1993–1994

Threshold Limit Values

for Chemical Substances

and Physical Agents

and

Biological Exposure Indices

ACGIH

INTRODUCTION TO THE CHEMICAL SUBSTANCES

Threshold Limit Values (TLVs) 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 health effects. 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. Smoking of tobacco is harmful for several reasons. Smoking may act to enhance the biological effects of chemicals encountered in the workplace and may reduce the body's defense mechanisms against toxic substances.

Individuals may also be hypersusceptible or otherwise unusually responsive to some industrial chemicals because of genetic factors, age, personal habits (smoking, alcohol, or other drugs), medication, or previous exposures. Such workers may not be adequately protected from adverse health effects from certain chemicals at concentrations at or below the threshold limits. An occupational physician should evaluate the extent to which such workers require additional protection.

TLVs 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 TLV *Documentation* should be consulted in order to assess the extent of the data available for a given substance.

These limits are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential health hazards and for no other use, e.g., in the evaluation or control of community air pollution nuisances; in estimating the toxic potential of continuous, uninterrupted exposures or other extended work periods; as proof or disproof of an existing disease or physical condition; or adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ. These limits *are not* fine lines between safe and dangerous concentration nor are they a relative index of toxicity. They *should not* be used by anyone untrained in the discipline of industrial hygiene.

The TLVs, as issued by the American Conference of Governmental Industrial Hygienists, are recommendations and should be used as guidelines for good practices. 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.

The American Conference of Governmental Industrial Hygienists disclaims liability with respect to the use of TLVs.

Notice of Intended Changes. Each year, proposed actions of the Chemical Substances TLV Committee for the forthcoming year are issued in the form of a "Notice of Intended Changes." This Notice provides an opportunity for comment and *solicits suggestions of substances to be added to the list. The suggestions should be accompanied by substantiating evidence.* The "Notice of Intended Changes" is presented after the Adopted Values in this section. 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.

Definitions. 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 and a 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 concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV–TWA is not exceeded. It is not a separate independent exposure limit; rather, it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV–TWA. Exposures above the TLV–TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects.

c) Threshold Limit Value–Ceiling (TLV–C)—the concentration that should not be exceeded during any part of the working exposure.

In conventional industrial hygiene practice if instantaneous monitoring is not feasible, then the TLV–C can be assessed by sampling over a 15-minute period except for those substances that may cause immediate irritation when exposures are short.

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

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

The Chemical Substances TLV Committee holds to the opinion that TLVs 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.

Time-Weighted Average (TWA) vs Ceiling (C) Limits. TWAs permit excursions above the TLV provided they are compensated by equivalent excursions below the TLV–TWA 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 the TLV and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which the TLVs 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.

Although the TWA concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the TLVs, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose TLV is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling 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 ceiling limit, is not appropriate to the TWA; here, a sufficient number of samples are needed to permit a TWA concentration throughout a complete cycle of operations or throughout the workshift.

Whereas the ceiling limit places a definite boundary that concentrations should not be permitted to exceed, the TWA requires an explicit limit to the excursions that are permissible above the listed TLVs. It should be noted that the same factors are used by the Chemical Substances TLV Committee in determining the magnitude of the value of the STEL or whether to include or exclude a substance for a ceiling listing.

Excursion Limits. For the vast majority of substances with a TLV–TWA, there is not enough toxicological data available to warrant a STEL. Nevertheless, excursions above the TLV–TWA should be controlled even where the 8-hour TLV–TWA is within recommended limits. Earlier editions of the TLV list included such limits whose values depended on the TLV–TWAs of the substance in question.

While no rigorous rationale was provided for these particular values, the basic concept was intuitive: in a well-controlled process exposure, excursions should be held within some reasonable limits. Unfortunately, neither toxicology nor collective industrial hygiene

experience provide a solid basis for quantifying what those limits should be. The approach here is that the maximum recommended excursion should be related to variability generally observed in actual industrial processes. In reviewing large numbers of industrial hygiene surveys conducted by the National Institute for Occupational Safety and Health, Leidel, Busch, and Crouse[1] found that short-term exposure measurements were generally lognormally distributed with geometric standard deviations mostly in the range of 1.5 to 2.0.

While a complete discussion of the theory and properties of the lognormal distribution is beyond the scope of this section, a brief description of some important terms is presented. The measure of central tendency in a lognormal description is the antilog of the mean logarithm of the sample values. The distribution is skewed, and the geometric mean is always smaller than the arithmetic mean by an amount which depends on the geometric standard deviation. In the lognormal distribution, the geometric standard deviation (sd_g) is the antilog of the standard deviation of the sample value logarithms and 68.26% of all values lie between m_g/sd_g and $m_g \times sd_g$.

If the short-term exposure values in a given situation have a geometric standard deviation of 2.0, 5% of all values will exceed 3.13 times the geometric mean. If a process displays a variability greater than this, it is not under good control and efforts should be made to restore control. This concept is the basis for the following excursion limit recommendations which apply to those TLV–TWAs that do not have STELs:

> *Excursions in worker exposure levels may exceed 3 times the TLV–TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV–TWA, provided that the TLV–TWA is not exceeded.*

The approach is a considerable simplification of the idea of the lognormal concentration distribution but is considered more convenient to use by the practicing industrial hygienist. If exposure excursions are maintained within the recommended limits, the geometric standard deviation of the concentration measurements will be near 2.0 and the goal of the recommendations will be accomplished.

When the toxicological data for a specific substance are available to establish a STEL, this value takes precedence over the excursion limit regardless of whether it is more or less stringent.

"Skin" Notation. Listed substances followed by the designation "Skin" refer to the potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes and the eyes, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance. Vehicles present in solutions or mixtures can also significantly enhance potential skin absorption. It should be noted that while some materials are capable of causing irritation, dermatitis, and sensitization in workers, these properties are *not considered relevant* when assigning a skin notation. It should be noted, however, that the development of a dermatological condition can significantly affect the potential for dermal absorption.

