg]	—	—
Sucrose	—	5	—	20
* Sulfur dioxide	2	5	5	13
Sulfur hexafluoride	1,000	6,000	1,250	7,500
Sulfuric acid	—	1	—	—
Sulfur monochloride	1	6	3	18
Sulfur pentafluoride	0.025	0.25	0.075	0.75
Sulfur tetrafluoride	0.1	0.4	0.3	1
Sulfuryl fluoride	5	20	10	40
Systox, see Demeton®—Skin	0.01	0.1	0.03	0.3
2, 4, 5-T	—	10	—	20
Tantalum	—	5	—	10
TEDP—Skin	—	0.2	—	0.6
Teflon® decomposition products	—	B1	—	B1
Tellurium & compounds (as Te)	—	0.1	—	—
Tellurium hexafluoride (as Te)	0.02	0.2	—	—
TEPP—Skin	0.004	0.05	0.01	0.2
*C Terphenyls	0.5	5	—	—
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane	500	4,170	625	5,210
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	500	4,170	625	5,210
† 1, 1, 2, 2-Tetrachloroethane—Skin	(5)	(35)	(10)	(70)
† Tetrachloroethylene, see Perchloromethylene—Skin	(100)	(670)	(150)	(1,000)
† Tetrachloromethane, see Carbon tetrachloride—Skin	(10)	(65)	(20)	(130)
Tetrachloronaphthalene	—	2	—	4
Tetraethyl lead (as Pb)—Skin	—	0.1[f5]	—	0.3
Tetrahydrofuran	200	590	250	735
Tetramethyl lead (as Pb)—Skin	—	0.15[f5]	—	0.5
Tetramethyl succinonitrile—Skin	0.5	3	2	9
Tetranitromethane	1	8	—	—
* Tetrasodium pyrophosphate	—	5	—	—
Tetryl (2, 4, 6-nitrophenyl-methylnitramine)—Skin	—	1.5	—	3
Thallium, soluble compounds (as Tl)—Skin	—	0.1	—	—
4, 4'-Thiobis(6-tert-butyl-m-cresol)	—	10	—	20
Thioglycolic acid	1	5	—	—
Thiram®	—	5	—	10
† Tin, inorganic compounds, except SnH_4 and SnO_2 (as Sn)	—	(2)	—	(4)
Tin, organic compounds (as Sn)—Skin	—	0.1	—	0.2
† Tin oxide (as Sn)	—	(5)	—	(20)
Titanium dioxide (as Ti)	—	5	—	20
Toluene (toluol)—Skin	100	375	150	560
†C Toluene-2, 4-diisocyanate (TDI)	(0.02)	(0.14)	—	—
† o-Toluidine	(5)	(22)	(10)	(44)
Toxaphene, see Chlorinated camphene—Skin	—	0.5	—	1
† Tributyl phosphate	—	(5)	—	(6)
* Trichloroacetic acid	1	5	—	—
C 1, 2, 4-Trichlorobenzene	5	40	—	—
1, 1, 1-Trichloroethane, see Methyl chloroform	350	1,900	450	2,450
1, 1, 2-Trichloroethane—Skin	10	45	20	90
†‡ Trichloroethylene	(100)	(535)	(150)	(800)
† Trichlorofluoromethane	(1,000)	(5,600)	(1,250)	(7,000)
Trichloromethane, see Chloroform	10, A2	50, A2	—	—
Trichloronaphthalene	—	5	—	10
1, 2, 3-Trichloropropane	50	300	75	450
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane	1,000	7,600	1,250	9,500
Tricyclohexyltin hydroxide (Plictran®)	—	5	—	10
Triethylamine	25	100	40	160
Trifluorobromomethane	1,000	6,100	1,200	7,300
Trimethyl benzene	25	125	35	170
† Trimethyl phosphite	(0.5)	(2.6)	—	—
2, 4, 6-Trinitrophenol, see Picric acid—Skin	—	0.1	—	0.3
2, 4, 6-Trinitrophenylmethylnitramine, see Tetryl—Skin	—	1.5	—	3.0
†C 2, 4, 6-Trinitrotoluene (TNT)	—	(0.5)	—	—
Triorthocresyl phosphate	—	0.1	—	0.3
* Triphenylamine	—	5	—	—
Triphenyl phosphate	—	3	—	6
Tungsten & compounds (as W)				
Soluble	—	1	—	3
Insoluble	—	5	—	10
Turpentine	100	560	150	840
Uranium (natural) soluble & insoluble compounds (as U)	—	0.2	—	0.6
† Vanadium, (V_2O_5) (as V) Dust	—	(0.5)	—	(1.5)
C Fume	—	(0.05)	—	—
Valeraldehyde	50	175	—	—
Vinyl acetate	10	30	20	60
† Vinyl benzene, see Styrene	(100)	(420)	(125)	(525)
* Vinyl bromide	5,A2	20,A2	—	—
*‡ Vinyl chloride	5,A1a,	10,A1a	—	—
‡‡ Vinyl cyanide, see Acrylonitrile	(A1b)	(A1b)	—	—
Vinyl cyclohexene dioxide	10	60	—	—
Vinylidene chloride	10	40	20	80
† Vinyl toluene	(100)	(480)	(150)	(720)
VM & P Naphtha	300	1,350	400	1,800
Warfarin	—	0.1	—	0.3
Welding fumes (NOC)§	—	5, B3	—	B3
† Wood dust (nonallergenic)	—	(5)	—	(10)
Xylene, (o-, m-, p-isomers)—Skin	100	435	150	655
C m-Xylene α, α'-diamine	—	0.1	—	—
† Xylidene—Skin	5	25	10	50
Yttrium	—	1	—	3
Zinc chloride fume	—	1	—	2
‡ Zinc chromate (as Cr)	—	0.05, A2	—	—
Zinc oxide fume	—	5	—	10
Zinc stearate	—	5	—	20

