Documentation for Immediately Dangerous To Life or Health Concentrations (IDLHs)

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PREFACE

This publication documents the criteria and information sources that have been used by the National Institute for Occupational Safety and Health (NIOSH) to determine immediately dangerous to life or health concentrations (IDLHs). IDLHs were originally determined for 387 substances in the mid-1970's as part of the Standards Completion Program (SCP), a joint project by NIOSH and the Occupational Safety and Health Administration (OSHA), for use in assigning respiratory protection equipment. NIOSH is currently evaluating the scientific adequacy of the criteria and procedures used during the SCP for establishing IDLHs. In the interim, the IDLHs have been reviewed and, (if appropriate) revised. In this document, IDLHs are listed with the basis and references for the current values as well as with the original IDLHs and their documentation (as paraphrased from the SCP draft technical standards).

CONTENTS

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ABBREVIATIONS

A1	confirmed human carcinogen (ACGIH)
A2	suspected human carcinogen (ACGIH)
A3	animal carcinogen (ACGIH)
A4	not classifiable as a human carcinogen (ACGIH)
A5	not suspected as a human carcinogen (ACGIH)
ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
CAS	Chemical Abstract Service
CF	correction factor for LC data
CFR	Code of Federal Regulations
EEGL	emergency exposure guidance level (NRC)
ERPG	emergency response planning guideline (AIHA)
IDLH	immediately dangerous to life or health concentration value
i.p.	intraperitoneal
i.v.	intravenous
kg	kilogram
LC	lethal concentration
LC_{50}	concentration causing death in 50%
LC_{Lo}	lowest concentration causing death
LD	lethal dose
LD_{50}	dosage causing death in 50%
LD_{Lo}	lowest dosage causing death
LEL	lower explosive limit
mg/kg	milligrams per kilogram of body weight
mg/m^3	milligrams per cubic meter of air
mmHg	millimeters of mercury (pressure measurement)
mppcf	millions of particles per cubic foot of air
NIOSH	National Institute for Occupational Safety and Health
NRC	National Research Council
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit (OSHA)
ppm	parts per million parts of air
RD_{50}	concentration producing a 50% decrease in respiratory rate following a 10-minute exposure
REL	recommended exposure limit (NIOSH)
s.c.	subcutaneous
SCP	Standards Completion Program (NIOSH/OSHA)
SPEGL	short-term public emergency guidance level (NRC)
STEL	short-term exposure limit
TC_{Lo}	lowest concentration resulting in a toxic effect
TD_{Lo}	lowest dose resulting in a toxic effect
TLV	threshold limit value (ACGIH)
TWA	time-weighted average

ABBREVIATIONS OF JOURNAL TITLES

Ader Hand BiolArbeitsmethod	Abdernalden's Handbuch der Biologischen Arbeitsmethoden
Acta Med Scand	Acta Medica Scandinavica (Stockholm)
Acta Med Scand Suppl	Acta Medica Scandinavica Supplementum (Stockholm)
Acta Pharmaceut Jugo	Acta Pharmaceutica Jugoslavica
Acta Pharmacol Toxicol	Acta Pharmacologica et Toxicologica (Copenhagen)
Acta Physiol Scand	Acta Physiologica Scandinavica (Oxford)
Agri Biol Chem	Agricultural and Biological Chemistry (Tokyo)
AMA Arch Ind Health	American Medical Association Archives of Industrial Health
AMA Arch Ind Hyg Occup Med	American Medical Association Archives of Industrial Hygiene and Occupational Medicine
Am Ind Hyg Assoc J	American Industrial Hygiene Association Journal
Am Ind Hyg Assoc Q	American Industrial Hygiene Association Quarterly
Am J Clin Pathol	American Journal of Clinical Pathology
Am J Ind Med	American Journal of Industrial Medicine
Am J Med	American Journal of Medicine
Am J Med Sci	American Journal of the Medical Sciences
Am J Pathol	American Journal of Pathology
Am J Public Health	American Journal of Public Health
Am J Public Health Nations Health	American Journal of Public Health and the Nations Health
Am J Vet Res	American Journal of Veterinary Research
Am Rev Pharmacol	American Review of Pharmacology
Anal Chem	Analytical Chemistry
Ann Intern Med	Annals of Internal Medicine
Arch Biochem	Archives of Biochemistry
Arch Environ Health	Archives of Environmental Health
Arch Exp Pathol Pharmakol	Archiv für Experimentelle Pathologie und Pharmakologie
Arch Gewerbepath Gewerbehyg	Archiv für Gewerbepathogie und Gewerbehygiene
Arch Hyg	Archiv für Hygiene
Arch Hyg Bakteriol	Arch für Hygiene und Bakteriologie (Munich)
Arch Int Pharmaco Ther	Archives Internationales de Pharmacodynamie et de Therapie
Arch Mal Prof	Archives des Maladies Professionnelles de Medecine du Travail et de Securite Sociale (Paris)

ABBREVIATIONS OF JOURNAL TITLES (Continued)

Arch Pathol	Archives of Pathology
Arch Sci Med	Archivio per le Scienze Mediche (Turin)
Arch Toxicol	Archives of Toxicology
Arch Toxikol	Archiv für Toxikologie (Berlin)
Biochem Pharmacol	Biochemical Pharmacology (Oxford)
Biomed Biochim Acta	Biomedica Biochimica Acta (Berlin)
Br J Ind Med	British Journal of Industrial Medicine (London)
Br Med J	British Medical Journal (London)
Bulletin Environ Contam Toxicol	Bulletin of Environmental Contamination and Toxicology
Bulletin Exp Biol Med	Bulletin of Experimental Biology and Medicine
Can J Public Health	Canadian Journal of Public Health (Ottawa)
Can Med Assoc J	Canadian Medical Association Journal (Ottawa)
Chem Abstr	Chemical Abstracts
Chem Biol Interact	Chemico-Biological Interactions (Ireland)
Chem Ind	Chemistry and Industry (London)
Chi J Prev Med	Chinese Journal of Preventive Medicine
Clin Res	Clinical Research
Clin Toxicol	Clinical Toxicology
Comp Rend Hebdom	Comptes Rendus Hebdomadaires des Seances, Academie des Sciences
CRC Crit Rev Toxicol	CRC Critical Reviews in Toxicology
Czech Med J	Czechoslovakian Medical Journal
Drug Chem Toxicol	Drug and Chemical Toxicology
Ecotoxicol Environ Safety	Ecotoxicological and Environmental Safety
Environ Health Perspect	Environmental Health Perspectives
Environ Res	Environmental Research
Exp Molec Pathol	Experimental and Molecular Pathology
Farmakol Toxsikol	Farmakologiya i Toxsikologiya (Moscow)
Fed Proc	Federation Proceedings
Fiz Akt Vesh	Fiziologicheski Aktivnye Veshchestva (Physiologically Active Substances)
Fluor Chem Rev	Fluorine Chemistry Reviews
Food Cosmet Toxicol	Food and Cosmetics Toxicology (Oxford)
Food Res	Food Research
Fundam Appl Toxicol	Fundamental and Applied Toxicology
Gen Pharmacol	General Pharmacology (Oxford)
Gig Nas Mest	Gigiena Naselennykh Mest (Hygiene in Populated Places)
Gig Sanit	Gigiena i Sanitariya (Moscow)

ABBREVIATIONS OF JOURNAL TITLES (Continued)

Gig Tr Prof Zabol	Gigiena Truda i Professional'nye Zabolevaniya (Labor Hygiene andOccupational Diseases) (Moscow)
Hum Toxicol	Human Toxicology (England)
Ind Eng Chem	Industrial Engineering Chemistry
Ind Hyg Newsletter	Industrial Hygiene Newsletter
Indian J Exp Biol	Indian Journal of Experimental Biology (New Delhi)
Ind Med	Industrial Medicine
Ind Med Surg	Industrial Medicine and Surgery
Int Arch Arbeitsmed	Internationales Archiv für Arbeitsmedizin (Berlin)
Int J Abnorm Develop	The International Journal of Abnormal Development
Int J Air Pollut	International Journal of Air Pollution
Int Polymer Sci Tech	International Polymer Science and Technology
J Agri Food Chem	Journal of Agriculture and Food Chemistry
J Air Pollut Control Assoc	Journal of the Air Pollution Control Association
JAMA	Journal of the American Medical Association
J Am Coll Toxicol	Journal of the American College of Toxicology
J Am Pharm Assoc	Journal of the American Pharmaceutical Association
J Appl Physiol	Journal of Applied Physiology
J Appl Toxicol	Journal of Applied Toxicology (England)
J Combustion Toxicol	Journal of Combustion Toxicology
J Econ Entomol	Journal of Economic Entomology
J Environ Pathol Toxicol	Journal of Environmental Pathology and Toxicology
J Eur Toxicol	Journal Europeen de Toxicologie (European Journal of Toxicology)
J Fire Sci	Journal of Fire Sciences
J Haz Mat	Journal of Hazardous Materials
J Hyg	Journal of Hygiene (London)
J Hyg Epidemiol Microbiol Immunol	Journal of Hygiene, Epidemiology, Microbiology, and Immunology (Prague)
J Ind Hyg	Journal of Industrial Hygiene
J Ind Hyg Toxicol	Journal of Industrial Hygiene and Toxicology
J Lab Clin Med	Journal of Laboratory and Clinical Medicine
J Occup Med	Journal of Occupational Medicine
J Osaka Cty Med Cntr	Journal of the Osaka City Medical Center
J Pathol Bacteriol	Journal of Pathology and Bacteriology (London)

ABBREVIATIONS OF JOURNAL TITLES (Continued)

J Pharmacol	Journal de Pharmacologie (Paris)
J Pharmacol Exp Ther	Journal of Pharmacology and Experimental Therapeutics
J Pharm Pharmacol	Journal of Pharmacy and Pharmacology (London)
J Pharm Sci	Journal of Pharmaceutical Sciences
J Royal Army Med Corps	Journal of the Royal Army Medical Corps
J Soc Occup Med	Journal of the Society of Occupational Medicine (Edinboro)
J Toxicol Environ Health	Journal of Toxicology and Environmental Health
J Toxicol Sci	Journal of Toxicological Sciences (Japan)
Kosm Biol Aviak Med	Kosmicheskaya Biologiya i Aviakomicheskaya Meditsnia (Space Biology and Aerospace Medicine) (Moscow)
Kuma Med J	Kumamoto Medical Journal (Japan)
Med Lav	Medicina del Lavoro (Industrial Medicine) (Milan)
Med Pr	Medycyna Pracy (Medical Practice) (Warsaw)
Milit Med	Military Medicine
Mutat Res	Mutation Research (Amsterdam)
N Engl J Med	New England Journal of Medicine
Neurotoxicol	Neurotoxicology
NIH Bulletin	National Institutes of Health Bulletin
N Z Med J	New Zealand Medical Journal (Dunedin)
Pest Biochem Physiol	Pesticide Biochemistry and Physiology
Pharmaceut J	Pharmaceutical Journal
Pharmacol Rev	Pharmacological Review
Pharmacol Res Commun	Pharmacological Research Communications
Pharmacol Ther	Pharmacology and Therapeutics
Pharm Chem J	Pharmaceutical Chemistry Journal
Proc Eur Soc St Drug Tox	Proceedings of the European Society for the Study of Drug Toxicity
Proc Eur Soc Toxicol	Proceedings of the European Society of Toxicology
Proc Soc Exp Biol Med	Proceedings of the Society for Experimental Biology and Medicine
Prog Exp Tumor Res	Progress in Experimental Tumor Research
Prom Toksikol Klin	Promyshlennaya Toksikologiya Klinika
Public Health Rep	Public Health Reports
QBulletin Assoc Food Drug Off U.S.	Quarterly Bulletin of the Association of Food and Drug Officials of the U.S.

ABBREVIATIONS OF JOURNAL TITLES (Continued)

Q J Stud Alcohol	Quarterly Journal of Studies on Alcohol
Rec Med Vet	Recueil de Medecine Veterinaire
S Afr Med J	South African Medical Journal (Capetown)
Scand J Work Environ Health	Scandinavian Journal of Work, Environment and Health (Helsinki)
Tab Biol Per	Tabulae Biologicae Periodicae
Toxicol Appl Pharmacol	Toxicology and Applied Pharmacology
Toxicol Lett	Toxicology Letters (Amsterdam)
Toksikol Nov Prom Khim Vesh	Toksikologiya Novykh Promyshlennykh Khimicheskikh Veshchestva (Toxicology of New Industrial Chemical Substances)
Trans Am Soc Heat Vent Eng	Transactions of the American Society of Heating and Ventilating Engineers
Vest Akad Med Nk	Vestnik Akademii Meditsinskikh Nouk SSR (Journal of the Academy of Medical Sciences of the USSR)
Vet Hum Toxicol	Veterinary and Human Toxicology
Vet Med	Veterinary Medicine
Vet Med Small Anim Clin	Veterinary Medicine, Small Animal Clinician
Vop Komm Gig	Voprosy Kommunal'noi Gigiena (Problems of Communal Hygiene)
Zeit Ges Exp Med	Zeitschrift für die Gesampte Experimentelle Medizin
Zeit Ges Med Gren	Zeitschrift für die Gesamte Innre Medizin und Ihre Grenzgebiete
Zentralbl Arbeitsmed Arbeitsschutz	Zentralblatt für Arbeitsmedizin und Arbeitsschutz

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INTRODUCTION

The "immediately dangerous to life or health air concentration values (IDLHs)" used by the National Institute for Occupational Safety and Health (NIOSH) as respirator selection criteria were first developed in the mid-1970's. The *Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs)* is a compilation of the rationale and sources of information used by NIOSH during the original determination of 387 IDLHs and their subsequent review and revision in 1994.

Background

Immediately Dangerous to Life or Health Conditions and Respirator Selection

The concept of using respirators to protect workers in situations that are immediately dangerous to life or health was discussed at least as early as the 1940's. The following is from a U.S. Department of Labor bulletin:

> The situations for which respiratory protection is required may be designated as, (1) nonemergency and (2) emergency. Nonemergency situations are the more or less normal ones that involve exposure to atmospheres that are not immediately dangerous to health and life, but will produce marked discomfort, sickness, permanent harm, or death after a prolonged exposure or with repeated exposure. Emergency situations are those that involve actual or potential exposure to atmospheres that are immediately harmful and dangerous to health or life after comparatively short exposures. [Yant 1944]

The Occupational Safety and Health Administration (OSHA) defines an immediately dangerous to life or health concentration in their hazardous waste operations and emergency response regulation as follows:

> An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. [29 CFR* 1910.120]

In the OSHA regulation on permit–required confined spaces, an immediately dangerous to life or health condition is defined as follows:

> Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space. Note: Some materials–hydrogen fluoride gas and cadmium vapor, for example–may produce immediate transient effects that, even if severe,

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*Code of Federal Regulations

may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately dangerous to life or health." [29 CFR 1910.146]

As part of their current respiratory protection standard [29 CFR 1910.134(e)], OSHA requires that a standby person be present with suitable rescue equipment when self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health. Furthermore, persons using air-line respirators in atmospheres immediately hazardous to life or health must be equipped with safety harnesses and safety lines for lifting or removing workers from hazardous atmospheres.

The Standards Completion Program

In 1974, NIOSH and OSHA jointly initiated the development of occupational health standards consistent with Section 6(b) of the Occupational Safety and Health Act of 1970 for substances with then-existing OSHA permissible exposure limits (PELs). This joint effort was called the Standards Completion Program (SCP) and involved the cooperative efforts of personnel from various divisions within NIOSH and OSHA, and several contractors. The SCP developed 387 substance-specific draft standards with supporting documentation that contained technical information and recommendations needed for the promulgation of new occupational health regulations. Although new standards were not promulgated at that time, these data became the original basis for the *NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards* [NIOSH/OSHA 1981].

As part of the respirator selection process for each draft technical standard, an IDLH was determined. The definition for an IDLH that was derived during the SCP was based on the definition stipulated in 30 CFR 11.3(t). The purpose for establishing this IDLH was to determine a concentration from which a worker could escape without injury or without irreversible health effects in the event of respiratory protection equipment failure (e.g., contaminant breakthrough in a cartridge respirator or stoppage of air flow in a supplied-air respirator) and a concentration above which only "highly reliable" respirators would be required. In determining IDLHs, the ability of a worker to escape without loss of life or irreversible health effects was considered along with severe eye or respiratory irritation and other deleterious effects (e.g., disorientation or incoordination) that could prevent escape. Although in most cases, egress from a particular worksite could occur in much less than 30 minutes, as a safety margin, IDLHs were based on the effects that might occur as a consequence of a 30-minute exposure. However, the 30-minute period was NOT meant to imply that workers should stay in the work environment any longer than necessary following the failure of respiratory protection equipment; in fact, EVERY EFFORT SHOULD BE MADE TO EXIT IMMEDIATELY!

IDLHs were determined for each substance during the SCP on a case-by-case basis, taking into account the toxicity data available at the time. Whenever possible, IDLHs were determined using health effects data from studies of humans exposed for short durations. However, in most instances, a lack of human data necessitated the use of animal toxicity data. When inhalation studies of animals exposed for short durations (i.e., 0.5 to 4 hours) were the only health effects data available, IDLHs were based on the lowest exposure causing death or irreversible health effects in any species. When lethal dose (LD) data from animals were used, IDLHs were estimated on the basis of an equivalent exposure to a 70-kg worker breathing 10 cubic meters of air.

Since chronic exposure data may have little relevance to acute effects, these types of data were used in determining IDLHs only when no acute toxicity data were available and only in conjunction with competent scientific judgment. In a number of instances when no relevant human or animal toxicity data were available, IDLHs were based on analogies with other substances with similar toxic effects.

Discussion of Original IDLHs

The basis for each of the 387 IDLHs determined during the SCP were reviewed and paraphrased from the individual draft technical standards for this publication. Also included is a complete listing of references cited in the SCP; in many cases where only secondary references were cited, the original sources have also been added. Whenever available, the references (secondary and primary) were obtained to verify the information cited in the SCP. However, a few of the original references such as personal communications and foreign reports could not be located.

Although 387 substances were originally included in the SCP, IDLHs were not specifically determined for all of them. The published data at that time for 40 of these substances (e.g., DDT and triphenyl phosphate) showed no evidence that an acute exposure to high concentrations would impede escape or cause any irreversible health effects following a 30-minute exposure and the designation "NO EVIDENCE" was used in the listing of IDLHs. For all of these substances, respirators were selected on the basis of assigned protection factors. For some (e.g., copper fume and tetryl), an assigned protection factor of 2,000 times the PEL was arbitrarily used to determine the concentration above which only the "most protective" respirators were permitted. However, for most particulate substances for which evidence for establishing an IDLH did not exist (e.g., ferbam and oil mist), the use of an assigned protection factor of 2,000 would have resulted in the assignment of respirators at concentrations that were not likely to be encountered in the occupational environment. In addition, exposure concentrations greater than 500 times the PEL for many airborne particulates could result in exposures that would hamper vision. Therefore, it was decided as part of the SCP (and during the review and revision of the IDLHs) that for such particulate substances, only the "most protective" respirators would be permitted for use in concentrations exceeding 500 times the PEL.

IDLHs could not be determined during the SCP for 22 substances (e.g., bromoform and calcium oxide) because of a lack of relevant toxicity data and therefore the designation "UNKNOWN" was used in the IDLH listing. For most of these substances, the concentrations above which only the "most protective" respirators were allowed were based arbitrarily on assigned protection factors that ranged from 10 to 2,000 times the PEL, depending on the substance.

There were also 10 substances (e.g., n-pentane and ethyl ether) for which it was determined only that the IDLHs were in excess of the lower explosive limits (LELs). Therefore, the LEL was selected as the IDLH with the designation "LEL" added in the IDLH listing. For these substances, only the "most protective" respirators were permitted above the LEL in the SCP draft technical standards.

For 14 substances (e.g., beryllium and endrin), the IDLHs determined during the SCP were greater than the concentrations permitted based on assigned respiratory protection factors. In most instances the IDLHs for these substances were set at concentrations 2,000 times the PEL.

Current NIOSH Use of IDLHs

The current NIOSH definition for an immediately dangerous to life or health condition, as given in the *NIOSH Respirator Decision Logic* [NIOSH 1987], is a situation "that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment." It is also stated that the purpose of establishing an IDLH is to "ensure that the worker can escape from a given contaminated environment in the event of failure of the respiratory protection equipment." The NIOSH respirator decision logic uses an IDLH as one of several respirator selection criteria. Under the NIOSH respirator decision logic, "highly reliable" respirators (i.e., the most protective respirators) would be selected for emergency situations, fire fighting, exposure to carcinogens, entry into oxygen-deficient atmospheres, entry into atmospheres that contain a substanca at a concentration greater than 2,000 times the NIOSH REL or OSHA PEL, and for entry into immediately dangerous to life or health conditions. These "highly reliable" respirators include either a self-contained breathing apparatus (SCBA) that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or a supplied-air respirator that has a full facepieca and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in a pressure-demand or other positive-pressure mode.

When the IDLHs were developed in the mid-1970's, only limited toxicological data were available for many of the substances. NIOSH has recently requested information on the current uses of IDLHs in the workplace and on the scientific adequacy of the criteria and procadures originally used for establishing them [Federal Register, Volume 58, Number 229, p. 63379, Wednesday, December 1, 1993]. The information received in response to the Federal Register announcement is being evaluated and will be used to establish future actions conceming IDLHs. In the interim, however, NIOSH decided to review the existing IDLHs, and revise them as appropriate.

This document includes IDLHs for 85 substances (e.g., benzene and methylene chloride) determined by NIOSH to meet the OSHA definition of "potential occupational carcinogen" as given in 29 CFR 1990.103. For all of these substances, except ethylene oxide and crystalline silica, NIOSH recommends that the "most protective" respirators be wom by workers exposed at concentrations above the NIOSH REL, or at any detectable concentration when there is no REL. For ethylene oxide and crystalline silica, NIOSH recommends that the "most protective" respirators be wom in concentrations exceeding 5 ppm and 25 mg/m^3, respectively [NIOSH 1989, 1994].

Revised Criteria for Determining IDLHs

The criteria utilized to determine the adequacy of existing IDLHs were a combination of those used during the SCP and a newer methodology developed by NIOSH. These criteria form a tiered approach with acute human toxicity data being used preferentially, followed next by acute animal inhalation toxicity data, and then finally by acute animal oral toxicity data to determine an updated IDLH. When relevant acute toxicity data were insufficient or unavailable, then the use of chronic toxicity data or an analogy to a chemical with similar toxic effects was considered. In order to facilitate the revision process, secondary toxicological data were primarily used. Once a preliminary IDLH was developed, it was compared to the existing IDLH and to several other factors (e.g., existing short-term exposure guidelines and lower explosive limits).

The following "hierarchy" was followed to develop a "preliminary" value for the revised IDLH:

A. Human acute toxicity data were used if sufficient to determine a concentration that for up to 30 minutes does not cause death, serious or irreversible health effects, or does not impair or impede the ability to escape.

B. Animal acute lethal concentration (LC) data were considered next. The only animal lethal concentration data used involved mammals; the vast majority of the data was from studies of rats, mice, guinea pigs, and hamsters. It was decided to generally use the lowest reliable LC data, with LC_{50} data preferred. If acute LC data determined during a 30-minute period were not available, then the data, based on a study by ten Berge et al. [1986], were "adjusted" to an equivalent 30-minute value using the following relationship:

$$\textit{Adjusted } LC_{50} \textit{ (30 minutes)} = LC_{50}(t) \times \left(\frac{t}{0.5}\right)^{\frac{1}{n}}$$

where: $LC_{50}(t)$ = LC_{50} determined over t hours
n = constant*

*Note: ten Berge et al. [1986] determined the relationship shown above based on experimental data. The constant "n" was determined by ten Berge et al. to be less than 3.0 for 18 of the 20 substances studied. Although the individual "n" values determined by ten Berge et al. [1986] were utilized when applicable during the review and revision of the original IDLHs, as a conservative estimate, an "n" = 3.0 was assumed when "adjusting" the LC data to 30 minutes for all other substances.

This equation with an "n" = 3.0 results in the following correction factors:

t(hours)	correction factor
0.5	1.0
1	1.25
2	1.6
3	1.8
4	2.0
5	2.15
6	2.3
7	2.4
8	2.5

The LC values (after "adjusting" if necessary to 30 minutes) were divided by a safety factor of 10 to determine a "preliminary" IDLH for comparison purposes.

C. Animal lethal dose (LD) data were considered next. As was the case with the lethal concentration data, the only animal lethal dose data used involved mammals; the vast majority of the data were from studies of rats, mice, guinea pigs, and hamsters. It was decided to generally use the lowest LD data with oral LD_{50} data preferred. The LD data was used to determine the equivalent total dose to a 70-kg worker and, as was done during the SCP, the air concentration containing this dose was determined by dividing by 10 cubic meters. [Note: A worker breathing at a rate of 50 liters per minute for 30 minutes would inhale 1.5 cubic meters of air.] A "preliminary" IDLH for comparison purposes was determined by dividing these air concentrations by a safety factor of 10.

D. Chronic toxicity data were considered if no relevant acute toxicity data existed. However, the fact that chronic exposures may have limited relevance to acute effects was taken into consideration.

E. When relevant toxicity data applying specifically to the chemicals in question were lacking, and if it was determined to be justified, then analogies to substances with similar acute toxic effects were considered.

F. All "preliminary" IDLHs derived during this update were checked against the following factors prior to establishing the final "revised" IDLH:

   1. Lower explosive limit (LEL): It was decided to restrict the "routine" entry into a possible explosive atmosphere to concentrations no greater than 10% of the LEL. [Note: SCP-derived IDLHs were set at 100% of the LELs if there were no known serious health hazards below these values. However, OSHA considers concentrations in excess of 10% of the LEL to be a hazardous atmosphere in confined spaces [29 CFR 1910.146(b)].]

2. RD_{50} data: An RD_{50} is defined as the 10-minute exposure concentration producing a 50% respiratory rate decrease in mice or rats and can be used to estimate severe respiratory irritation. Prolonged exposure to an RD_{50} concentration has been shown to produce respiratory tract lesions consistent with irritation [Alarie 1981; Buckley et al. 1984].

3. Other short-term exposure guidelines such as the American Industrial Hygiene Association's emergency response planning guidelines (ERPGs) and the National Research Council's emergency exposure guidance levels (EEGLs) and short-term public emergency guidance levels (SPEGLs), and occupational exposure standards or recommendations such as OSHA PELs, NIOSH RELs, or the American Conference of Governmental Industrial Hygienists (ACGIH) TLVs.

4. Based on the NIOSH respirator decision logic, the revised IDLHs could not be greater than 2,000 times the NIOSH REL (or OSHA PEL).

5. The revised IDLHs would not be greater than the original IDLHs derived during the SCP.

Anyone who is aware of additional published data that may affect the IDLHs determined for particular substances is encouraged to make this information available to NIOSH. All data will be reviewed and consideration will be made regarding subsequent revision of the IDLHs.

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Acetaldehyde

CAS number	75-07-0
NIOSH REL	None established; NIOSH considers acetaldehyde to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	200 ppm (360 mg/m³) TWA
1989 OSHA PEL	100 ppm (180 mg/m³) TWA, 150 ppm (270 mg/m³) STEL
1993-1994 ACGIH TLV	25 ppm (45 mg/m³) CEILING, A3
Description of substance	Colorless liquid or gas (above 69°F) with a pungent, fruity odor.
LEL	4.0% (10% LEL, 4,000 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Patty [1963] and ACGIH [1971] that all rats survived a 4-hour exposure to 8,000 ppm, but all rats died from a 16,000 ppm exposure [Smyth 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Appelman et al. 1982	13,000	-----	4 hr	26,000 ppm (2.0)	2,600 ppm
Hamster	Feron 1979	17,000	-----	4 hr	34,000 ppm (2.0)	3,400 ppm
Rat	Skog 1950	20,000	-----	30 min	20,000 ppm (1.0)	2,000 ppm
Rat	Skog 1950	20,536	-----	30 min	26,536 ppm (1.0)	2,054 ppm

Other animal data	RD_{50} (mouse), 4,946 ppm [Alarie 1981].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for acetaldehyde is 2,000 ppm based on acute inhalation toxicity data in animals [Alarie 1981; Skog 1950]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for acetaldehyde at any detectable concentration.]

REFERENCES:

1. ACGIH [1971]. Acetaldehyde. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1-2.
2. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect 42:9-13.
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7. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

Acetic acid

CAS number	64-19-7
NIOSH REL	10 ppm (25 mg/m³) TWA, 15 ppm (37 mg/m³) STEL
Current OSHA PEL	10 ppm (25 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (25 mg/m³) TWA, 15 ppm (37 mg/m³) STEL
Description of substance	Colorless liquid or crystals with a sour, vinegar-like odor.
LEL	4.0% (10% LEL, 4,000 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that Ghiringhelli and DiFabio [1957] determined a 1-hour LC_{50} of about 5,000 ppm for guinea pigs and mice. AIHA [1972] reported that 1 of 6 rats died following a 4-hour exposure to 16,000 ppm [Smyth et al. 1951]. However, the Standards Completion Program Respirator Committee felt that a worker might have difficulty escaping from 5,000 ppm due to the irritation effects, and reduced the IDLH to 1,000 ppm to allow escape without injury. According to AIHA [1972], workers have repeatedly sustained exposures up to about 200 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Ghiringhelli and DiFabio 1957	5,620	-----	1 hr	7,025 ppm (1.25)	703 ppm
Rat	Smyth 1956	16,000	-----	4 hr	32,000 ppm (2.0)	3,200 ppm

Other animal data	RD_{50} (mouse), 163 ppm [DeCeaurriz et al. 1981].
Human data	Marked irritation of the eyes, nose, and upper respiratory tract which could not be tolerated for more than 3 minutes was noted at 816 to 1,226 ppm [von Oettingen 1960]. It has been reported that 50 ppm or more is intolerable to most persons due to intense lacrimation and irritation of the eyes, nose, and throat [AIHA]. It has also been stated that repeated exposures to high concentrations may produce respiratory tract irritation with pharyngeal edema and chronic bronchitis [AIHA 1972].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for acetic acid is 50 ppm based on acute inhalation toxicity data in humans [AIHA 1972].

REFERENCES:

1. AIHA [1972]. Acetic acid. In: Hygienic guide series. Am Ind Hyg Assoc J *33*:624-627.
2. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett *9*(2):137-143.
3. Ghiringhelli L, DiFabio A [1957]. Pathology due to acetic acid: observations on experimental animals and man. Med Lav *48*(10):560-561 (in Italian).
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5. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*:129-185.
6. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med *4*:119-122.
7. von Oettingen WF [1960]. The aliphatic acids and their esters: toxicity and potential dangers. AMA Arch Ind Health *21*:40/28-77/65.

Acetic anhydride

CAS number	108-24-7
NIOSH REL	5 ppm (20 mg/m³) CEILING
Current OSHA PEL	5 ppm (20 mg/m³) TWA
1989 OSHA PEL	5 ppm (20 mg/m³) CEILING
1993-1994 ACGIH TLV	5 ppm (21 mg/m³) TWA
Description of substance	Colorless liquid with a strong, pungent, vinegar-like odor.
LEL	2.7% (10% LEL, 2,700 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	According to AIHA [1971], all rats exposed for 4 hours to 2,000 ppm were dead within 14 days while all rats exposed for 4 hours to 1,000 ppm survived the 14-day observation period [Capellini and Sartorelli 1967]. Because 2,000 ppm is obviously too high to be selected as the IDLH, 1,000 ppm has been chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Deichmann and Gerarde 1969	1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for acetic anhydride is 200 ppm based on acute inhalation toxicity data in animals [Deichmann and Gerarde 1969]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. AIHA [1972]. Acetic anhydride. In: Hygienic guide series. Am Ind Hyg Assoc J *32*(1):64-67.
2. Capellini A, Sartorelli [1967]. Episodio di intossicazione collettiva da anidride acetica ed acido acetico. Med Lav *58*:108-112 (in Italian).
3. Deichmann WB, Gerarde HW [1969]. Trifluoroacetic acid (3FA). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 607.

Acetone

CAS number	67-64-1
NIOSH REL	250 ppm (590 mg/m^3) TWA
Current OSHA PEL	1,000 ppm (2,400 mg/m^3) TWA
1989 OSHA PEL	750 ppm (1,800 mg/m^3) TWA, 1,000 ppm (2,400 mg/m^3) STEL
1993-1994 ACGIH TLV	750 ppm (1,780 mg/m^3) TWA, 1,000 ppm (2,380 mg/m^3) STEL
Description of substance	Colorless liquid with a fragrant, mint-like odor.
LEL	2.5% (10% LEL, 2,500 ppm)
Original (SCP) IDLH	20,000 ppm
Basis for original (SCP) IDLH	There is no evidence in the available toxicological data that acetone presents an IDLH hazard below the lower explosive limit (LEL) of 25,000 ppm. Because Patty [1963] reported that a 1.5-hour exposure to 20,256 ppm is narcotic for mice, 20,000 ppm has been chosen as the IDLH.
Existing short-term exposure guideline	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 8,500 ppm
24-hour EEGL: 1,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Flury and Wirth 1933	-----	45,455	1 hr	56,818 ppm (1.25)	5,682 ppm
Rat	Pozzani et al. 1959	20,702	-----	8 hr	51,755 ppm (2.5)	5,176 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Freeman and Hayes 1985	oral	5,800	-----	16,777 ppm	1,678 ppm
Mouse	Molodykh et al. 1980	oral	3,000	-----	8,678 ppm	868 ppm
Rabbit	WHO 1970	oral	5,340	-----	15,446 ppm	1,545 ppm

Other animal data	RD_{50} (mouse), 77,516 ppm [Alarie 1981].
Human data	Volunteers experienced slight irritation at 300 ppm but 500 ppm was tolerated [Nelson et al. 1943]. Eye irritation, headache, lightheadedness, nasal irritation, and throat irritation were noted in workers exposed to concentrations considerably in excess of 1,000 ppm and perhaps as high as 6,500 ppm [Raleigh and McGee 1972]. No indications of toxicity were reported following exposures to 2,100 ppm for 8 hours/day [Haggard et al. 1944].

Revised IDLH: 2,500 ppm [LEL]

Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Haggard et al. 1944; Raleigh and McGee 1972] and animals [Flury and Wirth 1933; Pozzani et al. 1959], a value of about 5,000 ppm would have been appropriate for acetone. However, the revised IDLH for acetone is 2,500 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2.5%).

Acetone (continued)

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Flury F, Wirth W [1933]. Zur toxikologie der lösungsmittel (Verschieden ester, aceton, methylalkohol). Arch Gewerbepath Gewerbehyg *5*:1-90 (in German).
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10. Raleigh RL, McGee WA [1972]. Effects of short, high-concentration exposures to acetone as determined by observation in the work area. J Occup Med *14*(8):607-610.
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Acetonitrile

CAS number	75-05-8
NIOSH REL	20 ppm (34 mg/m³) TWA
Current OSHA PEL	40 ppm (70 mg/m³) TWA
1989 OSHA PEL	40 ppm (70 mg/m³ TWA), 60 ppm (105 mg/m³) STEL
1993-1994 ACGIH TLV	40 ppm (67 mg/m³) TWA, 60 ppm (101 mg/m³) STEL
Description of substance	Colorless liquid with an aromatic odor.
LEL	3.0% (10% LEL, 3,000 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1965] report that a 4-hour exposure to 4,000 ppm killed 3 of 30 rats, 8,000 ppm killed 10 of 30 rats, and 16,000 ppm killed 17 of 30 rats. It is also based on the statement by AIHA [1960] that some deaths occurred in rats, dogs, and guinea pigs at 4,000 ppm, but no deaths occurred at 1,000 ppm. Pozzani et al. [1959] reported that a 53,000 ppm exposure was lethal to 3 of 6 rats in 30 minutes.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Pozzani et al. 1959	5,655	-----	4 hr	11,310 ppm (2.0)	1,131 ppm
Dog	Pozzani et al. 1959	-----	16,000	4 hr	32,000 ppm (2.0)	3,200 ppm
Rabbit	Pozzani et al. 1959	2,828	-----	4 hr	5,656 ppm (2.0)	566 ppm
Rat	Pozzani et al. 1959	53,000	-----	30 min	53,000 ppm (1.0)	5,300 ppm
Rat	Pozzani et al. 1959	7,500	-----	8 hr	18,750 ppm (2.5)	1,875 ppm
Mouse	Willhite 1981	2,693	-----	1 hr	3,366 ppm (1.25)	337 ppm

Human data .... Exposures to 160 ppm for 4 hours has caused flushing of the face and a feeling of constriction in the chest; exposures to 500 ppm for brief (undefined) time periods has resulted in only irritation to the nose and throat [Deichmann and Gerarde 1969].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for acetonitrile is 500 ppm based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 500 ppm.

REFERENCES:

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2. Deichmann WB, Gerarde HW [1969]. Acetonitrile (methyl cyanide; ethanenitrile). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 65.
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Acetylene tetrabromide

CAS number	79-27-6
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	1 ppm (14 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (14 mg/m^3) TWA
Description of substance	Pale-yellow liquid with a pungent odor similar to camphor or iodoform.
LEL	Noncombustible Liquid
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	Van Haaften [1969] reported that a chemist who had been exposed to 1 to 2 ppm for 7.5 hours, with only a single 10-minute exposure at 16 ppm, almost died from liver damage. Because the TLV is 1 ppm [ACGIH 1976], it is assumed that exposure to 1 to 2 ppm would be a safe concentration for the 7.5 hours the worker was exposed. Therefore, the injury must have been produced by the 10-minute exposure to 16 ppm, and the IDLH would be expected to fall between 2 ppm and 15 ppm. For this draft technical standard, an IDLH of 10 ppm is assumed. This is an extremely toxic substance.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	38	-----	4 hr	76 ppm (2.0)	7.6 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	Gray 1950	oral	400	-----	195 ppm	20 ppm
Rabbit	Gray 1950	oral	400	-----	195 ppm	20 ppm
Mouse	Izmerov et al. 1982	oral	269	-----	131 ppm	13 ppm
Rat	Paustovskaya et al. 1967	oral	1,200	-----	585 ppm	59 ppm

Human data .... Severe acute intoxication was reported in a chemist after exposure to 16 ppm for about 10 minutes and to 1 to 2 ppm for most of the day [Van Haaften 1969].

Revised IDLH: 8 ppm
Basis for revised IDLH: The revised IDLH for acetylene tetrabromide is 8 ppm based on acute inhalation toxicity data in animals [Izmerov et al. 1982].

REFERENCES:

1. ACGIH [1976]. TLVs, Threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1976. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 9.
2. Gray MG [1950]. Effect of exposure to the vapors of tetrabromoethane (acetylene tetrabromide). AMA Arch Ind Hyg Occup Med 2:407-419.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 107.
4. Paustovskaya VV, et al. [1967]. Effect of tetrabromomethane on the parenchymatous organs in experimental conditions. Med Pr 3:80-83 (in Polish).
5. Van Haaften AB [1969]. Acute tetrabromoethane (acetylene tetrabromide) intoxication in man. Am Ind Hyg Assoc J 30:251-256.

Acrolein

CAS number 107-02-8
NIOSH REL .... 0.1 ppm (0.25 mg/m³) TWA, 0.3 ppm (0.8 mg/m³) STEL
Current OSHA PEL .... 0.1 ppm (0.25 mg/m³) TWA
1989 OSHA PEL .... 0.1 ppm (0.25 mg/m³) TWA, 0.3 ppm (0.8 mg/m³) STEL
1993-1994 ACGIH TLV .... 0.1 ppm (0.23 mg/m³) TWA, 0.3 ppm (0.67 mg/m³) STEL
Description of substance .... Colorless or yellow liquid with a piercing, disagreeable odor.
LEL .... 2.8% (10% LEL, 2,800 ppm)
Original (SCP) IDLH .... 5 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that 5.5 ppm results in intense irritation and 10 ppm or more is lethal in a short time [Henderson and Haggard 1943]. According to MCA [1961], the irritation properties of acrolein are clearly evident at 1 ppm. ACGIH [1971] reported that 1 of 6 rats died after being exposed to 8 ppm for 4 hours and all died from exposure to 16 ppm [Smyth 1956].
Existing short-term exposure guidelines .... 1989 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 0.1 ppm (60-minute)
ERPG-2: 0.5 ppm (60-minute)
ERPG-3: 3 ppm (60-minute)

National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 0.1 ppm
60-minute EEGL: 0.05 ppm (tentative)
24-hour EEGL: 0.01 ppm (tentative)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Albin 1962	875	-----	1 min	280 ppm (0.32)	28 ppm
Mouse	Albin 1962	175	-----	10 min	121 ppm (0.69)	12 ppm
Dog	Albin 1962	150	-----	30 min	150 ppm (1.0)	15 ppm
Rat	Carpenter et al. 1949	8	-----	4 hr	16 ppm (2.0)	1.6 ppm
Rat	Catilina et al. 1966	375	-----	10 min	259 ppm (0.69)	26 ppm
Hamster	Kruysse 1971	25.4	-----	4 hr	51 ppm (2.0)	5.1 ppm
Rabbit	Pattle and Collumbine 1956	10.5	-----	6 hr	24 ppm (2.3)	2.4 ppm
G. pig	Pattle and Collumbine 1956	10.5	-----	6 hr	24 ppm (2.3)	2.4 ppm
Mouse	Pattle and Collumbine 1956	10.5	-----	6 hr	24 ppm (2.3)	2.4 ppm
Mouse	Philippin et al. 1970	66	-----	6 hr	152 ppm (2.3)	15 ppm
Hamster	Sangyo Igaku 1977	-----	1,000	10 min	690 ppm (0.69)	69 ppm
Cat	Skog 1950	-----	674	2 hr	1,078 ppm (1.6)	108 ppm
Rat	Skog 1950	131	-----	30 min	131 ppm (1.0)	13 ppm

Other animal data .... RD_{50} (mouse), 1.68 [Alarie 1981].
Human data .... It has been reported that 5.5 ppm results in intense irritation and marked lacrimation, after 60 seconds [Henderson and Haggard 1943]. Exposures to 1.6 ppm result in slight eye irritation after 1 minute and profuse lacrimation after 4 minutes [NRC 1981]. In volunteers exposed for 5 minutes, concentrations of 2 to 2.3 ppm produced severe irritation [Darley et al. 1960]. A 10-minute exposure at 8 ppm and a 5-minute exposure at 1.2 ppm elicited extreme irritation described as "only just tolerable" [Sim and Pattle 1957].

Revised IDLH: 2 ppm
Basis for revised IDLH: The revised IDLH for acrolein is 2 ppm based on acute inhalation toxicity data in humans [Darley et al. 1960; Henderson and Haggard 1943; NRC 1981; Sim and Pattle 1957].

REFERENCES:

1. ACGIH [1971]. Acrolein. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 5.
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3. Albin TB [1962]. Handling and toxicology. In: Acrolein, Smith CW, ed. New York, NY: John Wiley & Sons, Inc., pp. 234-239.
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17. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

Acrylamide

CAS number	79-06-1
NIOSH REL	0.03 mg/m^3 TWA [skin]; NIOSH considers acrylamide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.3 mg/m^3 TWA [skin]
1989 OSHA PEL	0.03 mg/m^3 TWA [skin]
1993-1994 ACGIH TLV	0.03 mg/m^3 TWA [skin], A2
Description of substance	White crystalline, odorless solid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 600 mg/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	Very little data are available on which to base an IDLH for acrylamide. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.3 mg/m^3 (i.e., 600 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 600 mg/m^3). Calculations based on an oral LD_{50} of 150 to 180 mg/kg for guinea pigs, rabbits, and rats [McCollister et al. 1964] indicate that a worker should be able to escape within 30 minutes without injury or irreversible health effects from 600 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mammal	Hashimoto 1979	oral	100-200	-----	700-1,400 mg/m^3	70-140 mg/m^3
Mouse	Hashimoto et al. 1981	oral	107	-----	749 mg/m^3	75 mg/m^3
Rabbit	McCollister et al. 1964	oral	150	-----	1,050 mg/m^3	105 mg/m^3
G. pig	McCollister et al. 1964	oral	150	-----	1,050 mg/m^3	105 mg/m^3
Rat	Paulet and Vidal 1975	oral	124	-----	868 mg/m^3	87 mg/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 60 mg/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for acrylamide. Based on acute oral toxicity data in animals [Hashimoto 1979], a value of about 70 mg/m^3 would have been appropriate. However, the revised IDLH for acrylamide is 60 mg/m^3 based on being 2,000 times the OSHA PEL of 0.03 mg/m^3 that was promulgated in 1989 (2,000 is an assigned protection factor for respirators; only the most reliable respirators are recommended above 2,000 times the OSHA PEL). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for acrylamide at concentrations above 0.03 mg/m^3.]

REFERENCES:

1. Hashimoto K [1979]. Safety of acrylamide monomer. Satisfactory understanding of the toxicity. Kagaku to Seibutsu *17*:495-498 (in Japanese).
2. Hashimoto K, Sakamoto J, Tanii H [1981]. Neurotoxicity of acrylamide and related compounds and their effects on male gonads in mice. Arch Toxicol *47*:179-189.
3. McCollister DD, Oyen F, Rowe VK [1964]. Toxicology of acrylamide. Toxicol Appl Pharmacol 6(2):172-181.
4. Paulet G, Vidal [1975]. De la toxicite de quelques esters acryliques et methacryliques de l'acrylamide et des polyacrylamides. Arch Mal Prof *36*:58-60 (in French).

Acrylonitrile

CAS number	107-13-1
NIOSH REL	1 ppm TWA, 10 ppm 15-minute CEILING [skin]; NIOSH considers acrylonitrile to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	2 ppm TWA, 10 ppm 15-minute CEILING [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 ppm (4.3 mg/m^3) TWA [skin], A2
Description of substance	Colorless to pale-yellow liquid with an unpleasant odor.
LEL	3.0% (10% LEL, 3,000 ppm)
Original (SCP) IDLH	500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Spector [1956] about a rat 4-hour LC_{50} of 500 ppm [Carpenter et al. 1949].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Carpenter et al. 1949	500	-----	4 hr	3,635 ppm (7.27)	364 ppm
Rabbit	Dudley and Neal 1942	-----	260	4 hr	1,890 ppm (7.27)	189 ppm
G. pig	Dudley and Neal 1942	-----	575	4 hr	4,180 ppm (7.27)	418 ppm
Mouse	Dudley and Neal 1942	313	-----	4 hr	2,276 ppm (7.27)	228 ppm
Rat	Jaeger et al. 1974	425	-----	4 hr	3,090 ppm (7.27)	309 ppm
Rat	Patty 1963	-----	636	4 hr	4,624 ppm (7.27)	462 ppm
Human	Schwanecke 1966	-----	452	1 hr	850 ppm (1.88)	85 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.1 [ten Berge et al. 1986].

Other human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 85 ppm
Basis for revised IDLH: The revised IDLH for acrylonitrile is 85 ppm based on acute inhalation toxicity data in humans [Schwanecke 1966]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for acrylonitrile at concentrations above 1 ppm. OSHA currently requires in 29 CFR 1910.1045 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 4,000 ppm (i.e., 2,000 × the PEL).]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute toxicity, and the grading and interpretation of results of 96 chemical compounds. J Ind Hyg Toxicol *31*(6):344.
2. Dudley HC, Neal PA [1942]. Toxicology of acrylonitrile (vinyl cyanide). A study of the acute toxicity. J Ind Hyg Toxicol *24*(2):27-36.
3. Jaeger RJ, Conolly RB, Murphy SD [1974]. Toxicity and biochemical changes in rats after inhalation exposure to 1,1-dichloroethylene, bromobenzene, styrene, acrylonitrile or 2-chlorobutadiene. (Abstract for Thirteenth Annual Meeting of the Society of Toxicology, Washington, DC, March 10-14, 1974.) Toxicol Appl Pharmacol *29*:81.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2009-2011.
5. Schwanecke R [1966]. Safety hazards in the handling of acrylonitrile and methacrylonitrile. Zentralbl Arbeitsmed Arbeitsschutz *16*(1):1-3 (in German).
6. Spector WS, ed. [1956]. Handbook of toxicology. Vol. I. Acute toxicities of solids, liquids and gases to laboratory animals. Philadelphia, PA: W.B. Saunders Company, pp. 322-323.
7. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Aldrin

CAS number	309-00-2
NIOSH REL	0.25 mg/m³ TWA [skin]; NIOSH considers aldrin to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.25 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.25 mg/m³ TWA [skin]
Description of substance	Colorless to dark-brown crystalline solid with a mild chemical odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	100 mg/m³
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for aldrin. The chosen IDLH, therefore, has been estimated from the statement by Baskin [1975] that severe symptoms follow swallowing or skin contamination with 15 to 50 mg/kg (average adult). According to Deichmann [1973], aldrin vapor gave no effect in man at 18 mg/m³ during exposure for 1 day.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	-----	5.8 mg/m³	4 hr	12 mg/m³ (2.0)	1.2 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	AAPCO 1966	oral	50	-----	350 mg/m³	35 mg/m³
G. pig	AAPCO 1966	oral	33	-----	231 mg/m³	23 mg/m³
Rat	Kenaga and Morgan 1978	oral	39	-----	273 mg/m³	27 mg/m³
Mouse	Kenaga and Morgan 1978	oral	44	-----	308 mg/m³	31 mg/m³

Human data	No effects were noted after exposure to 18 mg/m³ for 1 day [Deichmann 1973]. Ingestion of 25.6 mg/kg caused convulsions within 20 minutes [Ottolenghi et al. 1974]. [Note: An oral dose of 25.6 mg/kg is equivalent to a 70-kg worker being exposed to about 1,200 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 25 mg/m³
Basis for revised IDLH: The revised IDLH for aldrin is 25 mg/m³ based on acute toxicity data in humans [Deichmann 1973; Ottolenghi et al. 1974]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for aldrin at concentrations above 0.25 mg/m³.]

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of American Pesticide Control Officials, Inc., p. 7.

2. Baskin AD, ed. [1975]. Handling guide for potentially hazardous materials. Oxford, IN: The Richard B. Cross Company, PC 0180.
3. Deichmann WB [1973]. The chronic toxicity of organochlorine pesticides in man. In: Pesticides and the environment: a continuing controversy. Vol. II. New York, NY: Intercontinental Medical Book Corporation, pp. 347–420.
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 73.
5. Kenaga EE, Morgan RW [1978]. Commercial and experimental organic insecticides (1978 revision). Entomological Society of America Special Publication *78-1*:12.
6. Ottolenghi AD, Haseman JK, Suggs F [1974]. Teratogenic effects of aldrin, dieldrin, and endrin in hamsters and mice. Teratology *9*:11.

Allyl alcohol

CAS number	107-18-6
NIOSH REL	2 ppm (5 mg/m³) TWA, 4 ppm (10 mg/m³) STEL [skin]
Current OSHA PEL	2 ppm (5 mg/m³) TWA [skin]
1989 OSHA PEL	2 ppm (5 mg/m³) TWA, 4 ppm (10 mg/m³) STEL [skin]
1993-1994 ACGIH TLV	2 ppm (4.8 mg/m³) TWA, 4 ppm (9.5 mg/m³) STEL [skin]
Description of substance	Colorless liquid with a pungent, mustard-like odor.
LEL	2.5% (10% LEL, 2,500 ppm)
Original (SCP) IDLH	150 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1963] that from animal experiments, a single 1-hour exposure to 150 ppm might be fatal, while the same exposure to 100 ppm would probably allow survival [Dunlap et al. 1958].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Deichmann and Gerarde 1969	1,000	-----	1 hr	1,250 ppm (1.25)	125 ppm
Rat	Dunlap et al. 1958	76	-----	8 hr	190 ppm (2.5)	19 ppm
Mouse	Izmerov et al. 1982	207	-----	2 hr	330 ppm (1.6)	33 ppm
Rabbit	McCord 1932	1,000	-----	3.5 hr	1,910 ppm (1.91)	191 ppm
Monkey	McCord 1932	1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm
Rat	Smyth and Carpenter 1948	1,060	-----	1 hr	1,325 ppm (1.25)	132 ppm
Rat	Smyth and Carpenter 1948	165	-----	4 hr	330 ppm (2.0)	33 ppm
Rat	Smyth and Carpenter 1948	76	-----	8 hr	190 ppm (2.5)	19 ppm

Human data	Severe eye irritation is reported to result from exposure at 25 ppm [Dunlap et al. 1958].

Revised IDLH: 20 ppm
Basis for revised IDLH: The revised IDLH for allyl alcohol is 20 ppm based on acute inhalation toxicity data in humans [Dunlap et al. 1958] and animals [Dunlap et al. 1958; Smyth and Carpenter 1948].

REFERENCES:

1. AIHA [1963]. Allyl alcohol. In: Hygienic guide series. Am Ind Hyg Assoc J *24*:636-638.
2. Deichmann WB, Gerarde HW [1969]. Allyl alcohol (propenol). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 86.
3. Dunlap MK, Kodama JK, Wellington JS, Anderson HH, Hine CH [1958]. The toxicity of allyl alcohol. I. Acute and chronic toxicity. AMA Arch Ind Health *18*:303-311.
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 17.
5. McCord CP [1932]. The toxicity of allyl alcohol. JAMA *98*(26):2269-2270.
6. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range-finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *30*(1):63-68.

Allyl chloride

CAS number	107-05-1
NIOSH REL	1 ppm (3 mg/m³) TWA, 2 ppm (6 mg/m³) STEL
Current OSHA PEL	1 ppm (3 mg/m³) TWA
1989 OSHA PEL	1 ppm (3 mg/m³) TWA, 2 ppm (6 mg/m³) STEL
1993-1994 ACGIH TLV	1 ppm (3 mg/m³) TWA, 2 ppm (6 mg/m³) STEL
Description of substance	Colorless, brown, yellow, or purple liquid with a pungent, unpleasant odor.
LEL	2.9% (10% LEL, 2,900 ppm)
Original (SCP) IDLH	300 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Deichmann and Gerarde [1969] that a 1-hour exposure to 300 ppm might cause serious effects.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Boqin et al. 1982	11,000 mg/m³	-----	2 hr	4,323 ppm (1.25)	434 ppm
Mouse	Boqin et al. 1982	11,500 mg/m³	-----	2 hr	4,520 ppm (1.25)	452 ppm
G. pig	Boqin et al. 1982	5,800 mg/m³	-----	2 hr	2,280 ppm (1.25)	228 ppm
Rabbit	Boqin et al. 1982	22,500 mg/m³	-----	2 hr	8,844 ppm (1.25)	884 ppm
Cat	Boqin et al. 1982	10,500 mg/m³	-----	2 hr	4,127 ppm (1.25)	413 ppm

Human data .... It has been stated that a 1-hour exposure to 300 ppm might cause serious effects [Deichmann and Gerarde 1969].

Revised IDLH: 250 ppm
Basis for revised IDLH: The revised IDLH for allyl chloride is 250 ppm based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969] and animals [Boqin et al. 1982].

REFERENCES:

1. Boqin L, Shuwei D, Airu Y, Yinlin X, Taibao G, Tao C [1982]. Studies on the toxicity of allyl chloride. Ecotoxicol Environ Safety 6(1):19-27.
2. Deichmann WB, Gerarde HW [1969]. Allyl chloride. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 86-87.

Allyl glycidyl ether

CAS number 106-92-3
NIOSH REL .... 5 ppm (22 mg/m^3) TWA, 10 ppm (44 mg/m^3) STEL [skin]
Current OSHA PEL .... 10 ppm (45 mg/m^3) CEILING
1989 OSHA PEL .... 5 ppm (22 mg/m^3) TWA, 10 ppm (44 mg/m^3) STEL
1993-1994 ACGIH TLV .... 5 ppm (23 mg/m^3) TWA, 10 ppm (47 mg/m^3) STEL
Description of substance .... Colorless liquid with a pleasant odor.
LEL .... Unknown
Original (SCP) IDLH .... 270 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the mouse 4-hour LC_{50} of 270 ppm [Hine et al. 1956] cited in ACGIH [1971], AIHA [1965], and Patty [1963].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hine et al. 1956	270	-----	4 hr	540 ppm (2.0)	54 ppm
Rat	Hine et al. 1956	670	-----	8 hr	1,675 ppm (2.5)	168 ppm

Human data .... None relevant for determining the revised IDLH.

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for allyl glycidyl ether is 50 ppm based on acute inhalation toxicity data in animals [Hine et al. 1956]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. Allyl glycidyl ether. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 9.
2. AIHA [1965]. Allyl glycidyl ether. In: Hygienic guide series. Am Ind Hyg Assoc J *26*:89-91.
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4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1599.

2-Aminopyridine

CAS number	504-29-0
NIOSH REL	0.5 ppm (2 mg/m³) TWA
Current OSHA PEL	0.5 ppm (2 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 ppm (1.9 mg/m³) TWA
Description of substance	White powder, leaflets, or crystals with a characteristic odor.
LEL	Unknown
Original (SCP) IDLH	5 ppm
Basis for original (SCP) IDLH	Very little quantitative data are available on which to base an IDLH for 2-aminopyridine. The chosen IDLH is based on the statement by ACGIH [1971] that a 5-hour exposure to about 5 ppm produced headache, increased blood pressure, and nausea in a worker [Watrous and Schulz 1950].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Marhold 1986	oral	200	-----	385 ppm	39 ppm
Mouse	Verschueren 1983	oral	50	-----	90 ppm	9 ppm

Human data .... A 5-hour exposure to approximately 5 ppm caused severe headache, increased blood pressure, flushing of the extremities, and nausea [Watrous and Schulz 1950].

Revised IDLH: 5 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Watrous and Schulz 1950], the original IDLH for 2-aminopyridine (5 ppm) is not being revised at this time. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 5 ppm.

REFERENCES:

1. ACGIH [1971]. 2-Aminopyridine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 11.
2. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 838 (in Czechoslovakian).
3. Verschueren K [1983]. Handbook of environmental data of organic chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold, Co., p. 192.
4. Watrous RM, Schulz HN [1950]. Cyclohexylamine, p-chlornitrobenzene, 2-aminopyridine: toxic effects in industrial use. Ind Med Surg 19(7):317-320.

Ammonia

CAS number 7664-41-7
NIOSH REL .... 25 ppm (18 mg/m³) TWA, 35 ppm (27 mg/m³) STEL
Current OSHA PEL .... 50 ppm (35 mg/m³) TWA
1989 OSHA PEL .... 35 ppm (27 mg/m³) STEL
1993-1994 ACGIH TLV .... 25 ppm (17 mg/m³) TWA, 35 ppm (24 mg/m³) STEL
Description of substance .... Colorless gas with a pungent, suffocating odor.
LEL .... 15% (10% LEL, 15,000 ppm)
Original (SCP) IDLH .... 500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [1971] that 300 to 500 ppm for 30 to 60 minutes have been reported as a maximum short exposure tolerance [Henderson and Haggard 1943]. AIHA [1971] also reported that 5,000 to 10,000 ppm are reported to be fatal [Mulder and Van der Zahm 1967] and exposures for 30 minutes to 2,500 to 6,000 ppm are considered dangerous to life [Smyth 1956].
Existing short-term exposure guidelines .... 1988 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs)

ERPG-1: 25 ppm
ERPG-2: 200 ppm
ERPG-3: 1,000 ppm

National Research Council [NRC 1987] Emergency Exposure Guidance Levels (EEGLs)

1-hour EEGL: 100 ppm
24-hour EEGL: 100 ppm

U.S. Navy Standards [U.S. Bureau of Ships 1962] Maximum allowable concentrations (MACs):

Continuous exposure (60 days): 25 ppm
1 hour: 400 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Alarie 1981	40,300	-----	10 min	23,374 ppm (0.58)	2,337 ppm
Rat	Alarie 1981	28,595	-----	20 min	23,448 ppm (0.82)	2,335 ppm
Rat	Alarie 1981	20,300	-----	40 min	23,345 ppm (1.15)	2,335 ppm
Rat	Alarie 1981	11,590	-----	1 hr	16,342 ppm (1.41)	1,634 ppm
Rat	Back et al. 1972	7,338	-----	1 hr	10,347 ppm (1.41)	1,035 ppm
Mouse	Back et al. 1972	4,837	-----	1 hr	6,820 ppm (1.41)	682 ppm
Rabbit	Boyd et al. 1944	9,859	-----	1 hr	13,901 ppm (1.41)	1,309 ppm
Cat	Boyd et al. 1944	9,859	-----	1 hr	13,901 ppm (1.41)	1,309 ppm
Rat	Deichmann and Gerarde 1969	2,000	-----	4 hr	5,660 ppm (2.83)	566 ppm
Mammal	Flury 1928	-----	5,000	5 min	2,050 ppm (0.41)	205 ppm
Mouse	Kapeghian et al. 1982	4,230	-----	1 hr	5,964 ppm (1.41)	596 ppm
Human	Tab Biol Per 1933	-----	5,000	5 min	2,050 ppm (0.41)	205 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.0 [ten Berge et al. 1986].

Other animal data .... RD_{50} (mouse), 303 ppm [Appelman et al. 1982].

Other human data .... The maximum short exposure tolerance has been reported as being 300 to 500 ppm for 0.5 to 1 hour [Henderson and Haggard 1943]. A change in respiration rate and moderate to severe irritation has been reported in 7 subjects exposed to 500 ppm for 30 minutes [Silverman et al. 1946].

Revised IDLH: 300 ppm
Basis for revised IDLH: The revised IDLH for ammonia is 300 ppm based on acute inhalation toxicity data in humans [Henderson and Haggard 1943; Silverman et al. 1946].

REFERENCES:

1. AIHA [1971]. Anhydrous ammonia. In: Hygienic guide series. Am Ind Hyg Assoc J *32*:139-142.
2. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
3. Appelman LM, ten Barge WF, Reuzel PGJ [1982]. Acute inhalation toxicity study of ammonia in rats with variable exposure periods. Am Ind Hyg Assoc J *43*:662-665.
4. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-172 to A-173.
5. Boyd EM, MacLachlan ML, Perry WF [1944]. Experimental ammonia gas poisoning in rabbits and cats. J Ind Hyg Toxicol *26*:29-34.
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7. Flury F [1928]. Moderne gewerbliche vergiftungen in pharmakologisch-toxikologischer hinsicht (Pharmacological-toxicological aspects of intoxicants in modern industry). Arch Exp Pathol Pharmakol *138*:65-82 (translated).
8. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 126.
9. Kapeghian JC, Jones AB, Mincer HH, Verlangieri AJ, Waters IW [1982]. The toxicity of ammonia gas in the mouse. Fed Proc *41*:1568 [Abstract #7586].
10. Mulder JS, Van der Zahm HO [1967]. Fatal case of ammonium poisoning. Tydschrift Voor Sociale Geneeskunde (Amsterdam) *45*:458-460 (translated).
11. NRC [1987]. Emergency and continuous exposure guidance levels for selected airborne contaminants. Vol. 7. Ammonia, hydrogen chloride, lithium bromide, and toluene. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 7-15.
12. Silverman L, Whittenberger JL, Muller J [1946]. Physiological response of man to ammonia in low concentrations. J Ind Hyg Toxicol *31*:74-78.
13. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.
14. Tab Biol Per [1933]; *3*:231-296 (in German).
15. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.
16. U.S. Bureau of Ships [1962]. Submarine atmosphere habitability data book. AVSHIPS 250-649-1. Rev. 1. Washington, DC: U.S. Department of the Navy, U.S. Bureau of Ships, p. 629.

Ammonium sulfamate

CAS number	7773-06-0
NIOSH REL	10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
Current OSHA PEL	15 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
1989 OSHA PEL	10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of substance	Colorless to white crystalline, odorless solid.
LEL	Noncombustible Solid
Original (SCP) IDLH	5,000 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat intraperitoneal LD_{LO} of 800 mg/kg cited by NIOSH [1976] from Ambrose [1943]. This compound has a low toxicity.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Ball 1956	oral	2,000	-----	14,000 mg/m³	1,400 mg/m³
Mouse	Gig Tr Prof Zabol 1963	oral	3,100	-----	21,700 mg/m³	2,170 mg/m³
Rat	Lehman 1951	oral	3,900	-----	27,300 mg/m³	2,730 mg/m³
Mouse	Lehman 1951	oral	5,760	-----	40,320 mg/m³	4,032 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,500 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for ammonium sulfamate. Therefore, the revised IDLH for ammonium sulfamate is 1,500 mg/m³ based on the acute oral toxicity data in animals [Ball 1956]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Ambrose AM [1943]. Studies of the physiological effects of sulfamic acid and ammonium sulfamate. J Ind Hyg Toxicol *25*:26.
2. Ball WL [1956]. Threshold limits for pesticides. AMA Arch Ind Health *14*:178-185.
3. Gig Tr Prof Zabol [1963]; 7(5):56-57 (in Russian).
4. Lehman AJ [1951]. Chemicals in foods: a report to the Association of Food and Drug Officials on current developments. Part II. Pesticides. Q Bulletin Assoc Food Drug Off U.S. *15*(4):122-125.
5. NIOSH [1976]. WO61250. Sulfamic acid, monoammonium salt. In: Registry of Toxic Effects of Chemical Substances (RTECS) 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 1111.

n-Amyl acetate

CAS number	628-63-7
NIOSH REL	100 ppm (525 mg/m³) TWA
Current OSHA PEL	100 ppm (525 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (532 mg/m³) TWA
Description of substance	Colorless liquid with a persistent banana-like odor.
LEL	1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Browning [1965] that exposure to 4,000 ppm of a mixture of n-amyl acetate and isoamyl acetate produced complete loss of reflexes in rabbits within an hour [Koelsch 1912], and on the statement by Sax [1975] that 5,000 ppm n-amyl acetate produced deep narcosis in cats in 30 minutes.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NPIRI 1974	-----	5,200	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Marhold 1986	oral	7,400	-----	9,575 ppm	958 ppm
Rat	NPIRI 1974	oral	6,500	-----	8,410 ppm	841 ppm

Other animal data	RD_{50} (mouse), 1,531 ppm [Alarie 1981].
Human data	Somnolence has been reported after exposure to 952 ppm for 30 minutes [Lehmann 1913].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for n-amyl acetate is 1,000 ppm based on acute toxicity data in humans [Lehmann 1913] and animals [Alarie 1981; Marhold 1986].

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect 42:9-13.
2. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, p. 539.
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5. Marhold J [1986]. Prehled prumyslove toxikologie: organicke latky. Prague, Czechoslovakia: Avicenum, p. 357 (in Czechoslovakian).
6. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 3.
7. Sax NI [1975]. Dangerous properties of industrial materials. 4th ed. New York, NY: Van Nostrand Reinhold Company, Inc., p. 398.

sec-Amyl acetate

CAS number	626-38-0
NIOSH REL	125 ppm (650 mg/m^3) TWA
Current OSHA PEL	125 ppm (650 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	125 ppm (665 mg/m^3) TWA
Description of substance	Colorless liquid with a mild odor.
LEL	1% (10% LEL, 1,000 ppm)
Original (SCP) IDLH	9,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that 9,200 ppm was lethal to guinea pigs in 7 hours [Patty et al. 1936]. This is the only data on acute inhalation toxicity available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Patty et al. 1936	-----	9,200	7 hr	22,080 ppm (2.4)	2,208 ppm
G. pig	von Oettingen 1960	-----	10,000	5 hr	21,500 ppm (2.15)	2,150 ppm

Human data .... It has been stated that exposure to 1,000 ppm for an hour may be expected to produce serious toxic effects [von Oettingen 1960].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for sec-amyl acetate is 1,000 ppm based on acute inhalation toxicity data in humans [von Oettingen 1960] and the similarity of the toxic effects of sec-amyl acetate to those of n-amyl acetate (which also has a revised IDLH of 1,000 ppm).

REFERENCES:

1. ACGIH [1971]. sec-Amyl acetate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 13.
2. Patty FA, Yant WP, Schrenk HH [1936]. Acute response of guinea pigs to vapors of some new commercial organic compounds. XI. Secondary amyl acetate. Public Health Rep *51*(25):811-819.
3. von Oettingen WF [1960]. The aliphatic acids and their esters: toxicity and potential dangers. AMA Arch Ind Health *21*:40/28-77/65.

Aniline

CAS number	62-53-3
NIOSH REL	None established; NIOSH considers aniline to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	5 ppm (19 mg/m³) TWA [skin]
1989 OSHA PEL	2 ppm (8 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	2 ppm (7.6 mg/m³) TWA [skin]
Description of substance	Colorless to brown, oily liquid with an aromatic amine-like odor.
LEL	1.3% (10% LEL, 1,300 ppm)
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Henderson and Haggard [1943] that 100 to 160 ppm is the maximum concentration that can be inhaled for 1 hour without serious disturbance. AIHA [1955] reported that 50 to 100 ppm can probably be tolerated for 60 minutes.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Back et al. 1972	175	-----	7 hr	420 ppm (2.4)	42 ppm
Rat	Carpenter et al. 1949	-----	250	4 hr	500 ppm (2.0)	50 ppm
Cat	von Oettingen 1941	-----	180	8 hr	450 ppm (2.5)	45 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Back et al. 1972	oral	-----	195	353 ppm	35 ppm
Rat	Dieke et al. 1947	oral	-----	250	452 ppm	45 ppm
Mouse	Gig Tr Prof Zabol 1969	oral	-----	464	839 ppm	84 ppm
Rat	Jacobsen 1972	oral	-----	440	796 ppm	80 ppm
G. pig	Kodak 1984	oral	-----	400	724 ppm	72 ppm

Human data .... Volunteers tolerated 1-hour exposures ranging from 100-160 ppm with only moderate adverse health effects (undefined) [von Oettingen 1941]. It has also been reported that 100 to 160 ppm is the maximum concentration that can be inhaled for 1 hour without serious consequence [Henderson and Haggard 1943] and that 50 to 100 ppm can probably be tolerated for 60 minutes [AIHA 1955].

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [AIHA 1955; Henderson and Haggard 1943; von Oettingen 1941], the original IDLH for aniline of 100 ppm is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for aniline at any detectable concentration.]

REFERENCES:

1. AIHA [1955]. Aniline. In: Hygienic guide series. Am Ind Hyg Assoc Q *16*:331-332.
2. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-8 to A-9.
3. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-348.
4. Dieke SH, Allen GS, Richter CP [1947]. The acute toxicity of thioureas and related compounds to wild and domestic Norway rats. J Pharmacol Exp Ther *90*:260-270.
5. Gig Tr Prof Zabol [1969]; *13*(5):29-32 (in Russian).
6. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 228.
7. Jacobsen KH [1972]. Acute oral toxicity of mono- and di-alkyl ring-substituted derivatives of aniline. Toxicol Appl Pharmacol *22*:153-154.
8. Kodak [1984]. Aniline. In: TSCA 8d submission to U.S. Environmental Protection Agency (OTS 206512). Rochester, NY: Eastman Kodak Company.
9. von Oettingen WF [1941]. The aromatic amines and nitro compounds, their toxicity and potential dangers. Washington, DC: Government Printing Office, U.S. Public Health Service, Public Health Bulletin *271*:1-15.

o-Anisidine

CAS number	90-04-0
NIOSH REL	0.5 mg/m³ TWA [skin]; NIOSH considers o-anisidine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.5 mg/m³) TWA [skin]
Description of substance	Red or yellow, oily liquid with an amine-like odor.
LEL	Unknown
Original (SCP) IDLH	50 mg/m³
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available for anisidine (o-, p-isomers), the chosen IDLH is based on chronic data. ACGIH [1971] reported that mice survived exposures to 10 to 30 mg/m³ for 2 hours/day, 6 days/week for 1 month; a decrease in the excitability of nerves was noted [Zaeva and Fedorova 1962]. Because mice survived 30 mg/m³, 2 hours/day, 6 days/week for 1 month, a worker should be able to escape from 50 mg/m³ without injury or irreversible health effects.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	IARC 1982	oral	2,000	-----	14,000 mg/m³	1,400 mg/m³
Mouse	IARC 1982	oral	1,400	-----	9,800 mg/m³	980 mg/m³
Rabbit	IARC 1982	oral	870	-----	6,090 mg/m³	609 mg/m³

Other animal data	Mice have survived exposures to concentrations of 10 to 30 mg/m³ for 2 hours/day, 6 days/week for 1 month with only a decrease in the excitability of nerves noted [Zaeva and Fedorova 1962].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 50 mg/m³ [Unchanged]
Basis for revised IDLH: Based on subchronic inhalation toxicity data in animals [Zaeva and Fedorova 1962], the original IDLH for o-anisidine (50 mg/m³) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for o-anisidine at concentrations above 0.5 mg/m³.]

REFERENCES:

1. ACGIH [1971]. Anisidine (o-, p-isomers). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 14.
2. IARC [1982]. IARC monographs on the evaluation of carcinogenic risk of chemicals to humans. Vol. 27. Lyon, France: World Health Organization, International Agency for Research on Cancer, p. 63.
3. Zaeva GN, Fedorova VI [1962]. Toxsikol Nov Prom Khim Vesh 4:91 (in Russian).

p-Anisidine

CAS number 104-94-9
NIOSH REL .... 0.5 mg/m³ TWA [skin]
Current OSHA PEL .... 0.5 mg/m³ TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.1 ppm (0.5 mg/m³) TWA [skin]
Description of substance .... Yellow to brown, crystalline solid with an amine-like odor.
LEL .... Unknown
Original (SCP) IDLH .... 50 mg/m³
Basis for original (SCP) IDLH .... Because no data on acute inhalation toxicity are available for anisidine (o-, p-isomers), the chosen IDLH is based on chronic data. ACGIH [1971] reported that mice survived exposures to 10 to 30 mg/m³ for 2 hours/day, 6 days/week for 1 month; a decrease in the excitability of nerves was noted [Zaeva and Fedorova 1962]. Because mice survived 30 mg/m³, 2 hours/day, 6 days/week for 1 month, a worker should be able to escape from 50 mg/m³ without injury or irreversible health effects.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	IARC 1982	oral	2,900	-----	20,300 mg/m³	2,030 mg/m³
Mouse	IARC 1982	oral	1,300	-----	9,100 mg/m³	910 mg/m³
Mouse	Nippon 1956	oral	-----	1,000	7,000 mg/m³	700 mg/m³
Rat	Sziza and Podragyai 1957	oral	1,400	-----	9,800 mg/m³	980 mg/m³

Other animal data .... Mice have survived exposures to concentrations of 10 to 30 mg/m³ for 2 hours/day, 6 days/week for 1 month with a only decrease in the excitability of nerves noted [Zaeva and Fedorova 1962].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 50 mg/m³ [Unchanged]
Basis for revised IDLH: Based on subchronic inhalation toxicity data in animals [Zaeva and Fedorova 1962], the original IDLH for p-anisidine of 50 mg/m³ is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Anisidine (o-, p-isomers). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 14.
2. IARC [1982]. IARC monographs on the evaluation of carcinogenic risk of chemicals to humans. Vol. 27. Lyon, France: World Health Organization, International Agency for Research on Cancer, p. 63.
3. Nippon Yakurigaku Zasshi (Japanese Journal of Pharmacology) [1956]; 52:215-221 (in Japanese).
4. Sziza M, Podragyai L [1957]. Toxikologische untersuchung einiger in der ungarischen industrie zur anwendung gelangenden aromatischen amidoverbindungen. Arch Gewerbepath Gewerbehyg 15:447-456 (in German).
5. Zaeva GN, Fedorova VI [1962]. Toxsikol Nov Prom Khim Vesh 4:91 (in Russian).

Antimony compounds (as Sb)

CAS number	7440-36-0 (Metal)
NIOSH REL	0.5 mg Sb/m³ TWA
Current OSHA PEL	0.5 mg Sb/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg Sb/m³ TWA
Description of substance	Varies
Original (SCP) IDLH	80 mg Sb/m³
Basis for original (SCP) IDLH	AIHA [1959] reported that the severity of hazard is moderate to high for both acute and chronic exposures to antimony and its compounds. Brieger et al. [1954] noted an apparent increase in heart abnormalities in workers chronically exposed to antimony trisulfide (0.6 to 5.5 mg/m³) and demonstrated heart injury in experimental animals. The chosen IDLH is based on the report by Taylor [1966] that slightly delayed gastrointestinal disorders, including abdominal pain and persistent anorexia, were noted in workers briefly exposed to air containing up to 73 mg/m³ of antimony.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
$SbCl_5$						
Mouse	Chekunova and Minkina 1987	720 mg/m³	-----	?	?	?
Rat	Izmerov et al. 1982	720 mg/m³	-----	2 hr	469 mg Sb/m³	47 mg Sb/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Sb						
Rat	Coulston and Korte 1975	oral	7,500	-----	49,000 mg Sb/m³	4,900 mg Sb/m³
Sb_2O_3						
Rat	Smyth and Carpenter 1948	oral	>20,000	-----	>117,600 mg Sb/m³	>11,760 mg Sb/m³
$SbCl_3$						
Rat	Arzamastev 1964	oral	1,115	-----	3,179 mg Sb/m³	318 mg Sb/m³
G. pig	Arzamastev 1964	oral	900	-----	2,566 mg Sb/m³	257 mg Sb/m³

Human data .... Antimony pentafluoride ($SbCl_5$) is considered to be the most toxic of the antimony chlorides [ACGIH 1993]. The American Conference of Governmental Industrial Hygienists (ACGIH) TLV for antimony is based on an analogy to hydrogen chloride [ACGIH 1993].

Revised IDLH: 50 mg Sb/m³
Basis for revised IDLH: The revised IDLH for antimony compounds is 50 mg Sb/m³ based on acute inhalation toxicity data in animals [Izmerov et al. 1982] and an analogy to hydrogen chloride [ACGIH 1993] which has a revised IDLH of 50 ppm (75 mg/m³).

REFERENCES:

1. ACGIH [1991]. Antimony and compounds. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 73-75.
2. AIHA [1959]. Antimony and its compounds (excepting stibine). In: Hygienic guide series. Am Ind Hyg Assoc Q *20*:515-516.
3. Arzamastsev EV [1964]. Experimental substantiation of the permissible concentrations of tri- and pentavalent antimony in water bodies. Gig Sanit *29*(12):16-21 (translated).
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5. Chekunova MP, Minkina MA [1987]. Toxicity of pentachlorinated antimony in a chronic experiment. Gig Tr Prof Zabol *13*(10):25-29 (in Russian).
6. Coulston F, Korte F, eds. [1975]. Heavy metal toxicity, safety and hormology. In: Environmental Quality & Safety, Supplement 1. New York, NY: Georg Thieme Publishers, pp. 1-120.
7. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 22.
8. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *30*(1):63-68.
9. Taylor PJ [1966]. Acute intoxication from antimony trichloride. Br J Ind Med *23*(4):318-321.

ANTU

CAS number 86-88-4
NIOSH REL .... 0.3 mg/m³ TWA
Current OSHA PEL .... 0.3 mg/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.3 mg/m³ TWA
Description of substance .... White crystalline or gray, odorless powder.
LEL .... Noncombustible Solid
Original (SCP) IDLH .... 100 mg/m³
Basis for original (SCP) IDLH .... No useful acute inhalation toxicity data are available on which to base the IDLH for ANTU. The chosen IDLH, therefore, has been estimated from the fatal human oral dose of 1 gram given by Stolman [1969]. According to ACGIH [1971], McClosky and Smith [1945] reported that the acute oral toxicity varies greatly among different species, with rats and dogs being the most susceptible (LD_{50} of 30 to 50 mg/kg) and rabbits the least susceptible (LD_{50} of 1,000 mg/kg).
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	AAPCO 1966	oral	0.38	-----	2.7 mg/m³	0.3 mg/m³
Rat	Lehman 1952	oral	6	-----	42 mg/m³	4.2 mg/m³
Monkey	Perkow 1971/76	oral	4,250	-----	29,750 mg/m³	2,975 mg/m³
Mouse	Yakkyoku 1977	oral	5	-----	35 mg/m³	3.5 mg/m³

Other animal data .... It has been reported that the mean oral lethal dose is 4,000 mg/kg in monkeys and is presumably much the same in man [Gosselin et al. 1984].
Human data .... The fatal oral dose has been reported to be 1,000 mg [Stolman 1969]. [Note: An oral dose of 1,000 mg is equivalent to a worker being exposed to 650 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 mg/m³ [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for ANTU. However, based on acute oral toxicity data in humans [Stolman 1969] and animals [Gosselin et al. 1984; Perkow 1971/76], the original IDLH for ANTU (100 mg/m³) is not being revised at this time.

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of American Pesticide Control Officials, Inc., p. 57.
2. ACGIH [1971]. ANTU (alpha-naphthyl-thiourea). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 15-16.
3. Gosselin RE, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Section III. Baltimore, MD: Williams and Wilkins Company, pp. 40-42.
4. Lehman AJ [1952]. Chemicals in foods: a report to the Association of Food and Drug Officials on current developments. Part II. Pesticides. Section III. Subacute and chronic toxicity. Q Bulletin Assoc Food Drug Off U.S. *16*:47-53.
5. McClosky WT, Smith MI [1945]. Studies on the pharmacologic action and the pathology of alpha-naphthylthiourea (ANTU). I. Pharmacology. Public Health Rep *60*(38):1101-1113.
6. Perkow W [1971/76]. Wirksubstanzen der pflanzenschutz und schedlingsbekampfungsmittel. Berlin, Germany: Verlag Paul Parey (in German).
7. Stolman A, ed. [1969]. Progress in chemical toxicology. Vol. 4. New York, NY: Academic Press, p. 235.
8. Yakkyoku (Pharmacy) [1977]; *28*:329-335 (in Japanese).

Arsenic (inorganic compounds, as As)

CAS number .... 7440-38-2 (Metal)
NIOSH REL .... 0.002 mg As/m³ 15-minute CEILING; NIOSH considers inorganic arsenic compounds to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.010 mg As/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.01 mg As/m³ TWA, A1
Description of substance .... Varies
Original (SCP) IDLH .... 100 mg As/m³
Basis for original (SCP) IDLH .... The chosen IDLH is based on the cat 1-hour LC_{LO} of 100 mg/m³ for arsenic trichloride [Flury 1921 cited by NIOSH 1976].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
$AsCl_3$						
Cat	Flury 1921	-----	100 mg/m³	1 hr	52 mg As/m³ (1.25)	5.2 mg As/m³
Cat	Spector 1955	-----	200 mg/m³	20 min	79 mg As/m³ (0.96)	7.9 mg As/m³
Mouse	Spector 1955	-----	338 ppm	10 min	726 mg As/m³ (0.69)	73 mg As/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
As						
Rat	Davydova et al. 1987	oral	763	-----	5,341 mg As/m³	534 mg As/m³
Mouse	Davydova et al. 1987	oral	145	-----	1,015 mg As/m³	102 mg As/m³
$Ca_3(AsO_4)_2$						
Rat	Lehman 1951	oral	20	-----	53 mg As/m³	5.3 mg As/m³
Mouse	MacEwen and Vernot 1972	oral	794	-----	2,090 mg As/m³	209 mg As/m³
Rabbit	Muehlberger 1930	oral	50	-----	132 mg As/m³	13 mg As/m³
Dog	Perkow 1971/1976	oral	38	-----	100 mg As/m³	10 mg As/m³
$Pb_3(AsO_4)_2$						
Rabbit	Muehlberger 1930	oral	75	-----	88 mg As/m³	8.8 mg As/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg As/m³
Basis for revised IDLH: The revised IDLH for inorganic arsenic compounds is 10 mg As/m³ based on acute inhalation toxicity data in animals [Flury 1921; Spector 1955]. This may be a conservative value due to the lack of relevant acute toxicity data for workers. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for inorganic arsenic compounds at concentrations above 0.002 mg As/m³. OSHA currently requires in 29 CFR 1919.1018 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 20 mg As/m³ (i.e., 2,000 × the PEL).]

Arsenic (inorganic compounds, as As) (continued)

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2. Flury F [1921]. Arsentrichlorid. In: Uber kampfgasvergiftungen. IX. Lokal reizende arsenverbindungen. Zeit Ges Exp Med *13*:527-528 (in German).
3. Lehman AJ [1951]. Chemicals in foods: a report to the Association of Food and Drug Officials on current developments. Part II. Pesticides. Q Bulletin Assoc Food Drug Off U.S. *15*(4):122-125.
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6. NIOSH [1976]. CG17500. Arsenic chloride. In: Registry of toxic effects of chemical substances (RTECS) 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 126.
7. Perkow W [1971/1976]. Wirksubstanzen der Pflanzenschytz and Schadlingsbekampfungsmittel. Berlin, Germany: Verlag Paul Parey (in German).
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Arsine

CAS number	7784-42-1
NIOSH REL	0.002 mg/m³ 15-minute CEILING; NIOSH considers arsine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.05 ppm (0.2 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.05 ppm (0.16 mg/m³) TWA
Description of substance	Colorless gas with a mild, garlic-like odor.
LEL	5.1% (10% LEL, 5,100 ppm)
Original (SCP) IDLH	6 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 6 to 30 ppm is the maximum concentration that can be inhaled in 1 hour without serious consequences [Henderson and Haggard 1943]. The chosen IDLH falls within the range of 1 to 10 ppm, which AIHA [1965] suggested might be dangerous for a 1-hour exposure [Elkins 1959; Kipling and Fothergill 1964].
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 1.0 ppm
24-hour EEGL: 0.1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Gates et al. 1946	120	-----	10 min	83 ppm (0.69)	8.3 ppm
Mouse	Gates et al. 1946	77	-----	10 min	53 ppm (0.69)	5.3 ppm
Rabbit	Gates et al. 1946	201	-----	10 min	138 ppm (0.69)	14 ppm
Dog	Gates et al. 1946	108	-----	10 min	75 ppm (0.69)	7.5 ppm
Human	Henderson and Haggard 1943	-----	250	30 min	250 ppm (1.0)	25 ppm
Human	Tab Biol Per 1933	-----	300	5 min	165 ppm (0.55)	17 ppm
Human	Teitelbaum and Kier 1969	-----	25	30 min	25 ppm (1.0)	2.5 ppm

Other animal data	RD_{50} (mouse), 13 ppm [Peterson and Bhattacharyya 1985].
Other human data	It has been reported that poisoning symptoms occur after a few hours exposure to 3 to 10 ppm [Henderson and Haggard 1943]. It has been suggested that 1 to 10 ppm might be dangerous for a 1 hour exposure [AIHA 1965] and that 6 to 30 ppm is the maximum concentration that can be inhaled in 1 hour without serious consequences [Henderson and Haggard 1943]. It has been estimated that 1,543 ppm for 2 minutes and 62 ppm for 30 minutes are minimal disabling exposures [Gates et al. 1946].

Revised IDLH: 3 ppm
Basis for revised IDLH: The revised IDLH for arsine is 3 ppm based on acute inhalation toxicity data in humans [AIHA 1965; Henderson and Haggard 1943; Teitelbaum and Kier 1969]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for arsine at concentrations above 0.002 mg As/m³.]

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9. Tab Biol Per [1933]; *3*:231 (in German).
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Azinphos-methyl

CAS number	86-50-0
NIOSH REL	0.2 mg/m³ TWA [skin]
Current OSHA PEL	0.2 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA [skin]
Description of substance	Colorless crystals or a brown, waxy solid.
LEL	Noncombustible Solid
Original (SCP) IDLH	20 mg/m³
Basis for original (SCP) IDLH	Because no useful data on acute inhalation toxicity are available concerning the toxic effects produced by azinphos-methyl, the chosen IDLH has been based on an analogy with parathion, which has an IDLH of 20 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Newell and Dilley 1978	69 mg/m³	-----	1 hr	86 mg/m³ (1.25)	8.6 mg/m³
Rat	Sanderson 1961	79 mg/m³	-----	1 hr	99 mg/m³ (1.25)	9.9 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	DuBois et al. 1957	oral	16	-----	115 mg/m³	12 mg/m³
G. pig	DuBois et al. 1957	oral	80	-----	560 mg/m³	56 mg/m³
Rat	Gaines 1960	oral	11	-----	77 mg/m³	7.7 mg/m³
Rat	Gaines 1960	oral	13	-----	91 mg/m³	9.1 mg/m³
Mouse	Murphy et al. 1976	oral	8.6	-----	60 mg/m³	6.0 mg/m³
Rat	Sanderson 1961	oral	7	-----	49 mg/m³	4.9 mg/m³
Mouse	Sato 1959	oral	8	-----	56 mg/m³	5.6 mg/m³
Dog	Worthing 1991	oral	10	-----	70 mg/m³	7.0 mg/m³

Human data .... Eight workers exposed to concentrations as high as 9.6 mg/m³ (no time period given) showed no signs or symptoms of illness [Jegler 1964].

Revised IDLH: 10 mg/m³
Basis for revised IDLH: The revised IDLH for azinphos-methyl is 10 mg/m³ based on acute inhalation toxicity data in humans [Jegler 1964] and animals [Newell and Dilley 1978; Sanderson 1961]. This may be a conservative value due to the lack of acute toxicity data for workers exposed to concentrations above 10 mg/m³.

REFERENCES:

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7. Sato I [1959]. Studies on organic phosphorus gusathion and phosdrin. I. The toxicity of gusathion and phosdrin. Kuma Med J *12*(1):312-317.
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Barium (soluble compounds, as Ba)

CAS number	7440-39-3 (Metal)
NIOSH REL	0.5 mg Ba/m^3 TWA
Current OSHA PEL	0.5 mg Ba/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg Ba/m^3 TWA
Description of substance	Varies
Original (SCP) IDLH*	1,100 mg Ba/m^3 [*Note: "Effective" IDLH = 250 mg Ba/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	From the standpoint of deriving an appropriate IDLH, the soluble Ba compounds $BaCl_2$ and $Ba(NO_3)_2$ prove to be the most acutely toxic. Browning [1969] reported that the toxic dose of $BaCl_2$ for man was 200 to 500 mg [Lydtin et al. 1965]; Patty [1963] cited 800 to 900 mg of $BaCl_2$ (550 to 600 mg as Ba) as the fatal dose for man [Sollman 1953]. Acute toxicity data in animals show $Ba(NO_3)_2$ equally as toxic as $BaCl_2$. As no data on the acute inhalation toxicity of either of these two barium compounds exist, the IDLH is based on a calculated dose for a 30-minute exposure for man required to attain an intake of 200 mg $BaCl_2$ (as Ba), assuming a minute volume of 7.5 liters/minute and an 80% retention. Therefore, the IDLH is calculated to be about 1,100 mg Ba/m^3. However, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 0.5 mg Ba/m^3 (i.e., 250 mg Ba/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 250 mg Ba/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50}	LD_{Lo}	Adjusted LD	Derived value
$BaCl_2$						
Rabbit	Barnes and Eltherington 1973	oral	-----	112 mg Ba/kg	785 mg Ba/m^3	79 mg Ba/m^3
Dog	Barnes and Eltherington 1973	oral	-----	59 mg Ba/kg	416 mg Ba/m^3	42 mg Ba/m^3
Rat	Calvery 1942	oral	78 mg Ba/kg	-----	545 mg Ba/m^3	55 mg Ba/m^3
G. pig	Calvery 1942	oral	50 mg Ba/kg	-----	350 mg Ba/m^3	35 mg Ba/m^3
Mouse	Coulston and Korte 1975	oral	-----	46 mg Ba/kg	323 mg Ba/m^3	32 mg Ba/m^3
$Ba(NO_3)_2$						
Rat	Marhold 1972	oral	187 mg Ba/kg	-----	1,306 mg Ba/m^3	131 mg Ba/m^3
Rabbit	Yakkyoku 1980	oral	-----	79 mg Ba/kg	552 mg Ba/m^3	55 mg Ba/m^3
Dog	Yakkyoku 1980	oral	-----	421 mg Ba/kg	2,944 mg Ba/m^3	294 mg Ba/m^3

Human data .... It has been reported that the lethal oral dose is 43 to 57 mg Ba/kg [Reeve 1979]. [Note: An oral dose of 43 to 57 mg Ba/kg is equivalent to a 70-kg worker being exposed to 2,007 to 2,660 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Barium (soluble compounds, as Ba) (continued)

Revised IDLH: 50 mg Ba/m³

Basis for revised IDLH: Basis for "Revised" IDLH: No inhalation toxicity data are available on which to base an IDLH for soluble barium compounds. Therefore, the revised IDLH for soluble barium compounds is 50 mg Ba/m³ based on acute oral toxicity data in humans [Reeve 1979] and animals [Barnes and Eltherington 1973; Calvery 1942; Coulston and Korte 1975; Yakkyoku 1980]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 50 mg/m³.

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9. Sollman TA [1953]. Manual of pharmacology and its applications to therapeutics and toxicology. 7th ed. Philadelphia, PA: W.B. Saunders Company, p. 479.
10. Yakkyoku (Pharmacy) [1980]; *31*(10):1247-1252 (in Japanese).

Benzene

CAS number	71-43-2
NIOSH REL	0.1 ppm TWA, 1 ppm STEL; NIOSH considers benzene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	1 ppm TWA, 5 ppm STEL
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (32 mg/m^3) TWA, A2
Description of substance	Colorless to light-yellow liquid with an aromatic odor.
LEL	1.2% (10% LEL, 1,200 ppm)
Original (SCP) IDLH	3,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the report in Patty [1963] that for man, a single exposure to 3,000 ppm is endurable for 0.5 to 1 hour [Flury 1928].
Existing short-term exposure guidelines	National Research Council [NRC 1986] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 50 ppm
24-hour EEGL: 2 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Carpenter et al. 1944	-----	45,000	30 min	45,000 ppm (1.0)	4,500 ppm
Dog	Spector 1955	-----	44,923	?	?	?
Cat	Spector 1955	-----	52,308	?	?	?
Human	Tab Biol Per 1933	-----	20,000	5 min	11,000 ppm (0.55)	1,100 ppm

Other human data .... It has been stated that 3,000 ppm is endurable for 0.5 to 1 hour [Flury 1928]. It has also been stated that exposure at 19,000 to 20,000 ppm for 5 to 10 minutes is fatal; exposure at 7,500 ppm for 30 minutes is dangerous; exposure at 1,500 ppm for 60 minutes induces serious symptoms; exposure at 500 ppm for 60 minutes leads to symptoms of illness; exposure at 50 to 150 ppm for 5 hours produces headache, lassitude, and weakness; and exposure at 25 ppm for 8 hours has no effect [Gerarde 1960].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for benzene is 500 ppm based on acute inhalation toxicity data in humans [Gerarde 1960]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for benzene at concentrations above 0.1 ppm. OSHA currently requires in 29 CFR 1910.1028 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 1,000 ppm (i.e., 1,000 × the PEL).]

REFERENCES:

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2. Flury F [1928]. Moderne gewerbliche vergiftungen in pharmakologisch-toxikologischer hinsicht (Pharmacological-toxicological aspects of intoxicants in modern industry). Arch Exp Pathol Pharmakol *138*:65-82 (translated).

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5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1221.
6. Spector WS, ed. [1955]. Handbook of toxicology. Vol. 1. Acute toxicities of solids, liquids and gases to laboratory animals. Philadelphia, PA: W.B. Saunders Co., p. 324.
7. Tab Biol Per [1933]; 3:231 (in German).

Benzoyl peroxide

CAS number 94-36-0
NIOSH REL .... 5 mg/m³ TWA
Current OSHA PEL .... 5 mg/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 mg/m³ TWA
Description of Substance .... Colorless to white crystals or a granular powder with a faint, benzaldehyde-like odor.
LEL .... Unknown
Original (SCP) IDLH .... 7,000 mg/m³
Basis for original (SCP) IDLH .... The chosen IDLH is based on the estimated mouse 4-hour LC_{50} of 700 ppm (7,000 mg/m³) for benzoyl peroxide cited by ACGIH [1971]. However, this concentration is not an actual LC_{50} value for benzoyl peroxide; it was estimated by ACGIH [1971] by analogy from data concerning LC_{50} values for other related organic peroxides [Floyd and Stokinger 1958].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value (ppm)
Mouse	Floyd and Stokinger 1958	7,000 mg/m³	-----	4 hr	14,00 mg/m³ (2.0)	1,400 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	ARCO 1982	oral	7,710	-----	53,970 mg/m³	5,397 mg/m³

Human data .... Concentrations of 12 mg/m³ and higher have resulted in pronounced irritation of the nose and throat [Moskowitz and Grabois 1950].

Revised IDLH: 1,500 mg/m³
Basis for revised IDLH: The revised IDLH for benzoyl peroxide is 1,500 mg/m³ based on acute inhalation toxicity data in animals [Floyd and Stokinger 1958].

REFERENCES:

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2. ARCO [1982]. Toxicology report. 70% aqueous tertiary butyl hydroperoxide: acute toxicity evaluation. Newtown Square, PA: Arco Chemical Company, June 1982.
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Benzyl chloride

CAS number	100-44-7
NIOSH REL	1 ppm (5 mg/m^3) 15-minute CEILING
Current OSHA PEL	1 ppm (5 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (5.2 mg/m^3) TWA
Description of Substance	Colorless to slightly yellow liquid with a pungent, aromatic odor.
LEL	1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	Very little data are available on the acute effects of exposure to benzyl chloride. ACGIH [1971] reported that in 1 minute an exposure to 16 ppm is intolerable to man [Flury and Zernik 1931]. ILO [1972] reported that 20 ppm will render the atmosphere irrespirable in 1 minute. ILO [1971] reported that 50 to 100 mg/m^3 (10 to 19 ppm) immediately causes weeping and twitching of the eyelids, while 160 mg/m^3 (30 ppm) causes effects that are intolerable to the eyes and nasal mucous membranes. Based on this data, an IDLH of 10 ppm is assumed in order to avoid difficulties in escape in the event of respirator failure.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	IARC 1976	150	-----	2 hr	240 ppm (1.6)	24 ppm
Mouse	IARC 1976	80	-----	2 hr	128 ppm (1.6)	13 ppm
Dog	NIOSH 1978	-----	380	8 hr	950 ppm (2.5)	95 ppm

Other animal data	RD_{50} (mouse), 17 ppm [DeCeaurriz et al. 1981].
Human data	It has been reported that an exposure to 16 ppm for 1 minute is intolerable [Flury and Zernik 1931]. It has also been reported that 10 to 19 ppm immediately causes weeping and twitching of the eyelids [ILO 1971].

Revised IDLH: 10 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Flury and Zernik 1931; ILO 1971], the original IDLH for benzyl chloride (10 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Benzyl chloride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 24.
2. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett 9(2):137-143.
3. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 339 (in German).
4. IARC [1976]. IARC monographs on the evaluation of the carcinogenic risk of chemicals to man: benzyl chloride. Vol. 11. Lyon, France: World Health Organization, International Agency for Research on Cancer, p. 217.
5. ILO [1971]. Benzyl chloride. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 169-170.
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Beryllium compounds (as Be)

CAS number	7440-41-7 (Metal)
NIOSH REL	Not to exceed 0.0005 mg/m³; NIOSH considers beryllium compounds to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.002 mg/m³ TWA, 0.005 mg/m³ CEILING, 0.025 mg/m³ 30-minute MAXIMUM PEAK
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.002 mg/m³ TWA, A2
Description of Substance	Varies
Original (SCP) IDLH*	10 mg Be/m³ [*Note: "Effective" IDLH = 4 mg Be/m³ -- see discussion below.]
Basis for original (SCP) IDLH	This IDLH is based on the statement by Patty [1963] that 10 mg/m³ of beryllium fluoride was lethal to several species in 15 days. However, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.002 mg/m³ (i.e., 4 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 4 mg Be/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
BeF_2:						
Rat	Blair 1951	oral	90	-----	158 mg Be/m³	16 mg Be/m³
Mouse	Tabershaw 1972	oral	100	-----	161 mg Be/m³	16 mg Be/m³
$BeSO_4$:						
Rat	Sazhina 1965	oral	82	-----	49 mg Be/m³	4.9 mg Be/m³
Mouse	Sazhina 1965	oral	80	-----	48 mg Be/m³	4.8 mg Be/m³

Other animal data	It has been reported that 10 mg/m³ of beryllium fluoride (i.e., 2.3 mg Be/m³) was lethal to several species in 15 days [Patty 1963].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 4 mg Be/m³
Basis for revised IDLH: Based on acute toxicity data in animals [Patty 1963; Sazhina 1965], a value of about 5 mg Be/m³ would have been appropriate. However, the revised IDLH for beryllium compounds is 4 mg Be/m³ based on being 2,000 times the OSHA PEL of 0.002 mg Be/m³ (2,000 is an assigned protection factor for respirators; only the "most reliable" respirators are recommended for exposures greater than 2,000 times the OSHA PEL). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for beryllium compounds at concentrations above 0.0005 mg Be/m³.]

REFERENCES:

1. Blair HA [1951]. Quarterly technical report (January 1, 1951 through March 31, 1951). Rochester, NY: University of Rochester, Research and Development Report UR-154, U.S. Atomic Energy Commission Contract W-7401-eng-49.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1006.
3. Sazhina LA [1965]. Experimental data to substantiate the maximum permissible concentration of beryllium in the water of reservoirs. Gig Sanit *30*(1-3):169-176 (translated).
4. Tabershaw IR, ed. [1972]. The toxicology of beryllium. U.S. Public Health Service Publication *2173*:23.

Boron oxide

CAS number	1303-86-2
NIOSH REL	10 mg/m³ TWA
Current OSHA PEL	15 mg/m³ TWA
1989 OSHA PEL	10 mg/m³ TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of Substance	Colorless, semitransparent lumps or hard, white, odorless crystals.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	No evidence exists in the available toxicological data that an acute exposure to a high concentration of boron oxide would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of boron oxide, 500 × the OSHA PEL of 15 mg/m³ is 7,500 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Izmerov et al. 1982	oral	3,163	-----	22,141 mg/m³	2,214 mg/m³

Other animal data	Rats exposed for 6 hours/day, 5 days/week for 10 weeks to a concentration of 470 mg/m³ showed no signs of intoxication other than mild nasal irritation [Wilding et al. 1959].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 mg/m³
Basis for revised IDLH: The revised IDLH for boron oxide is 2,000 mg/m³ based on acute toxicity data in animals [Izmerov et al. 1982; Wilding et al. 1959].

REFERENCES:

1. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 27.
2. Wilding JL, Smith WJ, Yevich P, Sicks ME, Ryan SG, Punte CL [1959]. The toxicity of boron oxide. Am Ind Hyg Assoc J *20*:284-289.

Boron trifluoride

CAS number	7637-07-2
NIOSH REL	1 ppm (3 mg/m^3) CEILING
Current OSHA PEL	1 ppm (3 mg/m^3) CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (2.8 mg/m^3) CEILING
Description of Substance	Colorless gas with a pungent, suffocating odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	Because no useful data on acute inhalation toxicity are available on which to base the IDLH, the chosen IDLH is based on chronic toxicity data (i.e., repeated exposure to 100 ppm resulted in a uniformly high mortality rate in six laboratory species [Stokinger et al. 1953 cited by ACGIH 1971]). The only acute inhalation toxicity data available was not used to establish the IDLH because in 5.5 hours 10 of 10 guinea pigs succumbed to an exposure of 750 ppm [Livinskas 1964].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Farmakol Toksikol 1972	1,227	-----	2 hr	1,963 ppm (1.6)	196 ppm
G. pig	Farmakol Toksikol 1972	39	-----	4 hr	77 ppm (2.0)	8 ppm
Rat	Izmerov et al. 1982	418	-----	4 hr	837 ppm (2.0)	84 ppm

Other animal data	Exposure to a concentration of 100 ppm resulted in a uniformly high mortality rate in six laboratory species, and 15 ppm was occasionally fatal in 30-day studies [Stokinger et al. 1953]. Rats exposed 6 hours/day to 24 ppm or 2 weeks to 9 ppm showed signs of respiratory irritation, depression of body weight, increased lung weights, and depressed liver weights [Rusch et al. 1986].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 25 ppm
Basis for revised IDLH: The revised IDLH for boron trifluoride is 25 ppm based on subchronic inhalation toxicity data in animals [Rusch et al. 1986].

REFERENCES:

1. ACGIH [1971]. Boron trifluoride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 26-27.
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4. Livinskas GJ [1964]. In: Adams RM, ed. Boron metallo-boron compounds and boranes, New York, NY: Interscience Publishers, Inc..
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6. Stokinger HE, Spiegl CJ, et al. [1953]. Chapter 28. Special materials. In: Voegtlin C, Hodge HC, eds. Pharmacology and toxicology of uranium compounds, chronic inhalation and other studies. Vol. 4. New York, NY: McGraw-Hill Book Company, Inc., p. 2302.

Bromine

CAS number	7726-95-6
NIOSH REL	0.1 ppm (0.7 mg/m³) TWA, 0.3 ppm (2 mg/m³) STEL
Current OSHA PEL	0.1 ppm (0.7 mg/m³) TWA
1989 OSHA PEL	0.1 ppm (0.7 mg/m³) TWA, 0.3 ppm (2 mg/m³) STEL
1993-1994 ACGIH TLV	0.1 ppm (0.66 mg/m³) TWA, 0.3 ppm (2.0 mg/m³) STEL
Description of Substance	Dark reddish-brown, fuming liquid with suffocating, irritating fumes.
LEL	Noncombustible Liquid
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1958] that concentrations of 10 ppm or above cause such severe upper respiratory irritation that such concentrations will not be voluntarily borne [MCA 1968]. AIHA [1958] also reported that even brief exposures of 40 to 60 ppm are dangerous for humans [Henderson and Haggard 1943].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Mouse	Bitron and Aharonson 1978	750	-----	9 min	435 ppm (0.58)	44 ppm
Mouse	Bitron and Aharonson 1978	240	-----	2 hr	451 ppm (1.88)	45 ppm
Rat	Ivanov et al. 1976	407	-----	?	?	?
Rabbit	Spector 1955	-----	180	6.5 hr	578 ppm (3.21)	58 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.2 [ten Berge et al. 1986].