While limited quantitative data currently exist with regard to skin absorption of gases, vapors, and liquids by workers, the Chemical Substances TLV Committee recommends that the integration of data from acute dermal studies and repeated dose dermal studies in animals and/or humans, along with the ability of the chemical to be absorbed, be used in deciding on the appropriateness of the skin notation. In general, available data which suggest that the potential for absorption via the hands/forearms during the workday could be significant, especially for chemicals with lower TLVs, could justify a skin notation. From acute animal toxicity data, materials having a relatively low dermal LD_{50} (1000 mg/kg of body weight or less) would be given a skin notation. Where repeated dermal application studies have shown significant systemic effects following treatment, a skin notation would be considered. When chemicals penetrate the skin easily (higher octanol–water partition coefficients) and where extrapolations of systemic effects from other routes of exposure suggest dermal absorption may be important in the expressed toxicity, a skin notation should be considered.

Substances having a skin notation and a low TLV may present special problems for operations involving high airborne concentrations of the material, particularly under conditions where significant areas of the skin are exposed for a long period of time. Under these conditions, special precautions to significantly reduce or preclude skin contact may be required.

Biological monitoring should be considered to determine the relative contribution of exposure via the dermal route to the total dose. The TLV/BEI Booklet contains a number of adopted biological exposure indices, which provide an additional tool when assessing the worker's total exposure to selected materials.

Use of the skin designation is intended to alert the reader that air sampling alone is insufficient to accurately quantitate exposure and that measures to prevent significant cutaneous absorption may be required.

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

Respirable and Total Dust. For solid substances and liquified mists, TLVs are expressed in terms of total dust, except where the term "respirable dust" is used. See Appendix D, Particle Size-Selective Sampling Criteria for Airborne Particulate Matter, for the definition of respirable dust (respirable particulate mass).

Particulates Not Otherwise Classified (PNOC). 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. Such 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 PNOCs has the following characteristics: 1) the architecture of the air spaces remains intact; 2) collagen (scar tissue) is not formed to a significant extent; and 3) the tissue reaction is potentially reversible.

Excessive concentrations of PNOCs in the workroom air may seriously reduce visibility; may cause unpleasant deposits in the eyes, ears, and nasal passages (e.g., 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 TLV–TWA of 10 mg/m^3 of total dust containing no asbestos and < 1% crystalline silica is recommended for substances in these categories and for which no specific TLVs have been assigned. This value, 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 TLV has not yet been adopted.

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 torr). 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.

Biological Exposure Indices (BEI). A cross reference is indicated for those substances for which there are also Biological Exposure Indices. For such substances, biological monitoring should be instituted to evaluate the total exposure, e.g., dermal, ingestion, or nonoccupational. See the BEI section in this Booklet.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude), and the like may place added stress on the body so that the effects from exposure at a TLV may be altered. Most of these stresses act adversely to increase the toxic response of a substance. *Although most TLVs 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 32°C (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 TLVs.

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 Chemical Substances TLV Committee.

Unusual Work Schedules. Application of TLVs to workers on work schedules markedly different from the conventional 8-hour day, 40-hour week requires particular judgement in order to provide, for such workers, protection equal to that provided to workers on conventional workshifts.

As tentative guidance, field hygienists are referred to the "Brief and Scala model" which is described and explained at length in Patty.[2]

The Brief and Scala model reduces the TLV proportionately for both increased exposure time and reduced recovery (nonexposure) time. The model is generally intended to apply to work schedules longer than 8 hours/day or 40 hours/week. The model should not be used to justify very high exposures as "allowable" where the exposure periods are short (e.g., exposure to 8 times the TLV–TWA for one hour and zero exposure during the remainder of the shift). In this respect, the general limitations on TLV excursions and STELs should be applied to avoid inappropriate use of the model with very short exposure periods or shifts.

Since adjusted TLVs do not have the benefit of historical use and long-time observation, medical supervision during initial use of adjusted TLVs is advised. In addition, the hygienist should avoid unnecessary exposure of workers even if a model shows such exposures to be "allowable" and should not use models to justify higher-than-necessary exposures.

The Brief and Scala model is easier to use than some of the more complex models based on pharmacokinetic actions. However, hygienists thoroughly familiar with such models may find them more appropriate in specific instances. Use of such models usually requires knowledge of the biological half-life of each substance, and some models require additional data.

Short workweeks can allow workers to have two full-time jobs, perhaps with similar exposures, and may result in overexposure even if neither job by itself entails overexposure. Hygienists should be alert to such situations.

Conversion of TLVs in ppm to mg/m³. TLVs for gases and vapors are usually established in terms of parts per million of substance in air by volume (ppm). For convenience to the user, these TLVs are also listed here in terms of milligrams of substance per cubic meter of air (mg/m^3). The conversion is based on 760 torr barometric pressure at 25°C (77°F), and where 24.45 = molar volume in liters, giving a conversion equation of:

$$\text{TLV in mg/m}^3 = \frac{(\text{TLV in ppm})\ (\text{gram molecular weight of substance})}{24.45}$$

Conversely, the equation for converting TLVs in mg/m^3 to ppm is:

$$\text{TLV in ppm} = \frac{(\text{TLV in mg/m}^3)\ (24.45)}{(\text{gram molecular weight of substance})}$$

Resulting values are rounded to two significant figures below 100 and to three significant figures above 100. This is not done to give any converted value a greater precision than that of the original TLV, but to avoid increasing or decreasing the TLV significantly merely by the conversion of units.

The above equation may be used to convert TLVs to any degree of precision desired. When converting TLVs to mg/m^3 units for other temperatures and pressures, the reference TLVs should be used as a starting point. When converting values expressed as an element (e.g., as Fe, as Ni), the molecular value of the element should be used, not that of the entire compound.

In making conversions for substances with variable molecular weights, appropriate molecular weights have been estimated or assumed (see the TLV *Documentation*).

Biologically-derived Airborne Contaminants. The ACGIH Bioaerosols Committee has developed Guidelines for evaluating biological-source air contaminants in indoor environments (*Guidelines for the Assessment of Bioaerosols in the Indoor Environment*, ACGIH, 1989). The Guidelines rely on medical assessment of symptoms, evaluation of building performance, and professional judgement. For the reasons identified in the following, there are no numerical guidelines or TLVs that allow ready interpretation of bioaerosol data and routine sampling for bioaerosols is not recommended. If sampling is necessary (e.g., to document the contribution of identified sources), standard protocols are recommended in the Guidelines.