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Substance	TWA Adopted values ppm	TWA Adopted values mg/m³	STEL Tentative values ppm	STEL Tentative values mg/m³
Zirconium compounds (as Zr)	—	5	—	10

Mineral dusts

Silica, SiO_2

CRYSTALLINE

Quartz — TLV in mppcf:[9g]

$$\frac{300^{[2k]}}{\%\ \text{quartz}+10}$$

TLV for respirable dust in mg/m³:

$$\frac{10\ \text{mg/m}^3{}^{[2k]}}{\%\ \text{respirable quartz}+2}$$

TLV for "total dust", respirable and nonrespirable:

$$\frac{30\ \text{mg/m}^3}{\%\ \text{quartz}+3}$$

Cristobalite	Use one-half the value calculated from the count or mass formulae for quartz
Tridymite	Use one-half the value calculated from formulae for quartz
Silica, fused	Use quartz formulae
Tripoli	Use respirable[2m] mass quartz formula

†AMORPHOUS (20 mppcf[2k])

Silicates (<1% quartz)

*‡Asbestos,	
Amosite	0.5 fiber >5μm/cc, A1a
Chrysotile	2 fibers >5μm/cc, A1a
Crocidolite	0.2 fiber >5μm/cc, A1a
Other forms	2 fibers >5μm/cc, A1a
‡Mica	20 mppcf
Mineral wool fiber	10 mg/m³
Perlite	30 mppcf
Portland Cement	30 mppcf
Soapstone	20 mppcf
†‡Talc (nonasbestiform)	(20 mppcf)
‡‡Talc (fibrous, use Asbestos limit	

‡Coal Dust

2 mg/m³ (respirable dust fraction <5% quartz).
If >5% quartz, use respirable mass formula.

Nuisance particulates (see Appendix E)

30 mppcf or 10 mg/m³[2k] of total dust <1% quartz, or, 5 mg/m³ respirable dust.
Conversion factors:
mppcf × 35.3 = Million particles per cubic meter = particles per cc

NOTICE OF INTENDED CHANGES FOR 1980

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. If, after two years no evidence comes to light that questions the appropriateness of the values herein, the values will be reconsidered for the 'Adopted' list. Documentation is available for each of these substances.

Substance	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³
Acetone	750	1,780	1,000	2,375
Acrylic acid	10	30	—	—
*‡ Acrylonitrile	2, A1a	4.5, A1a	—	—
* Benzidine—Skin	—	A1b	—	—
Butane	800	1900	—	—
2-Butoxyethanol (Butyl Cellosolve®)—Skin	25	120	75	360
sec-Butyl alcohol	100	305	150	456
N-Butyl glycidyl ether (BGE)	25	135	—	—
* Cadmium oxide production	—	0.05	—	—
Carbon tetrachloride—Skin	5, A2	30, A2	20, A2	125, A2
Carbonyl fluoride	2	5	5	15
*C o-Chlorobenzylidene malononitrile	0.05	0.4	—	—
* Chloromethyl methyl ether	A2	A2	—	—
1-Chloro-1-nitropropane	2	10	—	—
Chloropentafluoroethane	1,000	6,320	—	—
‡ Chromium metal	—	0.5	—	—
‡ Chromium (II) compounds, (as Cr)	—	0.5	—	—
‡ Chromium (III) compounds, (as Cr)	—	0.5	—	—
‡ Chromium (VI) compounds, as Cr Water soluble Cr VI compounds	—	0.05	—	—
‡ Certain water insoluble Cr VI compounds	—	0.05, A1a	—	—
* Chromyl chloride	0.025	0.15	—	—
Chrysene	A2	A2	—	—
Cobalt metal, dust & fume, (as Co)	—	0.05	—	0.1
Cyclohexanone	25	100	100	400
Cyclopentane	600	1,720	900	2,580
1, 2-Dibromoethane, see Ethylene dibromide—Skin	A2	A2	—	—
1, 1-Dichloro-1-nitroethane	2	10	10	60
Diethylamine	10	30	25	75
Diethyl ketone	200	705	—	—
Diglycidyl ether (DGE)	0.1	0.5	—	—
Dioxane, tech. grade—Skin	25	90	100	360
Dipropyl ketone	50	235	—	—
* Enflurane	75	575	—	—
2-Ethoxyethanol—Skin	50	185	100	370
2-Ethoxyethyl acetate (Cellosolve® acetate)—Skin	50	270	100	540
Ethyl acrylate—Skin	5	20	25	100