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Gig Sanit 1970	oral	2,600	-----	2,741 ppm	274 ppm
Mouse	Gig Sanit 1970	oral	3,100	-----	3,268 ppm	327 ppm
Rabbit	Gig Sanit 1970	oral	4,160	-----	4,386 ppm	439 ppm
G. pig	Gig Sanit 1970	oral	5,500	-----	5,798 ppm	580 ppm

Human data .... It has been reported that 10 ppm and above cause such severe upper respiratory irritation that exposures will not be voluntarily borne [MCA 1968]. Also, it has been reported that 0.75 ppm caused no symptoms in 6 hours [Flury and Zernik 1931]. Further, 4 ppm has been recommended as the maximum concentration allowable for 0.5 to 1 hour, with 40 to 60 ppm dangerous for brief exposures [Henderson and Haggard 1943]. It has also been stated that respiratory damage occurs at 10 ppm [NFPA 1978]. It has been reported that 1.7 to 3.5 ppm produces severe choking, 4.5 to 9 ppm is extremely dangerous, and 30 ppm would prove fatal in a short time [ILO 1971].

Revised IDLH: 3 ppm
Basis for revised IDLH: The revised IDLH for bromine is 3 ppm based on acute inhalation toxicity data in humans [Flury and Zernik 1931; Henderson and Haggard 1943; ILO 1971; MCA 1968; NFPA 1978].

REFERENCES:

1. AIHA [1958]. Bromine. In: Hygienic guide series. Am Ind Hyg Assoc J *19*:349-350.
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3. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und stauberten. Berlin, Germany: Verlag von Julius Springer, p. 538 (in German).
4. Gig Sanit [1970]; *35*(11):11 (in Russian).
5. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 133.
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9. NFPA [1978]. Fire protection guide on hazardous materials. 7th ed. Boston, MA: National Fire Protection Association, p. 49-65.
10. Spector WS, ed. [1955]. Handbook of toxicology. Vol. 1. Acute toxicities of solids, liquids and gases to laboratory animals. Philadelphia, PA: W.B. Saunders Co., p. 324.
11. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Bromoform

CAS number	75-25-2
NIOSH REL	0.5 ppm (5 mg/m³) TWA [skin]
Current OSHA PEL	0.5 ppm (5 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 ppm (5.2 mg/m³) TWA [skin]
Description of Substance	Colorless to yellow liquid with a chloroform-like odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 1,000 ppm – see discussion below.]
Basis for original (SCP) IDLH	Grant [1974] reported that bromoform is a heavy liquid which resembles chloroform physically, chemically, and pharmacologically but is more toxic to the liver and more irritant on inhalation, causing tearing and salivation [Fairhall 1957]. AIHA [1965] reported that a concentration of chloroform immediately dangerous to life or health has not been established, but that a concentration of 14,000 to 16,000 ppm will cause rapid loss of consciousness in man [Patty 1963]. Lower concentrations of chloroform (4,100 ppm or less) may cause disorientation serious enough to result in falls or other mechanical accidents [Patty 1963]. However, for this draft technical standard, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.5 ppm (i.e., 1,000 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 1,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	-----	4,282	4 hr	8,564 ppm (2.0)	856 ppm
Mammal	Lublinov and Rabolnikova 1974	1,151	-----	?	?	?
Dog	Patty 1963	-----	7,000	1 hr	8,750 ppm (1.25)	875 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Bowman et al. 1978	oral	-----	1,400	932 ppm	93 ppm
Rat	Chu et al. 1980	oral	-----	1,147	764 ppm	76 ppm

Human data .... It has been reported that 14,000 to 16,000 ppm will cause rapid loss of consciousness [Patty 1963]. The reported lethal oral dose is 143 mg/kg [Deichmann and Gerarde 1969]. [Note: An oral dose of 143 mg/kg is equivalent to a 70-kg worker being exposed to about 635 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 850 ppm
Basis for revised IDLH: The revised IDLH for bromoform is 850 ppm based on acute inhalation toxicity data in animals [Izmerov et al. 1982]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations between 850 and 14,000 ppm.

REFERENCES:

1. AIHA [1965]. Bromoform. In: Hygienic guide series. Am Ind Hyg Assoc J *26*:637.
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3. Chu I, Secours V, Marino I, Villeneuve DC [1980]. The acute toxicity of four trihalomethanes in male and female rats. Toxicol Appl Pharmacol *52*:351-353.
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5. Fairhall LT [1957]. Industrial toxicology. 2nd ed. Baltimore, MD: Williams & Wilkins Company, pp. 170-171.
6. Grant WM [1974]. Toxicology of the eye. 2nd ed. Springfield, IL: C.C. Thomas, p. 203.
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8. Lublinov ET, Rabolnikova LB [1974]. Acute toxicity data of some bromohydrocarbons. Gig Tr Prof Zabol *18*(4):55-57 (in Russian).
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1,3-Butadiene

CAS number 106-99-0

NIOSH REL .... None established; NIOSH considers 1,3-butadiene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 1,000 ppm (2,200 mg/m^3) TWA

1989 OSHA PEL .... Same as current PEL

1993-1994 ACGIH TLV .... 10 ppm (22 mg/m^3) TWA, A2

Description of Substance .... Colorless gas with a mild aromatic or gasoline-like odor.

LEL .... 2.0% (10% LEL, 2,000 ppm)

Original (SCP) IDLH .... 20,000 ppm [LEL]

Basis for original (SCP) IDLH .... AIHA [1963] reported that narcosis did not occur in 2 humans inhaling 8,000 ppm during an 8-hour period [Carpenter et al. 1944]. AIHA [1963] also reported that inhalation of 6,700 ppm for 7.5 hours/day, 6 days/week for 8 months resulted in no significant chronic effects in rats, guinea pigs, rabbits, and dogs; some growth retardation and light cloudy swelling of livers did occur [Carpenter et al. 1944]. From the data given above, acutely toxic concentrations are obviously well above the lower explosive limit (LEL) of 20,000 ppm. For this draft technical standard, therefore, the LEL is used as the IDLH (i.e., the concentration above which only the "most protective" respirators are permitted).

Existing short-term exposure guidelines .... 1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 10 ppm (60-minute)
ERPG-2: 50 ppm (60-minute)
ERPG-3: 5,000 ppm (60-minute)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Carpenter et al. 1944	-----	250,000	30 min	250,000 ppm (1.0)	25,000 ppm
Mouse	Dow 1941	115,111	-----	?	?	?
Rat	Dow 1941	LC_{40}: 200,000	-----	30 min	200,000 ppm (1.0)	20,000 ppm
Mouse	Dow 1941	122,000	-----	2 hr	195,200 ppm (1.6)	19,500 ppm
Rat	Shugaev 1968	126,667	-----	4 hr	253,334 ppm (2.0)	25,334 ppm
Rat	von Oettingen 1940	130,000	-----	4 hr	260,000 ppm (2.0)	26,000 ppm

Other animal data .... Exposures to 6,700 ppm for 7.5 hours/day, 6 days/week for 8 months caused no progressive injury in rats, guinea pigs, rabbits, or 1 dog [Carpenter et al. 1944].

Human data .... Narcosis did not occur in volunteers exposed to 8,000 ppm for 8 hours [Carpenter et al. 1944]. Exposure to 10,000 ppm for 5 minutes has resulted in slight irritation and dryness of the nose and mouth with some increase in pulse rate but no effect on blood pressure or respiration [Shugaev 1968].

Revised IDLH: 2,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Carpenter et al. 1944; Von Oettingen 1940] and animals [Carpenter et al. 1944; Dow 1941; Shugaev 1968; von Oettingen 1940], a value between 10,000 and 20,000 ppm would have been appropriate. However, the revised IDLH for 1,3-butadiene is 2,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2%). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 1,3-butadiene at any detectable concentration.]

1,3-Butadiene (continued)

REFERENCES:

1. AIHA [1963]. 1,3-Butadiene. In: Hygienic guide series. Am Ind Hyg Assoc J *24*:91-92.
2. Carpenter CP, Shaffer CB, Weil CS, Smyth HF Jr [1944]. Studies on the inhalation of 1,3-butadiene; with a comparison of its narcotic effect with benzol, toluol, and styrene, and a note on the elimination of styrene by the human. J Ind Hyg Toxicol *26*(3):69-78.
3. Dow [1941]. Research report of inhalation toxicity of 1,3-butadiene. [Unpublished research]. Midland, MI: Dow Chemical Company. [From American Industrial Hygiene Association (AIHA) 1991 Emergency Response Planning Guidelines for 1,3-Butadiene.]
4. Shugaev BB [1968]. Distribution in the organism and toxicity of aliphatic hydrocarbons. Farmakol Toxsikol *31*:162-165 (translated).
5. von Oettingen WR [1940]. Toxicity and potential dangers of aliphatic and aromatic hydrocarbons. A critical review of the literature. Public Health Bulletin *255*:25.

2-Butanone

CAS number	78-93-3
NIOSH REL	200 ppm (590 mg/m³) TWA, 300 ppm (885 mg/m³) STEL
Current OSHA PEL	200 ppm (590 mg/m³) TWA
1989 OSHA PEL	200 ppm (590 mg/m³) TWA, 300 ppm (885 mg/m³) STEL
1993-1994 ACGIH TLV	200 ppm (590 mg/m³) TWA, 300 ppm (885 mg/m³) STEL
Description of Substance	Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor.
LEL(@200°F)	1.4% (10% LEL(@200°F), 1,400 ppm)
Original (SCP) IDLH	3,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that a 2-hour exposure of rats to 2,000 ppm caused no deaths, but 4 of 6 rats exposed to 4,000 ppm for a 2-hour period died [Smyth 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Esin and Vidgergauz 1986	12,667	-----	?	?	?
Mouse	Izmerov et al. 1982	13,333	-----	2 hr	21,333 ppm (1.6)	2,133 ppm
Rat	Pozzani et al. 1959	7,833	-----	8 hr	19,583 ppm (2.5)	1,958 ppm
Rat	Smyth 1956	LC_{67}: 4,000	-----	2 hr	6,400 ppm (1.6)	640 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kimura et al. 1971	oral	2,737	-----	6,386 ppm	639 ppm
Mouse	Tanii et al. 1986	oral	4,050	-----	9,450 ppm	945 ppm

Human data .... It has been reported that 3,000 ppm is irritating to the eyes and nose [Patty et al. 1935].

Revised IDLH: 3,000 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Patty et al. 1935], the original IDLH for 2-butanone (3,000 ppm) is not being revised at this time.

REFERENCES:

1. Esin MS, Vigdergauz MS [1986]. Correlation between toxicity indexes and chromatographic characteristics of chemical substances. Gig Sanit *51*(5):61-62 (in Russian).
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 83.
3. Kimura ET, Ebert DM, Dodge PW [1971]. Acute toxicity and limits of solvent residue for sixteen organic solvents. Toxicol Appl Pharmacol *19*:699-704.
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8. Tanii H, Tsuji H, Hashimoto K [1986]. Structure-toxicity relationship of monoketones. Toxicol Lett *30*:13-17.

2-Butoxyethanol

CAS number	111-76-2
NIOSH REL	5 ppm (24 mg/m³) TWA [skin]
Current OSHA PEL	50 ppm (240 mg/m³) TWA [skin]
1989 OSHA PEL	25 ppm (120 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	25 ppm (121 mg/m³) TWA [skin]
Description of Substance	Colorless liquid with a mild, ether-like odor.
LEL(@200°F)	1.1% (10% LEL(@200°F), 1,100 ppm)
Original (SCP) IDLH	700 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 7-hour LC_{50} of 700 ppm [Werner et al. 1943 cited by Patty 1963, Browning 1965, and ACGIH 1971]. No other useful data are available on which to base the IDLH. The chosen IDLH is probably conservative, because Patty [1963] reported that exposure of workers for several hours to 300 to 600 ppm would probably cause respiratory and eye irritation, narcosis, and damage to the kidney and liver. Both Patty [1963] and ACGIH [1971] noted that humans appear to be more resistant to the toxic effects of 2-butoxyethanol [Carpenter et al. 1956], which further indicates that the chosen IDLH might be conservative.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Dodd et al. 1983	450	-----	4 hr	900 ppm (2.0)	90 ppm
Mouse	Werner et al. 1943	700	-----	7 hr	1,680 ppm (2.4)	168 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Carpenter et al. 1956	oral	1,230	-----	1,754 ppm	175 ppm
Rat	Dow 1986	oral	470	-----	670 ppm	67 ppm
Rabbit	Dow 1986	oral	300	-----	428 ppm	43 ppm
G. pig	Smyth et al. 1941	oral	1,200	-----	1,711 ppm	171 ppm
Rat	Smyth et al. 1941	oral	1,480	-----	2,110 ppm	211 ppm

Other animal data .... RD_{50} (mouse), 2,824 ppm [Alarie 1981].

Human data .... It has been stated that humans would be able to tolerate saturated concentrations (i.e., about 1,000 ppm) for 1 hour without experiencing any significant nonreversible effects [Carpenter et al. 1956].

Revised IDLH: 700 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Carpenter et al. 1956], a value of about 1,000 ppm would have been appropriate for 2-butoxyethanol. However, the original IDLH for 2-butoxyethanol (700 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. 2-Butoxy ethanol (butyl cellosolve). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 29-30.

2. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
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4. Carpenter CP, Pozzani UC, Weil CS, Nair JH III, Keck GA, Smyth HF Jr [1956]. The toxicity of butyl cellosolve solvent. AMA Arch Ind Health *14*:129-131.
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8. Smyth HF Jr, Seaton J, Fischer L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol *23*:259-268.
9. Werner HW, Mitchel JL, Miller JW, von Oettingen WF [1943]. The acute toxicity of vapors of several monoalkyl ethers of ethylene glycol. J Ind Hyg Toxicol *25*(19):157-163.

n-Butyl acetate

CAS number	123-86-4
NIOSH REL	150 ppm (710 mg/m³) TWA, 200 ppm (950 mg/m³) STEL
Current OSHA PEL	150 ppm (710 mg/m³) TWA
1989 OSHA PEL	150 ppm (710 mg/m³) TWA, 200 ppm (950 mg/m³) STEL
1993-1994 ACGIH TLV	150 ppm (713 mg/m³) TWA, 200 ppm (950 mg/m³) STEL
Description of Substance	Colorless liquid with a fruity odor.
LEL	1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that a 4-hour exposure to 10,000 ppm killed no rats, but an 8-hour exposure to 10,000 ppm killed all 6 rats [Smyth 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	EPA 1987	160	-----	4 hr	320 ppm (2.0)	32 ppm
Cat	Flury and Wirth 1933	-----	14,079	72 min	18,866 ppm (1.34)	1,887 ppm
G. pig	Food Cosmet Toxicol 1979	-----	13,872	4 hr	27,744 ppm (2.0)	2,774 ppm
Rat	NPIRI 1974	2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Rat	Smyth 1956	LC_{100}: 10,000	-----	8 hr	25,000 ppm (2.5)	2,500 ppm
Rat	UCC 1987	391	-----	4 hr	782 ppm (2.0)	78 ppm
Mouse	Yakkyoku 1981	1,242	-----	2 hr	1,987 ppm (1.6)	199 ppm

Other animal data	A 4-hour exposure to 10,000 ppm was not lethal to rats [Smyth 1956].
Human data	Severe irritation of the throat has been reported in volunteers exposed to 300 ppm for 3 to 5 minutes [Nelson et al. 1943]. However, it has also been reported that irritation of the eyes and nose is first objectionable at 3,300 ppm and that higher concentrations cause tearing and hyperemia of the conjunctiva [Grant 1974].

Revised IDLH: 1,700 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Grant 1974], a value of about 3,300 ppm would have been appropriate for n-butyl acetate. However, the revised IDLH for n-butyl acetate is 1,700 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.7%).

REFERENCES:

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9. UCC [1987]. n-Butyl acetate: acute vapor inhalation toxicity test in rats. Export, PA: Union Carbide Corporation, Bushy Run Research Center, Project Report No. 50-135, November 17, 1987. [From ACGIH [1991]. n-Butyl acetate. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 164-165.]
10. Yakkyoku (Pharmacy) [1981]; *32*(10):1241-1247 (in Japanese).

sec-Butyl acetate

CAS number	105-46-4
NIOSH REL	200 ppm (950 mg/m^3) TWA
Current OSHA PEL	200 ppm (950 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	200 ppm (950 mg/m^3) TWA
Description of Substance	Colorless liquid with a pleasant, fruity odor.
LEL	1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with n-butyl acetate which has an IDLH of 10,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	The vapor of sec-butyl acetate is reportedly less irritating than that of n-butyl acetate [Richmond and Pagnotto 1965].

Revised IDLH: 1,700 ppm [LEL]
Basis for revised IDLH: Based on health considerations and an analogy to n-butyl acetate [Richmond and Pagnotto 1965], a value of about 2,500 ppm would have been appropriate for sec-butyl acetate. However, the revised IDLH for sec-Butyl acetate is 1,700 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.7%).

REFERENCE:

1. Richmond M, Pagnotto LD [1965]. Comparative toxicity of selective acetate esters. Unpublished data. [From: ACGIH [1991]. sec-Butyl acetate. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 166.]

tert-Butyl acetate

CAS number	540-88-5
NIOSH REL	200 ppm (950 mg/m^3) TWA
Current OSHA PEL	200 ppm (950 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	200 ppm (950 mg/m^3) TWA
Description of Substance	Colorless liquid with a fruity odor.
LEL	1.5% (10% LEL, 1,500 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with n-butyl acetate for which an IDLH of 10,000 ppm was chosen. No other data on acute inhalation toxicity are available on which to base the IDLH for tert-butyl acetate.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	Exposures of 200 to 300 ppm cause slight irritation of the eyes and nose, and short exposures to 3,300 ppm cause extreme irritation of the eyes and nose [ILO 1983].

Revised IDLH: 1,500 ppm [LEL]
Basis for revised IDLH: Based on health considerations, acute inhalation toxicity data in humans [ILO 1983], and an analogy to n-butyl acetate, a value of about 2,500 ppm would have been appropriate for tert-butyl acetate. However, the revised IDLH for tert-butyl acetate is 1,500 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.5%).

REFERENCE:

1. ILO [1983]. Butyl acetate. In: Encyclopaedia of occupational health and safety. Third (revised) edition. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 782-783.

n-Butyl alcohol

CAS number	71-36-3
NIOSH REL	50 ppm (150 mg/m^3) CEILING [skin]
Current OSHA PEL	100 ppm (300 mg/m^3) TWA
1989 OSHA PEL	50 ppm (150 mg/m^3) CEILING [skin]
1993-1994 ACGIH TLV	50 ppm (152 mg/m^3) CEILING [skin]
Description of Substance	Colorless liquid with a strong, characteristic, mildly alcoholic odor.
LEL	1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is conservative, but the only data available on which to base the IDLH is the statement by Patty [1963] that Smyth [1956] found rats survived when exposed for 4 hours to 8,000 ppm. The IDLH for isobutyl alcohol is also 8,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Esin and Vigdergauz 1986	9,221	-----	?	?	?
Rat	NPIRI 1974	8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	-----	3,484	7,918 ppm	792 ppm
Rat	Purchase 1969	oral	-----	790	1,795 ppm	180 ppm
Dog	Wurtz 1975	oral	-----	1,700	4,000 ppm	400 ppm

Other animal data	RD_{50} (mouse), 4,784 ppm [Alarie 1981].
Human data	It has been reported that corneal irritation was occasionally observed in workers exposed to 200 ppm [Sterner et al. 1949].

Revised IDLH: 1,400 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [NPIRI 1974], a value of about 1,600 ppm would have been appropriate for n-butyl alcohol. However, the revised IDLH for n-butyl alcohol is 1,400 ppm based strictly on safety considerations (i.e., being 10% if the lower explosive limit of 1.4%).

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Esin MS, Vigdergauz MS [1986]. Correlation between toxicity indexes and chromatographic characteristics of chemical substances. Gig Sanit *51*(5):61-62 (in Russian).
3. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
4. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 10.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1443.
6. Purchase IFH [1969]. Studies in kaffircorn malting and brewing. XXII. The acute toxicity of some fusel oils found in Bantu beer. S Afr Med J *43*:795-798.

7. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.
8. Sterner JH, Crouch HC, Brockmyre HF, Cusack M [1949]. A ten-year study of butyl alcohol exposure. Am Ind Hyg Assoc Q *10*:53-59.
9. Wurtz M [1975]. Sur les proprietes toxiques des alcools par fermentation. Comp Rend Hebdom *81*:192-194 (in French).

sec-Butyl alcohol

CAS number 78-92-2
NIOSH REL .... 100 ppm (305 mg/m^3) TWA, 150 ppm (455 mg/m^3) STEL
Current OSHA PEL .... 150 ppm (450 mg/m^3) TWA
1989 OSHA PEL .... 100 ppm (305 mg/m^3) TWA
1993-1994 ACGIH TLV .... 100 ppm (303 mg/m^3) TWA
Description of Substance .... Colorless liquid with a strong, pleasant odor.
LEL(@212°F) .... 1.7% (10% LEL(@212°F), 1,700 ppm)
Original (SCP) IDLH .... 10,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by Patty [1963] that 10,670 ppm for 225 minutes and 16,000 ppm for 160 minutes were fatal for mice [Weese 1928]. According to Patty [1963], at 20,000 ppm it took 12 to 20 minutes to produce prostration in mice and 40 minutes to produce narcosis; no deaths occurred [Starrek 1938]. The chosen IDLH is probably conservative.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Shell 1985	-----	16,000	4 hr	32,000 ppm (2.0)	3,200 ppm
Mouse	Weese 1928	-----	10,670	3.75 hr	20,913 ppm (1.96)	2,091 ppm
Mouse	Weese 1928	-----	16,000	2.67 hr	28,000 ppm (1.75)	2,800 ppm

Other animal data .... The limited acute toxicity data indicate that sec-butyl alcohol is less toxic than n-butyl alcohol [ACGIH 1991].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for sec-butyl alcohol is 2,000 ppm based on acute inhalation toxicity data in animals [Weese 1928]. This value also approximates 10% of the lower explosive limit (LEL) of 1.7% (which was determined at 212°F) and the revised IDLH for n-butyl alcohol. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1991]. sec-Butyl alcohol. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 172-173.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1447.
3. Shell [1985]. Material safety data sheet S280-4: secondary butyl alcohol. Houston, TX: Shell Chemical Company, pp. 1-4.
4. Starrek E [1938]. The effect of some alcohols, glycols, and esters. Doctoral dissertation (translated). Wurzburg, Germany: Julius Maximillian University.
5. Weese H [1928]. Comparative studies of the effect and toxicity of the vapors of lower aliphatic alcohols. Arch Exp Pathol Pharmakol *135*:118-130 (translated).

tert-Butyl alcohol

CAS number	75-65-0
NIOSH REL	100 ppm (300 mg/m^3) TWA, 150 ppm (450 mg/m^3) STEL
Current OSHA PEL	100 ppm (300 mg/m^3) TWA
1989 OSHA PEL	100 ppm (300 mg/m^3) TWA, 150 ppm (450 mg/m^3) STEL
1993-1994 ACGIH TLV	100 ppm (303 mg/m^3) TWA
Description of Substance	Colorless solid or liquid (above 77°F) with a camphor-like odor.
LEL	2.4% (10% LEL, 2,400 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for tert-butyl alcohol, but Patty [1963] reported that the signs of intoxication on the part of animals exposed to its vapors are similar to those induced by the other butyl alcohols [Weese 1928]. For this draft technical standard, therefore, the IDLH is based on an analogy with isobutyl alcohol and n-butyl alcohol, which have IDLHs of 8,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	3,559	-----	8,089 ppm	809 ppm
Rat	Schaffarzick and Brown 1952	oral	3,500	-----	7,955 ppm	796 ppm

Other animal data	It has been reported that inhalation toxicity for tert-butyl alcohol is similar to that induced by the other butyl alcohols [Weese 1928].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,600 ppm
Basis for revised IDLH: The revised IDLH for tert-butyl alcohol is 1,600 ppm based on analogies [Weese 1928] to isobutyl alcohol and n-butyl alcohol.

REFERENCES:

1. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1447.
3. Schaffarzick RW, Brown BJ [1952]. The anticonvulsant activity and toxicity of methylparafynol (Dormison®) and some other alcohols. Science *116*:663-665.
4. Weese H [1928]. Comparative studies of the effect of toxicity of lower aliphatic alcohol vapors (translated). Arch Exp Pathol Pharmakol *135*:121-123.

n-Butylamine

CAS number	109-73-9
NIOSH REL	5 ppm (15 mg/m³) CEILING [skin]
Current OSHA PEL	5 ppm (15 mg/m³) CEILING [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (15 mg/m³) CEILING [skin]
Description of Substance	Colorless liquid with a fishy, ammonia-like odor.
LEL	1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1960] that no rats died after a 4-hour exposure to 2,000 ppm [Smyth 1956], but 3 of 3 rats died after a 50-minute exposure to 3,100 ppm [Terhaar]. No other data on acute inhalation toxicity are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	AIHA 1960	LC_{100}: 3,100	-----	50 min	3,658 ppm (1.18)	366 ppm
Rat	Carpenter et al.1949	-----	4,000	4 hr	8,000 ppm (2.0)	800 ppm
Mouse	Izmerov et al. 1982	-----	263	2 hr	410 ppm (1.6)	41 ppm
Rat	Smyth 1956	LC_{100}: 4,000	-----	2-5 min	1,600-2,200 ppm (0.4/055)	160-220 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Cheever et al. 1982	oral	366	-----	843 ppm	84 ppm
Mouse	Trubko 1975	oral	430	-----	990 ppm	99 ppm
G. pig	Trubko 1975	oral	430	-----	990 ppm	99 ppm

Other animal data	Rats have survived a 4-hour exposure to 2,000 ppm [Cheever et al. 1982]. It has been stated that butylamine is more than twice as toxic as ethylamine by the respiratory route [ACGIH 1991].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 300 ppm
Basis for revised IDLH: The revised IDLH for n-butylamine is 300 ppm based on acute inhalation toxicity data in animals [AIHA 1960; Smyth 1956] and an analogy [ACGIH 1991] to ethylamine which has a revised IDLH of 600 ppm.

REFERENCES:

1. ACGIH [1991]. n-Butylamine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 176-177.
2. AIHA [1960]. n-Butylamine. In: Hygienic guide series. Am Ind Hyg Assoc J *21*:532-533.
3. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*(6):343-346.
4. Cheever KL, Richards DE, Plotnick HB [1982]. The acute oral toxicity of isomeric monobutylamines in the adult male and female rat. Toxicol Appl Pharmacol *63*:150-152.
5. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 28.

6. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*:129-185.
7. Terhaar CJ [?]. Personal communication to AIHA from the Laboratory of Industrial Medicine, Eastman Kodak Company, Rochester, NY. [From AIHA [1960]. n-Butylamine. In: Hygienic guide series. Am Ind Hyg Assoc J *21*:532-533.]
8. Trubko EI [1975]. Investigations on hygienic standardization of n-butylamines in water bodies. Gig Sanit *40*(11):21-23 (in Russian).

tert-Butyl chromate

CAS number	1189-85-1
NIOSH REL	0.001 mg Cr(VI)/m^3 TWA; NIOSH considers tert-butyl chromate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.1 mg CrO_3/m^3 CEILING [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg CrO_3/m^3 CEILING [skin]
Description of Substance	Liquid.
LEL	Unknown
Original (SCP) IDLH	30 mg CrO_3/m^3
Basis for original (SCP) IDLH	Very little toxicological data are available concerning the effects produced by exposure to tert-butyl chromate. Because AIHA [1965] reported that the severity of the health hazard is low for acute exposure to chromic acid, by analogy it is assumed that the hazard is also low for acute exposure to tert-butyl chromate. Therefore, the chosen IDLH is based on an analogy with chromic acid and chromates, which has an IDLH of 30 mg/m^3 (as CrO_3).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 15 mg Cr(VI)/m^3 [Unchanged]
Basis for revised IDLH: Due to the lack of toxicity data specifically for tert-butyl chromate, the revised IDLH for tert-butyl chromate is 15 mg Cr(VI)/m^3 (which is roughly equivalent to the original IDLH of 30 mg CrO_3/m^3) based on an analogy to chromic acid and other chromates which have a revised IDLH of 15 mg Cr(VI)/m^3. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for tert-butyl chromate at concentrations above 0.001 mg Cr(VI)/m^3.]

REFERENCE

1. AIHA [1965]. Chromic acid. In: Hygienic guide series. Reprinted in 1965 by the American Industrial Hygiene Association.

n-Butyl glycidyl ether

CAS number	2426-08-6
NIOSH REL	5.6 ppm (30 mg/m³) 15-minute CEILING
Current OSHA PEL	50 ppm (270 mg/m³) TWA
1989 OSHA PEL	25 ppm (135 mg/m³) TWA
1993-1994 ACGIH TLV	25 ppm (133 mg/m³) TWA
Description of Substance	Colorless liquid with an irritating odor.
LEL	Unknown
Original (SCP) IDLH	3,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that the mouse 4-hour LC_{50} was greater than 3,500 ppm [Hine et al. 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hine et al. 1956	>3,500	-----	4 hr	>7,000 ppm (2.0)	>700 ppm
Rat	Hine et al. 1956	1,030	-----	8 hr	2,575 ppm (2.5)	258 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Hine et al. 1956	oral	1,530	-----	1,980 ppm	198 ppm
Rat	Smyth et al. 1962	oral	2,050	-----	2,652 ppm	265 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 250 ppm
Basis for revised IDLH: The revised IDLH for n-butyl glycidyl ether is 250 ppm based on acute inhalation toxicity data in animals [Hine et al. 1956]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. n-Butyl glycidyl ether (BGE). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 33.
2. Hine CH, Kodama JK, Wellington JS, Dunlap MK, Anderson HH [1956]. The toxicology of glycidol and some glycidyl ethers. AMA Arch Ind Health *14*:250-264.
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J *23*:95-107.

n-Butyl mercaptan

CAS number	109-79-5
NIOSH REL	0.5 ppm (1.8 mg/m³) 15-minute CEILING
Current OSHA PEL	10 ppm (35 mg/m³) TWA
1989 OSHA PEL	0.5 ppm (1.5 mg/m³) TWA
1993-1994 ACGIH TLV	0.5 ppm (1.8 mg/m³) TWA
Description of Substance	Colorless liquid with a strong, garlic-, cabbage-, or skunk-like odor.
LEL	Unknown
Original (SCP) IDLH	2,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 4-hour LC_{50} of 2,500 ppm [Fairchild and Stokinger 1958] cited by ACGIH [1971]. It was also chosen to make the IDLH for butyl mercaptan consistent with the IDLH of 2,500 ppm for ethyl mercaptan, a compound with similar acute toxicity.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Fairchild and Stokinger 1958	4,020	-----	4 hr	8,040 ppm (2.0)	804 ppm
Mouse	Fairchild and Stokinger 1958	2,500	-----	4 hr	5,000 ppm (2.0)	500 ppm
Dog	Marhold 1986	770	-----	30 min	770 ppm (1.0)	77 ppm

Human data .... Accidental exposure for 1 hour to an estimated concentration of 50 to 500 ppm has been reported to cause muscular weakness, malaise, sweating, nausea, vomiting, headache, and confusion [Gobbato and Terribile 1968].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for n-butyl mercaptan is 500 ppm based on acute inhalation toxicity data in workers [Gobbato and Terribile 1968] and animals [Fairchild and Stokinger 1958], and to be consistent with ethyl mercaptan which has a revised IDLH of 500 ppm.

REFERENCES:

1. ACGIH [1971]. n-Butyl mercaptan (n-butanethiol). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 34.
2. Fairchild EJ II, Stokinger HE [1958]. Toxicologic studies on organic sulfur compounds. I. Acute toxicity of some aliphatic and aromatic thiols (mercaptans). Am Ind Hyg Assoc J *19*:171-189.
3. Gobbato F, Terribile PM [1968]. Toxicological properties of mercaptans. Folia Medica *51*:329-341. [From ACGIH [1991]. n-Butyl mercaptan. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 183-184.]
4. Marhold J [1986]. Prehled prumyslove toxikologie: organicke latky. Prague, Czechoslovakia: Avicenum, p. 982 (in Czechoslovakian).

p-tert-Butyltoluene

CAS number	98-51-1
NIOSH REL	10 ppm (60 mg/m^3) TWA, 20 ppm (120 mg/m^3) STEL
Current OSHA PEL	10 ppm (60 mg/m^3) TWA
1989 OSHA PEL	10 ppm (60 mg/m^3) TWA, 20 ppm (120 mg/m^3) STEL
1993-1994 ACGIH TLV	1 ppm (6.1 mg/m^3) TWA
Description of Substance	Colorless liquid with a distinct aromatic odor, somewhat like gasoline.
LEL	Unknown
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the female rat 1-hour LC_{50} of 934 ppm reported by Hine et al. [1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hine et al. 1954	934	-----	1 hr	1,168 ppm (1.25)	117 ppm
Rat	Hine et al. 1954	734	-----	2 hr	1,174 ppm (1.6)	117 ppm
Rat	Hine et al. 1954	248	-----	4 hr	496 ppm (2.0)	50 ppm
Rat	Hine et al. 1954	165	-----	8 hr	413 ppm (2.5)	41 ppm
Mouse	Hine et al. 1954	248	-----	4 hr	496 ppm (2.0)	50 ppm

Other animal data	RD_{50} (mouse), 360 ppm [Nielsen and Alarie 1982].
Human data	Giddiness and altered respiration have been reported in volunteers exposed to 160 ppm for 15 minutes [Hine et al. 1954].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for p-tert-butyltoluene is 100 ppm based on acute inhalation toxicity data in humans [Hine et al. 1954].

REFERENCES:

1. Hine CH, Ungar H, Anderson HH, Kodama JK, Critchlow JK, Jacobsen NW [1954]. Toxicological studies on p-tertiary-butyltoluene. AMA Arch Ind Hyg Occup Med 9:227-244.
2. Nielsen GD, Alarie Y [1982]. Sensory irritation, pulmonary irritation, and respiratory stimulation by airborne benzene and alkylbenzenes: prediction of safe industrial exposure levels and correlation of their thermodynamic properties. Toxicol Appl Pharmacol 65:459-477.

Cadmium compounds (as Cd)

CAS number	7440-43-9 (Metal)
NIOSH REL	None established; NIOSH considers cadmium compounds to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.005 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.01 mg/m³ (total dust) TWA, 0.002 mg/m³ (respirable dust) TWA, A2
Description of Substance	Varies
Original (SCP) IDLH for cadmium dust	50 mg Cd/m³
Basis for original (SCP) IDLH	Data on the dose-response relationship for cadmium are scarce and uncertain. Friberg et al. [1974] reported a rabbit 30-minute LC_{50} of about 8,000 mg-min/m³ (mg-min/m³ is the product of the concentration in mg/m³ and the exposure time in minutes); this represents a concentration of about 266 mg/m³ for 30 minutes. As serious irreversible renal cortical changes can precede death when renal cortical concentrations exceed 0.4 mg/g (tissue wet-weight), an IDLH of 50 mg/m³ is appropriate. This concentration would result in a human lung cadmium burden in 30 minutes of no more than 8 or 9 mg. This concentration is approximately that at which incipient morphologic changes occur in the kidneys of cadmium-exposed workers.
Original (SCP) IDLH for Cadmium fume	9 mg Cd/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that an exposure to 9 mg/m³ cadmium fume for 5 hours is a lethal dose [Beton et al. 1966]. AIHA [1962] reported that the lethal dose (single exposure) for man of thermally-generated cadmium oxide fume is not over 2,900 mg-min/m³ [Barrett and Card 1947] (mg-min/m³ is the product of the concentration in mg/m³ and the exposure time in minutes); this represents a concentration of about 50 mg/m³ for 1 hour. The concentration of 50 mg/m³ has not been chosen as the IDLH, however, because AIHA [1962] also reported that the doses which caused incapacitation must have been considerably lower [Barrett and Card 1947].
Short-term exposure guidelines	None developed

Cadmium compounds (as Cd) (continued)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cd:						
Rat	Yoshikawa and Homma 1974	25 mg/m³	----	30 min	25 mg Cd/m³ (1.0)	2.5 mg Cd/m³
CdO:						
Rat	Barrett et al. 1947	500 mg/m³	----	10 min	304 mg Cd/m³ (0.69)	30 mg Cd/m³
Rabbit	Barrett et al. 1947	2,500 mg/m³	----	10 min	1,518 mg Cd/m³ (0.69)	152 mg Cd/m³
G. pig	Barrett et al. 1947	3,500 mg/m³	----	10 min	2,125 mg Cd/m³ (0.69)	213 mg Cd/m³
Dog	Barrett et al. 1947	4,000 mg/m³	----	10 min	2,429 mg Cd/m³ (0.69)	243 mg Cd/m³
Rat	Gates et al. 1946	780 mg/m³	----	10 min	473 mg Cd/m³ (0.69)	47 mg Cd/m³
Mouse	Gates et al. 1946	340 mg/m³	----	10 min	206 mg Cd/m³ (0.69)	21 mg Cd/m³
Rabbit	Gates et al. 1946	3,000 mg/m³	----	15 min	2,086 mg Cd/m³ (0.79)	209 mg Cd/m³
G. pig	Gates et al. 1946	3,000 mg/m³	----	15 min	2,086 mg Cd/m³ (0.79)	209 mg Cd/m³
Dog	Gekkan Yakuji 1980	400 mg/m³	----	10 min	243 mg Cd/m³ (0.69)	24 mg Cd/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Cd:						
Rat	Kotsonis and Klaasen 1977	oral	225	-----	1,575 mg/m³	158 mg Cd/m³
Mouse	Tarasenko 1978	oral	890	-----	6,230 mg/m³	623 mg Cd/m³
CdO:						
Rat	Gekkan 1980	oral	72	-----	444 mg/m³	44 mg Cd/m³
Mouse	Tarasenko 1978	oral	72	-----	444 mg/m³	44 mg Cd/m³
$CdCl_2$:						
Mouse	Engstrom 1981	oral	60	-----	689 mg/m³	69 mg Cd/m³
Rat	Lehman 1951	oral	88	-----	376 mg/m³	38 mg Cd/m³

Other animal data .... A rabbit 30-minute LC_{50} of about 8,000 mg-min/m³ for cadmium dust has been reported [Friberg et al. 1974], which is equivalent to about 250 mg Cd/m³ for 30 minutes.

Human data .... It has been reported that exposure to 9 mg/m³ of cadmium fume for 5 hours is a lethal dose [Beton et al. 1966]. Fatalities have resulted from exposures to concentrations estimated to be 40 to 50 mg/m³ for 1 hour [Barrett and Card 1947; Bulmer et al. 1938; Reinl 1961]. The lethal dose of thermally generated cadmium oxide fume of not more than 2,900 mg-min/m³ has been reported [Barrett and Card 1947], which is equivalent to about 85 mg Cd/m³ for 30 minutes. It has been reported that 39 mg Cd/m³ was a fatal exposure after 20 minutes [Zavon and Meadows 1970].

Revised IDLH: 9 mg Cd/m³
Basis for revised IDLH: Based on acute inhalation toxicity data in workers [Barrett and Card 1947; Beton et al. 1966; Bulmer et al. 1938; Reinl 1961; Zavon and Meadows 1970], the revised IDLH for cadmium compounds is 9 mg Cd/m³ which was the original IDLH for cadmium fume. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for cadmium compounds at any detectable concentration.]

Cadmium compounds (as Cd) (continued)

REFERENCES:

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14. Tarasenko NY, ed. [1976]. Aktual'nye Problemy Gigieny Truda (Current Problems of Labor Hygiene) Moscow: Pervyi Moskovski Meditsinskii Institute, p. 14 (in Russian).
15. Yoshikawa H, Homma K [1974]. Toxicity of inhaled metallic cadmium fumes in rats. Sangyo Igaku (Japanese Journal of Industrial Health) *16*:212-215 (in Japanese).
16. Zavon MR, Meadows CD [1970]. Vascular sequelae to cadmium fume exposure. Am Ind Hyg Assoc J *31*(2):180-182.

Calcium arsenate (as As)

CAS number	7778-44-1
NIOSH REL	0.002 mg/m³ 15-minute CEILING; NIOSH considers calcium arsenate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.010 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.01 mg/m³ TWA, A1
Description of Substance	Colorless to white, odorless solid.
LEL	Noncombustible Solid
Original (SCP) IDLH	100 mg As/m³
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available for calcium arsenate, the chosen IDLH is based on an analogy with arsenic and compounds (as As) which has an IDLH of 100 mg As/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Back et al. 1972	oral	812	-----	2,103 mg As/m³	210 mg As/m³
Rat	Lehman 1951	oral	20	-----	52 mg As/m³	5.2 mg As/m³
Mouse	MacEwen and Vernot 1972	oral	794	-----	2,056 mg As/m³	206 mg As/m³
Rabbit	Muehlberger 1930	oral	50	-----	132 mg As/m³	13 mg As/m³
Dog	Perkow 1971/1976	oral	38	-----	98 mg As/m³	9.8 mg As/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5 mg As/m³

Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for calcium arsenate. Therefore, the revised IDLH for calcium arsenate is 5 mg As/m³ based on acute oral toxicity data in animals [Lehman 1951] and to be consistent with the revised IDLH for other inorganic arsenic compounds which have a revised IDLH of 5 mg As/m³. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for calcium arsenate at concentrations above 0.002 mg As/m³. OSHA currently requires in 29 CFR 1919.1018 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 20 mg As/m³ (i.e., 2,000 × the PEL).]

REFERENCES:

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4. Muehlberger CW [1930]. Toxicity studies of fluorine insecticides. J Pharmacol Exp Ther *39*:246-248.
5. Perkow W [1971/1976]. Wirksubstanzen der Pflanzenschytz and Schadlingsbekampfungsmittel. Berlin, Germany: Verlag Paul Parey (in German).

Calcium oxide

CAS number	1305-78-8
NIOSH REL	2 mg/m³ TWA
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 mg/m³ TWA
Description of Substance	White or gray, odorless lumps or granular powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 250 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for calcium oxide. Because Patty [1963] reported that inhalation of the dust can cause chemical pneumonia and severe respiratory tract irritation, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 50 × the OSHA PEL of 5 mg/m³ (i.e., 250 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 250 mg/m³. The available toxicological data indicate that severe respiratory irritation could inhibit escape.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	Strong nasal irritation has been reported to result from exposures to about 25 mg/m³, but exposures to 9 to 10 mg/m³ resulted in no observable irritation [ACGIH 1991].

Revised IDLH: 25 mg/m³
Basis for revised IDLH: The revised IDLH for calcium oxide is 25 mg/m³ based on acute inhalation toxicity data in humans [ACGIH 1991]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 25 mg/m³.

REFERENCES:

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2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 863.

Camphor (synthetic)

CAS number 76-22-2
NIOSH REL .... 2 mg/m^3 TWA
Current OSHA PEL .... 2 mg/m^3 TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 12 mg/m^3 (2 ppm) TWA, 19 mg/m^3 (3 ppm) STEL
Description of Substance .... Colorless or white crystals with a penetrating, aromatic odor.
LEL.. 0.6% (10% LEL, 3,600 mg/m^3)
Original (SCP) IDLH .... 200 mg/m^3
Basis for original (SCP) IDLH .... No data on acute inhalation toxicity are available on which to base an IDLH for camphor. For this draft technical standard, therefore, the chosen IDLH is based on a report by Gronka et al. [1969] concerning the camphor processing and packaging area of a plant. Concentrations of camphor ranging from 3 to 194 mg/m^3 produced nose and sinus irritation among workers in this plant [Gronka et al. 1969].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Nikolaeva 1957	-----	400 mg/m^3	3 hr	720 mg/m^3 (1.8)	72 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Flury and Zernik 1935	oral	-----	800	5,600 mg/m^3	560 mg/m^3
Mouse	Horikawa and Okada 1975	oral	1,310	-----	9,170 mg/m^3	917 mg/m^3
Rabbit	Smith and Margolis 1954	oral	-----	2,000	14,000 mg/m^3	1,400 mg/m^3

Human data .... It has been reported that concentrations during camphor processing and packaging ranged from 33 to 194 mg/m^3; workers had no complaints other than slight eye irritation and afternoon drowsiness [Gronka et al. 1969].

Revised IDLH: 200 mg/m^3 [Unchanged]
Basis for revised IDLH: Based on chronic inhalation toxicity data in workers [Gronka et al. 1969], the original IDLH for synthetic camphor (200 mg/m^3) is not being revised at this time.

REFERENCES:

1. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German).
2. Gronka PA, Bobkoski RL, Tomchick GJ, Rakow AB [1969]. Camphor exposures in a packaging plant. Am Ind Hyg Assoc J *30*:276-279.
3. Horikawa E, Okada T [1975]. Experimental study on acute toxicity of phenol camphor. Shika Gakuho (Journal of Dentistry) *75*:934-939 (in Japanese).
4. Nikolaeva [1957]. Toxicological evaluation of camphor vapors. Gig Sanit *22*(11):83-86 (in Russian).
5. Smith AG, Margolis G [1954]. Camphor poisoning: anatomical and pharmacologic study; report of a fatal case; experimental investigation of protective action of barbiturate. Am J Pathol *30*(5):857-868.

Carbaryl

CAS number	63-25-2
NIOSH REL	5 mg/m^3 TWA
Current OSHA PEL	5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m^3 TWA
Description of Substance	White or gray, odorless solid.
LEL	Noncombustible Solid
Original (SCP) IDLH	600 mg/m^3
Basis for original (SCP) IDLH	Because no useful data on acute inhalation toxicity are available for carbaryl, the chosen IDLH is based on the rat oral LD_{50} of 89 mg/kg [Boyd and Taylor 1971 cited by NIOSH 1974]. In addition, ACGIH [1971] reported that female rats may occasionally be killed by a single oral dose of 100 mg/kg [Gaines 1969].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	AAPCO 1966	oral	710	-----	4,970 mg/m^3	497 mg/m^3
G. pig	Benson and Dorough 1984	oral	250	-----	1,750 mg/m^3	175 mg/m^3
Dog	Buck 1979	oral	759	-----	5,313 mg/m^3	531 mg/m^3
Rat	Gaines 1960	oral	850	-----	5,950 mg/m^3	595 mg/m^3
Rat	Gaines 1960	oral	500	-----	3,500 mg/m^3	350 mg/m^3
Cat	Gig Sanit 1967	oral	150	-----	1,050 mg/m^3	105 mg/m^3
Mouse	Stevens et al. 1972	oral	128	-----	896 mg/m^3	90 mg/m^3
Rat	Weiss and Orzel 1967	oral	230	-----	1,610 mg/m^3	161 mg/m^3

Other animal data	A concentration of about 75 mg/m^3 produced typical poisoning in dogs within 5 hours [Carpenter et al. 1961].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg/m^3
Basis for revised IDLH: The revised IDLH for carbaryl is 100 mg/m^3 based on acute toxicity data in animals [Carpenter et al. 1961; Gig Sanit 1967; Stevens et al. 1972].

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of American Pesticide Control Officials, Inc., p. 192.
2. ACGIH [1971]. Carbaryl (Sevin). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 37-38.
3. Benson WH, Dorough HW [1984]. Comparative ester hydrolysis of carbaryl and ethiofencarb in four mammalian species. Pest Biochem Physiol *21*:199-206.
4. Boyd EM, Taylor FI [1971]. Toxaphene toxicity in protein-deficient rats. Toxicol Appl Pharmacol *18*:158-167.
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8. Gaines TB [1969]. Acute toxicity of pesticides. Toxicol Appl Pharmacol *14*:515-534.
9. Gig Sanit [1967]; *32*(4):29-33 (in Russian).
10. NIOSH [1974]. FC59500. Carbamic acid, methyl-, 1-naphthyl ester. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 182.
11. Stevens JT, Stitzel RE, McPhillips JJ [1972]. Effects of anticholinesterase insecticides on hepatic microsomal metabolism. J Pharmacol Exp Ther *181*:576-583.
12. Weiss LH, Orzel RA [1967]. Some comparative toxicologic and pharmacologic effects of dimethyl sulfoxide as a pesticide solvent. Toxicol Appl Pharmacol *11*:546-557.

Carbon black

CAS number	1333-86-4
NIOSH REL	3.5 mg/m³ TWA; 0.1 mg PAHs/m³ TWA Note: NIOSH considers carbon black in the presence of polycyclic aromatic hydrocarbons (PAHs) to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	3.5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	3.5 mg/m³ TWA
Description of Substance	Black, odorless solid.
LEL	Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 1,750 mg/m³ - see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that an acute exposure to a high concentration of carbon black would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of carbon black, 500 × the OSHA PEL of 3.5 mg/m³ is 1,750 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None indicating that high concentrations of carbon black would have significant health effects to workers within 30 minutes.

Revised IDLH: 1,750 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of carbon black would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for carbon black is 1,750 mg/m³ based on being 500 times the NIOSH REL and OSHA PEL of 3.5 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Carbon dioxide

CAS number	124-38-9
NIOSH REL	5,000 ppm (9,000 mg/m³) TWA, 30,000 ppm (54,000 mg/m³) STEL
Current OSHA PEL	5,000 ppm (9,000 mg/m³) TWA
1989 OSHA PEL	10,000 ppm (18,000 mg/m³) TWA, 30,000 ppm (54,000 mg/m³) STEL
1993-1994 ACGIH TLV	5,000 ppm (9,000 mg/m³) TWA, 30,000 ppm (54,000 mg/m³) STEL
Description of Substance	Colorless, odorless gas.
LEL	Nonflammable Gas
Original (SCP) IDLH	50,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by ACGIH [1971] that a 30-minute exposure at 50,000 ppm produces signs of intoxication, and a few minutes of exposure at 70,000 ppm and 100,000 ppm produces unconsciousness [Flury and Zemik 1931]. AIHA [1971] reported that 100,000 ppm is the atmospheric concentration immediately dangerous to life. In addition, Hunter [1975] noted that exposure to 100,000 ppm for only a few minutes can cause loss of consciousness.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Human	Tab Biol Per 1933	-----	90,000	5 min	49,500 ppm (0.55)	4,950 ppm

Other human data .... Signs of intoxication have been produced by a 30-minute exposure at 50,000 ppm [Aero 1953], and a few minutes exposure at 70,000 to 100,000 ppm produces unconsciousness [Flury and Zemik 1931]. It has been reported that submarine personnel exposed continuously at 30,000 ppm were only slightly affected, provided the oxygen content of the air was maintained at normal concentrations [Schaefer 1951]. It has been reported that 100,000 ppm is the atmospheric concentration immediately dangerous to life [AIHA 1971] and that exposure to 100,000 ppm for only a few minutes can cause loss of consciousness [Hunter 1975].

Revised IDLH: 40,000 ppm
Basis for revised IDLH: The revised IDLH for carbon dioxide is 40,000 ppm based on acute inhalation toxicity data in humans [Aero 1953; Flury and Zemik 1931; Schaefer 1951].

REFERENCES:

1. ACGIH [1971]. Carbon dioxide. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 39.
2. Aero Medical Association [1953]. Committee on Aviation Toxicology, Blakiston, New York.
3. AIHA [1964]. Carbon dioxide. In: Hygienic guide series. Am Ind Hyg Assoc J 25:519-521.
4. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, pp. 218-219 (in German).
5. Hunter D [1975]. The diseases of occupations. 5th ed. London, England: Hodder and Stoughton, p. 618.
6. Schaefer KE [1951]. Studies of carbon dioxide toxicity. New London, CT: Navy Department, Bureau of Medicine and Surgery, Medical Research Laboratory, U.S. Naval Submarine Base, Vol. 10, Report No. 181, pp. 156-189.
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Carbon disulfide

CAS number 75-15-0
NIOSH REL .... 1 ppm (3 mg/m^3) TWA, 10 ppm (30 mg/m^3) STEL [skin]
Current OSHA PEL .... 20 ppm TWA, 30 ppm CEILING, 100 ppm 30-minute MAXIMUM PEAK
1989 OSHA PEL .... 4 ppm (12 mg/m^3) TWA, 12 ppm (36 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV .... 10 ppm (31 mg/m^3) TWA [skin]
Description of Substance .... Colorless to faint-yellow liquid with a sweet ether-like odor.
LEL .... 1.3% (10% LEL, 1,300 ppm)
Original (SCP) IDLH .... 500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement in Patty [1963] that symptoms occur after 30 minutes of exposure to 420 to 510 ppm [Flury and Zernik 1931]. AIHA [1956] reported that severe symptoms and unconsciousness may occur within 30 minutes at 1,100 ppm [Patty 1963]. Patty [1963] also reported that exposure of humans to 4,800 ppm for 30 minutes causes coma and may be fatal [Flury and Zernik 1931].
Existing short-term exposure guidelines: .... 1992 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 1 ppm (60-minute)
ERPG-2: 50 ppm (60-minute)
ERPG-3: 500 ppm (60-minute)

National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 200 ppm
30-minute EEGL: 100 ppm
60-minute EEGL: 50 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	AIHA 1992	>1,670	-----	1 hr	>2,088 ppm (1.25)	>208 ppm
Rat	AIHA 1992	15,500	-----	1 hr	19,375 ppm (1.25)	1,938 ppm
Rat	AIHA 1992	3,000	-----	4 hr	6,000 ppm (2.0)	600 ppm
Rat	AIHA 1992	3,500	-----	4 hr	7,000 ppm (2.0)	700 ppm
Rat	Izmerov et al. 1982	7,911	-----	2 hr	12,658 ppm (1.6)	1,266 ppm
Mouse	Izmerov et al. 1982	3,165	-----	2 hr	5,063 ppm (1.6)	506 ppm
Human	Lefaux 1968	-----	4,000	30 min	4,000 ppm (1.0)	400 ppm

Other animal data .... RD_{50} (mouse), >81,000 ppm [AIHA 1992].

Carbon disulfide (continued)

Other human data .... Symptoms have occurred after 30 minutes of exposure to concentrations ranging from 420 to 510 ppm while exposure to 4,800 ppm for 30 minutes causes coma and may be fatal [Flury and Zernik 1931]. Severe symptoms and unconsciousness may occur within 30 minutes at 1,100 ppm [Patty 1963]. It has been reported that 760 ppm causes an immediate headache that lasts for hours [Browning 1953]. It has also been reported that minor symptoms are induced after several hours of exposure to 300 ppm, distinct signs of poisoning at 400 ppm, severe poisoning after 30 minutes at 1,150 ppm, and life-threatening health effects at 3,200 to 3,600 ppm [Bittersohl et al. 1972]. It has been reported that exposure at 2,000 to 3,300 ppm leads to narcosis in 30 minutes, and death occurs after 30 to 60 minutes of exposure at 5,000 ppm [Paluch 1954].

Revised IDLH: 500 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Bittersohl et al. 1972; Browning 1953; Flury and Zernik 1931; Lefaux 1968], the original IDLH for carbon disulfide (500 ppm) is not being revised at this time.

REFERENCES:

1. AIHA [1956]. Carbon disulfide (carbon bisulfide). In: Hygienic guide series. Am Ind Hyg Assoc Q 17:446-447.
2. AIHA [1992]. Emergency response planning guidelines: carbon disulfide. Akron, OH: American Industrial Hygiene Association.
3. Bittersohl G, Ehrhardt W, Grund W, Grunewald A [1972]. Schwefelkohlenstoff. In: E. Kersten, ed., Franz Koelsch Handbuch der Berufserkrankungen. Jean, Germany: VEB Gustav Fischer Verlag, pp. 271-273 (in German).
4. Browning E [1953]. Toxicity of industrial solvents. New York, NY: Chemical Publishing Company, pp. 381-391.
5. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 299 (in German).
6. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 32.
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8. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 41-56.
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Carbon monoxide

CAS number 630-08-0
NIOSH REL .... 35 ppm (40 mg/m^3) TWA, 200 ppm (229 mg/m^3) CEILING
Current OSHA PEL .... 50 ppm (55 mg/m^3) TWA
1989 OSHA PEL .... 35 ppm (40 mg/m^3) TWA, 200 ppm (229 mg/m^3) CEILING
1993-1994 ACGIH TLV .... 25 ppm (29 mg/m^3) TWA
Description of Substance .... Colorless, odorless gas.
LEL....................................... 12.5% (10% LEL, 12,500 ppm)
Original (SCP) IDLH .... 1,500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that a 1-hour exposure to 1,000 to 1,200 ppm would cause unpleasant, but no dangerous symptoms [Henderson et al. 1921]. Patty [1963] also reported that 1,500 to 2,000 ppm might be a dangerous concentration for an exposure of 1 hour [Henderson et al. 1921].
Existing short-term exposure guidelines .... National Research Council [NRC 1987] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 1,500 ppm
30-minute EEGL: 800 ppm
60-minute EEGL: 400 ppm
24-hour EEGL: 50 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hartzell et al. 1985	8,636	-----	15 min	6,822 ppm (0.79)	682 ppm
Rat	Hartzell et al. 1985	5,207	-----	30 min	5,207 ppm (1.0)	521 ppm
Human	Lefaux 1968	-----	4,000	30 min	4,000 ppm (1.0)	400 ppm
Rat	Rose et al. 1970	1,784	-----	4 hr	3,568 ppm (2.0)	357 ppm
Mouse	Rose et al. 1970	2,414	-----	4 hr	4,828 ppm (2.0)	482 ppm
G. pig	Rose et al. 1970	5,647	-----	4 hr	11,294 ppm (2.0)	1,129 ppm
Human	Tab Biol Per 1933	-----	5,000	5 min	2,750 ppm (0.55)	275 ppm

Other animal data .... The median effective concentrations to produce incapacitation (EC_{50}s) in rats have been determined to be 2,667 ppm and 1,450 ppm in 15 and 30 minutes, respectively [Hartzell et al. 1985].
Other human data .... It has been stated that a 1-hour exposure to 1,000 to 1,200 ppm would cause unpleasant but no dangerous symptoms, but that 1,500 to 2,000 ppm might be a dangerous concentration after 1 hour [Henderson et al. 1921a, 1921b]. In general, a carboxyhemoglobin (COHb) level of 10-20% will only cause slight headaches [NIOSH 1972] and a COHb of 11-13% will have no effect on hand and foot reaction time, hand steadiness, or coordination [Stewart and Peterson 1970]. At a COHb of 35%, manual dexterity is impaired [Stewart 1975]. At 40% COHb, mental confusion, added to increasing incoordination, precludes driving an automobile [Stewart 1975]. A 30-minute exposure to 1,200 ppm will produce a COHb of 10-13% [NIOSH 1972].

Carbon monoxide (continued)

Revised IDLH: 1,200 ppm
Basis for revised IDLH: The revised IDLH for carbon monoxide is 1,200 ppm based on acute inhalation toxicity data in humans [Henderson et al. 1921a, 1921b; NIOSH 1972; Stewart and Peterson 1970].

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Carbon tetrachloride

CAS number	56-23-5
NIOSH REL	2 ppm (12.6 mg/m³) 60-minute STEL; NIOSH considers carbon tetrachloride to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	10 ppm TWA, 25 ppm CEILING, 200 ppm 5-min MAXIMUM PEAK in any 4 hours
1989 OSHA PEL	2 ppm (12.6 mg/m³) TWA
1993-1994 ACGIH TLV	5 ppm (31 mg/m³) TWA, 10 ppm (63 mg/m³) STEL [skin], A3
Description of Substance	Colorless liquid with a characteristic ether-like odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	300 ppm
Basis for original (SCP) IDLH	ACGIH [1971] reported that a severe case of human poisoning has been observed after a 3-hour exposure to concentrations ranging from 75 to 600 ppm and averaging about 210 ppm [Barnes and Jones 1967]. AIHA [1961] reported that exposures for 0.5 to 1 hour to 1,000 to 2,000 ppm have caused human fatalities from acute kidney damage [Fassett]. Kirk-Othmer [1964] reported that a 30-minute exposure to about 300 ppm causes symptoms of intoxication. Based on these data, an IDLH of 300 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Human	AAPCO 1966	-----	1,000	?	?	?
G. pig	Clayton 1967	-----	20,000	2 hr	32,807 ppm (1.64)	3,281 ppm
Cat	Flury and Zernik 1935	-----	38,110	2 hr	62,500 ppm (1.64)	6,250 ppm
Mammal	Gig Tr Prof Zabol 1980	5,400	-----	?	?	?
Rat	NPIRI 1974	8,000	-----	4 hr	16,800 ppm (2.10)	1,680 ppm
Mouse	Svirbely et al. 1947	9,526	-----	8 hr	25,625 ppm (2.69)	2,563 ppm
Human	Tab Biol Per 1933	-----	50,000	5 min	26,374 ppm (0.53)	2,637 ppm
Dog	von Oettingen 1949	-----	14,620	8 hr	39,328 ppm (2.69)	3,933 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.8 [ten Berge et al. 1986].

Other human data .... A severe case of poisoning was observed after a 3-hour exposure to concentrations ranging from 75 to 600 ppm and averaging about 210 ppm [Barnes and Jones 1967]. It has been reported that exposures to 1,000 to 2,000 ppm for 0.5 to 1 hour have caused human fatalities from acute kidney damage [AIHA 1961]. It has also been reported that a 30-minute exposure to about 300 ppm causes symptoms of intoxication [Kirk-Othmer 1964].

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for carbon tetrachloride is 200 ppm based on acute inhalation toxicity data in humans [AIHA 1961; Barnes and Jones 1967; Kirk-Othmer 1964]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for carbon tetrachloride at concentrations above 2 ppm.]

Carbon tetrachloride (continued)

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2. ACGIH [1971]. Carbon tetrachloride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 43-44.
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Chlordane

CAS number 57-74-9
NIOSH REL .... 0.5 mg/m³ TWA [skin]; NIOSH considers chlordane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.5 mg/m³ TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.5 mg/m³ TWA [skin]
Description of Substance .... Amber-colored, viscous liquid with a pungent, chlorine-like odor.
LEL .... Noncombustible Liquid
Original (SCP) IDLH .... 500 mg/m³
Basis for original (SCP) IDLH .... No useful data on acute inhalation toxicity are available on which to base the IDLH for chlordane. For this draft technical standard, therefore, the chosen IDLH has been estimated from the fatal oral dose to an adult of 6 to 60 grams reported by the Pennsylvania Department of Environmental Resources [1969].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	AAPCO 1966	oral	100	-----	700 mg/m³	70 mg/m³
Rat	Ambrose et al. 1953	oral	590	-----	4,130 mg/m³	413 mg/m³
Mouse	Ambrose et al. 1953	oral	430	-----	3,010 mg/m³	301 mg/m³
Rabbit	Ambrose et al. 1953	oral	300	-----	2,100 mg/m³	210 mg/m³
Mouse	PCRB 1966	oral	145	-----	1,015 mg/m³	102 mg/m³
Hamster	Truhaut et al. 1974	oral	1,720	-----	12,040 mg/m³	1,204 mg/m³
Rat	von Schwabe and Wendling 1967	oral	200	-----	1,400 mg/m³	140 mg/m³

Human data .... The fatal oral dose has been estimated to be about 6 grams [Derbes et al. 1955] or to range from 6 to 60 grams [Pennsylvania 1969]. [Note: An oral dose of 6 grams is equivalent to a worker being exposed to about 4,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for chlordane. Therefore, the revised IDLH for chlordane is 100 mg/m³ based on acute oral toxicity data in humans [Derbes et al. 1955; Pennsylvania 1969] and animals [AAPCO 1966; PCRB 1966; von Schwabe and Wendling 1967]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chlordane at concentrations above 0.5 mg/m³.]

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Chlorinated camphene

CAS number	8001-35-2
NIOSH REL	None established; NIOSH considers chlorinated camphene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	0.5 mg/m³ TWA, 1 mg/m³ STEL [skin]
1993-1994 ACGIH TLV	0.5 mg/m³ TWA, 1 mg/m³ STEL [skin]
Description of Substance	Amber, waxy solid with a mild, piney, chlorine- and camphor-like odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	200 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH has been estimated from the statement by Patty [1963] from the Council on Pharmacy and Chemistry [1952], Deichmann and Gerarde [1969], Stolman [1969], Thienes and Haley [1972], and Sax [1968] that the human oral lethal dose is about 2 to 7 grams.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Wermer 1952	-----	2,000 mg/m³	2 hr	3,200 mg/m³ (1.6)	320 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Hartley and Kidd 1983-86	oral	75	-----	525 mg/m³	53 mg/m³
Mouse	Kenaga and Morgan 1978	oral	112	-----	784 mg/m³	78 mg/m³
G. pig	Perkow 1971/76	oral	250	-----	1,750 mg/m³	175 mg/m³
Rat	von Schwabe and Wendling 1967	oral	50	-----	350 mg/m³	35 mg/m³

Human data: No toxic responses were noted in 25 volunteers exposed to 500 mg/m³ for 30 minutes/day for 10 consecutive days [Shelansky 1947]. The oral lethal dose has been reported to be about 2 to 7 grams [Thienes and Haley 1972]. [Note: An oral dose of 2 to 7 grams is equivalent to a worker being exposed to about 1,300 to 4,700 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 200 mg/m³ [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Shelansky 1947], a value of about 500 mg/m³ would have been appropriate. However, the original IDLH of 200 mg/m³ is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chlorinated camphene at any detectable concentration.]

REFERENCES:

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12. Werner PL [1952]. Pharmacological properties of toxaphene, a chlorinated hydrocarbon insecticide. JAMA *149*:1135-1137.

Chlorinated diphenyl oxide

CAS number	31242-93-0
NIOSH REL	0.5 mg/m^3 TWA
Current OSHA PEL	0.5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m^3 TWA
Description of Substance	Light-yellow, very viscous, waxy liquid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 5 mg/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	No quantitative data are available concerning the toxic effects produced by the inhalation of chlorinated diphenyl oxide. Therefore, for this draft technical standard, using an analogy with the chloronaphthalenes, the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 10 × the OSHA PEL of 0.5 mg/m^3 (i.e., 5 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 5 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$C_{12}H_9ClO$ G. pig	Clayton and Clayton 1981	oral	-----	600	4,200 mg/m^3	420 mg/m^3
$C_{12}H_8Cl_2O$ G. pig	Clayton and Clayton 1981	oral	-----	1,000	7,000 mg/m^3	700 mg/m^3
$C_{12}H_7Cl_3O$ G. pig	Clayton and Clayton 1981	oral	-----	1,200	8,400 mg/m^3	840 mg/m^3
$C_{12}H_6Cl_4O$ G. pig	Clayton and Clayton 1981	oral	-----	50	350 mg/m^3	35 mg/m^3
$C_{12}H_5Cl_5O$ G. pig	Clayton and Clayton 1981	oral	-----	100	700 mg/m^3	70 mg/m^3
Rabbit	Hofmann 1957	oral	-----	0.3	2.1 mg/m^3	0.2 mg/m^3
$C_{12}H_4Cl_6O$ G. pig	Clayton and Clayton 1981	oral	-----	50	350 mg/m^3	35 mg/m^3
$C_{12}H_3Cl_7O$ Rat	NAS 1953	oral	-----	500	3,500 mg/m^3	350 mg/m^3
$C_{12}H_2Cl_8O$ Rat	NAS 1953	oral	-----	500	3,500 mg/m^3	350 mg/m^3
$C_{12}HCl_9O$ Rat	NAS 1953	oral	-----	500	3,500 mg/m^3	350 mg/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5 mg/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for chlorinated diphenyl oxide. Based on acute oral toxicity data in animals [Clayton and Clayton 1981], a value of about 35 mg/m^3 would have been appropriate for chlorinated diphenyl oxide. However, the revised IDLH for chlorinated diphenyl oxide is 5 mg/m^3 based on being 10 times the NIOSH REL and OSHA PEL of 0.5 mg/m^3 (10 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for chlorinated diphenyl oxide).

REFERENCES:

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2. Hofmann HT [1957]. Neuere erfahrungen mit hochtoxischen chlorkohlenwasserstoffen. Arch Exp Pathol Pharmakol *243*:228 (in German).
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Chlorine

CAS number	7782-50-5
NIOSH REL	0.5 ppm (1.45 mg/m³) 15-minute CEILING
Current OSHA PEL	1 ppm (3 mg/m³) CEILING
1989 OSHA PEL	0.5 ppm (1.5 mg/m³) TWA, 1 ppm (3 mg/m³) STEL
1993-1994 ACGIH TLV	0.5 ppm (1.5 mg/m³) TWA, 1 ppm (2.9 mg/m³) STEL
Description of Substance	Greenish-yellow gas with a pungent, irritating odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	30 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ILO [1971] that exposure to 30 ppm will cause intense coughing fits, and exposure to 40 to 60 ppm for 30 to 60 minutes or more may cause serious damage.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 3 ppm
24-hour EEGL: 0.5 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Back et al. 1972	293	-----	1 hr	357 ppm (1.22)	36 ppm
Mouse	Back et al. 1972	137	-----	1 hr	167 ppm (1.22)	17 ppm
G. pig	Lehmann 1887	-----	3,200	3 hr	5,342 ppm (1.67)	534 ppm
Human	Prentiss 1937	-----	858	30 min	858 ppm (1.0)	86 ppm
Human	Tab Biol Per 1933	-----	550	5 min	330 ppm (0.60)	33 ppm

*Note: Conversion factor (CF) was determined with "n" = 3.5 [ten Berge et al. 1986].

Other animal data	RD_{50} (mouse), 9.34 ppm [Alarie 1981].
Other human data	Exposures to 30 ppm have been reported to cause intense coughing fits and exposure to 40 to 60 ppm for 30 to 60 minutes or more may cause serious damage [ILO 1971]. A concentration of 34 to 51 ppm has been reported to be lethal in 1 to 1.5 hours [Freitag 1941] while 14 to 21 ppm has been suggested as being dangerous within 0.5 to 1 hour [NPIRI 1983].

Revised IDLH: 10 ppm
Basis for revised IDLH: The revised IDLH for chlorine is 10 ppm based on acute inhalation toxicity data in humans [Freitag 1941; ILO 1971; NPIRI 1983].

REFERENCES:

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Chlorine dioxide

CAS number 10049-04-4
NIOSH REL .... 0.1 ppm (0.3 mg/m^3) TWA, 0.3 ppm (0.9 mg/m^3) STEL
Current OSHA PEL .... 0.1 ppm (0.3 mg/m^3) TWA
1989 OSHA PEL .... 0.1 ppm (0.3 mg/m^3) TWA, 0.3 ppm (0.9 mg/m^3) STEL
1993-1994 ACGIH TLV .... 0.1 ppm (0.28 mg/m^3) TWA, 0.3 ppm (0.83 mg/m^3) STEL
Description of Substance .... Yellow to red gas or a red-brown liquid (below 52°F) with an unpleasant odor similar to chlorine and nitric acid.
LEL .... Unknown
Original (SCP) IDLH .... 10 ppm
Basis for original (SCP) IDLH .... AIHA [1958] reported that rats exposed repeatedly to about 10 ppm for 4 hours daily died, whereas those exposed to about 0.1 ppm, 5 hours daily for 10 weeks, showed no detectable effects [Dalhamn 1957]. AIHA [1958] also reported that animals survived 2-hour exposures to 20 ppm, though some species exhibited symptoms [Gloemme and Lundgren 1957].
Elkins [1950] stated that 5 ppm is definitely irritating and 2 cases of illness (1 fatal) resulted from exposure to less than 19 ppm. AIHA [1958] reported that delayed deaths occur in animals after single exposures to 150 to 200 ppm for less than 1 hour [Gloemme and Lundgren 1957]. Based on the data cited above, an IDLH of 10 ppm is chosen.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Dalhamn 1957	-----	260	2 hr	416 ppm (1.6)	42 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Abdel-Rahman et al. 1982	oral	292	-----	729 ppm	73 ppm

Human data .... It has been reported that 5 ppm is definitely irritating and that 19 ppm caused the death of one worker inside a tank (time of exposure was not specified) [Elkins 1950].

Revised IDLH: 5 ppm
Basis for revised IDLH: The revised IDLH is 5 ppm based on acute inhalation toxicity data in humans [Elkins 1950].

REFERENCES:

1. Abdel-Rahman MS, Gerges SE, Alliger H [1982]. Toxicity of alcide. J Appl Toxicol *2*(3):160-164.
2. AIHA [1958]. Chlorine dioxide. In: Hygienic guide series. Am Ind Hyg Assoc J *19*:261-262.
3. Dalhamn T [1957]. Chlorine dioxide: toxicity in animal experiments and industrial risks. AMA Arch Ind Health *15*(2):101-107.
4. Elkins HB [1950]. Chlorine dioxide, ClO_2. In: The chemistry of industrial toxicology. New York, NY: John Wiley & Sons, Inc., pp. 87-88.
5. Gloemme J, Lundgren KD [1957]. Health hazards from chlorine dioxide. AMA Arch Ind Health *16*:169-176.

Chlorine trifluoride

CAS number 7790-91-2
NIOSH REL .... 0.1 ppm (0.4 mg/m³) CEILING
Current OSHA PEL .... 0.1 ppm (0.4 mg/m³) CEILING
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.1 ppm (0.38 mg/m³) CEILING
Description of Substance .... Colorless gas or a greenish-yellow liquid (below 53°F) with a somewhat sweet, suffocating odor.
LEL .... Nonflammable Gas
Original (SCP) IDLH .... 20 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the following data presented by Horn and Weir [1955] concerning the inhalation toxicology of chlorine trifluoride. "Two dogs and 20 rats were exposed 6 hours/day for 2 days to 21 ppm. No mortality occurred among the animals, but during the first day's exposure, the dogs became nauseated, coughed up a small quantity of mucous material, and had rapid respiration and salivation. Both the rats and the dogs had a singed feel to their fur." This is probably a conservative IDLH because Deichmann and Gerarde [1969] made the statement that 50 ppm or more may be fatal in 0.5 to 2 hours.
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-min EEGL: 7 ppm
30-min EEGL: 3 ppm
60-min EEGL: 1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Dost et al. 1974	LC_{100}: 800	-----	15 min	632 ppm (0.79)	63 ppm
Rat	Dost et al. 1974	LC_{100}: 400	-----	35 min	420 ppm (1.05)	42 ppm
Rat	Horn and Weir 1955	95	-----	4 hr	190 ppm (2.0)	19 ppm
Mouse	MacEwen and Vernot 1970	178	-----	1 hr	223 ppm (1.25)	22 ppm
Monkey	MacEwen and Vernot 1970	230	-----	1 hr	288 ppm (1.25)	29 ppm
Rat	Vernot et al. 1977	299	-----	1 hr	374 ppm (1.25)	37 ppm

Other animal data .... No mortality occurred among 2 dogs and rats exposed to 21 ppm for 6 hours but the dogs became nauseated, coughed up a small amount of mucous material, and had rapid respiration and salivation [Horn and Weir 1955].
Human data .... It has been reported that 50 ppm or more may be fatal in 30 minutes to 2 hours [Deichmann and Gerarde 1969].

Revised IDLH: 20 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969] and animals [Horn and Weir 1955; MacEwen and Vernot 1970], the original IDLH for chlorine trifluoride (20 ppm) is not being revised at this time.

REFERENCES:

1. Deichmann WB, Gerarde HW [1969]. Chlorine trifluoride. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 651.
2. Dost FN, Reed DJ, Smith VN, Wang CH [1974]. Toxic properties of chlorine trifluoride. Toxicol Appl Pharmacol 27:527-536.

Chlorine trifluoride (continued)

3. Horn HJ, Weir RJ [1955]. Inhalation toxicology of chlorine trifluoride. AMA Arch Ind Health *12*:515-517.
4. MacEwen JD, Vernot CH [1970]. Toxic Hazards Research Unit annual technical report: 1970. Wright-Patterson Air Force Base, OH: Aerospace Medical Research Laboratory, Report AMRL-TR-70-77.
5. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 12-16.
6. Vernot EH, MacEwen JD, Haun CC, Kinkead ER [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol 42:417-423.

Chloroacetaldehyde

CAS number 107-20-0
NIOSH REL .... 1 ppm (3 mg/m³) CEILING
Current OSHA PEL .... 1 ppm (3 mg/m³) CEILING
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 1 ppm (3.2 mg/m³) CEILING
Description of Substance .... Colorless liquid with an acrid, penetrating odor.
LEL .... Unknown
Original (SCP) IDLH .... 100 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on an analogy with crotonaldehyde. Rinehart [1967] found 100 ppm crotonaldehyde to be a lethal concentration for rats for a 4-hour exposure; the LC_{50} for 30 minutes was 600 ppm. Human subjects found 45 ppm crotonaldehyde very disagreeable and conjunctival irritation was observed [Dow 1962 as cited by ACGIH 1971]. Based on the data cited above for crotonaldehyde, an IDLH of 100 ppm is chosen for chloroacetaldehyde.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	EPA 1987	200	-----	1 hr	250 ppm (1.25)	25 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Lawrence et al. 1972	oral	89	-----	191 ppm	19 ppm
Mouse	Lawrence et al. 1972	oral	82	-----	176 ppm	18 ppm

Human data .... Volunteers found 45 ppm to be very disagreeable and conjunctival irritation was observed [Dow 1962].

Revised IDLH: 45 ppm
Basis for revised IDLH: The revised IDLH for chloroacetaldehyde is 45 ppm based on acute inhalation toxicity data in humans [Dow 1962]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 45 ppm.

REFERENCES:

1. ACGIH [1971]. Crotonaldehyde. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 62-63.
2. Dow [1962]. Personal communication to a ACGIH TLV Committee member from the Dow Chemical Company, Biochemical Research Department.
3. EPA [1987]. TSCA section 8e submission and status report on chloroacetone and chloroacetaldehyde. Washington, DC: U.S. Environmental Protection Agency, Office of Toxic Substances, Report No. 8EHQ-0387-0660, April 22, 1987.
4. Lawrence WH, Dillingham EO, Turner JE [1972]. Toxicity profile of chloracetaldehyde. J Pharm Sci *61*:19-25.
5. Rinehart WE [1967]. The effect on rats of single exposures to crotonaldehyde vapor. Am Ind Hyg Assoc J *28*:561-566.

α-Chloroacetophenone

CAS number	532-27-4
NIOSH REL	0.3 mg/m³ (0.05 ppm) TWA
Current OSHA PEL	0.3 mg/m³ (0.05 ppm) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.32 mg/m³ (0.05 ppm) TWA
Description of Substance	Colorless to gray crystalline solid with a sharp, irritating odor.
LEL	Unknown
Original (SCP) IDLH	100 mg/m³
Basis for original (SCP) IDLH	ACGIH [1971] reported that the effective concentration to produce casualties as estimated from volunteer exposure is greater than 100 mg/m³. Deichmann and Gerarde [1969] reported that a fatality followed an exposure of less than 20 minutes to high concentrations of vapor (5.4 grams in a 34 m³ room, which is roughly equivalent to 160 mg/m³). Based on the data cited above, an IDLH of 100 mg/m³ is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Ballantyne and Swanston 1978	-----	417 mg/m³	15 min	329 mg/m³ (0.79)	33 mg/m³
Mouse	Ballantyne and Swanston 1978	-----	600 mg/m³	15 min	474 mg/m³ (0.79)	47 mg/m³
Rabbit	Ballantyne and Swanston 1978	-----	465 mg/m³	20 min	405 mg/m³ (0.87	41 mg/m³
G. pig	Ballantyne and Swanston 1978	-----	490 mg/m³	30 min	490 mg/m³ (1.0)	49 mg/m³
Human	Deichmann and Gerarde 1969	-----	159 mg/m³	20 min	138 mg/m³ (0.87)	14 mg/m³
Human	Prentiss 1937	-----	850 mg/m³	10 min	587 mg/m³ (0.69)	59 mg/m³

Other animal data	RD_{50} (mouse), 6.2 mg/m³ [Alarie 1981].
Other human data	It has been reported that 31 mg/m³ is intolerable after 3 minutes [Punte et al. 1962].

Revised IDLH: 15 mg/m³
Basis for revised IDLH: The revised IDLH for α-chloroacetophenone is 15 mg/m³ based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969; Punte et al. 1962].

REFERENCES:

1. ACGIH [1971]. alpha-Chloroacetophenone. In: Documentation of threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 48-49.
2. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect 42:9-13.
3. Ballantyne B, Swanston DW [1978]. The comparative acute mammalian toxicity of 1-chloroacetophenone (CN) and 2-chlorobenzylidene malononitrile (CS). Arch Toxicol 40:75-95.
4. Deichmann WB, Gerarde HW [1969]. Chloroacetophenone. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 163.
5. Prentiss AM [1937]. Chemicals in war. A treatise on chemical warfare. New York, NY: McGraw-Hill Book Company, Inc., pp. 142-144.
6. Punte CL, Ballard TA, Weimer JT [1962]. Inhalation studies with chloroacetophenone, diphenylaminochloroarsine and pelargonic morpholide. I. Animal exposures. Am Ind Hyg Assoc J 23:194-198.

Chlorobenzene

CAS number	108-90-7
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	75 ppm (350 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (46 mg/m³) TWA
Description of Substance	Colorless liquid with an almond-like odor.
LEL	1.3% (10% LEL, 1,300 ppm)
Original (SCP) IDLH	2,400 ppm
Basis for original (SCP) IDLH	AIHA [1964] reported that 8,000 ppm was fatal to cats in 30 minutes [Patty 1963; Flury and Zernik 1931]. Patty [1963] reported that the exposure of cats for 1 hour to 2,400 to 2,900 ppm causes unsteadiness, tremor, and twitching [Flury and Zernik 1931]. Based on the data cited above, an IDLH of 2,400 ppm is chosen for this draft technical standard.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Eastman 1978	LC_{47}: 22,000	-----	2.3 hr	36,520 ppm (1.66)	3,652 ppm
Rat	Eastman 1978	LC_{47}: 9,000	-----	3 hr	16,200 ppm (1.8)	1,620 ppm
Cat	Flury and Zernik 1931		8,000	3 hr	8,000 ppm (1.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Clayton and Clayton 1981	oral	2,290	-----	3,425 ppm	343 ppm
Rabbit	Clayton and Clayton 1981	oral	2,250	-----	3,365 ppm	337 ppm
Mouse	Izmerov et al. 1982	oral	2,300	-----	3,440 ppm	344 ppm
G. pig	Izmerov et al. 1982	oral	2,250	-----	3,365 ppm	337 ppm

Other animal data	RD_{50} (mouse), 1,054 ppm [DeCeaurriz et al. 1981].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for chlorobenzene is 1,000 ppm based on acute inhalation toxicity data in animals [DeCeaurriz et al. 1981; Flury and Zernik 1931].

REFERENCES:

1. AIHA [1964]. Chlorobenzene. In: Hygienic guide series. Am Ind Hyg Assoc J 25:97-99.
2. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. Vol. 2B. Toxicology. 3rd rev. ed. New York, NY: John Wiley & Sons, Inc., p. 3603.
3. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett 9:137-143.
4. Eastman Kodak Company [1978]. Toxicity and health hazard summary. Rochester, NY. [From ACGIH [1971]. Chlorobenzene. In: Documentation of threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 48-49.]
5. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 337 (in German).
6. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 34.
7. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1334.

o-Chlorobenzylidene malononitrile

CAS number	2698-41-1
NIOSH REL	0.05 ppm (0.4 mg/m³) CEILING [skin]
Current OSHA PEL	0.05 ppm (0.4 mg/m³) TWA
1989 OSHA PEL	0.05 ppm (0.4 mg/m³) CEILING [skin]
1993-1994 ACGIH TLV	0.05 ppm (0.39 mg/m³) CEILING [skin]
Description of Substance	White crystalline solid with a pepper-like odor.
LEL	Unknown
Original (SCP) IDLH	2 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the Army [1961] report that a 2-minute exposure to concentrations between 2 and 10 mg/m³ was considered "intolerable" by 6 of 15 persons. Grant [1974] reported that human volunteers have found concentrations greater than 10 mg/m³ to be extremely irritating, intolerable for more than 30 seconds because of burning and pain in the eyes and chest [Punte et al. 1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Ballantyne and Swanston 1978	-----	1,806 mg/m³	45 min	2,059 mg/m³ (1.14)	206 mg/m³
Mouse	Ballantyne and Swanston 1978	-----	2,753 mg/m³	20 min	2,643 mg/m³ (0.96)	264 mg/m³
Rabbit	Ballantyne and Swanston 1978	-----	1,802 mg/m³	10 min	1,243 mg/m³ (0.69)	124 mg/m³
G. pig	Ballantyne and Swanston 1978	-----	2,326 mg/m³	10 min	1,605 mg/m³ (0.69)	161 mg/m³

Other animal data	RD_{50}(mouse), 4.08 mg/m³ [Alarie 1981].
Human data	It has been reported that median incapacitating concentrations range from 12 to 20 mg/m³ after about 20 seconds of exposure [U.S. Depts of Army and Air Force 1963] and that a 2-minute exposure to concentrations between 2 and 10 mg/m³ was considered "intolerable" by 6 of 15 persons [Army 1961]. In another study, 3 of 4 volunteers exposed to 1.5 mg/m³ for 90 minutes developed headaches and 1 volunteer developed slight eye and nose irritation; human volunteers have found concentrations greater than 10 mg/m³ to be extremely irritating and intolerable for more than 30 seconds because of burning and pain in the eyes and chest [Punte et al. 1963]. Exposures above 14 mg/m³ for 1 hour produced extreme irritation, erythema, and vesication of the skin of volunteers [Weigand 1969].

Revised IDLH: 2 mg/m³ [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in human volunteers [Army 1961; Punte et al. 1963; U.S. Depts of Army and Air Force 1963; Weigand 1969], the original IDLH for o-chlorobenzylidene malononitrile (2 mg/m³) is not being revised at this time.

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Army [1961]. U.S. Army, Chemical Corps Safety Directive No. 385-12. Safety guide for processing, filling, handling and decontamination of CS and CS1. Edgewood Arsenal, MD: CML C SD-385-12, p. 4.
3. Ballantyne B, Swanston DW [1978]. The comparative acute mammalian toxicity of 1-chloroacetophenone (CN) and 2-chlorobenzylidene malononitrile (CS). Arch Toxicol *40*:75-95.
4. Grant WM [1974]. Toxicology of the eye. 2nd ed. Springfield, IL: C.C. Thomas, pp. 263-264.
5. Punte CL, Owens EJ, Gutentag PJ [1963]. Exposures to ortho-chlorobenzylidene malononitrile: controlled human exposures. Arch Environ Health *6*:366-374.
6. U.S. Departments of the Army and Air Force [1963]. Military chemistry and chemical agents. Washington, DC: Army Technical Manual TM3-215; Air Force Manual AFM 355-7, December 1963.
7. Weigand DA [1969]. Cutaneous reaction to the riot control agent CS. Milit Med *134*:437.

Chlorobromomethane

CAS number 74-97-5
NIOSH REL .... 200 ppm (1,050 mg/m^3) TWA
Current OSHA PEL .... 200 ppm (1,050 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 200 ppm (1,060 mg/m^3) TWA
Description of Substance .... Colorless to pale-yellow liquid with a chloroform-like odor.
LEL .... Noncombustible Liquid
Original (SCP) IDLH .... 5,000 ppm
Basis for original (SCP) IDLH .... Patty [1963] reported that light narcosis could be produced in animals at 3,000 ppm, and pulmonary edema and deaths during exposure at 27,000 ppm; delayed deaths occurred after exposure to 20,000 ppm [Comstock et al. 1953]. Patty [1963] also reported that guinea pigs survived 1-hour exposures but 1 of 3 guinea pigs died after 2-hour exposures to 8,000 to 10,000 ppm [Matson and Dufour 1948]. NIOSH [1974] cited 1,550 ppm as the mouse LC_{LO} [Svirbely et al. 1947]. Scheel (member of the Standards Completion Program Respirator Committee), in an evaluation of the work of Van Stee [1974], determined a cardiac toxicity concentration for chlorobromomethane of 7,000 ppm. Based on an evaluation of the toxicological data cited above, an IDLH of 5,000 ppm was chosen.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Comstock et al. 1952	-----	28,800	15 min	18,720 ppm (0.65)	1,872 ppm
Rat	Comstock and Oberst 1953	-----	29,000	15 min	18,850 ppm (0.65)	1,885 ppm
Mouse	Comstock and Oberst 1953	-----	27,000	15 min	17,550 ppm (0.65)	1,755 ppm
G. pig	Matson and Dufour 1948	LC_{57}: 27,000	-----	2 hr	47,600 ppm (2.38)	4,760 ppm
G. pig	Matson and Dufour 1948	LC_{47}: 27,000	-----	2 hr	19,040 ppm (2.38)	1,904 ppm
Mouse	Svirbely et al. 1947	3,000	-----	7 hr	15,600 ppm (5.2)	1,560 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.6 [ten Berge et al. 1986].

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Deichmann and Gerarde 1969	oral	5,000	-----	6,506 ppm	651 ppm
Mouse	Svirbely et al. 1947	oral	4,300	-----	5,595 ppm	560 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for chlorobromomethane is 2,000 ppm based on acute inhalation toxicity data in animals [Comstock et al. 1952; Comstock and Oberst 1953; Matson and Dufour 1948]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

Chlorobromomethane (continued)

REFERENCES:

1. Comstock C, Fogleman RW, Oberst FW [1953]. Acute narcotic effects of monochloro-monobromomethane vapor in rats. AMA Arch Ind Hyg Occup Med 7:526-528.
2. Comstock CC, MacNamee JK, Ozburn EE, Fogelman RW, Oberst FW [1952]. Monochloro-monobromomethane: inhalation toxicity, pathology, and symptomatology in rats and mice. Army Chemical Center, MD: Chemical Corps Medical Laboratories, Research Report #113.
3. Comstock CC, Oberst FW [1953]. Comparative inhalation toxicities of four halogenated hydrocarbons to rats and mice in the presence of gasoline fires. AMA Arch Ind Hyg Occup Med 7:157-167.
4. Deichmann WB, Gerarde HW [1969]. Methylene chlorobromide (bromochloromethane). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 390-391.
5. Matson AF, Dufour RE [1948]. The life hazards and nature of the products formed when chlorobromomethane extinguisher liquid is applied to fires. Chicago, Il: Underwriter's Laboratories Inc., Bulletin of Research No. 42, p. 19.
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8. Svirbely JL, Highman B, Alford WC, von Oettingen WF [1947]. The toxicity and narcotic action of mono-chloro-mono-bromo-methane with special reference to inorganic and volatile bromide in blood, urine and brain. J Ind Hyg Toxicol *29*:382-389.
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Chlorodiphenyl

CAS numbers .... 53469-21-9 (42% Cl); 11097-69-1 (54% Cl)

NIOSH REL .... 0.001 mg/m³ TWA; NIOSH considers chlorodiphenyl to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 42% Cl: 1 mg/m³ TWA [skin]; 54% Cl: 0.5 mg/m³ TWA [skin]

1989 OSHA PEL .... Same as current PEL

1993-1994 ACGIH TLV .... 1 mg/m³ TWA [skin]; 0.5 mg/m³ TWA [skin] (54% Cl)

Description of Substance .... Colorless to light-colored, viscous liquid with a mild, hydrocarbon odor.

LEL .... Noncombustible Liquid

Original (SCP) IDLH for chlorodiphenyl (42% Cl) .... 10 mg/m³

Basis for original (SCP) IDLH .... In the absence of any other toxicological data, the chosen IDLH is based on the human TC_{LO} (resulting in an irritant effect) of 10 mg/m³ [Elkins 1959 cited by NIOSH 1976].

Original (SCP) IDLH for chlorodiphenyl (54% Cl) .... 5 mg/m³

Basis for original (SCP) IDLH .... In the absence of human exposure data or data on acute animal exposure, data on chronic animal exposures were used to determine the IDLH. The chosen IDLH is based on inhalation exposure data reported by AIHA [1965] that indicated liver damage occurs in rats chronically exposed (7 hours/day for 83 exposures during 121 days) to 5.4 mg/m³ chlorodiphenyl (54% chlorine) [Treon et al. 1956].

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Chlorodiphenyl Mouse	Tanaka et al. 1969	oral	1,900	-----	13,300 mg/m³	1,330 mg/m³
Chlorodiphenyl (42% Cl) Rat	Bruckner et al. 1973	oral	4,250	-----	29,750 mg/m³	2,975 mg/m³
Chlorodiphenyl (54% Cl) Rat	Garihoff et al. 1981	oral	1,010	-----	7,070 mg/m³	707 mg/m³

Other animal data .... Chlorodiphenyl (42% Cl) had no discernable effects in cats, rabbits, guinea pigs, rats, and mice after 150 seven-hour exposures to 1.9 mg/m³ over 7 months [Treon et al. 1956]; 17 seven-hour exposures over 24 days at 8.6 mg/m³ also appeared to be noninjurious [Treon et al. 1956]. Slight, reversible, nonspecific liver injury was noted in cats, rabbits, guinea pigs, rats, and mice exposed to 1.5 mg/m³ of chlorodiphenyl (54% Cl) for 7 hours/day for 150 days; 5.4 mg/m³ resulted in more extensive but reversible liver damage [Treon et al. 1956].

Human data .... It has been reported that concentrations above 10 mg/m³ were unbearably irritating [Elkins 1959]. Several deaths due to atrophy of the liver have occurred among workers chronically exposed to the fumes of chlorodiphenyls and chloronaphthalenes [von Wedel et al. 1943].

Chlorodiphenyl (continued)

Revised IDLH: 5 mg/m³
Basis for revised IDLH: The revised IDLH for chlorodiphenyl is 5 mg/m³ based on acute inhalation toxicity data in humans [Elkins 1959] and animals [Treon et al. 1956]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chlorodiphenyl at concentrations above 0.001 mg/m³.]

REFERENCES:

1. AIHA [1965]. Chlorodiphenyls (containing 42% and 54% chlorine). In: Hygienic guide series. Am Ind Hyg Assoc J *26*:92-94.
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Chloroform

CAS number	67-66-3
NIOSH REL	2 ppm (9.78 mg/m^3) 60-minute STEL; NIOSH considers chloroform to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	50 ppm (240 mg/m^3) CEILING
1989 OSHA PEL	2 ppm (9.78 mg/m^3) TWA
1993-1994 ACGIH TLV	10 ppm (49 mg/m^3) TWA, A2
Description of Substance	Colorless liquid with a pleasant odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 1,024 ppm produced dizziness, intracranial pressure, and nausea after 7 minutes with definite after-effects [Lehmann and Flury 1943]. Also, Lehmann et al. [1936] reported that a 2-minute exposure to 1,107 ppm caused dizziness and vertigo. Because a person may become disoriented at concentrations greater than 1,000 ppm and be unable to escape, 1,000 ppm is chosen as the IDLH.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs): 1-hour EEGL: 100 ppm; 24-hour EEGL: 30 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Clayton 1967	-----	20,000	2 hr	32,000 ppm (1.6)	3,200 ppm
Rat	Lehmann and Flury 1943	9,617	-----	4 hr	19,235 ppm (2.0)	1,924 ppm
Cat	Lehmann et al. 1936	-----	7,056	4 hr	14,113 ppm (2.0)	1,411 ppm
Human	Tab Biol Per 1933	-----	25,000	5 min	13,750 ppm (0.55)	1,375 ppm

Other animal data .... It has been reported that inhalation of 10,000 ppm has produced clinical anesthesia [NIOSH 1974] and that exposure for 2 minutes to 1,107 ppm has caused dizziness and vertigo [Lehmann et al. 1936]. Workers exposed 4 hours/day to concentrations of 57 to 71 ppm complained of lassitude, loss of appetite, and nausea [Challen et al. 1958]. Exposures to 390 ppm were tolerated for 30 minutes without complaint, whereas 1,030 ppm resulted in dizziness, intracranial pressure, and nausea in 7 minutes, with headache for several hours [Lehmann and Flury 1943].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for chloroform is 500 ppm based on acute inhalation toxicity data in humans [Lehmann and Flury 1943]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chloroform at concentrations above 2 ppm.]

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1-Chloro-1-nitropropane

CAS number	600-25-9
NIOSH REL	2 ppm (10 mg/m³) TWA
Current OSHA PEL	20 ppm (100 mg/m³) TWA
1989 OSHA PEL	2 ppm (10 mg/m³) TWA
1993-1994 ACGIH TLV	2 ppm (10 mg/m³) TWA
Description of Substance	Colorless liquid with an unpleasant odor.
LEL	Unknown
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement in Patty [1963] that 1 of 2 guinea pigs died following a 1-hour exposure to 2,178 ppm; no rabbits died from this exposure, and no rabbits or guinea pigs died from a 1-hour exposure to 1,069 ppm [Machle et al. 1945].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Machle et al. 1945	2,178	-----	1 hr	2,723 ppm (1.25)	272 ppm
Rabbit	Machle et al. 1945	-----	389	6 hr	895 ppm (2.3)	90 ppm
Rabbit	Machle et al. 1945	LC_{100}: 2,574	-----	6 hr	5,920 ppm (2.3)	592 ppm
G. pig	Machle et al. 1945	-----	3,502	2 hr	5,603 ppm (1.6)	560 ppm
Mouse	Neklesova and Kudrina 1969	12,840	-----	3 hr	23,112 ppm (1.8)	2,311 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Machle et al. 1945	oral	-----	50	68 ppm	6.8 ppm
Rat	Marhold 1986	oral	-----	50	68 ppm	6.8 ppm
Mouse	Neklesova and Kudrina 1969	oral	510	-----	695 ppm	70 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 1-chloro-1-nitropropane is 100 ppm based on acute inhalation toxicity data in animals [Machle et al. 1945].

REFERENCES:

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2. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 596 (in Czechoslovakian).
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Chloropicrin

CAS number	76-06-2
NIOSH REL	0.1 ppm (0.7 mg/m^3) TWA
Current OSHA PEL	0.1 ppm (0.7 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.67 mg/m^3) TWA
Description of Substance	Colorless to faint-yellow, oily liquid with an intensely irritating odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	4 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Flury and Zernik [1931] cited in ACGIH [1971] and Patty [1963], and by Prentiss [1937] cited in ILO [1971] that a few seconds exposure to 4 ppm renders a man unfit for action. According to Patty [1963], a 10-minute exposure to 7.5 ppm is intolerable [Flury and Zernik 1931; Prentiss 1937]; therefore, a concentration this high might impede escape within 30 minutes.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Human	Deichmann and Gerarde 1969	-----	293	10 min	202 ppm (0.69)	20 ppm
Mouse	Okada et al. 1970	-----	340	1 min	109 ppm (0.32)	11 ppm
Cat	Ritlop 1939	-----	117	20 min	102 ppm (0.87)	10 ppm
Mouse	Sangyo Igaku 1973	9.7	-----	4 hr	19 ppm (2.0)	2 ppm
Rat	Sine 1993	117	-----	20 min	102 ppm (0.87)	10 ppm
Rat	Yoshida et al. 1991	14.4	-----	4 hr	29 ppm (2.0)	3 ppm

Other animal data	RD_{50} (mouse), 7.98 ppm [Alarie 1981].
Other human data	It has been reported that 4 ppm for a few seconds renders a worker unfit for activity and that a 10-minute exposure to 7.5 ppm is intolerable [Flury and Zernik 1931].

Revised IDLH: 2 ppm
Basis for revised IDLH: The revised IDLH for chloropicrin is 2 ppm based on acute inhalation toxicity data in workers [Flury and Zernik 1931] and animals [Sangyo Igaku 1973].

REFERENCES:

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6. Okada E, et al. [1970]. A study of chloropicrin intoxication. Nippon Naika Gakkai Zasshi (Journal of the Japanese Society of Internal Medicine) 59(11):1214 (in Japanese). [From ACGIH [1971]. Chloropicrin. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 54.]

7. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2082-2083.
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ß-Chloroprene

CAS number	126-99-8
NIOSH REL	1 ppm (3.6 mg/m^3) 15-minute CEILING; NIOSH considers ß-chloroprene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	25 ppm (90 mg/m^3) TWA [skin]
1989 OSHA PEL	10 ppm (35 mg/m^3) TWA [skin]
1993-1994 ACGIH TLV	10 ppm (36 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with a pungent, ether-like odor.
LEL	4.0% (10% LEL, 4,000 ppm)
Original (SCP) IDLH	400 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that no mice died from a 1-hour exposure to 277 ppm, but all mice died from a 1-hour exposure to 829.2 ppm [von Oettingen et al. 1936].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	3,207	-----	4 hr	6,414 ppm (2.0)	641 ppm
Mouse	von Oettingen et al. 1936	LC_{100}: 829	-----	1 hr	1,036 ppm (1.25)	104 ppm
Rabbit	von Oettingen et al. 1936	-----	1,052	8 hr	2,629 ppm (2.5)	263 ppm
Cat	von Oettingen et al. 1936	-----	350	8 hr	876 ppm (2.5)	88 ppm

Human data	Exposure to 973 ppm has resulted in nausea and giddiness in volunteers in 10 to 15 minutes [Nystrom 1948]. Extreme fatigue and unbearable chest pain has occurred following a month of exposure to concentrations ranging from 56 to 334 ppm [Nystrom 1948].

Revised IDLH: 300 ppm
Basis for revised IDLH: The revised IDLH for ß-chloroprene is 300 ppm based on acute inhalation toxicity data in humans [Nystrom 1948]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ß-chloroprene at concentrations above 1 ppm.]

REFERENCES:

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Chromic acid and chromates

CAS number	1333-82-0 (CrO_3)
NIOSH REL	0.001 mg Cr(VI)/m^3 TWA; NIOSH considers chromic acid and chromates to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.1 mg CrO_3/m^3 CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	Water soluble: 0.05 mg CrO_3/m^3 TWA; Certain water insoluble: 0.05 mg CrO_3/m^3 TWA, A1
Description of Substance	Varies
Original (SCP) IDLH	30 mg/m^3 (as CrO_3)
Basis for original (SCP) IDLH	Very little quantitative data are available concerning the acute toxicity produced by the inhalation of chromic acid and chromates. AIHA [1956] reported that both the short exposure tolerance to chromic acid and the atmospheric concentration immediately dangerous to life are unknown. The chosen IDLH is based on the statements by ILO [1971] that "a man exposed for several days to concentrations of chromic acid mist of about 20 to 30 mg/m^3 experienced cough, headache, dyspnea, and substernal pain; the signs persisted for 2 weeks. Another man working on the same process was similarly but less severely affected." No other useful data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$H_2CrO_4 \cdot 2Na$						
Rat	Gad et al. 1986	oral	51.9	-----	113 mg Cr(VI)/m^3	11 mg Cr(VI)/m^3
CrO_3						
Mouse	Chi J Prev Med 1980	oral	127	-----	462 mg Cr(VI)/m^3	46 mg Cr(VI)/m^3
Rat	Kobayashi et al. 1976	oral	80	-----	291 mg Cr(VI)/m^3	29 mg Cr(VI)/m^3

Human data: A worker exposed for several days to concentrations of chromic acid mist of about 20 to 30 mg/m^3 (equivalent to about 10 to 15 mg Cr(VI)/m^3) experienced cough, headache, dyspnea, and substernal pain; the signs persisted for 2 weeks [ILO 1971]. Another man working on the same process was similarly but less severely affected [ILO 1971]. The fatal oral dose of chromium has been reported to be 1 to 3 grams [Seiler et al. 1988]. [Note: An oral dose of 1 to 3 grams is equivalent to a 70-kg worker being exposed to 667 to 2,000 mg Cr(VI)/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 15 mg Cr(VI)/m^3 [Unchanged]
Basis for revised IDLH: Based on toxicity data in humans [ILO 1971; Seiler et al. 1988], the original IDLH for chromic acid and chromates is not being revised at this time. However, instead of 30 mg/m^3 (as CrO_3), the IDLH is being expressed as its equivalent, 15 mg Cr(VI)/m^3. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chromic acid and chromates at concentrations above 0.001 mg Cr(IV)/m^3.]

Chromic acid and chromates (continued)

REFERENCES:

1. AIHA [1956]. Chromic acid. In: Hygienic guide series. Am Ind Hyg Assoc Q *17*:233-234.
2. Chi J Prev Med [1980]; *14*:86-88 (in Chinese).
3. Gad SC, et al. [1986]. Acute toxicity of four chromate salts. Proceedings of the Chromium Symposium, pp. 43-58. In: DHHS/ATSDR Toxicological Profile for Chromium (Draft), p. 51.
4. ILO [1971]. Chromium, alloys, compounds. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 295-297.
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Chromium(II) compounds [as Cr(II)]

CAS number	Varies
NIOSH REL	0.5 mg/m³ TWA
Current OSHA PEL	0.5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA
Description of Substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 250 mg Cr(II)/m³ – see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] noted that early studies indicated trivalent chromium to be essentially nontoxic [Akatsuka and Fairhall 1934]. The available toxicological data show no evidence that an acute exposure to a high concentration of soluble chromous salts would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of chromium(II) compounds, 500 × the OSHA PEL of 0.5 mg Cr(II)/m³ is 250 mg Cr(II)/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$CrCl_2$ Rat	Smyth et al. 1969	oral	1,870	-----	5,528 mg Cr(II)/m³	553 mg Cr(II)/m³

Human data .... It has been reported that divalent chromium compounds (i.e., chromous salts) have a low order of toxicity and provide little industrial hazard [ACGIH 1971; Akatsuka and Fairhall 1934; Clayton and Clayton 1981].