Biologically derived airborne contaminants include bioaerosols (airborne particulates composed of or derived from living organisms) and volatile organic compounds released from living organisms. Bioaerosols include microorganisms (culturable, nonculturable, and dead microorganisms) and fragments, toxins, and particulate waste products from all varieties of living things. Biologically derived airborne contaminant mixtures are ubiquitous in nature and may be modified by human activity. All persons are repeatedly exposed, day after day, to a wide variety of such contaminants. At present, gravimetric Threshold Limit Values (TLVs) exist for some wood dusts, which are primarily of biological origin, and for cotton dust, which is at least in part biological. There are no TLVs for concentrations of total culturable or countable organisms and particles (e.g., "bacteria" or "fungi"); specific culturable or countable organisms and particles (e.g., *Aspergillus fumigatus*); infectious agents (e.g., *Legionella pneumophila*; or assayable biological-source contaminants (e.g., endotoxin or volatile organic compounds).

A. A general TLV for a concentration of culturable (e.g., total bacteria and/or fungi) or countable bioaerosols (e.g., total pollen, fungal spores, and bacteria) is not scientifically supportable because:

1. Culturable organisms or countable spores do not comprise a single entity, i.e., bioaerosols are complex mixtures of different kinds of particles.
2. Human responses to bioaerosols range from innocuous effects to serious disease and depend on the specific agent and susceptibility factors within the person.
3. Measured concentrations of culturable and countable bioaerosols are dependent on the method of sample collection and analysis. It is not possible to collect and evaluate all of these bioaerosol components using a single sampling method.

B. Specific TLVs for individual culturable or countable bioaerosols, established to prevent irritant, toxic, or allergic responses have not been established. At present, information relating culturable or countable bioaerosol concentrations to irritant, toxic, or allergic responses consists largely of case reports containing only qualitative exposure data. The epidemiologic data that exist are insufficient to describe exposure–response relationships. Reasons for the absence of good epidemiologic data on exposure–response relationships include:

1. Most data on concentrations of specific bioaerosols are derived from indicator measurements rather than from measurement of actual effector agents. For example, culturable fungi are used to represent exposure to allergens. In addition, most measurements are either from reservoir or from ambient air samples. These approaches are unlikely to accurately represent human exposure to actual effector agents.
2. The components and concentrations of bioaerosols vary widely. The most commonly used air sampling devices collect only "grab" samples over short periods of time and these single samples may not represent human exposure. Short-term grab samples may contain an amount of a particular bioaerosol that is orders of magnitude higher or lower than the average environmental concentration. Some organisms release aerosols as "concentration bursts" and can be detected only rarely using grab samples. Yet, such episodic bioaerosols may produce significant health effects.

C. Dose–response data are available for some infectious bioaerosols. At present, air sampling protocols for infectious agents are limited and suitable only for research endeavors. Traditional public health methods, including immunization, active case finding, and medical treatment, remain the primary defenses against infectious bioaerosols. Certain public and medical facilities with high risk for transmission of infection (e.g., tuberculosis) should employ exposure controls to reduce possible airborne concentrations of virulent and opportunistic pathogens.

D. Assayable, biologically derived contaminants are substances produced by living things that can be detected using either chemical, immunological, or biological assay and include endotoxin, mycotoxins, allergens, and volatile organic compounds. Evidence does not yet support TLVs for any of the assayable substances. Assay methods for certain common aeroallergens and endotoxin are steadily improving. Also, innovative molecular techniques are rendering assayable the concentration of specific organisms currently detected only by culture or counting. Dose–response relationships for some assayable bioaerosols have been observed in experimental studies and occasionally in epidemiologic studies. Validation of these assays in the field is also progressing.

The ACGIH Bioaerosols Committee actively solicits information, comments, and especially data that will assist it in evaluating the role of bioaerosols in the environment.

Operational Guidelines. The ACGIH Board of Directors has adopted Operational Guidelines and Procedures for the Chemical Substances TLV Committee. These guidelines prescribe: charge, authority, policies, membership, organization, and operating procedures. The policies include the appeals procedures.

References

1. Leidel, N.A.; Busch, K.A.; Crouse, W.E.: Exposure Measurement, Action Level and Occupational Environmental Variability. DHEW (NIOSH) Pub. No. 76-131 (December 1975).
2. Paustenbach, D.J.: Occupational Exposure Limits, Pharmacokinetics, and Unusual Work Schedules. In: Patty's Industrial Hygiene and Toxicology, 2nd ed., Vol. 3A, The Work Environment, Chap. 6, pp. 111–277. L.J. Cralley and L.V. Cralley, Eds. John Wiley and Sons, Inc., New York (1985).

Substance [CAS #]	ADOPTED VALUES TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
‡•■4,4'-Methylene bis (2-chloroaniline) [MOCA] [101-14-4]—Skin (1993)	0.01,A2	0.11,A2	—	—
Methylene bis(4-cyclo-hexylisocyanate) [5124-30-1] (1988)	0.005	0.054	—	—
■ 4,4'-Methylene dianiline [101-77-9]—Skin (1986)	0.1,A2	0.81,A2	—	—
◄ Methyl ethyl ketone (MEK) [78-93-3] (1976)	200	590	300	885
Methyl ethyl ketone peroxide [1338-23-4] (1977)	C 0.2	C 1.5	—	—
Methyl formate [107-31-3] (1976)	100	246	150	368
5-Methyl-3-heptanone, *see* Ethyl amyl ketone				
‡•■ Methyl hydrazine [60-34-4]—Skin (1976)	(C 0.2,A2)	(C 0.38,A2)	—	—
■ Methyl iodide [74-88-4]—Skin (1986)	2,A2	12,A2	—	—
Methyl isoamyl ketone [110-12-3] (1982)	50	234	—	—
Methyl isobutyl carbinol [108-11-2]—Skin (1976)	25	104	40	167
◄ Methyl isobutyl ketone [108-10-1] (1981)	50	205	75	307
Methyl isocyanate [624-83-9]—Skin (1977)	0.02	0.047	—	—
Methyl isopropyl ketone [563-80-4] (1981)	200	705	—	—
• Methyl mercaptan [74-93-1] (1977)	0.5	0.98	—	—
Methyl methacrylate [80-62-6] (1987)	100	410	—	—
◄ Methyl parathion [298-00-0]—Skin (1986)	—	0.2	—	—
• Methyl propyl ketone [107-87-9] (1976)	200	705	250	881
Methyl silicate [681-84-5] (1986)	1	6	—	—
α-Methyl styrene [98-83-9] (1981)	50	242	100	483
Metribuzin [21087-64-9] (1984)	—	5	—	—
◄ Mevinphos [7786-34-7]—Skin (1976)	0.01	0.092	0.03	0.27
Mica [12001-26-2] (1986)	—	3(f)	—	—
Mineral wool fiber (1974)	—	10(e)	—	—
Molybdenum [7439-98-7], as Mo Soluble compounds (1986)	—	5	—	—
Insoluble compounds (1986)	—	10	—	—
Monochlorobenzene, *see* Chlorobenzene				
Monocrotophos [6923-22-4]—Skin (1977)	—	0.25	—	—