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addition. †See Notice of intended changes. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Substance	TWA Threshold values ppm	TWA Threshold values mg/m³	STEL Threshold values ppm	STEL Threshold values mg/m³
* Ethylene dibromide—Skin	A2	A2	—	—
C Ethylene glycol, vapor	50	125	—	—
Ethylene glycol dinitrate	0.02	0.2	0.04	0.4
Ethylene oxide	10	20	—	—
* N-Ethylmorpholine—Skin	5	23	20	95
Furfural—Skin	2	8	10	40
* Furfuryl alcohol—Skin	10	40	15	60
* Gasoline	300	900	500	1,500
Glycidol (2, 3-Epoxy-1-propanol)	25	75	100	300
* Halothane	50	400	—	—
* Hexachlorobutadiene	0.02, A2	0.24, A2	—	—
* Hexachloroethane—Skin	10	100	—	—
* Hexane (n-Hexane)	50	180	—	—
(other isomers)	500	1,800	1,000	3,600
Hexone, see Methyl isobutyl ketone—Skin	50	205	75	300
* Iron pentacarbonyl, as Fe	0.1	0.8	0.2	0.16
* Isooctyl alcohol	50	270	—	—
Isopropoxyethanol	25	105	75	320
* Lead arsenate, as $Pb_3(AsO_4)_2$	—	0.15	—	0.45
* Mercury (All forms except alkyl—Skin, as Hg				
Vapor	—	0.05	—	—
Aryl & inorganic compounds	—	0.1	—	—
Mesityl oxide	15	60	25	100
Methacrylic acid	20	70	—	—
* 4-Methoxyphenol	—	5	—	—
Methyl n-amyl ketone (2-Heptanone)	50	235	100	465
* N-Methyl aniline—Skin	0.5	2	1	5
Methyl bromide—Skin	5	20	15	60
Methyl n-butyl ketone	5	20	—	—
Methyl chloride	50	105	100	205
Methylene chloride (dichloromethane)	100	360	500	1,700
Methyl iodide—Skin	2, A2	10, A2	5, A2	30, A2
* Methyl isoamyl ketone	50	240	—	—
Methyl isobutyl ketone—Skin	50	205	75	300
Methyl isopropyl ketone	200	705	—	—
Methyl silicate	1	6	6	30
α-Methyl styrene	50	240	100	485
* p-Nitroaniline—Skin	—	3	—	—
* p-Nitrochlorobenzene—Skin	0.5	3	—	—
Nitrogen dioxide	3	6	5	10
Nitroglycerin	0.02	0.2	0.04	0.4
1-Nitropropane	15	55	25	90
* Nitrotoluene—Skin	2	11	—	—
* Perchloroethylene—Skin	50	335	—	—
* Persulfates, alkali metal, as S_2O_8	—	2	—	—
Phenyl ether—Diphenyl mixture (vapor)	0.5	4	2	16
* Phenyl glycidyl ether (PGE)	1	6	—	—
* Phosphorus oxychloride	0.1	0.6	0.5	3
* Phosphorus trichloride	0.2	1.5	0.5	3
* Piperazine dihydrochloride	—	5	—	—
Platinum metal	—	1	—	—
β-Propiolactone	0.5, A2	1.5, A2	1, A2	3, A2
Propylene glycol dinitrate	0.02	0.2	0.04	0.4
* Propylene imine—Skin	2, A2	5, A2	—	—
Propylene oxide	20	50	—	—
* Rhodium, metal	—	1	—	—
Insoluble compounds, (as Rh)	—	0.1	—	0.3
* Silicon tetrahydride (Silane)	5	7	—	—
Silver, soluble compounds, (as Ag)	—	0.01	—	—
* Stoddard solvent	100	525	300	1,050
Styrene, monomer (phenylethylene)	50	215	100	425
* 1, 1, 2, 2-Tetrachloroethane—Skin	1	7	5	35
* Tin, tin oxide & inorganic compounds, except SnH_4, (as Sn)	—	2	—	4
* o-Tolidine	A2	A2	—	—
Toluene-2, 4-diisocyanate (TDI)	0.005	0.04	0.02	0.15
* o-Toluidine	2	9	—	—
Tributyl phosphate	0.2	2.5	0.4	5
*‡ Trichloroethylene	50	270	150	805
*C Trichlorofluoromethane	1,000	5,650	—	—
Trimellitic anhydride	0.005	0.04	—	—
* Trimethyl phosphite	2	10	5	25
* 2,4,6-Trinitrotoluene (TNT)—skin	—	0.5	—	3
* Vanadium, (as V_2O_5), dust & fume	—	0.05	—	—
Vinyl toluene	50	240	100	485
Wood dust, hard wood (as in furniture making)	—	1	—	—
* Xylidine—Skin	2	10	—	—