Revised IDLH: 250 mg Cr(II)/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of chromium(II) compounds would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for chromium(II) compounds is 250 mg Cr(II)/m³ based on being 500 times the NIOSH REL of 0.5 mg Cr(II)/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. ACGIH [1971]. Chromium (as Cr). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 56.
2. Akatsuka K, Fairhall LT [1934]. The toxicology of chromium. J Ind Hyg 16:1-28
3. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 1593-1596.
4. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA, Nycum JS [1969]. Range-finding toxicity data: list VII. Am Ind Hyg Assoc J *30*:470-476.

Chromium(III) compounds [as Cr(III)]

CAS number	Varies
NIOSH REL	0.5 mg/m³ TWA
Current OSHA PEL	0.5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA
Description of Substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 250 mg Cr(III)/m³ – see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] noted that early studies indicated trivalent chromium to be essentially nontoxic [Akatsuka and Fairhall 1934]. The available toxicological data show no evidence that an acute exposure to a high concentration of soluble chromic salts would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of chromium(III) compounds, 500 × the OSHA PEL of 0.5 mg Cr(III)/m³ is 250 mg Cr(III)/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$CrCl_3$						
Rat	Gekkan Yakuji 1980	oral	1,870	-----	4,320 mg Cr(III)/m³	432 mg Cr(III)/m³
CrF_3						
G. pig	Gekkan Yakuji 1980	oral	150	-----	500 mg Cr(III)/m³	50 mg Cr(III)/m³
$Cr(NO_3)_3$						
Rat	Gekkan Yakuji 1980	oral	3,250	-----	4,961 mg Cr(III)/m³	496 mg Cr(III)/m³
Mouse	Sangyo Igaku 1978	oral	110	-----	168 mg Cr(III)/m³	17 mg Cr(III)/m³

Human data . . . . It has been reported that trivalent chromium compounds (i.e., chromic salts) have a low order of toxicity and provide little industrial hazard [ACGIH 1971; Akatsuka and Fairhall 1934; Clayton and Clayton 1981]

Revised IDLH: 25 mg Cr(III)/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for chromium(III) compounds. Therefore, the revised IDLH for chromium(III) compounds is 25 mg Cr(III)/m³ based on acute oral toxicity data in animals [Gekkan Yakuji 1980; Sangyo Igaku 1978]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 25 mg Cr(III)/m³.

Chromium(III) compounds [as Cr(III)] (continued)

REFERENCES:

1. ACGIH [1971]. Chromium (as Cr). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 56.
2. Akatsuka K, Fairhall LT [1934]. The toxicology of chromium. J Ind Hyg *16*:1-28.
3. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 1593-1596.
4. Gekkan Yakuji (Pharmaceuticals Monthly) [1980]; *22*(2):291-298 (in Japanese).
5. Sangyo Igaku (Japanese Journal of Industrial Health) [1978]; *20*:590-591 (in Japanese).

Chromium metal (as Cr)

CAS number	7440-47-3
NIOSH REL	0.5 mg/m^3 TWA
Current OSHA PEL	1 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m^3 TWA
Description of Substance	Blue-white to steel-gray, lustrous, brittle, hard, odorless solid.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 mg Cr/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that an acute exposure to a high concentration of chromium metal would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL of 1 mg Cr/m^3, or 500 mg Cr/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 250 mg Cr/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of chromium metal would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for chromium metal is 250 mg Cr/m^3 based on being 500 times the NIOSH REL of 0.5 mg Cr/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Coal tar pitch volatiles

CAS number	65996-93-2
NIOSH REL	0.1 mg/m³ (cyclohexane-extractable fraction) TWA; NIOSH considers coal tar pitch volatiles to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.2 mg/m³ (benzene-soluble fraction) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m³ (benzene-soluble fraction) TWA, A1
Description of Substance	Black or dark-brown amorphous residue.
LEL	Unknown
Original (SCP) IDLH	700 mg/m³ [*Note: "Effective" IDLH = 400 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Redmond et al. [1972] have shown that the major health effects resulting from long-term repeated exposure to coal tar pitch volatiles (CTPV) are cancer of the lung, kidney, and skin; however, no studies have been made on carcinogenic effects by any route from single short-term exposure to CTPV that could relate to a 30-minute IDLH. Therefore, reliance must be placed on comparative data of single versus repeated carcinogenic doses of benzo(a)pyrene [B(a)P], a known component of CTPV. Bingham [1971] reported that B(a)P applied in a single dose of 2 mg to the skin of mice yielded tumors in 10% to 20% of the animals whereas 0.01 mg B(a)P applied in a noncarcinogenic solvant applied to the skin 3 times/week for 50 weeks yielded tumors in 50% of the animals. Thus, a single dose producing about 1/3 the number of tumors was 200 times the repeated 3 times/week dose. Using this factor and the value of 0.6 mg/m³ CTPV reported by Mazumdar et al. [1975] as safe for coke oven workers, a total dose IDLH of 120 mg CTPV (as benzene solubles) is calculated; by using 7.5 liters as the minute volume of coke oven workers and a 75% lung retention of CTPV a 30-minute IDLH is calculated to be about 700 mg/m³ (as benzene solubles). However, because of the assigned protection factor afforded by each device, 400 mg/m³ (i.e., 2,000 × the PEL) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Pyrene Rat	Potapova et al. 1971	170 mg/m³	-----	?	?	?

Coal tar pitch volatiles (continued)

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Pyrene						
Rat	Potapova et al. 1971	oral	2,700	-----	18,900 mg/m³	1,890 mg/m³
Mouse	Potapova et al. 1971	oral	800	-----	5,600 mg/m³	560 mg/m³
Anthracene						
Mouse	Nogochy 1969	oral	-----	>17,000	>119,000 mg/m³	>11,900 mg/m³
Phenanthrene						
Mouse	Rakhmanina 1964	oral	700	-----	4,900 mg/m³	490 mg/m³

Other animal data .... The major health effects resulting from long-term repeated exposure to coal tar pitch volatiles (CTPV) are cancer of the lung, kidney, and skin [Redmond et al. 1972]; however, no studies have been made on carcinogenic effects by any route from single short-term exposure to CTPV that could relate to a 30-minute IDLH. Therefore, reliance must be placed on comparative data of single versus repeated carcinogenic doses of benzo(a)pyrene [B(a)P], a known component of CTPV. It has been reported that B(a)P applied in a single dose of 2 mg to the skin of mice yielded tumors in 10% to 20% of the animals whereas 0.01 mg B(a)P applied in a noncarcinogenic solvent applied to the skin 3 times/week for 50 weeks yielded tumors in 50% of the animals [Bingham 1971]. Thus, a single dose producing about 1/3 the number of tumors was 200 times the repeated 3 times/week dose. Using this factor and the value of 0.6 mg/m³ CTPV reported as safe for coke oven workers [Mazumdar et al. 1975], a total dose IDLH of 120 mg CTPV (as benzene solubles) is calculated; by using 50 liters as the minute volume of workers and 100% lung retention of CTPV, a 30-minute IDLH is calculated to be about 80 mg/m³ (as benzene solubles).

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 80 mg/m³ (as the benzene-soluble fraction)
Basis for revised IDLH: The revised IDLH for coal tar pitch volatiles is 80 mg/m³ (as the benzene-soluble fraction) based on toxicity data in animals [Bingham 1971; Mazumdar et al. 1975; Redmond et al. 1972] (see discussion above). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for coal tar pitch volatiles at concentrations above 0.1 mg/m³ (cyclohexane-extractable fraction).]

REFERENCES:

1. Bingham E [1971]. Thresholds in cancer inductions. If they do exist, do they shift? Arch Environ Health *22*:692-695.
2. Mazumdar S, Redmond C, Sollecito W, Sussman N [1975]. An epidemiological study of exposure to coal tar pitch volatiles among coke oven workers. J Air Pollut Control Assoc *25*(4):382-389.
3. Nagochy PA [1969]. Comparative study of the toxicity of pure and technical anthracene. Gig Tr Prof Zabol *13*(5):59 (in Russian).
4. Potapova AN, Kapitulsky VB, et al. [1971]. Toxicological evaluation of pyrene. Gig Tr Prof Zabol *15*(2):59 (in Russian).
5. Rakhmanina NL [1964]. Establishing standards for the phenanthrene and pyrene contents in water bodies. Gig Sanit *29*(6):19-23 (translated).
6. Redmond CK, Ciocco A, Lloyd JW, Rush HW [1972]. Long-term mortality study of steel workers. VI. Mortality from malignant neoplasms among coke oven workers. J Occup Med *14*(8):621-629.

Cobalt metal dust and fume (as Co)

CAS number	7440-48-4 (Metal)
NIOSH REL	0.05 mg/m³ TWA
Current OSHA PEL	0.1 mg/m³ TWA
1989 OSHA PEL	0.05 mg/m³ TWA
1993-1994 ACGIH TLV	0.05 mg/m³ TWA
Description of Substance	Varies
Original (SCP) IDLH	20 mg Co/m³
Basis for original (SCP) IDLH	Browning [1969] made the statement that "metallic cobalt by inhalation and soluble salts by intratracheal injection act as acute lung irritants, producing oedema, and hemorrhage with a considerable outpouring of fluid from the capillaries in the peritoneal cavity. Many of the animals subjected to intratracheal injection of a suspension of cobalt metal dust developed acute pneumonia, often rapidly fatal as an initial reaction." Because no data on acute inhalation toxicity are available on which to base an IDLH for cobalt metal fume and dust, the chosen IDLH is based on the statement by Patty [1963] that animals chronically exposed to a cobalt-metal blend at a concentration of 20 mg Co/m³ developed lesions in the lungs.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	FDRL 1984	oral	6,170	-----	43,190 mg Co/m³	4,319 mg Co/m³
Rabbit	Simesen 1939	oral	-----	750	5,250 mg Co/m³	525 mg Co/m³

Other animal data	It has been reported that animals chronically exposed for 3 years to a cobalt-metal blend at a concentration of 20 mg Co/m³ developed fibrotic lesions in the lungs [Patty 1963].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 20 mg Co/m³ [Unchanged]
Basis for revised IDLH: Based on chronic toxicity data in animals [Patty 1963], the original IDLH for cobalt metal dust and fume (20 mg Co/m³) is not being revised at this time. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Browning E [1969]. Toxicity of industrial metals. 2nd ed. New York, NY: Appleton-Century-Crofts, p. 136.
2. FDRL [1984]. Acute oral LD50 study of cobalt powder-325 mesh t3N in Sprague Dawley rats. Waverly, NY: Food & Drugs Research Laboratories, Inc., FDRL Study No. 8005B.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1032.
4. Simesen M [1939]. The fate of cobalt after oral administration of metallic cobalt and subcutaneous injection of carbonatotetraminecobalt chloride, with remarks on the quantitative estimation of cobalt in organic materials. Arch Int Pharmaco Ther 62(3):347-356.

Copper (dusts and mists, as Cu)

CAS number	7440-50-8 (Metal)
NIOSH REL	1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
Current OSHA PEL	1 mg/m³ TWA
1993-1994 ACGIH TLV	1 mg/m³ TWA
Description of Substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 2,000 mg Cu/m³ – see discussion below.]
Basis for original (SCP) IDLH	There is no evidence that an acute exposure to a high concentration of copper dusts and mists could impede escape within 30 minutes. Browning [1969] noted that there is little evidence that copper presents a serious industrial hazard, either from acute or chronic poisoning. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 1 mg Cu/m³ (i.e., 2,000 mg Cu/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,000 mg Cu/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
$Cu(OH)_2$ Mammal	Worthing 1991	>2,000 mg/m³	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$Cu(OH)_2$ Rat	Sine 1991	oral	1,000	-----	4,559 mg Cu/m³	456 mg Cu/m³
CuCl Rat	Coulston and Korte 1975	oral	140	-----	629 mg Cu/m³	63 mg Cu/m³
$CuC_4H_4O_6$ Rat	Marhold 1977	oral	595	-----	1,457 mg Cu/m³	146 mg Cu/m³
$CuSO_4$ Rat	Siegle and Sisler 1977	oral	300	-----	836 mg Cu/m³	84 mg Cu/m³

Human data .... It has been stated that there is little evidence that copper presents a serious industrial hazard, either from acute or chronic poisoning [Browning 1969]. Inhalation of copper salts can result in irritation of the nasal mucous membranes [Clayton and Clayton 1981]. A lethal oral dose of 857 mg of $CuSO_4$/kg (equivalent to 341 mg Cu/kg) has been reported [Csiky 1958]. [Note: An oral dose of 341 mg Cu/kg is equivalent to a 70-kg worker being exposed to 227 mg Cu/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Copper (dusts and mists, as Cu) (continued)

Revised IDLH: 100 mg Cu/m^3
Basis for revised IDLH: The revised IDLH for copper dusts and mists is 100 mg Cu/m^3 based on acute oral toxicity data in humans [Csiky 1958] and animals [Coulston and Korte 1975; Marhold 1977; Siegel and Sisler 1977]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data in workers.

REFERENCES:

1. Browning E [1969]. Toxicity of industrial metals. 2nd ed. New York, NY: Appleton-Century-Crofts, p. 148.
2. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 1620-1630.
3. Coulston F, Korte F, eds. [1975]. Heavy metal toxicity, safety and hormology. In: Environmental Quality & Safety, Supplement 1. New York, NY: Georg Thieme Publishers, pp. 1-120.
4. Csiky P [1958]. Uber die akuten kupfersulfat-vergiftungen. Arch Toxikol 17:20-26 (in German).
5. Marhold JV [1977]. Personal communication. VUOS, 539-18, Pardubice, Czechoslovakia, March 29, 1977.
6. Siegel MR, Sisler HD [1977]. Antifungal compounds. Vol. 1. New York, NY: Marcel Dekker, p. 507.
7. Sine C, ed. [1991]. Copper hydroxide. In: Farm chemicals handbook '91, p. C89.
8. Worthing CR, ed. [1991]. Copper hydroxide. In: The pesticide manual. A world compendium. 9th ed. Farnham, Surrey, United Kingdom: The British Crop Protection Council, p. 184.

Copper fume (as Cu)

CAS number	1317-38-0 (CuO)
NIOSH REL	0.1 mg/m^3 TWA
Current OSHA PEL	0.1 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m^3 TWA
Description of Substance	Finely divided black particulate dispersed in air.
LEL	Noncombustible Solids
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 200 mg Cu/m^3 – see discussion below.]
Basis for original (SCP) IDLH	There is no evidence that an acute exposure to a high concentration of copper fume could impede escape within 30 minutes. Browning [1969] noted that there is little evidence that copper presents a serious industrial hazard, either from acute or chronic poisoning. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.1 mg Cu/m^3 (i.e., 200 mg Cu/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 200 mg Cu/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	Exposure to copper fume causes upper respiratory tract irritation, metallic taste, nausea, and metal fume fever. It has been reported that no ill effects resulted from exposures to copper fumes at concentrations up to 0.4 mg Cu/m^3 [Luxon 1972] and that there is little evidence that copper presents a serious industrial hazard, either from acute of chronic poisoning [Browning 1969].

Revised IDLH: 100 mg Cu/m^3
Basis for revised IDLH: The revised IDLH for copper fume is 100 mg Cu/m^3 based on an analogy to copper dusts and mists which have a revised IDLH of 100 mg Cu/m^3. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 mg Cu/m^3.

REFERENCES:

1. Browning E [1969]. Toxicity of industrial metals. 2nd ed. New York, NY: Appleton-Century-Crofts, p. 148.
2. Luxon SG [1972]. Letter to ACGIH TLV Committee. London, England: H.M. Factory Inspectorate, Industrial Hygiene Unit, August 1, 1972.

Cotton dust (raw)

CAS number	none
NIOSH REL	<0.200 mg/m^3 TWA
Current OSHA PEL	1 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m^3 TWA
Description of Substance	Colorless, odorless solid.
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data do not indicate that an acute exposure to a high concentration of cotton dust would cause death or any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances, it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of cotton dust (raw), 500 × the OSHA PEL of 1 mg/m^3 is 500 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of cotton dust (raw) would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for cotton dust (raw) is 100 mg/m^3 based on being 500 times the NIOSH REL of 0.2 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates). [Note: The 1 mg/m^3 OSHA PEL for cotton dust applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garnetting. In other sectors involving cotton, OSHA currently requires in 29 CFR 1919.1043 that workers be provided with and required to wear and use a powered, air-purifying respirator equipped with high-efficiency particulate filters in concentrations exceeding 100 × the applicable OSHA PEL of either 0.2, 0.5, or 0.75 mg/m^3.]

Crag® herbicide

CAS number 136-78-7
NIOSH REL .... 10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
Current OSHA PEL .... 15 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
1989 OSHA PEL .... 10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
1993-1994 ACGIH TLV .... 10 mg/m³ TWA
Description of Substance .... Colorless to white crystalline, odorless solid.
LEL .... Noncombustible Solid
Original (SCP) IDLH .... 5,000 mg/m³
Basis for original (SCP) IDLH .... According to many sources, Crag® herbicide is not very toxic to mammals. Because no acute inhalation toxicity data are available, the chosen IDLH has been estimated from the rat oral LD_{50} of 730 mg/kg [Gunther 1962 cited by NIOSH 1976].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Carpenter et al. 1961	oral	480	-----	3,360 mg/m³	336 mg/m³
Rat	Gunther 1962	oral	730	-----	5,110 mg/m³	511 mg/m³
Mammal	Sine 1991	oral	1,230	-----	8,610 mg/m³	861 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for Crag® herbicide. Therefore, the revised IDLH for Crag® herbicide is 500 mg/m³ based on acute oral toxicity data in animals [Carpenter et al. 1961; Gunther 1962; Sine 1991]. This may be a conservative value due to the lack of acute toxicity data for workers.

REFERENCES:

1. Carpenter CP, Weil CS, Smyth HF Jr. [1961]. Mammalian toxicity of sesone herbicide. J Agri Food Chem 9:382-385
2. Gunther FA, ed. [1962]. Residues of pesticides and other foreign chemicals in food and feeds. Vol. I. Secaucus, NJ: Springer Verlag New York, Inc., p. 18.
3. NIOSH [1976]. KK49000. Ethanol, 2-(2,4-dichlorophenoxy)-, hydrogen sulfate, sodium salt. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 503.
4. Sine C, ed. [1991]. Sesone. In: Farm chemicals handbook '91, p. C273.

Cresol (o-, m-, p-isomers)

CAS numbers .... 95-48-7 (o-isomer), 108-39-4 (m-isomer), 106-44-5 (p-isomer)
NIOSH REL .... 2.3 ppm (10 mg/m^3) TWA
Current OSHA PEL .... 5 ppm (22 mg/m^3) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 ppm (22 mg/m^3) TWA [skin]
Description of Substance .... White crystals with a sweet, tarry odor.
LEL(@300°F) .... 1.4% (10% LEL(@300°F), 1,400 ppm)
Original (SCP) IDLH .... 250 ppm
Basis for original (SCP) IDLH .... The only quantitative acute inhalation toxicity data available are those cited by Patty [1963]. Patty [1963] reported that rats exposed for 8 hours to a saturated concentration of cresol vapors survived the exposure [Smyth 1956]. The chosen IDLH is based on the isomer with the highest vapor pressure, that of o-cresol, which yields a saturated concentration of 323 ppm at 25°C. The chosen IDLH appears to be conservative because no rats died as a result of this exposure which was for 8 hours. Based on the rat oral LD_{50} of 207 mg/kg for p-cresol [Biofax 1969 cited by NIOSH 1976], an IDLH of 250 ppm is reasonable.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Cresols						
Rat	Back et al. 1972	oral	1,454	-----	2,262 ppm	226 ppm
Mouse	Back et al. 1972	oral	861	-----	1,339 ppm	134 ppm
Mouse	Kuroki et al. 1982	oral	760	-----	1,182 ppm	118 ppm
o-Cresol						
Rat	Biofax 1969b	oral	121	-----	188 ppm	19 ppm
Rat	Deichmann and Witherup 1944	oral	1,350	-----	2,100 ppm	210 ppm
Mouse	Gig Tr Prof Zabol 1974	oral	344	-----	535 ppm	54 ppm
m-Cresol						
Rat	Biofax 1969a	oral	242	-----	376 ppm	38 ppm
Rat	Deichmann and Witherup 1944	oral	2,020	-----	3,142 ppm	314 ppm
Mouse	Gig Tr Prof Zabol 1974	oral	828	-----	1,288 ppm	129 ppm
p-Cresol						
Rat	Biofax 1969c	oral	207	-----	322 ppm	32 ppm
Rat	Deichmann and Witherup 1944	oral	1,800	-----	2,800 ppm	280 ppm
Mouse	Gig Tr Prof Zabol 1974	oral	344	-----	535 ppm	54 ppm

Other animal data .... Rats exposed to a saturated concentration of cresol vapors (about 150 to 380 ppm) survived the exposure for 8 hours [Smyth 1956].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 250 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Smyth 1956], the original IDLH for cresol (250 ppm) is not being revised at this time.

REFERENCES:

1. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-330 to A-331.

Cresol (o-, m-, p-isomers) (continued)

2. Biofax [1969a]. Data sheet 3-5/69. Northbrook, IL: Biofax Industrial Bio-Test Laboratories, Inc.
3. Biofax [1969b]. Data sheet 4-5/69. Northbrook, IL: Biofax Industrial Bio-Test Laboratories, Inc.
4. Biofax [1969c]. Data sheet 5-5/69. Northbrook, IL: Biofax Industrial Bio-Test Laboratories, Inc.
5. Deichmann WB, Witherup S [1944]. Phenol Studies. VI. The acute and comparative toxicity of phenol and o-, m-, and p-cresols for experimental animals. J Pharmacol Exp Ther *80*:233-240.
6. Gig Tr Prof Zabol [1974]; *18*(2):58-59 (in Russian).
7. Kuroki K, Murakami Y, Osumi T, Kimura T [1982]. A study on acute toxicity of formalin-guaiacol. Kyushu Shika Gakkai Zasshi (Journal of the Kyushu Dental Society) *36*(6):932-939 (in Japanese).
8. NIOSH [1976]. GO64750. p-Cresol. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 353.
9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1390.
10. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

Crotonaldehyde

CAS number	123-73-9 (trans-isomer)
NIOSH REL	2 ppm (6 mg/m^3) TWA
Current OSHA PEL	2 ppm (6 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 ppm (5.7 mg/m^3) TWA
Description of Substance	Water-white liquid with a suffocating odor.
LEL	2.1% (10% LEL, 2,100 ppm)
Original (SCP) IDLH	400 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the report by Rinehart [1967] that a 1-hour exposure of 400 ppm is a lethal concentration for rats.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Rinehart 1967	600	-----	30 min	600 ppm (1.0)	60 ppm
Rat	Rinehart 1967	-----	400	1 hr	712 ppm (1.78)	71 ppm
Rat	Skog 1950	1,375	-----	30 min	1,375 ppm (1.0)	138 ppm
Mouse	ten Berge et al. 1986	519	-----	2 hr	1,647 ppm (3.17)	165 ppm
Rat	Trofimov 1962	1,500	-----	30 min	1,500 ppm (1.0)	150 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.2 [ten Berge et al. 1986].

Other animal data	RD_{50} (mouse), 3.53 - 4.88 ppm [Steinhagen and Barrow 1984].
Human data	Exposure to 4.1 ppm for 15 minutes was highly irritating to the nose and upper respiratory tract and produced lacrimation in 30 seconds [Sim and Pattle 1957]. In another study, exposures to 45 ppm proved very disagreeable after a few seconds, with conjunctival irritation evident [Rinehart 1967].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for crotonaldehyde is 50 ppm based on acute inhalation toxicity data in humans [Rinehart 1967] and animals [Rinehart 1967].

REFERENCES:

1. Rinehart WE [1967]. The effect on rats of single exposures to crotonaldehyde vapor. Am Ind Hyg Assoc J *28*:561-566.
2. Sim VM, Pattle RE [1957]. Effect of possible smog irritants in human subjects. JAMA *165*:1908-1957.
3. Skog E [1950]. A toxicological investigation of lower aliphatic aldehydes. I. Toxicity of formaldehyde, acetaldehyde, propionaldehyde and butyraldehyde; as well as of acrolein and crotonaldehyde. Acta Pharmacol Toxicol *6*:299-318.
4. Steinhagen WH, Barrow CS [1984]. Sensory irritation structure-activity study of inhaled aldehydes in B6C3F1 and Swiss-Webster mice. Toxicol Appl Pharmacol *72*:495-503.
5. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.
6. Trofimov LV [1962]. Comparative toxic action of crotonaldehyde and butyraldehyde. Gig Tr Prof Zabol *6*(9):34-40 (in Russian).

Cumene

CAS number	98-82-8
NIOSH REL	50 ppm (245 mg/m³) TWA [skin]
Current OSHA PEL	50 ppm (245 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	50 ppm (246 mg/m³) TWA [skin]
Description of Substance	Colorless liquid with a sharp, penetrating, aromatic odor.
LEL	0.9% (10% LEL, 900 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat 4-hour LC_{50} of 8,000 ppm [Smyth et al. 1951 cited by AIHA 1961].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1951	-----	8,000	4 hr	16,000 ppm (2.0)	1,600 ppm
Mouse	Werner et al. 1944	2,000	-----	7 hr	4,800 ppm (2.4)	480 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Sologob 1971	oral	12,750	-----	17,850 ppm	1,785 ppm
Rat	Wolf et al. 1956	oral	1,400	-----	1,960 ppm	196 ppm

Other animal data	Daily exposures of rats to 500 ppm for 5 months resulted in no significant blood changes, although hyperemia and congestion were noted in the lungs, liver, and kidneys [Clayton and Clayton 1981].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 900 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Clayton and Clayton 1981; Smyth et al. 1951], a value of about 1,500 ppm would have been appropriate. However, the revised IDLH for cumene is 900 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 0.9%).

REFERENCES:

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3. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med *4*:119-122.
4. Sologob AM [1971]. Experimental study on substantiation of the hygienic standard values of metadiisopropylbenzol and paradiisopropylbenzol in water bodies. Gig Sanit *36*(9):18-21 (in Russian).
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Cyanides (as CN)

CAS number	Varies
NIOSH REL	5 mg/m³ (4.7 ppm) 10-minute CEILING
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA [skin]
Description of Substance	Varies
Original (SCP) IDLH	50 mg/m³ (as CN)
Basis for original (SCP) IDLH	No useful acute inhalation toxicity data are available on which to base the IDLH for cyanides. For this draft technical standard, therefore, the chosen IDLH is based on an analogy with hydrogen cyanide. According to ACGIH [1971], Patty [1963] reported that hydrogen cyanide at 110 to 135 ppm (120 to 150 mg/m³) might be fatal to man after 0.5 to 1 hour or later, or dangerous to life; 45 to 54 ppm (50 to 60 mg/m³) could be tolerated for 0.5 to 1 hour without immediate or late effects [Flury and Zernik 1931; Dudley et al. 1942].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD (as CN)	Derived value (as CN)
NaCN						
Sheep	Burrows et al. 1978	oral	4	-----	15 mg/m³	1.5 mg/m³
Rat	Marhold 1972	oral	6.44	-----	22 mg/m³	2.2 mg/m³
Mammal	Smyth et al. 1969	oral	15	-----	56 mg/m³	5.6 mg/m³
Rat	Sterner 1979	oral	8	-----	30 mg/m³	3.0 mg/m³
KCN						
Rabbit	Barnes and Eltherington 1973	oral	5	-----	14 mg/m³	1.4 mg/m³
Rat	Gaines 1969	oral	10	-----	28 mg/m³	2.8 mg/m³
Rat	Lorke 1983	oral	5	-----	14 mg/m³	1.4 mg/m³
Mouse	Sheehy and Way 1968	oral	8.5	-----	24 mg/m³	2.4 mg/m³
$Pb(CN)_2$						
Rat	NRC 1953	i.p.	-----	100	141 mg/m³	14 mg/m³

Human data — Absorption of the alkali cyanides in amounts as low as 50 to 100 mg from a single, instantaneous dose may be followed by immediate collapse and cessation of respiration [Clayton and Clayton 1982]. It has been stated that although the fatal oral dose will vary considerably, depending on whether or not food is present in the stomach, it is probably in the order of 1 to 2 mg/kg [Clayton and Clayton]. [Note: An oral dose of 50 to 100 mg or 1 to 2 mg/kg is equivalent to a 70-kg worker being exposed to about 50 mg/m³ (as CN) for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 25 mg/m³ (as CN)
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for hydrogen cyanide. Therefore, the revised IDLH for cyanides is 25 mg/m³ (as CN) based on acute oral toxicity data in humans [Clayton and Clayton 1982].

REFERENCES:

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13. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA, Nycum JS [1969]. Range-finding toxicity data: list VII. Am Ind Hyg Assoc J *30*:470-476.
14. Sterner RT [1979]. Effects of sodium cyanide and diphacinone in coyotes (*canis latrans*): applications as predacides in livestock toxic collars. Bulletin Environ Contam Toxicol *23*:211-217.

Cyclohexane

CAS number	110-82-7
NIOSH REL	300 ppm (1,050 mg/m³) TWA
Current OSHA PEL	300 ppm (1,050 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	300 ppm (1,030 mg/m³) TWA
Description of Substance	Colorless liquid with a sweet, chloroform-like odor.
LEL	1.3% (10% LEL, 1,300 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on a statement by Patty [1963] that 12,600 ppm produced evidence of lethargy, narcosis, increased respiration rate, and convulsions in animals [Treon et al. 1943]. Also, AIHA [1963] reported that 9,300 ppm for 30 minutes resulted in restlessness, impaired coordination, and exhaustion, but no narcosis or deaths in cats, rabbits, and pigs [Flury and Zernik 1931].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Lazarew 1929	-----	17,142	2 hr	27,429 ppm (1.6)	2,743 ppm
Rabbit	Treon et al. 1943	-----	26,600	1 hr	33,250 ppm (1.25)	3,325 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kimura et al. 1971	oral	12,705	-----	25,410 ppm	2,541 ppm
Mouse	NPIRI 1974	oral	813	-----	1,626 ppm	163 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,300 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Lazarew 1929; Treon et al. 1943], a value of about 3,000 ppm would have been appropriate. However, the revised IDLH for cyclohexane is 1,300 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.3%).

REFERENCES:

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Cyclohexanol

CAS number	108-93-0
NIOSH REL	50 ppm (200 mg/m³) TWA [skin]
Current OSHA PEL	50 ppm (200 mg/m³) TWA
1989 OSHA PEL	50 ppm (200 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	50 ppm (206 mg/m³) TWA [skin]
Description of Substance	Sticky solid or colorless to light-yellow liquid (above 77°F) with a camphor-like odor.
LEL	Unknown
Original (SCP) IDLH	3,500 ppm
Basis for original (SCP) IDLH	No acute inhalation toxicity data are available on which to base an IDLH for cyclohexanol. The chosen IDLH, therefore, has been estimated from the rabbit oral LD_{50} of 2.2 to 2.6 g/kg [Treon et al. 1943 cited in Browning 1965]. The chosen IDLH of 3,500 ppm (14.3 g/m³) is probably conservative, because the lower end of the range of the LD_{50} values (i.e., 2.2 g/kg) has been used to estimate the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Bar and Griepentrog 1967	oral	2,060	-----	3,458 ppm	346 ppm
Rabbit	Treon et al. 1943	oral	2,200-2,600	-----	3,693-4,365 ppm	369-437 ppm

Human data .... The estimated acceptable concentration for 8 hours was reported in volunteers to be less than 100 ppm [Nelson et al. 1943].

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for cyclohexanol is 400 ppm based on acute oral toxicity data in animals [Bar and Griepentrog 1967; Treon et al. 1943].

REFERENCES:

1. Bar F, Griepentrog F [1967]. Die situation in der gesundheitlichen beurteilung der aromatisierungsmittel für lebensmittel. Med Ernahr 8:282-251. [From ACGIH [1991]. Cyclohexanol. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 357-358.]
2. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, p. 387.
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Cyclohexanone

CAS number	108-94-1
NIOSH REL	25 ppm (100 mg/m³) TWA [skin]
Current OSHA PEL	50 ppm (200 mg/m³) TWA
1989 OSHA PEL	25 ppm (100 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	25 ppm (100 mg/m³) TWA [skin]
Description of Substance	Water-white to pale-yellow liquid with a peppermint- or acetone-like odor.
LEL(@212°F)	1.1% (10% LEL(@212°F), 1,100 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1965] that a 4-hour exposure of rats to 4,000 ppm did not produce death but 8,000 ppm caused anesthesia and death [Smyth 1956]. In addition, Patty [1963] reported that typical narcotic symptoms have been observed in guinea pigs exposed for 6 hours to 4,000 ppm [Specht et al. 1940].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Gupta et al. 1979	-----	4,706	1.5 hr	6,776 ppm (1.44)	678 ppm
Rat	NPIRI 1974	8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm
Rat	Smyth 1956	LC_{100}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Other animal data	RD_{50} (mouse), 756 ppm [DeCeaurriz et al. 1981].
Human data	It has been reported that exposure to 75 ppm for 3 to 5 minutes has resulted in pronounced irritation of the eyes, nose, and throat [Nelson et al. 1943].

Revised IDLH: 700 ppm
Basis for revised IDLH: The revised IDLH for cyclohexanone is 700 ppm based on acute inhalation toxicity data in animals [Gupta et al. 1979; Smyth 1956].

REFERENCES:

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8. Specht H, Miller JW, Valaer PJ, Sayers RR [1940]. Acute response of guinea pigs to the inhalation of ketone vapors. Washington, DC: U.S. Government Printing Office, Federal Security Agency, U.S. Public Health Service, NIH Bulletin *176*:1-66.

Cyclohexene

CAS number	110-83-8
NIOSH REL	300 ppm (1,015 mg/m³) TWA
Current OSHA PEL	300 ppm (1,015 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	300 ppm (1,010 mg/m³) TWA
Description of Substance	Colorless liquid with a sweet odor.
LEL	Unknown
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	Because very little data are available concerning the effects produced by acute inhalation exposure to cyclohexene, the chosen IDLH is based on an analogy with cyclohexane which has an IDLH of 10,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Lazarew 1929	-----	13,196	2 hr	21,114 ppm	2,111 ppm

Other animal data .... A chronic inhalation study (6 hours/day, 5 days/week for 6 months) in rats, guinea pigs, and rabbits at concentrations of 150, 300, and 600 ppm showed that although significant increases in alkaline phosphatase occurred in all three groups, most of the hematologic parameters measured were within normal limits [Laham 1976].

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for cyclohexene is 2,000 ppm based on acute toxicity data in animals [Lazarew 1929]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Laham S [1976]. Inhalation toxicity of cyclohexene (Abstract #152). Toxicol Appl Pharmacol 37(1):155.
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Cyclopentadiene

CAS number	542-92-7
NIOSH REL	75 ppm (200 mg/m^3) TWA
Current OSHA PEL	75 ppm (200 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	75 ppm (203 mg/m^3) TWA
Description of Substance	Colorless liquid with an irritating, terpene-like odor.
LEL	Unknown
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Deichmann and Gerarde [1969] that 4 of 6 rats died from a 4-hour exposure to 2,000 ppm [Smyth et al. 1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Shashkina 1965	14,182	-----	2 hr	22,691 ppm (1.6)	2,269 ppm
Mouse	Shashkina 1965	5,091	-----	2 hr	8,146 ppm (1.6)	815 ppm
Rat	Smyth et al. 1954	LC_{67}: 2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 750 ppm
Basis for revised IDLH: The revised IDLH for cyclopentadiene is 750 ppm based on acute inhalation toxicity data in animals [Shashkina 1965]. [Note: It was decided to use the 2-hour lethal concentration data in mice rather than the 4-hour lethal concentration data in rats so as not to magnify the conservatism already present in the correction factors.]

REFERENCES:

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2. Shashkina LF [1965]. Materials for substantiation of maximum permissible concentration of cyclopentadiene and of its dimer -- dicyclopentadiene -- in the atmosphere of industrial premises. Gig Tr Prof Zabol *9*(12):13-19 (in Russian).
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2,4-D

CAS number	94-75-7
NIOSH REL	10 mg/m³ TWA
Current OSHA PEL	10 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of Substance	White to yellow, crystalline, odorless powder.
LEL	Noncombustible Solid
Original (SCP) IDLH	500 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH has been estimated from oral data, because no useful data on acute inhalation toxicity are available. NIOSH [1976] cited a dog oral LD_{50} of 100 mg/kg [Seabury 1963]. Dudley and Thapar [1972] estimated that the LD_{50} for humans was between 80 and 800 mg/kg.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Hamster	Cabral et al. 1979	oral	500	-----	3,500 mg/m³	350 mg/m³
Dog	Seabury 1963	oral	100	-----	700 mg/m³	70 mg/m³
Mouse	Senczuk and Pogorzelska 1980	oral	347	-----	2,429 mg/m³	243 mg/m³
Rat	Sine 1993	oral	699	-----	4,893 mg/m³	489 mg/m³

Human data .... It has been reported that the lethal oral dose ranges from 80 to 800 mg/kg [Dalgaard-Mikkelsen and Poulsen 1962; Dudley and Thapar 1972]. [Note: Oral doses of 80 to 800 mg/kg are equivalent to a worker being exposed to about 3,700 to 37,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for 2,4-D. Therefore, the revised IDLH for 2,4-D is 100 mg/m³ based on acute oral toxicity data in humans [Dalgaard-Mikkelsen and Poulsen 1962; Dudley and Thapar 1972] and animals [Seabury 1963]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

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4. NIOSH [1976]. AG68250. Acetic acid, (2,4-dichlorophenoxy)-. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 21.
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DDT

CAS number	50-29-3
NIOSH REL	0.5 mg/m^3 TWA; NIOSH considers DDT to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	TWA 1 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	TWA 1 mg/m^3 TWA [skin]
Description of Substance	Colorless crystals or off-white powder with a slight, aromatic odor.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that an acute exposure to a high concentration of DDT would impede escape or cause any irreversible health effects within 30 minutes. AIHA [1959] reported that the concentration immediately hazardous to life is "probably unobtainable," and that DDT has a low order of acute toxicity by inhalation. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL; in the case of DDT, 500 × the OSHA PEL of 1 mg/m^3 is 500 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	AAPCO 1966	oral	250	-----	1,750 mg/m^3	175 mg/m^3
Rat	Kenaga 1979	oral	87	-----	609 mg/m^3	61 mg/m^3
Rat	Lehman 1951	oral	250	-----	1,750 mg/m^3	175 mg/m^3
Mouse	Spencer 1953	oral	135	-----	945 mg/m^3	95 mg/m^3
G. pig	Truhaut et al. 1974	oral	150	-----	1,050 mg/m^3	105 mg/m^3

Human data ..... Exposure of volunteers to 423 mg/m^3 for periods of 1 hour/day for 6 days has been reported to only cause eye irritation [Neal et al. 1994]. It has been reported that 500 mg/kg is the lethal oral dose [Windholz 1983]. [Note: An oral dose of 500 mg/kg is equivalent to a 70-kg worker being exposed to about 23,000 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 500 mg/m^3
Basis for revised IDLH: The revised IDLH for DDT is 500 mg/m^3 based on acute toxicity data in humans [Neal et al. 1944; Windholz 1983]. This may be a conservative value due to the lack of relevant acute toxicity data in humans exposed to concentrations above 423 mg/m^3. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for DDT at concentrations above 0.5 mg/m^3.]

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1. AAPCO [1966]. Pesticide chemicals official compendium. Association of the American Pesticide Control Officials, Inc., p. 347.
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Decaborane

CAS number	17702-41-9
NIOSH REL	0.3 mg/m³ (0.05 ppm) TWA, 0.9 mg/m³ (0.15 ppm) STEL [skin]
Current OSHA PEL	0.3 mg/m³ (0.05 ppm) TWA [skin]
1989 OSHA PEL	0.3 mg/m³ (0.05 ppm) TWA, 0.9 mg/m³ (0.15 ppm) STEL [skin]
1993-1994 ACGIH TLV	0.25 mg/m³ (0.05 ppm) TWA, 0.75 mg/m³ (0.15 ppm) STEL [skin]
Description of Subetance	Colorless to white crystalline solid with an intense, bitter, chocolate-like odor.
LEL	Unknown
Original (SCP) IDLH	100 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ILO [1971] that the 4-hour LC_{50} was 122 to 230 mg/m³ for small animals.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Schechter 1958	276 mg/m³	-----	4 hr	552 mg/m³ (2.0)	55 mg/m³
Mouse	Schechter 1958	72 mg/m³	-----	4 hr	144 mg/m³ (2.0)	14 mg/m³
Mouse	Svirbely 1954	144 mg/m³	-----	4 hr	288 mg/m³ (2.0)	29 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 15 mg/m³
Basis for revised IDLH: The revised IDLH for decaborane is 15 mg/m³ based on acute inhalation toxicity data in animals [Schechter 1958].

REFERENCES:

1. ILO [1971]. Boron hydrides. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, p. 206.
2. Schechter WH [1958]. Toxicity of high energy fuels. AMA Arch Ind Health *17*:362-366.
3. Svirbely JL [1954]. Acute toxicity studies of decaborane and pentaborane by inhalation. AMA Arch Ind Hyg Occup Med *10*:298-304.

Demeton

CAS number	8065-48-3
NIOSH REL	0.1 mg/m³ TWA [skin]
Current OSHA PEL	0.1 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.11 mg/m³ (0.01 ppm) TWA [skin]
Description of Substance	Amber, oily liquid with a sulfur-like odor.
LEL	Unknown
Original (SCP) IDLH	20 mg/m³
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for demeton. The chosen IDLH, therefore, has been based on an analogy with parathion which has an IDLH of 20 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	-----	15 mg/m³	4 hr	30 mg/m³ (2.0)	3.0 mg/m³
Cat	Izmerov et al. 1982	-----	15 mg/m³	4 hr	30 mg/m³ (2.0)	3.0 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Gurevich et al. 1962	oral	-----	5	35 mg/m³	3.5 mg/m³
Mouse	Rosival et al. 1958	oral	-----	7.85	55 mg/m³	5.5 mg/m³
Rat	Schafer 1972	oral	-----	1.7	12 mg/m³	1.2 mg/m³

Other animal data	In a subchronic inhalation study, no signs of illness resulted from the first day of exposure to 3 mg/m³ for 2 hours, tremors were noted on the second day, lacrimation and more severe tremors on the third day, and 10 of the 17 rats died during the fourth day [Deichmann and Rakoczy 1955]. It has been reported that the acute oral and dermal toxicity of demeton in mammals is approximately the same as that of parathion; the American Conference of Governmental Industrial Hygienists TLV for demeton is based on an analogy to parathion [ACGIH 1991].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg/m³
Basis for revised IDLH: The revised IDLH for demeton is 10 mg/m³ based on an analogy with parathion [ACGIH 1991] which has a revised IDLH of 10 mg/m³.

REFERENCES:

1. ACGIH [1991]. Demeton. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 385-386.
2. Deichmann WB, Rakoczy R [1955]. Toxicity and mechanism of action of systox. AMA Arch Ind Health *11*:324-331.
3. Gurevich BA, Smetevin NE, Lubetsky KZ [1962]. On the question of toxicity of a new defoliant folex. Gig Sanit 27(8):97-99 (in Russian).
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 52.
5. Rosival L, Selecky FV, Vrbovsky L [1958]. Akutna experimentalna otrava organofosforovymi insekticidmi. Bratislavske Lekarske Listy *38*:151-160 (in Czechoslovakian).
6. Schafer EW [1972]. The acute oral toxicity of 369 pesticidal, pharmaceutical and other chemicals to wild birds. Toxicol Appl Pharmacol *21*:315-330.

Diacetone alcohol

CAS number 123-42-2
NIOSH REL .... 50 ppm (240 mg/m³) TWA
Current OSHA PEL .... 50 ppm (240 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 50 ppm (238 mg/m³) TWA
Description of Substance .... Colorless liquid with a faint, minty odor.
LEL .... 1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH .... 2,100 ppm
Basis for original (SCP) IDLH .... The only acute inhalation toxicity data available on which to base an IDLH for diacetone alcohol is the statement by Patty [1963] that animals exposed for 1 to 3 hours to 2,100 ppm exhibited restlessness, irritation of the membranes, excitement, and later somnolence [Gross as cited by Lehmann and Flury 1943]. The chosen IDLH is obviously conservative.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth and Carpenter 1948	oral	4,000	-----	5,797 ppm	580 ppm
Rabbit	Walton et al. 1928	oral	4,653	-----	6,743 ppm	674 ppm
Mouse	Wenzel and Koff 1956	oral	3,950	-----	5,725 ppm	573 ppm

Other animal data .... Animals exposed for 1 to 3 hours to 2,100 ppm exhibited restlessness, irritation of the membranes, excitement, and later, somnolence [Lehmann and Flury 1943].
Human data .... It has been reported that eye irritation appeared in volunteers exposed for 15 minutes at 100 ppm [Silverman et al. 1946].

Revised IDLH: 1,800 ppm (LEL)
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Lehmann and Flury 1943], a value of about 2,000 ppm would have been appropriate. However, the revised IDLH for diacetone alcohol is 1,800 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.8%).

REFERENCES:

1. Gross E [?]. Unpublished. [From Lehmann KB, Flury F, eds. [1943]. Toxicology and hygiene of industrial solvents. Translated by E. King and H.F. Smyth, Jr. Baltimore, MD: Williams & Wilkins Company, pp. 245-246.]
2. Lehmann KB, Flury F, eds. [1943]. Toxicology and hygiene of industrial solvents. Translated by E. King and H.F. Smyth, Jr. Baltimore, MD: Williams & Wilkins Company, pp. 245-246.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1752.
4. Silverman L, Schulte HF, First WW [1946]. Further studies on sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol *28*:262-266.
5. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range-finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *30*(1):63-68.
6. Walton DC, Kehr EF, Louvenhart AS [1928]. A comparison of the pharmacological action of diacetone alcohol and acetone. J Pharmacol Exp Ther *33*:175-183.
7. Wenzel DG, Koff GY [1956]. Anticonvulsant properties of some alkyldiols, alkyldiones and related compounds. J Am Pharm Assoc, Scientific Edition *45*(10):669-672.

Diazomethane

CAS number	334-88-3
NIOSH REL	0.2 ppm (0.4 mg/m³) TWA
Current OSHA PEL	0.2 ppm (0.4 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 ppm (0.34 mg/m³) TWA
Description of Substance	Yellow gas with a musty odor.
LEL	Unknown
Original (SCP) IDLH	2 ppm
Basis for original (SCP) IDLH	The only available acute inhalation toxicity data concerning diazomethane is the statement by Patty [1963] that a 10-minute exposure to 175 ppm was lethal for cats [Flury and Zernik 1931]. This concentration is obviously too high for an IDLH. ACGIH [1971] reported that the toxicity of diazomethane seems comparable to that of phosgene. Therefore, the chosen IDLH is based on an analogy with phosgene, which has an IDLH of 2 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Marhold 1986	175	-----	10 min	121 ppm (0.69)	12 ppm

Other animal data	It has been suggested that the toxicity of diazomethane is comparable to that of phosgene, possibly because diazomethane is a strong methylating agent [Potts et al. 1949].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2 ppm [Unchanged]
Basis for revised IDLH: Based on an analogy to phosgene [Potts et al. 1949] which has an IDLH of 2 ppm, the original IDLH for diazomethane of 2 ppm is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Diazomethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 71-72.
2. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 420 (in German).
3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 496 (in Czechoslovakian).
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 940, 2214.
5. Potts AM, Simon FP, Gerard RW [1949]. The mechanism of action of phosgene and diphosgene. Arch Biochem 24:329-337.

Diborane

CAS number	19287-45-7
NIOSH REL	0.1 ppm (0.1 mg/m^3) TWA
Current OSHA PEL	0.1 ppm (0.1 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.11 mg/m^3) TWA
Description of Substance	Colorless gas with a repulsive, sweet odor.
LEL	0.8% (10% LEL, 800 ppm)
Original (SCP) IDLH	40 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that Jacobson and Lawson [1962] found the rat 4-hour LC_{50} to be 40 or 80 ppm, depending on the age or strain of rats used.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Adams 1964	40	-----	4 hr	80 ppm (2.0)	8.0 ppm
Mouse	Jacobson and Lawson 1962	29	-----	4 hr	58 ppm (2.0)	5.8 ppm
Rat	Jacobson and Lawson 1962	40- 80	-----	4 hr	80-160 ppm (2.0)	8.0 ppm
Rat	Krackow 1953	159-181	-----	15 min	126-143 ppm (0.79)	13-14 ppm
Dog	Kunkel et al. 1956	-----	125	2 hr	200 ppm (1.6)	20 ppm
Hamster	Stumpe 1960	-----	50	8 hr	125 ppm (2.5)	13 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 15 ppm
Basis for revised IDLH: The revised IDLH for diborane is 15 ppm based on acute inhalation toxicity data in animals [Krackow 1953].

REFERENCES:

1. ACGIH [1971]. Diborane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 72.
2. Adams RM, ed. [1964]. Boron, metallo-boron compounds and boranes. New York, NY: John Wiley & Sons, Inc., p. 693.
3. Jacobson KH, Lawson LH [1962]. The effect of age or weight on the toxicity of diborane. Toxicol Appl Pharmacol *4*:215-219.
4. Krackow EH [1953]. Toxicity and health hazards of boron hydrides. AMA Arch Ind Hyg Occup Med *8*:335-339.
5. Kunkel AM, Murtha EF, Olkemus AH, Stabile DE, Saunders JP, Willis JH [1956]. Some pharmacologic effects of diborane. AMA Arch Ind Health *13*:346-351.
6. Stumpe AR [1960]. Toxicity of diborane in high concentrations. AMA Arch Ind Health *21*:519-524.

Dibutyl phosphate

CAS number	107-66-4
NIOSH REL	1 ppm (5 mg/m^3) TWA, 2 ppm (10 mg/m^3) STEL
Current OSHA PEL	1 ppm (5 mg/m^3) TWA
1989 OSHA PEL	1 ppm (5 mg/m^3) TWA, 2 ppm (10 mg/m^3) STEL
1993-1994 ACGIH TLV	1 ppm (8.6 mg/m^3) TWA, 2 ppm (17 mg/m^3) STEL
Description of Substance	Pale-amber, odorless liquid.
LEL	Unknown
Original (SCP) IDLH	125 ppm
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for dibutyl phosphate. Therefore, the chosen IDLH is based on an analogy with tributyl phosphate which has an IDLH of 125 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 30 ppm
Basis for revised IDLH: Due to the lack of relevant acute toxicity data, the revised IDLH for dibutyl phosphate is 30 ppm based on an analogy to tributyl phosphate which has a revised IDLH of 30 ppm.

Dibutyl phthalate

CAS number 84-74-2
NIOSH REL .... 5 mg/m³ TWA
Current OSHA PEL .... 5 mg/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 mg/m³ TWA
Description of Substance .... Colorless to faint-yellow, oily liquid with a slight, aromatic odor.
LEL(@456°F) .... 0.5% (10% LEL(@456°F), 32,700 mg/m³)
Original (SCP) IDLH .... 9,300 mg/m³
Basis for original (SCP) IDLH .... Because dibutylphthalate has a very low toxicity, the available toxicological data contains no evidence of an IDLH for it. Therefore, the chosen IDLH is based on an analogy with dimethylphthalate, which has an IDLH of 9,300 mg/m³.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Antonyuk and Aldyreva 1973	4,250 mg/m³	-----	?	?	?
Mouse	Izmerov et al. 1982	25,000 mg/m³	-----	2 hr	40,000 mg/m³ (1.6)	4,000 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Antonyuk 1963	oral	5,289	-----	37,023 mg/m³	3,702 mg/m³
Rat	Sine 1993	oral	8,000	-----	56,000 mg/m³	5,600 mg/m³
G. pig	Timofeevskaia et al. 1980	oral	10,000	-----	70,000 mg/m³	7,000 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 4,000 mg/m³
Basis for revised IDLH: The revised IDLH for dibutyl phthalate is 4,000 mg/m³ based on acute inhalation toxicity data in animals [Izmerov et al. 1982]. [Note: Due to its low volatility, this concentration could only be reached at elevated temperatures or if the liquid droplets become airborne as in a mist.]

REFERENCES:

1. Antonyuk OK [1963]. About the toxicity of didodecylphthalate. Gig Tr Prof Zabol *17*(11):51-52 (in Russian).
2. Antonyuk OK, Aldyreva MV [1973]. Substantiation of maximum permissible concentration of dibutyl phthalate in the air of industrial premises. Gig Tr Prof Zabol *17*(8):26-30 (in Russian).
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 44.
4. Sine C, ed. [1993]. Dibutyl phthalate. In: Farm chemicals handbook '93, p. C112.
5. Timofeevskaia LA, Ivanova NI, Balinlva ES [1980]. Toxicology of o-phthalic acid and esters and hygienic regimentation. Gig Tr Prof Zabol 24(3):25-27 (in Russian).

o-Dichlorobenzene

CAS number	95-50-1
NIOSH REL	50 ppm (300 mg/m³) CEILING
Current OSHA PEL	50 ppm (300 mg/m³) CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	25 ppm (150 mg/m³) TWA, 50 ppm (301 mg/m³) STEL
Description of Substance	Colorless to pale-yellow liquid with a pleasant, aromatic odor.
LEL	2.2% (10% LEL, 2,200 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that 1,000 ppm was fatal to guinea pigs after 20 hours [Browning 1953]. ACGIH [1971] also reported that Cameron et al. [1937] found liver damage in animals after exposure for a few hours at 50 to 800 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Browning 1953	-----	1,000	20 hr	3,450 ppm (3.45)	345 ppm
G. pig	Cameron et al. 1937	-----	800	24 hr	2,880 ppm (3.6)	288 ppm
Rat	Hollingsworth et al. 1958	-----	821	7 hr	1,970 ppm (2.4)	197 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Ben-Dyke et al. 1970	oral	500	-----	573 ppm	57 ppm
G. pig	Patty 1963	oral	2,000	-----	2,291 ppm	229 ppm
Rabbit	Thomson 1976/77	oral	500	-----	573 ppm	57 ppm
Mouse	Yakkyoku 1981	oral	4,386	-----	5,025 ppm	503 ppm

Other animal data	RD_{50} (mouse), 182 ppm [DeCeaurriz et al. 1981].
Human data	Concentrations up to 100 ppm have been reported to have caused sporadic irritation of the eyes and respiratory tract [Elkins 1959].

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for o-dichlorobenzene is 200 ppm based on acute inhalation toxicity data in animals [Hollingsworth et al. 1958]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 ppm.

REFERENCES:

1. ACGIH [1971]. o-Dichlorobenzene. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 78.
2. Ben-Dyke R, Sanderson DM, Noakes DN [1970]. Acute toxicity data for pesticides (1970). World Review of Pesticide Control 9:119-127.
3. Browning E [1953]. Toxicity of industrial organic solvents. New York, NY: Chemical Publishing Company, p. 190.
4. Cameron GR, Thomas JC, Ashmore SA, Buchan JL, Warren EH, Hughes AWM [1937]. The toxicity of certain chlorine derivatives of benzene, with special reference to o-dichlorobenzene. J Pathol Bacteriol *44*(2):281-296.
5. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett *9*(2):137-143.
6. Elkins HB [1959]. The chemistry of industrial toxicology. 2nd ed. New York, NY: John Wiley & Sons, Inc., p. 150.

o-Dichlorobenzene (continued)

7. Hollingsworth RL, Rowe VK, Oyen F, Torkelson TR, Adams EM [1958]. Toxicity of o-dichlorobenzene. AMA Arch Ind Health *17*:180-187.
8. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1336.
9. Thomson WT [1976/77]. Agricultural chemicals. Fresno, CA: Thomas Publications, *3*:32.
10. Yakkyoku (Pharmacy) [1981]; *32*:471-474 (in Japanese).

p-Dichlorobenzene

CAS number 106-46-7
NIOSH REL .... None established; NIOSH considers p-dichlorobenzene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 75 ppm (450 mg/m³) TWA
1989 OSHA PEL .... 75 ppm (450 mg/m³) TWA, 110 ppm (675 mg/m³) STEL
1993-1994 ACGIH TLV .... 10 ppm (60 mg/m³) TWA, A3
Description of Substance .... Colorless or white crystalline solid with a mothball-like odor.
LEL .... 2.5% (10% LEL, 2,500 ppm)
Original (SCP) IDLH .... 1,000 ppm
Basis for original (SCP) IDLH .... No useful data on acute inhalation toxicity are available on which to base the IDLH for p-dichlorobenzene. The chosen IDLH, therefore, is based on an analogy with o-dichlorobenzene, which has an IDLH of 1,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Ben-Dyke et al. 1970	oral	500	-----	573 ppm	57 ppm
Human	Deichmann and Gerarde 1969	oral	-----	857	982 ppm	98 ppm
Mouse	Domenjos 1946	oral	2,950	-----	3,380 ppm	338 ppm
Rat	Hollingsworth et al. 1956	oral	-----	4,000	4,583 ppm	458 ppm
G. pig	Hollingsworth et al. 1956	oral	-----	2,800	3,208 ppm	321 ppm
Rat	Varshavskaya 1967	oral	2,512	-----	2,878 ppm	288 ppm
Rabbit	Yakkyoku 1978	oral	2,830	-----	3,242 ppm	324 ppm

Other animal data .... No adverse effects were noted in a workplace averaging 105 ppm (range 50 to 170 ppm), but painful irritation of the eyes and nose was found at 80 to 160 ppm, and breathing was difficult at concentrations greater than 160 ppm [Hollingsworth et al. 1956]. In another workplace, workers exposed to 17 to 500 ppm reported severe eye irritation [Dow 1978].
Other human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 150 ppm
Basis for revised IDLH: The revised IDLH for p-dichlorobenzene is 150 ppm based on acute inhalation toxicity data in workers [Dow 1978; Hollingsworth et al. 1956]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for p-dichlorobenzene at any detectable concentration.]

REFERENCES:

1. Ben-Dyke R, Sanderson DM, Noakes DN [1970]. Acute toxicity data for pesticides (1970). World Review of Pesticide Control 9:119-127.
2. Deichmann WB, Gerarde HW [1969]. Dichlorobenzene, ortho and para (PDB, dichlorocide). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 210-211.
3. Spencer EY [1973]. Guide to the chemicals used in crop protection. London, Ontario, Canada: Research Institute, University of Western Ontario Sub Post Office, p. 183.
4. Dow Chemical Company [1978]. Preliminary study into the environmental fate of PARADOW blocks, May 17, 1973. TSCA 8(d) submission 8DHQ-0978-0299. EPA, Washington, D.C. [From ACGIH [1991]. p-Dichlorobenzene. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 410-416.]
5. Hollingsworth RL, Rowe VK, Oyen F, Hoyle HR, Spencer HC [1956]. Toxicity of paradichlorobenzene. AMA Arch Ind Health *14*:138-147.
6. Varshavskaya SP [1967]. The hygienic standardization of mono- and dichlorobenzenes in reservoir waters. Nauch Tr Aspir Ordinatorov Pervyi Mosk Med Inst, pp. 175-177 (in Russian). [From ACGIH [1991]. p-Dichlorobenzene. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 410-416.]
7. Yakkyoku (Pharmacy) [1978]; *29*:453-457 (in Japanese).

Dichlorodifluoromethane

CAS number	75-71-8
NIOSH REL	1,000 ppm (4,950 mg/m³) TWA
Current OSHA PEL	1,000 ppm (4,950 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (4,950 mg/m³) TWA
Description of Substance	Colorless gas with an ether-like odor at extremely high concentrations.
LEL	Nonflammable Gas
Original (SCP) IDLH	50,000 ppm
Basis for original (SCP) IDLH	Based on the statement by ILO [1971] that 50,000 ppm induces dizziness in humans, an IDLH of 50,000 ppm is chosen for this draft technical standard.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 10,000 ppm
24-hour EEGL: 1,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Paulet 1976	760,000	-----	30 min	760,000 ppm (1.0)	76,000 ppm
Rabbit	Paulet 1976	800,000	-----	30 min	800,000 ppm (1.0)	80,000 ppm
G. pig	Paulet 1976	800,000	-----	30 min	800,000 ppm (1.0)	80,000 ppm
Rat	Scholz 1962	600,000	-----	2 hr	960,000 ppm (1.6)	96,000 ppm

Other animal data	Serious cardiac arrhythmia was found in 5 of 12 dogs exposed to 50,000 ppm for 5 minutes and injected with epinephrine [Reinhardt et al. 1971]. In another study, respiratory-circulatory effects that included bronchoconstriction and tachycardia were found at 50,000 to 100,000 ppm [Aviado and Smith 1975].
Human data	Exposure up to 60,000 ppm was tolerated for 80 minutes by 1 volunteer [NRC 1984]; when exposed at 40,000 ppm for 14 minutes and then at 20,000 ppm for 66 minutes, another volunteer developed EEG changes and had slurred speech and decreased psychologic test scores [NRC 1984]. It has been stated that 50,000 ppm induces dizziness [ILO 1971]. Volunteers exposed for 2.5 hours to 10,000 ppm showed a 7% reduction in a standardized psychomotor test [Azar et al. 1972].

Revised IDLH: 15,000 ppm
Basis for revised IDLH: The revised IDLH for dichlorodifluoromethane is 15,000 ppm based on acute inhalation toxicity data in humans [Azar et al. 1972; ILO 1971] and animals [Aviado and Smith 1975; Reinhardt et al. 1971].

REFERENCES:

1. Aviado DM, Smith DG [1975]. Toxicity of aerosol propellants in the respiratory and circulatory systems. Toxicology 3:241-252.
2. Azar A, Reinhardt CF, Maxfield ME, et al. [1972]. Experimental human exposure to fluorocarbon 12 (dichlorodifluoromethane). Am Ind Hyg Assoc J 3:207-216.
3. ILO [1971]. Fluorocarbons. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 560-562.

4. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 34-40.
5. Paulet G [1976]. Les fluorocarbones en question. J Eur Toxicol (Supplement) *9*:385-407 (in French).
6. Reinhardt CF, Azar A, Maxfield ME, Smith PE Jr, Mullin LS [1971]. Cardiac arrhythmias and aerosol "sniffing." Arch Environ Health 22:265-279.
7. Scholz J [1962]. New toxicological investigations on certain types of freon used as propellants. Fortschr Biol Aerosol-forsch 1957-61 (in German). Ber Aerosol Kongr *4*:420-429. [From ACGIH [1991]. Dichlorodifluoromethane. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 420-422.]

1,3-Dichloro-5,5-dimethylhydantoin

CAS number	118-52-5
NIOSH REL	0.2 mg/m³ TWA, 0.4 mg/m³ STEL
Current OSHA PEL	0.2 mg/m³ TWA
1989 OSHA PEL	0.2 mg/m³ TWA, 0.4 mg/m³ STEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA, 0.4 mg/m³ STEL
Description of Substance	White powder with a chlorine-like odor.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 5 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Very little data are available on which to base an IDLH for 1,3-dichloro-5,5-dimethylhydantoin. For this draft technical standard, therefore, the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 25 × the OSHA PEL of 0.2 mg/m³ (i.e., 5 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 5 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Glyco 1981	-----	20,000 mg/m³	1 hr	25,000 mg/m³ (1.25)	2,500 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kay 1961/1962	oral	542	-----	3,794 mg/m³	379 mg/m³
Rabbit	Korolev et al. 1982	oral	1,520	-----	10,640 mg/m³	1,064 mg/m³
G. pig	Korolev et al. 1982	oral	1,350	-----	9,450 mg/m³	945 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5 mg/m³
Basis for revised IDLH: Based on health considerations and acute oral toxicity data in animals [Kay 1961/62; Korolev et al. 1982], a value of about 500 mg/m³ would have been appropriate for 1,3-dichloro-5,5-dimethylhydantoin. However, the revised IDLH for 1,3-dichloro-5,5-dimethylhydantoin is 5 mg/m³ based on being 25 times the NIOSH REL and OSHA PEL of 0.2 mg/m³ (25 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for 1,3-dichloro-5,5-dimethylhydantoin).

REFERENCES:

1. Chrostek WJ, Cromer JW [1975]. Health hazard evaluation report HHE 73-160-206, Glyco Chemicals, Inc., Williamsport, PA. Cincinnati, OH: National Institute for Occupational Safety and Health, Division of Surveillance, Hazard Evaluations, and Field Studies.
2. Glyco Chemicals [1981]. 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidinedione. In: TSCA 8(e) Submission to the U.S. Environmental Protection Agency (8EHQ-0281-0382). Williamsport,PA: Glyco® Chemicals, Inc.
3. Kay JH [1961/1962]. Unpublished technical reports. Northbrook, IL: Industrial Bio-Test Laboratories. (August 28, 1961; May 1, 1962).
4. Korolev AA, Vasilenko VE, et al. [1982]. Hygienic standard of dichloantine and the product of its transforation with dimethylhydantoin in water. Gig Sanit 47(6):76-78 (in Russian).

1,1-Dichloroethane

CAS number	75-34-3
NIOSH REL	100 ppm (400 mg/m^3) TWA
Current OSHA PEL	100 ppm (400 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (400 mg/m^3) TWA
Description of Substance	Colorless, oily liquid with a chloroform-like odor.
LEL	5.4% (10% LEL, 5,400 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	Patty [1963] reported that rats survived 8-hour exposures to 4,000 ppm, but died at 16,000 ppm [Smyth 1956]. However, 16,000 ppm has not been chosen as the IDLH because Kirk-Othmer [1964] indicated that 1,1-dichloroethane causes narcosis. For this draft technical standard, 4,000 ppm is chosen as the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	16,000	4 hr	32,000 ppm (2.0)	3,200 ppm
Mouse	Mueller 1925	-----	17,300	2 hr	27,680 ppm (1.6)	2,768 ppm
Rat	Smyth 1956	-----	16,000	8 hr	40,000 ppm (2.5)	4,000 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 3,000 ppm
Basis for revised IDLH: The revised IDLH for 1,1-dichloroethane is 3,000 ppm based on acute inhalation toxicity data in animals [Carpenter et al. 1949; Mueller 1925].

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.
2. Kirk-Othmer [1964]. Encyclopedia of chemical technology. 2nd ed. New York, NY: John Wiley & Sons, Inc. *5*:92-98.
3. Mueller J [1925]. Comparative investigations on the anesthetic and toxic effects of some halogenated hydrocarbons. Arch Exp Pathol Pharmakol *109*:276-294 (in German). [From ACGIH [1991]. 1,1-Dichloroethane. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 425-426.]
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 1279-1280.
5. Smyth HF Jr [1956]. Improved communication: hygianic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

1,2-Dichloroethylene

CAS number	540-59-0
NIOSH REL	200 ppm (790 mg/m^3) TWA
Current OSHA PEL	200 ppm (790 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	200 ppm (790 mg/m^3) TWA
Description of Substance	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.
LEL	5.6% (10% LEL, 5,600 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	Patty [1963] reported that rats exposed to the cis-isomer of dichloroethylene for 4 hours at 8,000 ppm were neither killed nor anesthetized, but at 16,000 ppm, anesthesia occurred in 8 minutes and death occurred in 4 hours [Smyth 1956]. Because Patty [1963] also reported that the trans-isomer was twice as toxic and anesthetic as the cis-isomer, an IDLH of 4,000 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
trans-isomer Mouse	ATSDR 1990	21,723	-----	6 hr	130,338 ppm (2.3)	13,034 ppm
cis-isomer Rat	Smyth 1956	-----	16,000	6 hr	32,000 ppm (2.0)	3,200 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	USDA 1966	oral	770	-----	1,337 ppm	134 ppm
trans-isomer Rat	Freudt et al. 1977	oral	1,275	-----	8,925 ppm	893 ppm

Human data . . . . It has been reported that exposure to the trans-isomer at 2,200 ppm caused burning of the eyes, vertigo, and nausea [von Oettingen 1955]. An exposure to the trans-isomer at 819 ppm for 30 minutes has been reported to cause no untoward effects, while inhalation of either 1,687 to 2,184 ppm for 5 minutes or 1,191 ppm for 10 minutes has resulted in vertigo, pressure in the head, and somnolence [von Oettingen 1937].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for 1,2-dichloroethylene is 1,000 ppm based on acute inhalation toxicity data in humans [von Oettingen 1937, 1955].

REFERENCES:

1. ATSDR [1990]. Toxicological profile for 1,2-dichloroethene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. ATSDR/TP-90-13, pp. 9-52.
2. Freudt KJ, Liebaldt GP, Lieberwirth E [1977]. Toxicity studies on trans-1,2-dichloroethylene. Toxicology 7:141-153.

3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1308.
4. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.
5. USDA [1966]. Informative memo no. 20. Beltsville, MD: U.S. Department of Agriculture, Agricultural Research Service, Entomology Research Division, Pesticide Chemicals Research Branch, p. 10.
6. von Oettingen WF [1937]. The halogenated hydrocarbons: their toxicity and potential dangers. J Ind Hyg Toxicol *19*(8):409-411.
7. von Oettingen WF [1955]. The halogenated hydrocarbons, toxicity and potential dangers. Washington, DC: U.S. Public Health Service Publication No. 414, p. 199. [From ACGIH [1991]. 1,2-Dichloroethylene. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 429-431.]

Dichloroethyl ether

CAS number 111-44-4
NIOSH REL .... 5 ppm (30 mg/m³) TWA, 10 ppm (60 mg/m³) STEL [skin]; NIOSH considers dichloroethyl ether to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 15 ppm (90 mg/m³) CEILING [skin]
1989 OSHA PEL .... 5 ppm (30 mg/m³) TWA, 10 ppm (60 mg/m³) STEL [skin]
1993-1994 ACGIH TLV .... 5 ppm (29 mg/m³) TWA, 10 ppm (58 mg/m³) STEL [skin]
Description of Substance .... Colorless liquid with a chlorinated solvent-like odor.
LEL. .... 2.7% (10% LEL, 2,700 ppm)
Original (SCP) IDLH .... 250 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by Patty [1963] that 250 ppm caused death in rats from a 4-hour exposure [Carpenter et al. 1949] and that 500 to 1000 ppm might cause death in guinea pigs from an exposure of only 30 to 60 minutes duration [Schrenk et al. 1933].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	250	4 hr	500 ppm (2.0)	50 ppm
Rat	Izmerov et al. 1982	77	-----	4 hr	154 ppm (2.0)	15 ppm
Mouse	Izmerov et al. 1982	152	-----	2 hr	243 ppm (1.6)	24 ppm
G. pig	Marhold 1986	500	-----	1 hr	625 ppm (1.25)	63 ppm
G. pig	Schrenk et al. 1933	-----	500	5 hr	1,075 ppm (2.15)	108 ppm

Human data .... Volunteers found brief (undefined) exposures to 100 to 260 ppm to be tolerable, although irritating [Schrenk et al. 1933].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for dichloroethyl ether is 100 ppm based on acute inhalation toxicity data in humans [Schrenk et al. 1933]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 ppm. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for dichloroethyl ether at concentrations above 5 ppm.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani C [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol 31:343-346.
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 45.
3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 541 (in Czechoslovakian).
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1675.
5. Schrenk HH, Patty FA, Yant WP [1933]. Acute response of guinea pigs to vapors of some new commercial organic compounds. VII. Dichloroethyl ether. Public Health Rep 48(46):1389-1398.

Dichloromonofluoromethane

CAS number	75-43-4
NIOSH REL	10 ppm (40 mg/m³) TWA
Current OSHA PEL	1,000 ppm (4,200 mg/m³) TWA
1989 OSHA PEL	10 ppm (40 mg/m³) TWA
1993-1994 ACGIH TLV	10 ppm (42 mg/m³) TWA
Description of Substance	Colorless gas with a slight, ether-like odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	50,000 ppm
Basis for original (SCP) IDLH	ACGIH [1971] reported that 52,000 ppm produced incoordination, irregular breathing, and tremors in guinea pigs [Underwriters' Laboratory 1935]. Scheel (member of the Standards Completion Program Respirator Committee), in evaluating the work of Aviado and Belej [1974], indicated cardiac toxicity at 100,000 ppm. Based on the above data, an IDLH of 50,000 ppm has been chosen.

Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 100 ppm
24-hour EEGL: 3 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Kozbakova 1976	>800,000 mg/m³	-----	2 hr	>373,832 ppm (2.0)	>37,383 ppm
Rat	Tappan and Waritz 1964	49,900 ppm	-----	4 hr	99,800 ppm (2.0)	9,980 ppm
G. pig	von Weigand 1971	-----	100,000 ppm	<1 hr	<125,000 ppm (1.25)	<12,500 ppm
Mouse	von Weigand 1971	-----	100,000 ppm	<1 hr	<125,000 ppm (1.25)	<12,500 ppm

Other animal data .... In 5-minute cardiac sensitization screening tests, 2 of 12 unanesthetized dogs exposed to 10,000 ppm of dichloromonofluoromethane plus intravenous epinephrine showed evidence of serious arrhythmia; no response was noted at 5,000 ppm [Mullin 1975].

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5,000 ppm
Basis for revised IDLH: The revised IDLH for dichloromonofluoromethane is 5,000 ppm based on acute inhalation toxicity data in animals [Mullin 1975; Tappan and Waritz 1964; von Weigand 1971]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. Dichloromonofluoromethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 81-82.
2. Aviado DM, Belej MA [1974]. Toxicity of aerosol propellants on the respiratory and circulatory systems. I. Cardiac arrythmia in the mouse. Toxicology 2:31-42.
3. Kozbakova AE [1976]. Comparative toxicity of chlorinated and fluorinated methane and ethane derivatives. Gig Tr Prof Zabol 20(11):38-41 (in Russian).
4. Mullin LS [1975]. Unpublished data. Newark, DE: Haskell Laboratory, E.I. DuPont de Nemours and Company, November 1975. [From ACGIH [1991]. Dichlorofluoromethane. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 434-435.]

5. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 41-45.
6. Tappan CH, Waritz RS [1964]. Unpublished data: acute inhalation toxicity of Freon-21® (fluorodichloromethane). Report No. 128-64. Newark, DE: E.I. DuPont de Nemours and Company, Haskell Laboratory for Toxicology and Industrial Medicine, November 1964.
7. Underwriters' Laboratory [1935]. The comparative life, fire, and explosion hazards of dichloromonofluoromethane (F21). Miscellaneous Hazard Report No. 2630. [From ACGIH [1971]. Dichloromonofluoromethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 81-82.]
8. von Weigand W [1971]. Investigations on the inhalation toxicity of fluorine derivatives of methane, ethane, and cyclobutane. Zentralbl Arbeitsmed Arbeitsschutz *21*:149-156 (in German).

1,1-Dichloro-1-nitroethane

CAS number 594-72-9
NIOSH REL .... 2 ppm (10 mg/m^3) TWA
Current OSHA PEL .... 10 ppm (60 mg/m^3) CEILING
1989 OSHA PEL .... 2 ppm (10 mg/m^3) TWA
1993-1994 ACGIH TLV .... 2 ppm (12 mg/m^3) TWA
Description of Substance .... Colorless liquid with an unpleasant odor.
LEL. .... Unknown
Original (SCP) IDLH .... 150 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the study by Machle et al. [1945] in which autopsies on animals exposed to over 170 ppm for over 30 minutes revealed pulmonary edema and hemorrhage, with damage to the heart, liver, and kidneys.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Machle et al. 1945	170	-----	30 min	170 ppm (1.0)	17 ppm
G. pig	Machle et al. 1945	170	-----	30 min	170 ppm (1.0)	17 ppm
Rabbit	Machle et al. 1945	97	-----	6 hr	223 ppm (2.3)	22 ppm
G. pig	Machle et al. 1945	97	-----	6 hr	223 ppm (2.3)	22 ppm
Rabbit	Machle et al. 1945	52	-----	18.75 hr	172 ppm (3.33)	17 ppm
G. pig	Machle et al. 1945	52	-----	18.75 hr	172 ppm (3.33)	17 ppm

Other animal data .... Animals have tolerated 25 ppm for 204 hours [Machle et al. 1945].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 25 ppm
Basis for revised IDLH: The revised IDLH for 1,1-dichloro-1-nitroethane is 25 ppm based on acute inhalation toxicity data in animals [Machle et al. 1945]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCE:

1. Machle W, Scott EW, Treon JF, Heyroth FF, Kitzmiller KV [1945]. The physiological response of animals to certain chlorinated mononitroparaffins. J Ind Hyg Toxicol 27(4):95-102.

Dichlorotetrafluoroethane

CAS number	76-14-2
NIOSH REL	1,000 ppm (7,000 mg/m³) TWA
Current OSHA PEL	1,000 ppm (7,000 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (6,990 mg/m³) TWA
Description of Substance	Colorless gas with a faint, ether-like odor at high concentrations.
LEL	Nonflammable Gas
Original (SCP) IDLH	50,000 ppm
Basis for original (SCP) IDLH	Dichlorotetrafluoroethane is known to be a narcotic in high concentrations, but no human exposure data are available concerning its narcotic effects. Based on an analogy with dichlorodifluoromethane, a related compound that produces dizziness in humans at 50,000 ppm [ILO 1971], an IDLH of 50,000 ppm is assumed for this draft technical standard.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs): 1-hr EEGL: 10,000 ppm 24-hr EEGL: 1,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Paulet 1976	720,000	-----	30 min	720,000 ppm (1.0)	72,000 ppm
Mouse	Paulet 1976	700,000	-----	30 min	700,000 ppm (1.0)	70,000 ppm
Rabbit	Paulet 1976	750,000	-----	30 min	750,000 ppm (1.0)	75,000 ppm

Other animal data	Evidence of serious arrhythmia was noted in 1 of 12 dogs exposed for 5 minutes to 25,000 ppm plus intravenous epinephrine [Reinhardt et al. 1971]. Cardiac sensitization has been induced with endogenous epinephrine at 50,000 to 800,000 ppm [Mullin et al. 1972; Reinhardt et al. 1971].
Human data	Significant reduction in ventilatory lung capacity, bradycardia, and increased variability in heart rate have been reported following exposures to 2,300 to 21,400 ppm for 15, 45, or 60 seconds [IPCS 1990].

Revised IDLH: 15,000 ppm
Basis for revised IDLH: The revised IDLH for dichlorotetrafluoroethane is 15,000 ppm based on acute inhalation toxicity data in animals [Reinhardt et al. 1971] and an analogy to dichlorodifluoroethane, another closely related halogenated hydrocarbon, which has a revised IDLH of 15,000 ppm.

REFERENCES:

1. ILO [1971]. Fluorocarbons. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 560-562.
2. IPCS [1990]. Environmental criteria 13. Fully halogenated chlorofluorocarbons. Geneva, Switzerland: World Health Organization, International Programme on Chemical Safety.
3. Mullin LS, Azar A, Reinhardt CF, Smith PE Jr, Fabryka EF [1972]. Halogenated hydrocarbon-induced cardiac arrhythmias with release of endogenous epinephrine. Am Ind Hyg Assoc J 33:389-396.
4. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 51-55.
5. Paulet G [1976]. Les fluorocarbones en question. J Eur Toxicol (Supplement) 9(7):385-407 (In French).
6. Reinhardt CF, Azar A, Maxfield ME, et al. [1971]. Cardiac arrhythmias and aerosol sniffing. Arch Environ Health 22:265-279.

Dichlorvos

CAS number	62-73-7
NIOSH REL	1 mg/m^3 TWA [skin]
Current OSHA PEL	1 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.90 mg/m^3 (0.1 ppm) TWA [skin]
Description of Substance	Colorless to amber liquid with a mild, chemical odor.
LEL	Unknown
Original (SCP) IDLH	200 mg/m^3
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for dichlorvos. If the IDLH were estimated from the female rat oral LD_{50} of 55 mg/kg [Mattson et al. 1955 cited by Patty 1963], an IDLH of 400 mg/m^3 would be chosen. On the basis of an analogy with parathion, however, which has an OSHA PEL of 0.1 mg/m^3 and an IDLH of 20 mg/m^3, an IDLH of 200 mg/m^3 has been chosen for dichlorvos which has an OSHA PEL of 1 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Gig Sanit 1968	15 mg/m^3	-----	4 hr	30 mg/m^3 (2.0)	3.0 mg/m^3
Mouse	Gig Sanit 1968	13 mg/m^3	-----	4 hr	16 mg/m^3 (2.0)	2.6 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Hartley and Kidd 1984	oral	100	-----	700 mg/m^3	70 mg/m^3
Mouse	Ikuzawa et al. 1966	oral	61	-----	427 mg/m^3	43 mg/m^3
Rabbit	Koksharova et al. 1977	oral	10	-----	70 mg/m^3	7.0 mg/m^3
Rat	Technical News 1972	oral	17	-----	119 mg/m^3	12 mg/m^3

Human data .... Exposure to a concentration of 1 mg/m^3 for 7.5 to 8.5 hours resulted in a plasma cholinesterase depression of 20 to 25% [Hunter 1964].

Revised IDLH: 100 mg/m^3
Basis for revised IDLH: The revised IDLH for dichlorvos is 100 mg/m^3 based on an analogy to parathion. Since the toxicity of dichlorvos is about 10 times lower than parathion (based on acute oral toxicity data in animals), the revised IDLH for dichlorvos is 10 times the revised IDLH for parathion (10 mg/m^3).

REFERENCES:

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Dieldrin

CAS number	60-57-1
NIOSH REL	0.25 mg/m³ TWA [skin]; NIOSH considers dieldrin to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.25 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.25 mg/m³ TWA [skin]
Description of Substance	Colorless to light-tan crystals with a mild, chemical odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	450 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for dieldrin. The chosen IDLH, therefore, has been estimated from the statement by Deichmann and Gerarde [1969] that an oral dose of 65 mg/kg is believed to be a reasonable estimate of the lethal dose in man. Thienes and Haley [1972] and Gleason et al. [1969] reported similar estimates of the lethal dose for man [Hodge et al. 1967; Kalushner 1960].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Gig Tr Prof Zabol 1964	80 mg/m³	-----	4 hr	160 mg/m³ (2.0)	16 mg/m³
Rat	Izmerov et al. 1982	13 mg/m³	-----	4 hr	26 mg/m³ (2.0)	2.6 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	AAPCO 1966	oral	45	-----	315 mg/m³	32 mg/m³
G. pig	AAPCO 1966	oral	49	-----	343 mg/m³	34 mg/m³
Mouse	Kenaga and Morgan 1978	oral	38	-----	266 mg/m³	27 mg/m³
Dog	Spencer 1973	oral	65	-----	455 mg/m³	46 mg/m³
Rat	Treon and Cleveland 1955	oral	38	-----	266 mg/m³	27 mg/m³

Human data ..... The lethal oral dose has been estimated to be about 5 grams [Deichmann and Gerarde 1969; Hodge et al. 1967]. [Note: An oral dose of 5 grams is equivalent to a worker being exposed to 3,300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 50 mg/m³
Basis for revised IDLH: The revised IDLH for dieldrin is 50 mg/m³ based on acute oral toxicity data in humans [Deichmann and Gerarde 1969; Hodge et al. 1967]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for dieldrin at concentrations above 0.25 mg/m³.]

REFERENCES:

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Dieldrin (continued)

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5. Hodge HC, Boyce AM, Deichmann WB, Kraybill HF [1967]. Toxicology and no-effect levels of aldrin and dieldrin. Toxicol Appl Pharmacol *10*:613-675.
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7. Kalushner A [1960]. Occupational dieldrin poisoning. JAMA *172*(18):148-151.
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11. Treon JF, Cleveland FP [1955]. Toxicity of certain chlorinated hydrocarbon insecticides for laboratory animals. J Agri Food Chem *3*:402-403.

Diethylamine

CAS number	109-89-7
NIOSH REL	10 ppm (30 mg/m^3) TWA, 25 ppm (75 mg/m^3) STEL
Current OSHA PEL	25 ppm (75 mg/m^3) TWA
1989 OSHA PEL	10 ppm (30 mg/m^3) TWA, 25 ppm (75 mg/m^3) STEL
1993-1994 ACGIH TLV	5 ppm (15 mg/m^3) TWA, 15 ppm (45 mg/m^3) STEL [skin]
Description of Substance	Colorless liquid with a fishy, ammonia-like odor.
LEL	1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	Patty [1963] made the statement that a 4-hour exposure to 4,000 ppm killed 3 of 6 rats. However, because of the severe eye and lung irritation that occurs as a result of exposure to high concentrations of diethylamine, an IDLH of 2,000 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hine et al. 1960	4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Hine et al. 1960	oral	540	-----	1,243 ppm	124 ppm
Mouse	Patel et al. 1985	oral	500	-----	1,151 ppm	115 ppm

Other animal data	RD_{50} (mouse), 184 ppm [Nielsen and Yamagiwa 1989].
Human data	It has been stated that the simple alkyl amines are generally more toxic than ammonia [ACGIH 1991]. The American Conference of Governmental Industrial Hygienists TLV for diethylamine (10 ppm TWA, 25 ppm STEL) was based on an analogy to ammonia (25 ppm TWA, 35 ppm STEL) [ACGIH 1991].

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for diethylamine is 200 ppm based on acute inhalation toxicity data in animals [Nielsen and Yamagiwa 1989] and an analogy to ammonia [ACGIH 1991].

REFERENCES:

1. ACGIH [1991]. Diethylamine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 460-461.
2. Hine CH, Kodama JK, Guzman RJ, Loquvam GS [1960]. The toxicity of allylamines. Arch Environ Health *1*:343-352.
3. Nielsen GD, Yamagiwa M [1989]. Structure-activity relationships of airway irritating aliphatic amines, receptor activation mechanisms and predicted industrial exposure limits. Chem Biol Interact *71*(2/3):228-244.
4. Patel VK, Venkatakrishna-Bhatt H, Patel NB, Jindal MN [1985]. Pharmacology of new glutarimide compounds. Biomed Biochim Acta *44*(5):795-803.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2044.

2-Diethylaminoethanol

CAS number	100-37-8
NIOSH REL	10 ppm (50 mg/m^3) TWA [skin]
Current OSHA PEL	10 ppm (50 mg/m^3) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (48 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with a nauseating, ammonia-like odor.
LEL	Unknown
Original (SCP) IDLH	500 ppm
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for diethylaminoethanol. The chosen IDLH is based on the following statements by Cornish [1965]: "exposure of rats to 500 ppm, 6 hours daily for 5 days, resulted in severe weight loss and high mortality. Daily exposure at 200 ppm resulted in the death of 7 of 50 rats during the first month. A single human exposure for a few seconds to a level well below 200 ppm resulted in nausea and vomiting."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Lomonova 1970	924	-----	4 hr	1,848 ppm (2.0)	185 ppm
Mouse	Lomonova 1970	1,027	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth and Carpenter 1944	oral	1,300	-----	1,869 ppm	187 ppm

Human data	A very short exposure (<30 seconds) to a concentration estimated to be less than 100 ppm has resulted in nausea and vomiting within 5 minutes; other persons in the same room also complained of the nauseating odor but did not become ill [Cornish 1965].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 2-diethylaminoethanol is 100 ppm based on acute inhalation toxicity data in humans [Cornish 1965].

REFERENCES:

1. Cornish HH [1965]. Oral and inhalation toxicity of 2-diethylaminoethanol. Am Ind Hyg Assoc J *26*:479-484.
2. Lomonova GV [1970]. Toxicology data on dimethylethanolamine and diethylethanolamine. Gig Tr Prof Zabol *14*(11):52-53 (translated).
3. Smyth HF Jr, Carpenter CP [1944]. The place of the range-finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *26*:269-273.

Difluorodibromomethane

CAS number 75-61-6
NIOSH REL .... 100 ppm (860 mg/m^3) TWA
Current OSHA PEL .... 100 ppm (860 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 100 ppm (858 mg/m^3) TWA
Description of Substance .... Colorless, heavy liquid or gas (above 76°F) with a characteristic odor.
LEL. .... Noncombustible Liquid/Nonflammable Gas
Original (SCP) IDLH .... 2,500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the rat LC_{LO} of 2,300 ppm [Comstock et al. 1953 cited by NIOSH 1974] and on the statement by Patty [1963] that 4,000 ppm for 15 minutes caused significant pulmonary damage in rats [Chambers et al. 1950].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Chambers et al. 1950	-----	54,630	15 min	43,158 ppm (0.79)	4,316 ppm
Rat	Comstock and Oberst 1952	-----	55,000	15 min	43,450 ppm (0.79)	4,345 ppm

Other animal data .... It has been reported that 4,000 ppm for 15 minutes caused significant pulmonary damage in rats [Chambers et al. 1950]. Fatalities were noted in rats after exposures of to 2,300 ppm for 6 hours/day, 5 days/week for 7 weeks [Comstock et al. 1953].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for difluorodibromomethane is 2,000 ppm based on inhalation toxicity data in animals [Chambers et al. 1950; Comstock et al. 1953].

REFERENCES:

1. Chambers WH, Krachow EH, McGroth FP, Goldberg SB, Lawson LH, McNamee K [1950]. An investigation of the toxicity of proposed fire extinguishing fluids. Part III. The pathology in rats produced by inhalation of vapors of proposed fire extinguishing compounds. Army Chemical Center, MD: U.S. Army Chemical Corps, Medical Division Research Report No. 23, p. 33.
2. Comstock CC, Oberst FW [1952]. Comparative inhalation toxicities of carbon tetrachloride, monochloromonobromomethane, difluorodibromomethane and trifluoromonobromomethane to rats and mice in the presence of gasoline fires. Army Chemical Center, MD: U.S. Army Chemical Corps Medical Laboratories, Research Report No. 107, p. 52.
3. Comstock CC, Kerschner J, Oberst FW [1953]. Toxicology of inhaled trifluoromonobromomethane and difluorodibromomethane vapors from subacute and chronic exposures of rats and dogs. Army Chemical Center, MD: U.S. Army Chemical Corps, Medical Laboratory Research Report No. 160, p. 6.
4. NIOSH [1974]. PA75250. Methane, dibromodifluoro-. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 477.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1328.

Diglycidyl ether

CAS number 2238-07-5
NIOSH REL .... 0.1 ppm (0.5 mg/m³) TWA; NIOSH considers diglycidyl ether to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.5 ppm (2.8 mg/m³) CEILING
1989 OSHA PEL .... 0.1 ppm (0.5 mg/m³) TWA
1993-1994 ACGIH TLV .... 0.1 ppm (0.53 mg/m³) TWA
Description of Substance .... Colorless liquid with a strong, irritating odor.
LEL. .... Unknown
Original (SCP) IDLH .... 25 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the male mouse 4-hour LC_{50} of 30 ppm [Hine et al. 1956].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hine et al. 1956	30	-----	4 hr	60 ppm (2.0)	6.0 ppm
Mouse	Hine et al. 1961	86	-----	4 hr	192 ppm (2.0)	19 ppm
Mouse	Hine et al. 1961	30	-----	8 hr	75 ppm (2.5)	7.5 ppm
Rat	Hine et al. 1961	200	-----	4 hr	400 ppm (2.0)	40 ppm
Rat	Hine et al. 1961	68	-----	8 hr	170 ppm (2.5)	17 ppm
Rat	Marhold 1986	200	-----	4 hr	400 ppm (2.0)	40 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 10 ppm
Basis for revised IDLH: The revised IDLH for diglycidyl ether is 10 ppm based on acute inhalation toxicity data in animals [Hine et al. 1956; Hine et al. 1961]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for diglycidyl ether at concentrations above 0.1 ppm.]

REFERENCES:

1. Hine CH, Kodama JK, Wellington JS, Dunlap MK, Anderson HH [1956]. The toxicology of glycidol and some glycidyl ethers. AMA Arch Ind Health *14*:250-264.
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3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 773 (in Czechoslovakian).

Diisobutyl ketone

CAS number 108-83-8
NIOSH REL .... 25 ppm (150 mg/m^3) TWA
Current OSHA PEL .... 50 ppm (290 mg/m^3) TWA
1989 OSHA PEL .... 25 ppm (150 mg/m^3) TWA
1993-1994 ACGIH TLV .... 25 ppm (145 mg/m^3) TWA
Description of Substance .... Colorless liquid with a mild, sweet odor.
LEL(@200°F) .... 0.8% (10% LEL(@200°F), 800 ppm)
Original (SCP) IDLH .... 2,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the UCC [1971] report that "breathing saturated vapors in air killed 1 of 6 animals in 8 hours; breathing 2,000 ppm for 8 hours killed 5 of 6 animals. Breathing 1,000 ppm for 8 hours produced illness but no deaths." This is the only useful data available on which to base the IDLH for this substance.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1949	-----	2,000	4 hr	4,000 ppm (2.0)	400 ppm
Rat	Smyth et al. 1949	2,000	-----	8 hr	5,000 ppm (2.5)	500 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	NPIRI 1974	oral	5,750	-----	6,799 ppm	680 ppm
Mouse	Shell 1961	oral	1,416	-----	1,674 ppm	167 ppm
Rat	Smyth et al. 1949	oral	5,800	-----	6,858 ppm	686 ppm

Human data .... It has been reported that a 3-hour exposure at 50 or 100 ppm caused slight irritation to the eyes, nose, and throat [Smyth et al. 1949].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for diisobutyl ketone is 500 ppm based on acute inhalation toxicity data in animals [Smyth et al. 1949].

REFERENCES:

1. Carpenter CP, Pozzani UC, Weil CS [1953]. Toxicity and hazard of diisobutyl ketone vapors. AMA Arch Ind Hyg Occup Med *8*:377-381.
2. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 23.
3. Shell [1961]. Unpublished report. Shell Chemical Company, p. 4.
4. Smyth HF Jr, Carpenter CP, Weil CS [1949]. Range-finding toxicity data: list III. J Ind Hyg Toxicol *31*:60-62.
5. UCC [1971]. Toxicology studies: diisobutyl ketone. New York, NY: Union Carbide Corporation.

Diisopropylamine

CAS number	108-18-9
NIOSH REL	5 ppm (20 mg/m^3) TWA [skin]
Current OSHA PEL	5 ppm (20 mg/m^3) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (21 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with an ammonia- or fish-like odor.
LEL	1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1971] report that a 4-hour exposure to 1,000 ppm killed 2 of 6 rats. Patty [1963] reported the same information [Smyth et al. 1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	1,140	-----	2 hr	1,824 ppm (1.6)	182 ppm
Mouse	Izmerov et al. 1982	1,000	-----	2 hr	1,596 ppm (1.6)	160 ppm
Rat	Smyth et al. 1954	LC_{33}: 1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm
Rabbit	Treon et al. 1949	-----	2,207	2.5 hr	3,752 ppm (1.7)	375 ppm
G. pig	Treon et al. 1949	-----	2,207	80 min	3,090 ppm (1.4)	309 ppm
Cat	Treon et al. 1949	-----	2,207	72 min	2,869 ppm (1.3)	287 ppm

Human data .... Complaints of nausea, headache, and temporary dimness in vision were reported in workers 2 to 3 hours following several 5- to 10-minute exposures to about 176 ppm; concentrations otherwise during the workshift averaged about 24 to 48 ppm [Treon et al. 1949]

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for diisopropylamine is 200 ppm based on acute inhalation toxicity data in workers [Treon et al. 1949] and animals [Izmerov et al. 1982; Smyth et al. 1954].

REFERENCES:

1. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 54.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2044.
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
4. Treon JF, Sigmon H, Kitzmiller KV, Heyroth FF [1949]. The physiological response of animals to respiratory exposure to the vapors of diisopropylamine. J Ind Hyg Toxicol 31:142-145.
5. UCC [1971]. Toxicology studies: diisopropyl amine. New York, NY: Union Carbide Corporation.

Dimethyl acetamide

CAS number	127-19-5
NIOSH REL	10 ppm (35 mg/m³) TWA [skin]
Current OSHA PEL	10 ppm (35 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (36 mg/m³) TWA [skin]
Description of Subetance	Colorless liquid with a weak, ammonia- or fish-like odor.
LEL(@212°F)	1.8% (10% LEL(@212°F), 1,800 ppm)
Original (SCP) IDLH	400 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Deichmann and Gerarde [1969] that acute inhalation at 406 and 575 ppm causes some deaths and degeneration of the liver in several species of laboratory animals. Although no time period is specified for that exposure, the chosen IDLH is probably reasonable, and perhaps even conservative, because Patty [1963] reported that liver injury was noted only in some rats and dogs exposed to repeated inhalation at 100 to 200 ppm [Horn].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Kennedy and Sherman 1986	2,475	-----	1 hr	2,970 ppm (1.2)	297 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Bartsch et al. 1976	oral	4,620	-----	8,934 ppm	893 ppm
Rat	Monsanto 1990	oral	4,800	-----	9,282 ppm	928 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 300 ppm
Basis for revised IDLH: The revised IDLH for dimethyl acetamide is 300 ppm based on acute inhalation toxicity data in animals [Kennedy and Sherman 1986].

REFERENCES:

1. Bartsch W, Sponer G, Dietmann K, Fuchs G [1976]. Acute toxicity of various solvents in the mouse and rat. Arzneimittel-Forschung (Drug Research) 26(8):1581-1583 (in German).
2. Deichmann WB, Gerarde HW [1969]. Dimethylacetamide (DMA). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 655.
3. Horn HJ [?]. Personal communication. [From Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1834.]
4. Kennedy GL, Sherman H [1986]. Acute and subchronic toxicity of dimethylformamide and dimethylacetamide following various routes of administration. Drug Chem Toxicol 9(2):147-170.
5. Monsanto [1990]. 8EHQ-0590-0981 submission on DMF/DMAC to U.S. EPA. St. Louis, MO: Monsanto Chemical Company. United States Environmental Protection Agency, Office of Pesticides and Toxic Substances.
6. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1834.

Dimethylamine

CAS number 124-40-3
NIOSH REL .... 10 ppm (18 mg/m³) TWA
Current OSHA PEL .... 10 ppm (18 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 ppm (9.2 mg/m³) TWA, 15 ppm (27.6 mg/m³) STEL
Description of Substance .... Colorless gas with an ammonia- or fish-like odor.
LEL .... 2.8% (10% LEL, 2,800 ppm)
Original (SCP) IDLH .... 2,000 ppm
Basis for original (SCP) IDLH .... No data on acute inhalation toxicity are available for dimethylamine. Therefore, the chosen IDLH is based on an analogy with diethylamine which has an IDLH of 2,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Koch et al. 1980	4,700	-----	4 hr	9,400 ppm (2.0)	940 ppm
Rat	Steinhagen et al. 1982	4,540	-----	6 hr	10,442 ppm (2.3)	1,044 ppm
Mouse	Steinhagen et al. 1982	7,650	-----	2 hr	12,240 ppm (1.6)	1,224 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Dzhanashvili 1967	oral	698	-----	2,613 ppm	261 ppm
Mouse	Dzhanashvili 1967	oral	316	-----	1,183 ppm	118 ppm
Rabbit	Dzhanashvili 1967	oral	240	-----	898 ppm	90 ppm
G. pig	Dzhanashvili 1967	oral	240	-----	898 ppm	90 ppm

Other animal data .... RD_{50} (mouse), 511 ppm [Steinhagen et al. 1982]; RD_{50} (rat), 573 ppm [Steinhagen et al. 1982].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for dimethylamine is 500 ppm based on acute inhalation toxicity data in animals [Steinhagen et al. 1982].

REFERENCES:

1. Dzhanashvili GD [1967]. Maximum permissible concentration of dimethylamine in water bodies. Gig Sanit 32(6):329-335 (translated).
2. Koch F, Guenter M, Kliche R, Lang R [1980]. Studies on the aerogenic intoxication of rats by means of methylamines. Wiss Z: Karl Marx University, Leipzig, Math-Naturwiss. Reihe 29:463-474. [From ACGIH [1991]. Dimethylamine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 479-481.]
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N,N-Dimethylaniline

CAS number	121-69-7
NIOSH REL	5 ppm (25 mg/m^3) TWA, 10 ppm (50 mg/m^3) STEL [skin]
Current OSHA PEL	5 ppm (25 mg/m^3) TWA [skin]
1989 OSHA PEL	5 ppm (25 mg/m^3) TWA, 10 ppm (50 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	5 ppm (25 mg/m^3) TWA, 10 ppm (50 mg/m^3) STEL [skin]
Description of Substance	Pale yellow, oily liquid with an amine-like odor.
LEL	Unknown
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	No quantitative data on acute inhalation toxicity are available for dimethylaniline. Because the TLV for dimethylaniline is based on an analogy with aniline [ACGIH 1971], the chosen IDLH is also based on an analogy with aniline, which has an IDLH of 100 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Slusar et al. 1972	-----	50	4 hr	100 ppm (2.0)	10 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1962	oral	1,410	-----	1,958 ppm	196 ppm

Human data .... N,N-Dimethylaniline has been reported to be quantitatively less toxic than aniline but produces a very similar effect -- notably, methemoglobinemia [Clayton and Clayton 1981]. It has been reported that 50 mg/kg is the lethal oral dose [Hall 1969]. [Note: An oral dose of 50 mg/kg is equivalent to a 70-kg worker being exposed to 2,333 mg/m^3 (463 ppm) for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on an analogy with aniline [Clayton and Clayton 1981] which has an IDLH of 100 ppm and to acute oral toxicity data in humans [Hall 1969], the original IDLH for N,N-dimethylaniline (100 ppm) is not being revised for at this time.

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4. Slusar MP, Zvezday VI, Kolodub FA [1972]. Hygienic standardization of N,N-dimethylaniline in the air of industrial premises. Gig Sanit 37(4):35-37 (in Russian).
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Dimethyl-1,2-dibromo-2,2-dichlorethyl phosphate (Naled)

CAS number	300-76-5
NIOSH REL	3 mg/m³ TWA [skin]
Current OSHA PEL	3 mg/m³ TWA
1989 OSHA PEL	3 mg/m³ TWA [skin]
1993-1994 ACGIH TLV	3 mg/m³ TWA [skin]
Description of Substance	Colorless to white solid or straw-colored liquid (above 80°F) with a slightly pungent odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	1,800 mg/m³
Basis for original (SCP) IDLH	Because no useful data on acute inhalation toxicity are available, the chosen IDLH has been estimated from the male rat oral LD_{50} of 250 mg/kg [Gaines 1969 cited by ACGIH 1971]. ACGIH [1971] also reported that the acute toxicity data, inhalation data, and experience to date indicate that this is not a highly dangerous material.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Berteau and Deen 1978	inhalation*	156	-----	1,092 mg/m³	109 mg/m³
Mouse	Berteau and Deen 1978	oral	222	-----	1,554 mg/m³	155 mg/m³
Rat	Berteau and Deen 1978	oral	160	-----	1,120 mg/m³	112 mg/m³
Mammal	Debska et al. 1975	oral	430	-----	3,010 mg/m³	301 mg/m³
Rat	Gaines 1969	oral	250	-----	1,750 mg/m³	175 mg/m³
Mouse	Haley et al. 1975	oral	330	-----	2,310 mg/m³	231 mg/m³

*Note: An inhalation exposure that was presented as "mg/kg."

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 200 mg/m³
Basis for revised IDLH: The revised IDLH for dimethyl-1,2-dibromo-2,2-dichlorethyl phosphate is 200 mg/m³ based on acute toxicity data in animals [Berteau and Deen 1978, Debske et al. 1975; Gaines 1969; Haley et al. 1975].

REFERENCES:

1. ACGIH [1971]. Dibrom (naled). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 73.
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4. Gaines TB [1969]. Acute toxicity of pesticides. Toxicol Appl Pharmacol 14:515-534.
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Dimethylformamide

CAS number	68-12-2
NIOSH REL	10 ppm (30 mg/m³) TWA [skin]
Current OSHA PEL	10 ppm (30 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (30 mg/m³) TWA [skin]
Description of Substance	Colorless to pale-yellow liquid with a faint, amine-like odor.
LEL(@212°F)	2.2% (10% LEL(@212°F), 2,200 ppm)
Original (SCP) IDLH	3,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Clayton et al. [1963] that rats survived a 4-hour exposure to air saturated with dimethylformamide vapor [Smyth and Carpenter 1948] and inhalation of saturated vapors for 6 hours was lethal [Haskell Laboratory]. A.D. Little reports that the saturated concentration at 20°C is 3,550 ppm. Because exposures to rats for 4 hours were at saturated concentrations, 3,500 ppm is chosen as the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Haskell	-----	5,000	6 hr	11,500 ppm (2.3)	1,150 ppm
Mouse	Stasenkova 1961	3,092	-----	2 hr	4,947 ppm (1.6)	496 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Druckrey et al. 1967	oral	2,800	-----	6,447 ppm	645 ppm
Mouse	Lobanova 1958	oral	3,700	-----	8,520 ppm	852 ppm
Rat	Massmann 1956	oral	3,500	-----	8,059 ppm	806 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for dimethylformamide is 500 ppm based on acute inhalation toxicity data in animals [Stasenkov 1961].