Substance [CAS #]	ADOPTED VALUES TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
Morpholine [110-91-8]—Skin (1991)	20	71	—	—
◄ Naled [300-76-5]—Skin (1986)	—	3	—	—
Naphthalene [91-20-3] (1976)	10	52	15	79
■ β-Naphthylamine [91-59-8] (1972)	—	A1	—	—
Neon [7440-01-9] (1981)	—(c)	—	—	—
‡■ Nickel [7440-02-0]				
‡Metal (1986)	—	(1)	—	—
‡Insoluble compounds, as Ni (1974)	—	(1)	—	—
‡•■Soluble compounds, as Ni (1976)	—	(0.1)	—	—
‡•■ Nickel carbonyl [13463-39-3], as Ni (1977)	(0.05)	(0.12)	—	—
‡•■ Nickel sulfide roasting, fume & dust, as Ni (1978)	—	(1,A1)	—	—
Nicotine [54-11-5]—Skin (1986)	—	0.5	—	—
Nitrapyrin [1929-82-4] (1982)	—	10	—	20
Nitric acid [7697-37-2] (1976)	2	5.2	4	10
◄ Nitric oxide [10102-43-9] (1986)	25	31	—	—
◄ p-Nitroaniline [100-01-6]—Skin (1982)	—	3	—	—
◄ Nitrobenzene [98-95-3]—Skin (1986)	1	5	—	—
◄■ p-Nitrochlorobenzene [100-00-5]—Skin (1988)	0.1	0.64	—	—
■ 4-Nitrodiphenyl [92-93-3]—Skin (1976)	—	A1	—	—
Nitroethane [79-24-3] (1986)	100	307	—	—
Nitrogen [7727-37-9] (1989)	—(c)	—	—	—
• Nitrogen dioxide [10102-44-0] (1981)	3	5.6	5	9.4
◄ Nitrogen trifluoride [7783-54-2] (1986)	10	29	—	—
• Nitroglycerin (NG) [55-63-0]—Skin (1985)	0.05	0.46	—	—
‡ Nitromethane [75-52-5] (1986)	(100)	(250)	—	—
1-Nitropropane [108-03-2] (1986)	25	91	—	—
■ 2-Nitropropane [79-46-9] (1987)	10,A2	36,A2	—	—
■ N-Nitrosodimethylamine [62-75-9]—Skin (1972)	—	A2	—	—
◄ Nitrotoluene [88-72-2; 99-08-1; 99-99-0] —Skin (1982)	2	11	—	—
Nitrotrichloromethane, *see* Chloropicrin				
Nitrous oxide [10024-97-2] (1989)	50	90	—	—
Nonane [111-84-2], all isomers (1976)	200	1050	—	—

Substance [CAS #]	ADOPTED VALUES TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
Nuisance particulates, *see* Particulates Not Otherwise Classified (PNOC)				
Octachloronaphthalene [2234-13-1]—Skin (1976)	—	0.1	—	0.3
Octane [111-65-9] (1976)	300	1400	375	1750
‡ Oil Mist, mineral (1976)	—	5[k]	—	(10)
Osmium tetroxide [20816-12-0], as Os (1976)	0.0002	0.0016	0.0006	0.0047
Oxalic acid [144-62-7] (1976)	—	1	—	2
Oxygen difluoride [7783-41-7] (1986)	C 0.05	C 0.11	—	—
‡ Ozone [10028-15-6] (1989)	(C 0.1)	(C 0.20)	(—)	(—)
Paraffin wax fume [8002-74-2] (1987)	—	2	—	—
Paraquat [4685-14-7], total dust (1978)	—	0.5	—	—
respirable fraction (1978)	—	0.1	—	—
◄• Parathion [56-38-2]—Skin (1986)	—	0.1	—	—
Particulate polycyclic aromatic hydrocarbons (PPAH), see Coal tar pitch volatiles				
Particulates Not Otherwise Classified (PNOC) (1989)	—	10[e]	—	—
Pentaborane [19624-22-7] (1976)	0.005	0.013	0.015	0.039
Pentachloronaphthalene [1321-64-8]—Skin (1986)	—	0.5	—	—
Pentachloronitrobenzene [82-68-8] (1991)	—	0.5	—	—
◄• Pentachlorophenol [87-86-5]—Skin (1986)	—	0.5	—	—
Pentaerythritol [115-77-5] (1986)	—	10	—	—
• Pentane [109-66-0] (1976)	600	1770	750	2210
2-Pentanone, *see* Methyl propyl ketone				
*◄•• Perchloroethylene (Tetrachloroethylene) [127-18-4] (1993)	25,A3	170,A3	100,A3	685,A3
Perchloromethyl mercaptan [594-42-3] (1977)	0.1	0.76	—	—
Perchloryl fluoride [7616-94-6] (1976)	3	13	6	25
Perfluoroisobutylene [382-21-8] (1992)	C 0.01	C 0.082	—	—
Precipitated silica, *see* Silica—Amorphous				
Perlite [93763-70-3] (1986)	—	10[e]	—	—
Petroleum distillates, *see* Gasoline; Stoddard solvent; VM&P naphtha				
Phenacyl chloride, *see* α-Chloroacetophenone				
◄ Phenol [108-95-2]—Skin (1987)	5	19	—	—