Mineral dusts

Diatomaceous earth, natural	1.5 mg/m³, respirable dust
Silica, amorphous	6 mg/m³, total dust (all sampled sizes)
	3 mg/m³, respirable dust (<5μm)
* Talc (containing no fibers)	15 mppcf or 2 mg/m³, respirable dust
* Talc (fiber-containing)	2 fibers/cc, >5μm in length

Capital letters refer to Appendices. References (a) to (p), see p.22. *1980 Addicon. ‡See Introduction, pp 2 to 5. §Not otherwise classified.

Appendix A
CARCINOGENS

The Committee lists below those substances in industrial use that have proven carcinogenic in man, or have induced cancer in animals under appropriate experimental conditions. Present listing of those substances carcinogenic for man takes two forms: Those for which a TLV has been assigned (1a) and those for which environmental conditions have not been sufficiently defined to assign a TLV (1b).

A1a *Human carcinogens.* Substances, or substances associated with industrial processes, recognized to have *carcinogenic or cocarcinogenic potential*, with an assigned TLV:

Substance	*TLV*
* Acrylonitrile	2 ppm
‡§¶ Asbestos, all forms	
Amosite	0.5 fiber>5μm/cc
Chrysotile	2 fibers>5μm/cc
Crocidolite	0.2 fibers>5μm/cc
Other forms	2 fibers>5μm/cc
bis (Chloromethyl) ether	0.001 ppm
Chromite ore processing (chromate)	0.05 mg/m³ (as Cr)
Nickel sulfide roasting, fume & dust	1.0 mg/m³ (as Ni)
Coal tar pitch volatiles	0.2 mg/m³ (as benzene solubles)
‡¶ Vinyl chloride	5 ppm

A1b *Human carcinogens. Substances,* or substances associated with industrial processes, recognized to have carcinogenic potential without an assigned TLV:

‡† Acrylonitrile
‡ 4-Aminodiphenyl (p-Xenylamine)
*‡ Benzidine—Skin
† Chloromethyl methyl ether
† 1, 2-Dibromoethane (Ethylene dibromide)
‡ β-Naphthylamine
‡ 4-Nitrodiphenyl

For the substances in 1b, no exposure or contact by any route—respiratory, skin or oral, as detected by the most sensitive methods—shall be permitted. The worker should be properly equipped to ensure virtually no contact with the carcinogen.

A2 *Industrial substances suspect of carcinogenic potential for MAN.* Chemical substances or substances associated with industrial processes, which are suspect of inducing cancer, based on either (1) limited epidemiologic evidence, exclusive of clinical reports of single cases, or (2) demonstration of carcinogenesis in one or more animal species by appropriate methods.

3-Amino-1, 2, 4-triazole	—
¶§ Antimony trioxide production	—
¶ Arsenic trioxide production	—
‡ Benzene	10 ppm
Benzo(a)pyrene	—
Beryllium	2.0μg/m³
†§ Cadmium oxide production	—
* Carbon tetrachloride	5 ppm
Chloroform	10 ppm
* Chloromethyl ether	—
‡ Chromates of lead and zinc (as Cr)	0.05 mg/m³
3, 3'-Dichlorobenzidine	—
Dimethylcarbamyl chloride	—
1, 1-Dimethyl hydrazine—Skin	0.5 ppm
Dimethyl sulfate—Skin	0.1 ppm
* Ethylene dibromide—Skin	—
* Hexachlorobutadiene	0.02 ppm
Hexamethyl phosphoramide—Skin	—
Hydrazine	0.1 ppm
‡ 4, 4'-Methylene bis-(2-chloroaniline)—Skin	0.02 ppm
Methyl hydrazine	0.2 ppm
* Methyl iodide	2 ppm
¶C 2-Nitropropane	25 ppm
n-Nitrosodimethylamine—Skin	—
n-Phenyl-beta-naphthylamine	—
Propane sultone	—
β-Propiolactone	—
* Propylene imine—Skin	2 ppm
* o-Tolidine	—
Vinyl bromide	5 ppm
Vinyl cyclohexene dioxide	10 ppm

For the above, worker exposure by all routes should be *carefully controlled to levels consistent with the animal* and human experience data (see *Documentation*), including those substances with a listed TLV.