REFERENCES:

1. A.D. Little [?]. A.D. Little, Inc. Information supplied to NIOSH during Standards Completion Project.
2. Clayton JW Jr, Barnes JR, Hood DB, Schepers GWH [1963]. The inhalation toxicity of dimethylformamide (DMF). Am Ind Hyg Assoc J *24*:144-154.
3. Druckrey H, Preussmann R, Ivankovic S, Schmahl D [1967]. Organotrope carcinogene wirkungen bei 65 vershiedenen N-nitroso-verbindungen and BD-ratten. Zeitschrift für Krebsforschung *69*:103-201 (in German).
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7. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range-finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *30*(1):63-68.
8. Stasenkova KP [1961]. Toxicity of dimethylformamide. Toksikol Nov Prom Khim Vesh *1*:54-69 (in Russian).

1,1-Dimethylhydrazine

CAS number 57-14-7
NIOSH REL .... 0.06 ppm (0.15 mg/m³) 2-hour CEILING; NIOSH considers 1,1-dimethylhydrazine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.5 ppm (1 mg/m³) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.5 ppm (1.2 mg/m³) TWA [skin], A2
Description of Substance .... Colorless liquid with an ammonia- or fish-like odor.
LEL .... 2% (10% LEL, 2,000 ppm)
Original (SCP) IDLH .... 50 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that 1 of 3 dogs died following a 4-hour exposure to 52 ppm [Jacobson et al. 1955]. Concentrations above 50 ppm may cause permanent eye damage.
Existing short-term exposure guidelines .... American Industrial Hygiene Association [AIHA 1964] Emergency Exposure Limits (EELs):

5-minute EEL: 600 ppm
10-minute EEL: 200 ppm
30-minute EEL: 100 ppm
60-minute EEL: 50 ppm

National Research Council [NRC 1985] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 0.24 ppm
2-hour EEGL: 0.12 ppm
4-hour EEGL: 0.06 ppm
8-hour EEGL: 0.03 ppm
16-hour EEGL: 0.015 ppm
24-hour EEGL: 0.01 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Jacobson et al. 1955	252	-----	4 hr	504 ppm (2.0)	50 ppm
Mouse	Jacobson et al. 1955	172	-----	4 hr	344 ppm (2.0)	34 ppm
Hamster	Jacobson et al. 1955	392	-----	4 hr	784 ppm (2.0)	78 ppm
Dog	Jacobson et al. 1955	LC_{100}: 111	-----	4 hr	222 ppm (2.0)	22 ppm
Dog	Jacobson et al. 1955	LC_{33}: 52	-----	4 hr	104 ppm (2.0)	10 ppm
Dog	Weeks et al. 1963	3,580	-----	15 min	2,828 ppm (0.79)	283 ppm
Rat	Weeks et al. 1963	1,410	-----	1 hr	1,763 ppm (1.25)	176 ppm
Dog	Weeks et al. 1963	981	-----	1 hr	1,226 ppm (1.25)	123 ppm

Other animal data .... No adverse effects were noted in dogs exposed at 50, 200, and 600 ppm for 60, 15, and 5 minutes, respectively; only mild toxic responses were noted at 100, 400, and 1,200 ppm for 60, 15, and 5 minutes, respectively [Weeks et al. 1963].
Human data .... None relevant for use in determining the revised IDLH.

1,1-Dimethylhydrazine (continued)

Revised IDLH: 15 ppm
Basis for revised IDLH: The revised IDLH for 1,1-dimethylhydrazine is 15 ppm based on acute toxicity data in animals [Jacobson et al. 1955]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 1,1-dimethylhydrazine at concentrations above 0.06 ppm.]

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Dimethylphthalate

CAS number	131-11-3
NIOSH REL	5 mg/m^3 TWA
Current OSHA PEL	5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m^3 TWA
Description of Substance	Colorless, oily liquid with a slight, aromatic odor.
LEL(@358°F)	0.9% (10% LEL(@358°F), 11,300 mg/m^3)
Original (SCP) IDLH	9,300 mg/m^3
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Spector [1956] that 9,300 mg/m^3 was a lethal concentration for the cat [Eller 1937].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Eller 1937	-----	9,630 mg/m^3	6 hr	22,149 mg/m^3 (2.3)	2,215 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Lehman 1955	oral	6,900	-----	48,300 mg/m^3	4,830 mg/m^3
Rabbit	Lehman 1955	oral	1,000	-----	7,000 mg/m^3	700 mg/m^3
G. pig	Lehman 1955	oral	2,400	-----	16,800 mg/m^3	1,680 mg/m^3
Rat	Timofeevskaia et al. 1963	oral	6,800	-----	47,600 mg/m^3	4,760 mg/m^3
Mouse	Timofeevskaia et al. 1963	oral	6,800	-----	47,600 mg/m^3	4,760 mg/m^3
Rabbit	Woodard and Hagan 1948	oral	4,400	-----	30,800 mg/m^3	3,080 mg/m^3
G. pig	Woodard and Hagan 1948	oral	2,400	-----	16,800 mg/m^3	1,680 mg/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 mg/m^3
Basis for revised IDLH: The revised IDLH for dimethylphthalate is 2,000 mg/m^3 based on acute inhalation toxicity data in animals [Eller 1937]. [Note: Due to its low volatility, this concentration could only be reached at elevated temperatures or if the liquid droplets become airborne as in a mist.]

REFERENCES:

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5. Woodard G, Hagan EC [1948]. Toxicological investigations of compounds proposed for use as insect repellents. B. Acute oral toxicity. J Pharmacol Exp Ther *93*:26-39.

Dimethyl sulfate

CAS number	77-78-1
NIOSH REL	0.1 ppm (0.5 mg/m³) TWA [skin]; NIOSH considers dimethyl sulfate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	1 ppm (5 mg/m³) TWA [skin]
1989 OSHA PEL	0.1 ppm (0.5 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	0.1 ppm (0.52 mg/m³) TWA [skin], A2
Description of Substance	Colorless, oily liquid with a faint, onion-like odor.
LEL	Unknown
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that a 20-minute exposure to 13 ppm caused severe symptoms in monkeys and a 20-minute exposure to 75 ppm resulted in the LC_{50} for guinea pigs [Ghiringhelli et al. 1957; Ghiringhelli and Sironi 1958]. No other useful data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Batzura et al. 1980	8.6	-----	4 hr	17 ppm (2.0)	1.7 ppm
Human	Deichmann and Gerarde 1969	-----	97	10 min	67 ppm (0.69)	6.7 ppm
G. pig	Ghiringhelli et al. 1957	75	-----	20 min	65 ppm (0.87)	6.5 ppm
Mouse	Gig Tr Prof Zabol 1979	53	-----	?	?	?
G. pig	Marhold 1986	32	-----	1 hr	40 ppm (1.25)	4.0 ppm

Other human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 7 ppm
Basis for revised IDLH: The revised IDLH for dimethyl sulfate is 7 ppm based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for dimethyl sulfate at concentrations above 0.1 ppm.]

REFERENCES:

1. Batzura FD, Kasparov AA, et al. [1980]. Pathogenesis of acute dimethyl sulfate intoxication (experimental study). Gig Tr Prof Zabol *24*(11):55-57 (in Russian).
2. Deichmann WB, Gerarde HW [1969]. Dimethylsulfate (DMS). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 226.
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Dinitrobenzene (o-, m-, p-isomers)

CAS number	528-29-0 (o-isomer), 99-65-0 (m-isomer), 100-25-4 (p-isomer)
NIOSH REL	1 mg/m³ TWA [skin]
Current OSHA PEL	1 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 mg/m³ (0.15 ppm) TWA [skin]
Description of Substance	Pale-white or yellow solid.
LEL	Unknown
Original (SCP) IDLH	200 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for dinitrobenzene. The chosen IDLH, therefore, has been estimated from the statement by Deichmann and Gerarde [1969] that the probable lethal oral dose for an adult is 2 grams.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
p-isomer						
Cat	Spector 1955	oral	-----	29	203 mg/m³	20 mg/m³
m-isomer						
Rat	Kitchens et al. 1978	oral	83	-----	581 mg/m³	58 mg/m³
Rabbit	Kitchens et al. 1978	oral	-----	400	2,800 mg/m³	280 mg/m³

Human data ..... The probable lethal oral dose hes been reported to be 2 grams [Deichmann and Gerarde 1969]. [Note: An oral dose of 2 grams is equivalent to a worker being exposed to about 1,300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 50 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for dinitrobenzene. Therefore, the revised IDLH for dinitrobenzene is 50 mg/m³ based on acute oral toxicity data in humans [Deichmann and Gerarde 1969].

REFERENCES:

1. Deichmann WB, Gerarde HW [1969]. Dinitrobenzenes. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 226-227.
2. Kitchens JF, Harward WE III, Lauter DM, Wentsel RS, Valentine RS [1978]. Preliminary problem definition of 48 munitions-related chemicals. Vol. 1. Explosives related chemicals. Alexandria, VA: Atlantic Research Corporation, U.S. Army Medical Research and Development Command Contract No. DAMD17-77-C-7057.
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Dinitro-o-cresol

CAS number 534-52-1
NIOSH REL .... 0.2 mg/m^3 TWA [skin]
Current OSHA PEL .... 0.2 mg/m^3 TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.2 mg/m^3 TWA [skin]
Description of Substance .... Yellow, odorless solid.
LEL .... Unknown
Original (SCP) IDLH .... 5 mg/m^3
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Hunter [1969] that 4.7 mg/m^3 per day caused the following symptoms in a factory worker: fever, weight loss, a 400% rise in the basal rate of metabolism, rapid pulse, rapid respiration, profuse sweating, shortness of breath, and cough [McDonald 1943]. It is obvious that the chosen IDLH has been set conservatively, but no other quantitative data are available on which to base an IDLH.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Burkatskaya 1965	LC_{33}: 40 mg/m^3	-----	4 hr	80 mg/m^3 (2.0)	8.0 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Colliot 1972	oral	7	-----	49 mg/m^3	4.9 mg/m^3
Cat	DeCeaurriz et al. 1981	oral	50	-----	350 mg/m^3	35 mg/m^3
Mouse	MacEwen and Vernot 1972	oral	21	-----	147 mg/m^3	15 mg/m^3
Rabbit	Popov and Vrochinsky 1976	oral	24.6	-----	172 mg/m^3	17 mg/m^3
G. pig	Popov and Vrochinsky 1976	oral	24.6	-----	172 mg/m^3	17 mg/m^3
Rat	Spencer et al. 1948	oral	31	-----	217 mg/m^3	22 mg/m^3

Human data .... An exposure of 4.7 mg/m^3 per day resulted in fever, a basal metabolic rate of 400, rapid pulse and respiration, profuse sweating, shortness of breath, and cough [Fairhall 1957]. A single oral dose 75 mg produced no toxic effects in five volunteers [Harvey et al. 1951]. [Note: An oral dose of 75 mg is equivalent to a worker being exposed to 50 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 5 mg/m^3 [Unchanged]
Basis for revised IDLH: Based on acute toxicity data in humans [Fairhall 1957; Harvey et al. 1951] and animals [Colliot 1972], the original IDLH for dinitro-o-cresol (5 mg/m^3) is not being revised at this time.

REFERENCES:

1. Burkatskaya EN [1965]. Maximum permissible concentration of dinitro-o-cresol in air. Gig Tr Prof Zabol *30*:34-37 (in Russian).
2. Colliot F [1972]. Intérêt présenté par l'acétate de dinoterbe pour le traitement d'hiver des arbres fruitiers et de la vigne. Defensi des Vegetaux *26*:69-84 (in French).

Dinitro-o-cresol (continued)

3. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett *9*(4):137-143.
4. Fairhall LT [1957]. Industrial toxicology. 2nd ed. Baltimore, MD: Williams & Wilkins Company, p. 230.
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9. Popov TA, Vrochinsky KK [1976]. Materials on substantiation of the threshold of DNOC in water bodies. Gig Sanit *41*(6):12-15 (in Russian).
10. Spencer HC, Rowe VK, Adams EM, Irish DD [1948]. Toxicological studies on laboratory animals of certain alkyldinitrophenols used in agriculture. J Ind Hyg Toxicol *30*:10-28.

Dinitrotoluene (mixed isomers)

CAS number	25321-14-6
NIOSH REL	1.5 mg/m³ TWA [skin]; NIOSH considers dinitrotoluene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	1.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1.5 mg/m³ TWA [skin]
Description of Substance	Orange-yellow crystalline solid with a characteristic odor.
LEL	Unknown
Original (SCP) IDLH	200 mg/m³
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available concerning the physiological response to dinitrotoluene, the chosen IDLH has been estimated from the oral cat minimal lethal dose of 27 mg/kg [White and Hay 1901 and Kuhls 1905 cited by Spector 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
3,5-isomer						
Rat	Rickert et al. 1984	oral	216	-----	1,512 mg/m³	151 mg/m³
2,4-isomer						
Mouse	Rickert et al. 1984	oral	1,954	-----	13,678 mg/m³	1,368 mg/m³
Cat	Rickert et al. 1984	oral	-----	27	189 mg/m³	19 mg/m³

Human data: It has been reported that the toxic effects of dinitrotoluene are similar in character to those of other aromatic nitro compounds, such as dinitrobenzene [ACGIH 1991].

Revised IDLH: 50 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for dinitrotoluene. Therefore, the revised IDLH for dinitrotoluene is 50 mg/m³ based on an analogy with dinitrobenzene [ACGIH 1991]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for dinitrotoluene at concentrations above 1.5 mg/m³.]

REFERENCES:

1. ACGIH [1991]. Dinitrotoluene. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 506-510.
2. Kuhls [1905]. Quantitative experiments on the intake of toxins through the skin (paranitrochlorobenzene, drop oil, dinitrotoluene). Doctoral dissertation (translated). Wurzburg, Germany: Julius Maximillian University, pp. 19-22.
3. Rickert DE, Butterworth BE, Popp JA [1984]. Dinitrotoluene: acute toxicity, oncogenicity, genotoxicity, and metabolism. CRC Crit Rev Toxicol *13*(3):217-234.
4. Spector WS, ed. [1956]. Handbook of toxicology. Vol. I. Acute toxicities. Philadelphia, PA: W.B. Saunders Company, pp. 118-119.
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Di-sec octyl phthalate

CAS number 117-81-7

NIOSH REL .... 5 mg/m³ TWA, 10 mg/m³ STEL; NIOSH considers di-sec octyl phthalate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 5 mg/m³ TWA

1989 OSHA PEL .... 5 mg/m³ TWA, 10 mg/m³ STEL

1993-1994 ACGIH TLV .... 5 mg/m³ TWA, 10 mg/m³ STEL

Description of Substance .... Colorless, oily liquid with a slight odor.

LEL(@474°F) .... 0.3% (10% LEL(@474°F), 8,600 mg/m³)

Original (SCP) IDLH* .... Unknown [*Note: "Effective" IDLH = 5,000 mg/m³ -- see discussion below.]

Basis for original (SCP) IDLH .... Patty [1963] made the statement that inhalation of the vapor-mist mixture produced by bubbling air through a column of plasticizer maintained at 170°C could be tolerated for 2 hours without producing fatalities. In a 4-hour period, however, all rats had succumbed. On the basis of these experiments, the hazard to exposed workers should be very low under ordinary circumstances. Because di-sec octyl phthalate has such a low toxicity, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 1,000 × the OSHA PEL of 5 mg/m³ (i.e., 5,000 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 5,000 mg/m³.

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Autian 1973	oral	34,000	-----	238,000 mg/m³	23,800 mg/m³
G. pig	Autian 1973	oral	26,000	-----	182,000 mg/m³	18,200 mg/m³
Rat	Shibko and Blumenthal 1973	oral	30,600	-----	214,200 mg/m³	21,420 mg/m³
Mouse	Yagi et al. 1976	oral	30,000	-----	210,000 mg/m³	21,000 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5,000 mg/m³

Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for di-sec octyl phthalate. Since the acute oral toxicity data in animals [Autian 1973; Shibko and Blumenthal 1973; Yagi et al. 1976] indicates that di-sec octyl phthalate has low acute toxicity, the revised IDLH for di-sec octyl phthalate is 5,000 mg/m³ based on being 1,000 times the OSHA PEL of 5 mg/m³ (1,000 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for di-sec octyl phthalate). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for di-sec octyl phthalate at concentrations above 5 mg/m³.]

REFERENCES:

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2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1909.
3. Shibko SI, Blumenthal H [1973]. Toxicology of phthalic acid esters used in food-packaging material. Environ Health Perspect 3:131-137.
4. Yagi Y, Tutikawa K, Shimoi N [1976]. Teratogenicity and mutagenicity of a phthalate ester. Int J Abnorm Develop *14*(2):259 [Abstract].

Dioxane

CAS number	123-91-1
NIOSH REL	1 ppm (3.6 mg/m^3) 30-minute CEILING; NIOSH considers dioxane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	100 ppm (360 mg/m^3) TWA [skin]
1989 OSHA PEL	25 ppm (90 mg/m^3) TWA [skin]
1993-1994 ACGIH TLV	25 ppm (90 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid or solid (below 53°F) with a mild, ether-like odor.
LEL	2.0% (10% LEL, 2,000 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the acute inhalation toxicity data cited by AIHA [1960] in which a lethal concentration of 1,000 to 3,000 ppm for 3 hours is reported for guinea pigs, and on the lethal concentration of 2,085 ppm (8 hours) for mice [Klimmer 1937] reported by Spector [1956]. ACGIH [1971] reported that guinea pigs could tolerate 2,000 ppm for several hours without serious symptoms [Yant et al. 1930]. Therefore, exposure of workers to 2,000 ppm for 30 minutes probably would not impede escape or cause any irreversible health effects.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	AIHA 1960	-----	1,000-3,000	3 hr	1,800-5,400 ppm (1.8)	180-540 ppm
Mouse	Izmerov et al. 1982	10,109	-----	2 hr	16,174 ppm (1.6)	1,617 ppm
Cat	Klimmer 1937	-----	12,022	7 hr	28,853 ppm (2.4)	2,885 ppm
Mouse	Klimmer 1937	-----	2,085	8 hr	5,213 ppm (2.5)	521 ppm
Rat	Kosm Biol Aviak Med 1977	12,568	-----	2 hr	20,109 ppm (1.6)	2,011 ppm

Other animal data	Guinea pigs can tolerate 2,000 ppm by inhalation for several hours without serious symptoms; higher concentrations produced eye, nose, and lung irritation [Yant et al. 1930].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for dioxane is 500 ppm based on acute inhalation toxicity data in animals [AIHA 1960; Klimmer 1937]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for dioxane at concentrations above 1 ppm.]

REFERENCES:

1. ACGIH [1971]. Dioxane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 94.
2. AIHA [1960]. Dioxane. In: Hygienic guide series. Am Ind Hyg Assoc J *21*:533-534.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 63.
4. Klimmer O [1937]. Dissertation: Beitrag zur toxikologischen wirkung technischer losungsmittel (in German). Germany: Pharmakologischen Institut der Universitat Wurzburg.
5. Kosm Biol Aviak Med [1977]; *11*(6):53-57 (in Russian).
6. Spector WS, ed. [1956]. Handbook of toxicology. Vol. I. Acute toxicities of solids, liquids and gases to laboratory animals. Philadelphia, PA: W.B. Saunders Co., pp. 334-335.
7. Yant WP, Schrenk HH, Patty FA, Waite CP [1930]. Acute response of guinea pigs to vapors of some new commercial organic compounds. VI. Dioxan. Public Health Rep *45*(2):2023-2032.

Diphenyl

CAS number	92-52-4
NIOSH REL	1 mg/m³ (0.2 ppm) TWA
Current OSHA PEL	1 mg/m³ (0.2 ppm) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1.3 mg/m³ (0.2 ppm) TWA
Description of Substance	Colorless to pale-yellow solid with a pleasant, characteristic odor.
LEL(@232°F)	0.6% (10% LEL(@232°F), 5,000 mg/m³)
Original (SCP) IDLH	300 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the following statements by Hakkinen et al. [1973]: "one fatal case of liver necrosis with some areas of cirrhosis occurred in a worker who had been regularly exposed to concentrations of vapor of approximately 100 mg/m³. Other workers with repeated exposure to concentrations greater than 5 mg/m³ had gastrointestinal symptoms as well as polyneuritic complaints, with abnormalities of both the electroencephalogram and electromyogram. Some showed hepatic damage detected by liver function tests and biopsy."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Deichmann et al. 1947	oral	2,400	-----	16,800 mg/m³	1,680 mg/m³
Rat	Deichmann et al. 1947	oral	3,280	-----	22,960 mg/m³	2,296 mg/m³
Mouse	Isshiki et al. 1983	oral	1,900	-----	13,300 mg/m³	1,330 mg/m³
Rat	Monsanto 1986	oral	2,400	-----	16,800 mg/m³	1,680 mg/m³

Human data .... [illegible]

Revised IDLH: 100 mg/m³
Basis for revised IDLH: The revised IDLH for diphenyl is 100 mg/m³ based on acute and chronic inhalation toxicity data in workers [Hakkinen et al. 1973].

REFERENCES:

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2. Hakkinen I, Siltanen E, Hernberg S, Seppalainen AM, Karli P, Vikkula E [1973]. Diphenyl poisoning in fruit paper production. Arch Environ Health *26*:70-74.
3. Isshiki K, Miyata K, Matsui S, Tsutsumi M, Watanabe T [1983]. Effects of post-harvest fungicides and piperonyl butoxide on the acute toxicity of pesticides in mice. Shokuhin Eiseigaku Zasshi (Food Hygiene Journal) *24*(3):268-274 (in Japanese).
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Dipropylene glycol methyl ether

CAS number	34590-94-8
NIOSH REL	100 ppm (600 mg/m^3) TWA, 150 ppm (900 mg/m^3) STEL [skin]
Current OSHA PEL	100 ppm (600 mg/m^3) TWA [skin]
1989 OSHA PEL	100 ppm (600 mg/m^3) TWA, 150 ppm (900 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	100 ppm (606 mg/m^3) TWA, 150 ppm (909 mg/m^3) STEL [skin]
Description of Substance	Colorless liquid with a mild, ether-like odor.
LEL(@392°F)	1.1% (10% LEL(@392°F), 1,100 ppm)
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 5,000 ppm -- see discussion below.]
Basis for original (SCP) IDLH	No acute toxicity data are available on which to base an IDLH for dipropylene glycol methyl ether. According to Patty [1963] this substance is low in toxicity by inhalation. Therefore, for this draft technical standard, respirators have been selected on the basis of the assigned protection factor afforded by each device up to a concentration of 50 × the OSHA PEL of 100 ppm (i.e., 5,000 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 5,000 ppm. Concentrations above 5,000 ppm are unlikely to be encountered in the workplace because of the high boiling point and low vapor pressure of this substance.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Rowe et al. 1954	oral	5,135	-----	5,835 ppm	584 ppm
Dog	Shideman and Procita 1951	oral	7,500	-----	8,523 ppm	852 ppm
Rat	Smyth et al. 1962	oral	5,350	-----	6,080 ppm	608 ppm

Human data: Concentrations between 300 and 400 ppm have been reported to be very disagreeable [Rowe et al. 1954]. Central nervous system impairment (undefined) occurred at 1,000 ppm in one of two subjects [Stewart et al. 1970].

Revised IDLH: 600 ppm
Basis for revised IDLH: The revised IDLH for dipropylene glycol methyl ether is 600 ppm based on acute toxicity data in humans [Rowe et al. 1954; Stewart et al. 1970] and animals [Rowe et al. 1954; Smyth et al. 1962]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations between 400 and 1,000 ppm.

REFERENCES:

1. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1573.
2. Rowe VK, McCollister DD, Spencer HC, Oyen F, Hollingsworth RL, Drill VA [1954]. Toxicology of mono-, di-, and tripropylene glycol methyl ethers. AMA Arch Ind Hyg Occup Med *9*:509-525.
3. Shideman FE, Procita L [1951]. The pharmacology of the monomethyl ethers of mono-, di-, and tripropylene glycol in the dog with observations on the auricular fibrillation produced by these compounds. J Pharmacol Exp Ther *102*:79-87.
4. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J *23*:95-107.
5. Stewart RD, Baretta ED, Dodd HC, Torkelson TR [1970]. Experimental human exposure to vapor of propylene glycol monomethyl ether. Arch Environ Health *20*:218-223.

Endrin

CAS number	72-20-8
NIOSH REL	0.1 mg/m³ [skin] TWA
Current OSHA PEL	0.1 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA [skin]
Description of Substance	Colorless to tan, crystalline solid with a mild, chemical odor.
LEL	Noncombustible Solid
Original (SCP) IDLH*	2,000 mg/m³ [*Note: "Effective" IDLH = 200 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Based on the statement by ACGIH [1971] that 3 of 10 rats were reported to have died following a 1-hour exposure at about 2,000 mg/m³ [Anderson et al. 1953; Hine et al. 1954], an IDLH of 2,000 mg/m³ was chosen. Because of the assigned protection factor afforded by each device, however, 2,000 × the OSHA PEL of 0.1 mg/m³ (i.e., 200 mg/m³) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	ACGIH 1971	LC_{30}: 2,000 mg/m³	-----	1 hr	2,500 mg/m³ (1.25)	250 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Monkey	AAPCO 1966	oral	3	-----	21 mg/m³	2.1 mg/m³
G. pig	AAPCO 1966	oral	16	-----	112 mg/m³	11 mg/m³
Hamster	Ottolenghi et al. 1974	oral	10	-----	70 mg/m³	7.0 mg/m³
Rat	Sanderson and Noakes 1970	oral	3	-----	21 mg/m³	2.1 mg/m³
Cat	Treon et al. 1955	oral	-----	5	35 mg/m³	3.5 mg/m³
Rabbit	Treon et al. 1955	oral	7	-----	49 mg/m³	4.9 mg/m³
Mouse	Webb et al. 1973	oral	1.4	-----	10 mg/m³	1.0 mg/m³

Human data .... An oral dose of 171 mg/kg has been reported to be lethal [Runhaar et al. 1985]. It has also been reported that the approximate oral dose producing convulsions is about 0.2 mg/kg [Hayes 1982]. [Note: Oral doses of 171 mg/kg or 0.2 mg/kg are equivalent to a 70-kg worker being exposed to about 8,000 mg/m³ or 9 mg/m³, respectively, for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2 mg/m³

Basis for revised IDLH: The revised IDLH for endrin is 2 mg/m³ based on acute oral toxicity data in humans [Hayes 1982] and animals [AAPCO 1966; Sanderson and Noakes 1970; Treon et al. 1955; Webb et al. 1973]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Association of the American Pesticide Control Officials, Inc., p. 475.
2. ACGIH [1971]. Endrin. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 98.
3. Anderson HH, et al. [1953]. Berkeley, CA: University of California, Report No. 213. [From ACGIH [1971]. Endrin. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 98.]
4. Hayes WH Jr [1982]. Pesticides studied in man. Baltimore, MD: Williams & Wilkins Company, pp. 247-251.
5. Hine CH, et al. [1954]. Berkeley, CA: University of California, Report No. 233. [From ACGIH [1971]. Endrin. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 98.]
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7. Runhaar EA, Sangster B, Greve PA, Voortman M [1985]. A case of fatal endrin poisoning. Hum Toxicol 4:241-247.
8. Sanderson DM, Noakes DN [1970]. Acute toxicity data for pesticides (1970). World Review of Pesticide Control 9:119-127.
9. Treon JF, Cleveland FP, Cappel J [1955]. Toxicity of endrin for laboratory animals. J Agri Food Chem 3:842-848.
10. Webb RE, Hartgrove RW, Randolph WC, Petrella VJ, Horsfall F Jr [1973]. Toxicity studies in endrin-susceptible and resistant strains of pine mice. Toxicol Appl Pharmacol 25:42-47.

Epichlorohydrin

CAS number	106-89-8
NIOSH REL	None established; NIOSH considers epichlorohydrin to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	5 ppm (19 mg/m^3) TWA [skin]
1989 OSHA PEL	2 ppm (8 mg/m^3) TWA [skin]
1993-1994 ACGIH TLV	2 ppm (7.6 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with a slightly irritating, chloroform-like odor.
LEL	3.8% (10% LEL, 3,800 ppm)
Original (SCP) IDLH	250 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat 4-hour LC_{LO} of 250 ppm [Carpenter et al. 1949 cited by NIOSH 1976a].
Existing short-term exposure guidelines	1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 2 ppm (60-minute)
ERPG-2: 20 ppm (60-minute)
ERPG-3: 100 ppm (60-minute)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	250	4 hr	500 ppm (2.0)	50 ppm
Rat	Dow	3,617	-----	1 hr	4,521 ppm (1.25)	452 ppm
Rat	Dow	2,165	-----	1 hr	2,706 ppm (1.25)	271 ppm
Mouse	Freuder and Leake 1941	LC_{100}: 8,300	-----	30 min	8,300 ppm (1.0)	830 ppm
Rat	NPIRI 1974	250	-----	8 hr	600 ppm (2.4)	60 ppm
Rat	Smyth and Carpenter 1948	244	-----	8 hr	538 ppm (2.4)	54 ppm
Mouse	Smyth and Pozzani 1986	LC_{100}: 7,414	-----	30 min	7,414 ppm (1.0)	741 ppm
Rat	Weil et al. 1963	360	-----	6 hr	828 ppm (2.3)	83 ppm
Rat	Weil et al. 1963	$LC_{[illegible]}$: 250	-----	8 hr	600 ppm (2.4)	60 ppm

Other animal data	RD_{50} (mouse), 687 ppm [Alarie 1981].
Human data	Workers engaged in the production of epichlorohydrin from dichlorohydrin glycerin, with isolated exposures to epichlorohydrin ranging from 4.9 to 54.9 ppm, showed no apparent adverse effects [Pet'ko et al. 1966]. Concentrations of 20 ppm produced transient burning of the eyes and nasal mucosa, 40 ppm produced eye and throat irritation that persisted for 48 hours, and concentrations in excess of 100 ppm were considered intolerable with a potential for lung edema and kidney lesions [NIOSH 1976b].

Revised IDLH: 75 ppm
Basis for revised IDLH: The revised IDLH for epichlorohydrin is 75 ppm based on acute inhalation toxicity data in humans [NIOSH 1976b; Pet'ko et al. 1966] and animals [Carpenter et al. 1949; NPIRI 1974; Smyth and Carpenter 1948; Weil et al. 1963]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for epichlorohydrin at any detectable concentration.]

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2. Carpenter CP, Smyth HF Jr, Pozzani VC [1949]. The assay of acute vapor toxicity and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-344.

3. Dow Chemical Company [?]. Material safety data sheet: epichlorohydrin [unpublished data]. Midland, MI: Dow Chemical Company, Health and Environmental Sciences USA. [From 1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs).]
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EPN

CAS number	2104-64-5
NIOSH REL	0.5 mg/m³ TWA [skin]
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA [skin]
Description of Substance	Yellow solid with an aromatic odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	50 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for EPN. The chosen IDLH, therefore, has been estimated from the female rat oral LD_{50} of 8 mg/kg [Gaines 1969 cited by NIOSH 1976].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	AAPCO 1966	oral	20	-----	140 mg/m³	14 mg/m³
Rat	Gaines 1969	oral	8	-----	56 mg/m³	5.6 mg/m³
Rat	Gaines 1969	oral	36	-----	252 mg/m³	25 mg/m³
Rat	Hodge et al. 1954	oral	7	-----	49 mg/m³	4.9 mg/m³
Mouse	Nishizawa et al. 1962	oral	12.2	-----	85 mg/m³	8.5 mg/m³

Human data: Ingestion of 3 mg EPN per day for 32 days did not depress plasma or red blood cell (RBC) cholinesterase; 6 mg EPN per day for 88 days did not cause a significant depression of RBC or plasma cholinesterase [Rider et al. 1959]. It has been reported that the threshold of incipient toxicity appears to be 9 mg [Moeller and Rider 1962].

Revised IDLH: 5 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for EPN. Therefore, the revised IDLH for EPN is 5 mg/m³ based on acute oral toxicity data in humans [Rider et al. 1959] and animals [Gaines 1969; Hodge et al. 1954]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

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Ethanolamine

CAS number: 141-43-5
NIOSH REL: 3 ppm (8 mg/m³) TWA, 6 ppm (15 mg/m³) STEL
Current OSHA PEL: 3 ppm (6 mg/m³) TWA
1989 OSHA PEL: 3 ppm (8 mg/m³) TWA, 6 ppm (15 mg/m³) STEL
1993-1994 ACGIH TLV: 3 ppm (7.5 mg/m³) TWA, 6 ppm (15 mg/m³) STEL
Description of Substance: Colorless, viscous liquid or solid (below 51°F) with an unpleasant, ammonia-like odor.
LEL(@284°F): 3.0% (10% LEL(@284°F), 3,000 ppm)
Original (SCP) IDLH: 1,000 ppm
Basis for original (SCP) IDLH: The chosen IDLH is based on the statement by AIHA [1968] that the saturated concentration (less than 1,316 ppm) at room temperature should not be immediately hazardous to life. However, AIHA [1968] also reported that sprays and mists evolving from these compounds at elevated temperatures may be dangerous.
Existing short-term exposure guidelines: National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 50 ppm
24-hour EEGL: 3 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Treon et al. 1957	LC_{67}: 233	-----	1 hr	291 ppm (1.25)	29 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Hartung and Cornish 1968	oral	3,320	-----	9,150 ppm	915 ppm
G. pig	Sidorov et al. 1968	oral	620	-----	1,709 ppm	171 ppm
Rat	Sidorov et al. 1968	oral	2,050	-----	5,650 ppm	565 ppm
Mouse	Sidorov et al. 1968	oral	1,475	-----	4,065 ppm	407 ppm
Rabbit	Sidorov et al. 1968	oral	1,000	-----	2,776 ppm	278 ppm
Rabbit	Sidorov and Timofievskaya 1979	oral	1,000	-----	2,756 ppm	276 ppm
Mouse	Timofievskaya 1962	oral	700	-----	1,920 ppm	192 ppm
Rat	Vernot et al. 1977	oral	1,720-1,970	-----	4,740-5,429 ppm	474-543 ppm

Other animal data: Cats exposed for 2 hours to vapors of ethanolamine at concentrations reaching 970 ppm displayed vomiting tendencies; mice had no adverse effects from the same exposures [Sidorov et al. 1968]. A single 8-hour exposure to "concentrated vapors" did not kill any of six rats [UCC 1970]. Guinea pigs survived a 15-minute exposure to ethanolamine at 193 ppm [Treon et al. 1957].
Human data: None relevant for use in determining the revised IDLH.

Revised IDLH: 30 ppm
Basis for revised IDLH: The revised IDLH for ethanolamine is 30 ppm based on acute inhalation toxicity data in animals [Treon et al. 1957].

REFERENCES:

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5. Sidorov KK, Timofievskaya LA [1979]. Data for use in setting the MAC for monoethanolamine in the working environment. Gig Tr Prof Zabol *23*(9):55 (in Russian).
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2-Ethoxyethanol

CAS number 110-80-5
NIOSH REL .... 0.5 ppm (1.8 mg/m^3) TWA [skin]
Current OSHA PEL .... 200 ppm (740 mg/m^3) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 ppm (18 mg/m^3) TWA [skin]
Description of Substance .... Colorless liquid with a sweet, pleasant, ether-like odor.
LEL(@200°F) .... 1.7% (10% LEL(@200°F), 1,700 ppm)
Original (SCP) IDLH .... 6,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [1963] that investigators concluded from animal experiments that substantially saturated atmospheres (6,000 ppm) at ordinary room temperatures will not produce serious injury in 1 hour [Waite et al. 1930].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NPIRI 1974	2,000	-----	7 hr	4,800 ppm (2.4)	480 ppm
G. pig	Waite et al. 1930	-----	3,000	24 hr	10,950 ppm (3.65)	1,095 ppm
Mouse	Werner et al. 1943	1,820	-----	7 hr	4,368 ppm (2.4)	437 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Eastman 1982	oral	2,451	-----	4,575 ppm	458 ppm
Rat	Gig Tr Prof Zabol 1963	oral	2,125	-----	3,967 ppm	397 ppm

Other animal data .... Some investigators have stated that at ordinary room temperatures substantially saturated atmospheres (i.e., about 6,000 ppm) will not produce serious injury in 1 hour [Waite et al. 1930].
Human data .... Volunteers with some work experience reported that odor levels of 125 ppm were noticeable and that the odor level that would be intolerable was greater than 255 ppm [Clayton and Clayton 1982].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for 2-ethoxyethanol is 500 ppm based on acute inhalation toxicity data in animals [NPIRI 1974; Werner et al. 1943]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 255 ppm.

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3. Eastman Chemical Products [1982]. Material safety data sheet: EKTASOLVE® EE solvent. Kingsport, TN: Eastman Chemical Products, Inc., MSDS-10, 170A-1 (10-82), pp. 1-7.
4. Gig Tr Prof Zabol [1963]; 32(3):48-54 (in Russian).

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2-Ethoxyethyl acetate

CAS number	111-15-9
NIOSH REL	0.5 ppm (2.7 mg/m^3) TWA [skin]
Current OSHA PEL	100 ppm (540 mg/m^3) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (27 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with a mild odor.
LEL	1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH	2,500 ppm
Basis for original (SCP) IDLH	Patty [1963] reported that guinea pigs survived a 1-hour exposure to an atmosphere essentially saturated with vapor (estimated to be less than 4,000 ppm) [Lehmann and Flury 1943]. Because the data concerning the concentration is not very specific, the IDLH is based on the concentration of 2-ethoxyethylacetate in saturated air at 20°C (i.e., 2,600 ppm).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Pozzani et al. 1959	2,204	-----	8 hr	5,510 ppm (2.5)	551 ppm
Rat	Smyth et al. 1941	LC_{11}: 1,500	-----	8 hr	3,750 ppm (2.5)	375 ppm
Rabbit	Truhaut et al. 1979	>2,000	-----	4 hr	>4,000 ppm (2.0)	>400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Eastman 1982	oral	1,950	-----	2,486 ppm	249 ppm
Rat	Isin et al. 1988	oral	2,700	-----	3,443 ppm	344 ppm
G. pig	Smyth et al. 1941	oral	1,910	-----	2,435 ppm	243 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for 2-ethoxyethyl acetate is 500 ppm based on acute inhalation toxicity data in animals [Pozzani et al. 1959; Smyth et al. 1941; Truhaut et al. 1979]. This may be a conservative value due to the lack of relevant inhalation acute toxicity data for workers.

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Ethyl acetate

CAS number	141-78-6
NIOSH REL	400 ppm (1,400 mg/m³) TWA
Current OSHA PEL	400 ppm (1,400 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	400 ppm (1,440 mg/m³) TWA
Description of Substance	Colorless liquid with an ether-like, fruity odor.
LEL	2.0% (10% LEL, 2,000 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	Spector [1956] cited a mouse 3-hour LC_{50} of 12,330 ppm [Spealman et al. 1945]. UCC [1968] reported that none of 6 rats died after a 4-hour exposure at 8,000 ppm, but 6 of 6 rats died after a 4-hour exposure at 16,000 ppm. AIHA [1964] reported a concentration in the range of 8,000 to 20,000 ppm has been considered dangerous to man for short exposures [Henderson and Haggard 1943]. Based on the data cited above, an IDLH of 10,000 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Blina 1933	-----	21	1 hr	26 ppm (1.25)	2.6 ppm
Rat	Clayton and Clayton 1981	16,000	-----	6 hr	36,800 ppm (2.3)	3,680 ppm
Mouse	Izmerov et al. 1982	12,295	-----	2 hr	19,672 ppm (1.6)	1,967 ppm
Rat	Patty 1963	1,600	-----	8 hr	4,000 ppm (2.5)	400 ppm
Mouse	Spealman et al. 1945	-----	12,330	3 hr	22,194 ppm (1.8)	2,219 ppm
Rat	UCC 1968	LC_{100}: 16,000	-----	4 hr	32,000 ppm (2.0)	3,200 ppm

Other animal data	RD_{50}(mouse), 614 ppm [Alarie 1981].
Human data	Workers regularly exposed to concentrations from 375 to 1,500 ppm for several months showed no unusual signs or symptoms [Patty 1963]. Concentrations in the range of 8,000 to 20,000 ppm have been considered dangerous for short exposures [Henderson and Haggard 1943].

Revised IDLH: 2,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in workers [Henderson and Haggard 1943; Patty 1963], a value between 2,000 and 8,000 ppm would have been appropriate for ethyl acetate. However, the revised IDLH for ethyl acetate is 2,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2.0%).

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Ethyl acetate (continued)

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8. Spealman CR, Main RJ, Haag HB, Larson PS [1945]. Monomeric methyl methacrylate. Am J Ind Med *14*(4):292-298.
9. Spector WS, ed. [1956]. Handbook of toxicology. Vol. I. Acute toxicities. Philadelphia, PA: W.B. Saunders Company, pp. 336-337.
10. UCC [1968]. Toxicology studies: ethyl acetate. New York, NY: Union Carbide Corporation.

Ethyl acrylate

CAS number 140-88-5
NIOSH REL . . . . None established; NIOSH considers ethyl acrylate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL . . . . 25 ppm (100 mg/m^3) TWA [skin]
1989 OSHA PEL . . . . 5 ppm (20 mg/m^3) TWA, 25 ppm (100 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV . . . . 5 ppm (20 mg/m^3) TWA, 15 ppm (61 mg/m^3) STEL, A2
Description of Substance . . . . Colorless liquid with an acrid odor.
LEL. . . . . 1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH . . . . 2,000 ppm
Basis for original (SCP) IDLH . . . . The chosen IDLH is based on the statements by Pozzani et al. 1949 cited by Patty [1963], and UCC [1971] that 5 of 6 rats died following a 4-hour exposure to 2,000 ppm, and that 1,000 ppm for 4 hours killed 0 of 6 rats.
Short-term exposure guidelines . . . . None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Oberly and Tansy 1985	2,180	-----	4 hr	4,360 ppm (2.0)	436 ppm
Rabbit	Pozzani et al. 1949	-----	1,204	7 hr	2,890 ppm (2.4)	289 ppm
G. pig	Pozzani et al. 1949	-----	1,204	7 hr	2,890 ppm (2.4)	289 ppm
Rat	Pozzani et al. 1949	LC_{83}: 2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Mouse	Sidorov and Timofievskaya 1979	3,894	-----	?	?	?

Other animal data . . . . RD_{50} (mouse), 315 ppm [DeCeaurriz et al. 1981]. Thirty-day exposures of rats to 300 or 540 ppm resulted in mortality; while rats survived 30-day exposures to 70 ppm [Treon et al. 1949].
Human data . . . . Prolonged inhalation exposures at 50 to 75 ppm produced drowsiness, headache, and nausea [Nemec and Bauer 1978].

Revised IDLH: 300 ppm
Basis for revised IDLH: The revised IDLH for ethyl acrylate is 300 ppm based on toxicity data in humans [Nemec and Bauer 1978] and animals [DeCeaurriz et al. 1981; Oberly and Tansy 1985; Pozzani et al. 1949; Treon et al. 1949]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ethyl acrylate at any detectable concentration.]

REFERENCES:

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7. Treon JF, Sigmon H, Wright H, Kitzmiller KV [1949]. The toxicity of methyl and ethyl acrylate. J Ind Hyg Toxicol *31*:317-326.
8. UCC [1971]. Toxicology studies: ethyl acrylate. New York, NY: Union Carbide Corporation.

Ethyl alcohol

CAS number 64-17-5
NIOSH REL .... 1000 ppm (1,900 mg/m^3) TWA
Current OSHA PEL .... 1000 ppm (1,900 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 1000 ppm (1,880 mg/m^3) TWA
Description of Substance .... Clear, colorless liquid with a weak, ethereal, vinous odor.
LEL .... 3.3% (10% LEL: 3,300 ppm)
Original (SCP) IDLH .... 15,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH (15,000 ppm) is based on human inhalation data and is conservative. At 15,000 ppm "there was continuous lachrymation and coughing" in the exposed individuals [Lester and Greenberg 1951]. Further evidence of the IDLH being conservative is the report in Patty [1963] that a 2-hour exposure to 19,260 ppm only produced light narcosis in the rat; a 255-minute exposure to 19,260 ppm produced no signs of intoxication in the guinea pig; a 75-minute exposure to 23,940 ppm produced narcosis in the mouse; and a 80-minute exposure to 13,300 ppm caused ataxia in the mouse.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NPIRI 1974	20,000	-----	10 hr	54,200 ppm (2.71)	5,420 ppm
Mouse	Tiunov et al. 1982	20,363	-----	4 hr	40,727 ppm (2.0)	4,073 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Savchenkov 1967	oral	3,450	-----	12,611 ppm	1,261 ppm
Rat	Wiberg et al. 1970	oral	7,060	-----	25,807 ppm	2,581 ppm

Other animal data .... RD_{50} (mouse), 27,314 ppm [Alarie 1981].
Human data .... It was reported in a clinical study that concentrations greater than 20,900 ppm were intolerably irritating and 15,000 ppm caused continuous lacrimation and coughing while concentrations between 5,200 and 10,400 ppm allowed work to be carried on, but with a certain amount of discomfort [Lester and Greenberg 1951]. In this same study, it was determined that 62% of the ethyl alcohol inhaled was absorbed [Lester and Greenberg 1951].

Revised IDLH: 3,300 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Lester and Greenberg 1951], a value of about 10,000 ppm would have been appropriate. However, the revised IDLH for ethyl alcohol is 3,300 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 3.3%).

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Ethylamine

CAS number	75-04-7
NIOSH REL	10 ppm (18 mg/m^3) TWA
Current OSHA PEL	10 ppm (18 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (9.2 mg/m^3) TWA, 15 ppm (27.6 mg/m^3) STEL
Description of Substance	Colorless gas or water-white liquid (below 62°F) with an ammonia-like odor.
LEL	3.5% (10% LEL, 3,500 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1958] report that a 4-hour exposure to 4,000 ppm killed 1 of 6 rats.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hine et al. 1960	-----	3,000	4 hr	6,000 ppm (2.0)	600 ppm
Mammal	Kulagina 1975	1,230	-----	?	?	?
Rat	UCC 1958	-----	4,000	4 hr	8,000 ppm (2.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	UCC 1958	oral	400	-----	1,497 ppm	150 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 600 ppm
Basis for revised IDLH: The revised IDLH for ethylamine is 600 ppm based on acute inhalation toxicity data in animals [Hine et al. 1960; UCC 1958].

REFERENCES:

1. Hine CH, Kodama JK, Guzman RJ, Loquvam GS [1960]. The toxicity of allylamines. Arch Environ Health *1*:343-352.
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4. UCC [1958]. Toxicology studies: ethyl amine. New York, NY: Union Carbide Corporation.

Ethyl benzene

CAS number	100-41-4
NIOSH REL	100 ppm (435 mg/m³) TWA, 125 ppm (545 mg/m³) STEL
Current OSHA PEL	100 ppm (435 mg/m³) TWA
1989 OSHA PEL	100 ppm (435 mg/m³) TWA, 125 ppm (545 mg/m³) STEL
1993-1994 ACGIH TLV	100 ppm (434 mg/m³) TWA, 125 ppm (543 mg/m³) STEL
Description of Substance	Colorless liquid with an aromatic odor.
LEL	0.8% (10% LEL, 800 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] and ACGIH [1971] that in an experimental study 2,000 ppm caused dizziness in one man after a brief exposure of 5 minutes [Yant et al. 1930].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1962	-----	4,000	4 hr	8,000 ppm (2.0)	800 ppm

Other animal data	RD_{50} (mouse): 1,430 ppm [DeCeaurriz et al. 1981; RD_{50} (mouse): 4,060 ppm [Nielsen and Alarie 1982].
Human data	Dizziness was caused in one volunteer after a 5-minute exposure to 2,000 ppm [Yant et al. 1930].

Revised IDLH: 800 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Yant et al. 1930] and animals [DeCeaurriz et al. 1981; Smyth et al. 1962], a value between 800 and 2,000 ppm would have been appropriate. However, the revised IDLH for ethyl benzene is 800 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 0.8%).

REFERENCES:

1. ACGIH [1971]. Ethylbenzene. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 104.
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Ethyl bromide

CAS number	74-96-4
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	200 ppm (890 mg/m^3) TWA
1989 OSHA PEL	200 ppm (890 mg/m^3) TWA, 250 ppm (1100 mg/m^3) STEL
1993-1994 ACGIH TLV	5 ppm (22 mg/m^3) TWA, A2
Description of Substance	Colorless to yellow liquid with an ether-like odor.
LEL	6.8% (10% LEL, 6,800 ppm)
Original (SCP) IDLH	3,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the minimal lethal concentration for mice of 3,500 ppm [Bachem 1927 as cited by von Oettingen 1937] cited by ACGIH [1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Bachem 1927	-----	3,500	?	?	?
Rat	Back et al. 1972	26,980	-----	1 hr	33,725 ppm (1.25)	3,373 ppm
Mouse	Back et al. 1972	16,230	-----	1 hr	20,288 ppm (1.25)	2,029 ppm
Rat	NTP 1988	4,681	-----	?	?	?
Mouse	NTP 1988	2,723	-----	?	?	?
G. pig	Sayers and Yant 1929	LC_{100}: 100,000	-----	1.5 hr	145,000 ppm (1.45)	14,500 ppm
G. pig	Sayers and Yant 1929	LC_{100}: 140,000	-----	10 min	96,600 ppm (0.69)	9,660 ppm
G. pig	Sayers and Yant 1929	-----	24,000	30 min	24,000 ppm (1.0)	2,400 ppm
G. pig	Sayers and Yant 1929	-----	7,000	>4.5 hr	>14,560 ppm (2.8)	>1,456 ppm

Other animal data	Exposure at 1,700 ppm for 9 hours caused no anesthesia or apparent adverse effects [Sayers and Yant 1929].
Human data	Concentrations of 12,000 ppm caused immediate eye irritation in volunteers and 5 minutes at 6,500 ppm resulted in eye irritation, headache, and vertigo [Sayers and Yant 1929]. Workers exposed intermittently to concentrations up to 1,500 ppm complained of no systematic symptoms over a period of several years [Watrous 1947].

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for ethyl bromide is 2,000 ppm based on acute inhalation toxicity data in humans [Sayers and Yant 1929; Watrous 1947] and animals [Back et al. 1972; Sayers and Yant 1937]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations between 1,500 and 6,500 ppm.

REFERENCES:

1. ACGIH [1971]. Ethyl bromide. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 105.
2. Bachem C [1927]. Contribution to the toxicology of the alkyl halides. Arch Exp Pathol Pharmakol *122*:73-76 (translated).
3. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-340 to A-341.
4. NTP [1988]. Technical report on the toxicology and carcinogenesis studies of bromoethane. Research Triangle Park, NC: National Toxicology Program, NTP/NIH Publication No. 89-2818.
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6. von Oettingen WF [1937]. The halogenated hydrocarbons: their toxicity and potential dangers. J Ind Hyg Toxicol *19*(8):349-448.
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Ethyl butyl ketone

CAS number 106-35-4
NIOSH REL .... 50 ppm (230 mg/m³) TWA
Current OSHA PEL .... 50 ppm (230 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 50 ppm (234 mg/m³) TWA
Description of Substance .... Colorless liquid with a powerful, fruity odor.
LEL .... Unknown
Original (SCP) IDLH .... 3,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by Patty [1963] and Deichmann and Gerarde [1969] that 0 rats died following a 4-hour exposure to 2,000 ppm, but 6 of 6 rats died following a 4-hour exposure to 4,000 ppm [Smyth et al. 1949].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1949	LC_{100}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1949	oral	2,760	-----	4,067 ppm	408 ppm

Other animal data .... It has been reported that rats survived a 4-hour exposure to 2,000 ppm [Smyth et al. 1949].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for ethyl butyl ketone is 1,000 ppm based on acute inhalation toxicity data in animals [Smyth et al. 1949].

REFERENCE:

1. Deichmann WB, Gerarde HW [1969]. Table 50. Toxicity of ketones. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 736.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1741.
3. Smyth HF Jr, Carpenter CP, Weil CS [1949]. Range-finding toxicity data: list III. J Ind Hyg Toxicol *31*:60-62.

Ethyl chloride

CAS number	75-00-3
NIOSH REL	Handle with caution in the workplace.
Current OSHA PEL	1,000 ppm (2,600 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (2,640 mg/m³) TWA
Description of Substance	Colorless gas or liquid (below 54°F) with a pungent, ether-like odor.
LEL	3.8% (10% LEL, 3,800 ppm)
Original (SCP) IDLH	20,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on human exposure data reported by Davidson [1926] in which 13,000 ppm caused no difficulty in walking or balancing after 21 minutes, but 19,000 ppm caused weak analgesia and slight dizziness after 12 minutes.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	59,701	-----	2 hr	95,522 ppm (1.6)	9,550 ppm
Mouse	Izmerov et al. 1982	54,478	-----	2 hr	87,164 ppm (1.6)	8,716 ppm
G. pig	Sayers and Yant 1929	-----	40,000	45 min	45,600 ppm (1.14)	4,560 ppm

Human data: It has been reported that 13,000 ppm for 21 minutes caused no difficulty in walking or balancing but 19,000 ppm caused weak analgesia and slight dizziness after 12 minutes [Davidson 1926].

Revised IDLH: 3,800 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Davidson 1926], a value of about 13,000 ppm would have been appropriate. However, the revised IDLH for ethyl chloride is 3,800 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 3.8%).

REFERENCES:

1. Davidson BM [1926]. Studies of intoxication. V. The action of ethyl chloride. J Pharmacol Exp Ther *26*:37-42.
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 66.
3. Sayers RR, Yant VP [1929]. Physiological response attending exposure to vapors of methyl bromide, methyl chloride, ethyl bromide and ethyl chloride. Washington, DC: U.S. Government Printing Office, Treasury Department, U.S. Public Health Service, Public Health Bulletin *185*:1-56.

Ethylene chlorohydrin

CAS number	107-07-3
NIOSH REL	1 ppm (3 mg/m^3) CEILING [skin]
Current OSHA PEL	5 ppm (16 mg/m^3) TWA [skin]
1989 OSHA PEL	1 ppm (3 mg/m^3) CEILING [skin]
1993-1994 ACGIH TLV	1 ppm (3.3 mg/m^3) CEILING [skin]
Description of Substance	Colorless liquid with a faint, ether-like odor.
LEL	4.9% (10% LEL, 4,900 ppm)
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	Browning [1965] stated that the lethal dose differs somewhat in the hands of different observers. An LC_{50} of 290 mg/m^3 (88 ppm) for rats [Semenova et al. 1971] was cited by NIOSH [1973]. However, an IDLH of 10 ppm is chosen based on other data (i.e., a rat 4-hour LC_{50} of 32 ppm [Browning 1965]; a rat 4-hour LC_{50} of 33 ppm [Patty 1963]; exposure to 7.5 ppm for 1 hour, which was lethal to rats, and 4 ppm, which was lethal to rats following 2 exposures of 1 hour each [Browning 1965]; and a ceiling TLV of 1 ppm [ACGIH 1976]).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Ambrose 1950	7.5	-----	1 hr	9 ppm (1.2)	0.9 ppm
Rat	Browning 1965	32	-----	4 hr	64 ppm (2.0)	6.4 ppm
G. pig	Kovyzin 1971	260	-----	?	?	?
Rat	Patty 1963	33	-----	4 hr	66 ppm (2.0)	6.6 ppm
Rat	Semenova et al. 1971	87	-----	?	?	?
Mouse	Semenova et al. 1971	115	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Goldblatt and Chiesman 1944	oral	72	-----	150 ppm	15 ppm
Mouse	Lawrence et al. 1971	oral	81	-----	169 ppm	17 ppm
Rat	Semenova et al. 1971	oral	71	-----	148 ppm	15 ppm
G. pig	Smyth et al. 1941	oral	110	-----	230 ppm	23 ppm

Other animal data	Rats exposed for 15 minutes a day at concentrations of 900 to 1,000 ppm died within a few days [Goldblatt and Chiesman 1944]. Repeated 1-hour exposures (not defined) to 2 ppm can be fatal to rats [Ambrose 1950].
Human data	Death has resulted from a 2-hour exposure at an estimated concentration of 300 ppm [Dierker and Brown 1944].

Revised IDLH: 7 ppm
Basis for revised IDLH: The revised IDLH for ethylene chlorohydrin is 7 ppm based on acute inhalation toxicity data in animals [Browning 1965; Patty 1963].

REFERENCES:

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2. Ambrose AM [1950]. Toxicological studies of compounds investigated for use as inhibitors of biological processes. II. Toxicity of ethylene chlorohydrin. AMA Arch Ind Hyg Occup Med *21*:591-597.
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5. Goldblatt MW, Chiesman WE [1944]. Toxic effects of ethylene chlorohydrin. Part I. Clinical. Br J Ind Med *1*:207-223.
6. Kovyzin VG [1971]. Experimental data on the substantiation of the threshold of ethylene chlorohydrin in the air of the working zone. Gig Tr Prof Zabol *15*(2):54-64 (in Russian).
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9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1495.
10. Semenova VN, Kazanina SS, Ekshtat BY [1971]. On the toxic properties of ethylene chlorohydrin in the air of working premises. Gig Sanit *36*:376 (translated).
11. Smyth HF Jr, Seaton J, Fischer L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol 23:259-268.

Ethylenediamine

CAS number 107-15-3
NIOSH REL .... 10 ppm (25 mg/m^3) TWA
Current OSHA PEL .... 10 ppm (25 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 10 ppm (25 mg/m^3) TWA [skin]
Description of Substance .... Colorless, viscous liquid with an ammonia-like odor.
LEL(@12°F) .... 2.5% (10% LEL(@12°F), 2,500 ppm)
Original (SCP) IDLH .... 2,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [1970] that an 8-hour exposure to 4,000 ppm killed 6 of 6 rats, but that an 8-hour exposure to 2,000 ppm killed 0 of 6 rats [Smyth et al. 1951]. Further support for the chosen IDLH is gained from the statement by UCC [1971] that humans will not stay in concentrations of 2,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et a. 1951	LC_{100}: 4,000	-----	8 hr	10,000 ppm (2.5)	1,000 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Izmerov et al. 1982	oral	500	-----	1,400 ppm	140 ppm
G. pig	Smyth et al. 1941	oral	470	-----	1,316 ppm	132 ppm
Rat	Smyth et al. 1951	oral	1,160	-----	3,248 ppm	325 ppm

Other animal data .... It has been reported that rats have survived an 8-hour exposure to 2,000 ppm [Smyth et al. 1951].
Human data .... It has been reported that workers will not stay in concentrations of 2,000 ppm [UCC 1971].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for ethylenediamine is 1,000 ppm based on acute inhalation toxicity data in animals [Smyth et al. 1951]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations between 1,000 and 2,000 ppm.

REFERENCES:

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3. Smyth HF, Seaton J, Fischer L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol 23(6):259-268.
4. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med 4:119-122.
5. UCC [1971]. Toxicology studies: ethylene diamine. New York, NY: Union Carbide Corporation.

Ethylene dibromide

CAS number 106-93-4
NIOSH REL .... 0.045 ppm TWA, 0.13 ppm 15-minute CEILING; NIOSH considers ethylene dibromide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 20 ppm TWA, 30 ppm CEILING, 50 ppm 5-minute MAXIMUM PEAK
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... A2 [skin]
Description of Substance .... Colorless liquid or solid (below 50°F) with a sweet odor.
LEL. .... Noncombustible Liquid
Original (SCP) IDLH .... 400 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the maximum survival exposure for rats of 400 ppm for 36 minutes [Rowe et al. 1952] cited by Patty [1963].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Bakhishev 1973	1,831	-----	30 min	1,831 ppm (1.0)	183 ppm
Rat	McCollister et al. 1956	-----	200	8 hr	2,020 ppm (10.1)	202 ppm
G. pig	Rowe et al. 1952	-----	400	3 hr	1,780 ppm (4.45)	178 ppm
Rat	Rowe et al. 1952	691	-----	1 hr	1,230 ppm (1.78)	123 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.2 [ten Berge et al. 1986].

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kenaga and Morgan 1978	oral	108	-----	97 ppm	9.7 ppm
Rabbit	Rowe et al. 1952	oral	55	-----	49 ppm	4.9 ppm
G. pig	Rowe et al. 1952	oral	110	-----	99 ppm	9.9 ppm
Rat	Rowe et al. 1952	oral	146	-----	131 ppm	13 ppm
Mouse	Rowe et al. 1952	oral	420	-----	376 ppm	38 ppm
Rat	Rowe et al. 1952	oral	117	-----	105 ppm	11 ppm

Other animal data .... It has been stated that ethylene dibromide is more toxic than carbon tetrachloride in inhalation exposures less than 7 hours [McCollister et al. 1956]. It has been reported that rats have survived a 36-minute exposure to 400 ppm [Rowe et al. 1952].
Human data .... It has been stated that a concentration of 50 ppm (for an unstated time period) could be dangerous to exposed humans [Kochmann 1928]. Exposures above 100 ppm for an hour or less or by longer exposures at lower concentrations (e.g., 75 ppm) have resulted in gastrointestinal discomfort, vomiting, and respiratory involvement [Ott et al. 1980].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for ethylene dibromide is 100 ppm based on acute inhalation toxicity data in humans [Ott et al. 1980] and animals [Rowe et al. 1952]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ethylene dibromide at concentrations above 0.045 ppm.]

REFERENCES:

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2. Kenaga EE, Morgan RW [1978]. Commercial and experimental organic insecticides. Entomological Society of America Special Publication *78-1*:17.
3. Kochmann M [1928]. Possible industrial poisonings with ethylene dibromide. Muench Med Wochschr 75:1334-1336. [From ACGIH [1991]. Ethylene dibromide. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 606-608.]
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7. Rowe VK, Spencer HC, McCollister DD, Hollingsworth RL, Adams EM [1952]. Toxicity of ethylene dibromide determined on experimental animals. AMA Arch Ind Hyg Occup Med *6*:158-173.
8. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Ethylene dichloride

CAS number	107-06-2
NIOSH REL	1 ppm (4 mg/m³) TWA, 2 ppm (8 mg/m³) STEL; NIOSH considers ethylene dichloride to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	50 ppm TWA, 100 ppm CEILING, 200 ppm 5-minute MAXIMUM PEAK in any 3 hours
1989 OSHA PEL	1 ppm (4 mg/m³) TWA, 2 ppm (8 mg/m³) STEL
1993-1994 ACGIH TLV	10 ppm (40 mg/m³) TWA
Description of Substance	Colorless liquid with a pleasant, chloroform-like odor.
LEL	6.2% (10% LEL, 6,200 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the maximum time-concentration in air of 1,000 ppm which was survived by female rats for 1.5 hours [Spencer et al. 1951 cited by Patty 1963]. The chosen IDLH is further supported by the rat 4-hour LC_{LO} of 1,000 ppm [Carpenter et al. 1949 cited by NIOSH 1976].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Arch Exp Pathol Pharmacol 1929	-----	1,217	2 hr	1,947 ppm (1.6)	195 ppm
Rat	Carpenter et al. 1949	-----	1,000	4 hr	2,000 ppm (2.0)	200 ppm
Rabbit	Heppel et al. 1945	-----	3,000	7 hr	7,200 ppm (2.4)	720 ppm
G. pig	Heppel et al. 1945	3,000	1,500	7 hr	3,600 ppm (2.4)	360 ppm
Monkey	Marhold 1986	-----	-----	7 hr	7,200 ppm (2.4)	720 ppm
Rat	Spencer et al. 1951	1,000	-----	7 hr	2,400 ppm (2.4)	240 ppm

Other animal data	It has been reported that female rats survived a 1.5-hour exposure to 1,000 ppm [Spencer et al. 1951].
Human data	In one study, 1 of 6 workers reported symptoms such as nausea, vomiting, and dizziness from exposures between 10 and 37 ppm [Brzozowski et al. 1954].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for ethylene dichloride is 50 ppm based on acute inhalation toxicity data in workers [Brzozowski et al. 1954]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ethylene dichloride at concentrations above 1 ppm.]

REFERENCES:

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Ethylene glycol dinitrate

CAS number	628-96-6
NIOSH REL	0.1 mg/m³ STEL [skin]
Current OSHA PEL	0.2 ppm (1 mg/m³) CEILING [skin]
1989 OSHA PEL	0.1 mg/m³ STEL [skin]
1993-1994 ACGIH TLV	0.05 ppm (0.31 mg/m³) TWA [skin]
Description of Substance	Colorless to yellow, oily, odorless liquid.
LEL	Unknown
Original (SCP) IDLH*	500 mg/m³ [*Note: "Effective" IDLH = 200 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for ethylene glycol dinitrate (EGDN) and/or nitroglycerin. The chosen IDLH, therefore, is based on chronic toxicity data concerning the physiological response of animals to EGDN. According to Patty [1963], rats and guinea pigs survived 6 months of exposure to 500 mg/m³ (80 ppm) EGDN with the only effect being slight drowsiness and some Heinz body formation [Stein 1956]. Although Patty [1963] stated that EGDN is more toxic for cats and rabbits, the chosen IDLH is still probably conservative because cats given 2-hour daily exposures to 21 ppm EGDN for 1,000 days exhibited only marked blood changes [von Oettingen 1946]. However, because of the assigned protection factor afforded by each device, 2,000 × the OSHA PEL of 0.1 mg/m³ (i.e., 200 mg/m³) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	Rats and guinea pigs have survived 6 months of exposure to 500 mg/m³ with the only effect being slight drowsiness and some Heinz body formation [NIOSH 1978]. Cats given 2-hour daily exposures for 1,000 days to 133 mg/m³ exhibited only marked blood changes [von Oettingen 1946].
Human data	Headaches have developed in workers exposed to 0.4 to 0.67 mg/m³ for 25 minutes; all workers had decreases in blood pressure [Trainor and Jones 1966]. Ethylene glycol dinitrate and nitroglycerine are vasodilators and initial exposures result in headache, dizziness, nausea, or decreases in blood pressure; however, workers became tolerant of the vasodilatory activity after 2 to 4 days of exposure [NIOSH 1978].

Revised IDLH: 75 mg/m³
Basis for revised IDLH: The revised IDLH for ethylene glycol dinitrate is 75 mg/m³ based on an analogy to nitroglycerine [NIOSH 1978] which has a revised IDLH of 75 mg/m³.

REFERENCES:

1. NIOSH [1978]. Criteria for a recommended standard: occupational exposure to nitroglycerine and ethylene glycol dinitrate. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78-167.
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Ethyleneimine

CAS number	151-56-4
NIOSH REL	None established; NIOSH considers ethyleneimine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	Carcinogen
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 ppm (0.88 mg/m³) TWA [skin]
Description of Substance	Colorless liquid with an ammonia-like odor.
LEL	3.3% (10% LEL, 3,300 ppm)
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	According to Patty [1963], 1 of 6 guinea pigs and 1 of 6 rats died from a 2-hour exposure to 100 ppm; a 2-hour exposure to 50 ppm killed 0 of 6 guinea pigs and 0 of 6 rats [Carpenter et al. 1948].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
G. pig	Carpenter et al. 1948	-----	25	8 hr	310 ppm (12.43)	31 ppm
G. pig	Carpenter et al. 1948	LC_{17}: 100	-----	2 hr	353 ppm (3.53)	35 ppm
Rat	Carpenter et al. 1948	LC_{17}: 100	-----	2 hr	353 ppm (3.53)	35 ppm
Rat	Carpenter et al. 1948	250	-----	1 hr	470 ppm (1.88)	47 ppm
G. pig	Carpenter et al. 1948	250	-----	1 hr	470 ppm (1.88)	47 ppm
Rat	Carpenter et al. 1949	62	-----	4 hr	219 ppm (7.27)	22 ppm
Rabbit	Izmerov et al. 1982	-----	56	2 hr	197 ppm (3.53)	20 ppm
Mouse	Izmerov et al. 1982	223	-----	2 hr	786 ppm (3.53)	79 ppm
Rat	Izmerov et al. 1982	56	-----	2 hr	197 ppm (3.53)	20 ppm
Mouse	Silver and McGrath 1948	2,236	-----	10 min	824 ppm (0.368)	82 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.1 [ten Berge et al. 1986].

Other animal data	It has been reported that rats and guinea pigs survived 2-hour exposures to 50 ppm [Carpenter et al. 1949].
Human data	Exposure to concentrations greater than 100 ppm has caused respiratory tract irritation and inflammation, but symptoms may be delayed several hours [Gosselin et al. 1976]. Also, it has been presumed that severe exposures might result in an overwhelming pulmonary edema since ethyleneimine is a powerful lacrimator and emetic [Gosselin et al. 1976].

Revised IDLH: 100 ppm [Unchanged]

Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Gosselin et al. 1976], the original IDLH for ethyleneimine (100 ppm) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ethyleneimine at any detectable concentration. OSHA currently requires in 29 CFR 1919.1012 that workers engaged in handling ethyleneimine be provided with and required to wear and use a supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Shaffer CB [1948]. The acute toxicity of ethylene imine to small animals. J Ind Hyg Toxicol *30*(1):2-6.
2. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.

3. Gosselin RE, Hodge HC, Smith RP, Gleason MN [1976]. Clinical toxicology of commercial products. 4th ed. Baltimore, MD: Williams and Wilkins Company, p. II-139.
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 67.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2174.
6. Silver SD, McGrath FP [1948]. A comparison of acute toxicities of ethylene imine and ammonia to mice. J Ind Hyg Toxicol *30*(1):7-9.
7. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Ethylene oxide

CAS number	75-21-8
NIOSH REL	<0.1 ppm (<0.18 mg/m^3) TWA, 5 ppm (9 mg/m^3) CEILING, 10-minutes/day; NIOSH considers ethylene oxide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	1 ppm TWA, 5 ppm 15-minute "EXCURSION"
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (1.8 mg/m^3) TWA, A2
Description of Substance	Colorless gas or liquid (below 51°F) with an ether-like odor.
LEL	3.0% (10% LEL, 3,000 ppm)
Original (SCP) IDLH	800 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1958] that the estimated LC_{50} for a 4-hour exposure is approximately 800 to 1,500 ppm depending on the species [Jacobson et al. 1956]. In addition, Patty [1963] stated that for humans 500 ppm is probably safe for single exposures (no more than once per week) of 1-hour duration.
Existing short-term exposure guidelines	National Research Council [NRC 1986] Emergency Exposure Guidance Levels (EEGLs): 1-hour EEGL: 20 ppm 24-hour EEGL: 1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Back et al. 1972	836	-----	4 hr	1,672 ppm (2.0)	167 ppm
Rat	Carpenter et al. 1949	4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
Rat	Deichmann and Gerarde 1969	800	-----	4 hr	1,600 ppm (2.0)	160 ppm
G. pig	Izmerov et al. 1982	819	-----	4 hr	1,638 ppm (2.0)	164 ppm
Rat	Jacobson et al. 1956	1,460	-----	4 hr	2,920 ppm (2.0)	292 ppm
Mouse	Jacobson et al. 1956	835	-----	4 hr	1,670 ppm (2.0)	167 ppm
Dog	Jacobson et al. 1956	960	-----	4 hr	1,920 ppm (2.0)	192 ppm

Human data: Other than temporary, slight irritation, no after-effects were reported in 4 men after intentional exposure to 2,500 ppm for a brief period; definite nasal irritation was reported after 10 seconds of exposure to 12,500 ppm [Walker and Greeson 1932]. Exposures to concentrations above 2,000 ppm have resulted in headache, nausea, vomiting, dyspnea, hematological abnormalities, and respiratory irritation [NRC 1986]. Based on acute toxicity data in animals, it has been suggested that injury or death would be associated with exposure to 8,000 ppm for 10 minutes, 4,000 ppm for 30 minutes, or 2,000 ppm for 60 minutes; a 1-hour exposure to 500 ppm was considered as not likely to produce injury [Clayton and Clayton 1981].

Revised IDLH: 800 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Clayton and Clayton 1981; NRC 1986; Walker and Greeson 1932] the original IDLH for ethylene oxide (800 ppm) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for ethylene oxide at concentrations above 5 ppm. OSHA currently requires in 29 CFR 1919.1047 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 2,000 ppm (2,000 × the PEL).]

Ethylene oxide (continued)

REFERENCES:

1. AIHA [1958]. Ethylene oxide. In: Hygienic guide series. Am Ind Hyg Assoc J *19*:528-529.
2. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-204 to A-205.
3. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.
4. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 2166-2186.
5. Deichmann WB, Gerarde HW [1969]. Ethylene oxide (epoxyethane; oxirane; dimethylene oxide). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 258-259.
6. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 67.
7. Jacobson KH, Hackley EB, Feinsilver L [1956]. The toxicity of inhaled ethylene oxide and propylene oxide vapors. Acute and chronic toxicity of ethylene oxide and acute toxicity of propylene oxide. AMA Arch Ind Health *13*(3):237-244.
8. NRC [1986]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 6. Benzene and ethylene oxide. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 35-71.
9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1633.
10. Walker WJG, Greeson CE [1932]. The toxicity of ethylene oxide. J Hyg *32*:409-416.

Ethyl ether

CAS number	60-29-7
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	400 ppm (1,200 mg/m³) TWA
1989 OSHA PEL	400 ppm (1,200 mg/m³) TWA, 500 ppm (1,500 mg/m³) STEL
1993-1994 ACGIH TLV	400 ppm (1,210 mg/m³) TWA, 500 ppm (1,520 mg/m³) STEL
Description of Substance	Colorless liquid with a pungent, sweetish odor.
LEL	1.9% (10% LEL, 1,900 ppm)
Original (SCP) IDLH	19,000 ppm [LEL]
Basis for original (SCP) IDLH	The chosen IDLH is based on the lower explosive limit (LEL) of 19,000 ppm [NFPA 1975]. The toxicological data do not indicate that exposure to this concentration for 30 minutes would impede escape or cause irreversible health effects. According to the Pennsylvania Department of Environmental Resources [1973], the inhalation of 3.5% by volume (35,000 ppm) causes loss of consciousness within 30 to 40 minutes, and concentrations above 7.5% (75,000 ppm) are dangerous to life.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Flury and Zernik 1935	-----	106,000	?	?	?
Dog	Flury and Zernik 1935	-----	76,000	?	?	?
Rat	Schwetz and Becker 1970	73,000	-----	2 hr	116,800 ppm (1.6)	11,680 ppm
Mouse	Schwetz and Becker 1970	6,500	-----	1.65 hr	9,685 ppm (1.49)	969 ppm

Human data [illegible]

Revised IDLH: 1,900 ppm [LEL]

Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Clayton and Clayton 1981; cook 1945; Henderson and Haggard 1943], a value between 2,000 and 19,000 ppm would have been appropriate. However, the revised IDLH for ethyl ether is 1,900 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.9%).

REFERENCES:

1. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York: John Wiley & Sons, Inc., pp. 2491-2511.
2. Cook WA [1945]. Maximum allowable concentrations of industrial atmospheric contaminants. Ind Med *14*:936-949.
3. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German).
4. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 195.
5. NFPA [1975]. Fire protection guide on hazardous materials. 6th ed. Boston, MA: National Fire Protection Association, p. 325M-79.
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7. Schwetz BA, Becker BA [1970]. Embryotoxicity and fetal malformations of rats and mice due to maternally administered ether. Toxicol Appl Pharmacol *17*:275 [Abstract].

Ethyl formate

CAS number	109-94-4
NIOSH REL	100 ppm (300 mg/m³) TWA
Current OSHA PEL	100 ppm (300 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (303 mg/m³) TWA
Description of Substance	Colorless liquid with a fruity odor.
LEL	2.8% (10% LEL, 2,800 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Smyth [1956] cited in Patty [1963] and by UCC [1968] that 5 of 6 rats died following a 4-hour exposure to 8,000 ppm and no rats died from a 4-hour exposure to 4,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Flury and Zernik 1931	-----	10,000	1.5 hr	14,500 ppm (1.45)	1,450 ppm
Rat	Smyth 1956	LC_{83}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm
Rat	Smyth et al. 1954	-----	8,000	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Jenner et al. 1964	oral	1,850	-----	4,205 ppm	421 ppm
G. pig	Jenner et al. 1964	oral	1,110	-----	2,523 ppm	252 ppm
Rabbit	Munch 1972	oral	2,075	-----	4,716 ppm	472 ppm

Other animal data	It has been stated that rats have survived a 4-hour exposure to 4,000 ppm [UCC 1968].
Human data	It has been reported that 330 ppm produced slight eye irritation and rapidly increasing nasal irritation [Flury and Zernik 1931].

Revised IDLH: 1,500 ppm
Basis for revised IDLH: The revised IDLH for ethyl formate is 1,500 ppm based on acute inhalation toxicity data in animals [Flury and Zernik 1931; Smyth 1956; Smyth et al. 1954]. This may be a conservative value due to the lack of relevant acute toxicity data for workers at concentrations above 330 ppm.

REFERENCES:

1. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 375 (in German).
2. Jenner PM, Hagan EC, Taylor JM, Cook EL, Fitzhugh OG [1964]. Food flavourings and compounds of related structure. I. Acute oral toxicity. Food Cosmet Toxicol *2*:327-343.
3. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1855.
5. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.
6. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
7. UCC [1968]. Toxicology studies: ethyl formate. New York, NY: Union Carbide Corporation.

Ethyl mercaptan

CAS number	75-08-1
NIOSH REL	0.5 ppm (1.3 mg/m³) 15-minute CEILING
Current OSHA PEL	10 ppm (25 mg/m³) CEILING
1989 OSHA PEL	0.5 ppm (1 mg/m³) TWA
1993-1994 ACGIH TLV	0.5 ppm (1.3 mg/m³) TWA
Description of Substance	Colorless liquid with a strong, skunk-like odor.
LEL	2.8% (10% LEL, 2,800 ppm)
Original (SCP) IDLH	2,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 4-hour LC_{50} of 2,770 ppm [Fairchild and Stokinger 1958 cited by ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Fairchild and Stokinger 1958	4,420	-----	4 hr	8,840 ppm (2.0)	884 ppm
Mouse	Fairchild and Stokinger 1958	2,770	-----	4 hr	5,540 ppm (2.0)	554 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Fairchild and Stokinger 1958	oral	682	-----	1,849 ppm	185 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for ethyl mercaptan is 500 ppm based on acute inhalation toxicity data in animals [Fairchild and Stokinger 1958]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. Ethyl mercaptan (ethanethiol). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 107.
2. Fairchild EJ II, Stokinger HE [1958]. Toxicologic studies on organic sulfur compounds. I. Acute toxicity of some aliphatic and aromatic thiols (mercaptans). Am Ind Hyg Assoc J *19*:171-189.

N-Ethylmorpholine

CAS number	100-74-3
NIOSH REL	5 ppm (23 mg/m^3) TWA [skin]
Current OSHA PEL	20 ppm (94 mg/m^3) TWA [skin]
1989 OSHA PEL	5 ppm (23 mg/m^3) TWA [skin]
1993-1994 ACGIH TLV	5 ppm (24 mg/m^3) TWA [skin]
Description of Substance	Colorless liquid with an ammonia-like odor.
LEL	Unknown
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement that 1 of 6 rats died following a 4-hour exposure to 2,000 ppm [Smyth et al. 1954 cited by ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1954	LC_{17}: 2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1954	oral	1,780	-----	2,601 ppm	260 ppm
Mouse	Timofievskaya 1979	oral	1,200	-----	1,754 ppm	175 ppm

Human data .... Exposures to 100 ppm for 2.5 minutes have resulted in olfactory fatigue and irritation of the eyes, nose, and throat; irritation was slight after 25 minutes at 50 ppm and absent at 25 ppm [Smyth 1964]. Corneal edema has been noted in workers exposed to concentrations greater than 40 ppm for several hours [Dernehl 1966]. In another study, workers exposed to concentrations as high as 11 ppm but averaging about 3 to 4 ppm complained of drowsiness, optical halos, and foggy vision [Woewicki 1968].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for N-ethylmorpholine is 100 ppm based on acute inhalation toxicity data in humans [Dernehl 1966; Smyth 1964]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 ppm.

REFERENCES:

1. ACGIH [1971]. N-Ethylmorpholine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 113.
2. Dernehl CU [1966]. Health hazards associated with polyurethane foams. J Occup Med *8*:59-62.
3. Smyth JF Jr [1964]. Personal communication to ACGIH TLV Committee (November 24, 1964). [From ACGIH [1991]. N-Ethyl morpholine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 638-639.]
4. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
5. Timofievskaya LA [1979]. Comparative evaluation of the toxicity of piperazine and N-methyl piperazine. Toksikol Nov Prom Khim Vesh *15*:116-123 (in Russian).
6. Woewicki A [1968]. Personal communication to ACGIH TLV Committee. [From ACGIH [1991]. N-Ethyl morpholine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 638-639.]

Ethyl silicate

CAS number	78-10-4
NIOSH REL	10 ppm (85 mg/m^3) TWA
Current OSHA PEL	100 ppm (850 mg/m^3) TWA
1989 OSHA PEL	10 ppm (85 mg/m^3) TWA
1993-1994 ACGIH TLV	10 ppm (85 mg/m^3) TWA
Description of Substance	Colorless liquid with a sharp, alcohol-like odor.
LEL	Unknown
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the following statements by AIHA [1968]: "Smyth and Seaton [1940] reported that 1,740 ppm in dry air caused the first guinea pig death in 15 minutes, while at 1,170 ppm the first death was in 2 hours. In the presence of 70% humidity, effects were less pronounced, presumably because part of the ethyl silicate was hydrolyzed."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	1,000	4 hr	2,000 ppm (2.0)	200 ppm
G. pig	Smyth and Seaton 1940	-----	700	6 hr	1,610 ppm (2.3)	161 ppm
G. pig	Smyth and Seaton 1940	-----	1,740	15 min	1,375 ppm (0.79)	138 ppm
G. pig	Smyth and Seaton 1940	-----	1,170	2 hr	1,872 ppm (1.6)	187 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Carpenter et al. 1949	oral	6,270	-----	5,068 ppm	507 ppm

Other animal data	It has been stated that 2,000 ppm is about the maximum exposure for 60 minutes without the production of serious disturbances in guinea pigs and rats; 500 ppm is the maximum exposure for several hours without causing serious effects [Smyth and Seaton 1940].
Human data	Exposure to a concentration of 1,200 ppm caused lacrimation and 250 ppm caused irritation of the eyes and nose [Smyth and Seaton 1940]. It has been stated that 700 ppm is probably intolerable for more than 30 minutes [Smyth and Seaton 1940].

Revised IDLH: 700 ppm
Basis for revised IDLH: The revised IDLH for ethyl silicate is 700 ppm based on acute inhalation toxicity data in humans [Smyth and Seaton 1940].

REFERENCES:

1. AIHA [1968]. Ethyl silicate. In: Hygienic guide series. Am Ind Hyg Assoc J *29*:624-626.
2. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.
3. Smyth HF Jr, Seaton J [1940]. Acute response of guinea pigs and rats to inhalation of the vapors of tetraethyl orthosilicate (ethyl silicate). J Ind Hyg Toxicol *22*(7):288-296.

Ferbam

CAS number	14484-64-1
NIOSH REL	10 mg/m³ TWA
Current OSHA PEL	15 mg/m³ TWA
1989 OSHA PEL	10 mg/m³ TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of Substance	Dark brown to black, odorless solid.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	There is no evidence in the available toxicological data of an IDLH for ferbam. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances, it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mg/m³ is 7,500 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Hodge et al. 1952	oral	3,000	-----	21,000 mg/m³	2,100 mg/m³
G. pig	Hodge et al. 1952	oral	2,000	-----	14,000 mg/m³	1,400 mg/m³
Rat	Korablev 1969	oral	1,130	-----	7,910 mg/m³	791 mg/m³
Mouse	Lee et al. 1978	oral	3,400	-----	23,800 mg/m³	2,380 mg/m³

Human data .... Large oral doses cause gastrointestinal disturbances [Proctor et al. 1988]. The dust is irritating to the eyes and respiratory tract; severe exposures are expected to cause depression of the central nervous system [Proctor et al. 1988].

Revised IDLH: 800 mg/m³
Basis for revised IDLH: The revised IDLH for ferbam is 800 mg/m³ based on acute oral toxicity data in animals [Korablev 1969].

REFERENCES:

1. Hodge HC, Maynard EA, Downs W, Blanchet HJ Jr, Jones CK [1952]. Acute and short-term oral toxicity tests of ferric dimethyldithiocarbamate (ferbam) and zinc dimethyldithiocarbamate (ziram). J Am Pharm Assoc 61(12):662-665.
2. Korablev MV [1969]. Toxicological characteristics of derivatives of dithiocarbamino acid used in industry and medicine. Farmakol Toksikol 32:356-362 (in Russian).
3. Lee C-C, Russell JQ, Minor JL [1978]. Oral toxicity of ferric dimethyl-dithiocarbamate (ferbam) and tetramethylthiuram disulfide (thiram) in rodents. J Toxicol Environ Health 4(1):93-106.
4. Proctor NH, Hughes, JP, Fischman ML [1988]. Chemical hazards of the workplace. 2nd ed. Philadelphia, PA: J.B. Lippincott Company, p. 257.

Ferrovanadium dust

CAS number	12604-58-9
NIOSH REL	1 mg/m³ TWA, 3 mg/m³ STEL
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	1 mg/m³ TWA, 3 mg/m³ STEL
1993-1994 ACGIH TLV	1 mg/m³ TWA, 3 mg/m³ STEL
Description of Substance	Dark, odorless particulate dispersed in air.
LEL	Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence of an IDLH for ferrovanadium dust. ACGIH [1971] reported that no acute intoxication occurred in animals exposed at concentrations as high as 10,000 mg/m³ [Roshchin 1952]. Therefore, for this draft technical standard, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 1 mg/m³ (i.e., 500 mg/m³); only the "most protective" respirators are permitted for concentrations exceeding 500 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	No acute intoxication occurred in animals exposed to concentrations as high as 10,000 mg/m³; serious pathologic changes occurred only at concentrations ranging from 1,000 to 2,000 mg/m³ in 1-hour exposures on alternate days for 2 months [Roshchin 1952]. It was also reported that exposure of rats to 40 to 80 mg/m³ for 2 months caused bronchitis, interstitial sclerosis, and perivascular edema [Clayton and Clayton 1981].
Human data	Systemic effects have not been reported from industrial exposure [Proctor et al. 1988].

Revised IDLH: 500 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of ferrovanadium dust would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for ferrovanadium dust is 500 mg/m³ based on being 500 times the NIOSH REL of 1 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. ACGIH [1971]. Ferrovanadium. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 114.
2. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., p. 2020.
3. Proctor NH, Hughes, JP, Fischman ML [1988]. Chemical hazards of the workplace. 2nd ed. Philadelphia, PA: J.B. Lippincott Company, pp. 257-258.
4. Roshchin IV [1952]. Hygienic description of production vanadium aerosol. Gig Sanit *11*:49-53 (translated).

Fluorides (as F)

CAS number	Varies
NIOSH REL	2.5 mg/m³ TWA
Current OSHA PEL	2.5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2.5 mg/m³ TWA
Description of Substance	Varies
Original (SCP) IDLH	500 mg F/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for fluorides. The chosen IDLH, therefore, has been estimated from the human acute lethal dose of 5 grams of sodium fluoride [Largent 1961 cited by AIHA 1965]. AIHA [1965] stated that the atmospheric concentration immediately hazardous to life is unknown, but "particulate fluorides are not likely to cause acute health problems among workmen unless large quantities are swallowed, or unless the more toxic decomposition products are involved. Exact concentrations producing immediate illness are unknown, but most likely are very high."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
SiF_4						
Rat	Carpenter et al. 1949	-----	69,220 mg/m³	4 hr	101,071 mg F/m³	10,107 mg F/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
CaF_2						
G. pig	Budavari 1989	oral	-----	>5,000	>17,051 mg F/m³	>1,705 mg F/m³
Rat	Vest Akad Med Nk 1977	oral	-----	4,250	14,488 mg F/m³	1,449 mg F/m³
$AlF_6 \cdot 3Na$						
Rabbit	Largent 1948	oral	-----	9,000	34,208 mg F/m³	3,421 mg F/m³
$F_6Si \cdot 2Na$						
Mouse	Gig Tr Prof Zabol 1988	oral	-----	70	297 mg F/m³	30 mg F/m³
Rabbit	Sine 1993	oral	-----	125	530 mg F/m³	53 mg F/m³
$F_6Si \cdot Mg \cdot 6H_2O$						
G. pig	Frear 1969	oral	200		581 mg F/m³	58 mg F/m³

Fluorides (as F) (continued)

Human data .... Skin rashes and complaints of the gastric, intestinal, circulatory, respiratory, and nervous systems have been reported in workers exposed chronically to concentrations ranging from 11 to 24 mg F/m³ [Roholm 1937]. Chronic exposures at concentrations greater than 24 mg F/m³ have been considered to be "elevated" and a concentration of 10 mg F/m³ was considered "excessive" [Collings et al. 1952]. It has also been stated that the atmospheric concentration immediately hazardous to life is unknown, and particulate fluorides are not likely to cause acute health problems among workers unless large quantities are ingested; concentrations producing immediate illness are unknown, but most likely are very high [AIHA 1965]. It has been stated that 5 grams of sodium fluoride is the probable lethal oral dose [Largent 1961]. [Note: An oral dose of 5 grams is equivalent to a worker being exposed to about 1,500 mg F/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 250 mg F/m³
Basis for revised IDLH: The revised IDLH for fluorides is 250 mg F/m³ based on toxicity data in humans [AIHA 1965; Largent 1961; Roholm 1937]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 250 mg F/m³.

REFERENCES:

1. AIHA [1965]. Fluoride-bearing dusts and fumes (inorganic). In: Hygienic guide series. Am Ind Hyg Assoc J *26*:426-430.
2. Budavari S, ed. [1989]. 1669. Calcium fluoride. In: The merck index. 11th edition. Rahway, NJ: Merck & Co., Inc., p. 253.
3. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.
4. Collings GH, Fleming RBL, May R, Bianconi WO [1952]. Absorption and excretion of inhaled fluorides. AMA Arch Ind Hyg Occup Med *6*:368-373.
5. Frear EH, ed. [1969]. Pesticide index. 4th ed. State College, PA: College Science Publishers, p. 265.
6. Gig Tr Prof Zabol [1988]; *53*(11):60 (in Russian).
7. Largent EJ [1948]. The comparative toxicity of cryolite for rats and for rabbits. J Ind Hyg Toxicol *30*:92-97.
8. Largent EJ [1961]. Fluorosis, the health aspects of fluorine compounds. Columbus, OH: Ohio State University Press.
9. Roholm K [1937]. Fluorine intoxication. A clinical hygiene study with a review of the literature and some experimental investigations. London, England: H.K. Lewis & Co.
10. Sine C, ed. [1993]. Safsan®. In: Farm chemicals handbook '93, p. C302.
11. Vest Akad Med Nk [1977]; 2:28-33 (in Russian).

Fluorine

CAS number	7782-41-4
NIOSH REL	0.1 ppm (0.2 mg/m³) TWA
Current OSHA PEL	0.1 ppm (0.2 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (1.6 mg/m³) TWA, 2 ppm (3.1 mg/m³) STEL
Description of Substance	Pale-yellow to greenish gas with a pungent, irritating odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	25 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1965] that "2 men were able to tolerate 25 ppm very briefly but both developed sore throats and chest pains lasting 6 hours; 50 ppm could not be tolerated [Rickey 1959]."
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 15 ppm
30-minute EEGL: 10 ppm
60-minute EEGL: 7.5 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Keplinger and Suissa 1968	185	-----	1 hr	231 ppm (1.25)	23 ppm
Mouse	Keplinger and Suissa 1968	150	-----	1 hr	188 ppm (1.25)	19 ppm
Rabbit	Keplinger and Suissa 1968	270	-----	30 min	270 ppm (1.0)	27 ppm
G. pig	Keplinger and Suissa 1968	170	-----	1 hr	213 ppm (1.25)	21 ppm

Human data .... It has been reported that 2 men were able to tolerate 25 ppm very briefly but both developed sore throats and chest pains that lasted 6 hours; 50 ppm could not be tolerated [Rickey 1959]. Volunteers tolerated 10 ppm for 15 minutes with a minimum of irritation [Ricca 1970]. Intermittent exposures to 10 ppm were repeated every 3 to 5 minutes for 15 minutes over 2 to 3 hours with only slight irritation of the eyes and skin noted [Ricca 1970]. Much irritation of the eyes have been noted at 100 ppm, but with no aftereffects after only 30 seconds [Grant 1974]. It has been observed that exposures up to 30 ppm for 5 to 30 minutes had no ill effects [Lyon 1962].

Revised IDLH: 25 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Grant 1974; Lyon 1962; Ricca 1970; Rickey 1959], the original IDLH for fluorine (25 ppm) is not being revised at this time.

REFERENCES:

1. AIHA [1965]. Fluorine (revised 1965). In: Hygienic guide series. Am Ind Hyg Assoc J *26*:624-627.
2. Grant WM [1974]. Toxicology of the eye. 2nd ed. Springfield, IL: C.C. Thomas, p. 499.
3. Keplinger ML, Suissa LW [1968]. Toxicity of fluorine short-term inhalation. Am Ind Hyg Assoc J *29*:10-18.
4. Lyon JS [1962]. Observations on personnel working with fluorine at a gaseous diffusion plant. J Occup Med *4*:199-201.
5. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 77-88.
6. Ricca PM [1970]. A survey of the acute toxicity of elemental fluorine. Am Ind Hyg Assoc J *3*:22-29.
7. Rickey RP [1959]. Decontamination of large liquid fluorine spills. Arlington, VA: Edwards Air Force Base, ASTIA Document Service Center, Air Force Flight Test Center Technical Report 59-31.

Fluorotrichloromethane

CAS number	75-69-4
NIOSH REL	1,000 ppm (5,600 mg/m^3) CEILING
Current OSHA PEL	1,000 ppm (5,600 mg/m^3) TWA
1989 OSHA PEL	1,000 ppm (5,600 mg/m^3) CEILING
1993-1994 ACGIH TLV	1,000 ppm (5,620 mg/m^3) CEILING
Description of Substance	Colorless to water-white, nearly odorless liquid or gas (above 75°F).
LEL	Noncombustible Liquid/Nonflammable Gas
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	Scheel (member of the Standards Completion Program Respirator Committee), in evaluating the work of Reinhardt et al. [1971], indicated cardiac toxicity occurred at 12,000 ppm. The chosen IDLH is based on that data.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs): 1-hour EEGL: 1,500 ppm 24-hour EEGL: 500 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Barras 1974	-----	26,200	4 hr	52,400 ppm (2.0)	5,240 ppm
Rat	Lester and Greenberg 1950	-----	100,000	20 min	96,000 ppm (0.96)	9,600 ppm
Rat	Scholz 1962	-----	100,000	2 hr	160,000 ppm (1.6)	16,000 ppm

Other animal data	Evidence of serious arrhythmia was noted in 1 of 12 conscious dogs exposed for 5 minutes to 5,000 ppm plus intravenous epinephrine [Reinhardt et al. 1971]. However, in another study, endogenous epinephrin was not sufficient to precipitate arrythmia in dogs exposed to 5,000 to 10,000 ppm [Reinhardt et al. 1971].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for fluorotrichloromethane is 2,000 ppm based on acute toxicity data in animals [Reinhardt et al. 1971] and to be consistent with a closely-related chlorofluorocarbon, 1,1,2-trichloro-1,2,2-trifluoroethane which has a revised IDLH of 2,000 ppm.

REFERENCES:

1. Barras CE [1974]. Unpublished data. Wilmington, DE: DuPont Company, Haskell Laboratory (October 1974). [From ACGIH [1986]. Documentation of the threshold limit values for substances in workroom air. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 598.]
2. Lester D, Greenberg LA [1950]. Acute and chronic toxicity of some halogenated derivatives of methane and ethane. AMA Arch Ind Hyg Occup Med 2:335-344.
3. Mullin LS, Azar A, Reinhardt CF, Smith PE, Fabryka EF [1972]. Halogenated hydrocarbon-induced cardiac arrhythmias associated with release of endogenous epinephrine. Am Ind Hyg Assoc J 33(6):389-396.
4. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 26-33.
5. Reinhardt CF, Azar A, Maxfield ME, Smith PE, Mullin LS [1971]. Cardiac arrhythmias and aerosol "sniffing." Arch Environ Health 22:265-279.
6. Scholz J [1962]. New toxicological investigations on certain types of freon used as propellants. Fortschr Biol Aerosol-forsch Jahren 1957-1961. Ber Aerosol Kongr 4:420-429. [From ACGIH [1991]. Trichlorofluoromethane. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 619-623.]

Formaldehyde

CAS number 50-00-0

NIOSH REL .... 0.016 ppm TWA, 0.1 ppm 15-minute CEILING; NIOSH considers formaldehyde to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 0.75 ppm TWA, 2 ppm STEL

1989 OSHA PEL .... Same as current PEL

1993-1994 ACGIH TLV .... 0.3 ppm (0.37 mg/m^3) CEILING, A2

Description of Substance .... Nearly colorless gas with a pungent, suffocating odor.

LEL .... 7.0% (10% LEL, 7,000 ppm)

Original (SCP) IDLH .... 30 ppm

Basis for original (SCP) IDLH .... Patty [1963] reported that "exposure to 10 to 20 ppm produces almost immediate eye irritation and a sharp burning sensation of the nose and throat which may be associated with sneezing, difficulty in taking a deep breath, and coughing; recovery is prompt from these transient effects [Kodak 1936-1960]." Because Patty [1963] also reported that "it has been estimated that exposure for 5 to 10 minutes to 50 to 100 ppm might cause serious injury to the lower respiratory passages in man [Kodak 1936-1960]," 30 ppm seems reasonable as the IDLH.

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	333	-----	2 hr	533 ppm (1.6)	53 ppm
Cat	Izmerov et al. 1982	-----	333	2 hr	533 ppm (1.6)	53 ppm
Rat	Skog 1950	815	-----	30 min	815 ppm (1.0)	81 ppm

Other animal data .... RD_{50} (mouse), 3.13 ppm [Alarie 1981].

Human data .... It has been reported that exposure to 10 to 20 ppm produces almost immediate eye irritation and a sharp burning sensation of the nose and throat which may be associated with sneezing, difficulty in taking a deep breath, and coughing; recovery is prompt from these transient effects [Kodak 1936-1960]. It has been estimated that exposure for 5 to 10 minutes to 50 to 100 ppm might cause serious injury to the lower respiratory passages [Kodak 1936-1960]. The following exposure-effect data has also been reported: most subjects experience irritation of the eyes, nose, and throat at 1 to 3 ppm; many subjects cannot tolerate prolonged exposures to 4 to 5 ppm; and difficulty in breathing was experienced at 10 to 20 ppm [IARC 1982]. In a summary of health effects data, upper airway irritation and increased nasal airway resistance were reported at 0.1 to 25 ppm and lower airway and chronic pulmonary obstruction at 5 to 30 ppm [NRC 1981].

Revised IDLH: 20 ppm

Basis for revised IDLH: The revised IDLH for formaldehyde is 20 ppm based on acute inhalation toxicity data in humans [IARC 1982; Kodak 1936-1960; NRC 1981]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for formaldehyde at concentrations above 0.016 ppm. OSHA currently requires in 29 CFR 1910.1048 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 75 ppm (i.e., 100 × the OSHA PEL of 0.75 ppm).]

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect 42:9-13.
2. IARC [1982]. IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans. Vol. 29. Some industrial chemicals and dyestuffs. Lyon, France: International Agency for Research on Cancer, pp. 345-389.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 69.
4. Kodak [1936-1960]. Personal observations. Rochester, NY: Eastman Kodak Company, Laboratory of Industrial Medicine. [From Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1971.]
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6. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1971.
7. Skog E [1950]. A toxicological investigation of lower aliphatic aldehydes. I. Toxicity of formaldehyde, acetaldehyde, propionaldehyde and butyraldehyde; as well as acrolein and crotonaldehyde. Acta Pharmacol Toxicol 6(4):299-318.

Formic acid

CAS number	64-18-6
NIOSH REL	5 ppm (9 mg/m^3) TWA
Current OSHA PEL	5 ppm (9 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (9.4 mg/m^3) TWA, 10 ppm (19 mg/m^3) STEL
Description of Substance	Colorless liquid with a pungent, penetrating odor.
LEL(90% solution)	18% (10% LEL (90% solution), 18,000 ppm)
Original (SCP) IDLH	30 ppm
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available on which to base an IDLH for formic acid, the chosen IDLH is based on an analogy with formaldehyde, which has an IDLH of 30 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Gig Tr Prof Zabol 1963	7,853	-----	15 min	6,204 ppm (0.79)	620 ppm
Mouse	Gig Tr Prof Zabol 1963	3,246	-----	15 min	2,564 ppm (0.79)	256 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Gig Tr Prof Zabol 1963	oral	1,100	-----	4,031 ppm	403 ppm
Mouse	Gig Tr Prof Zabol 1963	oral	700	-----	2,565 ppm	256 ppm
Dog	von Oettingen 1959	oral	4,000	-----	14,659 ppm	1,466 ppm

Human data .... Workers exposed to about 15 ppm have complained of nausea [Fahy and Elkins 1954].

Revised IDLH: 30 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Gig Tr Prof Zabol 1963], a value of about 250 ppm would have been appropriate for formic acid. However, the original IDLH for formic acid (30 ppm) is not being revised at this time.

REFERENCES:

1. Fahy JP, Elkins HB [1954]. Unpublished data. [From: ACGIH [1986]. Formic acid. In: Documentation of the threshold limit values and biological exposure indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 279.].
2. Gig Tr Prof Zabol [1963]; *23*(12):49 (in Russian).
3. von Oettingen WF [1959]. The aliphatic acids and their esters–toxicity and potential dangers. AMA Arch Ind Health *20*:517-531.

Furfural

CAS number 98-01-1
NIOSH REL .... The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL .... 5 ppm (20 mg/m³) TWA [skin]
1989 OSHA PEL .... 2 ppm (8 mg/m³) TWA [skin]
1993-1994 ACGIH TLV .... 2 ppm (7.9 mg/m³) TWA [skin]
Description of Substance .... Colorless to amber liquid with an almond-like odor.
LEL .... 2.1% (10% LEL, 2,100 ppm)
Original (SCP) IDLH .... 250 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement that 260 ppm was the lethal concentration for rats, but caused no deaths in mice or rabbits [Quaker Oats cited by AIHA 1965].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Dog	Deichmann and Gerarde 1969	370	-----	6 hr	851 ppm (2.3)	85 ppm
Mouse	Deichmann and Gerarde 1969	-----	370	6 hr	851 ppm (2.3)	85 ppm
Rat	Quaker Oats	-----	260	?	?	?
Rat	Terrill et al. 1989	175	-----	6 hr	403 ppm (2.3)	40 ppm
Rat	Terrill et al. 1989	1,037	-----	1 hr	1,296 ppm (1.25)	130 ppm

Other animal data .... It has been stated that 260 ppm (duration of exposure undefined) caused no deaths in mice or rabbits [Quaker].
Human data .... Widespread eye and respiratory tract irritation has been noted in workers exposed to concentrations ranging from 5 to 16 ppm [Apol and Lucas 1975]. Headaches, itching of the throat, and red and weeping eyes have occurred at concentrations ranging from 1.9 to 14 ppm [Korenman and Resnik 1930].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for furfural is 100 ppm based on acute inhalation toxicity data in humans [Apol and Lucas 1975; Korenman and Resnik 1930] and animals [Deichmann and Gerarde 1969; Terrill et al. 1989]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 16 ppm.

REFERENCES:

1. AIHA [1965]. Furfural. In: Hygienic guide series. Am Ind Hyg Assoc J 26:196-199.
2. Apol AG, Lucas JB [1975]. Health hazard evaluation, Pacific Grinding Wheel Co., Maysville, WA. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HHE 73-18-171, NTIS No. 246-444.
3. Deichmann WB, Gerarde HW [1969]. Furfural (2-furaldehyde; pyromucic aldehyde; artificial oil of ants). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 279-280.
4. Korenman IM, Resnik IB [1930]. Furfural as an industrial poison and its determination in the air. Arch Hyg *104*:344-357 (in German). [From ACGIH [1991]. Furfural. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 694-695.]
5. Quaker Oats [?]. Physiological data on QO furfural. Chicago, IL: Quaker Oats Company, Chemicals Division. [From AIHA [1965]. Furfural. In: Hygienic guide series. Am Ind Hyg Assoc J 26:196-199.]
6. Terrill JB, Van Horn WE, Robinson D, Thomas DL [1989]. Acute inhalation toxicity of furan, 2-methyl furan, furfuryl alcohol, and furfural in the rat. Am Ind Hyg Assoc J *50*:A359-A361.