Substance [CAS #]	ADOPTED VALUES TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
Phenothiazine [92-84-2]—Skin (1986)	—	5	—	—
▪ N-Phenyl-beta-naphthylamine [135-88-6] (1979)	A2	A2	—	—
o-Phenylenediamine [95-54-5] (1991)	—	0.1,A2	—	—
m-Phenylenediamine [108-45-2] (1991)	—	0.1	—	—
p-Phenylenediamine [106-50-3] (1991)	—	0.1	—	—
Phenyl ether [101-84-8], vapor (1976)	1	7	2	14
Phenylethylene, *see* Styrene, monomer				
‡•▪ Phenyl glycidyl ether (PGE) [122-60-1] (1982)	(1)	(6.1)	—	—
•▪ Phenylhydrazine [100-63-0]—Skin (1991)	0.1,A2	0.44,A 2	—	—
• Phenyl mercaptan [108-98-5] (1978)	0.5	2.3	—	—
Phenylphosphine [638-21-1] (1977)	C 0.05	C 0.23	—	—
Phorate [298-02-2]—Skin (1976)	—	0.05	—	0.2
Phosdrin, *see* Mevinphos				
Phosgene [75-44-5] (1978)	0.1	0.40	—	—
Phosphine [7803-51-2] (1976)	0.3	0.42	1	1.4
Phosphoric acid [7664-38-2] (1976)	—	1	—	3
Phosphorus (yellow) [7723-14-0] (1986)	0.02	0.1	—	—
Phosphorus oxychloride [10025-87-3] (1990)	0.1	0.63	—	—
Phosphorus pentachloride [10026-13-8] (1980)	0.1	0.85	—	—
Phosphorus pentasulfide [1314-80-3] (1976)	—	1	—	3
Phosphorus trichloride [7719-12-2] (1982)	0.2	1.1	0.5	2.8
Phthalic anhydride [85-44-9] (1987)	1	6.1	—	—
m-Phthalodinitrile [626-17-5] (1977)	—	5	—	—
Picloram [1918-02-1] (1990)	—	10	—	—
Picric acid [88-89-1] (1990)	—	0.1	—	—
Pindone [83-26-1] (1987)	—	0.1	—	—
Piperazine dihydrochloride [142-64-3] (1982)	—	5	—	—
2-Pivalyl-1,3-indandione, *see* Pindone				
Plaster of Paris, *see* Calcium sulfate				
Platinum [7440-06-4]				
Metal (1981)	—	1	—	—
Soluble salts, as Pt (1970)	—	0.002	—	—

NOTICE OF INTENDED CHANGES
(for 1993–1994)

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, for which a change in the "Adopted" listing has been proposed, or for which retention on the Notice of Intended Changes has been proposed. In all cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least one year. If, after one year 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 and their proposed values.

Substance	[CAS #]	TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
† Acetone cyanohydrin	[75-86-5], as CN—Skin	C 4.7	5	—	—
Adiponitrile	[111-69-3]—Skin	2	8.8		
† Ammonium perfluorooctanoate	[3825-26-1]	—	0.01,A3	—	—
Asbestos, all forms	[1332-21-4]	0.2 f/cc,[f]A1		—	—
Benzene	[71-43-2]—Skin	0.1,A1	0.3,A1	—	—
Benzyl acetate	[140-11-4]	10,A3	61,A3	—	—
† Bromine	[7726-95-6]	0.1	0.66	0.2	1.3
† 1,3-Butadiene	[106-99-0]	2,A2	4.4,A2	—	—
n-Butyl acetate	[123-86-4]	20	95	—	—
† Chromium, elemental	[7440-47-3], metal and inorganic compounds, as Cr				
Metal		—	0.5,A4	—	—
Cr III compounds		—	0.5,A4	—	—
Water-soluble Cr VI compounds		—	0.05,A1	—	—
Insoluble Cr VI compounds		—	0.01,A1	—	—
Cobalt, elemental	[7440-48-4], and inorganic compounds, as Co	—	0.02,A3	—	—
† 2-N-Dibutylaminoethanol	[102-81-8]—Skin	0.5	3.5	—	—
† Diethanolamine	[111-42-2]—Skin	0.46	2	—	—
† Diethylamine	[109-89-7]—Skin	5,A4	15,A4	15,A4	45,A4
† 2-Diethylaminoethanol	[100-37-8]—Skin	2	9.6	—	—
† Dimethylethoxysilane	[14857-34-2]	0.5	2.1	1.5	6.4
1,1-Dimethylhydrazine	[57-14-7]—Skin	0.01,A2	0.025,A2	—	—
Epichlorohydrin	[106-89-8]—Skin	0.1,A2	0.38,A2	—	—
† EPN	[2104-64-5]—Skin	—	0.1	—	—
† Ethylamine	[75-04-7]—Skin	5	9.2	15	27.6
† Ethyl chloride	[75-00-3]	100,A3	264	—	—
† Heptachlor and Heptachlor epoxide	[76-44-8]—Skin	—	0.05,A3	—	—

Substance	[CAS #]	TWA ppm[a]	TWA mg/m³[b]	STEL ppm[a]	STEL mg/m³[b]
† Hexachlorobenzene	[118-74-1]—Skin	—	0.025,A3	—	—
Hydrazine	[302-01-2]—Skin	0.01,A2	0.013,A2	—	—
† Hydrogen cyanide and Cyanide salts, as CN					
Hydrogen cyanide	[74-90-8]—Skin	C 4.7	C 5	—	—
Calcium cyanide	[592-01-8]—Skin	—	C 5	—	—
Potassium cyanide	[151-50-8]—Skin	—	C 5	—	—
Sodium cyanide	[143-33-9]—Skin	—	C 5	—	—
† Lead, elemental	[7439-92-1], and inorganic compounds, as Pb*	—	0.05,A3	—	—
Manganese, elemental	[7439-96-5], and inorganic compounds, as Mn	—	0.2	—	—
† Mercury, as Hg—Skin					
Alkyl compounds		—	0.01	—	0.03
Aryl compounds		—	0.1	—	—
Elemental	[7439-97-6] and inorganic compounds including Hg vapor	—	0.025,A4	—	—
† Methyl-tert butyl ether	[1634-04-4]	40	144	—	—
Methyl hydrazine	[60-34-4]—Skin	0.01,A2	0.019,A2	—	—
Nickel, elemental	[7440-02-0], insoluble and soluble compounds, as Ni	—	0.05,A1	—	—
Nickel carbonyl	[13463-39-3], as Ni	Delete listing; included in listing for Nickel, elemental, insoluble and soluble compounds			
Nickel sulfide roasting, fume & dust, as Ni		Delete listing; included in listing for Nickel, elemental, insoluble and soluble compounds			
Nitromethane	[75-52-5]	20	50	—	—
† Oil Mist, mineral					
Severely refined		—	5[k]	—	—
Mildly refined, as cyclohexane soluble particulate containing polynuclear aromatic hydrocarbons (PNAs)		—	0.2[k],A1	—	—
† Ozone	[10028-15-6]	0.05	0.1	0.2	0.4
† Phenyl glycidyl ether (PGE)	[122-60-1]—Skin	0.1,A3	0.6,A3	—	—
† Sodium fluoroacetate (previously listed as Sodium perfluoroacetate)	[62-74-8]—Skin	—	0.05	—	—
† Sulfometuron methyl	[74222-97-2]	—	5,A4	—	—
† Triethylamine	[121-44-8]—Skin	1	4.1	5	20.7