A3 *The Committee guidelines for classification of experimental ANIMAL carcinogens.* The following guidelines are offered in the present state of knowledge as an aid in classifying substances in the occupational environment found to be carcinogenic in experimental animals. A need was felt by the Threshold Limits Committee for such a classification in order to take the first step in developing an appropriate TLV for occupational exposure.

Determination of approximate threshold of response requirement. In order to determine in which category to classify an experimental carcinogen for the purpose of assigning an industrial air limit (TLV), an approximate threshold of neoplastic response must be determined. Because of practical experimental difficulties, a precisely defined threshold cannot be attained. For the purposes of standard-setting, this is of little moment, as an appropriate risk, or safety, factor can be applied to the approximate threshold, the magnitude of which is dependent on the degree of potency of the carcinogenic response.

*1980 Revision or Addition. †Notice of intended changes. ‡See Introduction, pp 2 to 5. §Cigarette smoking can enhance the incidence of respiratory cancers from this or others of these substances or processes. ¶1980 Adoption

To obtain the best 'practical' threshold of neoplastic response, dosage decrements should be less than logarithmic. This becomes particularly important at levels greater than 10 ppm (or corresponding mg/m³).

Accordingly, after a range-finding determination has been made by logarithmic decreases, two additional dosage levels are required within the levels of 'effect' and 'no effect' to approximate the true threshold of neoplastic response.

The second step should attempt to establish a metabolic relationship between animal and man for the particular substance found carcinogenic in animals. If the metabolic pathways are found comparable, the substance should be classed highly suspect as a carcinogen for man. If no such relation is found, the substance should remain listed as an experimental animal carcinogen until evidence to the contrary is found.

Proposed classification of experimental animal carcinogens. Substances occurring in the occupational environment found carcinogenic for animals may be grouped into three classes, those of high, intermediate and low potency. In evaluating the incidence of animal cancers, significant incidence of cancer is defined as a neoplastic response which represents, in the judgement of the Committee, a significant excess of cancers above that occurring in negative controls.

Exceptions. No substance is to be considered an occupational carcinogen of any practical significance which reacts by the respiratory route at or above 1000 mg/m³ for the mouse, 2000 mg/m³ for the rat; by the dermal route, at or above 1500 mg/kg for the mouse, 3000 mg/kg for the rat; by the gastrointestinal route at or above 500 mg/kg/d for a lifetime, equivalent to about 100 g TD for the rat, 10 g TD for the mouse.

These dosage limitations exclude such substances as dioxane and trichloroethylene from consideration as carcinogens.

Examples
Dioxane—rats, hepatocellular and nasal tumors from 1015 mg/kg/d, oral.
Trichloroethylene—female mice, tumors (30/98 @ 900 mg/kg/d), oral.

A3a *Industrial substances of high carcinogenic potency in experimental animals*

1 A substance to qualify as a carcinogen of high potency must fulfill one of the three following conditions in two animal species:

1a *Respiratory.* Elicit cancer from (1) dosages below 1 mg/m³ (or equivalent ppm) via the respiratory tract in 6-7-hour daily repeated inhalation exposures throughout lifetime; or (2) from a single intratracheally administered dose not exceeding 1 mg of particulate, or liquid, per 100 ml or less of animal minute respiratory volume;

Examples
bis-Chloromethyl ether—malignant tumors, rats, @ 0.47 mg/m³ (0.1 ppm) in 2 years;
Hexamethyl phosphoramide—nasal squamous cell carcinoma, rats, @ 0.05 ppm, in 13 months.

OR

1b *Dermal.* Elicit cancer within 20 weeks by skin-painting, twice weekly at 2 mg/kg body weight or less per application for a total dose equal to or less then 1.5 mg, in a biologically inert vehicle;

Examples
7, 12-Dimethylbenz(a)anthracene—skin tumors @ 0.12-0.8 mg TD in four weeks;
Benzo(a)pyrene—mice 12μg, 3X/wk for 18 months, TD 2.6 mg, 90.9% skin tumors.

OR

1c *Gastrointestinal.* Elicit cancer by daily intake via the gastrointestinal tract, within six months, with a six-month holding period, at a dosage below 1 mg/kg body weight per day; total dose, rat, ≤50 mg; mouse, ≤3.5 mg;

Examples
7, 12-Dimethylbenz(a)anthracene—mammary tumors from 10 mg 1X;
3-Methylcholanthrene—tumors @ 3 sites from 5 mg in 8½ weeks;
Benzo(a)pyrene—mice, 3.9% leukemias, from 30 mg TD 198 days

2 Elicit cancer by all three routes in at least two animal species at dose levels prescribed for high or intermediate potency.