Furfuryl alcohol

CAS number	98-00-0
NIOSH REL	10 ppm (40 mg/m^3) TWA, 15 ppm (60 mg/m^3) STEL [skin]
Current OSHA PEL	50 ppm (200 mg/m^3) TWA
1989 OSHA PEL	10 ppm (40 mg/m^3) TWA, 15 ppm (60 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	10 ppm (40 mg/m^3) TWA, 15 ppm (60 mg/m^3) STEL [skin]
Description of Substance	Colorless to amber liquid with a faint, burning odor.
LEL	1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH	250 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat 4-hour LC_{50} of 233 ppm of a furfuryl alcohol, hydrazine, and aniline mixture [Jacobson et al. 1958]. Also, Deichmann and Gerarde [1969] stated that 8% mortality resulted from a 6-hour exposure of rats to 47 ppm furfuryl alcohol and 100% mortality resulted at 243 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Comstock and Oberst 1952	LC_{18}: 700	-----	4 hr	1,400 ppm (2.0)	140 ppm
Rat	Comstock and Oberst 1952	LC_{25}: 700	-----	8 hr	1,750 ppm (2.5)	175 ppm
Rat	Deichmann and Gerarde 1969	LC_{8}: 47	-----	6 hr	108 ppm (2.3)	11 ppm
Rat	Deichmann and Gerarde 1969	LC_{100}: 243	-----	6 hr	559 ppm (2.3)	56 ppm
Mouse	Deichmann and Gerarde 1969	-----	597	6 hr	1,373 ppm (2.3)	137 ppm
Mouse	NIOSH 1979	397	-----	6 hr	913 ppm (2.3)	91 ppm
Rat	NIOSH 1979	85	-----	6 hr	196 ppm (2.3)	20 ppm
Rat	Terrill et al. 1989	592	-----	1 hr	740 ppm (1.25)	74 ppm

Other animal data	Exposure of rats to 100 ppm for 6 hours per day, 5 days per week for 16 weeks resulted in decreased weight gain and biochemical changes in the brain (i.e., increased cerebral glial acid-proteinase and phosphohydrase activity) [Savolainen and Pfaffli 1983].
Human data	No discomfort was reported from concentrations up to 10.8 ppm for 15 minutes, but severe lacrimation occurred at 15.8 ppm [Apol 1973]. It has also been reported that there is no hazard from exposures up to 16 ppm [Burton and Rivera 1972].

Revised IDLH: 75 ppm
Basis for revised IDLH: The revised IDLH is 75 ppm based on acute inhalation toxicity data in animals [Terrill et al. 1989].

REFERENCES:

1. Apol AG [1973]. Health hazard evaluation, Western Foundry Co., Tigard, OR. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HHE 72-116-85.
2. Burton DJ, Rivera RO [1972]. Health hazard evaluation, May Foundry, Salt Lake City, UT: Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HHE 2-10-15.
3. Comstock CC, Oberst FW [1952]. Inhalation toxicity of aniline, furfural alcohol, and their mixtures in rats and mice. U.S. Army Chemical Center, MD: Chemical Corps, Medical Laboratories, Research Report No. 139.
4. Deichmann WB, Gerarde HW [1969]. Furfuryl alcohol. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 280-281.

5. Jacobson KH, Rinehart WE, Wheelwright HJ Jr, Ross MA, Papin JL, Daly RC, Greene EA, Groff WA [1958]. The toxicology of an aniline-furfuryl alcohol-hydrazine vapor mixture. Am Ind Hyg Assoc J *19*:91-100.
6. NIOSH [1979]. Criteria for a recommended standard: occupational exposure to furfuryl alcohol. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 79-133.
7. Savolainen H, Pfaffli P [1983]. Neurotoxicity of furfuryl alcohol vapor in prolonged inhalation exposure. Environ Res *31*(2):420-427.
8. Terrill JB, Van Horn WE, Robinson D, Thomas DL [1989]. Acute toxicity of furan, 2-methyl furan, furfuryl alcohol, and furfural in the rat. Am Ind Hyg Assoc J *50*:A359-A361.

Glycidol

CAS number	556-52-5
NIOSH REL	25 ppm (75 mg/m^3) TWA
Current OSHA PEL	50 ppm (150 mg/m^3) TWA
1989 OSHA PEL	25 ppm (75 mg/m^3) TWA
1993-1994 ACGIH TLV	25 ppm (76 mg/m^3) TWA
Description of Substance	Colorless liquid.
LEL	Unknown
Original (SCP) IDLH	500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 4-hour LC_{50} of 450 ppm and the rat 8-hour LC_{50} of 580 ppm [Hine et al. 1956 cited by ACGIH 1971, and Patty 1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hine et al. 1956	450	-----	4 hr	900 ppm (2.0)	90 ppm
Rat	Hine et al. 1956	580	-----	8 hr	1,450 ppm (2.5)	145 ppm

Other animal data .... It has been reported that rats exposed repeatedly to 400 ppm for 7 hours per day, 5 days a week for 10 weeks showed no evidence of cumulative toxicity, only very slight irritation of the eyes, and slight lacrimation and respiratory distress following the first few exposures [Hine et al. 1956].

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 150 ppm
Basis for revised IDLH: The revised IDLH for glycidol is 150 ppm based on acute inhalation toxicity data in animals [Hine et al. 1956].

REFERENCES:

1. ACGIH [1971]. Glycidol. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 121-122.
2. Hine CH, Kodama JS, Wellington JS, Dunlap MK, Anderson HH [1956]. The toxicology of glycidol and some glycidyl ethers. AMA Arch Ind Health *14*:250-264.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1635.

Graphite (natural)

CAS number	7782-42-5
NIOSH REL	2.5 mg/m^3 (respirable dust) TWA
Current OSHA PEL	15 mppcf TWA
1989 OSHA PEL	2.5 mg/m^3 (respirable dust) TWA
1993-1994 ACGIH TLV	2 mg/m^3 (respirable dust) TWA
Description of Substance	Steel gray to black, greasy feeling, odorless solid.
LEL	Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mppcf — see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of graphite would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mppcf is 7,500 mppcf).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,250 mg/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of graphite would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for graphite (natural) is 1,250 mg/m^3 based on being 500 times the NIOSH REL of 2.5 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Hafnium compounds (as Hf)

CAS number	7440-58-6 (Metal)
NIOSH REL	0.5 mg/m^3 TWA
Current OSHA PEL	0.5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m^3 TWA
Description of Substance	Varies
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 250 mg Hf/m^3 — see discussion below.]
Basis for original (SCP) IDLH	MCA [1966] stated that hafnium metal has a low order of toxicity. ILO [1972] reported that hafnium compounds appear to have an acute toxicity slightly greater than those of corresponding zirconium salts ($ZrCl_4$, $ZrOCl_2$) [Haley et al. 1962]. However, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 0.5 mg/m^3 (i.e., 250 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 250 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
HfCl Rat	Izmerov et al. 1982	oral	2,362	-----	13,791 mg Hf/m^3	1,379 mg Hf/m^3
$HfCl_2O$ Mouse	Haley et al. 1962	oral	76	-----	359 mg Hf/m^3	36 mg Hf/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 50 mg Hf/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for hafnium compounds. Therefore, the revised IDLH for hafnium compounds is 50 mg Hf/m^3 based on acute oral toxicity data in animals [Haley et al. 1962]. This may be a conservative value due to the lack of acute inhalation toxicity data for workers.

REFERENCES:

1. Haley TJ, Raymond K, Komesu N, Upham HC [1962]. The toxicologic and pharmacologic effects of hafnium salts. Toxicol Appl Pharmacol 4:238-246.
2. ILO [1972]. Zirconium, hafnium. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. II (L-Z). Geneva, Switzerland: International Labour Office, pp. 1528-1529.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 71.
4. MCA [1966]. Chemical safety data sheet SD-92: properties and essential information for safe handling and use of zirconium and hafnium powder. Washington, DC: Manufacturing Chemists Association, Inc., pp. 1-10.

Heptachlor

CAS number 76-44-8
NIOSH REL .... 0.5 mg/m³ TWA [skin]; NIOSH considers heptachlor to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.5 mg/m³ TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.5 mg/m³ TWA [skin]
Description of Substance .... White to light-tan crystals with a camphor-like odor.
LEL.. Noncombustible Solid
Original (SCP) IDLH .... 700 mg/m³
Basis for original (SCP) IDLH .... No data on acute inhalation toxicity are available on which to base the IDLH for heptachlor. The chosen IDLH, therefore, has been estimated from the male rat oral LD_{50} of 100 mg/kg [Gaines 1960 cited by ACGIH 1971].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Izmerov et al. 1982	-----	150 mg/m³	4 hr	300 mg/m³ (2.0)	30 mg/m³
Mammal	Osetrov 1958	-----	200 mg/m³	4 hr	400 mg/m³ (2.0)	40 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	AAPCO 1966	oral	116	-----	812 mg/m³	81 mg/m³
Rat	Edson 1960	oral	40	-----	280 mg/m³	28 mg/m³
Rat	Gaines 1960	oral	100	-----	700 mg/m³	70 mg/m³
Mouse	Kenaga and Morgan 1978	oral	68	-----	476 mg/m³	48 mg/m³
Cat	Osetrov 1958	oral	-----	50	350 mg/m³	35 mg/m³
Hamster	Truhaut et al. 1974	oral	100	-----	700 mg/m³	70 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 35 mg/m³
Basis for revised IDLH: The revised IDLH for heptachlor is 35 mg/m³ based on acute inhalation toxicity data in animals [Izmerov et al. 1982; Osetrov 1958]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for heptachlor at concentrations above 0.5 mg/m³.]

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of the American Pesticide Control Officials, Inc. p. 576.
2. ACGIH [1971]. Heptachlor. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 123-124.
3. Edson EF [1960]. Applied toxicology of pesticides. Pharmaceut J 185:361-367.
4. Gaines TB [1960]. The acute toxicity of pesticides to rats. Toxicol Appl Pharmacol 2:88-99.
5. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 71.
6. Kenaga EE, Morgan RW [1978]. Commercial and experimental organic insecticides. Entomological Society of America Special Publication 78-1:12.
7. Osetrov VE [1958]. Experimental data on toxicology of the insecticide heptachlor. Gig Tr Prof Zabol 2(5):15 (in Russian).
8. Truhaut R, Gak JC, Graillot C [1974]. Recherches sur les modalités et les mécanismes d'action toxique des insecticides organochlorés. I. Étude comparative des effets de toxicité aiguë chez le hamster et chez le rat. J Eur Toxicol 7(3):159-166 (in French).

n-Heptane

CAS number	142-82-5
NIOSH REL	85 ppm (350 mg/m^3) TWA, 440 ppm (1,800 mg/m^3) 15-minute CEILING
Current OSHA PEL	500 ppm (2,000 mg/m^3) TWA
1989 OSHA PEL	400 ppm (1600 mg/m^3) TWA, 500 ppm (2,000 mg/m^3) STEL
1993-1994 ACGIH TLV	400 ppm (1,640 mg/m^3) TWA, 500 ppm (2,050 mg/m^3) STEL
Description of Substance	Colorless liquid with a gasoline-like odor.
LEL	1.05% (10% LEL, 1,050 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that a 15-minute exposure to 5,000 ppm produced a state of intoxication characterized by uncontrolled hilarity in some individuals and in others a stupor lasting for 30 minutes after the exposure [Patty and Yant 1929]. According to Patty [1963], a 4-minute exposure to this same concentration produces vertigo and incoordination [Patty and Yant 1929]. These symptoms described by Patty [1963] could perhaps impede escape.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Human	Flury and Zernik 1931	-----	16,000	?	?	?
Mouse	Marhold 1986	17,986	-----	2 hr	28,778 ppm (1.6)	2,878 ppm
Mouse	Swann et al. 1974	-----	15,000	30 min	15,000 ppm (1.0)	1,500 ppm

Other human data: Inhalation of 1,000 ppm for 6 minutes was associated with slight dizziness [Patty and Yant 1929]. Exposure to 5,000 ppm for 4 minutes produced complaints of nausea, a loss of appetite, vertigo, and incoordination [Patty and Yant 1929]. A 15-minute exposure to 5,000 ppm produced a state of intoxication characterized by uncontrolled hilarity in some individuals and in others a stupor lasting for 30 minutes after the exposure [Patty and Yant 1929].

Revised IDLH: 750 ppm
Basis for revised IDLH: The revised IDLH for n-heptane is 750 ppm based on acute inhalation toxicity data in humans [Patty and Yant 1929].

REFERENCES:

1. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, pp. 257-264 (in German).
2. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 9 (in Czechoslovakian).
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 1198-1199.
4. Patty FA, Yant WP [1929]. Odor intensity and symptoms produced by commercial propane, butane, pentane, hexane, and heptane vapor. Pittsburgh, PA: Department of Commerce, U.S. Bureau of Mines, Report of Investigations, No. 2979, pp. 1-10.
5. Swann HE Jr, Kwon BK, Hogan GK, Snellings WM [1974]. Acute inhalation toxicity of volatile hydrocarbons. Am Ind Hyg Assoc J *35*:511-518.

Hexachloroethane

CAS number 67-72-1

NIOSH REL .... 1 ppm (10 mg/m^3) TWA [skin]; NIOSH considers hexachloroethane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 1 ppm (10 mg/m^3) TWA [skin]

1989 OSHA PEL .... Same as current PEL

1993-1994 ACGIH TLV .... 1 ppm (9.7 mg/m^3) TWA [skin], A2

Description of Substance .... Colorless crystals with a camphor-like odor.

LEL... Noncombustible Solid

Original (SCP) IDLH .... 300 ppm

Basis for original (SCP) IDLH .... Based on the toxicological data relating to potential liver injury [Gleason et al. 1969; Elkins 1959], 300 ppm, the saturated vapor pressure at 20°C [Kirk-Othmer 1964] has been chosen as the IDLH.

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Weeks et al. 1979	oral	4,460	-----	3,173 ppm	317 ppm
G. pig	Weeks et al. 1979	oral	4,970	-----	3,536 ppm	354 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 300 ppm [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for hexachloroethane. Therefore, based on acute oral toxicity data in animals [Weeks et al. 1979], the original IDLH for hexachloroethane (300 ppm) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for hexachloroethane at concentrations above 1 ppm.]

REFERENCES:

1. Elkins HB [1959]. Hexachloroethane, C_2Cl_6. In: The chemistry of industrial toxicology. 2nd ed. New York, NY: John B. Wiley & Sons, Inc., pp. 142-143.
2. Gleason MN, Gosselin RE, Hodge HC, Smith RP [1969]. Clinical toxicology of commercial products. 3rd ed. Baltimore, MD: Williams & Wilkins Company, pp. II-76, III-65 to III-67.
3. Kirk-Othmer [1964]. Encyclopedia of chemical technology. 2nd ed. New York, NY: John Wiley & Sons, Inc. 5:166.
4. Weeks MH, Angerhofer KA, Bishop R, et al. [1979]. The toxicity of hexachloroethane in laboratory animals. Am Ind Hyg Assoc J 40:187-199.

Hexachloronaphthalene

CAS number	1335-87-1
NIOSH REL	0.2 mg/m³ TWA [skin]
Current OSHA PEL	0.2 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA [skin]
Description of Substance	White to light-yellow solid with an aromatic odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	2 mg/m³
Basis for original (SCP) IDLH	Although AIHA [1966] stated that "IDLHs for the chloronaphthalenes are probably unattainable," an IDLH of 2 mg/m³ for hexachloronaphthalene has been chosen for this draft technical standard. The chosen IDLH is based on the industrial exposure cited by ACGIH [1971] in which fatal cases of hepatic injury occurred in a plant where air concentrations of mixed pentachloronaphthalenes and hexachloronaphthalenes ranged from 1 to 2 mg/m³ [Elkins 1959].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	Repeated exposure of rats to 8.9 mg/m³ of a mixture of hexachloronaphthalene and pentachloronaphthalene for up to 4.5 months produced jaundice and was fatal; minor liver injury still occurred at 1.16 mg/m³ [Drinker et al. 1937]. Hexachloronaphthalene has been shown to be more toxic than pentachloronaphthalene in ingestion studies with calves [Bell 1958]. Total doses of hexachloronaphthalene ranging from 5 to 23 mg/kg were given orally in mineral oil over 10 days and lacrimation, salivation, nasal discharge, depression, and anorexia occurred by the 5th day [Bell 1958].
Human data	It has been reported that fatal cases of hepatic injury have occurred from chronic exposures in a plant where air concentrations of mixed pentachloronaphthalenes and hexachloronaphthalenes ranged from 1 to 2 mg/m³ [Elkins 1959].

Revised IDLH: 2 mg/m³ [Unchanged]
Basis for revised IDLH: Based on chronic inhalation toxicity data in humans [Elkins 1959] and animals [Bell 1958, Drinker 1937], the original IDLH for hexachloronaphthalene (2 mg/m³) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Hexachloronaphthalene. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 125.
2. AIHA [1966]. Chloronaphthalenes. In: Hygienic guide series. Am Ind Hyg Assoc J 27:89.
3. Bell WB [1958]. The relative toxicity of the chlorinated naphthalenes in experimentally produced bovine hyperkeratosis (x-disease). Vet Med 48:135-140.
4. Drinker CK, Warren MF, Bennett GA [1937]. The problem of possible systemic effects from certain chlorinated hydrocarbons. J Ind Hyg Toxicol 19(7):283-299.
5. Elkins HB [1959]. The chemistry of industrial toxicology. 2nd ed. New York, NY: John B. Wiley & Sons, Inc., pp. 151-152.

n-Hexane

CAS number 110-54-3
NIOSH REL .... 50 ppm (180 mg/m³) TWA
Current OSHA PEL .... 500 ppm (1,800 mg/m³) TWA
1989 OSHA PEL .... 50 ppm (180 mg/m³) TWA
1993-1994 ACGIH TLV .... 50 ppm (176 mg/m³) TWA
Description of Substance .... Colorless liquid with a gasoline-like odor.
LEL... 1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH .... 5,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that a 10-minute exposure to 5,000 ppm caused dizziness and a sensation of giddiness [Patty and Yant 1929]. Because these symptoms could impede escape, 5,000 ppm is judged to be the IDLH.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kimura et al. 1971	oral	28,710	56,137	5,614 ppm	-----

Human data .... It has been reported that a 10-minute exposure to 5,000 ppm caused dizziness and a sensation of giddiness [Patty and Yant 1929].

Revised IDLH: 1,100 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute toxicity data in humans [Patty and Yant 1929], a value of about 2,500 ppm would have been appropriate. However, the revised IDLH for n-hexane is 1,100 ppm based strictly on safety considerations (i.e., being 10% of the lower exposure limit of 1.1%).

REFERENCES:

1. Kimura ET, Ebert DM, Dodge PW [1971]. Acute toxicity and limits of solvent residue for sixteen organic solvents. Toxicol Appl Pharmacol 19:699-704.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1198.
3. Patty FA, Yant WP [1929]. Odor intensity and symptoms produced by commercial propane, butane, pentane, hexane, and heptane vapor. Pittsburgh, PA: Department of Commerce, U.S. Bureau of Mines, Report of Investigations, No. 2979, pp. 1-10.

2-Hexanone

CAS number	591-78-6
NIOSH REL	1 ppm (4 mg/m^3) TWA
Current OSHA PEL	100 ppm (410 mg/m^3) TWA
1989 OSHA PEL	5 ppm (20 mg/m^3) TWA
1993-1994 ACGIH TLV	5 ppm (20 mg/m^3) TWA
Description of Substance	Colorless liquid with an acetone-like odor.
LEL	Unknown
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by AIHA [1968] that guinea pigs exposed to 6,000 ppm showed signs of beginning narcosis at 30 minutes and deep anesthesia at the end of 1 hour; death did not occur for 6.5 hours at this concentration [Specht et al. 1940]. Also, AIHA [1968] reported that 8,000 ppm killed all rats during a 4-hour exposure [Smyth et al. 1954]. [Note: For "convenience", an IDLH of 5,000 ppm (50 × the OSHA PEL) was originally chosen rather than 6,000 ppm.]
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NPIRI 1974	8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm
G. pig	Schrenk et al. 1936	-----	20,000	70 min	26,600 ppm (1.33)	2,600 ppm
Rat	Smyth et al. 1954	LC_{100}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	Schrenk et al. 1936	oral	2,590	-----	4,358 ppm	436 ppm
Rat	Smyth et al. 1954	oral	-----	914	1,538 ppm	154 ppm
Mouse	Tanii et al. 1936	oral	2,430	-----	4,089 ppm	409 ppm

Other animal data	Narcosis occurs in guinea pigs after 30 minutes of exposure to 20,000 ppm [Schrenk et al. 1936].
Human data	Volunteers exposed to 1,000 ppm reported a strong odor and transient, moderate eye and nasal irritation [DiVencenzo et al. 1978].

Revised IDLH: 1,600 ppm
Basis for revised IDLH: The revised IDLH for 2-hexanone is 1,600 ppm based on acute inhalation toxicity data in humans [DiVencenzo et al. 1978] and animals [NPIRI 1974; Smyth et al. 1954]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 1,000 ppm.

REFERENCES:

1. AIHA [1968]. 2-Hexanone. In: Hygienic guide series. Am Ind Hyg Assoc J *29*:618-620.
2. DiVencenzo GD, Hamilton ML, Kaplan CJ, et al. [1978]. Studies on the respiratory uptake and excretion and the skin absorption of methyl n-butyl ketone in humans and dogs. Toxicol Appl Pharmacol *44*:593-604.
3. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 78.

4. Schrenk HH, Yant WP, Patty FA [1936]. Acute response of guinea pigs to vapors of some noncommercial organic compounds. X. Hexanone (methyl butyl ketone). Public Health Rep *51*:624-631.
5. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
6. Specht H, Miller JW, Valaer PJ, Sayers RR [1940]. Acute response of guinea pigs to the inhalation of ketone vapors. Washington, DC: U.S. Government Printing Office, Federal Security Agency, U.S. Public Health Service, National Institute of Health Bulletin No. 176, pp. 1-66.
7. Tanii H, Tsuji H, Hashimoto K [1936]. Structure-toxicity relationship of monoketones. Toxicol Lett *30*:13-17.

Hexone

CAS number	108-10-1
NIOSH REL	50 ppm (205 mg/m³) TWA, 75 ppm (300 mg/m³) STEL
Current OSHA PEL	100 ppm (410 mg/m³) TWA
1989 OSHA PEL	50 ppm (205 mg/m³) TWA, 75 ppm (300 mg/m³) STEL
1993-1994 ACGIH TLV	50 ppm (205 mg/m³) TWA, 75 ppm (307 mg/m³) STEL
Description of Substance	Colorless liquid with a pleasant odor.
LEL(@200°F)	1.2% (10% LEL(@200°F), 1,200 ppm)
Original (SCP) IDLH	3,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] from Smyth [1956] that rats survived a 4-hour exposure to 2,000 ppm; death occurred as a result of a 4-hour exposure to 4,000 ppm. Also, AIHA [1966] reported that exposure of rats to 4,000 ppm for 4 hours killed 6 of 6 and exposure at 2,000 ppm for 4 hours killed 0 of 6 [Smyth et al. 1951].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1951	LC_{100}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Other animal data	It has been reported that rats survived exposures to 2,000 ppm for 4 hours [Smyth et al. 1951].
Human data	It has been reported that 200 ppm has an objectionable odor and is irritating to the eyes [Silverman et al. 1946]. Among a group of workers exposed to concentrations of 500 ppm for 20 to 30 minutes and about 80 ppm for the rest of the shift, most experienced irritation of the eyes, nose, and throat, weakness, loss of appetite, headache, nausea, vomiting, and a sore throat [Linari et al. 1964].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for hexone is 500 ppm based on acute inhalation toxicity data in humans [Linari et al. 1964; Silverman et al. 1946]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 500 ppm.

REFERENCES:

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sec-Hexyl acetate

CAS number	108-84-9
NIOSH REL	50 ppm (300 mg/m³) TWA
Current OSHA PEL	50 ppm (300 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	50 ppm (295 mg/m³) TWA
Description of Substance	Colorless liquid with a mild, pleasant, fruity odor.
LEL	Unknown
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that 2 of 6 rats died from a 4-hour exposure to 4,000 ppm [Smyth et al. 1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1954	LC_{33}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
Rat	UCC 1966	-----	2,000	4 hr	4,000 ppm (2.0)	400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	UCC 1966	oral	6,160	-----	7,187 ppm	719 ppm

Human data .... Volunteers noted an unpleasant odor and irritation of the eyes and upper respiratory tract at 100 ppm [Silverman et al. 1946].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for sec-hexyl acetate is 500 ppm based on acute inhalation toxicity data in humans [Silverman et al. 1946] and animals [Smyth et al. 1954; UCC 1966].

REFERENCES:

1. ACGIH [1971]. sec-Hexyl acetate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 127.
2. Silverman L, Schulte HF, First MW [1946]. Further studies on sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol *28*:262-266.
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
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Hydrazine

CAS number	302-01-2
NIOSH REL	0.03 ppm (0.04 mg/m³) 2-hour CEILING; NIOSH considers hydrazine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	1 ppm (1.3 mg/m³) TWA [skin]
1989 OSHA PEL	0.1 ppm (0.1 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	0.1 ppm (0.13 mg/m³) TWA [skin], A2
Description of Substance	Colorless, fuming, oily liquid with an ammonia-like odor.
LEL	2.9% (10% LEL, 2,900 ppm)
Original (SCP) IDLH	80 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that a 4-hour exposure to 80 to 300 ppm killed 14 of 30 rats [Comstock et al. 1954].
Existing short-term exposure guidelines	National Research Council [NRC 1985] Short-term Public Emergency Exposure Guidance Levels (SPEGLs):

1-hour SPEGL: 0.12 ppm
2-hour SPEGL: 0.16 ppm
4-hour SPEGL: 0.03 ppm
8-hour SPEGL: 0.015 ppm
16-hour SPEGL: 0.008 ppm
24-hour SPEGL: 0.005 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Comstock et al. 1954	LC_{17}: 190	-----	4 hr	380 ppm (2.0)	38 ppm
Rat	Comstock et al. 1954	260	-----	4 hr	520 ppm (2.0)	52 ppm
Rat	Comstock et al. 1954	LC_{33}: 270	-----	4 hr	540 ppm (2.0)	54 ppm
Rat	Comstock et al. 1954	LC_{63}: 300	-----	4 hr	600 ppm (2.0)	60 ppm
Rat	Comstock et al. 1954	630	-----	1 hr	788 ppm (1.25)	79 ppm
Rat	Jacobson et al. 1955	570	-----	4 hr	1,140 ppm (2.0)	114 ppm
Mouse	Jacobson et al. 1955	252	-----	4 hr	504 ppm (2.0)	50 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Swiecicki 1973	oral	60	-----	316 ppm	32 ppm
Mouse	Swiecicki 1973	oral	59	-----	311 ppm	31 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for hydrazine is 50 ppm based on acute inhalation toxicity data in animals [Comstock et al. 1954; Jacobson et al. 1955]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for hydrazine at concentrations above 0.03 ppm.]

REFERENCES:

1. Comstock CC, Lawson LH, Greene EA, Oberst FW [1954]. Inhalation toxicity of hydrazine vapor. Arch Ind Hyg Occup Med *10*:476-490.
2. Jacobson KH, Clem JH, Wheelwright HJ Jr, Rinehart WE, Mayes N [1955]. The acute toxicity of the vapors of some methylated hydrazine derivatives. AMA Arch Ind Health *12*:609-616.

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Hydrogen bromide

CAS number	10035-10-6
NIOSH REL	3 ppm (10 mg/m³) CEILING
Current OSHA PEL	3 ppm (10 mg/m³) TWA
1989 OSHA PEL	3 ppm (10 mg/m³) CEILING
1993-1994 ACGIH TLV	3 ppm (9.9 mg/m³) CEILING
Description of Substance	Colorless gas with a sharp, irritating odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	50 ppm
Basis for original (SCP) IDLH	Hydrogen bromide is an extremely irritating and corrosive gas. The chosen IDLH is based on an analogy with bromine. According to ILO [1971], however, bromine produces a more marked toxic action. AIHA [1958] reported that for humans, 40 to 60 ppm bromine is dangerous for short exposure [Henderson and Haggard 1943]. Because hydrogen bromide is considered less irritating than bromine, an IDLH of 50 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Back et al. 1972	2,858	-----	1 hr	3,573 ppm (1.25)	357 ppm
Mouse	Back et al. 1972	814	-----	1 hr	1,018 ppm (1.25)	102 ppm

Other animal data	Hydrogen bromide (with a rat 1-hour LC_{50} of 2,858 ppm [Back et al. 1972]) is about as acutely toxic as hydrogen chloride (with a rat 1-hour LC_{50} of 3,124 ppm [MacEwen and Vernot 1974]).
Human data	Volunteers noted nose and throat irritation at 2 to 6 ppm after several minutes [Clayton and Clayton 1981]. It has been reported that 1,300 to 2,000 ppm are lethal in exposures lasting a few minutes [NRC 1981].

Revised IDLH: 30 ppm

Basis for revised IDLH: Based on an analogy to hydrogen chloride [Back et al. 1972; MacEwen and Vernot 1974] which has a revised IDLH of 50 ppm (which is 10 times the NIOSH REL), the revised IDLH for hydrogen bromide is 30 ppm (which is also 10 times the NIOSH REL). This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations of hydrogen bromide between 6 and 1,300 ppm.

REFERENCES:

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4. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 133.
5. ILO [1971]. Chlorine and compounds. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 211-213.
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7. NRC [1981]. Prudent practices for handling hazardous chemicals in laboratories. Washington, DC: National Academy of Sciences, National Research Council, p. 98.

Hydrogen chloride

CAS number	7647-01-0
NIOSH REL	5 ppm (7 mg/m^3) CEILING
Current OSHA PEL	5 ppm (7 mg/m^3) CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (7.5 mg/m^3) CEILING
Description of Substance	Colorless to slightly yellow gas with a pungent, irritating odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Patty [1963] that according to Matt [1889] as cited in Flury and Zernik [1931], work is impossible when one inhales air containing hydrogen chloride in concentrations of 75 to 150 mg/m^3 (50 to 100 ppm); work is difficult but possible when the air contains concentrations of 15 to 75 mg/m^3 (10 to 50 ppm); and work is undisturbed at the concentration of 15 mg/m^3 (10 ppm).
Existing short-term exposure guidelines	National Research Council [NRC 1987] Emergency Exposure Guidance Levels (EEGLs) and Short-term Public Emergency Guidance Levels (SPEGLs):

10-minute EEGL: 100 ppm
1-hour EEGL: 20 ppm
24-hour EEGL: 20 ppm

1-hour SPEGL: 1 ppm
24-hour SPEGL: 1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Human	Lefaux 1968	-----	1,300	30 min	1,300 ppm (1.0)	130 ppm
Rat	MacEwen and Vernot 1974	3,124	-----	1 hr	6,248 ppm (2.0)	625 ppm
Rabbit	Machle et al. 1942	-----	4,416	30 min	4,416 ppm (1.0)	442 ppm
G. pig	Machle et al. 1942	-----	4,416	30 min	4,416 ppm (1.0)	442 ppm
Human	Tab Biol Per 1933	-----	3,000	5 min	500 ppm (0.17)	50 ppm
Mouse	Wohlslagel et al. 1976	1,108	-----	1 hr	2,216 ppm (2.0)	222 ppm

*Note: Conversion factor (CF) was determined with "n" = 1.0 [ten Berge et al. 1986].

Other animal data	RD_{50} (mouse), 309 ppm [Alarie 1981].
Other human data	It has been reported that 50 to 100 ppm for 1 hour is barely tolerable and that 35 ppm causes irritation of the throat [Henderson and Haggard 1943]. It has also been reported that work is impossible at 50 to 100 ppm but is difficult but possible at 10 to 50 ppm [Flury and Zernik 1931].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for hydrogen chloride is 50 ppm based on acute inhalation toxicity data in humans [Flury and Zernik 1931; Henderson and Haggard 1943; Tab Biol Per 1933].

Hydrogen chloride (continued)

REFERENCES:

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2. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 128 (in German).
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4. Lefaux R [1968]. Practical toxicology of plastics. Cleveland, OH: Chemical Rubber Co., p. 207.
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7. Matt L [1889]. Doctoral dissertation. Wurzburg, Germany: Julius Maximillian University (in German). [From Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 851.]
8. NRC [1987]. Emergency and continuous exposure guidance levels for selected airborne contaminants. Vol. 7. Ammonia, hydrogen chloride, lithium bromide, and toluene. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 17-30.
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11. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.
12. Wohlslagel J, Dipasquale LC, Vernot EH [1976]. Toxicity of solid rocket motor exhaust: effects of HCl, HF, and alumina on rodents. J Combustion Toxicol *3*:61-70.

Hydrogen cyanide

CAS number 74-90-8
NIOSH REL .... 4.7 ppm (5 mg/m³) STEL [skin]
Current OSHA PEL .... 10 ppm (11 mg/m³) TWA [skin]
1989 OSHA PEL .... 4.7 ppm (5 mg/m³) STEL [skin]
1993-1994 ACGIH TLV .... 10 ppm (11 mg/m³) CEILING [skin]
Description of Substance .... Colorless or pale-blue liquid or gas (above 78°F) with a bitter, almond-like odor.
LEL .... 5.6% (10% LEL, 5,600 ppm)
Original (SCP) IDLH .... 50 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by Patty [1963] that 45 to 54 ppm is "tolerated by man for 0.5 to 1 hour without immediate or late effects; 110 to 135 ppm, however, may be fatal after 0.5 to 1 hour or later, or dangerous to life [Flury and Zernik 1931; Dudley et al. 1942]."
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Mammal	AAPCO 1966	-----	200	5 min	103 ppm (0.52)	10 ppm
Mammal	Arena 1970	-----	36	2 hr	60 ppm (1.67)	6.0 ppm
Human	Dudley et al. 1942	-----	107	10 min	71 ppm (0.67)	7.1 ppm
Rat	Dudley et al. 1942	503	-----	5 min	259 ppm (0.52)	26 ppm
Mouse	Dudley et al. 1942	323	-----	5 min	166 ppm (0.52)	17 ppm
Rabbit	Gates et al. 1946	-----	759	1 min	216 ppm (0.28)	22 ppm
Cat	Gates et al. 1946	-----	759	1 min	216 ppm (0.28)	22 ppm
Rat	Hartzell et al. 1985	275	-----	15 min	213 ppm (0.77)	21 ppm
Rat	Hartzell et al. 1985	170	-----	30 min	170 ppm (1.0)	17 ppm
Human	Izmerov et al. 1982	-----	357	2 min	131 ppm (0.37)	13 ppm
Rat	Levin et al. 1987	160	-----	30 min	160 ppm (1.0)	16 ppm
Rat	Vernot et al. 1977	323	-----	5 min	166 ppm (0.52)	17 ppm
Human	WHO 1970	-----	179	1 hr	231 ppm (0.69)	23 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.7 [ten Berge et al. 1986].

Other animal data .... The median effective concentrations to produce incapacitation (EC_{50}s) in rats have been determined to be 139 ppm and 115 ppm in 15 and 30 minutes, respectively [Hartzell et al. 1985].
Other human data .... It has been reported that 45 to 54 ppm can be tolerated for 0.5 to 1 hour without immediate or delayed effects while 110 to 135 ppm may be fatal after 0.5 to 1 hour or later, or dangerous to life [Flury and Zernik 1931].

Revised IDLH: 50 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Flury and Zernik 1931], the IDLH for hydrogen cyanide (50 ppm) is not being revised at this time.

REFERENCES:

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Hydrogen cyanide (continued)

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11. Vernot EH, MacEwen JD, Haun CC, Kinkead ER [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol 42:417-423.
12. WHO [1970]. Technical report series 30. Geneva, Switzerland: World Health Organization.

Hydrogen fluoride (as F)

CAS number	7664-39-3
NIOSH REL	3 ppm (2.5 mg/m³) TWA, 6 ppm (5 mg/m³) 15-minute CEILING
Current OSHA PEL	3 ppm TWA
1989 OSHA PEL	3 ppm TWA, 6 ppm STEL
1993-1994 ACGIH TLV	3 ppm (2.6 mg/m³) CEILING
Description of Substance	Colorless gas or fuming liquid (below 67°F) with a strong, irritating odor.
LEL	Nonflammable Gas/Noncombustible Liquid
Original (SCP) IDLH	30 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 24 mg/m³ (30 ppm) was tolerated by animals for a total of 41 hours without a fatality [Machle et al. 1934]. A concentration of 50 ppm is obviously too high to be selected as the IDLH, because Deichmann and Gerarde [1969] stated that 50 ppm may be fatal when inhaled for 30 to 60 minutes.
Existing short-term exposure guidelines	National Research Council (NRC) Emergency Exposure Limits (EELs) recommended to military and space agencies [Smyth 1966]

10-minute EEL: 20 ppm
30-minute EEL: 10 ppm
60-minute EEL: 8 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Darmer et al. 1972	1,276	-----	1 hr	1,799 ppm (1.41)	180 ppm
Monkey	MacEwen and Vernot 1970	1,774	-----	1 hr	2,501 ppm (1.41)	250 ppm
Rabbit	Treon et al. 1950	-----	313	7 hr	1,171 ppm (3.74)	117 ppm
G. pig	Wohlslagel et al. 1976	4,327	-----	15 min	3,072 ppm (0.71)	307 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.0 [ten Berge et al. 1986].

Other animal data	Guinea pigs and rabbits survived exposures to 30 ppm for 41 hours, but exposures to 300 ppm for 2 hours or more were fatal [Machle et al. 1934].
Human data	It has been stated that 50 ppm may be fatal when inhaled for 30 to 60 minutes [Deichmann and Gerarde 1969]. Volunteers tolerated concentrations as high as 4.7 ppm for 6 hours per day for 10 to 50 days without severe adverse effects [Largent 1961].

Revised IDLH: 30 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969; Largent 1961] and animals [Machle et al. 1934], the original IDLH for hydrogen fluoride (30 ppm) is not being revised at this time.

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Hydrogen peroxide

CAS number	7722-84-1
NIOSH REL	1 ppm (1.4 mg/m³) TWA
Current OSHA PEL	1 ppm (1.4 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (1.4 mg/m³) TWA
Description of Substance	Colorless liquid with a slightly sharp odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	75 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1957] that the short exposure tolerance is unknown for man, but is probably 75 ppm. AIHA [1957] also reported that a single 4-hour exposure to 75 ppm was tolerated by mice but higher concentrations produced delayed deaths [Svirbely]. According to AIHA [1957], concentrations in excess of 1,000 ppm would probably be lethal after a few minutes [Svirbely].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Gig Tr Prof Zabol 1977	1,418	-----	4 hr	2,836 ppm (2.0)	284 ppm
Mouse	Stokinger and Scheel 1962	-----	227	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Lyazsky et al. 1983	oral	2,000	-----	9,929 ppm	993 ppm

Other animal data	It has been reported that mice tolerated a single 4-hour exposure to 75 ppm [Svirbely].
Human data	It has been stated that although the short-term exposure tolerance is unknown, it is probably about 75 ppm [AIHA 1957]. Death has resulted in a man who drank 100 ml [Raukhverger and Solodko 1974].

Revised IDLH: 75 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation data in humans [AIHA 1957] and animals [Svirbely], the original IDLH for hydrogen peroxide (75 ppm) is not being revised at this time.

REFERENCES:

1. AIHA [1957]. Hydrogen peroxide (90%). In: Hygienic guide series. Am Ind Hyg Assoc Q *18*:275-276.
2. Gig Tr Prof Zabol [1977]; *21*(10):22-25 (in Russian).
3. Lyazsky PP, Gleiberman SE, et al. [1983]. Toxicological and hygienic characterization of decontaminating preparations based on hydrogen peroxide and its derivatives. Gig Sanit *48*(6):28-31 (in Russian).
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5. Stokinger HE, Scheel LD [1962]. Ozone toxicity: immunochemical and tolerance-producing aspects. Arch Environ Health *4*:327-334.
6. Svirbely JL [?]. Unpublished results. Cincinnati, OH: U.S. Public Health Service. [From AIHA [1957]. Hydrogen peroxide (90%). In: Hygienic guide series. Am Ind Hyg Assoc Q *18*:275-276.]

Hydrogen selenide (as Se)

CAS number	7783-07-5
NIOSH REL	0.05 ppm (0.2 mg/m^3) TWA
Current OSHA PEL	0.05 ppm (0.2 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.05 ppm (0.16 mg/m^3) TWA
Description of Substance	Colorless gas with an odor resembling decayed horse radish.
LEL	Unknown
Original (SCP) IDLH	2 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the report by Dudley and Miller [1941] that "12.5% of the guinea pigs which had been exposed for 2 hours at 1.8 ppm (0.006 mg/l) died within 30 days of the exposure. A 4-hour exposure to 1.8 ppm was lethal to 18.8% of the guinea pigs exposed, and a 4-hour exposure to 2.1 ppm was lethal to 25% of the animals exposed."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Dudley and Miller 1941	-----	0.3	8 hr	0.75 ppm (2.5)	0.08 ppm
G. pig	Dudley and Miller 1941	LC_{19}: 1.8	-----	4 hr	3.6 ppm (2.0)	0.36 ppm
G. pig	Dudley and Miller 1941	LC_{25}: 2.1	-----	4 hr	4.2 ppm (2.0)	0.42 ppm
G. pig	Dudley and Miller 1941	LC_{13}: 1.8	-----	2 hr	2.9 ppm (1.6)	0.29 ppm
Rat	Wilber 1980	-----	5.9	1 hr	7.4 ppm (1.25)	0.74 ppm

Human data	Although very toxic, no fatalities have been reported, possibly because hydrogen selenide is easily oxidized to red selenium on the surface of mucous membranes of the nose and throat [Friberg et al. 1979]. Concentrations of 1.5 ppm have been found to be intolerable due to eye and nasal irritation [Dudley and Miller 1941].

Revised IDLH: 1 ppm
Basis for revised IDLH: The revised IDLH for hydrogen selenide is 1 ppm based on acute inhalation data in humans [Dudley and Miller 1941; Friberg et al. 1979].

REFERENCES:

1. Dudley HC, Miller JW [1941]. Toxicology of selenium. VI. Effects of subacute exposure to hydrogen selenide. J Ind Hyg Toxicol 23(10):470-477.
2. Friberg L, Nordberg GR, Vouk VB [1979]. Handbook on the toxicology of metals. New York, NY: Elsevier North Holland, p. 568.
3. Wilber CG [1980]. Toxicology of selenium: a review. Clin Toxicol 17(2):171-230.

Hydrogen sulfide

CAS number	7783-06-4
NIOSH REL	10 ppm (15 mg/m³) 10-minute CEILING
Current OSHA PEL	20 ppm CEILING, 50 ppm 10-minute MAXIMUM PEAK
1989 OSHA PEL	10 ppm (14 mg/m³) TWA, 15 ppm (21 mg/m³) STEL
1993-1994 ACGIH TLV	10 ppm (14 mg/m³) TWA, 15 ppm (21 mg/m³) STEL
Description of Substance	Colorless gas with a strong odor of rotten eggs.
LEL	4.0% (10% LEL, 4,000 ppm)
Original (SCP) IDLH	300 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Patty [1963] that 170 to 300 ppm is the maximum concentration that can be endured for 1 hour without serious consequences; 400 to 700 ppm is dangerous after exposure of 0.5 to 1 hour [Henderson and Haggard 1943]. AIHA [1963] reported that 400 to 700 ppm caused loss of consciousness and possible death in 0.5 to 1 hour [MCA 1950].
Existing short-term exposure guidelines	1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 0.1 ppm (60-minute)
ERPG-2: 30 ppm (60-minute)
ERPG-3: 100 ppm (60-minute)

National Research Council [NRC 1985] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 50 ppm
24-hour EEGL: 10 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Back et al. 1972	713	-----	1 hr	977 ppm (1.37)	98 ppm
Mouse	Back et al. 1972	673	-----	1 hr	922 ppm (1.37)	92 ppm
Human	Lefaux 1968	-----	600	30 min	600 ppm (1.0)	60 ppm
Mouse	MacEwen and Vernot 1972	634	-----	1 hr	869 ppm (1.37)	87 ppm
Human	Tab Biol Per 1933	-----	800	5 min	354 ppm (0.44)	35 ppm
Rat	Tansey et al. 1981	444	-----	4 hr	1,141 ppm (2.57)	114 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.2 [ten Berge et al. 1986].

Other human data: It has been reported that 170 to 300 ppm is the maximum concentration that can be endured for 1 hour without serious consequences [Henderson and Haggard 1943] and that olfactory fatigue occurs at 100 ppm [Poda 1966]. It has also been reported that 50 to 100 ppm causes mild conjunctivitis and respiratory irritation after 1 hour; 500 to 700 ppm may be dangerous in 0.5 to 1 hour; 700 to 1,000 ppm results in rapid unconsciousness, cessation of respiration, and death; and 1,000 to 2,000 ppm results in unconsciousness, cessation of respiration, and death in a few minutes [Yant 1930].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for hydrogen sulfide is 100 ppm based on acute inhalation toxicity data in humans [Henderson and Haggard 1943; Poda 1966; Yant 1930] and animals [Back et al. 1972; MacEwen and Vernot 1972; Tansey et al. 1981].

REFERENCES:

1. AIHA [1963]. Hydrogen sulfide. In: Hygienic guide series. Am Ind Hyg Assoc J *24*:92-94.
2. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-220 to A-221.
3. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 245.
4. Lefaux R [1968]. Practical toxicology of plastics. Cleveland, OH: Chemical Rubber Co., p. 207.
5. MacEwen JD, Vernot EH [1972]. Toxic Hazards Research Unit annual report: 1972. Wright-Patterson Air Force Base, OH: Air Force Systems Command, Aerospace Medical Division, Aerospace Medical Research Laboratory Report, AMRL-TR-72-62.
6. MCA [1968]. Chemical safety data sheet SD-36: properties and essential information for safe handling and use of hydrogen sulfide. Washington, DC: Manufacturing Chemists Association, pp. 1-13.
7. NRC [1985]. Emergency and continuous exposure guidance levels for selected airborne contaminants. Vol. 4. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 55-68.
8. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 899.
9. Poda GA [1966]. Hydrogen sulfide can be handled safety. Arch Environ Health *12*:795-800.
10. Tab Biol Per [1933]; *3*:231 (in German).
11. Tansey MF, Kendall FM, Fantasia J, Landin WE, Oberly R [1981]. Acute and subchronic toxicity studies of rats exposed to vapors of methyl mercaptan and other reduced sulfur compounds. J Toxicol Environ Health *8*:71-88.
12. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.
13. Yant WP [1930]. Hydrogen sulfide in industry: occurrence, effects and treatment. Am J Public Health *20*:598-608.

Hydroquinone

CAS number	123-31-9
NIOSH REL	2 mg/m³ 15-minute CEILING
Current OSHA PEL	2 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 mg/m³ TWA
Description of Substance	Light-tan, light-gray, or colorless crystals.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 200 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	No acute inhalation toxicity data are available on which to base an IDLH for hydroquinone. For this draft technical standard, therefore, the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 100 × the OSHA PEL of 2 mg/m³ (i.e., 200 mg/m³); only the "most highly reliable" respirators are permitted for use in concentrations exceeding 200 mg/m³. This concentration is not likely to be attained in industry.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mammal	Kazpuchina 1979	oral	490	-----	3,430 mg/m³	343 mg/m³
Mouse	Korolev et al. 1973	oral	245	-----	1,715 mg/m³	172 mg/m³
Rabbit	Takahashi 1975	oral	200	-----	1,400 mg/m³	140 mg/m³
Rat	Woodward et al. 1949	oral	320	-----	2,240 mg/m³	224 mg/m³
G. pig	Woodward et al. 1949	oral	550	-----	3,850 mg/m³	385 mg/m³
Dog	Woodward et al. 1949	oral	200	-----	1,400 mg/m³	140 mg/m³
Cat	Woodward et al. 1949	oral	70	-----	490 mg/m³	49 mg/m³

Human data: It has been reported that 5 to 12 grams is the lethal oral dose [Zeidman and Deutel 1945]. [Note: An oral dose of 5 to 12 grams is equivalent to a worker being exposed to 3,333 to 8,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 50 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for hydroquinone. Therefore, the revised IDLH for hydroquinone is 50 mg/m³ based on acute oral toxicity data in humans [Zeidman and Deutel 1945] and animals [Woodward et al. 1949].

REFERENCES:

1. Kazpuchina EA [1979]. Estimation of the acute limit of the effect of benzene and its metabolites. Toksikol Nov Prom Khim Vesh *15*:136-139 (in Russian).
2. Korolev AA, Abinder AA, et al. [1973]. Hygienic and toxicologic features of products of phenol destruction in ozone treatment of water. Gig Sanit *38*(8):6-10 (in Russian).
3. Takahashi A [1975]. Problems of hygiene maintenance for food coming into contact with rubber and plastics products. Nippon Gomu Kyokaishi *48*(9):537 [Translated by Inglis EA [1976]. Int Polymer Sci Tech *3*(1):T/93-T/105.]
4. Woodward G, Hagan EC, Radomski JL [1949]. Toxicity of hydroquinone for laboratory animals. Fed Proc *8*:348.
5. Zeidman I, Deutel R [1945]. Poisoning by hydroquinone and monomethyl-paraaminophenol sulfate: report of 2 cases with autopsy findings. Am J Med Sci *210*:328-333.

Iodine

CAS number	7553-56-2
NIOSH REL	0.1 ppm (1 mg/m^3) CEILING
Current OSHA PEL	0.1 ppm (1 mg/m^3) CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (1 mg/m^3) CEILING
Description of substance	Violet solid with a sharp, characteristic odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with bromine which has an IDLH of 10 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Izmerov et al. 1982	-----	76	1 hr	95 ppm (1.25)	9.5 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Angelis 1979	oral	14,000	-----	9,289 ppm	929 ppm
Mouse	Angelis 1979	oral	22,000	-----	14,597 ppm	1,460 ppm
Rabbit	Angelis 1979	oral	10,000	-----	6,635 ppm	664 ppm
Dog	Flury and Zernik 1935	oral	-----	800	531 ppm	53 ppm

Human data ... It has been reported that work was difficult but possible at 0.15 to 0.2 ppm and that work was impossible at 0.3 ppm [Flury and Zernik 1931]. Exposures to 1 ppm have been reported to be highly irritating [Casarett 1975]. Eye irritation was experienced at 1.63 ppm after 2 minutes [ACGIH 1980]. It has been stated that iodine-containing materials appear to be more toxic than analogous bromine or chlorine-containing materials [ILO 1971]. The lethal oral dose has been reported to be 2 to 3 grams [Moore 1938]. [Note: An oral dose of 2 to 3 grams is equivalent to a worker being exposed to 126 to 190 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2 ppm
Basis for revised IDLH: The revised IDLH for iodine is 2 ppm based on acute inhalation toxicity data in humans [ACGIH 1980]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 2 ppm. However, since it has been reported that iodine-containing materials are more toxic than bromine-containing materials, a revised IDLH of 2 ppm for iodine is appropriate since the revised IDLH for bromine is 3 ppm.

REFERENCES:

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2. Angelis L [1979]. Iopamidol. Drugs of the Future 4:876-881.

3. Casarett LJ [1975]. Toxicology of the respiratory system. In: Toxicology. The basic science of poisons. Casarett LJ, Doull J, eds. New York, NY: Macmillan, pp. 201-224.
4. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebal, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 309 (in German).
5. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod *4*:1289-1422 (in German).
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7. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 76.
8. Moore M [1938]. The ingestion of iodine as a method of attempted suicide. N Eng J Med *219*:383-388.

Iron oxide dust and fume (as Fe)

CAS number	1309-37-1
NIOSH REL	5 mg/m³ TWA
Current OSHA PEL	10 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA (fume)
Description of substance	Reddish-brown solid.
LEL	Noncombustible Solids
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 5,000 mg Fe/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to iron oxide fume would impede escape or produce any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 10 mg Fe/m³ is 5,000 mg Fe/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,500 mg Fe/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of iron oxide dust and fume would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for iron oxide dust and fume is 2,500 mg Fe/m³ based on being 500 times the NIOSH REL of 5 mg Fe/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Isoamyl acetate

CAS number	123-92-2
NIOSH REL	100 ppm (525 mg/m³) TWA
Current OSHA PEL	100 ppm (525 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (532 mg/m³) TWA
Description of substance	Colorless liquid with a banana-like odor.
LEL(@212°F)	1.0% (10% LEL(@212°F), 1,000 ppm)
Original (SCP) IDLH	3,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that slight narcotic effects were noted in cats exposed for 6 hours at 2800 ppm [Flury and Wirth 1933]. This is the only useful data available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Flury and Wirth 1933	-----	6,470	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	7,422	-----	9,603 ppm	960 ppm
Rat	Yakkyoku 1981	oral	16,600	-----	21,479 ppm	2,148 ppm

Other animal data	Slight narcotic effects were noted in cats exposed to 2,800 ppm for 6 hours [Flury and Wirth 1933].
Human data	Isoamyl acetate is considered more irritating than butyl acetate. Exposure to 1,000 ppm for 30 minutes resulted in irritation, dyspnea, fatigue, and increased pulse [Amor 1950]. It is considered dangerous to life after 5 hours of exposure to 10,000 ppm [Browning 1965].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for isoamyl acetate is 1,000 ppm based on acute toxicity data in humans [Amor 1950] and animals [Munch 1972]. This value is also equal to 10% of the lower explosive limit of 1% (which was determined at 212°F).

REFERENCES:

1. ACGIH [1971]. Isoamyl acetate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 138-139.
2. Amor AJ [1950]. The toxicity of solvents. Paint Manufacture *20*:53-58.
3. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, p. 539.
4. Flury F, Wirth W [1933]. Zur toxikologie der lösungsmittel (Verschieden ester, aceton, methylalkohol). Arch Gewerbepath Gewerbehyg *5*:1-90 (in German).
5. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*(4):31-33.
6. Yakkyoku (Pharmacy) [1981]; *32*:1241-1247 (in Japanese).

Isoamyl alcohol (primary & secondary)

CAS number .... 123-51-3 (primary), 526-75-4 (secondary)
NIOSH REL .... 100 ppm (360 mg/m^3) TWA, 125 ppm (450 mg/m^3) STEL
Current OSHA PEL .... 100 ppm (360 mg/m^3) TWA
1989 OSHA PEL .... 100 ppm (360 mg/m^3) TWA, 125 ppm (450 mg/m^3) STEL
1993-1994 ACGIH TLV .... 100 ppm (361 mg/m^3) TWA, 125 ppm (452 mg/m^3) STEL
Description of substance .... Colorless liquids with a disagreeable odor.
LEL(primary) .... 1.2% (10% LEL, 1,200 ppm)
LEL (secondary) .... Unknown
Original (SCP) IDLH .... 10,000 ppm [LEL]
Basis for original (SCP) IDLH .... The chosen IDLH is based on the lower explosive limit (LEL) of 12,000 ppm and the statement in Patty [1963] attributed to Smyth [1956] that rats survived 8,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	3,438	-----	6,557 ppm	656 ppm
Rat	Purchase 1969	oral	1,300	-----	2,480 ppm	248 ppm

Other animal data .... RD_{50} (mouse), 4,452 ppm [Alarie 1981].
Human data .... An oral dose of 24.3 grams has been lethal for adults [Gosselin et al. 1984]. [Note: An oral dose of 24.3 grams is equivalent to a worker being exposed to 4,000 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 500 ppm
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for isoamyl alcohol. Therefore, the revised IDLH for isoamyl alcohol (primary & secondary) is 500 ppm based on acute oral toxicity data in humans [Gosselin et al. 1984] and animals [Munch 1972]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Gosselin RE, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Section II. Ingredients Index. Baltimore, MD: Williams & Wilkins Company, p. 175.
3. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1454.
5. Purchase IFH [1969]. Studies in kaffircorn malting and brewing. XXII. The acute toxicity of some fusel oils found in Bantu beer. S Afr Med J *43*:795-798.
6. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

Isobutyl acetate

CAS number	110-19-0
NIOSH REL	150 ppm (700 mg/m³) TWA
Current OSHA PEL	150 ppm (700 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	150 ppm (713 mg/m³) TWA
Description of substance	Colorless liquid with a fruity, floral odor.
LEL	1.3% (10% LEL, 1,300 ppm)
Original (SCP) IDLH	7,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the following statements: a 4-hour exposure to 8,000 ppm killed 4 of 6 rats [UCC 1971; Smyth et al. 1962 as cited by ACGIH 1971] and no deaths resulted from a 4-hour exposure of 6 rats to 4,000 ppm [UCC 1971; Smyth 1964 as cited by ACGIH 1971]. [Note: For "convenience" an IDLH of 7,500 ppm (50 × the OSHA PEL of 150 ppm) was chosen rather than 8,000 ppm.]
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Clayton and Clayton 1981	LC_{100}: 21,000	-----	2.5 hr	35,700 ppm (1.7)	3,570 ppm
Rat	Smyth et al. 1962	LC_{67}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	4,673	-----	6,772 ppm	677 ppm
Rat	NPIRI 1974	oral	13,400	-----	19,420 ppm	1,942 ppm

Other animal data	It was reported that no rats dies following a 4-hour exposure to 4,000 ppm [UCC 1971].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,300 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Smyth et al. 1962], a value of about 1,600 ppm would have been appropriate for isobutyl acetate. However, the revised IDLH for isobutyl acetate is 1,300 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.3%).

REFERENCES:

1. ACGIH [1971]. Isobutyl acetate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 139.
2. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., p. 2273.
3. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med 41:31-33.
4. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 8.
5. Smyth HF Jr [1964]. Private communication. [From ACGIH [1971]. Isobutyl acetate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 139.]
6. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J 23:95-107.6
7. UCC [1971]. Toxicology studies: isobutyl acetate. New York, NY: Union Carbide Corporation.

Isobutyl alcohol

CAS number	78-83-1
NIOSH REL	50 ppm (150 mg/m³) TWA
Current OSHA PEL	100 ppm (300 mg/m³) TWA
1989 OSHA PEL	50 ppm (150 mg/m³) TWA
1993-1994 ACGIH TLV	50 ppm (152 mg/m³) TWA
Description of substance	Colorless, oily liquid with a sweet, musty odor.
LEL(@123°F)	1.7% (10% LEL(@123°F), 1,700 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 2 of 6 rats died when exposed for 4 hours to 8,000 ppm [Smyth et al. 1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1954	LC_{33}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch and Schwartze 1925	oral	-----	3,750	8,522 ppm	852 ppm
Rat	Smyth et al. 1954	oral	-----	2,460	5,591 ppm	559 ppm

Other animal data	RD_{50} (mouse), 1,818 ppm [DeCeaurriz et al. 1981].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,600 ppm
Basis for revised IDLH: The revised IDLH for isobutyl alcohol is 1,600 ppm based on acute inhalation toxicity data in animals [Smyth et al. 1954]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett 9(2):137-143.
2. Munch JC, Schwartze EW [1925]. Narcotic and toxic potency of aliphatic alcohols upon rabbits. J Lab Clin Med *10*:985-995.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1448.
4. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.

Isophorone

CAS number	78-59-1
NIOSH REL	4 ppm (23 mg/m^3) TWA
Current OSHA PEL	25 ppm (140 mg/m^3) TWA
1989 OSHA PEL	4 ppm (23 mg/m^3) TWA
1993-1994 ACGIH TLV	5 ppm (28 mg/m^3) CEILING
Description of substance	Colorless to white liquid with a peppermint-like odor.
LEL	0.8% (10% LEL, 800 ppm)
Original (SCP) IDLH	800 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1971] report that exposure of animals for 1 hour to 880 ppm caused serious organ damage; only 1 of 6 animals died from an 8-hour exposure to air saturated with isophorone (approximately 525 ppm at 77°F).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	ATSDR 1989	-----	885	6 hr	2,036 ppm (2.3)	204 ppm
G. pig	Marhold 1986	4,600	-----	8 hr	11,500 ppm (2.5)	1,150 ppm
Rat	Smyth and Seaton 1940	-----	1,840	4 hr	3,680 ppm (2.0)	368 ppm
Mammal	UCC 1971	LC_{17}: 525	-----	8 hr	1,316 ppm (2.5)	132 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1970	oral	2,330	-----	2,841 ppm	284 ppm
Mouse	Smyth et al. 1970	oral	2,690	-----	3,280 ppm	328 ppm

Other animal data	RD_{50} (mouse), 27.8 ppm [DeCeaurriz et al. 1981]. It has been reported that exposure of animals for 1 hour to 880 ppm caused serious organ damage [UCC 1971].
Human data	A few of the 11 or 12 volunteers exposed for a few minutes to 200 or 400 ppm complained of nausea, headache, dizziness, faintness, inebriation, and a feeling of suffocation [Smyth and Seaton 1940].

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for isophorone is 200 ppm based on acute inhalation toxicity data in humans [Smyth and Seaton 1940] and animals [ATSDR 1989].

REFERENCES:

1. ATSDR [1989]. Toxicological profile for isophorone. Atlanta, GA: Agency for Toxic Substances and Disease Registry, ATSDR/TP-89/15.
2. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett 9:137-147.
3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 290 (in Czechoslovakian).
4. Smyth HF Jr, Seaton J [1940]. Acute response of guinea pigs and rats to inhalation of the vapors of isophorone. J Ind Hyg Toxicol 22(10):477-483.
5. Smyth HF Jr, Weil CS, West JS, Carpenter CP [1970]. An exploration of joint toxic action. II. Equitoxic versus equivolume mixtures. Toxicol Appl Pharmacol 17:498-503.
6. UCC [1971]. Toxicology studies: isophorone. New York, NY: Union Carbide Corporation.

Isopropyl acetate

CAS number	108-21-4
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	250 ppm (950 mg/m³) TWA
1989 OSHA PEL	250 ppm (950 mg/m³) TWA, 310 ppm (1,185 mg/m³) STEL
1993-1994 ACGIH TLV	250 ppm (1,040 mg/m³) TWA, 310 ppm (1,290 mg/m³) STEL
Description of substance	Colorless liquid with a fruity odor.
LEL(@100°F)	1.8% (10% LEL(@100°F), 1,800 ppm)
Original (SCP) IDLH	16,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1970] report that a 4-hour exposure to 16,000 ppm killed 1 of 6 rats.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Pozzani et al. 1959	11,918	-----	8 hr	29,795 ppm (2.5)	2,980 ppm
Rat	Smyth et al. 1954	LC_{83}: 32,000	-----	4 hr	64,000 ppm (2.0)	6,400 ppm
Rat	Smyth et al. 1954	LC_{17}: 16,000	-----	4 hr	32,000 ppm (2.0)	3,200 ppm

Other animal data .... It has been stated that isopropyl acetate is comparable in toxicity to ethyl acetate and n-propyl acetate [ACGIH 1991].

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,800 ppm
Basis for revised IDLH: The revised IDLH for isopropyl acetate is 1,800 ppm based on analogies to ethyl acetate and n-propyl acetate [ACGIH 1991]. This value is also 10% of the lower explosive limit of 1.8% (which was determined at 100°F).

REFERENCES:

1. ACGIH [1991]. Isopropyl acetate. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 826-827.
2. Pozzani UC, Weil CS, Carpenter CP [1959]. The toxicological basis of threshold limit values: 5. The experimental inhalation of vapor mixtures by rats, with notes upon the relationship between single dose inhalation and single dose oral data. Am Ind Hyg Assoc J *20*:364-369.
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
4. UCC [1970]. Toxicology studies: isopropyl acetate. New York, NY: Union Carbide Corporation.

Isopropyl alcohol

CAS number 67-63-0
NIOSH REL .... 400 ppm (980 mg/m³) TWA, 500 ppm (1,225 mg/m³) STEL
Current OSHA PEL .... 400 ppm (980 mg/m³) TWA
1989 OSHA PEL .... 400 ppm (980 mg/m³) TWA, 500 ppm (1,225 mg/m³) STEL
1993-1994 ACGIH TLV .... 400 ppm (983 mg/m³) TWA, 500 ppm (1,230 mg/m³) STEL
Description of substance .... Colorless liquid with the odor of rubbing alcohol.
LEL .... 2.0% (10% LEL, 2,000 ppm)
Original (SCP) IDLH .... 12,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that rats survived when exposed for 4 hours to 12,000 ppm but exposure for 8 hours to 12,000 ppm resulted in death among one half of the group [Smyth 1956].
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 400 ppm
24-hour EEGL: 200 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	16,000	4 hr	32,000 ppm (2.0)	3,200 ppm
Mouse	NCI 1974	-----	12,800	3 hr	23,040 ppm (1.8)	2,304 ppm
Rat	Smyth 1956	12,000	-----	8 hr	24,000 ppm (2.0)	2,400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Antonova and Salmina 1978	oral	5,045	-----	14,126 ppm	1,413 ppm
Mouse	Antonova and Salmina 1978	oral	3,600	-----	10,080 ppm	1,008 ppm
Rabbit	WHO 1970	oral	6,410	-----	17,948 ppm	1,795 ppm

Other animal data .... RD_{50} (mouse), 17,693 ppm [Alarie 1981]. It has been reported that rats survived when exposed to 12,000 ppm for 4 hours [Smyth 1956].
Human data .... Ten volunteers exposed for 3 to 5 minutes to 200, 400, or 800 ppm reported mild to moderate irritation of the eyes, nose, and throat at the two higher concentrations [Nelson et al. 1943]. The probable lethal oral dose has been reported to be 190 grams [Gosselin et al. 1984]. [Note: An oral dose of 190 grams is equivalent to a worker being exposed to about 50,700 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute toxicity data in humans [Gosselin et al. 1984; Nelson et al. 1943] and animals [NCI 1974; Smyth 1956], a value of about 2,400 ppm would have been appropriate for isopropyl alcohol. However, the revised IDLH for isopropyl alcohol is 2,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2%).

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Antonova VI, Salmina ZA [1978]. The maximal permissible concentration of isopropyl alcohol in water bodies with due regard for its action on the gonads and the progeny. Gig Sanit *43*(1):8-11 (in Russian).
3. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading. J Ind Hyg Toxicol *31*:343-346.
4. Gosselin RE, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Baltimore, MD: Williams & Wilkins Company, pp. III-217 to II-219.
5. NCI [1974]. Interagency Collaborative Group on Environmental Carcinogenesis, National Cancer Institute Memorandum, June 17, 1974.
6. Nelson KW, Ege JF Jr, Ross M, Woodman LE, Silverman L [1943]. Sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol 25(7):282-285.
7. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 56-68.
8. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1438.
9. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*:129-185.
10. WHO [1970]. Propan-2-ol: biological data. In: Toxicological evaluation of some extraction solvents and certain other substances. Food and Agriculture Organization Nutrition Meetings Report Series 48A. Geneva, Switzerland: United Nations, World Health Organization, pp. 114-120.

Isopropylamine

CAS number 75-31-0
NIOSH REL .... The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL .... 5 ppm (12 mg/m³) TWA
1989 OSHA PEL .... 5 ppm (12 mg/m³) TWA, 10 ppm (24 mg/m³) STEL
1993-1994 ACGIH TLV .... 5 ppm (12 mg/m³) TWA, 10 ppm (24 mg/m³) STEL
Description of substance .... Colorless liquid with an ammonia-like odor.
LEL .... Unknown
Original (SCP) IDLH .... 4,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that 0 of 6 rats died from a 4-hour exposure to 4,000 ppm and 6 of 6 rats died after a 4-hour exposure to 8,000 ppm [Smyth et al. 1951]. No other quantitative data are available on which to base the IDLH.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NCI 1974	4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
Mouse	Shell 1961	-----	7,000	40 min	7,630 ppm (1.09)	763 ppm
Rat	Smyth et al. 1951	LC_{100}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Other animal data .... It has been reported that rats have survived an exposure to 4,000 ppm for 4 hours [Smyth et al. 1951].
Human data .... Volunteers have complained of nose and throat irritation after brief exposures to concentrations ranging from 10 to 20 ppm [Amoore and Hautala 1983].

Revised IDLH: 750 ppm
Basis for revised IDLH: The revised IDLH for isopropylamine is 750 ppm based on acute inhalation toxicity data in animals [NCI 1974; Shell 1961]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 20 ppm.

REFERENCES:

1. ACGIH [1971]. Isopropylamine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 141-142.
2. Amoore JE, Hautala E [1983]. Odor as an aid to chemical safety: odor threshold compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. J Appl Toxicol 3(6):272-290.
3. NCI [1974]. Memorandum (June 17, 1974). Interagency Collaborative Group on Environmental Carcinogenesis, National Cancer Institute.
4. Shell [1961]. Unpublished report. New York, NY: Shell Chemical Corporation, p. 7.
5. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med 4:119-122.

Isopropyl ether

CAS number	108-20-3
NIOSH REL	500 ppm (2,100 mg/m³) TWA
Current OSHA PEL	500 ppm (2,100 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	250 ppm (1,040 mg/m³) TWA, 310 ppm (1,300 mg/m³) STEL
Description of substance	Colorless liquid with a sharp, sweet, ether-like odor.
LEL	1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1968] report that breathing the vapors in a state approaching saturation in room air killed all rats in a 10-minute exposure. [Note: Based on a vapor pressure of 119 mmHg [Patty 1963], the saturated concentration of isopropyl ether in air at 20°C is about 157,000 ppm.] Breathing 8,000 ppm was not fatal after a 4-hour exposure, but 16,000 ppm killed 6 of 6 animals exposed for the same period of time [UCC 1968].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Pavlova et al. 1963	38,138	-----	?	?	?
Rabbit	Pavlova et al. 1963	30,840	-----	?	?	?
Rabbit	Pavlova et al. 1963	28,486	-----	?	?	?
Rat	UCC 1968	LC_{100}: 157,000	-----	10 min	105,190 ppm (0.67)	10,519 ppm
Mammal	UCC 1968	LC_{100}: 16,000	-----	4 hr	32,000 ppm (2.0)	3,200 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Machle et al. 1939	oral	-----	5,000-6,500	8,235-10,706 ppm	824-1,071 ppm
Rat	UCC 1968	oral	8,470	-----	13,951 ppm	1,395 ppm

Other animal data	It has been reported that animals survived a 4-hour exposure to 8,000 ppm [UCC 1968].
Human data	Volunteers exposed to 800 ppm for 5 minutes reported irritation of the eyes and nose [Silverman et al. 1946].

Revised IDLH: 1,400 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [UCC 1968], a value of about 3,200 ppm would have been appropriate for isopropyl ether. However, the revised IDLH for isopropyl ether is 1,400 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.4%).

REFERENCES:

1. Machle W, Scott EW, Treon J [1939]. The physiological response to isopropyl ether and to a mixture of isopropyl ether and gasoline. J Ind Hyg Toxicol *21*:72-96.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1662.
3. Pavlova LP, Lagunova VV, Imanov RM [1963]. Determination of the maximal permissible concentration of diisopropyl ether in the air of working zone. Gig Tr Prof Zabol *19*(10):55-57 (in Russian).
4. Silverman L, Schulte HF, First MW [1946]. Further studies on sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol *28*:262-266.
5. UCC [1968]. Toxicology studies: isopropyl ether. New York, NY: Union Carbide Corporation.

Isopropyl glycidyl ether

CAS number 4016-14-2
NIOSH REL .... 50 ppm (240 mg/m^3) 15-minute CEILING
Current OSHA PEL .... 50 ppm (240 mg/m^3) TWA
1989 OSHA PEL .... 50 ppm (240 mg/m^3) TWA, 75 ppm (360 mg/m^3) STEL
1993-1994 ACGIH TLV .... 50 ppm (238 mg/m^3) TWA, 75 ppm (356 mg/m^3) STEL
Description of substance .... Colorless liquid.
LEL .... Unknown
Original (SCP) IDLH .... 1,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the mouse 4-hour LC_{50} of 1,500 ppm and the rat 8-hour LC_{50} of 1,100 ppm [Hine et al. 1956 cited by Patty 1963].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hine et al. 1956	1,500	-----	4 hr	3,000 ppm (2.0)	300 ppm
Rat	Hine et al. 1956	1,100	-----	8 hr	2,750 ppm (2.5)	275 ppm

Human data .... Workers exposed to 400 ppm have suffered irritation of the eyes and respiratory tract [Hine et al. 1956].

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for isopropyl glycidyl ether is 400 ppm based on acute inhalation toxicity data in workers [Hine et al. 1956]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 400 ppm.

REFERENCES:

1. Hine CH, Kodama JK, Wellington JS, Dunlap MK, Anderson HH [1956]. The toxicology of glycidol and some glycidyl ethers. AMA Arch Ind Health *14*:250-284.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1638.

Ketene

CAS number	463-51-4
NIOSH REL	0.5 ppm (0.9 mg/m^3) TWA, 1.5 ppm (3 mg/m^3) STEL
Current OSHA PEL	0.5 ppm (0.9 mg/m^3) TWA
1989 OSHA PEL	0.5 ppm (0.9 mg/m^3) TWA, 1.5 ppm (3 mg/m^3) STEL
1993-1994 ACGIH TLV	0.5 ppm (0.86 mg/m^3) TWA, 1.5 ppm (2.6 mg/m^3) STEL
Description of substance	Colorless gas with a penetrating odor.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 25 ppm — see discussion below.]
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for ketene. For this draft technical standard, therefore, the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 50 × the OSHA PEL of 0.5 ppm (i.e., 25 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 25 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Mendenhall and Stokinger 1959	17	-----	10 min	12 ppm (0.69)	1.2 ppm
Mouse	Treon et al. 1949	-----	23	30 min	23 ppm (1.0)	2.3 ppm
Rabbit	Treon et al. 1949	-----	53	2 hr	85 ppm (1.6)	8.5 ppm
G. pig	Treon et al. 1949	-----	53	2 hr	85 ppm (1.6)	8.5 ppm
Cat	Treon et al. 1949	-----	750	10 min	518 ppm (0.69)	52 ppm
Monkey	Treon et al. 1949	-----	200	10 min	138 ppm (0.69)	14 ppm
Mouse	Treon et al. 1949	-----	50	10 min	35 ppm (0.69)	3.5 ppm
Rabbit	Treon et al. 1949	-----	1,000	10 min	690 ppm (0.69)	69 ppm

Human data	It has been stated that 5 ppm is the lowest concentration productive of a clinically relevant physiologic response [Stokinger 1960].

Revised IDLH: 5 ppm
Basis for revised IDLH: The revised IDLH for ketene is 5 ppm based on acute inhalation toxicity data in humans [Stokinger 1960] and animals [Treon et al. 1949]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 5 ppm.

REFERENCES:

1. Mendenhall RM, Stokinger HE [1959]. Tolerance and cross-tolerance development to atmospheric pollutants ketene and ozone. J Appl Physiol *14*:923-926.
2. Stokinger HE [1960]. Toxicologic interactions of mixtures of air pollutants. Review of recent developments. Int J Air Pollut 2:313-326.
3. Treon JF, Sigmon H, Kitzmiller KV, Heyroth FF, Younker WJ, Cholak J [1949]. Physiologic response of animals exposed to airborne ketene. J Ind Hyg Toxicol *31*:209-219.

Lead compounds (as Pb)

CAS number . . . . . . 7439-92-1 (Metal)
NIOSH REL . . . . . . $0.100\ mg/m^3$ TWA
Current OSHA PEL . . . . . . $0.050\ mg/m^3$ TWA
1989 OSHA PEL . . . . . . Same as current PEL
1993-1994 ACGIH TLV . . . . . . $0.15\ mg/m^3$ TWA
Description of substance . . . . . . Varies
Original (SCP) IDLH* . . . . . . 700 mg Pb/m^3 [*Note: "Effective" IDLH = 400 mg Pb/m^3 -- see discussion below.]
Basis for original (SCP) IDLH . . . . . . No data on acute toxicity are available concerning the physiological effects caused by the inhalation of lead and its inorganic compounds. AIHA [1958], however, reported that the severity of the health hazard for a brief exposure is only moderate [Fairhall 1957; APHA 1943]. If the IDLH were estimated from the rat intraperitoneal LD_{LO} of 100 mg/kg for lead cyanide [NRC 1953] that was cited by NIOSH [1976], a value of 700 mg/m^3 would be chosen as the IDLH. Using these data for lead cyanide rather than other data cited by NIOSH yields the most conservative estimate of the IDLH. Because of the assigned protection factor afforded by each device, however, 2,000 × the OSHA PEL of 0.2 mg Pb/m^3 (i.e., 400 mg Pb/m^3) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines . . . . . . None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
PbO Dog	Flury and Zernik 1935	oral	-----	1,400	9,114 mg Pb/m^3	911 mg Pb/m^3
$PbC_4H_6O_4$ Dog	Flury and Zernik 1935	oral	-----	300	1,344 mg Pb/m^3	134 mg Pb/m^3
$PbCl_2$ G. pig	Budavair 1989	oral	-----	1,500	7,770 mg Pb/m^3	770 mg Pb/m^3
$Pb(NO_3)_2$ G. pig	Tartler 1941	oral	-----	500	2,205 mg Pb/m^3	221 mg Pb/m^3
$Pb(CN)_2$ Rat	NRC 1953	i.p.	-----	100	560 mg Pb/m^3	56 mg Pb/m^3

Human data . . . . . . It has been reported that 714 mg/kg of lead acetate (i.e., about 450 mg/kg of lead) is the lethal oral dose [Takahashi 1975]. [Note: An oral dose of 450 mg Pb/kg is equivalent to a 70-kg worker being exposed to 21,000 mg Pb/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 mg Pb/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for lead compounds. The revised IDLH for lead compounds is 100 mg Pb/m^3 based on acute oral toxicity data in humans [Takahashi 1975] and animals [Flury and Zernik 1935]. [Note: OSHA currently requires in 29 CFR 1919.1025 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 100 mg Pb/m^3 (i.e., 2,000 × the current OSHA PEL of 0.05 mg Pb/m^3).]

Lead compounds (as Pb) (continued)

REFERENCES:

1. AIHA [1958]. Lead and its inorganic compounds. In: Hygienic guide series. Am Ind Hyg Assoc J *19*:154-155.
2. APHA [1943]. Occupational lead exposure and lead poisoning. New York, NY: American Public Health Association, pp. 17-20.
3. Budavari S, ed. [1989]. 5278. Lead chloride. In: The merck index. 11th edition. Rahway, NJ: Merck & Co., Inc., p. 5275.
4. Fairhall LT [1957]. Industrial toxicology. 2nd ed. Baltimore, MD: Williams & Wilkins Company, pp. 68-71.
5. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod *4*:1289-1422 (in German).
6. NIOSH [1976]. OG01750. Lead(II) cyanide. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 660.
7. NRC [1953]. Chemical-Biological Coordination Center: review. Vol. 5. Washington, DC: National Academy of Sciences, National Research Council, p. 27.
8. Takahashi A [1975]. Problems of hygiene maintenance for food coming into contact with rubber and plastics products. Nippon Gomu Kyokaishi *48*(9):537 [Translated by Inglis EA [1976]. Int Polymer Sci Tech *3*(1):T/93-T/105.]
9. Tartler G [1941]. Die akute bleivergiftung. Ein experimenteller beitrag zur klärung der frage der giftigkeit von bleiverbindungen in quantitativen versuchen. Arch Hyg Bakteriol *125*:273-292 (in German).

Lindane

CAS number	58-89-9
NIOSH REL	0.5 mg/m³ TWA [skin]
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA [skin]
Description of substance	White to yellow, crystalline powder with a slight, musty odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	1,000 mg/m³
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for lindane. The chosen IDLH, therefore, has been based on the child oral TD_{Lo} of 180 mg/kg [CDC 1956 cited by NIOSH 1976] and the statement by Negherbon [1959] that the dangerous acute dose for man has been reported as 7 to 15 grams [CDC 1956].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Desi et al. 1978	oral	60	-----	420 mg/m³	42 mg/m³
Rat	Kenaga and Morgan 1978	oral	76	-----	532 mg/m³	53 mg/m³
Mouse	Sun 1972	oral	44	-----	308 mg/m³	31 mg/m³
Hamster	Truhaut et al. 1974	oral	360	-----	2,520 mg/m³	252 mg/m³
G. pig	Woodard and Hagan 1947	oral	127	-----	889 mg/m³	89 mg/m³

Human data: An oral dose of 150 mg/kg has been associated with grandmal seizures [Starr and Clifford 1972]. [Note: An oral dose of 150 mg/kg is equivalent to a 70-kg worker being exposed to 7,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.] It has also been stated that 7 to 15 grams is the dangerous acute dose [CDC 1956]. [Note: An oral dose of 7 to 15 grams is equivalent to a worker being exposed to 4,667 to 10,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 50 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for lindane. Therefore, the revised IDLH for lindane is 50 mg/m³ based on acute oral toxicity data in humans [Starr and Clifford 1972] and animals [Desi et al. 1978; Kenaga and Morgan 1978; Sun 1972; Woodard and Hagan 1947]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. CDC [1956]. Clinical memoranda on economic poisons. Atlanta, GA: Communicable Disease Center, Bureau of State Services, Public Health Service, U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 476, pp. 29-33.
2. Desi I, Varga L, Farkas I [1978]. Studies on the immunosuppressive effect of organochlorine and organophosphoric pesticides in subacute experiments. J Hyg Epi Microb Immunol 22(1):115-122.
3. Kenaga EE, Morgan RW [1978]. Commercial and experimental organic insecticides (1978 revision). Entomological Society of America Special Publication 78-1:1-11.
4. Negherbon WO [1959]. Handbook of toxicology. Vol. III. Insecticides, a compendium. Wright-Patterson Air Force Base, OH: U.S. Air Force, Air Research and Development Command, Wright Air Development Center, Aero Medical Laboratory, WADC Technical Report 55-16, p. 437.

5. NIOSH [1976]. GV49000. Cyclohexane, 1,2,3,4,5,6-hexachloro-, gamma-isomer. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 369.
6. Starr HG Jr, Clifford NJ [1972]. Acute lindane intoxication. Arch Environ Health 25:374-375
7. Sun Y-P [1972]. Correlation of toxicity of insecticides to the house fly and to the mouse. J Econ Entomol 65:632-635.
8. Truhaut R, Gak J-C, Graillot C [1974]. Recherches sur les modalités et les mécanismes d'action toxique des insecticides organochlorés. I. Étude comparative des effets de toxicité aiguë chez le hamster et chez le rat. J Eur Toxicol 7(3):159-166 (in French).
9. Woodard G, Hagan EC [1947]. Toxicological studies on the isomers and mixtures of isomers of benzene hexachloride. Fed Proc 6:386-388.

Lithium hydride

CAS number	7580-67-8
NIOSH REL	0.025 mg/m³ TWA
Current OSHA PEL	0.025 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.025 mg/m³ TWA
Description of substance	Odorless, off-white to gray, translucent, crystalline mass or white powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	55 mg/m³ [*Note: "Effective" IDLH = 50 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	The chosen IDLH of 55 mg/m³ is based on the statement by Patty [1963] that "animals exposed to 5 to 55 mg/m³ for periods up to 4 hours experienced intense irritation, coughing and sneezing, inflammation of the conjunctiva, partial sloughing of mucosal epithelium of trachea, and some pulmonary emphysema. No mortality occurred (however) as a result of any level of exposure [Spiegl et al. 1956]." Spiegl et al. [1956], however, found that 2 of 10 animals died from a 4-hour exposure at 22 mg/m³; Spiegl et al. [1956] stated, though, that the mortality among rats, rabbits, guinea pigs, and mice exposed to levels of from 5 to 55 mg/m³ for 1 day was low and probably unrelated to the exposure. A statement by ACGIH [1971] (i.e., that industrial experience has shown that a reduction in atmospheric concentration to 25 μg/m³ is required to attain just a sneezing level), indicates that 22 mg/m³ is too low to be the IDLH. Respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × OSHA PEL of 0.025 mg/m³ (i.e., 50 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 50 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Spiegl et al. 1956	LC_{20}: 22 mg/m³	-----	4 hr	44 mg/m³ (2.0)	4.4 mg/m³

Human data	It has been recommended that 0.5 mg/m³ is the maximum tolerable concentration for brief period of exposure [AIHA 1964].

Revised IDLH: 0.5 mg/m³
Basis for revised IDLH: The revised IDLH for lithium hydride is 0.5 mg/m³ based on acute inhalation toxicity data in humans [AIHA 1964].

REFERENCES:

1. ACGIH [1971]. Lithium hydride. In: Documentation of the Threshold Limit Values for Substances in Workroom Air, 3rd edition. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 147.
2. AIHA [1964]. Lithium hydride. In: Hygienic guide series. Akron, OH: American Industrial Hygiene Association.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1070.
4. Spiegl CJ, Scott JK, Steinhardt H, Leach LJ, Hodge HC [1956]. Acute inhalation toxicity of lithium hydride. AMA Arch Ind Health *14*:468-470.

L.P.G.

CAS number	68476-85-7
NIOSH REL	1,000 ppm (1,800 mg/m³) TWA
Current OSHA PEL	1,000 ppm (1,800 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (1,800 mg/m³) TWA
Description of substance	Colorless, noncorrosive, odorless gas when pure.
LEL(propane)	2.1% (10% LEL, 2,100 ppm)
LEL(butane)	1.9% (10% LEL, 1,900 ppm)
Original (SCP) IDLH	19,000 ppm [LEL]
Basis for original (SCP) IDLH	Because propane is a simple asphyxiant, L.P.G. is also considered to be a simple asphyxiant. L.P.G., therefore, does not present an IDLH hazard at concentrations below its lower explosive limit (LEL). The chosen IDLH, based on the "estimated" LEL for L.P.G. (19,000 ppm), is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	At extremely high concentrations, L.P.G. may cause asphyxia by oxygen displacement [Proctor et al. 1988]. Propane concentrations of 100,000 ppm may cause dizziness within a few minutes [Proctor et al. 1988].

Revised IDLH: 2,000 ppm [LEL]
Basis for revised IDLH: Because L.P.G. may cause asphyxia [Proctor et al. 1988] at concentrations well above the lower explosive limit (LEL), the revised IDLH for L.P.G. is 2,000 ppm based strictly on safety considerations (i.e., being about 10% of the LELs of 1.9% for butane and 2.1% for propane).

REFERENCE:

1. Proctor NH, Hughes JP, Fischman ML [1988]. Liquified petroleum gas. In: Chemical hazards of the workplace. 2nd ed. Philadelphia, PA: J.B. Lippincott Company, pp. 301, 420-421.

Magnesium oxide fume

CAS number	1309-48-4
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	15 mg/m³ (total dust) TWA
1989 OSHA PEL	10 mg/m³ (total dust) TWA
1993-1994 ACGIH TLV	10 mg/m³ (total dust) TWA
Description of substance	Finely divided white particulate dispersed in air.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence of an IDLH for magnesium oxide fume, because the symptoms of metal fume fever would not impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mg/m³ is 7,500 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	Volunteers exposed to freshly generated fume at concentrations ranging from 410 to 580 mg/m³ experienced only slight (unspecified) reactions [Drinker et al. 1927].

Revised IDLH: 750 mg/m³
Basis for revised IDLH: The revised IDLH for magnesium oxide fume is 750 mg/m³ based on acute inhalation toxicity data in humans [Drinker et al. 1927].

REFERENCE:

1. Drinker P, Thomson RN, Finn JL [1927]. Metal fume fever. III. The effects of inhaling magnesium oxide fume. J Ind Hyg 9:187-192.

Malathion

CAS number	121-75-5
NIOSH REL	10 mg/m^3 TWA [skin]
Current OSHA PEL	15 mg/m^3 TWA [skin]
1989 OSHA PEL	10 mg/m^3 TWA [skin]
1993-1994 ACGIH TLV	10 mg/m^3 TWA [skin]
Description of substance	Deep-brown to yellow liquid with a garlic-like odor.
LEL	Unknown
Original (SCP) IDLH	5,000 mg/m^3
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for malathion. The chosen IDLH, therefore, has been estimated from the statement by Stolman [1969] that the acute oral LD_{50} values for mice and rats range from 480 to 5,800 mg/kg.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Izmerov et al. 1982	-----	10 mg/m^3	4 hr	20 mg/m^3 (2.0)	2.0 mg/m^3
Rat	Sapegin and Mikhailov 1986	84.6 mg/m^3	-----	4 hr	169 mg/m^3 (2.0)	17 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Izmerov et al. 1982	oral	290	-----	2,030 mg/m^3	203 mg/m^3
Mouse	Izmerov et al. 1982	oral	190	-----	1,330 mg/m^3	133 mg/m^3
G. pig	von Dozent et al. 1955	oral	570	-----	3,990 mg/m^3	399 mg/m^3

Human data ... Workers exposed to initial concentrations up to 85 mg/m^3 for 1 hour (that may have declined rapidly) over 42 consecutive days suffered no adverse effects [Golz 1959]. Workers exposed to concentrations that peaked at 56 mg/m^3 and averaged 3.3 mg/m^3 for 5 hours had normal cholinesterase levels [Culver et al. 1956]. A lethal oral dose of 246 to 471 mg/kg has been reported [Farago 1967; Jusic and Milic 1978]. [Note: An oral dose of 246 to 471 mg/kg is equivalent to a 70-kg worker being exposed to about 11,500 to 22,100 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 250 mg/m^3
Basis for revised IDLH: The revised IDLH for malathion is 250 mg/m^3 based on acute toxicity data in humans [Farago 1967; Golz 1959; Jusic and Milic 1978].

REFERENCES:

1. Culver D, Caplan P, Batchelor GS [1956]. Study of human exposure during aerosol application of malathion and chlorthion. AMA Arch Ind Health *13*:37-50.
2. Farago A [1967]. Fatal, suicidal malathion poisonings. Arch Toxikol *23*:11-18 (in German).
3. Golz HH [1959]. Controlled human exposures to malathion aerosols. AMA Arch Ind Health *19*:516-523.

4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 56.
5. Jusic A, Milic S [1978]. Neuromuscular synapse testing in two cases of suicidal organophosphorous pesticide poisoning. Arch Environ Health *33*:240-243.
6. Sapegin DE, Mikhailov VV [1986]. Combined effect of carbophos, high temperature and an excess of ultraviolet radiation. Gig Sanit *51*(3):73-75 (in Russian)
7. Stolman A, ed. [1969]. Progress in chemical toxicology. Vol. 4. New York, NY: Academic Press, Inc., p. 213.
8. von Dozent J, Klimmer OR, Pfaff W [1955]. Vergleichende untersuchungen über die toxicität organischer thiophosphorsäureester. Arzneimittel-Forschung (Drug Research) 5:626-630 (in German).

Maleic anhydride

CAS number	108-31-6
NIOSH REL	1 mg/m³ (0.25 ppm) TWA
Current OSHA PEL	1 mg/m³ (0.25 ppm) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 mg/m³ (0.25 ppm) TWA
Description of substance	Colorless needles, white lumps, or pellets with an irritating, choking odor.
LEL	1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 2,000 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	No data on acute inhalation toxicity data are available on which to base an IDLH for maleic anhydride. MCA [1974] reported that it possesses little acute systemic toxic properties. For this draft technical standard, therefore, the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 1 mg/m³ (i.e., 2,000 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,000 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Berzin 1969	oral	465	-----	3,255 mg/m³	326 mg/m³
Rat	Berzin 1969	oral	850	-----	5,950 mg/m³	595 mg/m³
Rabbit	Izmerov et al. 1982	oral	875	-----	6,125 mg/m³	613 mg/m³
G. pig	Izmerov et al. 1982	oral	390	-----	2,730 mg/m³	273 mg/m³
Rat	NCI 1974	oral	400	-----	2,800 mg/m³	280 mg/m³

Human data .... In volunteers, 6 to 8 mg/m³ caused nasal irritation within 1 minute and ocular irritation after 15 to 20 minutes [Gervais 1967]. In another study, concentrations of 10 mg/m³ and higher were found to be extremely irritating [IHFA 1969].

Revised IDLH: 10 mg/m³
Basis for revised IDLH: The revised IDLH for maleic anhydride is 10 mg/m³ based on acute inhalation toxicity data in volunteers [IHFA 1969].

REFERENCES:

1. Berzin VI [1969]. Combined action of dinil and maleic anhydride on the organism. Gig Tr Prof Zabol *13*(4):42-44 (in Russian).
2. Gervais P [1967]. L'asthme dans l'industries des matieres plastiques. Connaissance des Plastiques 7:21 (in French). [Abstract in Chem Abstr [1967]; *66*(4):9043]. [From ACGIH [1991]. Maleic anhydride. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 874-875.]
3. IHFA [1969]. Central data repository project. Pittsburgh, PA: Industrial Hygiene Foundation of America, Inc. [From ACGIH [1991]. Maleic anhydride. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 874-875.]
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 78.
5. MCA [1974]. Chemical safety data sheet sd-88: properties and essential information for safe handling and use of maleic anhydride. Washington, DC: Manufacturing Chemists Association, p. 1-13.
6. NCI [1974]. Memorandum. Interagency Collaborative Group on Environmental Carcinogens. National Cancer Institute, June 17, 1974.

Manganese compounds (as Mn)

CAS number	7439-96-5 (Metal)
NIOSH REL	1 mg/m³ TWA, 3 mg/m³ STEL
Current OSHA PEL	5 mg/m³ CEILING
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 10,000 mg Mn/m³ -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data do not indicate that exposure to a high concentration of manganese could impede escape within 30 minutes. For this draft technical standard, therefore, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL (2,000 × 5 mg Mn/m³ is 10,000 mg Mn/m³; only the "most protective" respirators are permitted for use in concentrations exceeding 10,000 mg Mn/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mn Rat	Marhold 1972	oral	9,000	-----	63,000 mg Mn/m³	6,300 mg Mn/m³
$MnC_4H_6O_4$ Rat	Marhold 1977	oral	2,940	-----	6,586 mg Mn/m³	659 mg Mn/m³
$MnCl_2$ Mouse	Gupta et al. 1981	oral	1,715	-----	5,282 mg Mn/m³	528 mg Mn/m³

Human data: Chronic exposures to workers averaging 47 mg/m³ caused manganese poisoning, while no cases occurred at exposures less than 30 mg/m³ [Flinn et al. 1940]. Chronic exposure to concentrations averaging 210 mg/m³ have been associated with pneumonia [Lloyd-Davies 1946]. Workers chronically exposed to concentrations of manganese dust averaging 20 mg/m³ showed signs of manganism [Smyth et al. 1973].

Revised IDLH: 500 mg Mn/m³
Basis for revised IDLH: The revised IDLH for manganese is 500 mg Mn/m³ based on acute inhalation toxicity data in animals [Gupta et al. 1981]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Flinn RH, Neal PA, Reinhart WH, Dallavalle JM, Fulton WB, Dooley AE [1940]. Chronic manganese poisoning in an ore-crushing mill. Public Health Bulletin *247*:1-77.
2. Gupta PK, Murthy RC, Chandra SV [1981]. Toxicity of endosulfan and manganese chloride: cumulative toxicity rating. Toxicol Lett 7:221-227.
3. Lloyd-Davies TA [1946]. Manganese pneumonitis. Br J Ind Med *3*:111-135.
4. Marhold JV [1972]. Sbornik vysledku toxixologickeho vysetreni latek a pripravku. Czechoslovakia: Institut Pro Vychovu Vedoucicn Pracovniku Chemickeho Prumyclu Praha, p. 21 (in Czechoslovakian).
5. Marhold JV [1977]. Personal communication. Pardubice, Czechoslovakia: VUOS, 539-18, 3/29/77.
6. Smyth LT, Ruhf RC, Whitman NE, Dugan T [1973]. Clinical manganism and exposure to manganese in the production and processing of ferromanganese alloy. J Occup Med *15*:101-109.

Mercury compounds [except (organo) alkyls] (as Hg)

CAS number .... 7439-97-6 (Metal)

NIOSH REL .... Hg Vapor: 0.05 mg/m³ TWA [skin]; Other: 0.1 mg/m³ CEILING [skin]

Current OSHA PEL .... 0.1 mg/m³ CEILING

1989 OSHA PEL .... Hg Vapor: 0.05 mg/m³ CEILING [skin]; Other non-alkyl compounds: 0.1 mg/m³ CEILING [skin]

1993-1994 ACGIH TLV .... Hg Vapor: 0.05 mg/m³ TWA [skin]; Aryl & inorganic compounds: 0.1 mg/m³ TWA [skin]

Description of substance .... Varies

Original (SCP) IDLH .... 28 mg Hg/m³

Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] and AIHA [1966] that "severe damage has been produced in the kidneys, liver, brain, heart, lungs, and colon of rabbits exposed for a single 4-hour period to mercury vapor at an average concentration of 28.8 mg/m³; mild damage to most of these organs occurred from 1 hour of exposure [Ashe et al. 1953]."

Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

24-hour EEGL: 0.2 mg/m³

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Hg Rabbit	Ashe et al. 1953	-----	29 mg/m³	30 hr	113 mg Hg/m³ (3.91)	11 mg Hg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Hg_2Cl_2 Rat	Worthing 1991	oral	210	-----	1,250 mg Hg/m³	125 mg Hg/m³
$HgCl_2H_2H$ Rat	Trakhtenberg et al. 1981	oral	86	-----	482 mg Hg/m³	48 mg Hg/m³
Mouse	Trakhtenberg et al. 1981	oral	68	-----	381 mg Hg/m³	38 mg Hg/m³

Other animal data .... Severe damage has been produced in the kidneys, lungs, and colon of rabbits exposed for a single 4-hour period to mercury vapor at an average of 28.8 mg/m³; mild damage to most of the organs occurred after 1 hour of exposure [Ashe et al. 1953].

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg Hg/m³
Basis for revised IDLH: The revised IDLH for mercury compounds [except mercury (organo) alkyls] is 10 mg Hg/m³ based on acute inhalation toxicity data in animals [Ashe et al. 1953].

REFERENCES:

1. AIHA [1966]. Mercury and its inorganic compounds (revised 1966). In: Hygienic guide series. Am Ind Hyg Assoc J 27:310-313.
2. Ashe WF, Largent EJ, Dutra FR, Hubbard DM, Blackstone M [1953]. Behavior of mercury in the animal organism following inhalation. AMA Arch Ind Hyg Occup Med 7:23-24.
3. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 89-94.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1094.
5. Trakhtenberg EM, Kozshun NN, et al. [1981]. New data on toxicity of inorganic compounds of mercury. Gig Tr Prof Zabol 25(7):27-30 (in Russian).
6. Worthing CR, ed. [1991]. Mercurous chloride. In: The pesticide manual. A world compendium. 9th ed. Farnham, Surrey, United Kingdom: The British Crop Protection Council, p. 552.

Mercury (organo) alkyl compounds (as Hg)

CAS number .... Varies
NIOSH REL .... 0.01 mg/m³ TWA, 0.03 mg/m³ STEL [skin]
Current OSHA PEL .... 0.01 mg/m³ TWA, 0.04 mg/m³ CEILING
1989 OSHA PEL .... 0.01 mg/m³ TWA, 0.03 mg/m³ STEL [skin]
1993-1994 ACGIH TLV .... 0.01 mg/m³ TWA, 0.03 mg/m³ STEL [skin]
Description of substance .... Varies
Original (SCP) IDLH .... 10 mg Hg/m³
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that mice died within 3 to 5 hours at 10 to 30 mg/m³ organic mercury [Trakhtenberg 1950]. The chosen IDLH seems reasonable because NIOSH [1976] cited a mouse intraperitoneal LD_{LO} for dipropylmercury of 2 mg/kg [NRC 1952]. If the IDLH were estimated from this information, a value of 14 mg/m³ would be obtained.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
HgC_4H_{10}						
Rat	Russkykh and Frolova 1973	258 mg/m³	-----	?	?	?
Mouse	Russkykh and Frolova 1973	91 mg/m³	-----	?	?	?
Hg (organo) alkyl						
Mouse	Trakhtenberg 1950	-----	10-30 mg/m³	3 hr	18-54 mg Hg/m³ (1.8)	1.8-5.4 mg Hg/m³
Mouse	Trakhtenberg 1950	-----	10-30 mg/m³	5 hr	22-26 mg Hg/m³ (2.2)	2.2-2.6 mg Hg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
HgC_4H_{10}						
Rat	Izmerov et al. 1982	oral	51	-----	278 mg Hg/m³	28 mg Hg/m³
Mouse	Izmerov et al. 1982	oral	44	-----	240 mg Hg/m³	24 mg Hg/m³
$HgC_4H_6O_4$						
Rat	Grin et al. 1973	oral	40.9	-----	180 mg Hg/m³	18 mg Hg/m³
Mouse	Grin et al. 1973	oral	23.9	-----	105 mg Hg/m³	11 mg Hg/m³
$HgC_6H_{12}O_6$						
Rat	Frear 1969	oral	200	-----	742 mg Hg/m³	74 mg Hg/m³
HgC_6H_{14}						
Mouse	NRC 1952	i.p.	-----	1.9	9.3 mg Hg/m³	0.9 mg Hg/m³

Human data .... Deaths have resulted from 3 months exposure to diethyl mercury at an estimated concentration of 1 mg/m³ [Hill 1943]. The lethal dose of methyl mercury is estimated to be 200 mg, with paresthesia of the hands, feet, and mouth occurring at a total body burden of 40 mg [Bakir et al. 1973]. [Note: An oral dose of 200 mg of methyl mercury is equivalent to a worker being exposed to about 125 mg Hg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2 mg Hg/m^3

Basis for revised IDLH: The revised IDLH for mercury (organo) alkyl compounds is 2 mg Hg/m^3 based on acute toxicity data in humans [Bakir et al. 1973; Hill 1943] and animals [Trakhtenberg 1950].

REFERENCES:

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3. Frear EH, ed. [1969]. Pesticide index. 4th ed. State College, PA: College Science Publishers, p. 269.
4. Grin NV, Ezmachenko AB, Govozunova NN, Tepukina LA [1973]. Prognosis of the safe concentrations of some soluble compounds of mercury. Gig Sanit *46*(*8*):12-14 (in Russian).
5. Hill WH [1943]. A report of two deaths from exposure to the fumes of a di-ethyl mercury. Can J Public Health *34*:158-160.
6. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 52.
7. NIOSH [1976]. OW3225000. Mercury, dipropyl-. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 683.
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Mesityl oxide

CAS number 141-79-7
NIOSH REL .... 10 ppm (40 mg/m^3) TWA
Current OSHA PEL .... 25 ppm (100 mg/m^3) TWA
1989 OSHA PEL .... 15 ppm (60 mg/m^3) TWA, 25 ppm (100 mg/m^3) STEL
1993-1994 ACGIH TLV .... 15 ppm (60 mg/m^3) TWA, 25 ppm (100 mg/m^3) STEL
Description of substance .... Oily, colorless to light-yellow liquid with a peppermint- or honey-like odor.
LEL .... 1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH .... 5,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that 5,000 ppm might be dangerous to life in 30 to 60 minutes [Smyth et al. 1942].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	1,000 mg/m^3	-----	4 hr	2,000 ppm (2.0)	200 ppm
Rat	Izmerov et al. 1982	9,000 mg/m^3	-----	4 hr	18,000 ppm (2.0)	1,800 ppm
Mouse	Izmerov et al. 1982	10,000 mg/m^3	-----	2 hr	16,000 ppm (1.6)	1,600 ppm
G. pig	Specht et al. 1940	2,000 mg/m^3	-----	7 hr	4,800 ppm (2.4)	480 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Hann and Jansen 1974	oral	1,120	-----	1,922 ppm	192 ppm
Rabbit	Hann and Jansen 1974	oral	1,000	-----	1,716 ppm	172 ppm
Mouse	Izmerov et al. 1982	oral	710	-----	1,218 ppm	122 ppm

Human data .... The probable response to 100 ppm was predicted to be eye and mucous membrane irritation, difficulty breathing, headache, and vertigo [Shell 1957]. It has been stated that 5,000 ppm might be dangerous to life in 30 to 60 minutes [Smyth et al. 1942].

Revised IDLH: 1,400 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Smyth et al. 1942], a value of about 4,000 ppm would have been appropriate for mesityl oxide. However, the revised IDLH for mesityl oxide is 1,400 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.4%).

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*(6):343-346.
2. Hann W, Jansen PA [1974]. Water quality characteristics of hazardous materials. Vols. 1-4. College Station, TX: Texas A & M University, Civil Engineering Department, Environmental Engineering Division.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 80.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1758.
5. Shell [1957]. Mesityl oxide: safety data sheet SC:57-105. New York, NY: Shell Chemical Corporation, pp. 1-3.
6. Smyth HF Jr, Seaton J, Fischer L [1942]. Response of guinea pigs and rats to repeated inhalation of vapors of mesityl oxide and isophorone. J Ind Hyg Toxicol *24*(3):46-50.
7. Specht H, Miller JW, Valaer PJ, Sayers RR [1940]. Acute response of guinea pigs to the inhalation of ketone vapors. NIH Bulletin *176*:1-66.

Methoxychlor

CAS number	72-43-5
NIOSH REL	None established; NIOSH considers methoxychlor to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	15 mg/m³ TWA
1989 OSHA PEL	10 mg/m³ TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of substance	Colorless to light-yellow crystals with a slight, fruity odor.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] stated that methoxychlor has a very low toxicity. The available toxicological data indicate that an acute exposure to a high concentration of methoxychlor would not result in death or in any irreversible health effects. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances, it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mg/m³ is 7,500 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	CDC 1956	oral	5,000	-----	35,000 mg/m³	3,500 mg/m³
Mouse	Coats et al. 1977	oral	1,000	-----	7,000 mg/m³	700 mg/m³
Rabbit	Kenaga and Morgan 1978	oral	>6,000	-----	>42,000 mg/m³	>4,200 mg/m³

Human data .... It has been reported that 6,430 mg/kg is the estimated fatal oral dose [AAPCO 1966]. [Note: An oral dose of 6,430 mg/kg is equivalent to a worker being exposed to about 300,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 5,000 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of methoxychlor would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for methoxychlor is 5,000 mg/m³ based on being 500 times the OSHA PEL of 10 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methoxychlor at any detectable concentration.]