*Blood Pb should be controlled to a value at or below 20 µg/dl (see TLV Documentation for Lead, elemental, and inorganic compounds).

NOTES

ADVANCED
EXPERIMENTAL

FOOTNOTES

- 1993-1994 Adoption
- ‡ See Notice of Intended Changes
- ( ) Adopted values enclosed are those for which changes are proposed. Consult the Notice of Intended Changes for current proposal.
- † 1993–1994 Revision or Addition to the Notice of Intended Changes.
- ◄ Identifies substances for which there are also BEIs (see BEI section). Substances identified in the BEI documentations for methemoglobin inducers (for which methemoglobin is the principle toxicity) and organophosphorus cholinesterase inhibitors are part of this notation.
- • Substance for which the TLV is higher than the OSHA Permissible Exposure Limit (PEL) and/or the NIOSH Recommended Exposure Limit (REL). See CFR 58(124): 36338–33351, June 30, 1993, for revised OSHA PELs.
- ■ Substance identified by other sources as a suspected or confirmed human carcinogen.
- A Refers to Appendix A — Carcinogens.
- B Refers to Appendix B — Substances of Variable Composition.
- C Denotes Ceiling limit.
- (a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.
- (b) Milligrams of substance per cubic meter of air.
- (c) Simple asphyxiant; see definition in the "Introduction to the Chemical Substances."
- (d) NOC = not otherwise classified.
- (e) The value is for total dust containing no asbestos and < 1% crystalline silica.
- (f) Fibers longer than 5 μm and with an aspect ratio equal to or greater than 3:1 as determined by the membrane filter method at 400–450X magnification (4-mm objective) phase contrast illumination.
- (g) The value is for dust containing < 5% crystalline silica. For dust containing more than this percentage of crystalline silica, the environment should be evaluated against the TLV–TWA of 0.1 mg/m^3 for respirable quartz. The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics define d in the "c." paragraphs of Appendix D.
- (h) Lint-free dust as measured by the vertical elutriator cotton-dust sampler described in the Transactions of the National Conference on Cotton Dust, p. 33, by J.R. Lynch (May 2, 1970).
- (i) Total dust/particulate.
- (j) These TLVs are for the respirable fraction of dust (respirable particulate mass) for the substance listed. The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in the "c." paragraphs of Appendix D.
- (k) As sampled by method that does not collect vapor.
- (l) Does not include stearates of toxic metals.
- (m) Based on "high-volume" sampling.
- (n) However, sho uld not exceed 2 mg/m^3 respirable dust.
- (o) For greater assurance of worker protection, biological monitoring is recommended.
- (p) Except castor, cashew nut, or similar irritant oils.

Annual Reports of the Committees on Threshold Limit Values and Biological Exposure Indices

Chemical Substances TLV Committee

Report to the ACGIH Membership for Approval at the Annual Membership Meeting, May 24, 1994, Anaheim, California.

Notice of Intended Changes for 1994–1995

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, for which a change in the "Adopted" listing has been proposed, or for which retention on the Notice of Intended Changes has been proposed. In all cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least one year. If, after one year 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 and their proposed values.

	TWA		STEL	
Substance [CAS#]	ppm[a]	mg/m³[b]	ppm[a]	mg/m³[b]
†Acetone [67-64-1]	200, A4	476, A4	400, A4	952, A4
Asbestos, all forms [1332-21-4]	—	0.2 f/cc,[f] A1	—	—
†Benzene [71-43-2] - Skin	0.3, A1	0.96, A1	—	—
†Benzoyl chloride [98-88-4]	C 0.5	C 2.8	—	—
†Benzyl Acetate [140-11-4]	10, A4	61, A4	—	—
†tert-Butanol [75-65-0]	100, A4	303, A4	—	—
n-Butyl acetate [123-86-4]	20	95	—	—
†Dichloroacetylene [7572-29-4]	C 0.1, A3	C 0.39, A3	—	—
Dimethylethoxysilane [14857-34-2]	0.5	2.1	1.5	6.4
†1,1-Dimethylhydrazine [57-14-7] – Skin	0.01, A3	0.025, A3	—	—
Epichlorohydrin [106-89-8] – Skin	0.1, A2	0.38, A2	—	—
†Ethyl chloride [75-00-3] – Skin	100, A3	264, A3	—	—
†Ethylene glycol [107-21-1]	C 100, A4	39.4, A4	—	—
†Hydrazine [302-01-2] – Skin	0.01, A3	0.013, A3	—	—
†Isophorone [78-59-1]	C 5, A3	C 28, A3	—	—
Lead, elemental, [7439-92-1], and inorganic compounds, as Pb*	—	0.05, A3	—	—
Manganese, elemental [7439-96-5], and inorganic compounds, as Mn	—	0.2	—	—
†Methyl acrylate [96-33-3] – Skin	2, A4	7, A4	—	—
†Methyl hydrazine [60-34-4] – Skin	0.01, A3	0.019, A3	—	—
†Methyl-tert butyl ether [1634-04-4]	40, A3	144, A3	—	—
Nickel, elemental [7440-02-0], insoluble and soluble compounds, as Ni	—	0.05, A1	—	—
Nickel carbonyl [13463-39-3], as Ni	Delete listing; included in listing for Nickel, elemental, insoluble and soluble compounds			
Nickel sulfide roasting, fume & dust, as Ni	Delete listing; included in listing for Nickel, elemental, insoluble and soluble compounds			
Oil mist, mineral Severely refined	—	5[k]	—	—
Mildly refined, as cyclohexane soluble particulate containing polynuclear aromatic hydrocarbons (PNAs)	—	0.2[k], A1	—	—
Ozone [10028-15-6]	0.05	0.01	0.2	0.4
†Triethylamine [121-44-8] – Skin	1, A4	4.1, A4	3, A4	12.4, A4