A3b *Industrial substances of intermediate carcinogenic potency in experimental animals.* To qualify as a carcinogen of intermediate potency, a substance should elicit cancer in two animal species at dosages intermediate between those described in A3a and A3c by two routes of administration.

Example
Carbamic acid ethyl ester—
Dermal, mammary tumors, mice, 100%, 53 weeks, 500-1400 mg TD
Gastrointestinal, various type tumors, mice 42 weeks, 320 mg TD
Gastrointestinal, various type tumors, rats, 80 weeks, 110–930 mg TD.

A3c *Industrial substances of low carcinogenic potency in experimental animals.* To qualify as a carcinogen of low potency, a substance should elicit cancer in one animal species by any one of three routes of administration at the following prescribed dosages and conditions:

1a *Respiratory.* Elicit cancer from (1) dosages greater than *10 mg/m³ (or equivalent ppm) via the* respiratory tract in 6-7-hour, daily repeated inhalation exposures, for 12 months' exposure and 12 months' observation period; or (2) from intratracheally administered dosages totalling more than 10 mg of particulate or liquid per 100 ml or more of animal minute respiratory volume:

Examples
Beryl (beryllium aluminium silicate)—malignant lung tumors, rats, @ 15 mg/m³ @ 17 months;
Benzidine—various tumors, rats, 10–20 mg/m³ @>13 months.

OR

1b *Dermal.* Elicit cancer by skin-painting of mice in twice weekly dosages of >10 mg/kg body weight in a *biologically inert vehicle for at least* 75 weeks, i.e., ≥1.5 g TD.

Examples
Shale tar—mouse, *0.1 mix*50g=5g TD 59/80 skin* tumors;
Arsenic trioxide—man, dose unknown, but estimated to be *high.*

1c *Gastrointestinal.* Elicit cancer from daily oral dosages of 50 mg/kg/day or greater during the lifetime of the animal.

Appendix B
SUBSTANCES OF VARIABLE COMPOSITION

B1 *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.

B2 *Gasoline.* See Notice of Intended Changes.

B3 *Welding fumes—Total particulate (NOC†) TLV, 5 mg/m³.* Welding fumes cannot be classified simply. The composition and quantity are dependent both on the *alloy being welded and the process and electrodes* used. Reliable analysis of fumes cannot be made without considering the nature of the welding process and system being examined; reactive metals and alloys such as aluminium and titanium are arc-welded in a protective, inert atmosphere such as argon. These arcs create relatively little fume, but an intense radiation which can produce ozone. Similar processes are used to arc-weld steels, also creating a relatively low level of fume. *Ferrous alloys also are arc-welded in oxidizing en*ments which generate considerable fume, and can produce carbon monoxide instead of ozone. Such generally are composed of discrete particles of amorphous slags containing iron, manganese, silicon or other metallic constituents depending on the alloy system involved.

Chromium and nickel compounds are found in fu when stainless steels are arc-welded. Some coate flux-cored electrodes are formulated with fluoride the fumes associated with them can contain signi more fluorides than oxides. Because of the above factors, arc-welding fumes frequently must be te individual constituents *which are likely to be pres* determine whether specific TLVs are exceeded. C sions based on total fume concentration are gene adequate if no toxic elements are present in weld metal, or metal coating and conditions are not co to the formation of toxic gases.

Most welding, even with primitive ventilation, do produce exposures inside the welding helmet abo 5 mg/m³; that which does, should be controlled.

Appendix C
MIXTURES

C1 *Threshold Limit Values for mixtures.* When t more hazardous substances are present, their co effect, rather than that of either individually, sho given primary consideration. In the absence of in tion to the contrary, the effects of the different ha should be considered as additive. That is, if the s *the following fractions,*

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

exceeds unity, then the threshold limit of the mix should be considered as being exceeded. C_1 indi the observed atmospheric concentration, and T_1 corresponding threshold limit (see Examples 1. 1Ab). Exceptions to the above rule may be mad there is a good reason to believe that the chief e the different harmful substances are not in fact a but *independent* as when purely local effects on organs of the body are produced by the various c nents of the mixture. In such cases the threshol *ordinarily is exceeded only* when at least one o series,

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

itself has a value exceeding unity (see Example

Synergistic action or potentiation may occur wi combinations of *atmospheric contaminants.* Su

*Trade Names: Algofluon, Fluon, Halon, Teflon, Tetran. †Not otherwise classified.

at present must be determined individually. Potentiating or synergistic 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.

C1A *Examples of Threshold Limit Values for mixtures.* The following formulae apply only when the components in a mixture have similar toxicologic effects; they should not be used for mixtures with widely differing reactivities, e.g. hydrogen cyanide and sulfur dioxide. In such case the formula for independent effects (1Ac) should be used.