Methoxychlor (continued)

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of the American Pesticide Control Officials, Inc., p. 750.
2. ACGIH [1971]. Methoxychlor (2,2-bis-p-methoxy phenyl-1,1,1-trichloroethane). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 152-153.
3. CDC [1956]. Clinical memoranda on economic poisons. Atlanta, GA: Communicable Disease Center, Bureau of State Services, Public Health Service, U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 476, pp. 33-38.
4. Coats JR, Metcalf RL, Kapoor IP [1977]. Effective DDT analogues with altered aliphatic moieties. Isobutanes and chloropropanes. J Agri Food Chem 25:859-868.
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Methyl acetate

CAS number	79-20-9
NIOSH REL	200 ppm (610 mg/m³) TWA, 250 ppm (760 mg/m³) STEL
Current OSHA PEL	200 ppm (610 mg/m³) TWA
1989 OSHA PEL	200 ppm (610 mg/m³) TWA, 250 ppm (760 mg/m³) STEL
1993-1994 ACGIH TLV	200 ppm (606 mg/m³) TWA, 250 ppm (757 mg/m³) STEL
Description of substance	Colorless liquid with a fragrant, fruity odor.
LEL	3.1% (10% LEL, 3,100 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with butyl acetate and ethyl acetate which have IDLHs of 10,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Flury and Wirth 1933	-----	11,039	4 hr	22,078 ppm (2.0)	2,208 ppm
Cat	Flury and Wirth 1933	-----	21,753	1 hr	27,191 ppm (1.25)	2,719 ppm
Rat	Smyth et al. 1962	-----	32,000	4 hr	64,000 ppm (2.0)	6,400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	3,700	-----	8,409 ppm	841 ppm

Human data .... It has been reported that concentrations of 10,000 ppm for a short time caused irritation which persisted after exposure stopped [Clayton and Clayton 1981].

Revised IDLH: 3,100 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Clayton and Clayton 1981], the original value of about 10,000 ppm would have been appropriate for methyl acetate. However, the revised IDLH for methyl acetate is 3,100 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 3.1%).

REFERENCES:

1. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., p. 2272.
2. Flury F, Wirth W [1933]. Zur toxikologie der lösungsmittel (Verschieden ester, aceton, methylalkohol). Arch Gewerbepath Gewerbehyg 5:1-90 (in German).
3. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg 41:31-33.
4. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J 23:95-107.

Methyl acetylene

CAS number	74-99-7
NIOSH REL	1,000 ppm (1,650 mg/m³) TWA
Current OSHA PEL	1,000 ppm (1,650 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (1,640 mg/m³) TWA
Description of substance	Colorless gas with a sweet odor.
LEL	1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH	15,000 ppm [LEL]
Basis for original (SCP) IDLH	The chosen IDLH is based on the lower explosive limit (LEL) of 17,000 ppm rounded down to 15,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	It has been stated that methyl acetylene appears to be a general anesthetic with comparatively low toxicity [ACGIH 1991].

Revised IDLH: 1,700 ppm [LEL]
Basis for revised IDLH: Since methyl acetylene appears to have relatively low toxicity [ACGIH 1991], the revised IDLH is 1,700 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.7%).

REFERENCE:

1. ACGIH [1991]. Methyl acetylene. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 929.

Methyl acetylene-propadiene mixture (MAPP)

CAS number	59355-75-8
NIOSH REL	1,000 ppm (1,800 mg/m³) TWA, 1,250 ppm (2,250 mg/m³) STEL
Current OSHA PEL	1,000 ppm (1,800 mg/m³) TWA
1989 OSHA PEL	1,000 ppm (1,800 mg/m³) TWA, 1,250 ppm (2,250 mg/m³) STEL
1993-1994 ACGIH TLV	1,000 ppm (1,640 mg/m³) TWA, 1,250 ppm (2,050 mg/m³) STEL
Description of substance	Colorless gas with a strong, characteristic, foul odor.
LEL	3.4% (10% LEL, 3,400 ppm)
Original (SCP) IDLH	15,000 ppm
Basis for original (SCP) IDLH	Because the TLV for a methyl acetylene-propadiene mixture has been set by analogy to methyl acetylene [ACGIH 1971], the chosen IDLH is also set by analogy with methyl acetylene which has an IDLH of 15,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.
Other data	The American Conference of Governmental Industrial Hygienists TLV for a methyl acetylene-propadiene mixture (MAPP) is based on an analogy to methyl acetylene [ACGIH 1991].

Revised IDLH: 3,400 ppm [LEL]
Basis for revised IDLH: Since a methyl acetylene-propadiene mixture appears to have relatively low toxicity, and based on an analogy to methyl acetylene [ACGIH 1991], the revised IDLH is 3,400 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 3.4%).

REFERENCES:

1. ACGIH [1971]. Methyl acetylene-propadiene mixture (MAPP). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 154.
2. ACGIH [1991]. Methyl acetylene-propadiene mixture. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 930.

Methyl acrylate

CAS number	96-33-3
NIOSH REL	10 ppm (35 mg/m³) TWA [skin]
Current OSHA PEL	10 ppm (35 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (35 mg/m³) TWA [skin]
Description of substance	Colorless liquid with an acrid odor.
LEL	2.8% (10% LEL, 2,800 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat 4-hour LC_{50} of 1,000 ppm in which 3 of 6 rats died [Smyth and Carpenter 1948 cited by Patty 1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Lomonova and Klimova 1979	3,575	-----	?	?	?
Rat	Oberly and Tansey 1985	1,350	-----	4 hr	2,700 ppm (2.0)	270 ppm
Rat	Smyth and Carpenter 1948	1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm
Rabbit	Treon et al. 1949	2,522	-----	1 hr	3,153 ppm (1.25)	315 ppm

Other animal data	Rats exposed 4 hours per day, 5 days per week at 110 ppm for a total of 32 exposures had eye discomfort at the start of the investigation, but no overt signs of respiratory distress or other manifestations of toxicity were recorded [Oberly and Tansey 1985].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 250 ppm
Basis for revised IDLH: The revised IDLH for methyl acrylate is 250 ppm based on acute inhalation data in animals [Oberly and Tansey 1985; Smyth and Carpenter 1948; Treon et al. 1949].

REFERENCES:

1. Lomonova GV, Klimova EI [1979]. On the toxicity methyl and ethyl acrylates. Gig Tr Prof Zabol 23(9):55-56 (in Russian).
2. Oberly R, Tansey MF [1985]. LC_{50} values for rats acutely exposed to vapors of acrylic and methacrylic acid esters. J Toxicol Environ Health *16*:811-822.
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4. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range-finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol *30*:63-68.
5. Treon JF, Sigmon H, Wright H, Kitzmiller KV [1949]. The toxicity of methyl and ethyl acrylate. J Ind Hyg Toxicol *31*:317-326.

Methylal

CAS number	109-87-5
NIOSH REL	1,000 ppm (3,100 mg/m^3) TWA
Current OSHA PEL	1,000 ppm (3,100 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1,000 ppm (3,110 mg/m^3) TWA
Description of substance	Colorless liquid with a chloroform-like odor.
LEL	2.2% (10% LEL, 2,200 ppm)
Original (SCP) IDLH	15,000 ppm [LEL]
Basis for original (SCP) IDLH	Patty [1963] reported that Weaver et al. [1951] noted only minor irritation in 50 mice that received fifteen 7-hour exposures to 11,000 ppm and that 6 of 50 mice died after fifteen 7-hour exposures to 18,000 ppm. Because the data indicate that acutely toxic effects occur only above the lower explosive limit (LEL) of 16,000 ppm, the IDLH is based on the LEL rounded down to 15,000 ppm. This is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Marhold 1986	18,000	-----	7 hr	43,291 ppm (2.4)	4,329 ppm
Rat	NPIRI 1974	15,000	-----	?	?	?
Mouse	Weaver et al. 1951	18,354	-----	7 hr	44,050 ppm (2.4)	4,405 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Knoefel et al. 1932	oral	5,708	-----	12,644 ppm	1,264 ppm

Other animal data	In one study, the "no effect" levels were determined to be 2,810 and 8,450 ppm in rats and guinea pigs, respectively [Price et al. 1978]. Fifteen 7-hour exposures to 11,000 ppm caused only minor irritation in 50 mice [Weaver et al. 1951].
Human data	Methylal has been used as an anesthetic in surgery [ACGIH 1991].

Revised IDLH: 2,200 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [ACGIH 1991] and animals [Price et al. 1978; Weaver et al. 1951], a value of about 10,000 ppm would have been appropriate for methylal. However, the revised IDLH for methylal is 2,200 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2.2%).

REFERENCES:

1. ACGIH [1991]. Methylal. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 937-938.
2. Knoefel PK, Lonergan L, Leake CD [1932]. Biochemorphic aspects of paraldehyde and certain acetals. Proc Soc Exp Biol Med 29:730-732.
3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 259 (in Czechoslovakian).

Methylal (continued)

4. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 73.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 1984-1987.
6. Price NH, Allen SD, Daniels AU, Yates WG [1976]. Toxicity data for establishing "immediately dangerous to life or health" (IDLH) values. Salt Lake City, UT: University of Utah Research Institute, UBTL Division, Report No. TR 1510-005, Contract No. CDC-210-76-0143.
7. Weaver FL, Hough AR, Highman B, Fairhall LT [1951]. The toxicity of methylal. Br J Ind Med 8:279-283.

Methyl alcohol

CAS number	67-56-1
NIOSH REL	200 ppm (260 mg/m^3) TWA, 250 ppm (325 mg/m^3) STEL [skin]
Current OSHA PEL	200 ppm (260 mg/m^3) TWA
1989 OSHA PEL	200 ppm (260 mg/m^3) TWA, 250 ppm (325 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	200 ppm (262 mg/m^3) TWA, 250 ppm (328 mg/m^3) STEL [skin]
Description of substance	Colorless liquid with a characteristic pungent odor.
LEL	6.0% (10% LEL, 6,000 ppm)
Original (SCP) IDLH	25,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that it probably would be dangerous for men to be exposed to the vapors of methyl alcohol in concentrations of the order of 30,000 to 50,000 ppm for as much as 30 to 60 minutes.
Existing short-term exposure guidelines	National Research Council [NRC 1985] Emergency Exposure Guidance Levels (EEGLs):

10-min EEGL: 800 ppm
30-min EEGL: 400 ppm
1-hour EEGL: 200 ppm
24-hour EEGL: 10 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Flury and Wirth 1933	-----	33,082	6 hr	76,090 ppm (2.3)	7,609 ppm
Mouse	Izmerov et al. 1982	-----	37,594	2 hr	60,150 ppm (1.6)	6,015 ppm
Rat	NPIRI 1974	64,000	-----	4 hr	128,000 ppm (2.0)	12,800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Larionov and Broitman 1975	oral	5,628	-----	29,621 ppm	2,962 ppm
Mouse	Smith and Taylor 1982	oral	7,300	-----	38,421 ppm	3,842 ppm
Rat	Smyth et al. 1941	oral	12,880	-----	67,789 ppm	6,779 ppm
Rabbit	WHO 1970	oral	14,200	-----	74,737 ppm	7,474 ppm

Other animal data	RO_{50} (mouse), 41,514 ppm [Alarie 1981].
Human data	Two human studies showed no effects at vapor concentrations ranging from 160 to 1,000 ppm [McAllister 1954; MDOH 1937]. It has been stated that it probably would be dangerous to be exposed to concentrations of the order of 30,000 to 50,000 ppm for as much as 30 to 60 minutes [Patty 1963]. It has been reported that the lethal oral dose is between 143 and 6,422 mg/kg [Arena 1970; Deichmann and Gerarde 1969; Handa 1983]. [Note: An oral dose of 143 to 6,422 mg/kg is equivalent to a 70-kg worker being exposed to about 7,000 to 225,000 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 6,000 ppm
Basis for revised IDLH: The revised IDLH for methyl alcohol is 6,000 ppm based on acute inhalation toxicity data in animals [Izmerov et al. 1982]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations between 1,000 and 30,000 ppm. However, this value is also 10% of the lower explosive limit of 6%.

Methyl alcohol (continued)

REFERENCES:

1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Arena JM [1970]. Poisoning; toxicology, symptoms, treatments. 2nd ed. Springfield, IL: C.C. Thomas, p. 73.
3. Deichmann WB, Gerarde HW [1969]. Methyl alcohol (methanol; methyl hydroxide; methyl hydrate; Columbian spirits; wood naphtha; wood spirits; wood alcohol; sterno; carbinols; colonial spirits). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 383-385.
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15. WHO [1970]. Methyl alcohol: biological data. In: Toxicological evaluation of some extraction solvents and certain other substances. Food and Agriculture Organization Nutrition Meetings Report Series 48A. Geneva, Switzerland: United Nations, World Health Organization, p. 105.

Methylamine

CAS number	74-89-5
NIOSH REL	10 ppm (12 mg/m^3) TWA
Current OSHA PEL	10 ppm (12 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (6.4 mg/m^3) TWA, 15 ppm (19 mg/m^3) STEL
Description of substance	Colorless gas with a fish- or ammonia-like odor.
LEL	4.9% (10% LEL, 4,900 ppm)
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the severe respiratory tract irritation produced by methylamine. Deichmann and Gerarde [1969] stated that inhalation of methylamine vapors (greater than 100 ppm) causes irritation of the nose and throat, followed by violent sneezing, burning sensation of the throat, coughing, constriction of the larynx and difficulty in breathing, pulmonary congestion, and edema of the lungs.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	1,860	-----	2 hr	2,977 ppm (1.6)	298 ppm

Human data: It has been reported that transient irritation of the eyes, nose, and throat has resulted from brief exposures to concentrations of 20 to 100 ppm; the odor was intolerable at 100 to 500 ppm [Clayton and Clayton 1981]. Inhalation of methylamine vapors (at concentrations greater than 100 ppm) has caused irritation of the nose and throat, followed by violent sneezing, burning sensation of the throat, coughing, constriction of the larynx and difficulty in breathing, pulmonary congestion, and edema of the lungs [Deichmann and Gerarde 1969].

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Clayton and Clayton 1981; Deichmann and Gerarde 1969], the original IDLH for methylamine (100 ppm) is not being revised at this time.

REFERENCES:

1. Clayton GD, Clayton FC, eds. [1981]. Patty's industrial and toxicology. 3rd rev. ed. Vol. 2B. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 3135-3173.
2. Deichmann WB, Gerarde HW [1969]. Methylamines (monomethylamine; dimethylamine; trimethylamine). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 385.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 81.

Methyl (n-amyl) ketone

CAS number	110-43-0
NIOSH REL	100 ppm (465 mg/m³) TWA
Current OSHA PEL	100 ppm (465 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	50 ppm (233 mg/m³) TWA
Description of substance	Colorless to white liquid with a banana-like, fruity odor.
LEL(@151°F)	1.1% (10% LEL(@151°F), 1,100 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 2,000 ppm was strongly narcotic and 4,800 ppm caused narcosis and death in guinea pigs in 4 to 8 hours [Specht et al. 1940].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Clayton and Clayton 1981	-----	4,000	4 hr	8,000 ppm (2.0)	800 ppm
G. pig	Specht et al. 1940	-----	2,000	14.8 hr	6,180 ppm (3.09)	618 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1962	oral	1,670	-----	2,461 ppm	246 ppm
Mouse	Srepel and Akacic 1962	oral	730	-----	1,076 ppm	108 ppm

Other animal data	Exposures to guinea pigs lasting 4-8 hours were irritating to the mucous membranes at 1,500 ppm, strongly narcotic at 2,000 ppm, and caused narcosis and death at 4,800 ppm [Specht et al. 1940].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 800 ppm
Basis for revised IDLH: The revised IDLH for methyl (n-amyl) ketone is 800 ppm based on acute inhalation toxicity data in animals [Clayton and Clayton 1981].

REFERENCES:

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2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1740.
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J *23*:95-107.
4. Specht H, Miller JW, Valaer PJ, Sayers RR [1940]. Acute response of guinea pigs to the inhalation of ketone vapors. NIH Bulletin *176*:1-66.
5. Srepel B, Akacic B [1962]. Ispitivanje anthelmintičkog djelovanja eteričnih ulja roda Ruta. Acta Pharmaceut Jugo *12*:79-88 (in Serbo-Croatian).

Methyl bromide

CAS number	74-83-9
NIOSH REL	None established; NIOSH considers methyl bromide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	20 ppm (80 mg/m³) CEILING [skin]
1989 OSHA PEL	5 ppm (20 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	5 ppm (19 mg/m³) TWA [skin]
Description of substance	Colorless gas with a chloroform-like odor at high concentrations.
LEL	10% (10% LEL, 10,000 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that rats survived 2,600 ppm for 24 minutes [Irish et al. 1940].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Alexeeff et al. 1985	1,200	-----	1 hr	1,500 ppm (1.25)	150 ppm
Rabbit	Bakhishev 1973	7,316	-----	30 min	7,316 ppm (1.0)	732 ppm
Rat	Bakhishev 1975	2,833	-----	30 min	2,833 ppm (1.0)	283 ppm
Rat	Honma et al. 1985	302	-----	8 hr	755 ppm (2.5)	76 ppm
Mouse	Izmerov et al. 1982	390	-----	2 hr	624 ppm (1.6)	62 ppm
G. pig	Sayers et al. 1929	-----	300	9 hr	780 ppm (2.6)	78 ppm

Other animal data	It has been reported that rats have survived an exposure to 2,600 ppm for 24 minutes [Irish et al. 1940].
Human data	It has been stated that 220 ppm can be endured for several hours without serious effects [Clarke et al. 1945].

Revised IDLH: 250 ppm

Basis for revised IDLH: The revised IDLH for methyl bromide is 250 ppm based on acute inhalation toxicity data in humans [Clarke et al. 1945]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 220 ppm. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methyl bromide at any detectable concentration.]

REFERENCES:

1. Alexeeff GV, Kilgore WW, Munoz P, Watt D [1985]. Determination of acute toxic effects in mice following exposure to methyl bromide. J Toxicol Environ Health *15*:109-123.
2. Bakhishev GN [1973]. Relative toxicity of aliphatic halohydrocarbons to rats. Farmakol Toksikol *6*:140-143 (in Russian).
3. Bakhishev GN [1975]. Relationship between chemical structure and toxicity for some halogenated aliphatic hydrocarbons. Fiz Akt Vesh 7:35-36 (in Russian).
4. Clarke CA, Roworth CG, Holling HE [1945]. Methyl bromide poisoning. An account of four recent cases met with in one of H.M. ships. Brit J Ind Med 2:17-23.
5. Honma T, Miyagawa M, Sato M, Hasegawa H [1985]. Neurotoxicity and metabolism of methyl bromide in rats. Toxicol Appl Pharmacol *81*:183-191.
6. Irish DD, Adams EM, Spencer HC, Rowe VK [1940]. The response attending exposure of laboratory animals to vapors of methyl bromide. J Ind Hyg Toxicol 22(6):218-230.
7. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 81.
8. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1252.
9. Sayers RR, Yant WP, Thomas BGH, Berger LB [1929]. Physiological response attending exposure to vapors of methyl bromide, methyl chloride, ethyl bromide, and ethyl chloride. Public Health Bulletin *185*:1-56.

Methyl Cellosolve®

CAS number	109-86-4
NIOSH REL	0.1 ppm (0.3 mg/m³) TWA [skin]
Current OSHA PEL	25 ppm (80 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (16 mg/m³) TWA [skin]
Description of substance	Colorless liquid with a mild, ether-like odor.
LEL	1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH*	2,000 ppm [*Note: "Effective" IDLH = 1,250 ppm -- see discussion below.]
Basis for original (SCP) IDLH	Based on a UCC [1969] report that 0 of 6 rats died after a 2-hour exposure to 2,000 ppm, 4 of 6 rats died after a 4-hour exposure to 2,000 ppm, and 6 of 6 rats died after an 8-hour exposure to 2,000 ppm, an IDLH of 2,000 ppm was chosen. However, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to a concentration of 50 × the OSHA PEL of 25 ppm (i.e., 1,250 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 1,250 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	UCC 1969	LC_{67}: 2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Rat	UCC 1969	LC_{100}: 2,000	-----	8 hr	5,000 ppm (2.5)	500 ppm
Mouse	Werner et al. 1943	1,480	-----	7 hr	3,552 ppm (2.4)	355 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Ballantyne 1987	oral	-----	2,370	5,250 ppm	525 ppm
Rabbit	Carpenter et al. 1956	oral	-----	890	1,972 ppm	197 ppm
Mouse	Gig Tr Prof Zabol 1963	oral	-----	1,480	3,278 ppm	328 ppm
G. pig	Smyth et al. 1941	oral	-----	950	2,104 ppm	210 ppm

Other animal data	It has been reported that rats survived a 2-hour exposure to 2,000 ppm [UCC 1969].
Human data	Chronic exposure to 50 to 100 ppm has been associated with headache, dizziness, lethargy, weakness, hyperreflexia, disorientation, unequal pupil size, and visual and/or auditory disturbances [ACGIH 1991]. It has been reported that 3,380 mg/kg is the lethal oral dose [Young and Woolner 1946]. [Note: An oral dose of 3,380 mg/kg is equivalent to a 70-kg worker being exposed to about 50,000 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 200 ppm

Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [UCC 1969], a value of about 400 ppm would have been appropriate for methyl Cellosolve®. However, the revised IDLH for methyl Cellosolve® is 200 ppm based on being 2,000 times the current NIOSH REL of 0.1 ppm (2,000 is an assigned protection factor for respirators; only the "most reliable" respirators are recommended above 2,000 times the NIOSH REL).

REFERENCES:

1. ACGIH [1991]. 2-Methoxyethanol. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 918.
2. Ballantyne [1987]. The comparative acute toxicity and primary irritancy of the monohexyl ethers of ethylene and diethylene glycol. Vet Hum Toxicol *29*(5):361-366.
3. Carpenter CP, Pozzani UC, Weil CS, Nair JH III, Keck GA, Smyth HF Jr [1956]. The toxicity of butyl cellosolve solvent. AMA Arch Ind Health *14*:114-131.
4. Gig Tr Prof Zabol [1963]; *32*(3):48-54 (in Russian).
5. Smyth HF Jr, Seaton J, Fischer L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol *23*:259-268.
6. UCC [1969]. Toxicology studies: methyl cellosolve. New York, NY: Union Carbide Corporation.
7. Werner HW, Mitchell JL, Miller JW, von Oettingen WF [1943]. The acute toxicity of vapors of several monoalkyl ethers of ethylene glycol. J Ind Hyg Toxicol *25*(4):157-163.
8. Young EG, Woolner LB [1946]. A case of fatal poisoning from 2-methoxy-ethanol. J Ind Hyg Toxicol *28*(6):267-268.

Methyl Cellosolve® acetate

CAS number 110-49-6
NIOSH REL .... 0.1 ppm (0.5 mg/m^3 TWA [skin]
Current OSHA PEL .... 25 ppm (120 mg/m^3) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 ppm (24 mg/m^3) TWA [skin]
Description of substance .... Colorless liquid with a mild, ether-like odor.
LEL .... 1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH .... 4,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on an analogy with methyl methacrylate which has an IDLH of 4,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Flury and Wirth 1933	-----	1,222	7 hr	2,933 ppm (2.4)	293 ppm
Rat	Smyth and Carpenter 1948	-----	7,000	4 hr	14,000 ppm (2.0)	1,400 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth and Carpenter 1948	oral	3,390	-----	4,833 ppm	483 ppm
G. pig	Smyth et al. 1941	oral	1,250	-----	1,782 ppm	178 ppm

Human data .... It has been stated that methyl Cellosolve® acetate is slightly less toxic than methyl Cellosolve® [Gosselin et al. 1984].

Revised IDLH: 200 ppm
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Flury and Wirth 1933; Smyth and Carpenter 1948], a value of about 1,000 ppm would have been appropriate for methyl Cellosolve® acetate. However, the revised IDLH for methyl Cellosolve® acetate is 200 ppm based on being 2,000 times the current NIOSH REL of 0.1 ppm (2,000 is an assigned protection factor for respirators; only the most reliable respirators are recommended above 2,000 times the NIOSH REL).

REFERENCES:

1. Flury F, Wirth W [1933]. Zur toxikologie der lösungsmittel (Verschieden ester, aceton, methylalkohol). Arch Gewerbepath Gewerbehyg 5:1-90 (in German).
2. Gosselin RF, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Baltimore, MD: Williams & Wilkins Company, p. II-183.
3. Smyth HF Jr, Carpenter CP [1948]. Further experience with the range finding test in the industrial toxicology laboratory. J Ind Hyg Toxicol 30:63-68.
4. Smyth HF Jr, Seaton J, Fischer L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol 23:259-268.

Methyl chloride

CAS number	74-87-3
NIOSH REL	None established; NIOSH considers methyl chloride to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	100 ppm TWA, 200 ppm CEILING, 300 ppm 5-minute MAXIMUM PEAK IN ANY 3 HOURS
1989 OSHA PEL	50 ppm (105 mg/m^3) TWA, 100 ppm (210 mg/m^3) STEL
1993-1994 ACGIH TLV	50 ppm (103 mg/m^3) TWA, 100 ppm (207 mg/m^3) STEL [skin]
Description of substance	Colorless gas with a faint, sweet odor which is not noticeable at dangerous concentrations.
LEL	8.1% (10% LEL, 8,100 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 20,000 to 40,000 ppm is dangerous to animals in 30 to 60 minutes [Flury and Zernik 1931] and the report by MacDonald [1964] that a worker repeatedly walked in and out of an area in which concentrations greater than 10,000 ppm were measured.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Bakhishev 1975	72,000	-----	30 min	72,000 ppm (1.0)	7,200 ppm
Mouse	Chellman et al. 1986	2,200	-----	6 hr	5,060 ppm (2.3)	506 ppm
Mammal	Clayton and Clayton 1981	2,760	-----	4 hr	5,520 ppm (2.0)	552 ppm
G. pig	Clayton 1967	-----	20,000	2 hr	32,000 ppm (1.6)	3,200 ppm
Rat	Izmerov et al. 1982	2,524	-----	4 hr	5,048 ppm (2.0)	505 ppm
Dog	von Oettingen 1949	-----	14,661	6 hr	33,720 ppm (2.3)	3,372 ppm

Other animal data	It has been reported that 20,000 to 40,000 ppm is dangerous in 30 to 60 minutes [Flury and Zernik 1931].
Human data	It has been reported that a worker repeatedly walked in and out of an area in which concentrations greater than 10,000 ppm were measured; symptoms included blurring of vision, dizziness, and a slight headache [MacDonald 1964]. A worker exposed to concentrations of 2,000 to 4,000 ppm for 13 days stated that during the first week he was very sleepy and became quite dizzy; during the second week headache, blurring of vision, slurring of speech, dizziness, mental confusion, and a staggering gait occurred [MacDonald 1964]. Another worker exposed to concentrations of 1,000 to 2,000 ppm during the workshift experienced dizziness, blurring of vision, headache, nausea, and vomiting [MacDonald 1964]. It has been stated that exposures to 20,000 ppm for 2 hours may be fatal [Deichmann and Gerarde 1969].

Revised IDLH: 2,000 ppm

Basis for revised IDLH: The revised IDLH for methyl chloride is 2,000 ppm based on acute inhalation toxicity data in humans [MacDonald 1964]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methyl chloride at any detectable concentration.]

REFERENCES:

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2. Chellman GJ, White RD, Norton RM, Bus JS [1986]. Inhibition of the acute toxicity of methyl chloride in male B6C3F1 mice by glutathione depletion. Toxicol Appl Pharmacol *86*:93-104.
3. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2B. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 3436-3442.
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5. Deichmann WB, Gerarde HW [1969]. Methyl chloride. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 386-387.
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9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1249.
10. von Oettingen WF [1949]. Studies on the relation between the toxic action of chlorinated methanes and their chemical and physicochemical properties. NIH Bulletin *191*:1-85.

Methyl chloroform

CAS number	71-55-6
NIOSH REL	350 ppm (1,900 mg/m^3) 15-minute CEILING
Current OSHA PEL	350 ppm (1,900 mg/m^3) TWA
1989 OSHA PEL	350 ppm (1,900 mg/m^3) TWA, 450 ppm (2,450 mg/m^3) STEL
1993-1994 ACGIH TLV	350 ppm (1,910 mg/m^3) TWA, 450 ppm (2,460 mg/m^3) STEL
Description of substance	Colorless liquid with a mild, chloroform-like odor.
LEL	7.5% (10% LEL, 7,500 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by MCA [1965] that "humans exposed to 900 to 1,000 ppm experience prompt, though minimal impairment of coordination. Above 1,700 ppm, obvious disturbances of equilibrium in humans have been observed." Deichmann and Gerarde [1969] stated that "the earliest symptoms of a single vapor exposure are lightheadedness and lassitude. The earliest sign of intoxication is an impaired Romberg test. In humans an abnormal Romberg test is usually observed shortly after exposures to 900 to 1,700 ppm." Because data are not available to indicate at what concentrations above 1,000 ppm a person's equilibrium would be affected enough to impede escape, 1,000 ppm is used as the IDLH. AIHA [1961] reported that humans exposed to 800 to 1,000 ppm exhibit early anesthetic effects including incoordination [Stewart et al. 1961; Torkelson et al. 1958]. Browning [1965] reported that several human subjects exposed to 920 ppm for periods ranging from 5 to 45 minutes showed a slight loss of coordination and equilibrium [Stewart et al. 1961].
Existing short-term exposure guidelines	American Industrial Hygiene Association [AIHA 1964] Emergency Exposure Limits (EELs): 5-minute EEL: 2,500 ppm 15-minute EEL: 2,000 ppm 30-minute EEL: 2,000 ppm 60-minute EEL: 1,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	AIHA 1964	3,911	-----	2 hr	6,258 ppm (1.6)	626 ppm
Rat	Sangyo Igaku 1971	18,000	-----	4 hr	36,000 ppm (2.0)	3,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Pal'gov et al. 1990	oral	9,600	-----	12,108 ppm	1,211 ppm
Mouse	Pal'gov et al. 1990	oral	6,000	-----	7,568 ppm	757 ppm
Rabbit	Torkelson et al. 1958	oral	5,660	-----	7,139 ppm	714 ppm

Methyl chloroform (continued)

Other animal data .... No significant signs of intoxication were seen in rats inhaling 500 ppm, 6 hours per day for 4 days [Savolainen et al. 1977]; in mice inhaling up to 1,300 ppm for 1 hour [Kjellstrand et al. 1985]; in rats inhaling up to 3,000 ppm for 0.5 to 4 hours [Mullin and Krivanek 1982]; or in baboons inhaling up to 1,400 ppm for 4 hours [Geller et al. 1982].

Human data .... The onset of central anesthesia has occurred in individuals exposed for up to 7 hours to concentrations approaching 500 ppm [Stewart et al. 1969]. It has been stated that exposure to 900 to 1,000 ppm causes prompt, though minimal impairment of coordination; obvious disturbances in equilibrium have been noted above 1,700 ppm [MCA 1965]. Those exposed to 800 to 1,000 ppm have exhibited early anesthetic effects including incoordination [Stewart et al. 1961]. Volunteers exposed to 920 ppm for 5 to 45 minutes showed a slight loss of coordination and equilibrium [Stewart et al. 1961].

Revised IDLH: 700 ppm
Basis for revised IDLH: The revised IDLH for methyl chloroform is 700 ppm based on acute inhalation toxicity data in humans [MCA 1965; Stewart et al. 1961, 1969].

REFERENCES:

1. AIHA [1961]. 1,1,1-Trichloroethane (methyl chloroform) (revised 1961). In: Hygienic guide series. Am Ind Hyg Assoc J 22:509-511.
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14. Stewart RD, Gay HH, Schaffer AW, Duncan SE, Rowe VK [1969]. Experimental human exposure to methyl chloroform vapor. Arch Environ Health *19*:476-472.
15. Torkelson TR, Oyen F, McCollister DD, Rowe VK [1958]. Toxicity of 1,1,1-trichloroethane as determined on laboratory animals and human subjects. Am Ind Hyg Assoc J *19*:353-362.

Methylcyclohexane

CAS number	108-87-2
NIOSH REL	400 ppm (1,600 mg/m^3) TWA
Current OSHA PEL	500 ppm (2,000 mg/m^3) TWA
1989 OSHA PEL	400 ppm (1,600 mg/m^3) TWA
1993-1994 ACGIH TLV	400 ppm (1,610 mg/m^3) TWA
Description of substance	Colorless liquid with a faint, benzene-like odor.
LEL	1.2% (10% LEL, 1,200 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	With no reported human toxicological data, the chosen IDLH is based on the statement by Browning [1965] that Treon et al. [1943] were able to produce light narcosis in mice at 10,054 ppm. Browning [1965] also reported that Lazarew [1929] found the narcotic dose for mice to be 7,500 to 10,000 ppm. ACGIH [1971] noted that this narcotic dose (7,500 to 10,000 ppm) was for a 2-hour exposure [Lazarew 1929; Treon et al. 1943].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	10,172	-----	2 hr	16,275 ppm (1.6)	1,268 ppm
Mouse	Lazarew 1929	10,000-12,500	-----	2 hr	16,000-20,000 ppm (1.6)	1,600-2,000 ppm
Rabbit	Treon et al. 1943	15,227	-----	1 hr	19,034 ppm (1.25)	1,903 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Izmerov et al. 1982	oral	2,250	-----	3,860 ppm	386 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,200 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in animals [Izmerov et al. 1982; Lazarew 1929; Treon et al. 1943], a value of about 1,600 ppm would have been appropriate for methylcyclohexane. However, the revised IDLH for methylcyclohexane is 1,200 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.2%).

REFERENCES:

1. ACGIH [1971]. Methylcyclohexane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 162-163.
2. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, pp. 136-137.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 82.
4. Lazarew NW [1929]. Uber die giftigkeit verschiedener kohlenwasserstoffdampfe. Arch Exp Pathol Pharmakol *143*:223-233 (in German).
5. Lazarew NW [1929]. Zur toxikologie des benzins (The toxicology of gasoline). Arch Hyg, pp. 228-239 (translated).
6. Treon JF, Crutchfield WE, Kitzmiller KV [1943]. The physiological response of animals to cyclohexane, methyl cyclohexane, and certain derivatives of these compounds. II. Inhalation. J Ind Hyg Toxicol 25(8):323-347.

Methylcyclohexanol

CAS number	25639-42-3
NIOSH REL	50 ppm (235 mg/m³) TWA
Current OSHA PEL	100 ppm (470 mg/m³) TWA
1989 OSHA PEL	50 ppm (235 mg/m³) TWA
1993-1994 ACGIH TLV	50 ppm (234 mg/m³) TWA
Description of substance	Straw-colored liquid with a weak odor like coconut oil.
LEL	Unknown
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for methylcyclohexanol. The chosen IDLH, therefore, has been estimated from the rabbit oral lethal dose of 1.75 to 2.0 g/kg [Treon et al. 1943 cited by Browning 1965]. Because this compound has such a low vapor pressure, a concentration this great can only be achieved if the substance is heated.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Deichmann and LeBlanc 1943	oral	1,660	-----	2,446 ppm	245 ppm
Rabbit	Treon et al. 1943a	oral	-----	1,750-2,000	2,579-2,947 ppm	258-295 ppm

Other animal data	Rabbits exposed for 6 hours/day, 5 days/week for 10 weeks at 503 ppm had increased salivation, conjunctival irritation, and slight lethargy, while 232 ppm caused no such signs of intoxication [Treon et al. 1943b].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for methylcyclohexanol is 500 ppm based on subchronic inhalation data in animals [Treon et al. 1943b]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, p. 372.
2. Deichmann WB, LeBlanc TJ [1943]. Determination of the approximate lethal dose with about six animals. J Ind Hyg Toxicol 25(9):415-417.
3. Treon JF, Crutchfield WE Jr, Kitzmiller KV [1943a]. The physiological response of rabbits to cyclohexane, methylcyclohexane, and certain derivatives of these compounds. I. Oral administration and cutaneous application. J Ind Hyg Toxicol 25(6):199-214.
4. Treon JF, Crutchfield WE, Kitzmiller KV [1943b]. The physiological response of animals to cyclohexane, methyl cyclohexane, and certain derivatives of these compounds. II. Inhalation. J Ind Hyg Toxicol 25(8):323-347.

o-Methylcyclohexanone

CAS number 583-60-8
NIOSH REL .... 50 ppm (230 mg/m^3) TWA, 75 ppm 345 mg/m^3) STEL [skin]
Current OSHA PEL .... 100 ppm (460 mg/m^3) TWA [skin]
1989 OSHA PEL .... 50 ppm (230 mg/m^3) TWA, 75 ppm (345 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV .... 50 ppm (229 mg/m^3) TWA, 75 ppm (344 mg/m^3) STEL [skin]
Description of substance .... Colorless liquid with a weak, peppermint-like odor.
LEL.. Unknown
Original (SCP) IDLH .... 2,500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that rabbits and cats exhibited sleepiness, respiratory irregularities, and poor coordination after a 1-hour exposure to 2,500 ppm; a 30-minute exposure to 3,500 ppm caused prostration in mice, guinea pigs, and rats [Gross as cited by Lehmann and Flury 1943].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1969	2,800	-----	4 hr	5,600 ppm (2.0)	560 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1969	oral	2,140	-----	3,215 ppm	322 ppm
Rabbit	Treon et al. 1943	oral	-----	1,000-1,250	1,502-1,878 ppm	150-188 ppm

Other animal data .... Mice, guinea pigs, and rats exposed at 3,500 ppm for 30 minutes suffered irritation of the mucous membranes and exhibited signs of central nervous system depression [Clayton and Clayton 1981]. Rabbits and cats exhibited sleepiness, respiratory irregularities, and poor coordination after a 1-hour exposure to 2,500 ppm [Clayton and Clayton 1981].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 600 ppm
Basis for revised IDLH: The revised IDLH for o-methylcyclohexanone is 600 ppm based on acute inhalation toxicity data in animals [Smyth et al. 1969]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2C. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 4722-4723, 4782-4784.
2. Gross E [?]. Unpublished. [From Lehmann KB, Flury F, eds. [1943]. Toxicology and hygiene of industrial solvents. Translated by E. King and H.F. Smyth, Jr. Baltimore, MD: Williams & Wilkins Company, p. 247.]
3. Lehmann KB, Flury F, eds. [1943]. Toxicology and hygiene of industrial solvents. Translated by E. King and H.F. Smyth, Jr. Baltimore, MD: Williams & Wilkins Company, p. 247.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1770.
5. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA, Nycum JS [1969]. Range-finding toxicity data: list VII. Am Ind Hyg Assoc J 30(5):470-476.
6. Treon JF, Crutchfield WE Jr, Kitzmiller KV [1943]. The physiological response of rabbits to cyclohexane, methylcyclohexane, and certain derivatives of these compounds. I. Oral administration and cutaneous application. J Ind Hyg Toxicol 25(6):199-214.

Methylene bisphenyl isocyanate (MDI)

CAS number 101-68-8
NIOSH REL .... 0.05 mg/m³ (0.005 ppm) TWA, 0.2 mg/m³ (0.020 ppm) 10-minute CEILING
Current OSHA PEL .... 0.2 mg/m³ (0.02 ppm) CEILING
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.051 mg/m³ (0.005 ppm) TWA
Description of substance .... White to light-yellow, odorless flakes.
LEL .... Unknown
Original (SCP) IDLH .... 100 mg/m³
Basis for original (SCP) IDLH .... The chosen IDLH is based on an analogy with toluene diisocyanate, which has an IDLH of 10 ppm. [Note: A concentration of 10 ppm methylene bisphenyl isocyanate is equivalent to about 100 mg/m³.]
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Bunge et al. 1977	369 mg/m³	-----	4 hr	738 mg/m³ (2.0)	74 mg/m³
Rat	Bunge et al. 1977	380 mg/m³	-----	4 hr	760 mg/m³ (2.0)	76 mg/m³
Rat	Woolrich 1982	178 mg/m³	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Izmerov et al. 1982	oral	2,200	-----	15,400 mg/m³	1,540 mg/m³
Rat	Woolrich 1982	oral	-----	31,690	221,830 mg/m³	22,183 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 75 mg/m³
Basis for revised IDLH: The revised IDLH for methylene bisphenyl isocyanate is 75 mg/m³ based on acute inhalation toxicity data in animals [Bunge et al. 1977].

REFERENCES:

1. Bunge W, Ehrlicher H, Kimmerle G [1977]. Medical aspects of work with surface coating systems using the spraying technique. Zentralbl Arbeitsmed Arbeitsschutz Prophylaxe 4(spec. ed.):1-46 (in German). [From ACGIH [1991]. Methylene bisphenyl isocyanate. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 978-980.]
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 83.
3. Woolrich PF [1982]. Industrial hygiene and medical control of TDI, MDI and PMPPI. Am Ind Hyg Assoc J 43(2):89-97.

Methylene chloride

CAS number	75-09-2
NIOSH REL	None established; NIOSH considers methylene chloride to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	500 ppm TWA, 1,000 ppm CEILING, 2,000 ppm 5-minute MAXIMUM PEAK IN ANY 2 HOURS
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	50 ppm (174 mg/m^3) TWA, A2
Description of substance	Colorless liquid with a chloroform-like odor.
LEL	13% (10% LEL, 13,000 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	Negherbon [1959] reported that a 10-minute exposure to 2,330 ppm produces vertigo in man [Lehmann et al. 1936]. However, Sax [1975] stated that at 2,300 ppm there was no feeling of dizziness during 1-hour exposures. Thienes and Haley stated that no dizziness, but slight nausea, is caused by exposure to 2,300 ppm for 1 hour and that methylene chloride is not lethal at 25,000 ppm. Considering the data cited above, an IDLH of 5,000 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Clayton 1967	-----	5,000	2 hr	8,000 ppm (1.6)	800 ppm
Rat	Fiz Akt Vesh 1975	24,929	-----	30 min	24,929 ppm (1.0)	2,493 ppm
Rabbit	Heppel et al. 1944	-----	10,000	7 hr	24,000 ppm (2.4)	2,400 ppm
Cat	Lehmann et al. 1936	-----	12,295	4.5 hr	25,820 ppm (2.1)	2,582 ppm
Mouse	von Oettingen 1949	14,400	-----	7 hr	34,560 ppm (2.4)	3,456 ppm
Dog	von Oettingen 1949	-----	14,108	7 hr	33,859 ppm (2.4)	3,386 ppm

Human data	Volunteers exposed at 1,000 ppm for 2 hours had carboxyhemoglobin levels in excess of those permitted in industry from exposure to carbon monoxide alone [Stewart et al. 1972]. A 10-minute exposure at 2,330 ppm has produced vertigo [Lehmann et al. 1936]. However, it has also been reported that no feeling of dizziness was noted after 1 hour of exposure to 2,300 ppm [Sax 1975]. It has been stated that no dizziness, but slight nausea, is caused by exposure to 2,300 ppm for 1 hour and that methylene chloride is not lethal at 25,000 ppm [Thienes and Haley].

Revised IDLH: 2,300 ppm
Basis for revised IDLH: The revised IDLH for methylene chloride is 2,300 ppm based on acute inhalation toxicity data in humans [Sax 1975]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methylene chloride at any detectable concentration.]

REFERENCES:

1. Clayton JW [1967]. Fluorocarbon toxicity and biological action. Fluor Chem Rev *1*:197-252.
2. Fiz Akt Vesh [1975]; *7*:35-36 (in Russian).
3. Heppel LA, Neal PA, Perrin TL, Orr ML, Porterfield VT [1944]. The toxicology of dichloromethane (methylene chloride). I. Studies on effects of daily inhalation. J Ind Hyg Toxicol *26*(1):8-16.

Methylene chloride (continued)

4. Lehmann KB, Schmidt-Kehl L, Ruf H, Crescitelli, Dahl, Eppinghausen, Eshe, Falker, Grotefendt, Junkenita, Maier, Mergner, Pantehtsch, Schiitzer, Shoenes, Spettmann, Wirges, Barnsreiter, Benninger, Lazarus, Manasse, Kummeth, Reuss, Schwarzweller [1936]. Die 13 wichtisgsten chlorkohlenwasserstoffe der fettreihe vom standpunkt der gewerbehygiene (The 13 most important chlorinated hydrocarbons of the aliphatic series from the standpoint of occupational medicine). Arch Hyg Bakteriol *116*:131-200 (translated).
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8. Thienes CH, Haley TJ [?].
9. von Oettingen WF [1949]. Studies on the relation between the toxic action of chlorinated methanes and their physicochemical properties. NIH Bulletin *191*:1-85.

Methyl formate

CAS number	107-31-3
NIOSH REL	100 ppm (250 mg/m^3) TWA, 150 ppm (375 mg/m^3) STEL
Current OSHA PEL	100 ppm (250 mg/m^3) TWA
1989 OSHA PEL	100 ppm (250 mg/m^3) TWA, 150 ppm (375 mg/m^3) STEL
1993-1994 ACGIH TLV	100 ppm (246 mg/m^3) TWA, 150 ppm (368 mg/m^3) STEL
Description of substance	Colorless liquid with a pleasant odor.
LEL	4.5% (10% LEL, 4,500 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that 5,000 ppm was considered the maximum concentration guinea pigs could tolerate for 60 minutes without serious disturbances [Schrenk et al. 1936].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Schrenk et al. 1936	-----	50,000	20 min	43,500 ppm (0.87)	4,350 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch 1972	oral	1,622	-----	4,542 ppm	454 ppm

Other animal data	It has been stated that 5,000 ppm was considered the maximum concentration that guinea pigs could tolerate for 60 minutes without serious disturbances [Schrenk et al. 1936].
Human data	No adverse effects were found in humans after exposure to 1,500 ppm for 1 minute [Schrenk et al. 1936].

Revised IDLH: 4,500 ppm
Basis for revised IDLH: The revised IDLH for methyl formate is 4,500 ppm based on acute inhalation toxicity data in animals [Schrenk et al. 1936]. Also, this value is 10% of the lower explosive limit of 4.5%.

REFERENCES:

1. ACGIH [1971]. Methyl formate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 165-166.
2. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
3. Schrenk HH, Yant WP, Chornyak J, Patty FA [1936]. Acute response of guinea pigs to vapors of some new commercial organic compounds. XIII. Methylformate. Public Health Rep *51*:1329-1335.

5-Methyl-3-heptanone

CAS number	541-85-5
NIOSH REL	25 ppm (130 mg/m^3) TWA
Current OSHA PEL	25 ppm (130 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	25 ppm (131 mg/m^3) TWA
Description of substance	Colorless liquid with a pungent odor.
LEL	Unknown
Original (SCP) IDLH	3,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 0 of 6 rats died, but 3 of 6 mice died when exposed for 4 hours to about 3,000 ppm [Shell 1958].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Shell 1958	3,000	-----	4 hr	6,000 ppm (2.0)	600 ppm
Rat	Shell 1958	LC_{47}: 6,000	-----	8 hr	15,000 ppm (2.5)	1,500 ppm
Rat	Shell 1961	-----	3,484	8 hr	8,710 ppm (2.5)	871 ppm
Mouse	Shell 1961	-----	3,484	4 hr	6,968 ppm (2.0)	697 ppm

Other animal data	It has been reported that rats survived a 4-hour exposure to 3,000 ppm [Shell 1958].
Human data	Humans exposed to 25 ppm experienced irritation of the eyes and respiratory tract and detected a strong odor, while 100 ppm caused irritation of the mucous membranes, headache, and nausea which was too severe to tolerate for more than a few minutes [Clayton and Clayton 1981].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 5-methyl-3-heptanone is 100 ppm based on acute inhalation toxicity data in humans [Clayton and Clayton 1981].

REFERENCES:

1. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2C. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 4767-4768.
2. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1744.
3. Shell [1958]. Toxicity data sheet: SC 57-99. Houston, TX: Shell Chemical Corporation, Industrial Hygiene Bulletin Toxicity Data Sheet.
4. Shell [1961]. Unpublished report. Houston, TX: Shell Chemical Corporation, p. 6.

Methyl hydrazine

CAS number	60-34-4
NIOSH REL	0.04 ppm (0.08 mg/m³) 2-hour CEILING; NIOSH considers methyl hydrazine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.2 ppm (0.35 mg/m³) CEILING [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 ppm (0.38 mg/m³) CEILING [skin], A2
Description of substance	Fuming, colorless liquid with an ammonia-like odor.
LEL	2.5% (10% LEL, 2,500 ppm)
Original (SCP) IDLH	50 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the report by Jacobson et al. [1955] of a mouse LC_{50} of 56 ppm.
Short-term exposure guidelines	National Research Council [NRC 1985] Short-term Public Emergency Guidance Levels (SPEGLs):

1-hour SPEGL:	0.24 ppm
2-hour SPEGL:	0.12 ppm
4-hour SPEGL:	0.06 ppm
8-hour SPEGL:	0.03 ppm
16-hour SPEGL:	0.015 ppm
24-hour SPEGL:	0.01 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Fairchild 1967	34	-----	4 hr	68 ppm (2.0)	6.8 ppm
Rat	Haun et al. 1969	74	-----	4 hr	148 ppm (2.0)	15 ppm
Monkey	Haun et al. 1969	162	-----	1 hr	203 ppm (1.25)	20 ppm
Dog	Haun et al. 1970	195	-----	30 min	195 ppm (1.0)	20 ppm
Monkey	Haun et al. 1970	145	-----	30 min	145 ppm (1.0)	15 ppm
Mouse	Haun et al. 1970	272	-----	30 min	272 ppm (1.0)	27 ppm
Rat	Haun et al. 1970	427	-----	30 min	427 ppm (1.0)	43 ppm
Mouse	Jacobson et al. 1955	56	-----	4 hr	112 ppm (2.0)	11 ppm
Hamster	Jacobson et al. 1955	143	-----	4 hr	286 ppm (2.0)	29 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 20 ppm
Basis for revised IDLH: The revised IDLH for methyl hydrazine is 20 ppm based on acute inhalation toxicity data in animals [Haun et al. 1969, 1970]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methyl hydrazine at concentrations above 0.04 ppm.]

REFERENCES:

1. Fairchild EJ II [1967]. Toxic Hazards Re-search Unit annual technical report: 1967. Wright-Patterson Air Force Base, OH: Aerospace Medical Research Laboratory, Report No. AMRL-TR-67-137, pp. 1-58.
2. Haun CC, MacEwen JD, Vernont EH, Egan GF [1969]. The acute inhalation toxicity of monomethyl hydrazine vapor. Wright-Patterson Air Force Base, OH: Aerospace Medical Research Laboratory Report No. AMRL-TR-68-169.
3. Haun CC, MacEwen JD, Vernot EH, Egan GF [1970]. Acute inhalation toxicity of monomethylhydrazine vapor. Am Ind Hyg Assoc J *31*:667-677.
4. Jacobson KH, Clem JH, Wheelwright HJ, Rinehart WE, Mayes N [1955]. The acute toxicity of the vapors of some methylated hydrazine derivatives. AMA Arch Ind Health *12*:609-616.
5. NRC [1985]. Emergency and continuous exposure guidance levels for selected airborne contaminants. Vol. 5. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 23-35.

Methyl iodide

CAS number	74-88-4
NIOSH REL	2 ppm (10 mg/m³) TWA [skin]; NIOSH considers methyl iodide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	5 ppm (28 mg/m³) TWA [skin]
1989 OSHA PEL	2 ppm (10 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	2 ppm (12 mg/m³) TWA [skin], A2
Description of substance	Colorless liquid with a pungent, ether-like odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	800 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 57-minute LC_{50} of 860 ppm [Buckell 1950 cited by Patty 1963].
Existing short-term exposure guidelines	1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 25 ppm (60-minute)
ERPG-2: 50 ppm (60-minute)
ERPG-3: 125 ppm (60-minute)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Bakhishev 1975	1,550	-----	30 min	1,550 ppm (1.0)	155 ppm
Mouse	Buckell 1950	860	-----	57 min	1,065 ppm (1.24)	107 ppm
Rat	Deichmann and Gerarde 1969	220	-----	4 hr	440 ppm (2.0)	44 ppm
Rat	von Oettingen 1955	-----	3,800	15 min	3,017 ppm (0.79)	302 ppm

Other animal data	In a subchronic study, no rats died following exposures to 150 ppm for 6 hours/day for 3 days [Monsanto 1986].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for methyl iodide is 100 ppm based on acute inhalation toxicity data in animals [Bakhishev 1975; Buckell 1950; Monsanto 1986]. [Note: The 30-minute and 57-minute LC_{50} data were used rather than the 4-hour LC_{50} data so as not to magnify the conservatism already present in the correction factors. NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for methyl iodide at concentrations above 2 ppm.]

REFERENCES:

1. Bakhishev GN [1975]. Relationship between chemical structure and toxicity for some halogenated aliphatic hydrocarbons. Fiz Akt Vesh 7:35-36 (in Russian).
2. Buckell M [1950]. The toxicity of methyl iodide: I. Preliminary survey. Br J Ind Med 7:122-124.
3. Deichmann WB, Gerarde HW [1969]. Table 67. Acute inhalation toxicity of alkyl iodides. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 756.
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Methyl isobutyl carbinol

CAS number	108-11-2
NIOSH REL	25 ppm (100 mg/m^3) TWA, 40 ppm (165 mg/m^3) STEL [skin]
Current OSHA PEL	25 ppm (100 mg/m^3) TWA [skin]
1989 OSHA PEL	25 ppm (100 mg/m^3) TWA, 40 ppm (165 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	25 ppm (104 mg/m^3) TWA, 40 ppm (167 mg/m^3) STEL
Description of substance	Colorless liquid with a mild odor.
LEL	1.0% (10% LEL, 1,000 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Browning [1965] and Patty [1963] that exposures for 8 hours to 2,000 ppm killed 5 of 6 rats, but no rats died from a 2-hour exposure to the saturated vapor [Smyth et al. 1951].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Browning 1965	LC_{83}: 2,000	-----	8 hr	5,000 ppm (2.5)	500 ppm
Rat	Carpenter et al. 1949	2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Mouse	McOmie and Anderson 1949	LC_{40}: 4,600	-----	10 hr	12,420 ppm (2.7)	1,242 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	McOmie and Anderson 1949	oral	-----	1,000	1,647 ppm	165 ppm
Rat	Smyth et al. 1951	oral	2,590	-----	4,266 ppm	427 ppm

Other animal data	It has been reported that rats survived a 2-hour exposure to the saturated vapor (about 4,000 ppm at 68°F) [Smyth et al. 1951].
Human data	Eye irritation has occurred after exposures to 50 ppm for 15 minutes [Silverman et al. 1946].

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for methyl isobutyl carbinol is 400 ppm based on acute inhalation toxicity data in animals [Browning 1965; Carpenter et al. 1949]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 50 ppm.

REFERENCES:

1. Browning E [1965]. Toxicity and Metabolism of Industrial Solvents. New York, NY: Elsevier Publishing Company, p. 369.
2. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.
3. McOmie WA, Anderson HH [1949]. Comparative toxicologic effects of some isobutyl carbinols and ketones. University of California Publication, Pharmacology *2*:217-230.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1460.
5. Silverman L, Schulte HF, First MW [1946]. Further studies on sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol *28*:262-266.
6. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med *4*:119-122.

Methyl isocyanate

CAS number	624-83-9
NIOSH REL	0.02 ppm (0.05 mg/m³) TWA [skin]
Current OSHA PEL	0.02 ppm (0.05 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.02 ppm (0.047 mg/m³) TWA [skin]
Description of substance	Colorless liquid with a sharp, pungent odor.
LEL	5.3% (10% LEL, 5,300 ppm)
Original (SCP) IDLH	20 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that the rat 2-hour LC_{50} is 21 ppm [Kimmerle and Eben 1964].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Dodd et al. 1986	6.1	-----	6 hr	14 ppm (2.3)	1.4 ppm
Mouse	Dodd et al. 1986	12.2	-----	6 hr	28 ppm (2.3)	2.8 ppm
G. pig	Dood et al. 1986	5.4	-----	6 hr	12 ppm (2.3)	1.2 ppm
Rat	Kimmerle and Eben 1964	21	-----	2 hr	34 ppm (1.6)	3.4 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Vernot et al. 1977	oral	120	-----	354 ppm	35 ppm
Rat	Vijayarachavan and Kaushik 1987	oral	51.5	-----	152 ppm	15 ppm

Human data .... Volunteers experienced eye irritation and lacrimation after 1 to 5 minutes at 2 ppm, with more marked irritation at 4 ppm; exposures were unbearable at 21 ppm [Kimmerle and Eben 1964]. In another study, volunteers noted eye irritation and lacrimation at 5 ppm in less than 50 seconds [Mellon 1963].

Revised IDLH: 3 ppm
Basis for revised IDLH: The revised IDLH for methyl isocyanate is 3 ppm based on acute inhalation toxicity data in humans [Kimmerle and Eben 1964; Mellon 1963].

REFERENCES:

1. ACGIH [1971]. Methyl isocyanate. In: Documentation of the threshold limit values. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 167.
2. Dodd DE, Fowler EH, Snellings WM, Pritts IM, Baron RL [1986]. Acute inhalation studies with methyl isocyanate vapor. I. Methodology and LC50 determinations in guinea pigs, rats, and mice. Fundam Appl Toxicol 6:747-755.
3. Kimmerle G, Eben A [1964]. Zur toxicität von methylisocyanat und dessen quantitativer bestimmung in der luft (Toxicity of methyl isocyanate and its quantitative determination in the air). Arch Toxikol 20:235-241 (in German).
4. Mellon [1963]. Special report 26-23. Pittsburgh, PA: Mellon Institute (March 13, 1963).
5. Vernot EH, MacEwen JD, Haun CC, Kinkead FR [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol 42:417-423.
6. Vijayarachavan R, Kaushik MP [1987]. Acute toxicity of methyl isocyanate and ineffectiveness of sodium thiosulphate in preventing its toxicity. Indian J Exp Biol 25:531-534.

Methyl mercaptan

CAS number	74-93-1
NIOSH REL	0.5 ppm (1 mg/m^3) 15-minute CEILING
Current OSHA PEL	10 ppm (20 mg/m^3) CEILING
1989 OSHA PEL	0.5 ppm (1 mg/m^3) TWA
1993-1994 ACGIH TLV	0.5 ppm (0.98 mg/m^3) TWA
Description of substance	Colorless gas with a disagreeable odor like garlic or rotten cabbage.
LEL	3.9% (10% LEL, 3,900 ppm)
Original (SCP) IDLH	400 ppm
Basis for original (SCP) IDLH	Because no useful data on acute inhalation toxicity are available on which to base the IDLH for methyl mercaptan, the chosen IDLH is based on an analogy with hydrogen sulfide. ACGIH [1971] reported that some investigators show toxicities of the same magnitude for hydrogen sulfide and methyl mercaptan [Ljunggren and Norberg 1943]; others indicate that the toxicity of methyl mercaptan is somewhat less than that of hydrogen sulfide [DeRekowski 1893; Frankel 1921]. Patty [1963] reported that 400 to 700 ppm hydrogen sulfide is dangerous after exposure of 0.5 to 1 hour [Henderson and Haggard 1943]. AIHA [1971] reported that concentrations of 400 to 700 ppm hydrogen sulfide caused loss of consciousness and possible death in 0.5 to 1 hour [MCA 1950]. Based on the data cited above, an IDLH of 400 ppm is chosen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Seluzhitsky 1972	3.3	-----	2 hr	4 ppm (1.25)	0.4 ppm
Rat	Tansy et al. 1981	675	-----	4 hr	1,350 ppm (2.0)	135 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mammal	Seluzhitsky 1972	?	60.67	-----	212 ppm	21 ppm

Human data	Students accidentally exposed to about 4 ppm for several hours experienced headaches and nausea [Clayton and Clayton 1981]. Some investigators have reported that the toxicity of methyl mercaptan is similar to hydrogen sulfide while others report the toxicity to be somewhat less than hydrogen sulfide [DeRekowski 1893; Frankel 1921].

Revised IDLH: 150 ppm
Basis for revised IDLH: The revised IDLH for methyl mercaptan is 150 ppm based on acute inhalation toxicity data in animals [Tansy et al. 1981] and an analogy to hydrogen sulfide [DeRekowski 1893; Frankel 1921] which has a revised IDLH of 150 ppm.

Methyl mercaptan (continued)

REFERENCES:

1. ACGIH [1971]. Methyl mercaptan (methanethiol). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 167-168.
2. AIHA [1955]. Hydrogen sulfide. In: Hygienic guide series. Am Ind Hyg Assoc Q *16*:335.
3. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 2063-2070.
4. DeRekowski L [1893]. Arch de Sc Biologie (St. Petersbourg) 2:305. [From ACGIH [1971]. Methyl mercaptan (methanethiol). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 167-168.]
5. Frankel J [1921]. Die Arzenermittel-Synthese. Berlin, Germany: Julius Springer, p. 108 (in German).
6. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 245.
7. Ljunggren G, Norberg B [1943]. On the effect and toxicity of dimethyl sulfide, dimethyl disulfide and methyl mercaptan. Acta Physiol Scand *5*:248-255.
8. MCA [1950]. Chemical safety data sheet SD-36: hydrogen sulfide. Washington, DC: Manufacturing Chemists Association, p. 12.
9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 899.
10. Seluzhitsky GV [1972]. Experimental data for substantiation of the threshold of methyl mercaptan, dimethyl sulfide, and dimethyldisulfide in the air of the working zone of paper industries. Gig Tr Prof Zabol *16*(6):46-47 (in Russian).
11. Tansy MF, Kendall FM, Fantasia J, Landin WE, Oberly R [1981]. Acute and subchronic toxicity studies of rats exposed to vapors of methyl mercaptan and other reduced-sulfur compound. J Toxicol Environ Health *8*:71-88.

Methyl methacrylate

CAS number 80-62-6
NIOSH REL .... 100 ppm (410 mg/m³) TWA
Current OSHA PEL .... 100 ppm (410 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 100 ppm (410 mg/m³) TWA
Description of substance .... Colorless liquid with an acrid, fruity odor.
LEL .... 1.7% (10% LEL, 1,700 ppm)
Original (SCP) IDLH .... 4,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that 4,400 ppm was fatal to rats and rabbits in 8 hours [Deichmann 1941]. Also, Patty [1963] cited an approximate rat LC_{50} of 3,750 ppm [Deichmann 1941; Spealman et al. 1945].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Blagodatin et al. 1976	18,750	-----	4 hr	37,500 ppm (2.0)	3,750 ppm
Mouse	Blagodatin et al. 1976	4,447	-----	2 hr	7,115 ppm (1.6)	712 ppm
Rat	Deichmann 1941	-----	4,400	8 hr	11,000 ppm (2.5)	1,100 ppm
Rabbit	Deichmann 1941	-----	4,400	8 hr	11,000 ppm (2.5)	1,100 ppm
Rabbit	Deichmann 1941	-----	4,207	4.5 hr	8,751 ppm (2.08)	875 ppm
G. pig	Deichmann 1941	-----	4,567	5 hr	9,819 ppm (2.15)	982 ppm
Rat	Deichmann 1941	3,750	-----	?	?	?
Mammal	Gig Sanit 1986	4,808	-----	?	?	?

Human data .... Workers have experienced irritation, but tolerated 200 ppm without complaint [Spealman et al. 1945]. It has also been reported that 2,300 ppm was intolerable [Coleman 1963].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for methyl methacrylate is 1,000 ppm based on acute inhalation toxicity data in humans [Coleman 1963] and animals [Blagodatin et al. 1976; Deichmann 1941].

REFERENCES:

1. ACGIH [1971]. Methyl methacrylate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 168.
2. Blagodatin VM, Smiznova ES, et al. [1976]. Substantiation of the maximum permissible concentration of methacrylic acid methyl ether in the air of the working zone. Gig Tr Prof Zabol *20*(6):5-8 (in Russian).
3. Coleman AL [1963]. Letter to the TLV Committee from State of Connecticut, Labor Department, Occupational Health Section (March 15, 1963).
4. Deichmann W [1941]. Toxicity of methyl, ethyl, and n-butyl methacrylate. J Ind Hyg Toxicol *23*:343-351.
5. Gig Sanit [1986]; *51*(5):61 (in Russian).
6. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1880.
7. Spealman CR, Main RJ, Haag HB, Larson PS [1945]. Monomeric methyl methacrylate. Am J Ind Med *14*(4):292-298.

α-Methyl styrene

CAS number 98-83-9
NIOSH REL .... 50 ppm (240 mg/m^3) TWA, 100 ppm (485 mg/m^3) STEL
Current OSHA PEL .... 100 ppm (480 mg/m^3) CEILING
1989 OSHA PEL .... 50 ppm (240 mg/m^3) TWA, 100 ppm (485 mg/m^3) STEL
1993-1994 ACGIH TLV .... 50 ppm (242 mg/m^3) TWA, 100 ppm (483 mg/m^3) STEL
Description of substance .... Colorless liquid with a characteristic odor.
LEL .... 1.9% (10% LEL, 1,900 ppm)
Original (SCP) IDLH .... 5,000 ppm
Basis for original (SCP) IDLH .... Because no data on acute inhalation toxicity are available on which to base the IDLH for α-methyl styrene, the chosen IDLH is based on an analogy with styrene which has an IDLH of 5,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Wolf et al. 1956	oral	4,900	-----	6,982 ppm	698 ppm

Other animal data .... A considerable number of rats and guinea pigs exposed to 3,000 ppm for 7 to 8 hours/day, 5 days/week for up to 6 months died [Gerarde 1960; Wolf et al. 1956]. Rats and guinea pigs had slight changes in liver and kidney weights and some reduction in body weight following exposure to 800 ppm for 7 hours/day, 5 days/week for 27 days [Wolf et al. 1956]. No adverse effects were noted in rats, rabbits, mice, monkeys, and guinea pigs exposed 7 hours/day, 5 days/week for 5 months to 200 ppm [Wolf et al. 1956].
Human data .... Four volunteers reported a definite unpleasant odor and slight eye irritation after about 2 minutes of exposure to 200 ppm [Wolf et al. 1956]. Strong eye and nasal irritation has been noted at concentrations above 600 ppm [Gerarde 1960; Wolf et al. 1956].

Revised IDLH: 700 ppm
Basis for revised IDLH: The revised IDLH for α-methyl styrene is 700 ppm based on acute toxicity data in humans [Wolf et al. 1956] and animals [Gerarde 1960; Wolf et al. 1956] and an analogy to styrene which has a revised IDLH of 700 ppm.

REFERENCES:

1. Gerarde HW [1960]. Toxicology and biochemistry of aromatic hydrocarbons. Princeton, NJ: Elsevier Publishing Company, pp. 131-133.
2. Wolf MA, Rowe VK, McCollister DD, et al. [1956]. Toxicological studies of certain alkylated benzenes and benzene. AMA Arch Ind Health *14*:387-398.

Mica

CAS number	12001-26-2
NIOSH REL	3 mg/m^3 (respirable dust) TWA
Current OSHA PEL	20 mppcf TWA
1989 OSHA PEL	3 mg/m^3 (respirable dust) TWA
1993-1994 ACGIH TLV	3 mg/m^3 (respirable dust) TWA
Description of substance	Colorless, odorless flakes or sheets of hydrous silicates.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 10,000 mppcf – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that an acute exposure to a high concentration of mica would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 20 mppcf is 10,000 mppcf).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,500 mg/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of mica would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for mica is 1,500 mg/m^3 based on being 500 times the NIOSH REL of 3 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Molybdenum (insoluble compounds, as Mo)

CAS number	7439-98-7 (Metal)
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	15 mg/m³ TWA
1989 OSHA PEL	10 mg/m³ TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg Mo/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of insoluble molybdenum compounds would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mg Mo/m³ is 7,500 mg Mo/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	No fatalities were reported among animals that ingested amounts of molybdenum disulfide in doses as great as 6,000 mg Mo/kg [Fairhall et al. 1945]. No changes were observed in rats over a 4-week period following inhalation exposures to metallic molybdenum at 25,000 to 30,000 mg/m³ or to molybdenum dioxide at 10,000 to 12,000 mg/m³ for 1 hour [FDA 1975].
Human data	Mining and metallurgy workers chronically exposed to 60 to 600 mg Mo/m³ reported an increased incidence of nonspecific symptoms that included weakness, fatigue, headache, anorexia, and joint and muscle pain [Lener and Bibr 1984].

Revised IDLH: 5,000 mg Mo/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of insoluble molybdenum compounds would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for insoluble molybdenum compounds is 5,000 mg Mo/m³ based on being 500 times the OSHA PEL of 10 mg Mo/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. Fairhall LT, Dunn RC, Sharpless NE, Pritchard EA [1945]. The toxicity of molybdenum. Public Health Bulletin *293*:1-36,40-41.
2. FDA [1975]. Toxicity of essential minerals. Information pertinent to establishing appropriate levels of single-mineral dietary supplements. Washington, DC: U.S. Food and Drug Administration.
3. Lener J, Bibr B [1984]. Effects of molybdenum on the organism: a review. J Hyg Epidemiol Microbiol Immunol *29*:405-419.

Molybdenum (soluble compounds, as Mo)

CAS number	Varies
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 2,500 mg Mo/m³ -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no data that an acute exposure to the soluble compounds of molybdenum could impede escape or cause irreversible health effects in 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 5 mg Mo/m³ (i.e., 2,500 mg Mo/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,500 mg Mo/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Na_2MoO_4 Rat	Barltrop 1991	>2,080 mg/m³	-----	4 hr	>1,939 mg Mo/m³	>194 mg Mo/m³
MoO_3 Rat	Barltrop 1991	>5,840 mg/m³	-----	4 hr	>7,784 mg Mo/m³	>778 mg Mo/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Na_2MoO_4 Rat	Barltrop 1991	oral	4,000	-----	13,048 mg Mo/m³	1,305 mg Mo/m³
MoO_3 Rat	Barltrop 1991	oral	2,689	-----	12,541 mg Mo/m³	1,254 mg Mo/m³
MoO_3, $CaMoO_4$, $(NH_4)_2MoO_4$ Rat	Fairhall et al. 1945	oral	-----	120 mg Mo/kg	840 mg Mo/m³	84 mg Mo/m³
MoO_3, $CaMoO_4$, $(NH_4)_2MoO_4$ G pig	Fairhall et al. 1945	oral	-----	120 mg Mo/kg	840 mg Mo/m³	84 mg Mo/m³
$CaMoO_4$ Rat	Browning 1961	oral	101	-----	339 mg Mo/m³	34 mg Mo/m³
$(NH_4)_2MoO_4$ Rabbit	Coulston & Korte 1975	oral	1,870	-----	6,371 mg Mo/m³	637 mg Mo/m³
G. pig	Coulston & Korte 1975	oral	2,200	-----	7,546 mg Mo/m³	755 mg Mo/m³
Cat	Coulston & Korte 1975	oral	1,600	-----	5,488 mg Mo/m³	549 mg Mo/m³

Molybdenum (soluble compounds, as Mo) (continued)

Other animal data .... No changes were observed in rats over a 4-week period following inhalation exposures to molybdenum trioxide at 12,000 to 15,000 mg/m³ or to ammonium paramolybdate at 3,000 to 5,000 mg/m³ for 1 hour [Fairhall et al. 1945]; however, irritation of the upper respiratory passages occurred after exposure to the ammonium paramolybdate dust [FDA 1975].

Human data .... Mining and metallurgy workers chronically exposed to 60 to 600 mg Mo/m³ reported an increased incidence of nonspecific symptoms that included weakness, fatigue, headache, anorexia, and joint and muscle pain [Lener and Bibr 1984].

Revised IDLH: 1,000 mg Mo/m³
Basis for revised IDLH: The revised IDLH for soluble molybdenum compounds is 1,000 mg Mo/m³ based on toxicity data in workers [Lener and Bibr 1984] and animals [Barltrop 1991].

REFERENCES:

1. Barltrop D [1991]. The acute toxicity of certain compounds of molybdenum. Report to the International Molybdenum Association, London, April 1991. London, England: Department of Child Health, Charing Cross and Westminster Medical School.
2. Browning E [1961]. Toxicity of industrial metals. London, England: Butterworths, p. 214.
3. Coulston F, Korte F, eds. [1975]. Heavy metal toxicity, safety and hormology. In: Environmental Quality & Safety, Supplement 1. New York, NY: Georg Thieme Publishers, pp. 1-120.
4. Fairhall LT, Dunn RC, Sharpless NE, Pritchard EA [1945]. The toxicity of molybdenum. Public Health Bulletin *293*:1-36, 40-41.
5. FDA [1975]. Toxicity of essential minerals. Information pertinent to establishing appropriate levels of single-mineral dietary supplements. Washington, DC: U.S. Food and Drug Administration.
6. Lener J, Bibr B [1984]. Effects of molybdenum on the organism: a review. J Hyg Epidemiol Microbiol Immunol *29*:405-419.

Monomethyl aniline

CAS number	100-61-8
NIOSH REL	0.5 ppm (2 mg/m³) TWA [skin]
Current OSHA PEL	2 ppm (9 mg/m³) TWA [skin]
1989 OSHA PEL	0.5 ppm (2 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	0.5 ppm (2.2 mg/m³) TWA [skin]
Description of substance	Yellow to light-brown liquid with a weak, ammonia-like odor.
LEL	Unknown
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with aniline which has an IDLH of 100 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Treon et al. 1949	oral	-----	280	439 ppm	44 ppm
G. pig	von Oettingen 1941	oral	-----	1,200	1,883 ppm	188 ppm

Other animal data	It has been reported that a dog survived 50 seven-hour exposures to 86 ppm [Treon et al. 1949].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on animal subchronic inhalation toxicity data [Treon et al. 1949] and an analogy to aniline which has a revised IDLH of 100 ppm, the original IDLH for monomethyl aniline (100 ppm) is not being revised at this time.

REFERENCES:

1. Treon JF, Deichmann WB, Sigmon HE, Wright H, Witherup SO, Heyroth FF, Kitzmiller KV, Keenan C [1949]. The toxic properties of xylidine and monomethylaniline. I. The comparative toxicity of xylidine and monomethylaniline when administered orally or intravenously to animals or applied on their skin. J Ind Hyg Toxicol *31*:1-20.
2. von Oettingen WF [1941]. The aromatic amino and nitro compounds, their toxicity and potential dangers. Public Health Bulletin *271*:16.

Morpholine

CAS number	110-91-8
NIOSH REL	20 ppm (70 mg/m³) TWA, 30 ppm (105 mg/m³) STEL [skin]
Current OSHA PEL	20 ppm (70 mg/m³) TWA [skin]
1989 OSHA PEL	20 ppm (70 mg/m³) TWA, 30 ppm (105 mg/m³) STEL [skin]
1993-1994 ACGIH TLV	20 ppm (71 mg/m³) TWA [skin]
Description of substance	Colorless liquid with a weak, ammonia- or fish-like odor.
LEL	1.4% (10% LEL, 1,400 ppm)
Original (SCP) IDLH	8,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ILO [1972] that 1 of 6 rats died following an 8-hour exposure to 8,497 ppm. The chosen IDLH is also supported by Patty [1963] who reported that 1 hour was the maximum survival time for rats exposed to the saturated vapor (9,200 ppm); exposure of 6 rats to 8,000 ppm (calculated) for 8 hours resulted in no deaths [Smyth et al. 1954].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	ILO 1972	LC_{17}: 8,497	-----	8 hr	21,243 ppm (2.5)	2,124 ppm
Mouse	Toksikol Nov Prom Khim Vesh 1966	365	-----	2 hr	584 ppm (1.6)	58 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mammal	Bazarova and Miguekina 1975	oral	1,220	-----	2,359 ppm	236 ppm
Mouse	Patel et al. 1985	oral	525	-----	1,015 ppm	102 ppm
Rat	Smyth et al. 1954	oral	1,050	-----	2,030 ppm	203 ppm

Other animal data	No deaths resulted from exposures of 6 rats to 8,000 ppm for 8 hours [Smyth et al. 1954].
Human data	Irritation of the nose has been reported after a 1-minute exposure to 12,000 ppm and coughing started after 1.5 minutes; it was suggested that this concentration would probable be intolerable for long periods [Shea 1939].

Revised IDLH: 1,400 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Shea 1939] and animals [ILO 1972; Smyth et al. 1954], a value of 2,000 ppm would have been appropriate for morpholine. However, the revised IDLH for morpholine is 1,400 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.4%).

REFERENCES:

1. Bazarova LA, Miguekina NV [1975]. Comparative evaluation of the toxicity, hazard and effect of piperidine and morpholine. Toksikol Nov Prom Khim Vesh *14*:90-95 (in Russian).
2. ILO [1972]. Morpholine. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. II (L-Z). Geneva, Switzerland: International Labour Office, pp. 915-916.
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4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2203-2204.
5. Shea TE Jr [1939]. The acute and sub-acute toxicity of morpholine. J Ind Hyg Toxicol *21*(7):236-245.
6. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.
7. Toksikol Nov Prom Khim Vesh [1966]; *8*:60-70 (in Russian).

Naphtha (coal tar)

CAS number 8030-30-6
NIOSH REL .... 100 ppm (400 mg/m^3) TWA
Current OSHA PEL .... 100 ppm (400 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 400 ppm (1,590 mg/m^3) TWA
Description of substance .... Reddish-brown, mobile liquid with an aromatic odor.
LEL .... 1.0-1.3% (10% LEL, 1,000-1,300 ppm)
Original (SCP) IDLH .... 10,000 ppm [LEL]
Basis for original (SCP) IDLH .... According to AIHA [1970], 7,500 ppm benzene is judged dangerous to human life for exposures of 30 minutes or more [Henderson and Haggard 1943]. Because benzene is the most hazardous constituent of coal tar naphtha which is present in any appreciable amount, an IDLH of 7,500 ppm could be assumed. However, because the amount of benzene contained in naphtha is usually small, the lower explosive limit (LEL) of 10,000 ppm been used as the IDLH for this draft technical standard. [Note: The draft technical standard noted that the range of the LELs for each of the constituents of coal tar naphtha were between 10,000 and 13,000 ppm.]
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1975	15,000	-----	4 hr	30,000 ppm (2.0)	3,000 ppm
Mouse	Stubblefield et al. 1989	2,319	-----	6 hr	5,335 ppm (2.3)	534 ppm
Human	Tab Biol Per 1933	-----	30,000	5 min	16,500 ppm (0.55)	1,650 ppm
Rat	Taylor 1939	1,600	-----	6 hr	3,680 ppm (2.3)	368 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Stubblefield et al. 1989	oral	>5,000	-----	>7,659 ppm	>766 ppm

Other human data .... Acute exposure to 430 ppm has been reported to cause only slight eye and throat irritation [Carpenter et al. 1975].

Revised IDLH: 1,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Carpenter et al. 1975; Tab Biol Per 1933], a value of about 1,700 ppm would have been appropriate for coal tar naphtha. However, the revised IDLH for coal tar naphtha is 1,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limits of the various constituents of coal tar naphtha which range from 1.0 to 1.3%).

REFERENCES:

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3. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 213.
4. Stubblefield WA, McKee RH, Kapp RW Jr, Hinz JP [1989]. An evaluation of the acute toxic properties of liquids derived from oil sands. J Appl Toxicol *9*(1):59-65.
5. Tab Biol Per [1933]; 3:231 (in German).
6. Taylor H [1939]. Toxicity of coal tar naphtha distillates. Chem Ind *17*:1078-1080.

Naphthalene

CAS number	91-20-3
NIOSH REL	10 ppm (50 mg/m^3) TWA, 15 ppm (75 mg/m^3) STEL
Current OSHA PEL	10 ppm (50 mg/m^3) TWA
1989 OSHA PEL	10 ppm (50 mg/m^3) TWA, 15 ppm (75 mg/m^3) STEL
1993-1994 ACGIH TLV	10 ppm (52 mg/m^3) TWA, 15 ppm (79 mg/m^3) STEL
Description of substance	Colorless to brown solid with an odor of mothballs.
LEL	0.9% (10% LEL, 900 ppm)
Original (SCP) IDLH	500 ppm
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for naphthalene. The chosen IDLH, therefore, has been estimated from the probable oral lethal dose of 5 to 15 grams for an adult [Gerarde 1960 cited by AIHA 1967].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Gosselin et al. 1984	oral	1,800	-----	2,355 ppm	236 ppm
Rat	Izmerov et al. 1982	oral	490	-----	641 ppm	64 ppm
G. pig	Matorova 1982	oral	1,200	-----	1,570 ppm	157 ppm
Mouse	Shopp et al. 1984	oral	533	-----	697 ppm	70 ppm

Human data .... The probable oral lethal dose has been reported to be between 5 and 15 grams [Gerarde 1960]. [Note: An oral dose between 5 and 15 grams is equivalent to a worker being exposed to about 600 to 1,800 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 250 ppm
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for naphthalene. Therefore, the revised IDLH for naphthalene is 250 ppm based on acute oral toxicity data in humans [Gerarde 1960].

REFERENCES:

1. AIHA [1967]. Naphthalene. In: Hygienic guide series. Am Ind Hyg Assoc J *28*:493-496.
2. Gerarde HW [1960]. Toxicology and biochemistry of aromatic hydrocarbons. Princeton, NJ: Elsevier Publishing Company, p. 228.
3. Gosselin RE, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Section III. Therapeutics Index. Baltimore, MD: Williams & Wilkins Company, pp. 307-310.
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 89.
5. Matorova NI [1982]. Data on establishing the maximum permissible concentration of naphthalene and chloronaphthalene in reservoir water. Gig Sanit *11*:78-79 (in Russian).
6. Shopp GM, White KL Jr, Holsapple MP, Barnes DW, Duke SS, Anderson AC, Condie LW, Hayes JR, Borzelleca JF [1984]. Naphthalene toxicity in CD-1 mice: general toxicology and immunotoxicology. Fundam Appl Toxicol *4*:406-419.

Nickel carbonyl (as Ni)

CAS number 13463-39-3
NIOSH REL .... 0.001 ppm (0.007 mg/m³) TWA; NIOSH considers nickel carbonyl to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 0.001 ppm (0.007 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.05 ppm (0.12 mg/m³) TWA
Description of substance .... Colorless to yellow liquid with a musty odor.
LEL .... 2% (10% LEL, 2,000 ppm)
Original (SCP) IDLH* .... 7 ppm [*Note: "Effective" IDLH = 2 ppm -- see discussion below.]
Basis for original (SCP) IDLH .... The chosen IDLH could be based on the statement by ACGIH [1971] that a 30-minute exposure to 7 ppm is lethal for mice [Kincaid et al. 1953]. According to AIHA [1968], the mouse 30-minute LC_{50} is 10 ppm [Kincaid et al. 1953]. Because of the assigned protection factor afforded by each device, however, 2,000 × the OSHA PEL of 0.001 ppm (i.e., 2 ppm) is the concentration above which only the "most protective" respirators are permitted. With regard to the short exposure tolerance for humans, AIHA [1968] reported that a concentration of 3 ppm for 30 minutes has been suggested [Kincaid et al. 1953].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Dog	Armit 1909	-----	360	90 min	519 ppm (1.44)	52 ppm
Human	Brief et al. 1971	-----	30	30 min	30 ppm (1.0)	3.0 ppm
Cat	Coulston and Korte 1975	266	-----	30 min	266 ppm (1.0)	27 ppm
Rabbit	Gekkan Yakuji 1980	-----	42	30 min	42 ppm (1.0)	4.2 ppm
Rat	Kincaid et al. 1956	35	-----	30 min	35 ppm (1.0)	3.5 ppm
Mouse	Kincaid et al. 1956	-----	7	30 min	7 ppm (1.0)	0.7 ppm
Mouse	Kincaid et al. 1953	94	-----	30 min	94 ppm (1.0)	9.4 ppm
Mouse	Kincaid et al. 1953	10	-----	30 min	10 ppm (1.0)	1.0 ppm

Other human data .... It has been stated that 3 ppm for 30 minutes is the probable short-term exposure limit [Kincaid et al. 1956].

Revised IDLH: 2 ppm
Basis for revised IDLH: Based on acute toxicity data in humans [Brief et al. 1971; Kinkaid et al. 1956], an IDLH of 3 ppm would have been appropriate for nickel carbonyl. However, the revised IDLH for nickel carbonyl is 2 ppm based on being 2,000 times the current OSHA PEL of 0.001 ppm (2,000 is an assigned protection factor for respirators; only the "most reliable" respirators are recommended above 2,000 times the OSHA PEL). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for nickel carbonyl at concentrations above 0.001 ppm.]

REFERENCES:

1. ACGIH [1971]. Nickel carbonyl. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 180.
2. AIHA [1968]. Nickel carbonyl. In: Hygienic guide series. Am Ind Hyg Assoc J 29:304-307.
3. Armit HW [1909]. The toxicology of nickel carbonyl. J Hyg 7:525-551.
4. Brief RS, Blanchard JW, Scala RA, Blacker JH [1971]. Metal carbonyls in the petroleum industry. Arch Environ Health 23:373-384.

Nickel carbonyl (as Ni) (continued)

5. Coulston F, Korte F, eds. [1975]. Heavy metal toxicity, safety and hormology. In: Environmental Quality & Safety, Supplement 1. New York, NY: Georg Thieme Publishers, pp. 1-120.
6. Gekkan Yakuji (Pharmaceuticals Monthly) [1980]; 22(3):455-459 (in Japanese).
7. Kincaid JF, Stanley EL, Beckworth CH, Sunderman FW [1956]. Nickel poisoning. III. Procedures for detection, prevention, and treatment of nickel carbonyl exposure including a method for the determination of nickel in biologic materials. Am J Clin Pathol *26*:107-119.
8. Kincaid JF, Strong JS, Sunderman FW [1953]. Nickel poisoning. I. Experimental study of the effects of acute and subacute exposure to nickel carbonyl. AMA Arch Ind Hyg Occup Med *8*:48-60.

Nickel metal and other compounds (as Ni)

CAS number	7440-02-0 (Metal)
NIOSH REL	0.015 mg/m³ TWA; NIOSH considers nickel compounds to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	Metal and insoluble compounds: 1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	Metal and insoluble compounds: 1 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 2,000 mg Ni/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data do not indicate that exposure to a high concentration of nickel metal or soluble nickel compounds could impede escape within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL (2,000 × 1 mg Ni/m³ is 2,000 mg Ni/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,000 mg Ni/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
NiB_2F_4 Mouse	NDRC 1943	-----	530 mg/m³	10 min	92 mg Ni/m³ (0.69)	9.2 mg Ni/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
NiB_2F_4						
Rat	NRC 1953	oral	-----	500	844 mg Ni/m³	88 mg Ni/m³
NiO						
Rat	FDRL 1983	oral	-----	5,000	27,504 mg Ni/m³	2,750 mg Ni/m³
Ni						
Rat	FDRL 1983	oral	-----	5,000	35,000 mg Ni/m³	3,500 mg Ni/m³
G. pig	Gekkan Yakuji 1980	oral	-----	5	35 mg Ni/m³	3.5 mg Ni/m³
$Ni(NH_4)_2(SO_4)_2$						
Rat	FDRL 1984	oral	400	-----	573 mg Ni/m³	57 mg Ni/m³
$NiC_4H_6O_4$						
Rat	Haro et al. 1968	oral	350	-----	814 mg Ni/m³	81 mg Ni/m³
Mouse	Haro et al. 1968	oral	410	-----	953 mg Ni/m³	95 mg Ni/m³
$NiCl_2$						
Rat	Itskova et al. 1969	oral	105	-----	333 mg Ni/m³	33 mg Ni/m³

Other animal data	It has been reported that pulmonary inflammation, degeneration of the bronchiolar mucosa, and atrophy of the olfactory epithelium resulted in rats and mice exposed to nickel sulfate hexahydrate at concentrations ranging from 0.7 to 13.5 mg Ni/m³ for 6 hours/day for 12 days [Benson et al. 1988].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg Ni/m^3
Basis for revised IDLH: The revised IDLH for nickel compounds is 10 mg Ni/m^3 based on acute inhalation toxicity data in animals [NDRC 1943]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for nickel compounds at concentrations above 0.015 mg Ni/m^3.]

REFERENCES:

1. Benson JM, Burt DG, Carpenter RL, et al. [1988]. Comparative inhalation toxicity of nickel sulfate to F344/N rats and B6C3F1 mice exposed for twelve days. Fundam Appl Toxicol *10*:164-178.
2. FDRL [1983]. Acute oral LD_{50} study in rats (OECD). Waverly, NY: Food and Drug Research Laboratories, Inc., FDRL Study No. 7684D.
3. FDRL [1984]. Acute oral LD_{50} study of ammonium nickel sulfate technical grade in Sprague-Dawley rats. Waverly, NY: Food and Drug Research Laboratories, Inc., FDRL Study No. 8005A.
4. Gekkan Yakuji (Pharmaceuticals Monthly) [1980]; *22*:455 (in Japanese).
5. Haro RT, Furst A, Falk HL [1968]. Studies on the acute toxicity of nickelocene. In: Proc W Pharmacol Soc *11*:39-42.
6. Itskova AI, Elakhovskaya NP, Kolbasova OV, Lychnikova TD [1969]. The toxicity of soluble nickel compounds taken by mouth. Farmakol Toxsikol *32*:102-105 (translated).
7. NDRC [1943]. Informal monthly progress report on toxicity of chemical warfare agents. National Defense Research Committee, Office of Scientific Research and Development, Division 9, Progress Report No. 9-4-1-19.
8. NRC [1953]. Relationship between chemical structure and toxic action on rats. National Academy of Sciences, National Research Council, Chemical-Biological Coordination Center, Review *5*:28.

Nicotine

CAS number	54-11-5
NIOSH REL	0.5 mg/m³ TWA [skin]
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA [skin]
Description of substance	Pale-yellow to dark-brown liquid with a fish-like odor when warm.
LEL	0.7% (10% LEL, 4,700 mg/m³)
Original (SCP) IDLH	35 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for nicotine. The chosen IDLH, therefore, has been estimated from the human oral lethal dose of 60 mg [Lehman 1938 cited by Patty 1963 and ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Franke and Thomas 1932	oral	9.2	-----	64 mg/m³	6.4 mg/m³
Mouse	Lazutka et al. 1969	oral	3.34	-----	23 mg/m³	2.3 mg/m³
Rat	Sine 1993	oral	50	-----	350 mg/m³	35 mg/m³

Human data .... The fatal human dose has been estimated to be about 50 to 60 mg [Lazutka et al. 1969]. [Note: An oral dose of 50 to 60 mg/kg is equivalent to a 70-kg worker being exposed to about 30 to 40 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 5 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for nicotine. Therefore, the revised IDLH for nicotine is 5 mg/m³ based on acute oral toxicity data in humans [Lazutka et al. 1969] and animals [Franke and Thomas 1932; Lazutka et al. 1969].

REFERENCES:

1. ACGIH [1971]. Nicotine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 181.
2. Franke FE, Thomas JE [1932]. A note on the minimal fatal dose of nicotine for unanesthetized dogs. Proc Soc Exp Biol Med *29*:1177-1179.
3. Lazutka FA, Vasilyauskene AD, Gefen SG [1969]. Toxicological evaluation of the insecticide nicotine sulfate. Gig Sanit *34*(5):30-33 (translated).
4. Lehman AJ [1938]. Pharmacological considerations of insecticides. Q Bulletin Assoc Food Drug Off U.S. *13*(2):65-70.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2196.
6. Sine C, ed. [1993]. Nicotine. In: Farm chemicals handbook '93, p. C245.

Nitric acid

CAS number 7697-37-2
NIOSH REL . . . . 2 ppm (5 mg/m^3) TWA, 4 ppm (10 mg/m^3) STEL
Current OSHA PEL . . . . 2 ppm (5 mg/m^3) TWA
1989 OSHA PEL . . . . 2 ppm (5 mg/m^3) TWA, 4 ppm (10 mg/m^3) STEL
1993-1994 ACGIH TLV . . . . 2 ppm (5.2 mg/m^3) TWA, 4 ppm (10 mg/m^3) STEL
Description of substance . . . . Colorless, yellow, or red, fuming liquid with an acrid, suffocating odor.
LEL . . . . Noncombustible Liquid
Original (SCP) IDLH . . . . 100 ppm
Basis for original (SCP) IDLH . . . . The chosen IDLH is based on the statement by MCA [1961] that pulmonary edema may result from an exposure of 100 to 150 ppm for only 0.5 to 1 hour. It is not clear if MCA [1961] was referring to nitric acid specifically, or to nitrogen oxides. The chosen IDLH seems reasonable, however, because an IDLH of 100 ppm was also selected for hydrogen chloride.
Short-term exposure guidelines . . . . None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Gray et al. 1954	138	-----	30 min	138 ppm (1.0)	14 ppm

Other animal data . . . . Rats receiving a single exposure to 63 mg/m^3 nitric acid (24 ppm) exhibited no apparent adverse effects [Diggle and Gage 1954].
Human data . . . . A maximum allowable workplace concentration of 10 ppm has been proposed [Fairhall 1957]. It has been reported that 430 mg/kg is the lethal oral dose [Gekkan Yakuji 1980]. [Note: An oral dose of 430 mg/kg is equivalent to a worker being exposed to about 2,300 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 25 ppm
Basis for revised IDLH: The revised IDLH for nitric acid is 25 ppm based on acute toxicity data in humans [Gekkan 1980] and animals [Diggle and Gage 1954]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. Diggle WM, Gage JC [1954]. The toxicity of nitrogen pentoxide. Br J Ind Med *11*:140-144.
2. Fairhall LT [1957]. Industrial toxicology. 2nd ed. Baltimore, MD: Williams & Wilkins Company, pp. 83-84.
3. Gekkan Yakuji (Phamaceuticals Monthly) [1980]; 22(4):651-656 (in Japanese).
4. Gray EL, Patton FM, Goldberg SB, Kaplan E [1954]. Toxicity of oxides of nitrogen. II. Acute inhalation toxicity of nitrogen dioxide, red fuming nitric acid, and white fuming nitric acid. AMA Arch Ind Hyg Occup Med *10*:418-422.
5. MCA [1961]. Chemical safety data sheet SD-5: properties and essential information for safe handling and use of nitric acid. Washington, DC: Manufacturing Chemists Association, pp. 1-17.

Nitric oxide

CAS number 10102-43-9
NIOSH REL .... 25 ppm (30 mg/m^3) TWA
Current OSHA PEL .... 25 ppm (30 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 25 ppm (31 mg/m^3) TWA
Description of substance .... Colorless gas.
LEL .... Nonflammable Gas
Original (SCP) IDLH .... 100 ppm
Basis for original (SCP) IDLH .... No useful data on acute inhalation toxicity are available on which to base the IDLH for nitric oxide. The chosen IDLH, therefore, is based on the statement by Sax [1975] that 100 to 150 ppm oxides of nitrogen are dangerous for short exposures of 30 to 60 minutes. The chosen IDLH seems reasonable because NIOSH [1976] cited a rabbit 15-minute LC_{50} of 315 ppm for nitric oxide [Carson et al. 1962].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Carson et al. 1962	315	-----	15 min	249 ppm (0.79)	25 ppm
Mouse	Flury and Zernik 1931	-----	2,500	12 min	1,850 ppm (0.74)	185 ppm
Rat	Ivanov and Szubaev 1979	854	-----	4 hr	1,709 ppm (2.0)	171 ppm
Mouse	Pflesser 1935	320	-----	?	?	?

Other animal data .... Guinea pigs have survived an exposure at 175 ppm for an unstated period [Bodansky 1951].
Human data .... It has been stated that exposures to oxides of nitrogen between 100 and 150 ppm are dangerous for exposures of 30 to 60 minutes [Sax 1975].

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Sax 1975], the original IDLH for nitric oxide (100 ppm) is not being revised at this time.

REFERENCES:

1. Bodansky O [1951]. Methemoglobinemia and methemoglobin-producing compounds. Pharmacol Rev *3*:144-195.
2. Carson TR, Rosenholtz MS, Wilinski FT, Weeks MH [1962]. The responses of animals inhaling nitrogen dioxide for single, short-term exposures. Am Ind Hyg Assoc J *23*:457-462.
3. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, pp. 157-165 (in German).
4. Ivanov NG, Szubaev EN [1979]. About the limitation of the content of nitrogen dioxide in the air of the working zone. Toksikol Nov Prom Khim Vesh *15*:53-58 (in Russian).
5. NIOSH [1976]. QX05250. Nitrogen monoxide. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 780.
6. Pflesser G [1935]. The significance of nitric oxide in poisoning by nitrous gases. Arch Exp Pathol Pharmakol *179*:545-557 (in German).
7. Sax NI [1975]. Nitric oxide. In: Dangerous properties of industrial materials. 4th ed. New York, NY: Van Nostrand Reinhold Company, pp. 961-962.

p-Nitroaniline

CAS number	100-01-6
NIOSH REL	3 mg/m³ TWA [skin]
Current OSHA PEL	6 mg/m³ (1 ppm) TWA [skin]
1989 OSHA PEL	3 mg/m³ TWA [skin]
1993-1994 ACGIH TLV	3 mg/m³ TWA [skin]
Description of substance	Bright yellow, crystalline powder with a slight ammonia-like odor.
LEL	Unknown
Original (SCP) IDLH	300 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH (300 mg/m³ or 50 ppm) is based on an analogy with aniline and the statement by AIHA [1955] that 50 to 100 ppm aniline can probably be tolerated for 1 hour. Although the IDLH chosen for aniline was 100 ppm, the IDLH of 50 ppm (300 mg/m³) chosen for p-nitroaniline is reasonable because Von Oettingen [1941] stated that p-nitroaniline is more toxic than aniline.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Back et al. 1972	oral	3,249	-----	22,743 mg/m³	2,274 mg/m³
Rat	Matrka et al. 1978	oral	750	-----	5,250 mg/m³	525 mg/m³
G. pig	Moskalenko 1966	oral	450	-----	3,150 mg/m³	315 mg/m³
Mouse	Vernot et al. 1977	oral	810	-----	5,670 mg/m³	567 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 300 mg/m³ [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for p-nitroaniline. Therefore, based on acute oral toxicity data in animals [Matrka et al. 1978; Moskalenko 1966; Vernot et al. 1977], the original IDLH for p-nitroaniline (300 mg/m³) is not being revised at this time.

REFERENCES:

1. AIHA [1955]. Aniline. In: Hygienic guide series. Am Ind Hyg Assoc Q *16*:331-332.
2. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-298 to A-299.
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4. Moskalenko EG [1966]. Toxicological characteristics of nitroanilines. Vop Komm Gig *6*:89-94 (in Russian).
5. Vernot EH, MacEwen JD, Haun CC, Kinkead FR [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol *42*:417-423.
6. von Oettingen WF [1941]. The aromatic amino and nitro compounds, their toxicity and potential dangers. Public Health Bulletin *271*:34.

Nitrobenzene

CAS number	98-95-3
NIOSH REL	1 ppm (5 mg/m^3) TWA [skin]
Current OSHA PEL	1 ppm (5 mg/m^3) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 ppm (5 mg/m^3) TWA [skin]
Description of substance	Yellow, oily liquid with a pungent odor like paste shoe polish.
LEL(@200°F)	1.8% (10% LEL(@200°), 1,800 ppm)
Original (SCP) IDLH	200 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] and AIHA [1959] that Henderson and Haggard [1943] reported that 200 ppm is the maximum concentration that can be inhaled for 1 hour without serious disturbance.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Flury and Zernik 1935	oral	-----	750	1,025 ppm	103 ppm
Rat	Kashkalda and Kolodub 1988	oral	780	-----	1,066 ppm	107 ppm
Rat	Smyth et al. 1969	oral	600	-----	820 ppm	82 ppm
Mouse	Vasilenko and Zvezdai 1981	oral	590	-----	807 ppm	81 ppm

Human data .... It has been reported that 200 ppm is the maximum concentration that can be inhaled for 1 hour without serious disturbance [Henderson and Haggard 1943].

Revised IDLH: 200 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Henderson and Haggard 1943], the original IDLH for nitrobenzene (200 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Nitrobenzene. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 183.
2. AIHA [1959]. Nitrobenzene. In: Hygienic guide series. Am Ind Hyg Assoc J *20*:66-67.
3. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod *4*:1289-1422 (in German).
4. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 228.
5. Kashkalda DA, Kolodub FA [1988]. Effect of para-nitrobenzol and 2,4-dinitrochlorobenzol on condition of hydrocarbon-energetic exchange in rats. Gig Tr Prof Zabol *32*(2):48-49 (in Russian).
6. Smyth HF Jr, Weil CS, West JS, Carpenter CP [1969]. An exploration of joint toxic action: twenty-seven industrial chemicals intubated in rats in all possible pairs. Toxicol Appl Pharmacol *14*:340-347.
7. Vasilenko NM, Zvezdai VI [1981]. Mathematical prognosing of toxicity data for nitro and amino compounds having a benzene ring. Gig Tr Prof Zabol *25*(6):50-52 (in Russian).

p-Nitrochlorobenzene

CAS number	100-00-5
NIOSH REL	None established; NIOSH considers p-nitrochlorobenzene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990] that may be absorbed through the skin.
Current OSHA PEL	1 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.64 mg/m^3 (0.1 ppm) TWA [skin]
Description of substance	Yellow, crystalline solid with a sweet odor.
LEL	Unknown
Original (SCP) IDLH	1,000 mg/m^3
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for p-nitrochlorobenzene. The chosen IDLH, therefore, is based on an analogy with nitrobenzene, which has an IDLH of 200 ppm. [Note: A concentration of 200 ppm nitrobenzene is equivalent to about 1,000 mg/m^3 p-nitrochlorobenzene.]
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Watrous and Schultz 1950	164 mg/m^3	-----	7 hr	393 mg/m^3 (2.4)	39 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Back et al. 1972	oral	812	-----	5,684 mg/m^3	568 mg/m^3
Mouse	Back et al. 1972	oral	1,414	-----	9,898 mg/m^3	990 mg/m^3
Mouse	Izmerov et al. 1982	oral	440	-----	3,080 mg/m^3	308 mg/m^3
Rat	Sziza and Magos 1959	oral	420	-----	2,940 mg/m^3	294 mg/m^3

Other animal data	Exposures of cats and guinea pigs to 87 mg/m^3 for 8 hours/day for 6 weeks resulted in methemoglobinemia and slight anemia [Watrous and Schultz 1950].
Human data	Workers exposed intermittently for 0.5 to 1 hour over many months to concentrations ranging from 7 to 400 mg/m^3 (average of 90 mg/m^3) had only vague complaints of tiredness, loss of appetite, headache, and afternoon fatigue [Watrous and Schultz 1950]. Because of the strong and disagreeable odor, these workers voluntarily wore respiratory protection when exposed to the higher concentrations [Watrous and Schultz 1950].

Revised IDLH: 100 mg/m^3

Basis for revised IDLH: The revised IDLH for p-nitrochlorobenzene is 100 mg/m^3 based on subchronic inhalation toxicity data in workers [Watrous and Schultz 1950] and animals [Watrous and Schultz 1950]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 mg/m^3. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for p-nitrochlorobenzene at any detectable concentration.]

p-Nitrochlorobenzene (continued)

REFERENCES:

1. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-270 to A-271.
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 92.
3. Sziza M, Magos l [1959]. Toxikologische untersuchung einiger in der ungarischen industrie zur anwendung gelangenden aromatischen nitroverbindungen. Arch Gewerbepath Gewerbehyg *17*:217-226 (in German).
4. Watrous RM, Schultz HN [1950]. Cyclohexylamine, p-chloronitrobenzene, 2-aminopyridine: toxic effects in industrial use. Ind Med Surg *19*:317-320.

Nitroethane

CAS number	79-24-3
NIOSH REL	100 ppm (310 mg/m³) TWA
Current OSHA PEL	100 ppm (310 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (307 mg/m³) TWA
Description of substance	Colorless, oily liquid with a mild, fruity odor.
LEL	3.4% (10% LEL, 3,400 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Patty [1963] that exposure to 5,000 ppm for 2 hours was lethal to 1 of 2 rabbits and to 0 of 2 guinea pigs; exposure to the same concentration for 3 hours was fatal to 2 of 2 rabbits and to 0 of 2 guinea pigs [Machle et al. 1940].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	IMCC 1979	LC_{100}: 13,000	-----	6 hr	29,900 ppm (2.3)	2,990 ppm
Mouse	Izmerov et al. 1982	-----	6,250	2 hr	10,000 ppm (1.6)	1,000 ppm
Rabbit	Machle et al. 1940	5,000	-----	2 hr	8,000 ppm (1.6)	800 ppm
Rabbit	Machle et al. 1940	LC_{100}: 5,000	-----	3 hr	9,000 ppm (1.8)	900 ppm

Other animal data	Guinea pigs survived both a 2-hour and a 3-hour exposure to 5,000 ppm [Machle et al. 1940]. Rats exposed to 2,200 ppm for 6 hours had no noticeable difficulty [IMCC 1979].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,000 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Izmerov et al. 1982; Machle et al. 1940], the original IDLH for nitroethane (1,000 ppm) is not being revised at this time.

REFERENCES:

1. IMCC [1979]. Technical data sheet no. 21: nitromethane. Des Plaines, IL: International Minerals and Chemical Corporation, Inc., NP Division.
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 93.
3. Machle W, Scott EW, Treon J [1940]. The physiological response of animals to some simple mononitroparaffins and to certain derivatives of these compounds. J Ind Hyg Toxicol 22(8):315-332.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2077.