* A value for blood Pb is under review.
† 1994–1995 Revision or Addition to the Notice of Intended Changes.
(a) Parts of vapor or gas per million parts of air by volume at 25°C and 760 torr.
(b) Milligrams of substance per cubic meter of air.
(f) Fibers longer than 5 μm and with an aspect ratio equal to or greater than 3:1 as determined by the membrane filter method at 400–450x magnification (4-mm objective) phase contrast illumination.
(i) Total dust/particulate.
(j) This TLV is for the respirable fraction of dust for the substance listed. The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in the "c" paragraphs of Appendix D in the TLV/BEI Booklet.
(k) As sampled by method that does not collect vapor.
A Refers to Appendix A – Carcinogens, in the TLV/BEI Booklet.
A1 – Confirmed Human Carcinogen
A2 – Suspected Human Carcinogen
A3 – Animal Carcinogen
A4 – Not Classifiable as a Human Carcinogen
A5 – Not Suspected as a Human Carcinogen
C Denotes Ceiling Limit.

Transfers to the Adopted List for 1994–1995

Substance [CAS#]	TWA ppm[a]	TWA mg/m3[b]	STEL ppm[a]	STEL mg/m3[b]
Acetone cyanohydrin [75-86-5], as CN – Skin	C 4.7	C 5	—	—
Adiponitrile [111-69-3] – Skin	2	8.8	—	—
Ammonium perfluorooctanoate [3825-26-1] – Skin	—	0.01, A3	—	—
Bromine [7726-95-6]	0.1	0.66	0.2	1.3
1,3-Butadiene [106-99-0]	2, A2	4.4, A2	—	—
Chromium, metal [7440-47-3], and inorganic compounds, as Cr				
Metal and Cr III compounds	—	0.5, A4	—	—
Water soluble Cr VI compounds, Not Otherwise Classified	—	0.05, A1	—	—
Insoluble Cr VI compounds, Not Otherwise Classified	—	0.01, A1	—	—
Cobalt, elemental [7440-48-4], and inorganic compounds, as Co	—	0.02, A3	—	—
2-N-Dibutylaminoethanol [100-37-8] – Skin	0.5	3.5	—	—
Diethanolamine [111-42-2] – Skin	0.46	2	—	—
Diethylamine 109-89-7] – Skin	5, A4	15, A4	15, A4	45, A4
...thylaminoethanol [100-37-8] – Skin	2	9.6	—	—
EPN [2104-64-5] – Skin	—	0.1	—	—
Ethylamine [75-04-7] – Skin	5	9.2	15	27.6
Heptachlor [76-44-8] and Heptachlor epoxide [1024-57-3] – Skin	—	0.05, A3	—	—
Hexachlorobenzene [118-74-1] – Skin	—	0.025, A3	—	—
Hydrogen cyanide and Cyanide salts, as CN				
Hydrogen cyanide [74-90-8] – Skin	C 4.7	C 5	—	—
Calcium cyanide [592-01-8] – Skin	—	C 5	—	—
Potassium cyanide [151-50-8] – Skin	—	C 5	—	—
Sodium cyanide [143-33-9] – Skin	—	C 5	—	—
Mercury [7439-97-6], as Hg				
Aryl compounds – Skin	—	0.1	—	—
Inorganic forms including metallic mercury – Skin	—	0.025, A4	—	—
Methyl-tert butyl ether [1634-04-4]	40	144	—	—
Nitromethane [75-52-5]	20	50	—	—
...pnyl glycidyl ether (PGE) [122-60-1] – Skin	0.1, A3	0.6, A3	—	—
Sodium fluoroacetate [62-74-8] – Skin	—	0.05	—	—
Sulfometuron methyl [74222-97-2]	—	5, A4	—	—
Triethylamine [121-44-8] – Skin	1	4.1	5	20.7

Chemical Substances and Other Issues Under Study

Information, data especially, and comments are solicited to assist the Committee in its deliberations and in the possible development of draft documents. Draft documentations are used by the Committee to decide what action, if any, to recommend on a given question.

Chemical Substances

Acetomethylchloride
Aluminum alkyls
Antimony
Attapulgite/Palygorskite/ Sepiolite
Aviation Fuel
Bentonite
Borax and boron compounds
Bromochloromethane
Bromodichloromethane
Bromoform
1,2,3,4-Butanetetracarboxylic acid
sec-Butyl acetate
sec-Butanol
2-t-Butylazo-2-hydroxy-5-methylhexane
Carbon disulfide
Chlorine
Chlorodiphenyls (42% & 54% chlorine)
Copper fume
Cristobalite
Crystalline silicas
Cyanamide
Dichlorocyclopentadiene
Dichlorodiphenyl sulfone
1,2-Dichloroethane
2,4-D (2,4-Dichlorophenoxy acetic acid)
1,3-Dichloropropene
Diesel Fuel
1,4-Diethyl benzene
N,N-Dimethyl acetamide
Dimethylformamide
Dimethyl disulfide
Dimethylterephthalate
2-Ethoxyethanol (EGEE)
2-Ethoxyethyl acetate (EGEEA)
Ethyl bromide
Ethyl tert-butyl ether
2-Ethylhexoic acid
Fibrous glass dust (synthetic inorganic fibers)
Fluorine
Furfural
Gallium arsenide
Gasoline (unleaded)
Glycol ethers
Glycidol
Graphite fibers
1-Hexene
Hexachlorocyclopentadiene
Isobutene
Isopropyl glycidyl ether (IGE)
Lead, organic compounds
2-Methoxyethanol (EGME)
2-Methoxyethyl acetate (EGMEA)
Methyl n-butyl ketone
Methyl chloride
Methyl propyl ketone
α-Methyl styrene
Methyl vinyl ketone
Methylene chloride
Methylene diamine
4,4'-Methylene dianiline
Mineral spirits
Naled
Pentachlorophenol
Pentane
2,4-Pentanedione
Perlite
Petroleum solvents
Phosphates (including mining)
Picolene
Propylene dichloride
Styrene
Synthetic Inorganic Fibers (Man-made mineral fibers)
Tantalum
tert-Amyl methyl ether (TAME)
1,1,2,2-Tetrachloroethane
Tetrahydrofuran