1Aa General case, where air is analyzed for each component:

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).

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

Example 1Aa

Air contains 400 ppm of acetone (TLV=1000 ppm) 150 ppm of sec-butyl acetate (TLV=200 ppm) and 100 ppm of 2-butanone (TLV=200 ppm).

Atmospheric concentration of mixture
=400+150+100=650 ppm of mixture.

$$\frac{400}{1000} + \frac{150}{200} + \frac{100}{200} = 0.4 + 0.75 + 0.5 = 1.65$$

Threshold limit is exceeded.

1Ab Special case where 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.

Additive effects (approximate solution). The percent composition (by weight) of the liquid mixture is known, the TLVs of the constituents must be listed in *mg/m³*.

(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 × the TLV; 10 × the TLV; etc.)

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

Example 1Ab

Liquid contains (by weight)
50% heptane: TLV=400 ppm or 1600 mg/m³
1 mg/m³=0.25 ppm
30% methyl chloroform: TLV=350 ppm or 1900 mg/m³
1 mg/m³=0.28 ppm
20% perchloroethylene: TLV=100 ppm or 670 mg/m³
1 mg/m³=0.15 ppm

$$\text{TLV of mixture} = \frac{1}{\frac{0.5}{1600} + \frac{0.3}{1900} + \frac{0.2}{670}}$$

$$= \frac{1}{0.00031 + 0.00016 + 0.00030}$$

$$= \frac{1}{0.00077} = 1300 \text{ mg/m}^3$$

Of this mixture
50% or (1300) (0.5) = 650 mg/m³ is heptane
30% or (1300) (0.3) = 390 mg/m³ is methyl chloroform
20% or (1300) (0.2) = 260 mg/m³ is perchloroethylene.

These values can be converted to ppm as follows:
heptane: 650 mg/m³ × 0.25 = 162 ppm
methyl chloroform: 390 mg/m³ × 0.18 = 70 ppm
perchloroethylene: 260 mg/m³ × 0.15 = 39 ppm
TLV of mixture = 162 + 70 + 39 = 271 ppm or 1300 mg/m³

1Ac *Independent effects.* Air contains 0.15 mg/m³ of lead (TLV, 0.15) and 0.7 mg/m³ of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.15} = 1; \quad \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

C1B *TLV for mixtures of mineral dusts.* For mixtures of biologically active mineral dusts the general formula for mixtures may be used.

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

$$TLV = \frac{1}{\frac{0.8}{20} + \frac{0.2}{2.7}} = 9 \text{ mppcf}$$

TLV of nonasbestiform talc (pure) = 20 mppcf

$$TLV \text{ of quartz (pure)} = \frac{300}{100+10} = \frac{300}{110} = 2.7 \text{ mppcf}$$

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:

25% quartz—TLV (pure) = 2.7 mppcf
25% amorphous silica—TLV (pure) = 20 mppcf
50% talc—TLV (pure) = 20 mppcf

$$TLV = \frac{1}{\frac{0.25}{2.7} + \frac{0.25}{20} + \frac{0.5}{20}} = 8 \text{ mppcf}$$

The limit for 25% quartz approximates 9 mppcf.

Appendix E
SOME NUISANCE PARTICULATES (o)

TLV, 30 mppcf or 10 mg/m³ of total dust< 1% quartz or 5 mg/m³ respirable dust.

Aluminium oxide (Al_2O_3)
Calcium carbonate
Calcium silicate
Cellulose (paper fiber)
Portland Cement
Emery
Glycerin mist
Graphite (synthetic)
Gypsum
Vegetable oil mists
(except castor, cashew nut, or similar irritant oils)
Kaolin
Limestone
Magnesite
Marble
Mineral wool fiber
Pentaerythritol
Plaster of Paris
Silicon
Silicon carbide
Starch
Sucrose
Tin oxide*
Titanium dioxide
Zinc oxide dust
Zinc stearate

Appendix F
SOME SIMPLE ASPHYXIANTS(p)

Acetylene
Argon
Butane
Ethane
Ethylene
Helium
Hydrogen
Methane
Neon
Propane
Propylene

Appendix G
CONVERSION OF MPPCF TO MASS CONCENTRATION

Calculations for Conversion of Particle Count Concentration (by Standard Light Field—Midget Impinger Techniques), in mppcf to Respirable Mass Concentration (by Respirable Sampler) in mg/m³†

1 In 1967, Jacobson and Tombt derived an empirical relationship of 5.6 mppcf to 1 milligram of respirable dust per cubic meter of air, based on 23 sets of samples, mostly coal dust. The following calculation results in an equivalence of 6.37 mppcf to 1 mg/m³ of respirable dust. *Thus, an approximate ratio of 6 mppcf to 1 mg/m³ of respirable dust is suggested for conversion of TLVs from a count to a mass basis when the density and mass median diameter have not been determined.*

2 Basic assumptions:

(a) Average density for silica containing dusts = 2.5 gm/cm³ (2500 mg/cm³). Pulmonary significant dust densities may vary from 1.2 gm/cm³ for coal dust to 3.1 gm/cm³ for Portland Cement. Silica densities vary from 2.2 (amorphous) to 2.3 (cristobalite and tridymite) to 2.5 (alpha-quartz) gm/cm³.