Nitrogen dioxide

CAS number 10102-44-0
NIOSH REL .... 1 ppm (1.8 mg/m³) STEL
Current OSHA PEL .... 5 ppm (9 mg/m³) CEILING
1989 OSHA PEL .... 1 ppm (1.8 mg/m³) STEL
1993-1994 ACGIH TLV .... 3 ppm (5.6 mg/m³) TWA, 5 ppm (9.4 mg/m³) STEL
Description of substance .... Yellowish-brown liquid or reddish-brown gas (above 70°F) with a pungent, acrid odor.
LEL .... Noncombustible Liquid/Nonflammable Gas
Original (SCP) IDLH .... 50 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that concentrations above 50 ppm are considered dangerous to man for short exposures. Also, NIOSH [1974] cited a rat 4-hour LC_{50} of 68 ppm [Gray et al. 1954].
Existing short-term exposure guidelines .... American Industrial Hygiene Association [AIHA 1964] Emergency Exposure Limits (EELs):

5-minute EEL: 35 ppm
15-minute EEL: 25 ppm
30-minute EEL: 20 ppm
60-minute EEL: 10 ppm

National Research Council [NRC 1985] Short-term Public Emergency Guidance Levels (SPEGLs):

1-hour SPEGL: 1 ppm
2-hour SPEGL: 0.5 ppm
4-hour SPEGL: 0.25 ppm
8-hour SPEGL: 0.12 ppm
16-hour SPEGL: 0.06 ppm
24-hour SPEGL: 0.04 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
G. pig	Buckley and Balchum 1965	30	-----	1 hr	37 ppm (1.22)	3.7 ppm
Rabbit	Carson et al. 1962	315	-----	15 min	258 ppm (0.82)	26 ppm
Rat	Gray et al. 1954	68	-----	4 hr	123 ppm (1.81)	12 ppm
Rat	Gray et al. 1954	138	-----	30 min	138 ppm (1.0)	14 ppm
Mouse	Hialado and Machado 1977	1,000	-----	10 min	730 ppm (0.73)	73 ppm
Dog	Steadman et al. 1966	-----	64	8 hr	141 ppm (2.21)	14 ppm
Monkey	Steadman et al. 1966	-----	64	8 hr	141 ppm (2.21)	14 ppm

*Note: Conversion factor (CF) was determined with "n" = 3.5 [ten Berge et al. 1986].

Human data .... It has been reported that 10 to 20 ppm has been mildly irritating [Patty 1963]. Exposure to 150 ppm or more (no time period given) has been reported to cause death from pulmonary edema [NRC 1979]. It has been predicted that 50% lethality would occur following exposure to 174 ppm for 1 hour [Book 1982].

Revised IDLH: 20 ppm
Basis for revised IDLH: The revised IDLH for nitrogen dioxide is 20 ppm based on acute inhalation toxicity data in humans [Patty 1963]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 20 ppm.

REFERENCES:

1. American Industrial Hygiene Association, Toxicology Committee [1964]. Emergency exposure limits. Am Ind Hyg Assoc J *25*:578-586.
2. Book SA [1982]. Scaling toxicity from laboratory animals to people: an example with nitrogen dioxide. J Toxicol Environ Health *9*:719-725.
3. Buckley RD, Balchum OJ [1965]. Acute and chronic exposures to nitrogen dioxide. Effects on oxygen consumption and enzyme activity on guinea pig tissues. Arch Environ Health *10*:220-223.
4. Carson TR, Rosenholtz MS, Wilinski FT, Weeks MH [1962]. The responses of animals inhaling nitrogen dioxide for single, short-term exposures. Am Ind Hyg Assoc J *23*:457-462.
5. Gray E LeB, Patton FM, Goldberg SB, Kaplan E [1954]. Toxicity of the oxides of nitrogen. II. Acute inhalation toxicity of nitrogen dioxide, red fuming nitric acid, and white fuming nitric acid. AMA Arch Ind Hyg Occup Med *10*:418-422.
6. Hielado CJ, Machado AM [1977]. Effect of nitrogen dioxide on Swiss albino mice. J Combustion Toxicol *4*:246-253.
7. NIOSH [1974]. QW98000. Nitrogen dioxide. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 534.
8. NRC [1979]. Nitrogen dioxide: an assessment of the health effects of short-term exposure. Washington, DC: National Academy of Sciences, National Research Council, Committee on Toxicology.
9. NRC [1985]. Emergency and continuous exposure guidance levels for selected airborne contaminants. Vol. 4. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 83-95.
10. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 919-923.
11. Steadman BL, Jones RA, Rector DE, Siegel J [1966]. Effects on experimental animals of long-term continuous inhalation of nitrogen dioxide. Toxicol Appl Pharmacol *9*(1):160-170.
12. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Nitrogen trifluoride

CAS number	7783-54-2
NIOSH REL	10 ppm (29 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
Current OSHA PEL	10 ppm (29 mg/m^3) TWA
1993-1994 ACGIH TLV	10 ppm (29 mg/m^3) TWA
Description of substance	Colorless gas with a moldy odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 4-hour LC_{50} of 2,000 ppm cited by Deichmann and Gerarde [1969]. Deichmann and Gerarde [1969] also stated that nitrogen trifluoride is a pulmonary irritant comparable in toxicity to the oxides of nitrogen.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Deichmann and Gerarde 1969	2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Dog	MacEwen and Vernot 1969	9,600	-----	1 hr	12,000 ppm (1.25)	1,200 ppm
Monkey	MacEwen and Vernot 1969	7,500	-----	1 hr	9,375 ppm (1.25)	938 ppm
Rat	Vernot et al. 1973	6,700	-----	1 hr	8,375 ppm (1.25)	838 ppm
Mouse	Vernot et al. 1973	7,500	-----	1 hr	9,375 ppm (1.25)	938 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for nitrogen trifluoride is 1,000 ppm based on acute inhalation toxicity data in animals [MacEwen and Vernot 1969; Vernot et al. 1973].

REFERENCES:

1. Deichmann WB, Gerarde HW [1969]. Nitrogen trifluoride. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 427.
2. MacEwen JD, Vernot EH [1969]. Toxic Hazards Research Unit annual technical report: 1969. Wright-Patterson Air Force Base, OH: Aerospace Medical Research Laboratory, Report AMRL-TR-69-84, pp. 1-49.
3. Vernot EH, Haun CC, MacEwen JD, Egan GF [1973]. Acute inhalation toxicology and proposed emergency exposure limits of nitrogen trifluoride. Toxicol Appl Pharmacol 26:1-13.

Nitroglycerine

CAS number	55-63-0
NIOSH REL	0.1 mg/m^3 STEL [skin]
Current OSHA PEL	2 mg/m^3 (0.2 ppm) CEILING [skin]
1989 OSHA PEL	0.1 mg/m^3 STEL [skin]
1993-1994 ACGIH TLV	0.46 mg/m^3 (0.05 ppm) TWA [skin]
Description of substance	Colorless to pale-yellow, viscous liquid or solid (below 56°F).
LEL	Unknown
Original (SCP) IDLH*	500 mg/m^3 [*Note: "Effective" IDLH = 200 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for ethylene glycol dinitrate (EGDN) and/or nitroglycerin. The chosen IDLH, therefore, is based on chronic toxicity data concerning the physiological response of animals to EGDN. According to Patty [1963], rats and guinea pigs survived 6 months of exposure to 500 mg/m^3 (80 ppm) EGDN with the only effect being slight drowsiness and some Heinz body formation [Stein 1956]. Although Patty [1963] stated that EGDN is more toxic for cats and rabbits, the chosen IDLH is still probably conservative because cats given 2-hour daily exposures to 21 ppm EGDN for 1,000 days exhibited only marked blood changes [von Oettingen 1946]. However, because of the assigned protection factor afforded by each device, 2,000 × the OSHA PEL of 0.1 mg/m^3 (i.e., 200 mg/m^3) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Horioka et al. 1982	oral	1,607	-----	11,249 mg/m^3	1,125 mg/m^3
Rat	Pharmacol Ther 1985	oral	105	-----	735 mg/m^3	74 mg/m^3
Mouse	Pharmacol Ther 1985	oral	115	-----	805 mg/m^3	81 mg/m^3

Human data: Headaches have developed in workers exposed to 0.4 to 0.67 mg/m^3 for 25 minutes; all had decreases in blood pressure [Trainor and Jones 1966]. Ethylene glycol dinitrate and nitroglycerine are vasodilators and initial exposures result in headache, dizziness, nausea, or decreases in blood pressure; however, workers become tolerant of the vasodilatory activity after 2 to 4 days of exposure [NIOSH 1978]. It has been estimated that the lethal oral dose in humans is 200 mg although others have survived doses of 1,200 mg with no apparent ill effects [Rabinowitch 1944]. [Note: An oral dose of 200 mg is equivalent to a worker being exposed to about 150 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 75 mg/m^3
Basis for revised IDLH: The revised IDLH for nitroglycerine is 75 mg/m^3 based on acute oral toxicity data in humans [NIOSH 1978] and animals [Pharmacol 1985].

Nitroglycerine (continued)

REFERENCES:

1. Horioka M, Saito T, Takagi K, Takasugi M, eds. [1982]. Drugs in Japan (Ethical Drugs). p. 786.
2. NIOSH [1978]. Criteria for a recommended standard: occupational exposure to nitroglycerine and ethylene glycol dinitrate. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78-167.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2094.
4. Pharmacol Ther [1985]; *13*(7):3649-3673 (in Japanese).
5. Rabinowitch IM [1944]. Acute nitroglycerine poisoning. Can Med Assoc J *50*:199-202.
6. Stein W [1956]. Mechanism of action of chronic inhalation of nitroglycol (translated). Arch Gewerbepath Gewerbehyg *15*:23-26 (translated).
7. Trainor DC, Jones RC [1966]. Headaches in explosive magazine workers. Arch Environ Health *12*:231-234.
8. von Oettingen WF [1946]. The effects of aliphatic nitrous and nitric acid esters on the physiological functions with special reference to their chemical constitution. NIH Bulletin *186*:29.

Nitromethane

CAS number	75-52-5
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	100 ppm (250 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (250 mg/m^3) TWA
Description of substance	Colorless, oily liquid with a disagreeable odor.
LEL	7.3% (10% LEL, 7,300 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Browning [1965] that with concentrations above 1,000 ppm, if the product of this and the time of exposure was greater than 1 (e.g., 1,000 ppm for 3 hours) some of the animals, including 1 monkey, died. Also, AIHA [1961] reported severe eye irritation at 500 ppm [Machle et al. 1940]. [Note: The statement by Browning [1965] regarding the product of the concentration and the time of exposure is apparently in error; the value "greater than 1" should probably be "greater than 1,000".]
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	-----	7,087	2 hr	11,339 ppm (1.6)	1,134 ppm
Monkey	Skinner 1947	-----	1,000	?	?	?
Rabbit	Weatherby 1955	-----	2,500	12 hr	7,250 ppm (2.9)	725 ppm
Rabbit	Weatherby 1955	-----	5,000	6 hr	11,500 ppm (2.3)	1,150 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Machle et al. 1940	oral	-----	750	2,067 ppm	207 ppm
Rat	Subbotin 1967	oral	940	-----	2,590 ppm	259 ppm
Mouse	Subbotin 1967	oral	950	-----	2,618 ppm	262 ppm
Dog	Weatherby 1955	oral	-----	125	344 ppm	34 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 750 ppm
Basis for revised IDLH: The revised IDLH for nitromethane is 750 ppm based on acute inhalation toxicity data in animals [Weathery 1955].

REFERENCES:

1. AIHA [1961]. Nitromethane. In: Hygienic guide series. Am Ind Hyg Assoc J *22*:518-520.
2. Browning E [1965]. Toxicity and metabolism of industrial solvents. New York, NY: Elsevier Publishing Company, p. 282.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 93.
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5. Skinner JB [1947]. The toxicity of 2-nitropropane. Ind Med *16*:441-443.
6. Subbotin VG [1967]. Hygienic assessment of nitromethane and ether nitroparaffins in connection with sanitary protection of water bodies. Gig Sanit *32*(9):9-13 (in Russian).
7. Weatherby JH [1955]. Observations on the toxicity of nitromethane. AMA Arch Ind Health *11*:102-106.

1-Nitropropane

CAS number	108-03-2
NIOSH REL	25 ppm (90 mg/m³) TWA
Current OSHA PEL	25 ppm (90 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	25 ppm (91 mg/m³) TWA
Description of substance	Colorless liquid with a somewhat disagreeable odor.
LEL	2.2% (10% LEL, 2,200 ppm)
Original (SCP) IDLH	2,300 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with 2-nitropropane which has an IDLH of 2,300 ppm. The animal data for 1-nitropropane given in Patty [1963] (i.e., 5,000 ppm for 3 hours killed 2 of 2 rabbits and 2 of 2 guinea pigs; 10,000 ppm for 1 hour killed 0 of 2 rabbits and 2 of 2 guinea pigs [Machle et al. 1940]) have not been used to determine the IDLH for 1-nitropropane because cats, which were far more susceptible to 2-nitropropane than guinea pigs or rabbits, were not used to study the effects of 1-nitropropane.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Marhold 1986	LC_{100}: 5,000	-----	3 hr	9,000 ppm (1.8)	900 ppm
Rabbit	Machle et al. 1940	LC_{100}: 5,000	-----	3 hr	9,000 ppm (1.8)	900 ppm
G. pig	Machle et al. 1940	LC_{100}: 5,000	-----	3 hr	9,000 ppm (1.8)	900 ppm
G. pig	Machle et al. 1940	LC_{100}: 10,000	-----	1 hr	12,500 ppm (1.25)	1,250 ppm
Rat	NPIRI 1974	3,100	-----	8 hr	7,750 ppm (2.5)	775 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Gig Sanit 1967	oral	800	-----	1,514 ppm	151 ppm
Rabbit	Machle 1940	oral	-----	250	473 ppm	47 ppm
Rat	NPIRI 1974	oral	455	-----	861 ppm	86 ppm

Other animal data	It has been reported that rabbits survived a 1-hour exposure to 10,000 ppm [Machle et al. 1940].
Human data	Volunteers found brief exposures to concentrations exceeding 100 ppm to cause eye irritation [Silverman et al. 1946].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for 1-nitropropane is 1,000 ppm based on acute inhalation toxicity data in animals [Machle et al. 1940; Marhold 1986; NPIRI 1974]. This may be a conservative value due to the lack of relevant acute toxicity data in workers exposed to concentrations above 100 ppm.

REFERENCES:

1. Gig Sanit [1967]; *32*(9):9 (in Russian).
2. Machle W, Scott EW, Treon J [1940]. The physiological response of animals to some simple mononitroparaffins and to certain derivatives of these compounds. J Ind Hyg Toxicol 22(8):315-332.
3. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 404 (in Czechoslovakian).

1-Nitropropane (continued)

4. NPIRI [1974]. Raw materials data handbook, physical and chemical properties, fire hazard and health hazard data. Vol. 1. Organic solvents. Bethlehem, PA: National Printing Ink Research Institute, p. 91.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2077-2078.
6. Silverman L, Schulte HF, First MW [1946]. Further studies on sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol 28:262-266.

2-Nitropropane

CAS number	79-46-9
NIOSH REL	None established; NIOSH considers 2-nitropropane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	25 ppm (90 mg/m³) TWA
1989 OSHA PEL	10 ppm (35 mg/m³) TWA
1993-1994 ACGIH TLV	10 ppm (36 mg/m³) TWA, A2
Description of substance	Colorless liquid with a pleasant, fruity odor.
LEL	2.6% (10% LEL, 2,600 ppm)
Original (SCP) IDLH	2,300 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that the lowest lethal concentration for the cat for a 1-hour exposure was found to be 2,353 ppm; the response of different species to 2-nitropropane varies considerably, but the cat was the most sensitive species in this investigation [Treon and Dutra 1952].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	2,703	-----	2 hr	4,324 ppm (1.6)	432 ppm
Rat	Lewis et al. 1979	400	-----	6 hr	920 ppm (2.3)	92 ppm
Cat	Treon and Dutra 1952	-----	714	5 hr	1,535 ppm (2.15)	154 ppm
Rabbit	Treon and Dutra 1952	-----	2,381	5 hr	5,119 ppm (2.15)	512 ppm
G. pig	Treon and Dutra 1952	-----	4,622	5 hr	9,937 ppm (2.15)	994 ppm
Cat	Treon and Dutra 1952	-----	2,353	1 hr	2,941 ppm (1.25)	294 ppm

Human data .... Nausea, vomiting, diarrhea, anorexia, and severe headache have been reported in workers exposed to daily concentrations of 20 to 45 ppm [Skinner 1947].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 2-nitropropane is 100 ppm based on acute inhalation toxicity data in animals [Lewis et al. 1979]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 45 ppm. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 2-nitropropane at any detectable concentration.]

REFERENCES:

1. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 94.
2. Lewis TR, Ulrich CE, Busey WM [1979]. Subchronic inhalation toxicity of nitromethane and 2-nitropropane in rats. J Environ Pathol Toxicol 2(5):233-249.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2077-2078.
4. Skinner JB [1947]. The toxicity of 2-nitropropane. Ind Med *16*(9):441-443.
5. Treon JF, Dutra FR [1952]. Physiological response of experimental animals to the vapor of 2-nitropropane. AMA Arch Ind Hyg Occup Med 5:52-61.

Nitrotoluene (o-, m-, p-isomers)

CAS numbers	88-72-2 (o-isomer), 99-08-1 (m-isomer), 99-99-0 (p-isomer)
NIOSH REL	2 ppm (11 mg/m³) TWA [skin]
Current OSHA PEL	5 ppm (30 mg/m³) TWA [skin]
1989 OSHA PEL	2 ppm (11 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	2 ppm (11 mg/m³) TWA [skin]
Description of substance	Yellow liquids (o-, m-isomers) or a crystalline solid (p-isomer) with weak, aromatic odors.
LEL(o-isomer)	2.2% (10% LEL, 2,200 ppm)
Original (SCP) IDLH	200 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with nitrobenzene which has an IDLH of 200 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
o-isomer						
Rat	Vasilerko et al. 1978	oral	891	-----	1,094 ppm	109 ppm
Mouse	Vasilerko et al. 1978	oral	970	-----	1,191 ppm	119 ppm
Rabbit	Vasilerko et al. 1978	oral	1,750	-----	2,149 ppm	215 ppm
p-isomer						
Mouse	Back et al. 1972	oral	1,231	-----	1,512 ppm	151 ppm
Rat	Vasilerko et al. 1978	oral	1,960	-----	2,407 ppm	241 ppm
Rabbit	Vasilerko et al. 1978	oral	1,750	-----	2,149 ppm	215 ppm

Human data .... It has been stated that nitrotoluene is only slightly toxic, especially in comparison with nitrobenzene [Linch 1974].

Revised IDLH: 200 ppm [Unchanged]
Basis for revised IDLH: Based on acute oral toxicity data in animals [Back et al. 1972; Vasilerko et al. 1978] and an analogy to nitrobenzene [Linch 1974] which has an IDLH of 200 ppm, the original IDLH for nitrotoluene (200 ppm) is not being revised at this time.

REFERENCES:

1. Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A-310 to A-311.
2. Linch AL [1974]. Biological monitoring for industrial exposure to cyanogenic aromatic nitro and amino compounds. Am Ind Hyg Assoc J 35:426-432.
3. Vasilerko NM, Kovalenko EE, Batuzina TS [1978]. Experimental substantiation of hygienic concentrations of isomers of mononitrotoluenes in the air of the working zone. Gig Tr Prof Zabol 22(7):52 (in Russian).

Octachloronaphthalene

CAS number	2234-13-1
NIOSH REL	0.1 mg/m³ TWA, 0.3 mg/m³ STEL [skin]
Current OSHA PEL	0.1 mg/m³ TWA [skin]
1989 OSHA PEL	0.1 mg/m³ TWA, 0.3 mg/m³ STEL [skin]
1993-1994 ACGIH TLV	0.1 mg/m³ TWA, 0.3 mg/m³ STEL [skin]
Description of substance	Waxy, pale-yellow solid with an aromatic odor.
LEL	Noncombustible Solid
Original (SCP) IDLH*	Unknown [*Note: Effective IDLH = 1 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	AIHA [1966] reported that the atmospheric concentration immediately hazardous to life is probably unattainable for the chloronaphthalenes with the possible exception of monochloronaphthalene. For this draft technical standard, however, an analogy with other chloronaphthalenes was used, and the respirators were selected on the basis of the assigned protection factor afforded by each device up to 10 × the OSHA PEL of 0.1 mg/m³ (i.e., 1 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 1 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: Unknown [Unchanged]
Basis for revised IDLH: Due to a lack of relevant acute toxicity data, the IDLH for octachloronaphthalene remains "Unknown." The "most protective" respirators will continue to be recommended for concentrations exceeding 1 mg/m³ based on being 10 times the NIOSH REL and OSHA PEL of 0.1 mg/m³ (10 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for octachloronaphthalene).

REFERENCE:

1. AIHA [1966]. Chloronaphthalenes. In: Hygienic guide series. Am Ind Hyg Assoc J 27:89-91.

Octane

CAS number 111-65-9
NIOSH REL .... 75 ppm (350 mg/m³) TWA, 385 ppm (1,800 mg/m³) 15-minute CEILING
Current OSHA PEL .... 500 ppm (2,350 mg/m³) TWA
1989 OSHA PEL .... 300 ppm (1,450 mg/m³) TWA, 375 ppm (1,800 mg/m³) STEL
1993-1994 ACGIH TLV .... 300 ppm (1,400 mg/m³) TWA, 375 ppm (1,750 mg/m³) STEL
Description of substance .... Colorless liquid with a gasoline-like odor.
LEL .... 1.0% (10% LEL, 1,000 ppm)
Original (SCP) IDLH .... 5,000 ppm
Basis for original (SCP) IDLH .... Because no human exposure data are available for octane, the chosen IDLH is based on an analogy with heptane which has an IDLH of 5,000 ppm.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Jeppsson 1975	i.v.	-----	428	631 ppm	63 ppm

Other animal data .... Narcosis resulted in mice exposed for 0.5 to 1.5 hours to 6,600 to 13,700 ppm [Fuhner 1921]. Respiratory arrest occurred in 1 of 4 mice within 5 minutes at 16,000 ppm and in 4 of 4 mice within 3 minutes at 32,000 ppm [Swann et al. 1974].
Human data .... The narcotic concentration has been estimated to be either 8,000 ppm [Flury and Zernik 1931] or 10,000 ppm [Patty and Yant 1929]. The fatal concentration has been estimated to be 13,500 ppm [Flury and Zernik 1931].

Revised IDLH: 1,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Flury and Zernik 1931; Patty and Yant 1929], a value of about 3,000 ppm would have been appropriate for octane. However, the revised IDLH for octane is 1,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1%).

REFERENCES:

1. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, pp. 257-264 (in German).
2. Fuhner H [1921]. The narcotic effect of gasoline and its components (pentane, hexane, heptane, octane). Biochemische Zeitschrift *115*:235-261 (in German).
3. Jeppsson R [1975]. Parabolic relationship between lipophilicity and biological activity of aliphatic hydrocarbons, ethers and ketones after intravenous injections of emulsion formulations into mice. Acta Pharmacol Toxicol 37:56-64.
4. Patty FA, Yant WP [1929]. Odor intensity and symptoms produced by commercial propane, butane, pentane, hexane, and heptane vapor. Pittsburgh, PA: U.S. Department of the Interior, Bureau of Mines, Bureau of Mines Report, Investigation No. 2979.
5. Swann HE, Kwon BK, Hogan GK, Snellings WM [1974]. Acute inhalation toxicology of volatile hydrocarbons. Am Ind Hyg Assoc J *35*:511-518.

Oil mist (mineral)

CAS number	8012-95-1
NIOSH REL	5 mg/m³ TWA, 10 mg/m³ STEL
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA, 10 mg/m³ STEL
Description of substance	Colorless, oily liquid aerosol dispersed in air.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 2,500 mg/m³ — see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to mineral oil mist would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 5 mg/m³ is 2,500 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Bothe et al. 1975	oral	22,000	-----	154,000 mg/m³	15,400 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,500 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of oil mist (mineral) would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for oil mist (mineral) is 2,500 mg/m³ based on being 500 times the NIOSH REL and OSHA PEL of 5 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCE:

1. Bothe J, Braun W, Donhardt A [1975]. Untersuchungen zur antidotwirkung von paraffinöl bei vergiftungen mit kohlenwasserstoffen an der maus. Arch Toxikol *30*:243-250 (in German).

Osmium tetroxide (as Os)

CAS number 20816-12-0

NIOSH REL .... 0.002 mg/m^3 (0.0002 ppm) TWA, 0.006 mg/m^3 (0.0006 ppm) STEL

Current OSHA PEL .... 0.002 mg/m^3 TWA

1989 OSHA PEL .... 0.002 mg/m^3 (0.0002 ppm) TWA, 0.006 mg/m^3 (0.0006 ppm) STEL

1993-1994 ACGIH TLV .... 0.0016 mg/m^3 (0.0002 ppm) TWA, 0.0047 mg/m^3 (0.0006 ppm) STEL

Description of substance .... Colorless, crystalline solid or pale-yellow mass with an unpleasant, acrid, chlorine-like odor.

LEL .... Noncombustible Solid

Original (SCP) IDLH .... 1 mg Os/m^3

Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [197] that 1 mg/m^3 has been suggested as tolerable for 30 minutes [Flury and Zernik 1931]. No other data on acute inhalation toxicity are available which would be useful in determining the IDLH. AIHA [1968] reported that McLaughlin et al. [1946] found that workers exposed to 0.1 to 0.6 mg/m^3 suffered from lacrimation and disturbances of vision and in some cases, headache, conjunctivitis, and cough.

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Brunot 1933	-----	1,316 mg/m^3	30 min	987 mg Os/m^3 (1.0)	99 mg Os/m^3
Rat	Shell 1961	-----	423 mg/m^3	4 hr	317 mg Os/m^3 (2.0)	32 mg Os/m^3
Mouse	Shell 1961	-----	423 mg/m^3	4 hr	317 mg Os/m^3 (2.0)	32 mg Os/m^3

Human data .... It has been suggested that 1 mg/m^3 is tolerable for 30 minutes [Flury and Zernik 1931]. Workers exposed to 0.1 to 0.6 mg/m^3 suffered from lacrimation and disturbances of vision and in some cases, headache, conjunctivitis, and cough [McLaughlin et al. 1946].

Revised IDLH: 1 mg Os/m^3 [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Flury and Zernik 1931; McLaughlin et al. 1946], the original IDLH for osmium tetroxide (1 mg Os/m^3) is not being revised at this time.

REFERENCES:

1. AIHA [1968]. Osmium and its compounds. In: Hygienic guide series. Am Ind Hyg Assoc J 29:621-623.
2. Brunot FR [1933]. The toxicity of osmium tetroxide (osmic acid). J Ind Hyg *15*:136-143.
3. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 254 (in German).
4. McLaughlin AIG, Milton R, Perry KMA [1946]. Toxic manifestations of osmium tetroxide. Br J Ind Med 3:183-186.
5. Shell [1961]. Unpublished report. San Ramon, CA: Shell Chemical Co., p. 8.

Oxalic acid

CAS number 144-62-7
NIOSH REL .... 1 mg/m³ TWA, 2 mg/m³ STEL
Current OSHA PEL .... 1 mg/m³ TWA
1989 OSHA PEL .... 1 mg/m³ TWA, 2 mg/m³ STEL
1993-1994 ACGIH TLV .... 1 mg/m³ TWA, 2 mg/m³ STEL
Description of substance .... Colorless, odorless powder or granular solid.
LEL .... Unknown
Original (SCP) IDLH .... 500 mg/m³
Basis for original (SCP) IDLH .... The chosen IDLH has been calculated from the total oral lethal dose for man of 5 grams [ACGIH 1971].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Flury and Zernik 1935	oral	-----	1,000	7,000 mg/m³	700 mg/m³
Rat	Shtabsky and Shatinskaya 1985	?	-----	1,400	9,800 mg/m³	980 mg/m³
Rat	Vernot et al. 1977	oral	-----	7,500	52,500 mg/m³	5,250 mg/m³

Human data .... It has been reported that the lethal oral dose is 15 to 30 grams [Webster 1930]. [Note: An oral dose of 15 to 30 grams is equivalent to a 30-minute exposure to 10,000 to 20,000 mg/m³ assuming a 50 liter per minute breathing rate and 100% absorption.]

Revised IDLH: 500 mg/m³ [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for oxalic acid. Therefore, based on acute oral toxicity data in humans [Webster 1930] and animals [Flury and Zernik 1935], the original IDLH for oxalic acid (500 mg/m³) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Oxalic acid. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 193.
2. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German).
3. Shtabsky BM, Shatinskaya EG [1985]. Evaluation of cumulative properties of toxic chemicals from the subchronic experiment. Gig Sanit 50(3):57-60 (in Russian).
4. Vernot EH, MacEwen JD, Haun CC, Kinkead FR [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol 42:417-423.
5. Webster RW [1930]. Legal medicine and toxicology. Philadelphia, PA: W.B. Saunders.

Oxygen difluoride

CAS number	7783-41-7
NIOSH REL	0.05 ppm (0.1 mg/m³) CEILING
Current OSHA PEL	0.05 ppm (0.1 mg/m³) TWA
1989 OSHA PEL	0.05 ppm (0.1 mg/m³) CEILING
1993-1994 ACGIH TLV	0.05 ppm (0.11 mg/m³) CEILING
Description of substance	Colorless gas with a peculiar, foul odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	0.5 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Deichmann and Gerarde [1969] that oxygen difluoride is a strong irritant to the entire respiratory tract and causes pulmonary edema and hemorrhage when inhaled for a few hours at 0.5 ppm. Development of pulmonary signs leading to death may be delayed several hours after the exposure [Deichmann and Gerarde 1969]. In addition, AIHA [1967] reported that the Committee on Toxicology of the National Research Council recommended an Emergency Exposure Limit (EEL) of 0.5 ppm for a 10-minute exposure. This EEL is supposed to be for exposures that are "rare in the lifetime of an individual and permit some degree of reversible injury short of incapacitation" [Smyth 1966].
Existing short-term exposure guidelines	National Research Council (NRC) Emergency Exposure Limits (EELs) recommended to military and space agencies [Smyth 1966]: 10-minute EEL: 0.5 ppm 30-minute EEL: 0.2 ppm 60-minute EEL: 0.1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Darmer et al. 1972	2.6	-----	1 hr	3.3 ppm (1.25)	0.3 ppm
Mouse	Darmer et al. 1972	1.5	-----	1 hr	1.9 ppm (1.25)	0.2 ppm
Dog	Darmer et al. 1972	26	-----	1 hr	33 ppm (1.25)	3.3 ppm
Monkey	Darmer et al. 1972	16	-----	1 hr	20 ppm (1.25)	2.0 ppm

Human data .... Oxygen difluoride is a strong irritant to the entire respiratory tract and causes pulmonary edema and hemorrhage when inhaled for a few hours at 0.5 ppm [Deichmann and Gerarde 1969].

Revised IDLH: 0.5 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969], the original IDLH for oxygen difluoride (0.5 ppm) is not being revised at this time.

REFERENCES:

1. AIHA [1967]. Oxygen difluoride. In: Hygienic guide series. Am Ind Hyg Assoc J *28*:194-196.
2. Darmer KI Jr, Haun CC, MacEwen JD [1972]. The acute inhalation toxicology of chlorine pentafluoride. Am Ind Hyg Assoc J *33*:661-668.
3. Deichmann WB, Gerarde HW [1969]. Oxygen difluoride (OF_2). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 444.
4. Smyth HF Jr [1966]. Military and space short-term inhalation standards. Arch Environ Health *12*:488-490.

Ozone

CAS number 10028-15-6
NIOSH REL .... 0.1 ppm (0.2 mg/m³) CEILING
Current OSHA PEL .... 0.1 ppm (0.2 mg/m³) TWA
1989 OSHA PEL .... 0.1 ppm (0.2 mg/m³) TWA, 0.3 ppm (0.6 mg/m³) STEL
1993-1994 ACGIH TLV .... 0.1 ppm (0.2 mg/m³) CEILING
Description of substance .... Colorless to blue gas with a very pungent odor.
LEL .... Nonflammable Gas
Original (SCP) IDLH .... 10 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [1966] that pulmonary edema developed in welders who had a severe acute exposure to an estimated 9 ppm ozone plus other air pollutants [Kleinfeld et al. 1957]. Patty [1963] reported that 15 to 20 ppm is lethal to small animals within 2 hours [Witheridge and Yaglou 1937]. AIHA [1966] also reported that on the basis of animal data, exposure at 50 ppm for 60 minutes will probably be fatal to humans [King 1963].
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 1 ppm
24-hour EEGL: 0.1 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Clamann and Bancroft 1957	-----	12.6	3 hr	23 ppm (1.8)	2.3 ppm
Human	Deichmann and Gerarde 1969	-----	50	30 min	50 ppm (1.0)	5.0 ppm
Rabbit	Mittler et al. 1956	-----	36	3 hr	65 ppm (1.8)	6.5 ppm
Mouse	Mittler et al. 1956	-----	21	3 hr	38 ppm (1.8)	3.8 ppm
Rat	Mittler et al. 1956	-----	21.8	3 hr	39 ppm (1.8)	3.9 ppm
G. pig	Mittler et al. 1957	-----	24.8	3 hr	45 ppm (1.8)	4.5 ppm
Rat	Stokinger 1957	-----	4.8	4 hr	10 ppm (2.0)	1.0 ppm

Other animal data .... It has been reported that 15 to 20 ppm is lethal to small animals within 2 hours [Witheridge and Yaglou 1937].
Human data .... Pulmonary edema developed in welders who had a severe acute exposure to an estimated 9 ppm ozone plus other air pollutants [Kleinfeld et al. 1957]. It has been reported that on the basis of animal data, exposure at 50 ppm for 60 minutes will probably be fatal to humans [King 1963].

Revised IDLH: 5 ppm
Basis for revised IDLH: The revised IDLH for ozone is 5 ppm based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969; Kleinfeld et al. 1957].

REFERENCES:

1. AIHA [1966]. Ozone. In: Hygienic guide series. Am Ind Hyg Assoc J *27*:196-198.
2. Clamann HG, Bancroft RW [1957]. Physiological effects of ozone. Fed Proc *16*:22 [Abstract].
3. Deichmann WB, Gerarde HW [1969]. Ozone. In: Toxicity of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 446-448.
4. King ME [1963]. Toxicity of ozone. V. Factors affecting acute toxicity. Ind Med Surg 32:93-94.
5. Kleinfeld M, Giel C, Tabershaw IR [1957]. Health hazards associated with inert-gas-shielded metal arc welding. AMA Arch Ind Health *15*(1):27-31.

6. Mittler S, Hedrick D, King M, Gaynor A [1956]. Toxicity of ozone. I. Acute toxicity. Ind Med Surg *25*:301-306.
7. Mittler S, Hedrick D, Phillips L [1957]. Toxicity of ozone. II. Effect of oxygen and carbon dioxide upon acute toxicity. Ind Med Surg *26*:63-66.
8. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 99-106.
9. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 917.
10. Stokinger HE [1957]. Evaluation of the hazards of ozone and oxides of nitrogen. Arch Ind Health *15*:181-190.
11. Witheridge WN, Yaglou CP [1937]. Ozone in ventilation: its possibilities and limitations. Trans Am Soc Heat Vent Eng *45*(1132):509-522.

Paraquat

CAS number	1910-42-5
NIOSH REL	0.1 mg/m^3 (respirable dust) TWA [skin]
Current OSHA PEL	0.5 mg/m^3 (respirable dust) TWA [skin]
1989 OSHA PEL	0.1 mg/m^3 (respirable dust) TWA [skin]
1993-1994 ACGIH TLV	0.1 mg/m^3 (respirable dust) TWA, 0.5 mg/m^3 (total dust) TWA
Description of substance	Yellow solid with a faint, ammonia-like odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	1.5 mg/m^3
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by Gage [1968] that "after single exposures the LC_{50} appears to be a function of the duration and of the concentration; in the rat the lethal concentration-time product is about 6 micrograms/liter-hour. Guinea pigs and male mice are about as sensitive as rats. Female mice are less sensitive. The dog can tolerate a concentration-time product of 25 micrograms/liter-hour without ill effects."
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Respirable dust						
G. pig	Gage 1968	3 mg/m^3	-----	30 min	3.0 mg/m^3 (1.0)	0.30 mg/m^3
Mouse	Gage 1968	3 mg/m^3	-----	30 min	3.0 mg/m^3 (1.0)	0.30 mg/m^3
Rat	Gage 1968	-----	1 mg/m^3	6 hr	2.3 mg/m^3 (2.3)	0.23 mg/m^3
Nonrespirable dust						
Rat	Palazzolo 1965	-----	6,400 mg/m^3	4 hr	12,800 mg/m^3 (2.0)	1,280 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Bailey and White 1965	oral	57	-----	399 mg/m^3	40 mg/m^3
Mouse	Barabas et al. 1981	oral	120	-----	840 mg/m^3	84 mg/m^3
Dog	Iyakuhin 1979	oral	25	-----	175 mg/m^3	18 mg/m^3
G. pig	Murray and Gibson 1972	oral	22	-----	154 mg/m^3	15 mg/m^3

Human data .... It has been stated that the high acute inhalation toxicity of paraquat is dependent wholly on the size of the particulate, with respirable sizes (i.e., <5 micrometer mass median diameter) found to be 5 to 6 times more toxic than nonrespirable dusts [McElligo 1965]. It has been reported that under paraquat spraying conditions particle sizes appear to be nonrespirable [Swan 1969].

Revised IDLH: 1 mg/m^3
Basis for revised IDLH: The revised IDLH for paraquat is 1 mg/m^3 based on the acute inhalation toxicity data for respirable particulate in animals [Gage 1968]. This is a conservative value if the occupational exposure is totally to nonrespirable size particles of paraquat since respirable aerosols are much more toxic [McElligo 1965; Swan 1969].

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8. Swan AAB [1969]. Exposure of spray operators to paraquat. Br J Ind Med *26*:322-329.

Parathion

CAS number	56-38-2
NIOSH REL	0.05 mg/m³ TWA [skin]
Current OSHA PEL	0.1 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA [skin]
Description of substance	Pale-yellow to dark-brown liquid with a garlic-like odor.
LEL	Unknown
Original (SCP) IDLH	20 mg/m³
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for parathion. If the IDLH were estimated from the statement by AIHA [1971] that "the minimum lethal oral dose for humans has been estimated as ranging from less than 10 mg to 120 mg [Bidstrup 1950; Grob 1950; Hayes 1963]," then an IDLH of 5 mg/m³ would be chosen. This appears to be far too conservative, however, because ACGIH [1971] noted that workers regularly exposed to 2 to 15 mg/m³, with an average concentration of 8 mg/m³, exhibited only a 25% decrease in cholinesterase levels [Kay et al. 1952]. The chosen IDLH, therefore, has been estimated from the female rat oral LD_{50} of 3 mg/kg cited by ACGIH [1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rabbit	Deichmann et al. 1952	-----	50 mg/m³	2 hr	80 mg/m³	8.0 mg/m³
G. pig	Deichmann et al. 1952	-----	14 mg/m³	2 hr	22 mg/m³	2.2 mg/m³
Mouse	Izmerov et al. 1982	-----	15 mg/m³	?	?	?
Rat	USAF 1977	84 mg/m³	-----	4 hr	168 mg/m³	17 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Eto et al. 1966	oral	5	-----	35 mg/m³	3.5 mg/m³
Rabbit	Kenaga and Morgan 1978	oral	10	-----	70 mg/m³	7.0 mg/m³
Dog	Kenaga and Morgan 1978	oral	3	-----	21 mg/m³	2.1 mg/m³
Cat	Nishizawa et al. 1961	oral	0.93	-----	6.5 mg/m³	0.7 mg/m³
Horse	Perkow 1971/1976	oral	5	-----	35 mg/m³	3.5 mg/m³
G. pig	von Dozent et al. 1955	oral	8	-----	56 mg/m³	5.6 mg/m³
Rat	Weiss and Orzel 1967	oral	2	-----	14 mg/m³	1.4 mg/m³

Human data	Workers regularly exposed to 2 to 15 mg/m³ (average of 8 mg/m³) exhibited only a 25% decrease in cholinesterase levels [CDC 1956]. The minimum lethal oral dose has been reported to range from 0.17 to 1.471 mg/kg [Arena 1970; CDC 1956; Hartley and Kidd 1986]. [Note: An oral dose ranging from 0.17 to 1.471 mg/kg is equivalent to a worker being exposed to about 8 to 69 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 10 mg/m³
Basis for revised IDLH: The revised IDLH for parathion is 10 mg/m³ based on chronic inhalation toxicity data in humans [CDC 1956]. This may be a conservative value due to the lack of relevant acute toxicity data in humans exposed to concentrations above 10 mg/m³.

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2. AIHA [1969]. Parathion. In: Hygienic Guide Series. Am Ind Hyg Assoc J *30*:308-312.
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4. Bidstrup PL [1950]. Poisoning by organic phosphorus insecticides. Br Med J *2*:548-551.
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Pentaborane

CAS number	19624-22-7
NIOSH REL	0.005 ppm (0.01 mg/m³) TWA, 0.015 ppm (0.03 mg/m³) STEL
Current OSHA PEL	0.005 ppm (0.01 mg/m³) TWA
1989 OSHA PEL	0.005 ppm (0.01 mg/m³) TWA, 0.015 ppm (0.03 mg/m³) STEL
1993-1994 ACGIH TLV	0.005 ppm (0.013 mg/m³) TWA, 0.015 ppm (0.039 mg/m³) STEL
Description of substance	Colorless liquid with a pungent odor like sour milk.
LEL	0.42% (10% LEL, 420 ppm)
Original (SCP) IDLH	3 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 4-hour LC_{50} of 3 ppm [Jacobson 1958 cited by ACGIH 1971].
Existing short-term exposure guidelines	American Industrial Hygiene Association [AIHA 1966] Emergency Exposure Limits (EELs):

5 minute EEL: 25 ppm
15-minute EEL: 8 ppm
30-minute EEL: 4 ppm
60-minute EEL: 2 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Jacobson 1958	3	-----	4 hr	6 ppm (2.0)	0.6 ppm
Rat	Levinskas et al. 1958	6	-----	4 hr	12 ppm (2.0)	1.2 ppm
Mouse	Levinskas et al. 1958	3.4	-----	4 hr	6.8 ppm (2.0)	0.7 ppm
Dog	Weeks et al. 1964	35	-----	15 min	28 ppm (0.79)	2.8 ppm
Monkey	Weeks et al. 1964	244	-----	2 min	100 ppm (0.41)	10 ppm
Rat	Weir et al. 1964	67	-----	5 min	37 ppm (0.55)	3.7 ppm
Mouse	Weir et al. 1964	40	-----	5 min	22 ppm (0.55)	2.2 ppm
Rat	Weir et al. 1964	31	-----	15 min	24 ppm (0.79)	2.4 ppm
Mouse	Weir et al. 1964	19	-----	15 min	15 ppm (0.79)	1.5 ppm
Rat	Weir et al. 1964	15	-----	30 min	15 ppm (1.0)	1.5 ppm
Mouse	Weir et al. 1964	11	-----	30 min	11 ppm (1.0)	1.1 ppm
Rat	Weir et al. 1964	10	-----	1 hr	13 ppm (1.25)	1.3 ppm
Mouse	Weir et al. 1964	6	-----	1 hr	7.5 ppm (1.25)	0.8 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1 ppm
Basis for revised IDLH: The revised IDLH for pentaborane is 1 ppm based on acute inhalation toxicity data in animals [Jacobson 1958; Levinskas et al. 1958; Weir et al. 1964].

REFERENCES:

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Pentachloronaphthalene

CAS number	1321-64-8
NIOSH REL	0.5 mg/m^3 TWA [skin]
Current OSHA PEL	0.5 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m^3 TWA [skin]
Description of substance	Pale-yellow or white solid or powder with an aromatic odor.
LEL	Noncombustible Solid
Original (SCP) IDLH*	Unknown [*Note: Effective IDLH = 5 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	AIHA [1970] reported that the atmospheric concentration immediately hazardous to life is probably unattainable for the chloronaphthalenes with the possible exception of monochloronaphthalene. For this draft technical standard, however, an analogy with other chloronaphthalenes was used, and the respirators were selected on the basis of the assigned protection factor afforded by each device up to 10 × the OSHA PEL of 0.5 mg/m^3 (i.e., 5 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 5 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: Unknown [Unchanged]
Basis for revised IDLH: Due to a lack of relevant acute toxicity data, the IDLH for pentachloronaphthalene remains "Unknown." The "most protective" respirators will continue to be recommended for concentrations exceeding 5 mg/m^3 based on being 10 times the NIOSH REL and OSHA PEL of 0.5 mg/m^3 (10 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for pentachloronaphthalene).

REFERENCE:

1. AIHA [1966]. Chloronaphthalenes. In: Hygienic guide series. Am Ind Hyg Assoc J 27:89-91.

Pentachlorophenol

CAS number	87-86-5
NIOSH REL	0.5 mg/m³ TWA [*skin*]
Current OSHA PEL	0.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.5 mg/m³ TWA [skin]
Description of substance	Colorless to white, crystalline solid with a benzene-like odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	150 mg/m³
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for pentachlorophenol. AIHA [1970] stated that the atmospheric concentration immediately hazardous to life is not known for humans, but painful irritation to the nose is observed at concentrations below those that would be immediately hazardous to life. The chosen IDLH, therefore, has been estimated from the smallest lethal intravenous dose in rabbits of 22 mg/kg [Kehoe et al. 1939 as cited by ACGIH 1971]. According to AIHA [1970], the cause of death from an acute overdose is hyperexia and cardiac failure [Patty 1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Demidenko 1969	355 mg/m³	-----	?	?	?
Mouse	Demidenko 1969	225 mg/m³	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Borzelleca et al. 1985	oral	117	-----	819 mg/m³	82 mg/m³
Hamster	Cabral et al. 1979	oral	168	-----	1,176 mg/m³	118 mg/m³
Rat	Deichmann et al. 1942	oral	27	-----	189 mg/m³	19 mg/m³
Rabbit	Deichmann et al. 1942	oral	-----	70	490 mg/m³	49 mg/m³
Rat	Fielder et al. 1982	oral	150	-----	1,050 mg/m³	105 mg/m³

Human data ..... Dusts are particularly irritating to the eyes and nose at concentrations greater than 1 mg/m³ but concentrations up to 2.4 mg/m³ have been tolerated by workers that have been conditioned [Clayton and Clayton 1981]. It has been reported that 401 mg/kg is the minimum lethal oral dose [Haley 1977]. [Note: An oral dose of 401 mg/kg is equivalent to a worker being exposed to about 19,000 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2.5 mg/m³
Basis for revised IDLH: The revised IDLH for pentachlorophenol is 2.5 mg/m³ based on acute toxicity data in humans [Clayton and Clayton 1981]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 2.4 mg/m³.

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n-Pentane

CAS number	109-66-0
NIOSH REL	120 ppm (350 mg/m³) TWA, 610 ppm (1,800 mg/m³) 15-minute CEILING
Current OSHA PEL	1,000 ppm (2,950 mg/m³) TWA
1989 OSHA PEL	600 ppm (1,800 mg/m³) TWA, 750 ppm (2,250 mg/m³) STEL
1993-1994 ACGIH TLV	600 ppm (1,770 mg/m³) TWA, 750 ppm (2,210 mg/m³) STEL
Description of substance	Colorless liquid with a gasoline-like odor.
LEL	1.5% (10% LEL, 1,500 ppm)
Original (SCP) IDLH	15,000 ppm [LEL]
Basis for original (SCP) IDLH	Patty [1963] reported the following: "n-pentane causes narcosis in 5 to 60 minutes at 90,000 to 120,000 ppm. Only a narrow margin exists between the concentrations that cause narcosis and death in mice. In human studies, a 10-minute exposure to 5,000 ppm did not cause mucous membrane irritation or other symptoms. The odor of n-pentane at this concentration is readily detectable" [Fuhner 1921]. AIHA [1966] reported that the atmospheric concentration immediately hazardous to life is unknown for man, but that the lethal concentration for mice has been reported as 128,200 ppm for a 37-minute exposure [Spector 1956]. Because the data indicate that acute toxic effects occur above the lower explosive limit (LEL) of 15,000 ppm, the LEL has been chosen as the IDLH (i.e., the concentration above which only the "most protective" respirators are permitted).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Flury and Zernik 1931	-----	130,000 mg/m³	30 min	130,000 ppm (1.0)	13,000 ppm
Mouse	Spector 1956	-----	128,200 ppm	37 min	137,175 ppm (1.07)	13,718 ppm
Mouse	Stoughton & Lamson 1936	-----	325,000 mg/m³	2 hr	173,333 ppm (1.6)	17,333 ppm

Other animal data	It has been reported that narcosis occurs after 5 to 60 minutes of exposure to 90,000 to 120,000 ppm [Patty 1963].
Human data	Mucous membrane irritation or other symptoms were not noted after a 10-minute exposure of 5,000 ppm [Patty and Yant 1929].

Revised IDLH: 1,500 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Patty and Yant 1929], a value of at least 5,000 ppm would have been appropriate for n-pentane. However, the revised IDLH for n-pentane is 1,500 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.5%).

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2-Pentanone

CAS number	107-87-9
NIOSH REL	150 ppm (530 mg/m³) TWA
Current OSHA PEL	200 ppm (700 mg/m³) TWA
1989 OSHA PEL	200 ppm (700 mg/m³) TWA, 250 ppm (875 mg/m³) STEL
1993-1994 ACGIH TLV	200 ppm (705 mg/m³) TWA, 250 ppm (881 mg/m³) STEL
Description of substance	Colorless to water-white liquid with a characteristic acetone-like odor.
LEL	1.5% (10% LEL, 1,500 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that the maximum concentration that caused no serious disturbances in guinea pigs in 1 hour was 5,000 ppm [Yant et al. 1936].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1962	LC_{17}: 2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Rat	Smyth et al. 1962	LC_{100}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
G. pig	Yant et al. 1936	-----	50,000	50 min	60,000 ppm (1.2)	6,000 ppm
G. pig	Yant et al. 1936	-----	13,000	5 hr	27,950 ppm (2.15)	2,795 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Clayton and Clayton 1982	oral	1,600	-----	3,128 ppm	313 ppm
Mouse	Clayton and Clayton 1982	oral	1,600	-----	3,128 ppm	313 ppm

Human data .... Exposure to a concentration of 1,500 ppm was associated with complaints of ocular and upper respiratory irritation [Yant et al. 1936].

Revised IDLH: 1,500 ppm
Basis for revised IDLH: The revised IDLH for 2-pentanone is 1,500 ppm based on acute inhalation toxicity data in humans [Yant et al. 1936]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 1,500 ppm. Also, this value is 10% of the lower explosive limit of 1.5%.

REFERENCES:

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4. Yant WP, Patty FA, Schrenk HH [1936]. Acute response of guinea pigs to vapors of some new commercial organic compounds. IX. Pentanone (methyl propyl ketone). Public Health Rep 51:392-399.

Perchloromethyl mercaptan

CAS number	594-42-3
NIOSH REL	0.1 ppm (0.8 mg/m³) TWA
Current OSHA PEL	0.1 ppm (0.8 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.76 mg/m³) TWA
Description of substance	Pale-yellow, oily liquid with an unbearable, acrid odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for perchloromethyl mercaptan. The ch[illegible]n IDLH, therefore, has been based on an analogy with hyd[illegible]n sulfide. According to ACGIH, perchloromethyl mercapta[illegible] about 20 times more toxic than hydrogen sulfide which has an IDLH of 300 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Althoff 1973	11	-----	1 hr	14 ppm (1.25)	1.4 ppm
Rat	Althoff 1973	16	-----	1 hr	20 ppm (1.25)	2.0 ppm
Mouse	Althoff 1973	9	-----	3 hr	16 ppm (1.8)	1.6 ppm
Human	Flury and Zernik 1931	-----	388	10 min	2[illegible] ppm (0.69)	27 ppm
Mouse	Izmerov et al. 1982	38	-----	2 hr	[illegible] ppm (1.6)	6.1 ppm
Mouse	Marhold 1972	-----	46	15 min	3[illegible] ppm (0.79)	3.6 ppm
Rat	Vernot et al. 1977	11	-----	1 hr	14 ppm (1.25)	1.4 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Marhold 1972	oral	82.6	-----	75 ppm	7.5 ppm

Other human data .... It has been stated that perchloromethyl mercaptan is about one-sixth as toxic as phosgene [Prentiss 1937].

Revised IDLH: 10 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Flury and Zernik 1931], a value of about 25 ppm would have been appropriate for perchloromethyl mercaptan. However, the original IDLH for perchloromethyl mercaptan (10 ppm) is not being revised at this time based on an analogy to phosgene [Prentiss 1937] which has a revised IDLH of 2 ppm.

REFERENCES:

1. ACGIH [?].
2. Althoff H [1973]. Todliche perchlormethylmercaptan-intoxikation. Arch Toxikol *31*:121-134. [From ACGIH [1991]. Perchloromethyl mercaptan. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1195-1196.]
3. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 362 (in German).
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 97.
5. Marhold JV [1972]. Sbornik vysledku toxixologiekeho vysetreni latek a pripravku. Prague, Czechoslovakia: Institut Prumyclu, p. 13 (in Czechoslovakian).
6. Prentiss AM [1937]. Chemicals in war. A treatise on chemical warfare. New York, NY: McGraw-Hill Book Company, Inc., p. 154.
7. Vernot EH, MacEwen JD, Haun CC, Kinkead ER [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol *42*(2):417-423.

Perchloryl fluoride

CAS number	7616-94-6
NIOSH REL	3 ppm (14 mg/m^3) TWA, 6 ppm (28 mg/m^3) STEL
Current OSHA PEL	3 ppm (13.5 mg/m^3) TWA
1989 OSHA PEL	3 ppm (14 mg/m^3) TWA, 6 ppm (28 mg/m^3) STEL
1993-1994 ACGIH TLV	3 ppm (13 mg/m^3) TWA, 6 ppm (25 mg/m^3) STEL
Description of substance	Colorless gas with a characteristic, sweet odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	385 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat 4-hour LC_{50} of 385 ppm [Greene et al. 1960 cited by ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Dost et al. 1974	-----	2,000	40 min	2,200 ppm (1.1)	220 ppm
Rat	Greene et al. 1960	385	-----	4 hr	770 ppm (2.0)	77 ppm
Mouse	Greene et al. 1960	630	-----	4 hr	1,260 ppm (2.0)	126 ppm
Dog	Jacobson 1958	-----	451	4 hr	902 ppm (2.0)	90 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for perchloryl fluoride is 100 ppm based on acute inhalation toxicity data in animals [Greene et al. 1960; Jacobson 1958].

REFERENCES:

1. ACGIH [1971]. Perchloryl fluoride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 202-203.
2. Dost FN, Reed DJ, Smith VN, Wang CH [1974]. Toxic properties of chlorine trifluoride. Toxicol Appl Pharmacol 27:527-536.
3. Greene EA, Colbourn JL, Donati E, Weeks MH [1960]. The inhalation toxicity of perchloryl fluoride. Army Chemical Center, Maryland: U.S. Army Chemical Research and Development Laboratories, Technical Report No. CRDLR 3010, p. 9.
4. Jacobson KH [1958]. Transactions of the Symposium on Health Hazards of Military Chemicals. Army Chemical Center, MD: Directorate of Medical Research, U.S. Army Chemical Warfare Laboratories, CWL Special Publication 2-10.

Petroleum distillates (naphtha)

CAS number	8002-05-9
NIOSH REL	350 mg/m³ TWA, 1,800 mg/m³ 15-minute CEILING
Current OSHA PEL	500 ppm (2,000 mg/m³) TWA
1989 OSHA PEL	400 ppm (1,600 mg/m³) TWA
1993-1994 ACGIH TLV	400 ppm (1,590 mg/m³) TWA
Description of substance	Colorless liquid with a gasoline- or kerosene-like odor.
LEL	1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH	10,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1963] that the atmospheric concentrations immediately hazardous to life are from 10,000 to 20,000 ppm [Henderson and Haggard 1943]. In addition, the short exposure tolerance to petroleum naphtha is based on a statement by AIHA [1963] that 4,000 to 7,000 ppm may be tolerated for 1 hour [Henderson and Haggard 1943], but not without development of definite symptoms of narcosis [Drinker et al. 1943].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	It has been reported that concentrations of 10,000 to 20,000 ppm are immediately dangerous to health [Henderson and Haggard 1943]. It has also been stated that concentrations of 4,000 to 7,000 ppm could be tolerated for 1 hour, but not without definite symptoms of narcosis [Drinker et al. 1943].

Revised IDLH: 1,100 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Drinker et al. 1943; Henderson and Haggard 1943], a value of about 4,000 ppm would have been appropriate for petroleum distillates (naphtha). However, the revised IDLH for petroleum distillates (naphtha) is 1,100 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 1.1%).

REFERENCES:

1. AIHA [1963]. Petroleum naphtha. In: Hygienic guide series. Am Ind Hyg Assoc J 24:427-428.
2. Drinker P, Yaglou CP, Warren MF [1943]. The threshold toxicity of gasoline vapor. J Ind Hyg Toxicol 25:225-232.
3. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 192.

Phenol

CAS number	108-95-2
NIOSH REL	5 ppm (19 mg/m³) TWA, 15.6 ppm (60 mg/m³) 15-minute CEILING [skin]
Current OSHA PEL	5 ppm (19 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 ppm (19 mg/m³) TWA [skin]
Description of substance	Colorless to light-pink, crystalline solid with a sweet, acrid odor.
LEL	1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH	250 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with cresol which has an IDLH of 250 ppm.
Existing short-term exposure guidelines	1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 10 ppm (60-minute)
ERPG-2: 50 ppm (60-minute)
ERPG-3: 200 ppm (60-minute)

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Gig Tr Prof Zabol 1955	19	-----	?	?	?
Rat	Nagoznyi 1976	81	-----	?	?	?
Mouse	Nagoznyi 1976	69	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Brown and Lamson 1935	oral	317	-----	568 ppm	57 ppm
Rabbit	Deichmann and Witherup 1944	oral	-----	420	752 ppm	75 ppm
Dog	Flury and Zernik 1935	oral	-----	500	895 ppm	90 ppm
Cat	Flury and Zernik 1935	oral	-----	80	143 ppm	14 ppm
Mouse	Korolev et al. 1973	oral	270	-----	483 ppm	48 ppm

Other animal data	RD_{50} (mouse), 166 ppm [DeCeaurriz et al. 1981]. In rats, an exposure of 312 ppm for 1 hour only resulted in lacrimation and eye and nasal irritation; a slight loss of coordination was reported within 4 hours of exposure to 230 ppm [Flickinger 1976].
Human data	It has been stated that the toxicity of phenol is closely related to that of cresol [ACGIH 1991]. It has been reported that 14 to 140 mg/kg is the lethal oral dose [Deichmann and Gerarde 1969; Lefaux 1978]. [Note: An oral dose of 14 to 140 mg/kg is equivalent to a 70-kg worker being exposed to 167 to 1,670 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 250 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Flickinger 1976] and an analogy to cresol [ACGIH 1991] which has a revised IDLH of 250 ppm, the original IDLH for phenol of 250 ppm is not being revised at this time.

REFERENCES:

1. ACGIH [1991]. Cresol, all isomers. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 340-341.
2. Brown HW, Lamson PD [1935]. Oral toxicity of ortho-n-alkylphenols to white rats. Proc Soc Exp Biol Med *32*:592-594.
3. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett *9*(2):137-143.
4. Deichmann WB, Gerarde HW [1969]. Phenol (carbolic acid). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 463-464.
5. Deichmann WB, Witherup S [1944]. Phenol studies. VI. The acute and comparative toxicity of phenol and o-, m- and p-cresols for experimental animals. J Pharmacol Exp Ther *80*:233-240.
6. Flickinger CW [1976]. The benzenediols: catechol, resorcinol and hydroquinone: a review of the industrial toxicology and current industrial exposure limits. Am Ind Hyg Assoc J *37*:596-606.
7. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod *4*:1319 (in German).
8. Gig Tr Prof Zabol [1955]. On the toxicity and maximum permissible concentration of a complex set of the neoleucorite (phenoformaldhyde) resin volatile products; *19*(8):37-40 (in Russian).
9. Korolev AA, Abirdir AA, et al. [1973] Hygienic and toxicologic features of products of phenol destruction in ozone treatment of water. Gig Sanit *38*(8):6-10 (in Russian).
10. Lefaux R [1978]. Practical toxicology of plastics. Cleveland, OH: Chemical Rubber Co., p. 329.
11. Nagoznyi PA [1976]. About the elimination of the problem of combined effect of several toxic materials. Gig Sanit *41*(6):103-105 (in Russian).

p-Phenylene diamine

CAS number 106-50-3
NIOSH REL .... 0.1 mg/m³ TWA [skin]
Current OSHA PEL .... 0.1 mg/m³ TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.1 mg/m³ TWA
Description of substance .... White to slightly red, crystalline solid.
LEL .... Unknown
Original (SCP) IDLH* .... Unknown [*Note: "Effective" IDLH = 25 mg/[illegible] discussion below.]
Basis for original (SCP) IDLH .... ACGIH [1971] reported that the TLV for this [illegible] is believed to be sufficiently low to minimize the numb[illegible]ns who become sensitized, but the limit is not low [illegible] prevent exacerbation of asthma in those already [illegible] p-phenylene diamine. Because sensiti[illegible] may be endangered by concentrations far below [illegible] cannot be used to set an IDLH. Therefore, in the ab[illegible] toxicological data and noting that Patty [illegible]d systemic poisoning from industrial exposure to t[illegible] [Reichel 1934], for this draft technical [illegible] respirators have been selected on the basis of the ass[illegible]tection factor afforded by each device up to th[illegible] concentration at 20°C (approximately 29.1 mg/m³) r[illegible] to 25 mg/m³; only the "most protective" respirators [illegible] for use in concentrations exceeding 25 mg/m³.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Burnett et al. 1977	oral	80	-----	560 mg/m³	56 mg/m³
Rabbit	Hanzlik 1923	oral	-----	250	1,750 mg/m³	175 mg/m³
Cat	Hanzlik 1923	oral	-----	100	700 mg/m³	70 mg/m³
Rat	Lloyd et al. 1977	oral	98	-----	686 mg/m³	69 mg/m³
G. pig	Sheftel 1988	oral	145	-----	1,015 mg/m³	102 mg/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 25 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for p-phenylene diamine. Therefore, based on health considerations and acute oral toxicity data in animals [Burnett et al. 1977; Hanzlik 1923; Lloyd et al. 1977], a value of about 50 mg/m³ would have been appropriate. However, the revised IDLH for p-phenylene diamine is 25 mg/m³ based on the concentration recommended originally in the Standards Completion Program for deciding when the "most protective" respirators should be used. Because sensitized workers may be affected by concentrations far below occupational exposure limits, exacerbation of asthma cannot be used to set an IDLH.

REFERENCES:

1. ACGIH [1971]. p-Phenylenediamine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 205.
2. Burnett C, Loehr R, Corbett J [1977]. Dominant lethal mutagenicity study on hair dyes. J Toxicol Environ Health 2:657-662.
3. Hanzlik PJ [1923]. The pharmacology of some phenylenediamines. J Ind Hyg 4:386-409, 448, 462.

4. Lloyd GK, Ligget MP, Kynoch SR, Davies RE [1977]. Assessment of the acute toxicity and potential irritancy of hair dye constituents. Food Cosmet Toxicol *15*(6):607-610.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2121.
6. Reichel H [1934]. Vergifungsfalien 5:A21 (in German).
7. Sheftel VO [1988]. Toxic properties of phenylene diamine. Gig Sanit 53(7):62-63 (in Russian).

Phenyl ether (vapor)

CAS number 101-84-8
NIOSH REL .... 1 ppm (7 mg/m^3) TWA
Current OSHA PEL .... 1 ppm (7 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 1 ppm (7 mg/m^3) TWA, 2 ppm (14 mg/m^3) STEL
Description of substance .... Colorless, crystalline solid or liquid (above 82°F) with a geranium-like odor.
LEL .... 0.7% (10% LEL, 700 ppm)
Original (SCP) IDLH* .... No Evidence [*Note: "Effective" IDLH = 100 ppm -- see discussion below.]
Basis for original (SCP) IDLH .... No evidence of an IDLH for phenyl ether exists in the available toxicological data. Patty [1963] reported that phenyl ether's vapors do not present a toxicological problem, but may be a nuisance because of its disagreeableness. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 100 × the OSHA PEL of 1 ppm (i.e., 100 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 100 ppm. High concentrations of the vapor are unlikely to be encountered in the workplace because of its high boiling point and low vapor pressure.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Opdyke 1974	oral	3,370	-----	3,337 ppm	334 ppm
Rat	Vogel et al. 1964	oral	4,000	-----	3,960 ppm	396 ppm
G. pig	Vogel et al. 1964	oral	4,000	-----	3,960 ppm	396 ppm

Other animal data .... Rats exposed to 20 ppm for 7 hours per day for 20 days exhibited only eye and nasal irritation [Hefner et al. 1975].
Human data .... It has been reported that industrial experience has shown no evidence that phenyl ether, either as a liquid, mist, or vapor, is a health hazard under ordinary conditions of production and use; no overt systemic toxicity was found at concentrations that were not intolerably disagreeable [Clayton and Clayton 1981].

Revised IDLH: 100 ppm
Basis for revised IDLH: Based on acute oral toxicity data in animals [Opdyke 1974; Vogel et al. 1964], a value of about 350 ppm would have been appropriate for phenyl ether vapor. However, the revised IDLH for phenyl ether vapor is 100 ppm based on being 100 times the NIOSH REL or OSHA PEL (100 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for phenyl ether vapor).

REFERENCES:

1. Clayton GD, Clayton FE, eds. [1981]. Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2A. Toxicology. New York, NY: John Wiley & Sons, Inc., pp. 2498-2499, 2541-2543.
2. Hefner RE Jr, Leong BKJ, Kociba RJ, Gehring PJ [1975]. Repeated inhalation toxicity of diphenyl oxide in experimental animals. Toxicol Appl Pharmacol *33*:78-86.
3. Opdyke DLJ [1974]. Dipentene. In: Monographs on fragrance raw materials. Food Cosmet Toxicol *12*:703-736.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1700.
5. Vogel WH, Snyder R, Schulman MP [1964]. Effects of aromatic and non-aromatic model compounds and drugs on enzymic activities. J Pharmacol Exp Ther *146*:66-73.

Phenyl ether-biphenyl mixture (vapor)

CAS number	8004-13-5
NIOSH REL	1 ppm (7 mg/m³) TWA
Current OSHA PEL	1 ppm (7 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	Not specifically listed
Description of substance	Colorless to straw-colored liquid or solid (below 54°F) with a disagreeable, aromatic odor.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 100 ppm -- see discussion below.]
Basis for original (SCP) IDLH	Patty [1963] reported that concentrations of the vapor of a phenyl ether-biphenyl mixture that are sufficiently high to cause toxic effects from a single exposure of up to 7 hours duration are not attainable [Dow]. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 100 × the OSHA PEL of 1 ppm (i.e., 100 ppm); only the "most protective" respirators are permitted for use in concentrations exceeding 100 ppm. High concentrations of the vapor are not likely to be encountered in the workplace because of the high boiling point and low vapor pressure of this material.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Gig Tr Prof Zabol 1967	oral	3,210	-----	3,178 ppm	318 ppm
Rabbit	Izmerov et al. 1982	oral	4,200	-----	4,158 ppm	416 ppm
G. pig	Izmerov et al. 1982	oral	3,000	-----	2,970 ppm	297 ppm
Rat	Marhold 1986	oral	2,460	-----	2,436 ppm	243 ppm

Human data	Concentrations ranging from 7 to 10 ppm have caused burning of the eyes, irritation of the respiratory tract, and severe nausea [ILO 1971].

Revised IDLH: 10 ppm
Basis for revised IDLH: The revised IDLH for a phenyl ether-biphenyl vapor mixture is 10 ppm based on acute inhalation toxicity data in humans [ILO 1971]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 10 ppm.

REFERENCES:

1. Dow [?]. Unpublished data from the Dow Chemical Company, Biochemical Research Laboratory. [From Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1703.]
2. Gig Tr Prof Zabol [1967]; *13*(4):42-44 (in Russian).
3. ILO [1971]. Diphenyl and derivatives. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. I (A-K). Geneva, Switzerland: International Labour Office, pp. 391-392.
4. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 61.
5. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 271 (in Czechoslovakian).
6. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1703.

Phenyl glycidyl ether

CAS number	122-60-1
NIOSH REL	1 ppm (6 mg/m^3) 15-minute CEILING; NIOSH considers phenyl glycidyl ether to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	10 ppm (60 mg/m^3) TWA
1989 OSHA PEL	1 ppm (6 mg/m^3) TWA
1993-1994 ACGIH TLV	1 ppm (6.1 mg/m^3) TWA
Description of substance	Colorless liquid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 500 ppm -- see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] reported that 10 rats exposed to 100 ppm phenyl glycidyl ether 7 hours/day for 50 days exhibited no immediately obvious signs of toxicity, and no deaths occurred [Hine et al. 1956]. The IDLH is unknown, but for this draft technical standard, 50 × the OSHA PEL of 10 ppm (i.e., 500 ppm) has been chosen as the concentration above which only the "most protective" respirators are permitted. Because of the high boiling point and low vapor pressure of phenyl glycidyl ether, high concentrations are not likely to be encountered in the industrial environment.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hine et al. 1956	>100	-----	8 hr	>250 ppm (2.5)	>25 ppm
Mouse	Hine et al. 1956	>100	-----	4 hr	>200 ppm (2.0)	>20 ppm
Rat	Smyth et al. 1954	>323	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Hine et al. 1956	oral	3,350	-----	4,319 ppm	432 ppm
Mouse	Hine et al. 1956	oral	1,400	-----	1,571 ppm	157 ppm
Mammal	Smyth et al. 1954	oral	4,260	-----	4,779 ppm	478 ppm

Other animal data	In an chronic study, rats exposed to 100 ppm for 7 hours/day for 50 days exhibited no immediately obvious signs of toxicity, and no deaths occurred [Hine et al. 1956].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for phenyl glycidyl ether is 100 ppm based on chronic inhalation toxicity data in animals [Hine et al. 1956]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for phenyl glycidyl ether at concentrations above 1 ppm.]

REFERENCES:

1. ACGIH [1971]. Phenyl glycidyl ether (PGE). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 206-207.
2. Hine CH, Kodama JK, Wellington JS, Dunlap MK, Anderson HH [1956]. The toxicology of glycidol and some glycidyl ethers. AMA Arch Ind Health *14*:250-264.
3. Smyth HF Jr, Carpenter CP, Weil CP, Pozzani UC [1954]. Range-finding toxicity data: list V. AMA Arch Ind Hyg Occup Med *10*:61-68.

Phenylhydrazine

CAS number	100-63-0
NIOSH REL	0.14 ppm (0.6 mg/m³) 2-hr CEILING [skin]; NIOSH considers phenylhydrazine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	5 ppm (22 mg/m³) TWA [skin]
1989 OSHA PEL	5 ppm (20 mg/m³) TWA, 10 ppm (45 mg/m³) STEL [skin]
1993-1994 ACGIH TLV	0.1 ppm (0.44 mg/m³) TWA [skin], A2
Description of substance	Colorless to pale-yellow liquid or solid (below 67°F) with a faint, aromatic odor.
LEL	Unknown
Original (SCP) IDLH*	295 ppm [*Note: "Effective" IDLH = 250 ppm -- see discussion below.]
Basis for original (SCP) IDLH	No data on acute or chronic inhalation toxicity are available on which to base the IDLH. Systemic effects described by Patty [1963] were caused by chronic exposures from oral dosing. NIOSH [1976] cited a rat oral LD_{50} of 188 mg/kg [Ekshtat 1965] which provides a calculated estimate of 1,300 mg/m³ (295 ppm) for the IDLH. Because of the assigned protection factor afforded by each device, however, 50 × the OSHA PEL of 5 ppm (i.e., 250 ppm) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Ekshtat 1965	oral	188	-----	293 ppm	29 ppm
Mouse	Ekshtat 1965	oral	175	-----	273 ppm	27 ppm
Rabbit	Ekshtat 1965	oral	80	-----	125 ppm	13 ppm
G. pig	Ekshtat 1965	oral	80	-----	125 ppm	13 ppm
Dog	Ekshtat 1965	oral	200-250	-----	312-390 ppm	31-39 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 15 ppm
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for phenylhydrazine. Therefore, the revised IDLH for phenylhydrazine is 15 ppm based on acute oral toxicity data in animals [Ekshtat 1965]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for phenyl hydrazine at concentrations above 0.14 ppm.]

REFERENCES:

1. Ekshtat BY [1965]. Maximum permissible concentrations of hydrazine hydrate and phenylhydrazine in water bodies. Gig Sanit *30*(6):191-197 (translated).
2. NIOSH [1976]. MV89250. Hydrazine, phenyl-. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 598.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2227-2228.

Phosdrin

CAS number	7786-34-7
NIOSH REL	0.01 ppm (0.1 mg/m^3) TWA, 0.03 ppm (0.3 mg/m^3) STEL [skin]
Current OSHA PEL	0.1 mg/m^3 TWA [skin]
1989 OSHA PEL	0.01 ppm (0.1 mg/m^3) TWA, 0.03 ppm (0.3 mg/m^3) STEL [skin]
1993-1994 ACGIH TLV	0.01 ppm (0.92 mg/m^3) TWA, 0.03 ppm (0.27 mg/m^3) STEL [skin]
Description of substance	Pale-yellow to orange liquid with a weak odor.
LEL	Unknown
Original (SCP) IDLH	4 ppm
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for Phosdrin. The chosen IDLH has been estimated from the male rat oral LD_{50} of 6 to 7 mg/kg [Shell 1956 cited by ACGIH 1971]. [Note: A concentration of 4 ppm phosdrin is equivalent to about 40 mg/m^3.]
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Kodama et al. 1954	14	-----	1 hr	18 ppm (1.25)	1.8 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kenaga 1979	oral	3	-----	2.3 ppm	0.2 ppm
Mouse	Kodama et al. 1954	oral	4	-----	3.0 ppm	0.3 ppm
Rat	Shell 1956	oral	6-7	-----	4.5-5.3 ppm	0.5 ppm

Human data .... A dose of 2.5 mg/day for 27 days caused a 25% decrease in red blood cell cholinesterase [Rider et al. 1975]. [Note: An oral dose of 2.5 mg/day for 27 days is equivalent to a worker being exposed to about 5 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 4 ppm [Unchanged]
Basis for revised IDLH: Based on acute toxicity data in humans [Rider et al. 1975], the original IDLH for phosdrin (4 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Phosdrin (mevinphos). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 208.
2. Kenaga EE [1979]. Acute and chronic toxicity of 75 pesticides to various animal species. Down to Earth 35:25-31.
3. Kodama J, Morse MS, Anderson HH, Dunlap MK, Hines CH [1954]. Comparative toxicity of two vinyl-substituted phosphates. AMA Arch Ind Hyg Occup Med 9:45-61.
4. Rider JA, Puletti EJ, Swader JI [1975]. The minimal oral toxicity level for mevinphos in man. Toxicol Appl Pharmacol 32(10):97-100.
5. Shell [1956]. Personal communication to ACGIH from the Shell Chemical Corporation, August 31, 1956. [From ACGIH [1991]. Phosdrin. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1044-1046.]

Phosgene

CAS number	75-44-5
NIOSH REL	0.1 ppm (0.4 mg/m³) TWA, 0.2 ppm (0.8 mg/m³) 15-minute CEILING
Current OSHA PEL	0.1 ppm (0.4 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.40 mg/m³) TWA
Description of substance	Colorless gas with a suffocating odor like musty hay.
LEL	Nonflammable Gas
Original (SCP) IDLH	2 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Jacobs [1967] that 1 part in 200,000 (5 ppm) is probably lethal for exposures of 30 minutes. Gross et al. [1965] indicated that concentrations as low as 0.5 ppm for 2 hours caused definite pathological changes in the lungs of rats sacrificed 96 hours post exposure; the investigators believed some abnormalities were present 3 months after rats had been exposed at 2 ppm for 80 minutes. An IDLH of 2 ppm is used for phosgene to prevent irreversible adverse health effects.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs): 1-hour EEGL: 0.2 ppm; 24-hour EEGL: 0.02 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Human	Diller 1978	500	-----	1 min	160 ppm (0.32)	16 ppm
Human	Diller 1978	-----	3	2.83 hr	5.3 ppm (1.78)	0.5 ppm
Human	Diller 1978	-----	30	17 min	25 ppm (0.82)	2.5 ppm
Mammal	Flury 1928	-----	50	5 min	28 ppm (0.55)	2.8 ppm
Human	Izmerov et al. 1982	-----	88	30 min	88 ppm (1.0)	8.8 ppm
Cat	Izmerov et al. 1982	-----	46	15 min	37 ppm (0.79)	3.7 ppm
Rat	NDRC 1946	340	-----	30 min	340 ppm (1.0)	34 ppm
Mouse	NDRC 1946	438	-----	30 min	438 ppm (1.0)	44 ppm
Rabbit	NDRC 1946	243	-----	30 min	243 ppm (1.0)	24 ppm
G. pig	NDRC 1946	316	-----	30 min	316 ppm (1.0)	32 ppm
Dog	NDRC 1946	1,022	-----	20 min	981 ppm (0.96)	98 ppm
Monkey	NDRC 1946	145	-----	1 min	46 ppm (0.32)	4.6 ppm
Human	Tab Biol Per 1933	-----	50	5 min	28 ppm (0.55)	2.8 ppm
Mammal	Tab Biol Per 1933	-----	2.7	30 min	2.7 ppm (1.0)	0.3 ppm

Other animal data	It has been reported that concentrations as low as 0.5 ppm for 2 hours caused definite pathological changes in the lungs of rats sacrificed 96 hours post exposure; the investigators believed some abnormalities were present 3 months after the rats had been exposed at 2 ppm for 80 minutes [Gross et al. 1965].
Other human data	It has been calculated that based on acute toxicity data in humans, the lethal dose for a 30-minute exposure would be about 17 ppm [Diller 1978]. It has been stated that 25 ppm for 30 to 60 minutes is dangerous and brief exposure to 50 ppm may be rapidly fatal [Henderson and Haggard 1943]. It has also been stated that 5 ppm is probably lethal for a 30-minute exposure [Jacobs 1967].

Phosgene (continued)

Revised IDLH: 2 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Diller 1978; Jacobs 1967], the original IDLH for phosgene (2 ppm) is not being revised at this time.

REFERENCES:

1. Diller WF [1978]. Medical phosgene problems and their possible solution. J Occup Med *20*:189-193.
2. Flury F [1928]. Moderne gewerbliche vergiftungen in pharmakologisch-toxikologischer hinsicht (Pharmacological-toxicological aspects of intoxicants in modern industry). Arch Exp Pathol Pharmakol *138*:65-82 (translated).
3. Gross P, Rinehart WE, Hatch T [1965]. Chronic pneumonitis caused by phosgene. Arch Environ Health *10*:768-775.
4. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, pp. 137-138.
5. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 99.
6. Jacobs MB [1967]. The analytical toxicology of industrial inorganic poisons. New York, NY: Interscience Publishers, pp. 648-649.
7. NDRC [1946]. Summary technical report of division 9, NDRC. Vol 1. Chemical warfare agents and related chemical problems. Parts I-II. Washington, DC: National Defence Research Committee, pp. 1-385.
8. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 69-86.
9. Tab Biol Per [1933]; *3*:231 (in German).

Phosphine

CAS number	7803-51-2
NIOSH REL	0.3 ppm (0.4 mg/m^3) TWA, 1 ppm (1 mg/m^3) STEL
Current OSHA PEL	0.3 ppm (0.4 mg/m^3) TWA
1989 OSHA PEL	0.3 ppm (0.4 mg/m^3) TWA, 1 ppm (1 mg/m^3) STEL
1993-1994 ACGIH TLV	0.3 ppm (0.42 mg/m^3) TWA, 1 ppm (1.4 mg/m^3) STEL
Description of substance	Colorless gas with a fish- or garlic-like odor.
LEL	1.79% (10% LEL, 1,790 ppm)
Original (SCP) IDLH	200 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 290 to 430 ppm is dangerous to life after 1 hour, and 100 to 200 ppm is the maximum amount for 0.5 to 1 hour [Henderson and Haggard 1943].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mammal	Flury 1928	-----	1,000	5 min	550 ppm (0.55)	55 ppm
Mouse	Izmerov et al. 1982	-----	270	2 hr	431 ppm (1.6)	43 ppm
G. pig	Izmerov et al. 1982	-----	100	4 hr	200 ppm (2.0)	20 ppm
Cat	Izmerov et al. 1982	-----	50	2 hr	80 ppm (1.6)	8.0 ppm
Rabbit	Schulz 1890	-----	2,500	20 min	2,400 ppm (0.96)	240 ppm
Human	Tab Biol Per 1933	-----	1,000	5 min	550 ppm (0.55)	55 ppm
Rat	Waritz and Brown 1975	11	-----	4 hr	22 ppm (2.0)	2.2 ppm

Other human data .... Symptoms such as diarrhea, nausea and vomiting, tightness of the chest, cough, headache, and dizziness have been reported in workers exposed intermittently to concentrations up to 35 ppm [Jones et al. 1964]. It has been stated that 290 to 430 ppm is dangerous to life after 1 hour, and 100 to 200 ppm is the maximum amount for 0.5 to 1 hour [Henderson and Haggard 1943].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for phosphine is 50 ppm based on acute inhalation toxicity data in humans [Jones et al. 1964; Tab Biol Per 1933]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 35 ppm.

REFERENCES:

1. Flury F [1928]. Moderne gewerbliche vergiftungen in pharmakologisch-toxikologischer hinsicht (Pharmacological-toxicological aspects of intoxicants in modern industry). Arch Exp Pathol Pharmakol *138*:65-82 (translated).
2. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 243.
3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 75.
4. Jones AT, Jones RC, Longley EO [1964]. Environmental and clinical aspects of bulk wheat fumigation with aluminum phosphide. Am Ind Hyg Assoc J *25*:376-379.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 884.
6. Schulz H [1890]. Uber phosphorwasserstoff. Arch Exp Pathol Pharmakol 27:314-335 (in German).
7. Tab Biol Per [1933]; *3*:231 (in German).
8. Waritz RS, Brown RM [1975]. Acute and subacute inhalation toxicities of phosphine, phenylphosphine, and triphenylphosphine. Am Ind Hyg Assoc J *36*:452-458.

Phosphoric acid

CAS number	7664-38-2
NIOSH REL	1 mg/m³ TWA, 3 mg/m³ STEL
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	1 mg/m³ TWA, 3 mg/m³ STEL
1993-1994 ACGIH TLV	1 mg/m³ TWA, 3 mg/m³ STEL
Description of substance	Thick, colorless, odorless, crystalline solid.
LEL	Noncombustible Solid
Original (SCP) IDLH*	10,000 mg/m³ [*Note: "Effective" IDLH = 2,000 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	According to MCA [1958], phosphoric acid does not cause any systemic effect, and the chance of pulmonary edema from mist or spray inhalation is very remote. The rat oral LD_{50} of 1,530 mg/kg [Biofax 1970] cited by NIOSH provides a calculated IDLH of about 10,000 mg/m³. However, for this draft technical standard, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL (i.e., 2,000 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,000 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Biofax 1970	oral	1,530	-----	10,710 mg/m³	1,071 mg/m³

Human data .... It has been stated that phosphoric acid does not cause any systemic effect and that the chance of pulmonary edema from mist or spray inhalation is very remote [MCA 1958].

Revised IDLH: 1,000 mg/m³
Basis for revised IDLH: The revised IDLH for phosphoric acid is 1,000 mg/m³ based on acute oral toxicity data in animals [Biofax 1970]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Biofax [1970]. Data sheet 19-4/70. Northbrook, IL: Biofax Industrial Bio-Test Laboratories, Inc.
2. MCA [1958]. Chemical safety data sheet SD-70: properties and essential information for safe handling and use of phosphoric acid. Washington, DC: Manufacturing Chemists Association, pp. 1-13.
3. NIOSH [1976]. TB63000. Phosphoric acid. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 879.

Phosphorus (yellow)

CAS number	7723-14-0
NIOSH REL	0.1 mg/m³ TWA
Current OSHA PEL	0.1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.02 ppm (0.1 mg/m³) TWA
Description of substance	White to yellow, soft, waxy solid with acrid fumes in air.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 200 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	There is no evidence of an IDLH because, as ACGIH [1971] stated, acute effects rarely result from inhalation of phosphorus vapor. ACGIH [1971] also reported that rabbits survived daily 30-minute exposures to 150 to 160 mg/m³ [Maruo 1955]. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.1 mg/m³ (i.e., 200 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 200 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Cheng-Chun et al. 1975	oral	3.03	-----	21 mg/m³	2.1 mg/m³
Mouse	Cheng-Chun et al. 1975	oral	4.82	-----	34 mg/m³	3.4 mg/m³
Dog	Yakkyoku 1977	oral	-----	10	70 mg/m³	7.0 mg/m³
Cat	Yakkyoku 1977	oral	-----	4	28 mg/m³	4.0 mg/m³

Other animal data	It has been reported that rabbits have survived daily 30-minute exposures to 150 to 160 mg/m³ [Maruo 1955].
Human data	Death has reportedly resulted from a single dose of 1 mg/kg [Smyth 1956]. Severe toxic symptoms have been reported following a single oral dose of 15 mg [Sollmann 1943]. However, survival of ingestion up to 1.5 grams have also been reported [Diza-Rivera et al. 1950; Newburger et al. 1948]. [Note: An oral dose of 15 mg is equivalent to a 70-kg worker being exposed to 10 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 5 mg/m³
Basis for revised IDLH: The revised IDLH for phosphorus (yellow) is 5 mg/m³ based on acute oral toxicity data in humans [Sollmann 1943] and animals [Cheng-Chun et al. 1975; Yakkyoku 1977].

REFERENCES:

1. ACGIH [1971]. Phosphorus (yellow). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 210.
2. Cheng-Chun L, Dilley JV, Hodgson JR, Helton DO, Wiagand WJ, Roberts DN, Anderson BS, Halfpap LM, Kurtz LD [1975]. Mammalian toxicity of munition compounds: phase I. Acute oral toxicity, primary skin and eye irritation, dermal sensitization and disposition and metabolism. Washington, DC: Headquarters, U.S. Army Medical Research and Development Command, Contract DMD-17-74-C-4073.
3. Diaz-Rivera RS, Collazo PJ, Pons ER, Torregrosa MV [1950]. Acute phosphorus poisoning in men. A study of 56 cases. Medicine 29:269-298.

4. Maruo T [1955]. Experimental study on poisoning due to gas of yellow phosphor. Part I. The hemogram of rabbits. Fukuoka Acta Medica *46*:604-615 (in Japanese).
5. Newburger RA, Beaser SB, Schwachman H [1948]. Phosphorus poisoning with recovery accompanied by electrocardiographic changes. Am J Med *4*:927-930.
6. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-165.
7. Sollmann T [1943]. A manual of pharmacology and its applications to therapeutics and toxicology. 6th ed. Philadelphia, PA: W.B. Saunders, pp. 884-889.
8. Yakkyoku (Pharmacy) [1977]; *28*:329 (in Japanese).

Phosphorus pentachloride

CAS number	10026-13-8
NIOSH REL	1 mg/m³ TWA
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.85 mg/m³ (0.1 ppm) TWA
Description of substance	White to pale-yellow, crystalline solid with a pungent, unpleasant odor.
LEL	Noncombustible Solid
Original (SCP) IDLH	200 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with phosphorus trichloride (PCl_3) and statements by Henderson and Haggard [1943] that 2 to 4 ppm PCl_3 is the maximum concentration allowable for short exposures (0.5 to 1 hour) and 50 to 90 ppm is dangerous for short exposures. Therefore, 200 mg/m³ (24 ppm) is chosen as the IDLH for phosphorus pentachloride.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Henderson and Haggard 1943	-----	1,020 mg/m³	10 min	704 mg/m³ (1.45)	70 mg/m³
Rat	Molodkena 1973	205 mg/m³	-----	?	?	?

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Molodkena 1973	oral	660	-----	4,620 mg/m³	462 mg/m³

Other data	The vapors of phosphorus pentachloride decompose in the presence of moisture with the subsequent liberation of hydrochloric and phosphoric acids [Henderson and Haggard 1943].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 70 mg/m³
Basis for revised IDLH: The revised IDLH for phosphorus pentachloride is 70 mg/m³ based on acute inhalation toxicity data in animals [Henderson and Haggard 1943]. This may be a conservative value due to the lack of relevant acute toxicity data for workers. However, an IDLH of 70 mg/m³ for phosphorus pentachloride (PCl_5) is roughly equivalent on a "chlorine basis" to the revised IDLH of 50 ppm (i.e., 75 mg/m³) for hydrogen chloride (HCl) which may be appropriate since PCl_5 decomposes in the presence of moisture to HCl [Henderson and Haggard 1943].

REFERENCES:

1. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 134.
2. Molodkena NN [1973]. Toxicological comparisons of chlorine phosphate compounds ($POCl_3$, PCl_3, PCl_5) by single and repeated exposures. Toksikol Nov Prom Khim Vesh *13*:104 (in Russian).

Phosphorus pentasulfide

CAS number	1314-80-3
NIOSH REL	1 mg/m³ TWA, 3 mg/m³ STEL
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	1 mg/m³ TWA, 3 mg/m³ STEL
1993-1994 ACGIH TLV	1 mg/m³ TWA, 3 mg/m³ STEL
Description of substance	Greenish-gray to yellow, crystalline solid with an odor of rotten eggs.
LEL	Unknown
Original (SCP) IDLH	750 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for phosphorus pentasulfide (P_2S_5). MCA [1958] reported that "P_2S_5 is a compound which by itself possesses little toxicity; P_2S_5, however, hydrolyses [sic] rapidly on contact with water or even with moisture present in the atmosphere to cause the liberation of hydrogen sulfide (H_2S) gas." For this draft technical standard, therefore, the chosen IDLH has been based on an analogy with H_2S assuming complete conversion of P_2S_5 into H_2S gas. [Note: The complete conversion of 750 mg/m³ of P_2S_5 will result in about 400 ppm H_2S.]. Patty [1963] reported that 400 to 700 ppm H_2S is dangerous after exposure for 0.5 to 1 hour [Henderson and Haggard 1943]. The chosen IDLH for H_2S is 300 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Marhold 1972	oral	389	-----	2,723 mg/m³	272 mg/m³

Other data	Phosphorus pentasulfide (P_2S_5) rapidly hydrolyzes to hydrogen sulfide (H_2S) and phosphoric acid on contact with water or with moisture present in the air [ACGIH 1991].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 250 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for phosphorus pentasulfide (P_2S_5). Therefore, the revised IDLH for phosphorus pentasulfide is 250 mg/m³ based on acute oral toxicity data in animals [Marhold 1972] and an analogy to hydrogen sulfide [ACGIH 1991] which has a revised IDLH of 150 ppm. [Note: The complete conversion of 270 mg/m³ P_2S_5 will result in 150 ppm H_2S.]

REFERENCES:

1. ACGIH [1991]. Phosphorus pentasulfide. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1259-1260.
2. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 245.
3. Marhold JV [1972]. Sbornik vysledku toxixologiekeho vysetreni latek a pripravku. Prague, Czechoslovakia: Institut Prumyclu, p. 16 (in Czechoslovakian).
4. MCA [1958]. Chemical safety data sheet SD-71: properties and essential information for safe handling and use of phosphorus pentasulfide. Washington, DC: Manufacturing Chemists Association, pp. 1-14.
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 899.

Phosphorus trichloride

CAS number 7719-12-2
NIOSH REL .... 0.2 ppm (1.5 mg/m^3) TWA, 0.5 ppm (3 mg/m^3) STEL
Current OSHA PEL .... 0.5 ppm (3 mg/m^3) TWA
1989 OSHA PEL .... 0.2 ppm (1.5 mg/m^3) TWA, 0.5 ppm (3 mg/m^3) STEL
1993-1994 ACGIH TLV .... 0.2 ppm (1.1 mg/m^3) TWA, 0.5 ppm (2.8 mg/m^3) STEL
Description of substance .... Colorless to yellow, fuming liquid with an odor like hydrochloric acid.
LEL .... Noncombustible Liquid
Original (SCP) IDLH .... 50 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that serious disturbances in animals resulted from exposure to 50 to 90 ppm for 1 hour [Butjagin 1904].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Weeks et al. 1964	104	-----	4 hr	208 ppm (2.0)	21 ppm
G. pig	Weeks et al. 1964	50	-----	4 hr	100 ppm (2.0)	10 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Parent 1990	oral	18	-----	22 ppm	2.2 ppm

Other animal data .... Cats and guinea pigs exposed for 6 hours at 0.7 ppm showed only mild signs of intoxication and a 1-hour exposure at 2 to 4 ppm failed to produce severe signs of poisoning; however, a single 1-hour exposure at 50 to 90 ppm resulted in serious disturbances [Butjagin 1904].
Human data .... Workers exposed to concentrations ranging from 1.8 to 27 ppm had symptoms that included burning of the eyes and throat, irritation of the pharyngeal mucous membranes, and mild bronchitis within 2 to 6 hours after exposure [Sassi 1952].

Revised IDLH: 25 ppm
Basis for revised IDLH: The revised IDLH for phosphorus trichloride is 25 ppm based on acute inhalation toxicity data in humans [Sassi 1952] and animals [Butjagin 1904; Weeks et al. 1964].

REFERENCES:

1. ACGIH [1971]. Phosphorus trichloride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 211-212.
2. Butjagin PW [1904]. Experimental studies on the effect of technically and hygienically important gases on the organism. Part XII. Studies on phosphorus trichloride. Arch Hyg 49:307-335 (in German). [From ACGIH [1971]. Phosphorus trichloride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 211-212.]
3. Parent RA, ed. [1990]. Acute toxicity data. J Am Coll Toxicol, Part B 1:71.
4. Sassi C [1952]. Occupational poisoning with phosphorus trichloride. Med Lav 43:298-308 (in Italian).
5. Weeks MH, Musselman NP, Yevich PP, Jacobson KH, Oberst FW [1964]. Acute vapor toxicity of phosphorus oxychloride phosphorus trichloride and methyl phosphoric dichloride. Am Ind Hyg Assoc J 25:470-475.

Phthalic anhydride

CAS number	85-44-9
NIOSH REL	6 mg/m³ (1 ppm) TWA
Current OSHA PEL	12 mg/m³ (2 ppm) TWA
1989 OSHA PEL	6 mg/m³ (1 ppm) TWA
1993-1994 ACGIH TLV	6.1 mg/m³ (1 ppm) TWA
Description of substance	White solid (flake) or a clear, colorless, mobile liquid (molten) with a characteristic, acrid odor.
LEL	1.7% (10% LEL, 10,500 mg/m³)
Original (SCP) IDLH	10,000 mg/m³
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available on which to base an IDLH for phthalic anhydride, the chosen IDLH is based on repeated exposure data. AIHA [1967] reported that exposure of rats and rabbits to 10,000 mg/m³ for 4 hours/day for several days produced a 25% fatality rate [Malten and Zielhuis 1964].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Biofax 1970	oral	4,020	-----	28,140 mg/m³	2,814 mg/m³
Mouse	Izmerov et al. 1982	oral	1,520	-----	10,500 mg/m³	1,050 mg/m³
Cat	Marhold 1986	oral	800	-----	5,600 mg/m³	560 mg/m³
Rat	Patty 1963	oral	800-1,600	-----	5,600-11,200 mg/m³	560-1,120 mg/m³
Mouse	Zhilova and Kasparov 1969	oral	2,210	-----	15,470 mg/m³	1,547 mg/m³

Other animal data	It has been reported that exposure of rats and rabbits to 10,000 mg/m³ for 4 hours/day for several days produced a 25% fatality rate [Malten and Zielhuis 1964].
Human data	It has been reported that an exposure of 30 mg/m³ is associated with conjunctivitis, while 25 mg/m³ is associated with signs of mucous membrane irritation [Baader 1955]. It has been stated that phthalic anhydride has similar toxic effects (i.e., irritation of the skin, eyes, and upper respiratory system) as maleic anhydride, but has reduced potency [ACGIH 1991].

Revised IDLH: 60 mg/m³
Basis for revised IDLH: Based on acute toxicity data in animals [Biofax 1970; Izmerov et al. 1982; Malten and Zielhuis 1964; Marhold 1986; Patty 1963; Zhilova and Kasparov 1969], a value between 600 and 3,000 mg/m³ would have been appropriate. However, the revised IDLH for phthalic anhydride is 60 mg/m³ (i.e., 10 times the NIOSH REL) based on acute inhalation data in humans [Baader 1955] and an analogy to maleic anhydride [ACGIH 1991] which has a revised IDLH that is 10 times its NIOSH REL. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 30 mg/m³.

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2. AIHA [1967]. Phthalic anhydride. In: Hygienic guide series. Am Ind Hyg Assoc J *28*:395-398.
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5. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 322.
6. Malten KE, Zielhuis RL [1964]. Alkyd resins. In: Industrial toxicology and dermatology in the production and processing of plastics. Amsterdam, The Netherlands: Elsevier Publishing Company, pp. 59-70.
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Picric acid

CAS number	88-89-1
NIOSH REL	0.1 mg/m³ TWA, 0.3 mg/m³ STEL [skin]
Current OSHA PEL	0.1 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA
Description of substance	Yellow, odorless solid.
LEL	Unknown
Original (SCP) IDLH	100 mg/m³
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available on which to base an IDLH for picric acid, the chosen IDLH has been estimated from data concerning the oral toxicity. According to ACGIH [1971], the ingestion of 1 or 2 grams of picric acid in man causes severe poisoning.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	Flury and Zernik 1935	oral	-----	100	700 mg/m³	70 mg/m³
Cat	Flury and Zernik 1935	oral	-----	250	1,750 mg/m³	175 mg/m³
Rabbit	von Ottingen 1941	oral	-----	120	940 mg/m³	84 mg/m³

Human data .... The ingestion of 1 to 2 grams of picric acid has been reported to cause severe poisoning [ACGIH 1991]. [Note: An oral dose of 1 to 2 grams is equivalent to a worker being exposed to 660 to 1,330 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 75 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for picric acid. Therefore, the revised IDLH for picric acid is 75 mg/m³ based on acute oral toxicity data in humans [ACGIH 1991] and animals [Flury and Zernik 1935; von Ottingen 1941].

REFERENCES:

1. ACGIH [1971]. Picric acid. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 212-213.
2. ACGIH [1991]. Picric acid. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1271-1273.
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Pindone

CAS number	83-26-1
NIOSH REL	0.1 mg/m³ TWA
Current OSHA PEL	0.1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA
Description of substance	Bright-yellow powder with almost no odor.
LEL	Unknown
Original (SCP) IDLH	200 mg/m³
Basis for original (SCP) IDLH	According to ACGIH [1971], the critical rodenticidal dosages of Pival® (pindone) and warfarin are similar. Therefore, the chosen IDLH is based on an analogy with warfarin which has an IDLH of 200 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Gaines 1960	oral	280	-----	1,960 mg/m³	196 mg/m³
Dog	Klimmer 1971	oral	75	-----	525 mg/m³	53 mg/m³
Rabbit	Perkow 1971/1976	oral	150	-----	1,050 mg/m³	105 mg/m³

Other animal data	It has been reported that the critical rodenticidal dosages of Pival® (pindone) and warfarin are similar [ACGIH 1971].
Human data	It has been reported that 50 to 500 mg/kg is the probable lethal oral dose [Gosselin et al. 1984]. [Note: An oral dose of 50 to 500 mg/kg is equivalent to a 70-kg worker being exposed to about 2,330 to 23,300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 100 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for pindone. Therefore, the revised IDLH for pindone is 100 mg/m³ based on acute oral toxicity data in humans [Gosselin et al. 1984] and animals [Gaines 1960; Klimmar 1971; Perkow 1971/1976] and an analogy to warfarin [ACGIH 1971] which has a revised IDLH of 100 mg/m³.

REFERENCES:

1. ACGIH [1971]. Pival (2-pivalyl-1,3-inandione). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 213.
2. Gaines TB [1960]. The acute toxicity of pesticides to rats. Toxicol Appl Pharmacol 2:88-99.
3. Gosselin RG, Smith RP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Baltimore, MD: Williams & Wilkins Company, p. II-348.
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Platinum (soluble salts, as Pt)

CAS number	Varies
NIOSH REL	0.002 mg/m^3 TWA
Current OSHA PEL	0.002 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.002 mg/m^3 TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 4 mg Pt/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	Air concentrations at or slightly above the OSHA PEL for soluble platinum salts can elicit an allergic response in sensitized workers. Therefore, the IDLH cannot be set to protect these sensitized individuals. The available toxicological data do not indicate any toxic effects in nonsensitized individuals. Because there is no evidence of an IDLH for nonsensitized individuals, for this draft technical standard, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.002 mg Pt/m^3 (i.e., 4 mg Pt/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 4 mg Pt/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 4 mg Pt/m^3

Basis for revised IDLH: Since the available toxicological data do not indicate any acute toxic effects in nonsensitized individuals, the revised IDLH for soluble platinum salts is 4 mg Pt/m^3 based on being 2,000 times the NIOSH REL or OSHA PEL (2,000 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for soluble platinum salts). Since air concentrations of soluble platinum salts slightly above the NIOSH REL and OSHA PEL can elicit allergic responses in sensitized individuals, the revised IDLH cannot be set to protect these sensitized individuals.

Portland cement

CAS number	65997-15-1
NIOSH REL	10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
Current OSHA PEL	50 mppcf TWA
1989 OSHA PEL	10 mg/m³ (total dust) TWA, 5 mg/m³ (respirable dust) TWA
1993-1994 ACGIH TLV	10 mg/m³ (total dust) TWA
Description of substance	Gray, odorless powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 25,000 mppcf – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that an acute exposure to a high air concentration of Portland cement would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 50 mppcf is 25,000 mppcf).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 5,000 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of Portland cement would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for portland cement is 5,000 mg/m³ based on being 500 times the NIOSH REL of 10 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Propane

CAS number	74-98-6
NIOSH REL	1,000 ppm (1,800 mg/m³) TWA
Current OSHA PEL	1,000 ppm (1,800 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	Simple asphyxiant
Description of substance	Colorless, odorless gas.
LEL	2.1% (10% LEL, 2,100 ppm)
Original (SCP) IDLH	20,000 ppm [LEL]
Basis for original (SCP) IDLH	Propane is a simple asphyxiant and does not present an IDLH hazard at concentrations below its lower explosive limit (LEL). The chosen IDLH is based on the LEL of 21,000 ppm rounded down to 20,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	None relevant for use in determining the revised IDLH.
Human data	It has been reported that brief inhalation exposures to 10,000 ppm propane cause no symptoms in humans [Braker and Mossman 1980]. Propane is considered to be a simple asphyxiant [ACGIH 1991].

Revised IDLH: 2,100 ppm [LEL]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [ACGIH 1991; Braker 1980], a value much greater than 10,000 ppm would have been appropriate. However, the revised IDLH for propane is 2,100 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2.1%).