Tetrakis (hydroxymethyl) phosphonium chloride
Tetrakis (hydroxymethyl) phosphonium sulfate
Tetrasodium pyrophosphate (Phosphates)
Tridymite
Trona
Uranium
Vanadium
Vinylidene chloride
Vinyl cyclohexene dioxide
Xylene

Other Issues

1. Ceiling Limit, Excursion Limit and Short-Term Exposure Limit (STEL).
2. Reproductive Effects Notation. Under further review, but for the present, a notation will not be included in the TLV/BEI Booklet listing.
3. Risk Assessment.
4. Neurotoxicity.

Revisions to the "Introduction To The Chemical Substances," TLV/BEI Booklet

Following the third paragraph, add the following:

"Health impairments considered include those that shorten life expectancy, compromise physiological function, impair the capability for resisting other toxic substances or disease processes, or adversely affect reproductive function or developmental processes."

Particulates Not Otherwise Classified (PNOC)

This section of the "Introduction" is revised to read as follows:

"There are many substances on the TLV list, and many more that are not on the list, for which there is no evidence of specific toxic effects. Where these are particulates, they have frequently been called "nuisance dusts". Although these materials may not cause fibrosis or systemic effects, they are not biologically inert. At high concentrations, otherwise nontoxic dusts have been associated with the occasionally fatal condition known as alveolar proteinosis. At lower concentrations, they can inhibit the clearance of toxic particulates from the lung by decreasing the mobility of the alveolar macrophages. Accordingly, the Chemical Substances TLV Committee recommends the use of the term "Particulates Not Otherwise Classified (PNOC)" to emphasize that all materials are potentially toxic and to avoid the implication that these materials are harmless at all exposure concentrations. To recognize the adverse effects of exposure to otherwise nontoxic dusts, a TLV–TWA of 10 mg/m^3 for inhalable particulate and a TLV–TWA of 3 mg/m^3 for respirable particulate have been established and are included in the main TLV list. Refer to the documentation for Particulates Not Otherwise Classified (PNOC) for a complete discussion of this subject."

Unlisted Substances

This section of the "Introduction" is revised as follows:

"The list of TLVs is by no means a complete list of all hazardous substances or of all hazardous substances used in industry. For a large number of materials of recognized toxicity, there are little or no data available that could be used to establish a TLV. Substances that do not appear on the TLV list should not be considered to be harmless or nontoxic. When unlisted substances are introduced into a workplace, the medical and scientific literature should be reviewed to identify potentially dangerous toxic effects. It may also be advisable to conduct preliminary toxicity studies. In any case, it is necessary to remain alert to adverse health effects in workers which may be associated with the use of new materials. The TLV Committee strongly encourages industrial hygienists and other occupational health professionals to bring to the Committee's attention information which would suggest that a TLV should be established. Such information should include exposure concentrations and correlated health effects data (dose–response) that would support a recommended TLV."

Committee Activities for 1993–1994 Included:

1. New Committee Members: Michael J. Blotzer, CIH, CSP, National Aeronautics and Space Administration, Lewis Research Center; James S. Bus, Ph.D., Dow Chemical Company; Richard E. Fairfax, CIH, Occupational Safety and Health Administration, Seattle Regional Office; Gregory L. Kedderis, Ph.D., Chemical Industry Institute of Toxicology; M. Val Roloff, Ph.D., Monsanto Company, is the American Industrial Hygiene Association (AIHA), Workplace Environmental Exposure Levels (WEEL) Committee liaison to the TLV Committee.
2. Committee and Subcommittee Meetings: The plenary Committee held meetings September 13–14, 1993, in Rockville, MD, and March 7–8, 1994, in Dallas, TX. The subcommittees met individually a total of 10 times during the 1993–1994 interval. These meetings included presentations and receipt of data from interested outside groups relative to Notice of Intended Changes or Chemical Substances Under Study for: Benzene, 1,3-Butadiene, Cadmium, Cobalt, Epichlorohydrin, Hydrazines, Lead, Manganese, Mercury, Methyl-tert butyl ether, Methyl acrylate, Nickel, Oil Mists, and Styrene. Data and research activities associated with the Dusts and Inorganics Subcommittee's considerations of asbestos and synthetic inorganic fibers were presented during the Subcommittee's laboratory site visit to the Chemical Industry Institute of Toxicology (CIIT). Two AIHA WEEL Committee meetings were attended by the TLV Committee Staff Liaison.
3. Federal Republic of Germany MAK and BAT Values: Dr. H. Greim, Chair, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area, attended the March 7–8, 1994 meeting of the TLV Committee. Dr. Greim and Dr. J. Doull, Chair, Chemical Substances TLV Committee, have utilized such liaison to foster teamwork in the international industrial hygiene and occupational health arena.
4. Documentation, Sixth Edition: The Sixth Edition of the Documentation of TLVs and BEIs was completed early in 1994 and distribution completed to all subscribers. The publication, a three-volume companion document to the TLV BEI Booklet, is available from the ACGIH Office; Publication No. 0206.
5. Presentations: Presentations were made by members of the Committee and ACGIH Staff on the process of TLV and documentation development and technical, scientific, and political issues confronting the Committee. Included were a Professional Development Course (PDC) at the 1993 American Industrial Hygiene Conference & Exposition; TLV orientation of industrial hygiene and occupational health graduate students at the University of Cincinnati Institute of Environmental Health; presentations at Local Sections of AIHA: Central Ohio and Northern California; and TLV representation at the International Conference on Crystalline Silica Health Effects.