(b) The mass median diameter (mmd) of particles collected in midget impinger samplers and counted by the standard light field technique, *and* collected in a respirable sampler is approximately 1.5 μm or 1.5×10^{-4} cm. This assumption is, of course, quite arbitrary since the mmd of all dust clouds is quite variable, depending on *many independent parameters, such as source of dust*, age of dust cloud, meteorological conditions, etc.

3 Calculation:

(a) vol. per particle = $4/3\pi r^3$; $r = 0.75 \times 10^{-4}$ cm
$= 4/3\pi(0.75 \times 10^{-4})^3$
$= 1.77 \times 10^{-12}$ cm³

(b) wt. per particle = vol × density
$= 1.77 \times 10^{-12}$ cm³ $\times 2.5 \times 10^3$ mg/cm³
$= 4.425 \times 10^{-9}$ mg/particle

(c) 1 particle/ft³ = 35.5 part./m³
(since 35.5 cu ft = 1 cu m)
10^6 part./ft³ = mppcf = 35.5×10^6 part/m³
wt. of 1 mppcf = 35.5×10^6 part/m³ $\times 4.425 \times 10^{-9}$ mg/part.
1 mppcf = 0.157 mg/m³
or
6.37 mppcf = 1 mg/m³
or approximately 6 mppcf = 1 mg/m³.

*See Notice of intended changes. †*Relationship Between Gravimetric Respirable Dust Concentration and Midget Impinger Number Concentration*, by Murray Jacobson and T F Tomb, AIHAJ, 28: Nov-Dec 1967. References (a) to (p), see p 22.

‡ Equivalent TLVs in mppcf and mg/m³ (respirable mass) for mineral dusts.

Substance	Threshold Limit Value		
	Count mppcf	Respirable Mass mg/m³	Total Mass* mg/m³
Silica (SiO_2)			
Amorphous	20	(3)†	(6)
Cristobalite	1.5	0.05	0.15
Fused silica	3	0.1	0.3
Quartz	3	0.1	0.3
Tridymite	1.5	0.05	0.15
‡Coal dust	(12)	2	(4)
Diatomaceous earth, (natural)	—	1.5	—
Graphite (natural)	15	(2.5)	(5)
‡Mica	20	(3)	(6)
Mineral wool fiber	—	(5)	10
Nuisance particulates	30	(5)	10
Perlite	30	(5)	(10)
Portland Cement	30	(5)	(10)
Soapstone	20	(3)	(6)
Tripoli	(3)	0.1	(0.3)

* Unless otherwise specified, respirable mass is presumed to equal approximately 50% of total mass.

† All values in parentheses represent newly calculated values based on equivalence of 6 mppcf=1 mg/m$_3$ respirable mass and respirable mass=50% total mass.

‡ See Introduction pp 2 to 5.

References

(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 substance per cubic meter of air.

(c) An atmospheric concentration of not more than 0.02 ppm, or personal protection may be necessary to avoid headache for intermittent exposure.

(d) <7 μm in diameter.

(e) As sampled by method that does not collect vapor.

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

(g) Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

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

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

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

(j) Containing <1% quartz; if quartz content >1%, use formulae for quartz.

(k) Lint-free dust as measured by the vertical-elutriator, cotton-dust sampler described in the Transactions of the National Conference on Cotton Dust, J R Lynch, p 33, May 2, 1970.

(l) As determined by the membrane filter method at 400–450X magnification (4 mm objective) phase contrast illumination.

(m) Based on 'high volume' sampling.

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

(1) T E Hatch, and P Gross, Pulmonary Deposition and Retention 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.

(o) When toxic impurities are not present, e.g. quartz<1%.

(p) As defined on p 6.

Documentation of Threshold Limit Values for Substances in Workroom Air®

A separate companion piece to the Chemical TLVs is issued by ACGIH under this title. This 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.

Enquiries concerning the availability of copies of *Documentation of Threshold Limit Values for Substances in Workroom Air* should be directed to the Secretary-Treasurer, American Conference of Governmental Industrial Hygienists, PO Box 1937, Cincinnati, Ohio 45201.

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*See p3 under 'Sampling and analysis'. †Only available from the Health and Safety Executive. ‡In preparation