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n-Propyl acetate

CAS number 109-60-4
NIOSH REL .... 200 ppm (840 mg/m^3) TWA, 250 ppm (1,050 mg/m^3) STEL
Current OSHA PEL .... 200 ppm (840 mg/m^3) TWA
1989 OSHA PEL .... 200 ppm (840 mg/m^3) TWA, 250 ppm (1,050 mg/m^3) STEL
1993-1994 ACGIH TLV .... 200 ppm (835 mg/m^3) TWA, 250 ppm (1,040 mg/m^3) STEL
Description of substance .... Colorless liquid with a mild, fruity odor.
LEL(@100°F) .... 1.7% (10% LEL(@100°F), 1,700 ppm)
Original (SCP) IDLH .... 8,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1971] that a 4-hour exposure to 8,000 ppm was fatal to 4 of 6 rats [Smyth et al. 1954].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Flury and Wirth 1933	-----	8,941	5 hr	19,223 ppm (2.15)	1,922 ppm
Rat	Smyth et al. 1969	LC_{67}: 8,000	-----	4 hr	16,000 ppm (2.0)	1,600 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Jenner et al. 1964	oral	9,370	-----	15,433 ppm	1,543 ppm
Mouse	Jenner et al. 1964	oral	8,300	-----	13,671 ppm	1,367 ppm
Rabbit	Munch 1972	oral	6,640	-----	10,936 ppm	1,094 ppm
Rat	Smyth et al. 1969	oral	8,700	-----	14,329 ppm	1,433 ppm

Other animal data .... It has been reported that based on acute inhalation studies, n-propyl acetate appears to be more toxic than isopropyl acetate and ethyl acetate but less toxic than n-butyl acetate [ACGIH 1991].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1,700 ppm
Basis for revised IDLH: The revised IDLH for n-propyl acetate is 1,700 ppm based on acute inhalation toxicity data in animals [Flury and Wirth 1933; Smyth et al. 1969]. The revised IDLH is roughly the same as the revised IDLHs for ethyl acetate and n-butyl acetate and is also 10% of the lower explosive limit of 1.7% (which was determined at 100°F). This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

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5. Munch JC [1972]. Aliphatic alcohols and alkyl esters: narcotic and lethal potencies to tadpoles and to rabbits. Ind Med Surg *41*:31-33.
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n-Propyl alcohol

CAS number	71-23-8
NIOSH REL	200 ppm (500 mg/m^3) TWA, 250 ppm (625 mg/m^3) STEL [skin]
Current OSHA PEL	200 ppm (500 mg/m^3) TWA
1989 OSHA PEL	200 ppm (500 mg/m^3) TWA, 250 ppm (625 mg/m^3) STEL
1993-1994 ACGIH TLV	200 ppm (492 mg/m^3) TWA, 250 ppm (614 mg/m^3) STEL [skin]
Description of substance	Colorless liquid with a mild, alcohol-like odor.
LEL	2.2% (10% LEL, 2,200 ppm)
Original (SCP) IDLH	4,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that 2 of 6 rats died following a 4-hour exposure to 4,000 ppm [Smyth et al. 1954]. In addition, Patty [1963] reported that deep narcosis was produced in 2 mice exposed to 4,100 ppm for 4 hours [Starrek 1938].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Smyth et al. 1954	LC_{33}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Munch and Schwartze 1925	oral	2,800	-----	7,840 ppm	784 ppm
Mouse	Savini 1968	oral	6,800	-----	19,040 ppm	1,904 ppm
Rat	Smyth et al. 1954	oral	1,870	-----	5,236 ppm	524 ppm

Other animal data	RD_{50} (mouse), 12,704 ppm [Alarie 1981]. It has been reported that deep narcosis was produced in 2 mice exposed to 4,100 ppm for 4 hours [Starrek 1938].
Human data	Mild irritation of the eyes, nose, and throat have been reported at 400 ppm [Nelson et al. 1943]. It has been reported that 5,700 mg/kg is the lethal oral dose [Durwald and Degen 1956]. [Note: An oral dose of 5,700 mg/kg is equivalent to a 70-kg worker being exposed to about 94,000 ppm for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 800 ppm
Basis for revised IDLH: The revised IDLH for n-propyl alcohol is 800 ppm based on acute inhalation toxicity data in humans [Nelson et al. 1943] and animals [Smyth et al. 1954]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 400 ppm.

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1. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.
2. Durwald W, Degen W [1956]. Eine todliche vergiftung mit n-propyl alkohol. Arch Toxikol *16*:85 (in German). [From ACGIH [1991]. n-Propyl alcohol. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1301-1302.]
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n-Propyl alcohol (continued)

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Propylene dichloride

CAS number 78-87-5
NIOSH REL .... None established; NIOSH considers propylene dichloride to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 75 ppm (350 mg/m³) TWA
1989 OSHA PEL .... 75 ppm (350 mg/m³) TWA, 110 ppm (510 mg/m³) STEL
1993-1994 ACGIH TLV .... 75 ppm (347 mg/m³) TWA, 110 ppm (508 mg/m³) STEL
Description of substance .... Colorless liquid with a chloroform-like odor.
LEL .... 3.4% (10% LEL, 3,400 ppm)
Original (SCP) IDLH .... 2,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the rat 4-hour LC_{50} of 2,000 ppm [Carpenter et al. 1949 cited by Spector 1956].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	2,000	-----	4 hr	4,000 ppm (2.0)	400 ppm
Mouse	Clayton and Clayton 1981	720	-----	10 hr	1,944 ppm (2.7)	194 ppm
Rat	Pozzani et al. 1959	2,980	-----	8 hr	7,450 ppm (2.5)	745 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Marhold 1986	oral	860	-----	1,281 ppm	128 ppm
Rat	Pozzani et al. 1959	oral	1,947	-----	2,900 ppm	290 ppm
G. pig	Sine 1993	oral	2,000	-----	3,111 ppm	311 ppm

Other animal data .... Animals exposed to 400 ppm for 7 hours per day, 5 days per week for 128 to 140 exposures had no histologic changes [Heppel et al. 1948].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for propylene dichloride is 400 ppm based on inhalation toxicity data in animals [Carpenter et al. 1949; Heppel et al. 1948]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for propylene dichloride at any detectable concentration.]

REFERENCES:

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Propylene imine

CAS number 75-55-8
NIOSH REL .... 2 ppm (5 mg/m^3) TWA [skin]; NIOSH considers propylene imine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 2 ppm (5 mg/m^3) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 2 ppm (4.7 mg/m^3) TWA [skin], A2
Description of substance .... Colorless, oily liquid with an ammonia-like odor.
LEL .... Unknown
Original (SCP) IDLH .... 500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by Patty [1963] that 5 of 6 rats died from a 4-hour exposure to 500 ppm and 3 of 5 guinea pigs died from a 2-hour exposure to 500 ppm; at 500 ppm, rats survived a 2-hour exposure, and guinea pigs survived a 30-minute exposure [Carpenter et al. 1948].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	500	4 hr	1,000 ppm (2.0)	100 ppm
G. pig	Carpenter et al. 1948	LC_{17} : 500	-----	1 hr	625 ppm (1.25)	63 ppm
G. pig	Carpenter et al. 1948	LC_{66} : 500	-----	2 hr	800 ppm (1.6)	80 ppm
G. pig	Carpenter et al. 1948	LC_{100}: 500	-----	4 hr	1,000 ppm (2.0)	100 ppm
Rat	Carpenter et al. 1948	LC_{83} : 500	-----	4 hr	1,000 ppm (2.0)	100 ppm

Other animal data .... It has been reported that rats survived a 2-hour exposure to 500 ppm and guinea pigs survived a 30-minute exposure to 500 ppm [Carpenter et al. 1948].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for propylene imine is 100 ppm based on acute inhalation toxicity data in animals [Carpenter et al. 1948, 1949]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for propylene imine at concentrations above 2 ppm.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity, and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-348.
2. Carpenter CP, Smyth HF Jr, Shaffer CB [1948]. The acute toxicity of ethylene imine to small animals. J Ind Hyg Toxicol *30*:2-6.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2175.

Propylene oxide

CAS number	75-56-9
NIOSH REL	None established; NIOSH considers propylene oxide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	100 ppm (240 mg/m³) TWA
1989 OSHA PEL	20 ppm (50 mg/m³) TWA
1993-1994 ACGIH TLV	20 ppm (48 mg/m³) TWA
Description of substance	Colorless liquid with a benzene-like odor.
LEL	2.3% (10% LEL, 2,300 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the dog 4-hour LC_{LO} of 2,005 ppm and the mouse 4-hour LC_{50} of 1,740 ppm [Jacobson et al. 1956 cited by NIOSH 1976].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Jacobson et al. 1956	1,740	-----	4 hr	3,480 ppm (2.0)	348 ppm
Dog	Jacobson et al. 1956	-----	2,005	4 hr	4,010 ppm (2.0)	401 ppm
Rat	Jacobson et al. 1956	4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
G. pig	Rowe et al. 1956	-----	4,000	4 hr	8,000 ppm (2.0)	800 ppm
Rat	Smyth et al. 1969	LC_{67}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	Gig Tr Prof Zabol 1981	oral	660	-----	1,909 ppm	191 ppm
Rat	Pugaeva et al. 1970	oral	380	-----	1,099 ppm	110 ppm
Mouse	Pugaeva et al. 1970	oral	440	-----	1,273 ppm	127 ppm
Rat	Smyth et al. 1941	oral	1,140	-----	3,298 ppm	330 ppm
G. pig	Smyth et al. 1941	oral	690	-----	4,830 ppm	483 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for propylene oxide is 400 ppm based on acute inhalation toxicity data in animals [Jacobson et al. 1956]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for propylene oxide at any detectable concentration.]

REFERENCES:

1. Gig Tr Prof Zabol [1981]; *46*(7):76 (in Russian).
2. Jacobson KH, Hackley EB, Feinsilver L [1956]. The toxicity of inhaled ethylene oxide and propylene oxide vapors. Acute and chronic toxicity of ethylene oxide and acute toxicity of propylene oxide. AMA Arch Ind Health *13*(3):237-244.
3. NIOSH [1976]. TZ29750. Propane, 1,2-epoxy-. In: Registry of toxic effects of chemical substances, 1976 ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 968.
4. Pugaeva VP, Klochkova SE, et al. [1970]. Experimental materials on hygienic reglamentation of propylene oxide. Gig Tr Prof Zabol *14*(11):55-57 (in Russian).

Propylene oxide (continued)

5. Rowe VK, Hollingsworth RL, Oyen F, McCollister DD, Spencer HC [1956]. Toxicity of propylene oxide determined on experimental animals. AMA Arch Ind Health *13*:228-236.
6. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA, Nycum JS [1969]. Range-finding toxicity data: list VII. Am Ind Hyg Assoc J *30*(5):470-476.
7. Smyth HF, Seaton J, Fisher L [1941]. The single dose toxicity of some glycols and derivatives. J Ind Hyg Toxicol *23*:259-268.

n-Propyl nitrate

CAS number	627-13-4
NIOSH REL	25 ppm (105 mg/m^3) TWA, 40 ppm (170 mg/m^3) STEL
Current OSHA PEL	25 ppm (110 mg/m^3) TWA
1989 OSHA PEL	25 ppm (105 mg/m^3) TWA, 40 ppm (170 mg/m^3) STEL
1993-1994 ACGIH TLV	25 ppm (107 mg/m^3) TWA, 40 ppm (172 mg/m^3) STEL
Description of substance	Colorless to straw-colored liquid with an ether-like odor.
LEL	2% (10% LEL, 2,000 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that the dog 4-hour LC_{50} is 2,000 to 2,500 ppm [Rinehart et al. 1958].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Hood 1953	-----	10,000	4 hr	20,000 ppm (2.0)	2,000 ppm
Rat	Rinehart et al. 1958	-----	9,000-10,000	4 hr	18,000-20,000 ppm (2.0)	1,800-2,000 ppm
Mouse	Rinehart et al. 1958	-----	6,000- 7,000	4 hr	12,000-14,000 ppm (2.0)	1,200-1,400 ppm
Dog	Rinehart et al. 1958	-----	2,000- 2,500	4 hr	4,000- 5,000 ppm (2.0)	400- 500 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for n-propyl nitrate is 500 ppm based on acute inhalation toxicity data in animals [Rinehart et al. 1958].

REFERENCES:

1. ACGIH [1971]. n-Propyl nitrate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 217-218.
2. Hood DB [1953]. Toxicity of n-propyl nitrate and isopropyl nitrate. Report No. 21-53, Medical Research Project No. MR-170. Newark, DE: E.I. du Pont de Nemours & Co., Inc., Haskell Laboratory for Toxicology and Industrial Medicine.
3. Rinehart WE, Garbers RC, Greene EA, Stoufer RM [1958]. Studies on the toxicity of n-propyl nitrate vapor. Am Ind Hyg Assoc J *19*:80-83.

Pyrethrum

CAS number	8003-34-7
NIOSH REL	5 mg/m^3 TWA
Current OSHA PEL	5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m^3 TWA
Description of substance	Brown, viscous oil or solid.
LEL	Unknown
Original (SCP) IDLH	5,000 mg/m^3
Basis for original (SCP) IDLH	The chosen IDLH has been estimated from the rat oral LD_{50} of 820 mg/kg [Carpenter et al. 1950 cited by ACGIH 1971]. In addition, ACGIH [1971] reported that rats experienced moderate lung congestion when exposed for 30 minutes to 6,000 mg/m^3 pyrethrum in peanut oil [Carpenter et al. 1950].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Carpenter et al. 1950	oral	820	-----	5,740 mg/m^3	574 mg/m^3
Rat	Hayes 1982	oral	200-1,870	-----	1,400-13,090 mg/m^3	140-1,309 mg/m^3
Rat	Malone and Brown 1968	oral	273- 796	-----	1,911- 5,572 mg/m^3	191- 557 mg/m^3
Mouse	Miyamoto 1976	oral	370	-----	2,590 mg/m^3	259 mg/m^3
G. pig	Shimkin and Anderson 1936	oral	-----	1,000	7,000 mg/m^3	700 mg/m^3

Other animal data	It has been reported that rats experienced moderate lung congestion when exposed for 30 minutes to 6,000 mg/m^3 pyrethrum in peanut oil [Carpenter et al. 1950].
Human data	It has been estimated that the fatal human dose might be between 1 and 2 g/kg [Gosselin et al. 1984; Lehman 1949]. [Note: An oral dose of 1 to 2 g/kg is equivalent to a 70-kg worker being exposed to about 47,000 to 93,000 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 5,000 mg/m^3 [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for pyrethrum. Therefore, based on acute oral toxicity data in humans [Gosselin et al. 1984; Lehman 1949], the original IDLH for pyrethrum (5,000 mg/m^3) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Pyrethrum. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 219-220.
2. Carpenter CP, Weil CS, Pozzani UC, Smyth HF Jr [1950]. Comparative acute and subacute toxicities of allethrin and pyrethrins. AMA Arch Ind Hyg Occup Med 2:420-432.
3. Gosselin RE, Smith HP, Hodge HC [1984]. Clinical toxicology of commercial products. 5th ed. Section III. Therapeutics Index. Baltimore, MD: Williams & Wilkins Company, pp. 352-355.
4. Hayes WJ Jr [1982]. Pesticides studied in man. Baltimore, MD: Williams & Wilkins Company, pp. 75-80.
5. Lehman AJ [1949]. Pharmacological considerations of insecticides. Q Bulletin Assoc Food Drug Off U.S. *13*(2):65-70.
6. Malone JC, Brown NC [1968]. Toxicity of various grades of pyrethrum to laboratory animals. Pyrethrum Post 9:3-8.
7. Miyamoto J [1976]. Degradation, metabolism and toxicity of synthetic pyrethroids. Environ Health Perspect *14*:15-28.
8. Shimkin MB, Anderson HH [1936]. Acute toxicities of rotenone and mixed pyrethrins in mammals. Proc Soc Exp Biol Med *34*:135-138.

Pyridine

CAS number 110-86-1
NIOSH REL .... 5 ppm (15 mg/m³) TWA
Current OSHA PEL .... 5 ppm (15 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 5 ppm (16 mg/m³) TWA
Description of substance .... Colorless to yellow liquid with a nauseating, fish-like odor.
LEL .... 1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH .... 3,600 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Patty [1963] that 2 of 3 rats died following a 6-hour exposure to 3,600 ppm [Fassett and Roudabush 1953].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Fassett and Roudabush 1953	LC_{67}: 3,600	-----	6 hr	8,280 ppm (2.3)	828 ppm
Rat	Smyth et al. 1951	LC_{33}: 4,000	-----	4 hr	8,000 ppm (2.0)	800 ppm
Rat	Vernot et al. 1977	9,000	-----	1 hr	11,250 ppm (1.25)	1,125 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Biofax 1970	oral	891	-----	1,896 ppm	190 ppm
Mouse	Leslie et al. 1973	oral	1,500	-----	3,191 ppm	319 ppm
Rat	Smyth et al. 1951	oral	1,580	-----	3,362 ppm	386 ppm

Human data .... Nausea, headache, insomnia, nervousness, and low back or abdominal discomfort with urinary frequency have occurred in individuals exposed to concentrations averaging 125 ppm for 4 hours/day for 1 to 2 weeks [Patty 1963]. Chronic poisoning with mild symptoms of central nervous system injury occurred in workers at a plant where pyridine vapor concentrations ranged from 6 to 12 ppm [Teisinger 1948].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for pyridine is 1,000 ppm based on acute inhalation toxicity data in animals [Vernot et al. 1977].

REFERENCES:

1. Biofax [1970]. Data sheet 14. Northbrook, IL: Biofax Industrial Bio-Test Laboratories, Inc.
2. Fassett DW, Roudabush RL [1953]. Toxicity of pyridine derivatives with relationship to chemical structure. Unpublished paper presented to the American Industrial Hygiene Association Conference, Los Angeles, CA.
3. Leslie GB, Hanahoe THP, Ireson JD, Sturman G [1973]. Some pharmacological properties of pyridine. Pharmacol Res Commun 5(4):341-365.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., pp. 2190, 2727-2731.
5. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med 4:119-122.
6. Teisinger J [1948]. Mild chronic intoxication with pyridine. Czech Med J 39(1947); abstracted in J Ind Hyg Toxicol 30:58. [From ACGIH [1991]. Pyridine. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1328-1330.]
7. Vernot EH, MacEwen JD, Haun CC, Kinkead ER [1977]. Acute toxicity and skin corrosion data for some organic and inorganic compounds and aqueous solutions. Toxicol Appl Pharmacol 42(2):417-423.

Quinone

CAS number	106-51-4
NIOSH REL	0.4 mg/m^3 (0.1 ppm) TWA
Current OSHA PEL	0.4 mg/m^3 (0.1 ppm) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.44 mg/m^3 (0.1 ppm) TWA
Description of substance	Pale-yellow solid with an acrid, chlorine-like odor.
LEL	Unknown
Original (SCP) IDLH	300 mg/m^3
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse LC_{LO} of 320 mg/m^3 [Zabolevanii 1962 cited by NIOSH 1976]. No other data on acute inhalation toxicity are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mammal	Izmerov et al. 1982	s.c.	296	-----	2,072 mg/m^3	207 mg/m^3
Mouse	Marquardt et al. 1947	s.c.	93.8	-----	657 mg/m^3	66 mg/m^3
Mouse	Serif and Seymour 1963	i.p.	8.5	-----	60 mg/m^3	6.0 mg/m^3
Rat	Tomchin et al. 1978	?	5.6	-----	39 mg/m^3	3.9 mg/m^3
Rat	Woodward et al. 1949	oral	130	-----	910 mg/m^3	91 mg/m^3
Rat	Woodward et al. 1949	i.v.	25	-----	175 mg/m^3	18 mg/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for quinone. Therefore, the revised IDLH for quinone is 100 mg/m^3 based on acute oral toxicity data in animals [Woodward et al. 1949]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 25.
2. Marquardt P, Koch R, Aubert J-P [1947]. Die toxizität der ein-, zwei- und dreiwertigen phenole. Zeit Ges Med Gren 2:333 (in German).
3. NIOSH [1976]. DK26250. p-Benzoquinone. In: Registry of toxic effects of chemical substances, 1976 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 202.
4. Serif GS, Seymour LE [1963]. Catabolism and excretion of the antithyroid substance, diacetyl-2,6-diiodohydroquinone. Biochem Pharmacol *12*:885-891.
5. Tomchin AB, Aleksandrova AE, Vinogradov VM [1978]. Structure and anti-hypoxic activity of alpha-dicarbonyl compounds and their derivatives. Farmakol Toxsikol *41*(4):482-491 (in Russian).
6. Woodward G, Hagan EC, Radomski JL [1949]. Toxicity of hydroquinone for laboratory animals. Fed Proc *8*:348.
7. Zabolevanii Prof. Khim. Etiol. Sb. [1962]. Prom Toksikol Klin, p. 137 (in Russian). [From NIOSH [1976]. DK26250. p-Benzoquinone. In: Registry of toxic effects of chemical substances, 1976 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76-191, p. 202.]

Rhodium (metal fume and insoluble compounds, as Rh)

CAS number .... 7440-16-6 (Metal)
NIOSH REL .... 0.1 mg/m³ TWA
Current OSHA PEL .... 0.1 mg/m³ TWA
OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 1 mg/m³ TWA
Description of substance .... Varies
Original (SCP) IDLH* .... No Evidence [*Note: "Effective" IDLH = 200 mg Rh/m³ -- see discussion below.]
Basis for original (SCP) IDLH .... Because no evidence of an IDLH for rhodium (metal fume and insoluble compounds) is available, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.1 mg Rh/m³ (i.e., 200 mg Rh/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 200 mg Rh/m³.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$RhCl_3$						
Rat	Johnson 1981	oral	>500	-----	>1,778 mg Rh/m³	>179 mg Rh/m³
Rat	Veselov 1977	oral	1,302	-----	4,638 mg Rh/m³	464 mg Rh/m³
Na_3RhCl_6						
Rat	Johnson 1981	oral	>500	-----	>936 mg Rh/m³	>94 mg Rh/m³
$[Rh(NH_3)_5Cl]Cl_2$						
Rat	Johnson 1981	oral	>500	-----	>1,223 mg Rh/m³	>122 mg Rh/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg Rh/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for insoluble rhodium compounds. Therefore, the revised IDLH for insoluble rhodium compounds is 100 mg Rh/m³ based on acute oral toxicity data in animals [Johnson 1981; Veselov 1977]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. Johnson, Matthey and Co., Ltd. [1981]. Biological effects of rhodium metal and compounds. Material Safety Report N5 81-48. [From ACGIH [1985]. Rhodium and compounds. In: Documentation of the threshold limit values and biological exposure indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 512.]
2. Veselov VG [1977]. Comparative toxicity of platinoids in conditions of acute oral intoxication of animals. Gig Tr Prof Zabol *21*(7):55-57 (in Russian).

Rhodium (soluble compounds, as Rh)

CAS number	Varies
NIOSH REL	0.001 mg/m^3 TWA
Current OSHA PEL	0.001 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.01 mg/m^3 TWA
Description of substance	Varies
Original (SCP) IDLH*	No evidence [*Note: "Effective" IDLH = 2 mg Rh/m^3 – see discussion below.]
Basis for original (SCP) IDLH	There is no indication from experimental data or industrial experience that the soluble compounds of rhodium produce toxic effects in man. Therefore, because no evidence of an IDLH exists, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.001 mg Rh/m^3 (i.e., 2 mg Rh/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 2 mg Rh/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2 mg Rh/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of soluble rhodium compounds would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for soluble rhodium compounds is 2 mg Rh/m^3 based on being 2,000 times the NIOSH REL and OSHA PEL of 0.001 mg Rh/m^3 (2,000 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for soluble rhodium compounds).

Ronnel

CAS number	299-84-3
NIOSH REL	10 mg/m^3 TWA
Current OSHA PEL	15 mg/m^3 TWA
1989 OSHA PEL	10 mg/m^3 TWA
1993-1994 ACGIH TLV	10 mg/m^3 TWA
Description of substance	White to light-tan, crystalline solid.
LEL	Noncombustible Solid
Original (SCP) IDLH	5,000 mg/m^3
Basis for original (SCP) IDLH	No useful data on acute inhalation toxicity are available on which to base the IDLH for ronnel. The chosen IDLH, therefore, has been estimated from the statement by ACGIH [1971] that the dog oral LD_{50} is greater than 500 mg/kg.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	AAPCO 1966	oral	2,000	-----	7,000 mg/m^3	700 mg/m^3
Rabbit	AAPCO 1966	oral	420	-----	2,940 mg/m^3	294 mg/m^3
G. pig	AAPCO 1966	oral	1,400	-----	9,800 mg/m^3	980 mg/m^3
Dog	Klimmer 1971	oral	500	-----	3,500 mg/m^3	350 mg/m^3
Rat	Gig Sanit 1990	oral	625	-----	4,375 mg/m^3	438 mg/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 300 mg/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for ronnel. Therefore, the revised IDLH for ronnel is 300 mg/m^3 based on acute oral toxicity in animals [AAPCO 1966; Klimmer 1971]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. AAPCO [1966]. Pesticide chemicals official compendium. Topeka, KS: Association of American Pesticide Control Officials, Inc., p. 965.
2. ACGIH [1971]. Ronnel. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 222.
3. Klimmer OR [1971]. Pflanzenschutz-und schaedlingsbekaempfungsmittel: Abriss einer Toxikologie und Therapie von Vergiftungen. 2nd ed. Hattingen, Germany: Hundt-Verlag, p. 26.
4. Gig Sanit [1990]. Long-term effects from transformation products of pesticides and surfactants; 45(6):14-17 (in Russian).

Rotenone

CAS number	83-79-4
NIOSH REL	5 mg/m^3 TWA
Current OSHA PEL	5 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m^3 TWA
Description of substance	Colorless to red, odorless, crystalline solid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 5,000 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] reported that Lehman [1949], on the basis of his own work and a literature survey, estimated the fatal human oral dose to be about 200 grams. Accordingly, this is a relatively nontoxic compound for humans, and thus respirators have been assigned based on the assigned protection factor afforded by each device up to 1,000 × the OSHA PEL of 5 mg/m^3 (i.e., 5,000 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 5,000 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Kenaga 1979	oral	60	-----	420 mg/m^3	42 mg/m^3
Rat	Lehman 1951	oral	132	-----	924 mg/m^3	92 mg/m^3
Rat	Lightbody and Matthews 1936	oral	25	-----	175 mg/m^3	18 mg/m^3
Mouse	Soloway 1976	oral	2.8	-----	20 mg/m^3	2.0 mg/m^3

Human data .... The fatal oral dose has been reported to be 200 grams [Lehman 1949]. [Note: An oral dose of 200 grams is equivalent to a worker being exposed to about 130,000 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2,500 mg/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for rotenone. Therefore, the revised IDLH for rotenone is 2,500 mg/m^3 based on acute oral toxicity data in humans [Lehman 1949] and being 500 times the NIOSH REL and OSHA PEL (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. ACGIH [1971]. Rotenone (commercial). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 224.
2. Kenaga EE [1979]. Acute and chronic toxicity of 75 pesticides to various animal species. Down to Earth *35*:25-31.
3. Lehman AJ [1949]. Pharmacological considerations of insecticides. Q Bulletin Assoc Food Drug Off U.S. *13*(2):65-70.
4. Lehman AJ [1951]. Chemicals in foods: a report to the Association of Food and drug Officials on current developments. Part II. Pesticides. Section I. Introduction. Q Bulletin Assoc Food Drug Off U.S. *15*(4):122-123.
5. Lightbody DH, Matthews JA [1936]. Toxicology of rotenone. Ind Eng Chem *28*:809-811.
6. Soloway SB [1976]. Naturally occurring insecticides. Environ Health Perspect *14*:109-117.

Selenium compounds (as Se)

CAS number	7782-49-2 (Elemental)
NIOSH REL	0.2 mg/m³ TWA
Current OSHA PEL	0.2 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 100 mg Se/m³ -- see discussion below.]
Basis for original (SCP) IDLH	ACGIH [1971] reported that the LD_{50} values of soluble selenium compounds (selenite and selenate) for various animals and by different routes of administration ranged from 1.5 to 5 mg/kg [Hall et al. 1951]. However, respirators have been selected based on the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 0.2 mg Se/m³ (i.e., 100 mg Se/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 100 mg Se/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
SeO_2						
Rabbit	Zapp 1946	-----	5,890 mg/m³	20 min	3,638 mg Se/m³ (0.87)	364 mg Se/m³
Goat	Zapp 1946	-----	6,590 mg/m³	10 min	3,228 mg Se/m³ (0.69)	323 mg Se/m³
Sheep	Zapp 1946	-----	6,590 mg/m³	10 min	3,228 mg Se/m³ (0.69)	323 mg Se/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Se						
Rat	Cummins and Kimura 1971	oral	6,700	-----	46,900 mg Se/m³	4,690 mg Se/m³
SeO_3·2Na						
Rat	Cummins and Kimura 1971	oral	7	-----	22 mg Se/m³	2.2 mg Se/m³
Pig	Olson 1986	oral	-----	13	42 mg Se/m³	4.2 mg Se/m³
Cow	Olson 1986	oral	-----	9.9	32 mg Se/m³	3.2 mg Se/m³
Goat	Olson 1986	oral	-----	3.3	11 mg Se/m³	1.1 mg Se/m³
Sheep	Olson 1986	oral	-----	3.3	11 mg Se/m³	1.1 mg Se/m³
Mouse	Pletnikova 1970a	oral	7.08	-----	23 mg Se/m³	2.3 mg Se/m³
G. pig	Pletnikova 1970a	oral	5.06	-----	16 mg Se/m³	1.6 mg Se/m³
Rabbit	Pletnikova 1970b	oral	2.25	-----	7.2 mg Se/m³	0.7 mg Se/m³
Horse	Stowe 1980	oral	13	-----	42 mg Se/m³	0.4 mg Se/m³
$SeOCl_2$						
Rabbit	Wilber 1980	skin	-----	2	6.7 mg Se/m³	0.7 mg Se/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1 mg Se/m³

Basis for revised IDLH: The revised IDLH for selenium compounds is 1 mg Se/m³ based on acute toxicity data in animals [Olson 1986; Pletnikova 1970a, 1970b]. This may be a conservative value for selenium compounds in general since it is based on sodium selenite, which is orders of magnitude more toxic than many other selenium compounds. Further, this may also be a conservative value due to the lack of relevant acute toxicity data for workers.

Selenium compounds (as Se) (continued)

REFERENCES:

1. ACGIH [1971]. Selenium compounds (as Se). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 224-225.
2. Cummins LM, Kimura ET [1971]. Safety evaluation of selenium sulfide antidandruff shampoos. Toxicol Appl Pharmacol *20*:89-96.
3. Hall RH, Laskin S, Frank P, Maynard EA, Hodge HC [1951]. Preliminary observations on toxicity of elemental selenium. AMA Arch Ind Hyg Occup Med *4*:458-464.
4. Olson OE [1986]. Selenium toxicity in animals with emphasis on man. J Am Coll Toxicol *5*(1):45-70.
5. Pletnikova IP [1970a]. Biological action and the non-injuriousness level of selenium when it enters the organism together with drinking water. Gig Sanit *35*(2):14-19 (in Russian).
6. Pletnikova IP [1970b]. Biological effect and safe concentration of selenium in drinking water. Gig Sanit 35(1-3):176-181 (translated).
7. Stowe HD [1980]. Effects of copper pretreatment upon the toxicity of selenium in ponies. Am J Vet Res *41*(12):1925-1928.
8. Wilber CG [1980]. Toxicology of selenium: a review. Clin Toxicol *17*:171-230.
9. Zapp JA [1946]. Chapter 11. Cadmium, selenium, and the carbonyls of iron and nickel. In: Summary technical report of division 9, NDRC. Vol 1. Chemical warfare agents and related chemical problems. Parts I-II. Washington, DC: National Defence Research Committee, pp. 173-178.

Selenium hexafluoride (as Se)

CAS number	7783-79-1
NIOSH REL	0.05 ppm (0.16 mg/m³) TWA
Current OSHA PEL	0.05 ppm (0.4 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.05 ppm (0.16 mg/m³) TWA
Description of substance	Colorless gas.
LEL	Nonflammable Gas
Original (SCP) IDLH	5 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by ACGIH [1971] that 5 ppm for 4 hours resulted in pulmonary edema from which rabbits, guinea pigs, rats, and mice survived [Kimmerle 1960]; exposures to 10 ppm and greater for 4 hours were uniformly fatal to the exposed animals [Kimmerle 1960].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Kimmerle 1960	-----	10	1 hr	13 ppm (1.25)	1.3 ppm
Mouse	Kimmerle 1960	-----	10	1 hr	13 ppm (1.25)	1.3 ppm
G. pig	Kimmerle 1960	-----	10	1 hr	13 ppm (1.25)	1.3 ppm

Other animal data	It has been reported that 5 ppm for 4 hours resulted in pulmonary edema from which rabbits, guinea pigs, rats, and mice survived [Kimmerle 1960].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2 ppm
Basis for revised IDLH: The revised IDLH for selenium hexafluoride is 2 ppm based on acute inhalation toxicity data in animals [Kimmerle 1960].

REFERENCES:

1. ACGIH [1971]. Selenium hexafluoride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 226.
2. Kimmerle G [1960]. Vergleichende untersuchungen der inhalationstoxicitat von schwefel-, selen- und tellurhexafluorid (Comparative study of the inhalation toxicity of sulfur, selenium and tellurium hexafluorides). Arch Toxikol *18*:140-144 (in German).

Silica, amorphous

CAS number	7631-86-9
NIOSH REL	6 mg/m^3 TWA
Current OSHA PEL	20 mppcf TWA; 80 mg/m^3/%SiO_2 TWA
1989 OSHA PEL	6 mg/m^3 TWA
1993-1994 ACGIH TLV	10 mg/m^3 TWA
Description of substance	Transparent to gray, odorless powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 times the OSHA PEL – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of amorphous silica would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 3,000 mg/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of amorphous silica would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for amorphous silica is 3,000 mg/m^3 based on being 500 times the NIOSH REL of 6 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Silica, crystalline (as respirable dust)

CAS number	14808-60-7
NIOSH REL	0.05 mg/m³ TWA; NIOSH considers crystalline silica to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	Crystalline quartz (respirable): 250 mppcf/(%SiO_2 +5) TWA 10 mg/m³/(%SiO_2 + 2) TWA Crystalline quartz (total dust): 30 mg/m³/(%SiO_2 + 2) TWA Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz; Tridymite: Use ½ the value calculated from the formulae for quartz
1989 OSHA PEL	Cristobalite: 0.05 mg/m³ TWA Tridymite: 0.05 mg/m³ TWA Quartz: 0.1 mg/m³ TWA Tripoli: 0.1 mg/m³ TWA
1993-1994 ACGIH TLV	Quartz (respirable dust): 0.1 mg/m³ TWA Cristobalite (respirable dust): 0.05 mg/m³ TWA Tridymite (respirable dust): 0.05 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 times the OSHA PEL -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data show no evidence that indicates an acute exposure to a high concentration of crystalline silica would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 25 mg/m³ (Cristobalite & Tridymite); 50 mg/m³ (Quartz & Tripoli)
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of crystalline silica would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLHs for crystalline silica are 25 mg/m³ for Cristobalite and Tridymite and 50 mg/m³ for Quartz and Tripoli, based on being 500 times the 1989 OSHA PELs of 0.05 mg/m³ and 0.1 mg/m³, respectively (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates). [Note: NIOSH recommends that the "most protective" respirators be worn for all varieties of crystalline silica at concentrations above 25 mg/m³.]

Silver (metal dust and soluble compounds, as Ag)

CAS number	7440-22-4 (Metal)
NIOSH REL	0.01 mg/m^3 TWA
Current OSHA PEL	0.01 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	Metal: 0.1 mg/m^3 TWA; Soluble compounds: 0.01 mg/m^3 TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 20 mg Ag/m^3 – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure by inhalation to silver metal or the soluble compounds of silver could impede escape. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.01 mg Ag/m^3 (i.e., 20 mg Ag/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 20 mg Ag/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$AgNO_3$						
Rabbit	Flury and Zernik 1935	oral	-----	800	3,556 mg Ag/m^3	356 mg Ag/m^3
Dog	Flury and Zernik 1935	oral	-----	20	89 mg Ag/m^3	8.9 mg Ag/m^3
Ag_2O						
Rat	Smyth et al. 1969	oral	2,820	-----	18,385 mg Ag/m^3	1,839 mg Ag/m^3

Human data: It has been reported that 29 mg/kg is the probable lethal dose [Arena 1970]. [Note: A dose of 29 mg/kg is equivalent to a 70-kg worker being exposed to 135 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 10 mg Ag/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for silver (metal dust and soluble compounds). Therefore, the revised IDLH for silver (metal dust and soluble compounds) is 10 mg Ag/m^3 based on acute oral toxicity data in humans [Arena 1970] and animals [Flury and Zernik 1935].

REFERENCES:

1. Arena JM [1970]. Poisoning; toxicology, symptoms, treatments. 2nd ed. Springfield, IL: C.C. Thomas, 2:73.
2. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German).
3. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA, Nycum JS [1969]. Range-finding toxicity data: list VII. Am Ind Hyg Assoc J *30*(5):470-476.

Soapstone

CAS number	none assigned
NIOSH REL	6 mg/m^3 (total dust) TWA, 3 mg/m^3 (respirable) TWA
Current OSHA PEL	20 mppcf TWA
1989 OSHA PEL	6 mg/m^3 (total dust) TWA, 3 mg/m^3 (respirable dust) TWA
1993-1994 ACGIH TLV	6 mg/m^3 (total dust) TWA, 3 mg/m^3 (respirable dust) TWA
Description of substance	Odorless, white-gray powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 10,000 mppcf -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of soapstone would impede escape or cause any irreversible health effects within 30 minutes. The toxic effects of talc that are described in the literature result from chronic exposures to this substance. Talc is a major constituent of soapstone [Miller and Sayers 1941 as cited by ACGIH 1971]. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substences it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 20 mppcf is 10,000 mppcf).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 3,000 mg/m^3
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of soapstone would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for soapstone is 3,000 mg/m^3 based on being 500 times the NIOSH REL of 6 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. ACGIH [1971]. Soapstone. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 232.
2. Miller JW, Sayers RR [1941]. The response of peritoneal tissue to industrial dusts. Public Health Rep 56(1):264-272.

Sodium fluoroacetate

CAS number	62-74-8
NIOSH REL	0.05 mg/m³ TWA, 0.15 mg/m³ STEL [skin]
Current OSHA PEL	0.05 mg/m³ TWA [skin]
1989 OSHA PEL	0.05 mg/m³ TWA, 0.15 mg/m³ STEL [skin]
1993-1994 ACGIH TLV	0.05 mg/m³ TWA, 0.15 mg/m³ STEL [skin]
Description of substance	Fluffy, colorless to white (sometimes dyed black), odorless powder.
LEL	Noncombustible Solid
Original (SCP) IDLH	5 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Deichmann and Gerarde [1969] that the probable lethal oral dose for an adult is 50 mg. No data on acute inhalation toxicity are available on which to base the IDLH for this highly toxic compound.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Lehman 1951	oral	1.7	-----	12 mg/m	1.2 mg/m³
Rabbit	McIlroy 1982	oral	0.34	-----	2.4 mg/m	0.24 mg/m³
Rat	Ward 1946	oral	0.1	-----	0.7 mg/m	0.07 mg/m³
G. pig	Ward 1946	oral	0.3	-----	2.1 mg/m	0.21 mg/m³
Mouse	Yakkyoku 1977	oral	0.1	-----	0.7 mg/m	0.07 mg/m³

Human data: The probable oral lethal dose has been reported to be 50 mg [Deichmann and Gerarde 1969]. [Note: An oral dose of 50 mg is equivalent to a worker being exposed to about 30 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 2.5 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for sodium fluoroacetate. Therefore, the revised IDLH for sodium fluoroacetate is 2.5 mg/m³ based on acute oral toxicity data in humans [Deichmann and Gerarde 1969].

REFERENCES:

1. Deichmann WB, Gerarde HW [1969]. Sodium fluoroacetate (1080). In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., p. 542.
2. Lehman AJ [1951]. Chemicals in foods: a report to the Association of Food and drug Officials on current developments. Part II. Pesticides. Section I. Introduction. Q Bulletin Assoc Food Drug Off U.S. *15*(4):122-123.
3. McIlroy JC [1982]. The sensitivity of Australian animals to 1080 poison. III. Marsupial and eutherian herbivores. Australian Wildlife Research 9:487-503.
4. Ward JC [1946]. Rodent control with 1080, ANTU, and other war-developed toxic agents. Am J Public Health Nations Health *36*:1427-1431.
5. Yakkyoku (Pharmacy) [1977]; *28*(3):329-339 (in Japanese).

Sodium hydroxide

CAS number	1310-73-2
NIOSH REL	2 mg/m^3 CEILING
Current OSHA PEL	2 mg/m^3 TWA
1989 OSHA PEL	2 mg/m^3 CEILING
1993-1994 ACGIH	2 mg/m^3 CEILING
Description of substance	Colorless to white, odorless solid (flakes, beads, granular form).
LEL	Noncombustible Solid
Original (SCP) IDLH	250 mg/m^3
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for sodium hydroxide. The chosen IDLH, therefore, has been estimated from the mouse intraperitoneal LD_{50} of 40 mg/kg [Nofre et al. 1963 cited by NIOSH 1974].
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 2 mg/m^3
30-minute EEGL: 2 mg/m^3
60-minute EEGL: 2 mg/m^3

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Fazekas 1937	oral	-----	500	3,500 mg/m^3	350 mg/m^3
Mouse	Nofre et al. 1963	i.p.	40	-----	280 mg/m^3	28 mg/m^3

Human data .... Workplace concentrations ranging from 2 to 8 mg/m^3 have been associated with irritation of the respiratory system [Ott et al. 1977].

Revised IDLH: 10 mg/m^3
Basis for revised IDLH: The revised IDLH for sodium hydroxide is 10 mg/m^3 based on acute inhalation toxicity data in workers [Ott et al. 1977]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 8 mg/m^3.

REFERENCES:

1. Fazekas JG [1937]. Die veränderungen des blutchemismus bei experimenteller laugenvergiftung. Arch Exp Pathol Pharmakol *184*:587-604 (in German).
2. NIOSH [1974]. WB49000. Sodium hydroxide. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 721.
3. Nofre C, Dufour H, Cier A [1963]. Toxicite generale comparee des anions mineraux chez la souris. In: Comp Rend Hebdom (Juillet 17, 1963), pp. 791-794 (in French). [From NIOSH [1974]. WB49000. Sodium hydroxide. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 721.]
4. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 87-94.
5. Ott MG, Gordon HL, Schneider EJ [1977]. Mortality among employees chronically exposed to caustic dust. J Occup Med *17*:813-816.

Stibine

CAS number	7803-52-3
NIOSH REL	0.1 ppm (0.5 mg/m^3) TWA
Current OSHA PEL	0.1 ppm (0.5 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 ppm (0.51 mg/m^3) TWA
Description of substance	Colorless gas with a disagreeable odor like hydrogen sulfide.
LEL	Unknown
Original (SCP) IDLH	40 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1960] that exposure of dogs and cats to 40 to 45 ppm for 1 hour has proven dangerous [Webster 1946].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Browning 1961	-----	100	1 hr	125 ppm (1.25)	13 ppm
G. pig	Browning 1961	-----	92	1 hr	115 ppm (1.25)	12 ppm
Dog	Browning 1961	-----	40	1 hr	50 ppm (1.25)	5 ppm

Other animal data	It has been reported that exposure of dogs and cats to 40 to 45 ppm for 1 hour has proven dangerous [Webster 1946].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 5 ppm
Basis for revised IDLH: The revised IDLH for stibine is 5 ppm based on acute inhalation toxicity data in animals [Browning 1961].

REFERENCES:

1. AIHA [1960]. Stibine. In: Hygienic guide series. Am Ind Hyg Assoc J *21*:529-530.
2. Browning E [1961]. Toxicity of industrial metals. London, England: Butterworths, p. 30.
3. Webster SH [1946]. Volatile hydrides of toxicological importance. J Ind Hyg Toxicol *28*:167-182.

Stoddard solvent

CAS number	8052-41-3
NIOSH REL	350 mg/m³ TWA, 1,800 mg/m³ 15-minute CEILING
Current OSHA PEL	2,900 mg/m³ (500 ppm) TWA
1989 OSHA PEL	525 mg/m³ (100 ppm) TWA
1993-1994 ACGIH TLV	525 mg/m³ (100 ppm) TWA
Description of substance	Colorless liquid with a kerosene-like odor.
LEL	Unknown
Original (SCP) IDLH	29,500 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the statements by AIHA [1975] that the atmospheric concentration immediately hazardous to life is probably between 5,000 ppm and 10,000 ppm when high temperature or other factors make these concentrations attainable, and exposure to levels approaching 5,000 ppm should be avoided [Rector et al. 1966]. [Note: A concentration of 5,000 ppm is equivalent to about 29,500 mg/m³ assuming an approximate molecular weight of 144 for Stoddard solvent.]
Short-term exposure guidelines	None

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1975	$LC_{?}$: 8,200 mg/m³	-----	8 hr	20,500 mg/m³ (2.5)	2,050 mg/m³
Rat	Vernot et al. 1990	>5,500 mg/m³	-----	4 hr	>11,000 mg/m³ (2.0)	>1,100 mg/m³
Cat	Vernot et al. 1990	-----	9,061 mg/m³	7 hr	21,746 mg/m³ (2.4)	2,175 mg/m³

Human data	It has been reported that the atmospheric concentration immediately hazardous to life is probably between 5,000 and 10,000 ppm when high temperature or other factors make these concentrations attainable and exposure to levels approaching 5,000 ppm should be avoided [Rector et al. 1966]. [Note: A concentration of 5,000 ppm is equivalent to about 29,500 mg/m³ assuming an approximate molecular weight of 144 for Stoddard solvent.]

Revised IDLH: 20,000 mg/m³
Basis for revised IDLH: The revised IDLH for Stoddard solvent is 20,000 mg/m³ based on acute inhalation toxicity data in humans [Rector et al. 1966].

REFERENCES:

1. AIHA [1975]. Stoddard solvent. In: Hygienic guide series. Am Ind Hyg Assoc J *36*:553-558.
2. Carpenter CP, Kinkead ER, Geary DL Jr, Sullivan LJ, King JM [1975]. Petroleum hydrocarbon toxicity studies. III. Animal and human response to vapors of stoddard solvent. Toxicol Appl Pharmacol 32:282-297.
3. Rector DE, Steadman BL, Jones RA, Siegel J [1966]. Effects on experimental animals of long-term inhalation exposure to mineral spirits. Toxicol Appl Pharmacol *9*:267-268.
4. Vernot EH, Drew RT, Kane ML [1990]. Acute toxicological evaluation of stoddard solvent. In: Acute toxicity data. J Am Coll Toxicol, Part B *1*:32-33.

Strychnine

CAS number	57-24-9
NIOSH REL	0.15 mg/m³ TWA
Current OSHA PEL	0.15 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.15 mg/m³ TWA
Description of substance	Colorless to white, odorless, crystalline solid.
LEL	Unknown
Original (SCP) IDLH	3 mg/m³
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base the IDLH for strychnine. The chosen IDLH, therefore, has been estimated from the statement by Gleason et al. [1969] that 30 mg by the oral route is usually a threat to an adult's life [Witthaus 1911].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Flury and Zernik 1935	oral	-----	0.6	4.2 mg/m³	0.4 mg/m³
Dog	Moraillon and Pinault 1978	oral	0.5	-----	3.5 mg/m³	0.4 mg/m³
Cat	Moraillon and Pinault 1978	oral	0.5	-----	3.5 mg/m³	0.4 mg/m³
Mouse	Prasad et al. 1981	oral	2	-----	14 mg/m³	1.4 mg/m³
Rat	Spector 1956	oral	16	-----	112 mg/m³	11 mg/m³
Rat	Ward and Crabtree 1942	oral	2.35	-----	17 mg/m³	1.7 mg/m³

Human data .... It has been reported that the probable lethal oral dose is 1.5 to 2 mg/kg [Gosselin et al. 1984]. [Note: An oral dose of 1.5 to 2 mg/kg is equivalent to a 70-kg worker being exposed to 70 to 93 mg/m³ for 30 minutes assuming a 50 liter per minute breathing rate and 100% absorption.]

Revised IDLH: 3 mg/m³ [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for strychnine. However, based on acute oral toxicity data in humans [Gosselin et al. 1984], the original IDLH for strychnine (3 mg/m³) is not being revised at this time.

REFERENCES:

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Styrene

CAS number	100-42-5
NIOSH REL	50 ppm (215 mg/m³) TWA, 100 ppm (425 mg/m³) STEL
Current OSHA PEL	100 ppm TWA, 200 ppm CEILING, 600 ppm 5-minute MAXIMUM PEAK IN ANY 3 HOURS
1989 OSHA PEL	50 ppm (215 mg/m³) TWA, 100 ppm (425 mg/m³) STEL
1993-1994 ACGIH TLV	50 ppm (213 mg/m³) TWA, 100 ppm (426 mg/m³) CEILING [skin]
Description of substance	Colorless to yellow, oily liquid with a sweet, floral odor.
LEL	0.9% (10% LEL, 900 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that rats and guinea pigs exposed to 5,000 ppm become unconscious within 1 hour [Spencer et al. 1942].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	2,194	-----	4 hr	4,388 ppm (2.0)	439 ppm
Human	Lefaux 1978	-----	10,000	30 min	10,000 ppm (1.0)	1,000 ppm
G. pig	Spencer et al. 1942	-----	2,771	14 hr	8,314 ppm (3.0)	831 ppm
Rat	Tiunov et al. 1982	5,543	-----	4 hr	11,085 ppm (2.0)	1,109 ppm

Other animal data	RD_{50} (mouse), 980 ppm [Alarie 1981].
Other human data	Volunteers exposed to 376 ppm for up to 7 hours experienced unpleasant subjective symptoms and objective signs of neurologic impairment [Stewart et al. 1968]. Drowsiness, nausea, headache, fatigue, and dizziness have been reported in workers exposed to 200 to 700 ppm [AIHA 1959].

Revised IDLH: 700 ppm
Basis for revised IDLH: The revised IDLH for styrene is 700 ppm based on acute inhalation toxicity data in humans [AIHA 1959; Stewart et al. 1968].

REFERENCES:

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3. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 106.
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Sulfur dioxide

CAS number	7446-09-5
NIOSH REL	2 ppm (5 mg/m^3) TWA, 5 ppm (13 mg/m^3) STEL
Current OSHA PEL	5 ppm (13 mg/m^3) TWA
1989 OSHA PEL	2 ppm (5 mg/m^3) TWA, 5 ppm (13 mg/m^3) STEL
1993-1994 ACGIH TLV	2 ppm (5.2 mg/m^3) TWA, 5 ppm (13 mg/m^3) STEL
Description of substance	Colorless gas with a characteristic, irritating, pungent odor.
LEL	Nonflammable Gas
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1955] that 50 to 100 ppm is considered the maximum concentration for exposures of 0.5 to 1 hour [Henderson and Haggard 1943]. With regard to the atmospheric concentration immediately hazardous to life, AIHA [1955] reported that 400 to 500 ppm is considered dangerous for even short periods of exposure [Henderson and Haggard 1943] and that exposure to unendurable concentrations is not necessarily hazardous if escape is made within a few minutes.
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 30 ppm
30-minute EEGL: 20 ppm
60-minute EEGL: 10 ppm
24-hour EEGL: 5 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Flury and Zernik 1935	-----	993	20 min	864 ppm (0.87)	86 ppm
Rat	Flury and Zernik 1935	-----	611	5 hr	1,314 ppm (2.15)	131 ppm
Mouse	Flury and Zernik 1935	-----	764	20 min	665 ppm (0.87)	67 ppm
Mouse	Hilado and Machado 1977	3,000	-----	30 min	3,000 ppm (1.0)	300 ppm
Rat	Kinkead and Einhaus 1984	2,520	-----	1 hr	3,150 ppm (1.25)	315 ppm
Human	Shupe et al. 1972	-----	1,000	10 min	690 ppm (0.69)	69 ppm
Human	Tab Biol Per 1933	-----	3,000	5 min	1,500 ppm (0.5)	150 ppm

Other animal data	RD_{50} (mouse), 117 ppm [Alarie 1981].
Other human data	The maximum concentration for exposures of 0.5 to 1 hour is considered to be 50 to 100 ppm [Henderson and Haggard 1943]. It has been reported that 400 to 500 ppm is considered dangerous for even short periods of exposure [Henderson and Haggard 1943].

Revised IDLH: 100 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Henderson and Haggard 1943; Shupe et al. 1972; Tab Biol Per 1933], the original IDLH for sulfur dioxide (100 ppm) is not being revised at this time.

REFERENCES:

1. AIHA [1955]. Sulfur dioxide. In: Hygienic guide series. Am Ind Hyg Assoc Q *16*:332-333.
2. Alarie Y [1981]. Dose-response analysis in animal studies: prediction of human responses. Environ Health Perspect *42*:9-13.

3. Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen für die gebräuchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German). [From Back KC, Thomas AA, MacEwen JD [1972]. Reclassification of materials listed as transportation health hazards. Wright-Patterson Air Force Base, OH: 6570th Aerospace Medical Research Laboratory, Report No. TSA-20-72-3, pp. A250 to A251.]
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8. Shupe JL, Olson AE, Sharma RP [1972]. Fluoride toxicity in domestic and wild animals. Clin Toxicol 5:195-213.
9. Tab Biol Per [1933]; 3:231 (in German).

Sulfuric acid

CAS number	7664-93-9
NIOSH REL	1 mg/m³ TWA
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 mg/m³ TWA, 3 mg/m³ STEL
Description of substance	Colorless to dark-brown, oily, odorless liquid.
LEL	Noncombustible Liquid
Original (SCP) IDLH	80 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that guinea pigs died after 2.75 hours of exposure at 87 mg/m³ [Treon et al. 1950].
Existing short-term exposure guidelines	National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 5 mg/m³
30-minute EEGL: 2 mg/m³
60-minute EEGL: 1 mg/m³

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Amdur et al. 1952a	50 mg/m³	-----	8 hr	125 mg/m³ (2.5)	13 mg/m³
Rat	Izmerov et al. 1982	510 mg/m³	-----	2 hr	816 mg/m³ (1.6)	82 mg/m³
Mouse	Izmerov et al. 1982	320 mg/m³	-----	2 hr	512 mg/m³ (1.6)	51 mg/m³
G. pig	Raule 1954	18 mg/m³	-----	?	?	?
G. pig	Treon et al. 1950	-----	87 mg/m³	2.75 hr	154 mg/m³ (1.77)	15 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Smyth et al. 1969	oral	2,140	-----	14,980 mg/m³	1,498 mg/m³

Human data .... In exposures of 5 to 15 minutes, some volunteers found 5 mg/m³ to be very objectionable, while others found it less so [Amdur et al. 1952b]. The lethal oral dose has been reported to be 135 mg/kg [Arena 1970]. [Note: An oral dose of 135 mg/kg is equivalent to a worker being exposed to about 6,300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 15 mg/m³
Basis for revised IDLH: The revised IDLH for sulfuric acid is 15 mg/m³ based on acute inhalation toxicity data in humans [Amdur et al. 1952b] and animals [Amdur et al. 1952a; Treon et al. 1950]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 5 mg/m³.

REFERENCES:

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6. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 1. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 107-112.
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Sulfur monochloride

CAS number	10025-67-9
NIOSH REL	1 ppm (6 mg/m^3) CEILING
Current OSHA PEL	1 ppm (6 mg/m^3) TWA
1989 OSHA PEL	1 ppm (6 mg/m^3) CEILING
1993-1994 ACGIH TLV	1 ppm (5.5 mg/m^3) CEILING
Description of substance	Light-amber to yellow-red, oily liquid with a pungent, nauseating, irritating odor.
LEL	Unknown
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	Very little data are available on which to base the IDLH for sulfur monochloride. The chosen IDLH has been estimated from the statement by ACGIH [1971] that 12 ppm for 15 minutes was tolerated by cats, but four times that concentration, also for 15 minutes, could lead to death after a few days [Flury and Zernik 1931]. No other useful data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Flury and Zernik 1931	-----	150	1 min	48 ppm (0.32)	4.8 ppm
Cat	Henderson and Haggard 1943	LC_{100}: 60	-----	15 min	47 ppm (0.79)	4.7 ppm

Other animal data	It has been reported that cats have tolerated 15-minute exposures to 12 ppm, while 48 ppm could lead to death after a few days [Flury and Zernik 1931].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 5 ppm
Basis for revised IDLH: The revised IDLH for sulfur monochloride is 5 ppm based on acute inhalation toxicity data in animals [Flury and Zernik 1931; Henderson and Haggard 1943].

REFERENCES:

1. ACGIH [1971]. Sulfur monochloride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 240-241.
2. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, pp. 146-147 (in German).
3. Henderson Y, Haggard HW [1943]. Noxious gases. 2nd ed. New York, NY: Reinhold Publishing Corporation, p. 130.

Sulfur pentafluoride

CAS number	5714-22-7
NIOSH REL	0.01 ppm (0.1 mg/m³) CEILING
Current OSHA PEL	0.025 ppm (0.25 mg/m³) TWA
1989 OSHA PEL	0.01 ppm (0.1 mg/m³) CEILING
1993-1994 ACGIH TLV	0.01 ppm (0.1 mg/m³) CEILING
Description of substance	Colorless liquid or gas (above 84°F) with an odor like sulfur dioxide.
LEL	Noncombustible Liquid/Nonflammable Gas
Original (SCP) IDLH	1 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that a 1-hour exposure to 1 ppm caused severe congestion of the lungs of rats [Greenberg and Lester 1950]. According to ACGIH [1971], sulfur pentafluoride is more toxic than phosgene; the TLV of 0.025 ppm for sulfur pentafluoride reflects its greater toxicity in comparison with phosgene. The chosen IDLH also reflects the greater toxicity of sulfur pentafluoride in comparison with phosgene, which has an IDLH of 2 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	NDRC 1946	2,000 mg/m³	-----	10 min	130 ppm (0.69)	13 ppm
Mouse	NDRC 1946	1,000 mg/m³	-----	10 min	66 ppm (0.69)	6.6 ppm
Rabbit	NDRC 1946	4,000 mg/m³	-----	10 min	262 ppm (0.69)	26 ppm
G. pig	NDRC 1946	4,000 mg/m³	-----	10 min	262 ppm (0.69)	26 ppm
Dog	NDRC 1946	4,000 mg/m³	-----	10 min	262 ppm (0.69)	26 ppm

Other animal data	It has been reported that exposure for 1 hour at 10 ppm caused multiple diffuse hemorrhagic lesions in the lungs of rats, one hour at 1 ppm caused severe congestion of the lungs, and 1 hour at 0.1 ppm had no effect [Greenberg and Lester 1950].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Greenberg and Lester 1950], the original IDLH for sulfur pentafluoride (1 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Sulfur pentafluoride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 241.
2. Greenberg LA, Lester G [1950]. The toxicity of sulfur pentafluoride. AMA Arch Ind Hyg Occup Med 2:350-352.
3. NDRC [1946]. Summary technical report of division 9, NDRC. Vol 1. Chemical warfare agents and related chemical problems. Parts I-II. Washington, DC: National Defence Research Committee, pp. 1-385.

Sulfuryl fluoride

CAS number	2699-79-8
NIOSH REL	5 ppm (20 mg/m³) TWA, 10 ppm (40 mg/m³) STEL
Current OSHA PEL	5 ppm (20 mg/m³) TWA
1989 OSHA PEL	5 ppm (20 mg/m³) TWA, 10 ppm (40 mg/m³) STEL
1993-1994 ACGIH TLV	5 ppm (21 mg/m³) TWA, 10 ppm (42 mg/m³) STEL
Description of substance	Colorless, odorless gas.
LEL	Nonflammable Gas
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the report by Taxay [1966] that less than 5% mortality resulted from exposure of animals for 3 hours to 1,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Nitschke et al. 1986	991	-----	4 hr	1,982 ppm (2.0)	198 ppm
Mouse	Truhaut et al. 1973	-----	1,200	1 hr	1,500 ppm (1.25)	150 ppm
Rabbit	Truhaut et al. 1973	-----	5,000	1 hr	6,250 ppm (1.25)	625 ppm

Other animal data	It has been reported that less than 5% mortality resulted from exposure for 3 hours to 1,000 ppm [Taxay 1966].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for sulfuryl fluoride is 200 ppm based on acute inhalation toxicity data in animals [Nitschke et al. 1986; Truhaut et al. 1973].

REFERENCES:

1. Nitschke KD, Albee RR, Mattsson JL, Miller RR [1986]. Incapacitation and treatment of rats exposed to a lethal dose of sulfuryl fluoride. Fundam Appl Toxicol 7:664-670.
2. Taxay EP [1966]. Vikane inhalation. J Occup Med 8:425-426.
3. Truhaut R, Boudene C, Cluet JL [1973]. Toxicite de quelques derives gazeux fluores et oxyfluores du soufre. Arch Mal Prof 34(10-11):581-591 (in French).

2,4,5-T

CAS number	93-76-5
NIOSH REL	10 mg/m³ TWA
Current OSHA PEL	10 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of substance	Colorless to tan, odorless, crystalline solid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 5,000 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	According to ACGIH [1971], "the toxicity of this compound appears to be similar to the somewhat better known 2,4-D. According to Rowe and Hymas [1954], the oral LD_{50} values fall in a range of 300 to 1,000 mg/kg for rats, mice, guinea pigs, and rabbits. Chronic exposure is not necessarily more hazardous. Drill and Hiratzka [1953] found that there were no deaths among dogs treated with 2, 5, or 10 mg/kg/day of 2,4,5-T (5 days/week for 13 weeks); some deaths occurred at 20 mg/kg/day. There are no reports of illness from occupational exposure. It appears that the TLV of 10 mg/m³ is justified on the basis of extrapolation from animal feeding studies and extensive use experience." Based on the toxicological data cited above, 2,4,5-T is a relatively nontoxic compound. Because data on acute inhalation toxicology are not available for this substance and to be consistent with the IDLHs selected for similar, relatively nontoxic compounds, 5,000 mg/m³ (i.e., 500 × the OSHA PEL of 10 mg/m³) has been chosen as the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
G. pig	AAPCO 1966	oral	381	-----	2,667 mg/m³	267 mg/m³
Rat	Bailey and White 1965	oral	300	-----	2,100 mg/m³	210 mg/m³
Hamster	Grant 1979	oral	425	-----	2,975 mg/m³	298 mg/m³
Mouse	Senczuk and Pogorzelska 1980	oral	242	-----	1,694 mg/m³	169 mg/m³

Other animal data	It has been reported that there were no deaths among dogs treated with 2, 5, or 10 mg/kg/day of 2,4,5-T (5 days/week for 13 weeks); some deaths occurred at 20 mg/kg/day [Drill and Hiratzka 1953].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 250 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for 2,4,5-T. Therefore, the revised IDLH for 2,4,5-T is 250 mg/m³ based on acute oral toxicity data in animals [AAPCO 1966; Bailey and White 1965; Grant 1979; Senczuk and Pogorzelska 1980]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

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2. ACGIH [1971]. 2,4,5-T (2,4,5 trichlorophenoxyacetic acid). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 242.
3. Bailey GW, White JL [1965]. Herbicides: a compilation of their physical, chemical, and biological properties. Residue Reviews *10*:97-102.
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Talc

CAS number	14807-96-6
NIOSH REL	2 mg/m^3 (respirable dust) TWA
Current OSHA PEL	20 mppcf TWA
1989 OSHA PEL	2 mg/m^3 (respirable dust) TWA
1993-1994 ACGIH TLV	2 mg/m^3 (respirable dust) TWA
Description of substance	Odorless, white powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 10,000 mppcf – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of talc would impede escape or cause any irreversible health effects within 30 minutes. The toxic effects of talc that which are described in the literature result from chronic exposures to this substance. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 20 mppcf is 10,000 mppcf).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 1,000 mg/m^3

Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of talc would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for talc is 1,000 mg/m^3 based on being 500 times the NIOSH REL of 2 mg/m^3 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

Tantalum (metal and oxide dust, as Ta)

CAS number	7440-25-7 (Metal)
NIOSH REL	5 mg/m³ TWA, 10 mg/m³ STEL
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 2,500 mg Ta/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Because no evidence of an IDLH is shown in the available toxicological data, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 5 mg Ta/m³ (i.e., 2,500 mg Ta/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 2,500 mg Ta/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Ta_2O_5 Rat	Coulston and Korte 1975	oral	8,000	-----	45,862 mg Ta/m³	4,586 mg Ta/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 2,500 mg Ta/m³

Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for tantalum metal and oxide dust. Therefore, based on acute oral toxicity data in animals [Coulston and Korte 1975], a value of about 4,500 mg Ta/m³ would have been appropriate. However, the revised IDLH for tantalum metal and oxide dust is 2,500 mg Ta/m³ based on being 500 times the NIOSH REL and OSHA PEL of 5 mg Ta/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCE:

1. Coulston F, Korte F, eds. [1975]. Heavy metal toxicity, safety and hormology. In: Environmental Quality & Safety, Supplement 1. New York, NY: Georg Thieme Publishers, pp. 1-120.

TEDP

CAS number	89-24-5
NIOSH REL	0.2 mg/m³ TWA [skin]
Current OSHA PEL	0.2 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA [skin]
Description of substance	Pale-yellow liquid with a garlic-like odor.
LEL	Unknown
Original (SCP) IDLH	35 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat oral LD_{50} of 5 mg/kg [Lehman 1951 cited by ACGIH 1971]. No other useful data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Kimmerle and Klimmer 1974	38 mg/m³	-----	4 hr	76 mg/m³ (2.0)	7.6 mg/m³
Mouse	Kimmerle and Klimmer 1974	40 mg/m³	-----	4 hr	80 mg/m³ (2.0)	8.0 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Kimmerle and Klimmer 1974	oral	22	-----	154 mg/m³	15 mg/m³
Rabbit	Kimmerle and Klimmer 1974	oral	25	-----	175 mg/m³	18 mg/m³
Dog	Kimmerle and Klimmer 1974	oral	5	-----	35 mg/m³	3.5 mg/m³
Rat	Lehman 1951	oral	5	-----	35 mg/m³	3.5 mg/m³

Other animal data	It has been stated that TEDP is an organophosphate pesticide whose toxicity is similar to that of parathion [ACGIH 1991].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg/m³
Basis for revised IDLH: The revised IDLH for TEDP is 10 mg/m³ based on acute inhalation toxicity data in animals [Kimmerle and Klimmer 1974] and on an analogy with parathion [ACGIH 1991] which has a revised IDLH of 10 mg/m³.

REFERENCES:

1. ACGIH [1971]. TEDP (tetraethyl dithionopyrophosphate). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 244-245.
2. ACGIH [1991]. Sulfotep. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1452-1454.
3. Kimmerle G, Klimmer OR [1974]. Acute and subchronic toxicity of sulfotep. Arch Toxicol 33:1-16.
4. Lehman AJ [1951]. Chemicals in foods: A report to the Association of Food and Drug Officials on current developments. Part II. Pesticides. Section II. Dermal Toxicity. Q Bulletin Assoc Food Drug Off U.S. 15(1):3-9.

Tellurium compounds (as Te)

CAS number	13494-80-9 (Metal)
NIOSH REL	0.1 mg/m³ TWA
Current OSHA PEL	0.1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 50 mg Te/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Because no evidence of an IDLH for tellurium is shown in the available toxicological data, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 0.1 mg Te/m³ (i.e., 50 mg Te/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 50 mg Te/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Te:						
Rat	Izmerov et al. 1982	oral	83	-----	581 mg Te/m³	58 mg Te/m³
Mouse	Izmerov et al. 1982	oral	20	-----	140 mg Te/m³	14 mg Te/m³
Rabbit	Izmerov et al. 1982	oral	67	-----	469 mg Te/m³	47 mg Te/m³
G. pig	Izmerov et al. 1982	oral	45	-----	315 mg Te/m³	32 mg Te/m³
TeO_6H_6:						
Rabbit	Muehlberger and Schrenk 1928	oral	56	-----	392 mg Te/m³	39 mg Te/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 25 mg Te/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for tellurium compounds. Therefore, the revised IDLH for tellurium compounds is 25 mg Te/m³ based on acute oral toxicity data in animals [Izmerov et al. 1982; Muehlberger and Schrenk 1928].

REFERENCES:

1. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 107.
2. Muehlberger CW, Schrenk HH [1928]. The effect of the state of oxidation on the toxicity of certain elements. J Pharmacol Exp Ther 33:270-271.

Tellurium hexafluoride (as Te)

CAS number 7783-80-4
NIOSH REL .... 0.02 ppm (0.1 mg/m³) TWA
Current OSHA PEL .... 0.02 ppm (0.2 mg/m³) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.02 ppm (0.10 mg/m³) TWA
Description of substance .... Colorless gas with a repulsive odor.
LEL .... Nonflammable Gas
Original (SCP) IDLH .... 1 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statements by ACGIH [1971] that "animals showed evidence of pulmonary edema (disturbed breathing) at the lowest exposure tested, 1 ppm for 4 hours; a 1-hour exposure at 1 ppm produced greatly accelerated respiration but no mortality" [Kimmerle 1960]. The IDLH has been conservatively set, but no other data on acute inhalation toxicity are available on which to base an IDLH. Exposure for 4 hours to higher concentrations (5, 10, 25, 50, and 100 ppm) invariably proved fatal to all exposed animals [Kimmerle 1960].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Kimmerle 1960	-----	5	4 hr	10 ppm (2.0)	1.0 ppm
Mouse	Kimmerle 1960	-----	5	1 hr	6.3 ppm (1.25)	0.6 ppm
Rabbit	Kimmerle 1960	-----	5	4 hr	10 ppm (2.0)	1.0 ppm
G. pig	Kimmerle 1960	-----	5	4 hr	10 ppm (2.0)	1.0 ppm

Other animal data .... It has been reported that animals showed evidence of pulmonary edema (disturbed breathing) at the lowest exposure tested, 1 ppm for 4 hours; a 1-hour exposure at 1 ppm produced greatly accelerated respiration but no mortality [Kimmerle 1960].
Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 1 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Kimmerle 1960], the original IDLH for tellurium hexafluoride (1 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Tellurium hexafluoride. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 248.
2. Kimmerle G [1960]. Vergleichende untersuchungen der inhalationstoxicitat von schwefel-, selen- und tellurhexafluorid. Arch Toxikol *18*:140-144 (in German).

TEPP

CAS number	107-49-3
NIOSH REL	0.05 mg/m³ TWA [skin]
Current OSHA PEL	0.05 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.004 ppm (0.47 mg/m³) TWA [skin]
Description of substance	Colorless to amber liquid with a faint, fruity odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	10 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the estimated oral lethal dose in man of 100 mg cited by Patty [1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Edson 1960	oral	-----	0.5	3.5 mg/m³	0.4 mg/m³
G. pig	Frawley et al. 1952	oral	-----	2.3	16 mg/m³	1.6 mg/m³
Mouse	Kamimura et al. 1963	oral	-----	3	21 mg/m³	2.1 mg/m³

Human data .... TEPP, a cholinesterase inhibitor, has been judged to be twice as toxic as parathion; the American Conference of Governmental Industrial Hygienists TLV for TEPP was based on an analogy to parathion and was half that selected for parathion [ACGIH 1986]. It has been reported that the lethal oral dose is 1.429 mg/kg [CDC 1956; Patty 1963]. [Note: An oral dose of 1.429 mg/kg is equivalent to a 70-kg worker being exposed to 67 mg/m³ for 30 minutes assuming a 50 liter per minute breathing rate and 100% absorption.]

Revised IDLH: 5 mg/m³
Basis for revised IDLH: No inhalation data are available on which to base an IDLH for TEPP. Therefore, the revised IDLH for TEPP is 5 mg/m³ based on acute oral toxicity data in humans [CDC 1956; Patty 1963] and an analogy to parathion [ACGIH 1986] which has a revised IDLH of 10 mg/m³.

REFERENCES:

1. ACGIH [1986]. TEPP. In: Documentation of the threshold limit values and biological exposure indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 558.
2. CDC [1956]. Clinical memoranda on economic poisons. Atlanta, GA: Communicable Disease Center, Bureau of State Services, Public Health Service, U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 476, pp. 21-23.
3. Edson EF [1960]. Applied toxicology of pesticides. Pharmaceut J *185*:361-367.
4. Frawley JP, Hagan EC, Fitzhugh OG [1952]. A comparative pharmacological and toxicological study of organic phosphate-anticholinesterase compounds. J Pharmacol Exp Ther *105*:156-165.
5. Kamimura H, Matsumoto A, Miyazaki Y, Yamamoto I [1963]. Studies on nicotinoids as an insecticide. Part IV. Relation of structure to toxicity of pyridylmethylamines. Agri Biol Chem *27*(10):684-688.
6. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1956.

Terphenyl (o-, m-, p-isomers)

CAS number	26140-60-3 (mixed isomers)
NIOSH REL	5 mg/m³ (0.5 ppm) CEILING
Current OSHA PEL	9 mg/m³ (1 ppm) CEILING
1989 OSHA PEL	5 mg/m³ (0.5 ppm) CEILING
1993-1994 ACGIH TLV	5 mg/m³ (0.53 ppm) CEILING
Description of substance	Colorless or light-yellow solid.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 900 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	According to Testa and Masi [1964], workers have been exposed to 280 mg/m³ without adverse effect. For this draft technical standard, however, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 100 × the OSHA PEL of 9 mg/m³ (i.e., 900 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 900 mg/m³. This is a concentration unlikely to occur because of its low vapor pressure.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mixed isomers						
Mouse	Zhenjiang and Gengliang 1986	oral	13,200	-----	92,400 mg/m³	9,240 mg/m³
o-Isomer						
Rat	Cornish et al. 1962	oral	1,900	-----	13,300 mg/m³	1,330 mg/m³
m-Isomer						
Rat	Cornish et al. 1962	oral	2,400	-----	16,800 mg/m³	1,680 mg/m³
p-Isomer						
Rat	Cornish et al. 1962	oral	>10,000	-----	>70,000 mg/m³	>7,000 mg/m³
Rat	NRC 1953	oral	-----	500	3,500 mg/m³	350 mg/m³

Other animal data	In 30-day feeding studies involving doses of 250 or 500 mg/kg/day, rats fed o-terphenyl showed elevated liver and kidney weight ratios, rats fed m-terphenyl showed elevated kidney weight ratios only, and rats fed p-terphenyl showed no elevation in liver or kidney weight ratios [Cornish et al. 1962].
Human data	It has been reported that workers have been exposed to 280 mg/m³ without adverse effect [Testa and Masi 1964].

Revised IDLH: 500 mg/m³

Basis for revised IDLH: Based on health considerations and acute toxicity data in animals [NRC 1953], a value of about 2,000 mg/m³ would have been appropriate for terphenyl. However, the revised IDLH for terphenyl is 500 mg/m³ based on being 100 times the NIOSH REL of 5 mg/m³ (100 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for terphenyl).

REFERENCES:

1. Cornish HH, Bahor RE, Ryan RC [1962]. Toxicity and metabolism of ortho-, meta-, and para-terphenyls. Am Ind Hyg Assoc J 23:372-378.

2. NRC [1953]. Relationship between chemical structure and toxic action on rats. National Academy of Sciences, National Research Council, Chemical-Biological Coordination Center, Review *5*:26.
3. Testa C, Masi G [1964]. Determination of polyphenyls in working environments of organic reactors by spectrophotometric methods. Anal Chem *36*(12):2284-2287.
4. Zhenjiang L, Gengliang W [1986]. Development of hydroterphenyl for use as high temperature organic heat carrier. Shiyou Huagong (Petrochemical Technology) *15*:305-308 (in Chinese).

1,1,1,2-Tetrachloro-2,2-difluoroethane

CAS number	76-11-9
NIOSH REL	500 ppm (4,170 mg/m³) TWA
Current OSHA PEL	500 ppm (4,170 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	500 ppm (4,170 mg/m³) TWA
LEL	Noncombustible solid
Description of substance	Colorless solid with a slight, ether-like odor.
Original (SCP) IDLH	15,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that rats became slightly intoxicated after being exposed for 1.5 hours to 15,000 ppm [Greenburg and Lester 1950] and on the statement by ACGIH [1971] that rats died following a 4-hour exposure to 15,000 ppm [Clayton et al. 1966].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Clayton et al. 1966	15,000	-----	4 hr	30,000 ppm (2.0)	3,000 ppm
Rat	Torkelson et al. 1971	20,000	-----	30 min	20,000 ppm (1.0)	2,000 ppm

Other animal data	Rats exposed to 10,000 ppm for 1.5 to 2 hours showed slight signs of intoxication but no loss of reflexes, while a concentration of 20,000 to 30,000 ppm was fatal in 1.0 to 2.5 hours [Greenberg and Lester 1950].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for 1,1,1,2-tetrachloro-2,2-difluoroethane is 2,000 ppm based on acute inhalation toxicity data in animals [Torkelson et al. 1971] and to be consistent with the revised IDLH for the similar chlorofluorocarbon 1,1,2,2-tetrachloro-1,2-difluoroethane which has a revised IDLH of 2,000 ppm. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. 1,1,1,2-Tetrachloro-2,2-difluoroethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 249.
2. Clayton JW Jr, Sherman H, Morrison SD, Barnes JR, Hood DB [1966]. Toxicity studies on 1,1,2,2-tetrachloro-1,2-difluoroethane and 1,1,1,2-tetrachloro-2,2-difluoroethane. Am Ind Hyg Assoc J 27(4):332-340.
3. Greenberg LA, Lester D [1950]. Toxicity of the tetrachlorodifluoroethanes. AMA Arch Ind Hyg Occup Med 2:345-347.
4. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1331.
5. Torkelson TR, Kary CD, Chenoweth MB, Larsen ER [1971]. Single exposure of rats to the vapors of trace substances in methoxyflurene. Toxicol Appl Pharmacol 19:1-9.

1,1,2,2-Tetrachloro-1,2-difluoroethane

CAS number	76-12-0
NIOSH REL	500 ppm (4,170 mg/m³) TWA
Current OSHA PEL	500 ppm (4,170 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	500 ppm (4,170 mg/m³) TWA
Description of substance	Colorless solid or liquid (above 77°F) with a slight, ether-like odor.
LEL	Noncombustible Solid/Noncombustible Liquid
Original (SCP) IDLH	15,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that exposure to 10,000 ppm for 1.5 to 2 hours produced slight intoxication in rats but no loss of reflexes [Greenberg and Lester 1950], and on the report that a 4-hour exposure to 15,000 ppm was fatal to rats [Clayton et al. 1966].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Clark and Tinston 1982	20,000	-----	15 min	15,800 ppm (0.79)	1,580 ppm
Rat	Clayton et al. 1966	15,000	-----	4 hr	30,000 ppm (2.0)	3,000 ppm
Mouse	Izmerov et al. 1982	14,522	-----	2 hr	23,235 ppm (1.6)	2,324 ppm

Other animal data	Rats exposed to 10,000 ppm for 1.5 to 2 hours showed slight signs of intoxication but no loss of reflexes, while 20,000 to 30,000 ppm was fatal in 1.0 to 2.5 hours [Greenberg and Lester 1950].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for 1,1,2,2-tetrachloro-1,2-difluoroethane is 2,000 ppm based on acute inhalation toxicity data in animals [Greenberg and Lester 1950] and to be consistent with the revised IDLH for the similar chlorofluorocarbon 1,1,1,2-tetrachloro-2,2-difluoroethane which has a revised IDLH of 2,000 ppm. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

REFERENCES:

1. ACGIH [1971]. 1,1,2,2-Tetrachloro 1,2-difluoroethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 249.
2. Clark DG, Tinston DJ [1982]. Acute inhalation toxicity of some halogenated and non-halogenated hydrocarbons. Hum Toxicol 1:239-247.
3. Clayton JW Jr, Sherman H, Morrison SD, Barnes JR, Hood DB [1966]. Toxicity studies on 1,1,2,2-tetrachloro-1,2-difluoroethane and 1,1,1,2-tetrachloro-2,2-difluoroethane. Am Ind Hyg Assoc J 27(4):332-340.
4. Greenberg LA, Lester D [1950]. Toxicity of the tetrachlorodifluoroethanes. AMA Arch Ind Hyg Occup Med 2:345-347.
5. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 54.

1,1,2,2-Tetrachloroethane

CAS number	79-34-5
NIOSH REL	1 ppm (7 mg/m³) TWA [skin]; NIOSH considers 1,1,2,2-tetrachloroethane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	5 ppm (35 mg/m³) TWA [skin]
1989 OSHA PEL	1 ppm (7 mg/m³) TWA [skin]
1993-1994 ACGIH TLV	1 ppm (6.9 mg/m³) TWA [skin]
Description of substance	Colorless to pale-yellow liquid with a pungent, chloroform-like odor.
LEL	Noncombustible Liquid
Original (SCP) IDLH	150 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Negherbon [1959] that a 30-minute exposure to 146 ppm caused vertigo (along with irritation of the mucous membranes, sense of pressure in the head, and fatigue) in humans; the same effects were noted after a 10-minute exposure to 335 ppm [Lehmann et al. 1936].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Carpenter et al. 1949	-----	1,000	4 hr	2,000 ppm (2.0)	200 ppm
Mouse	Izmerov et al. 1982	-----	643	2 hr	1,029 ppm (1.6)	103 ppm
Cat	Lehmann et al. 1936	-----	2,714	45 min	3,094 ppm (1.14)	309 ppm
Rat	Smyth 1956	1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm

Human data .... A 30-minute exposure to 146 ppm has caused vertigo, irritation of the mucous membranes, sense of pressure in the head, and fatigue; the same effects were noted after a 10-minute exposure to 335 ppm [Lehmann et al. 1936; Negherbon 1959].

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 1,1,2,2-tetrachloroethene is 100 ppm based on acute inhalation toxicity data in humans [Lehmann et al. 1936; Negherbon 1959] and animals [Izmerov et al. 1982]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 1,1,2,2-tetrachloroethane at concentrations above 1 ppm.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*(6):343-346.
2. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 75.
3. Lehmann KB, Schmidt-Kehl L, Ruf H, Crescitelli, Dahl, Eppinghausen, Eshe, Falker, Grotefendt, Junkenita, Maier, Mergner, Pantehtsch, Schlitzer, Shoenes, Spettmann, Wirges, Bamsreiter, Benninger, Lazarus, Manasse, Kummeth, Reuss, Schwarzweller [1936]. The 13 most important chlorinated hydrocarbons of the aliphatic series from the standpoint of occupational hygiene. Arch Hyg Bakteriol *116*:132-200 (translated).
4. Negherbon WO [1959]. Handbook of toxicology. Vol. III. Insecticides, a compendium. Wright-Patterson Air Force Base, OH: U.S. Air Force, Air Research and Development Command, Wright Air Development Center, Aero Medical Laboratory, WADC Technical Report 55-16, p. 735.
5. Smyth HF Jr [1956]. Improved communication: hygienic standards for daily inhalation. Am Ind Hyg Assoc Q *17*(2):129-185.

Tetrachloroethylene

CAS number 127-18-4
NIOSH REL .... Minimize workplace exposure concentrations; NIOSH considers tetrachloroethylene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL .... 100 ppm TWA, 200 ppm CEILING, 300 ppm 5-minute MAXIMUM PEAK IN ANY 3 HOURS
1989 OSHA PEL .... 25 ppm (170 mg/m^3) TWA
1993-1994 ACGIH TLV .... 25 ppm (170 mg/m^3) TWA, 100 ppm (685 mg/m^3) STEL, A3
Description of substance .... Colorless liquid with a mild, chloroform-like odor.
LEL .... Noncombustible Liquid
Original (SCP) IDLH .... 500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by Negherbon [1959] that a 95-minute exposure to 1,000 ppm produces slight drunkenness, but no narcosis [Rowe et al. 1952]. Negherbon [1959] also reported that a 20- to 30-minute exposure to 206 to 235 ppm causes dizziness in humans (along with eye irritation, sinus congestion, nasal discharge, and sleepiness) [Rowe et al. 1952]. An IDLH of 500 ppm is used to prevent disorientation during escape.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Carpenter et al. 1949	4,000	-----	4 hr	11,320 ppm (2.83)	1,132 ppm
Mouse	Friberg et al. 1953	5,200	-----	4 hr	14,716 ppm (2.83)	1,472 ppm
Rat	Pozzani et al. 1959	4,964	-----	8 hr	19,856 ppm (4.0)	1,986 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.0 [ten Berge et al. 1986].

Human data .... It has been reported that 2,000 ppm caused slight narcosis in 5 minutes; 930-1185 ppm caused irritation of the eyes and throat, and marked dizziness after 2 minutes; 1,000 ppm caused slight drunkenness, but no narcosis after 95 minutes; 513-690 ppm caused eye, throat, and nose irritation, dizziness, loss of inhibition, and some incoordination after 10 minutes; 500 ppm for 2 hours caused slight discomfort; 206-356 ppm for 2 hours caused headache, burning of the eyes, sinus congestion, impaired coordination, and nausea; 206-235 ppm for 20-30 minutes caused eye irritation, sinus congestion, dizziness, and sleepiness; and 106 ppm caused only slight eye irritation [Negherbon 1959; Rowe et al. 1952].

Revised IDLH: 150 ppm
Basis for revised IDLH: The revised IDLH for tetrachloroethylene is 150 ppm based on acute inhalation toxicity data in humans [Negherbon 1959; Rowe et al. 1952] [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for tetrachloroethylene at any detectable concentration.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity and the grading and interpretation of results on 96 chemical compounds. J Ind Hyg Toxicol *31*:343-346.

2. Friberg L, Kylin B, Nystrom A [1953]. Toxicities of trichloroethylene and tetrachloroethylene and Fujiwara's pyridine-alkali reaction. Acta Pharmacol Toxicol 9:303-312.
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4. Pozzani UC, Weil CS, Carpenter CP [1959]. The toxicological basis of threshold limit values: 5. The experimental inhalation of vapor mixtures by rats, with notes upon the relationship between single dose inhalation and single dose oral data. Am Ind Hyg Assoc J *20*:364-369.
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6. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. J Haz Mat *13*:301-309.

Tetrachloronaphthalene

CAS number	1335-88-2
NIOSH REL	2 mg/m^3 TWA [skin]
Current OSHA PEL	2 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 mg/m^3 TWA
Description of substance	Colorless to pale-yellow solid with an aromatic odor.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 20 mg/m^3 – see discussion below.]
Basis for original (SCP) IDLH	No toxicological data are available concerning the effects of acute exposures to tetrachloronaphthalene. For this draft technical standard, however, an analogy with other chloronaphthalenes was used, and the respirators have been selected on the basis of the assigned protection factor afforded by each device up to 10 × the OSHA PEL of 2 mg/m^3 (i.e., 20 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 20 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	It has been stated that tetrachloronaphthalene has been shown to be less toxic to the liver than more highly chlorinated derivatives of naphthalene [ACGIH 1986].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: Unknown [Unchanged]
Basis for revised IDLH: Due to a lack of relevant acute toxicity data, the IDLH for tetrachloronaphthalene remains "Unknown." The "most protective" respirators will continue to be recommended for concentrations exceeding 20 mg/m^3 based on being 10 times the NIOSH REL and OSHA PEL of 2 mg/m^3 (10 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for tetrachloronaphthalene).

REFERENCE:

1. ACGIH [1986]. Tetrachloronaphthalene. In: Documentation of the threshold limit values and biological exposure indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 562.

Tetraethyl lead (as Pb)

CAS number	78-00-2
NIOSH REL	0.075 mg/m³ TWA [skin]
Current OSHA PEL	0.075 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m³ TWA [skin]
Description of substance	Colorless liquid (unless dyed red, orange, or blue) with a pleasant, sweet odor.
LEL	1.8% (10% LEL, 1,800 ppm)
Original (SCP) IDLH	40 mg Pb/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on the rat LC_{50} of 6 ppm (approximately 80 mg/m³) [Saglik Dergisi 1963 cited by NIOSH 1974]. However, because of the unreliability of tetraethyl lead analytical methods utilized prior to 1968, 40 mg Pb/m³, which is approximately 50% of the LC_{50}, has been utilized as the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Akatsuka 1973	-----	650 mg/m³	7 hr	999 mg Pb/m³ (2.4)	100 mg Pb/m³
Rat	Cremer and Calloway 1961	850 mg/m³	-----	1 hr	680 mg Pb/m³ (1.25)	68 mg Pb/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Akatsuka 1973	oral	-----	30	135 mg Pb/m³	14 mg Pb/m³
Rat	Magistretti et al. 1963	oral	35	-----	157 mg Pb/m³	16 mg Pb/m³
Rat	Schepers 1964	oral	17	-----	76 mg Pb/m³	7.6 mg Pb/m³
Rat	Schroeder et al. 1972	oral	12.3	-----	55 mg Pb/m³	5.5 mg Pb/m³
Rat	Springman et al. 1963	oral	-----	24	108 mg Pb/m³	11 mg Pb/m³

Human data .... It has been stated that 100 mg Pb/m³ for 1 hour may produce illness [Fleming 1963].

Revised IDLH: 40 mg Pb/m³ [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Fleming 1963] and animals [Akatsuka 1973; Cremer and Calloway 1961], a value of about 100 mg Pb/m³ would have been appropriate for tetraethyl lead. However, the original IDLH for tetraethyl lead (40 mg Pb/m³) is not being revised at this time.

REFERENCES:

1. Akatsuka K [1973]. Tetraalkyl lead poisoning. Sangyo Igaku (Japanese Journal of Industrial Health) *15*:3-66.
2. Cremer JE, Calloway S [1961]. Further studies on the toxicity of some tetra and trialkyl lead compounds. Brit J Ind Med *18*:277-282.
3. Fleming AJ [1963]. Lead Symposium, Kettering Laboratory, University of Cincinnati, February 25-27, 1963.
4. Magistretti M, Zurlo N, Scollo F, Pacillo D [1963]. Tossicità comparata del piombo tetra-etile e del piombo tetra-metile. Med Lav *54*:486-495 (in Italian).
5. NIOSH [1974]. TP45500. Plumbane, tetraethyl-. In: The toxic substances list, 1974 ed. Rockville, MD: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 74-134, p. 634.
6. Saglik Dergisi [1963]; *38*:653.
7. Schepers GWH [1964]. Tetraethyl lead and tetramethyl lead comparative experimental pathology: Part I. Lead absorption and pathology. Arch Environ Health *8*:277-295.
8. Schroeder T, Avery DD, Cross HA [1972]. Tetraethyl lead dose response curve for mortality in laboratory rats. Experientia *28*:923-924.
9. Springman E, Bingham E, Stemmer KL [1963]. The acute effects of lead alkyls. Arch Environ Health *6*:469.

Tetrahydrofuran

CAS number	109-99-9
NIOSH REL	200 ppm (590 mg/m^3) TWA, 250 ppm (735 mg/m^3) STEL
Current OSHA PEL	200 ppm (590 mg/m^3) TWA
1989 OSHA PEL	200 ppm (590 mg/m^3) TWA, 250 ppm (735 mg/m^3) STEL
1993-1994 ACGIH TLV	200 ppm (590 mg/m^3) TWA, 250 ppm (737 mg/m^3) STEL
Description of substance	Colorless liquid with an ether-like odor.
LEL	2% (10% LEL, 2,000 ppm)
Original (SCP) IDLH	20,000 ppm [LEL]
Basis for original (SCP) IDLH	AIHA [1959] reported that exposure to 25,000 ppm will cause anesthesia and that 17,000 ppm appears to be safe for 3 hours [Hofmann and Oettel 1954]. Therefore, 20,000 ppm has been chosen as the IDLH because it is the lower explosive limit (LEL) of tetrahydrofuran.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Horiguchi et al. 1984	21,000	-----	3 hr	37,800 ppm (1.8)	3,780 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	GAF 1991	oral	1,650	-----	3,850 ppm	385 ppm
Mouse	Pozdnyakov 1967	oral	2,300	-----	5,367 ppm	537 ppm
G. pig	Pozdnyakov 1967	oral	2,300	-----	5,367 ppm	537 ppm

Human data .... It has been reported that exposure to 25,000 ppm will cause anesthesia and 17,000 ppm appears to be safe for 3 hours [Hofmann and Oettel 1954].

Revised IDLH: 2,000 ppm [LEL]
Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Hofmann and Oettel 1954], a value of at least 17,000 ppm would have been appropriate for tetrahydrofuran. However, the revised IDLH is 2,000 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2%).

REFERENCES:

1. AIHA [1959]. Tetrahydrofuran. In: Hygienic guide series. Am Ind Hyg Assoc J *20*:250-251.
2. GAF [1991]. Material safety data sheet: Agrisynth THF. Wayne, NJ: GAF Chemicals Corporation, pp. 1-3.
3. Hofmann G, Oettel H [1954]. Zur frage der toxizitat von tetrahydrofuran. Arch Exp Pathol Pharmakol *222*:233-235 (in German).
4. Horiguchi S, Teramoto K, Katahira T [1984]. Acute and repeated inhalation toxicity of tetrahydrofuran in laboratory animals. Sumitomo Sangyo Eisei (Sumitomo Industrial Health) *20*:141-157.
5. Pozdnyakov AG [1967]. Materials on hygienic reglamentation of tetrahydrofuryl (THF) alcohol in water bodies. Gig Sanit *32*(2):99-101 (in Russian).

Tetramethyl lead (as Pb)

CAS number	75-74-1
NIOSH REL	0.075 mg/m³ TWA [skin]
Current OSHA PEL	0.075 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.15 mg/m³ TWA [skin]
Description of substance	Colorless liquid (unless dyed red, orange, or blue) with a fruity odor.
LEL	Unknown
Original (SCP) IDLH	40 mg Pb/m³
Basis for original (SCP) IDLH	The chosen IDLH is based on an analogy with tetraethyl lead which has an IDLH of 40 mg Pb/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Castellino et al. 1963	40,800 mg/m³	-----	30 min	31,626 mg Pb/m³ (1.0)	3,163 mg Pb/m³
Rat	Cremer and Calloway 1961	8,870 mg/m³	-----	30 min	6,876 mg Pb/m³ (1.0)	688 mg Pb/m³
Mouse	Marhold 1986	-----	8,500 mg/m³	30 min	6,589 mg Pb/m³ (1.0)	659 mg Pb/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Akatsuka 1973	oral	-----	24	130 mg Pb/m³	13 mg Pb/m³
G. pig	Gekkan Yakuji 1980	oral	109	-----	591 mg Pb/m³	59 mg Pb/m³
Rat	Magistretti et al. 1963	oral	105	-----	570 mg Pb/m³	57 mg Pb/m³

Other animal data	It has been reported that signs of acute tetramethyl lead intoxication in rats were similar to that seen after acute poisoning with tetraethyl lead [ACGIH 1991].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 40 mg Pb/m³ [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Castellino et al. 1963; Cremer and Calloway 1961; Marhold 1986], a value of 150 mg Pb/m³ (i.e., 2,000 times the NIOSH REL) would have been appropriate for tetramethyl lead. However based on an analogy to tetraethyl lead which has a revised IDLH of 40 mg Pb/m³, the original IDLH for tetramethyl lead (40 mg Pb/m³) is not being revised at this time

REFERENCES:

1. ACGIH [1991]. Tetramethyl lead. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1521-1523.
2. Akatsuka K [1973]. Tetraalkyl lead poisoning. Sangyo Igaku (Japanese Journal of Industrial Health) *15*:3-66.
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4. Cremer JE, Calloway S [1961]. Further studies on the toxicity of some tetra and trialkyl lead compounds. Brit J Ind Med *18*:277-282.
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7. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 1258 (in Czechoslovakian).

Tetramethyl succinonitrile

CAS number 3333-52-6
NIOSH REL .... 3 mg/m³ (0.5 ppm) TWA [skin]
Current OSHA PEL .... 3 mg/m³ (0.5 ppm) TWA [skin]
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 2.8 mg/m³ (0.5 ppm) TWA [skin]
Description of substance .... Colorless, odorless solid.
LEL .... Unknown
Original (SCP) IDLH .... 5 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by ACGIH [1972] that 6 ppm for 30 hours was lethal to rats [Spolyar 1948]. A concentration of 22 ppm is obviously too high to be chosen as the IDLH, because no mice survived a 3.5-hour exposure at this concentration [Hecht and Kimmerle 1956-1957 as quoted by Reinl 1957].
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Hecht and Kimmerle 1956/1957	-----	28	3 hr	50 ppm (1.8)	5.0 ppm
Mouse	Hecht and Kimmerle 1956/1957	LC_{100}: 22	-----	3.5 hr	42 ppm (1.9)	4.2 ppm
Rat	Spolyar 1948	-----	6	30 hr	24 ppm (3.91)	2.4 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Johannsen and Livinskas 1986	oral	38.9	-----	48 ppm	4.8 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 5 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in animals [Hecht and Kimmerle 1956-1957], the original IDLH for tetramethyl succinonitrile (5 ppm) is not being revised at this time.

REFERENCES:

1. ACGIH [1972]. Tetramethyl succinonitrile. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 254.
2. Harger RN, Hupieu HR [1949]. Toxicity of tetramethyl succinonitrile and the antidotal effects of thiosulphate, nitrile, and barbiturates. Fed Proc 8:205.
3. Hecht G, Kimmerle H [1956/1957]. Toxikologische Untersuchungen uber Tetramethyl-bernsteinsauredinitril. Unpublished investigations (in German). [From Reinl W [1957]. Intoxication in manufacturing of plastics by tetramethyl-succinic acid dinitrile. Arch Toxikol 16:367-380 (in German).]
4. Johannsen FR, Livinskas GJ [1986]. Subchronic toxicity of tetramethyl succinonitrile. Fundam Appl Toxicol 7:41-48.
5. Reinl W [1957]. Intoxication in manufacturing of plastics by tetramethyl-succinic acid dinitrile. Arch Toxikol 16:367-380 (in German).
6. Spolyar LW [1948]. Indiana chemists report toxicity of product of Porofor M. Ind Hyg Newsletter 8(10)3.

Tetranitromethane

CAS number	509-14-8
NIOSH REL:	1 ppm (8 mg/m³) TWA
Current OSHA PEL	1 ppm (8 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.005 ppm (0.04 mg/m³) TWA, A2
Description of substance	Colorless to pale-yellow liquid or solid (below 57°F) with a pungent odor.
LEL	Unknown
Original (SCP) IDLH	5 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by AIHA [1964] that concentrations above 5 ppm may cause irreversible lung and systemic damage [Koelsch 1917]. Patty [1963] reported that a cat exposed to 10 ppm for 20 minutes died within 10 days [Flury and Zernik 1931], and 5 cats exposed to 7 to 25 ppm for periods ranging from 2.5 to 5 hours died within 1 to 5.5 hours [Sievers et al. 1947].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Horn 1953	LC_{41}: 33	-----	6.5 hr	78 ppm (2.35)	7.8 ppm
Rat	Kinkead et al. 1977	18	-----	4 hr	36 ppm (2.0)	3.6 ppm
Cat	Marhold 1986	100	-----	20 min	87 ppm (0.87)	8.9 ppm
Mouse	USAF 1977	54	-----	4 hr	108 ppm (2.0)	11 ppm

Other animal data	Cats exposed to 10 ppm for 20 min died within ten days [Flury and Zernik 1931]. It has been reported that cats exposed to 7 to 25 ppm for periods ranging from 2.5 to 5 hours died within 1 to 5.5 hours [Sievers et al. 1947].
Human data	It has been stated that concentrations above 5 ppm may cause irreversible lung and systemic damage [Koelsch 1917].

Revised IDLH: 4 ppm
Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Koelsch 1917] and animals [Horn 1953; Kinkead et al. 1977], the revised IDLH for tetranitromethane is 4 ppm.

REFERENCES:

1. AIHA [1964]. Tetranitromethane. In: Hygienic guide series. Am Ind Hyg Assoc J 25:513-515.
2. Flury F, Zernik F [1931]. Schädliche gase dämpfe, nebel, rauch- und staubarten. Berlin, Germany: Verlag von Julius Springer, p. 417 (in German).
3. Horn HJ [1953]. Chemical Corps Medical Laboratories Contract Report No. 20.
4. Kinkead ER, MacEwen JD, Haun CC, Vernot EH, Dacre JC [1977]. Toxic hazards evaluation of five atmospheric pollutants from Army ammunition plants. Wright-Patterson Air Force Base, OH: Air Force Systems Command, Aerospace Medical Division, Aerospace Medical Research Laboratory Technical Report AMRL-TR-77-25.
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6. Marhold J [1986]. Prehled Prumyslove Toxikologie, Organicke Latky. Prague, Czechoslovakia: Avicenum, p. 403 (in Czechoslovakian).
7. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 2075.
8. Sievers RF, Rushing E, Gay H, Monaco AR [1947]. Toxic effects of tetranitromethane, a contaminant in crude TNT. Public Health Rep 62:1054-1058.
9. USAF [1977]. Proceedings of the 8th annual conference on environmental toxicology. Wright-Patterson Air Force Base, OH: Air Force Systems Command, Aerospace Medical Division, Aerospace Medical Research Technical Report, AMRL-TR-77-97.

Tetryl

CAS number	479-45-8
NIOSH REL	1.5 mg/m³ TWA [skin]
Current OSHA PEL	1.5 mg/m³ TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1.5 mg/m³ TWA
Description of substance	Colorless to yellow, odorless, crystalline solid.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 3,000 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that an acute exposure to a high concentration of tetryl would impede escape or cause any irreversible health effects within 30 minutes. For this draft technical standard, therefore, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 1.5 mg/m³ (i.e., 3,000 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 3,000 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Dog	Wells et al. 1920	s.c.	-----	5,000	35,000 mg/m³	3,500 mg/m³

Human data .... Tetryl is highly irritating to the skin and mucous membranes and may cause severe upper respiratory tract irritation with coughing and epistaxis; heavy airborne exposures may also cause liver damage [Hardy and Maloof 1950]. No systemic poisoning was noted following chronic exposure to 1.5 mg/m³, other than some skin sensitization [Bergman 1952].

Revised IDLH: 750 mg/m³
Basis for revised IDLH: Based on acute subcutaneous toxicity data in animals [Wells et al. 1920], a value of about 3,500 mg/m³ would have been appropriate. However, the revised IDLH for tetryl is 750 mg/m³ based on being 500 times the NIOSH REL and OSHA PEL of 1.5 mg/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

1. Bergman BB [1952]. Tetryl toxicity: a summary of ten years experience. AMA Arch Ind Hyg Occup Med 5(1):10-20.
2. Hardy WL, Maloof CC [1950]. Evidence of systemic effect of tetryl. AMA Arch Ind Hyg Occup Med 1:545-555.
3. Wells HG, Lewis JH, Sansum WD, McClure WB, Lussky HO [1920]. Observations on the toxicity of tetranitromethylaniline (tetryl), tetranitroxylene (T.N.X.), tetranitraniline (T.N.A.), dinitrodichlorbenzene (parazol), and metanitraniline. J Ind Hyg 2:247-252.

Thallium (soluble compounds, as Tl)

CAS number	Varies
NIOSH REL	0.1 mg/m^3 TWA [skin]
Current OSHA PEL	0.1 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.1 mg/m^3 TWA [skin]
Description of substance	Varies
Original (SCP) IDLH	20 mg Tl/m^3
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available on which to base the IDLH for the soluble compounds of thallium, research in this area is needed. The chosen IDLH has been estimated from the data given by ACGIH [1971] that LD_{50} values for different thallium compounds, by various routes of administration and for several species of animals ranged from 3 to 92 mg/kg [Downs et al. 1960 as cited by Patty 1963]. Further support for the chosen IDLH can be gained from the statement by Deichmann and Gerarde [1969] that a dose of 0.2 gram (inorganic salts of thallium) may be lethal unless treatment is started promptly.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
TlCl						
Mouse	Tikhova 1964	oral	24	-----	143 mg Tl/m^3	14 mg Tl/m^3
$TlSO_4$						
Rat	Gekkan Yakuji 1980	oral	16	-----	91 mg Tl/m^3	9.1 mg Tl/m^3
Mouse	Tikhova 1964	oral	23.5	-----	133 mg Tl/m^3	13 mg Tl/m^3
$TlC_2H_3O_2$						
Mouse	Kusano 1969	oral	35	-----	191 mg Tl/m^3	19 mg Tl/m^3
Rat	Venugopal and Luckey 1978	oral	41.3	-----	225 mg Tl/m^3	23 mg Tl/m^3
Tl_2CO_3						
Mouse	Tikhova 1964	oral	21	-----	128 mg Tl/m^3	13 mg Tl/m^3
Rat	Tikhova 1964	oral	-----	23	140 mg Tl/m^3	14 mg Tl/m^3

Human data ..... Lethal oral doses ranging from 0.9 to 9.4 mg/kg have been reported [Gekkan Yakuji 1980; Tanaka et al. 1978; Venugopal and Luckey 1978; Yakkyoku 1977]. [Note: An oral dose ranging from 0.9 to 9.4 mg/kg is equivalent to a 70-kg worker being exposed to concentrations ranging from about 40 to 450 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 15 mg Tl/m^3
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for soluble thallium compounds. Therefore, the revised IDLH for soluble thallium compounds is 15 mg Tl/m^3 based on acute oral toxicity data in humans [Gekkan Yakuji 1980; Tanaka et al. 1978; Venugopal and Luckey 1978; Yakkyoku 1977] and animals [Kusano 1969; Tikhova 1964].

REFERENCES:

1. ACGIH [1971]. Thallium. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 256.
2. Deichmann WB, Gerarde HW [1969]. Thallium. In; Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 582-583.
3. Downs WL, Scott JK, Steadman LT, Maynard EA [1960]. Acute and sub-acute toxicity studies of thallium compounds. Am Ind Hyg Assoc J *21*:399–406.
4. Gekkan Yakuji (Pharmaceuticals Monthly) [1980]; *22*:291-298 (in Japanese).
5. Kusano T [1969]. Studies on the improved effectiveness of anticoagulative rodenticides on rodents. I. Synergistic toxic action between coumarin or indandione derivatives and thallium salts on mice. Journal of the Faculty of Agriculture, Tottori University *5*(2):15-52.
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9. Venugopal B, Luckey TD [1978]. Metal toxicity in mammals. Vol. 2. Chemical toxicity of metals and metalloids. New York, NY: Plenum Press, p. 101.
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Thiram

CAS number	137-26-8
NIOSH REL	5 mg/m³ TWA
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 mg/m³ TWA
Description of substance	Colorless to yellow, crystalline solid with a characteristic odor.
LEL	Unknown
Original (SCP) IDLH	1,500 mg/m³
Basis for original (SCP) IDLH	The chosen IDLH has been estimated from the rabbit oral LD_{50} of 210 mg/kg [Sakuramoto 1977 cited by NIOSH 1976]. Rats survived a 4-hour exposure to concentrations above 500 mg/m³ [Smyth 1937-1955 cited by ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Marhold 1986	500 mg/m³	-----	4 hr	1,000 mg/m³ (2.0)	100 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Arkhangel'skaya and Roshchina 1964	oral	1,350	-----	9,450 mg/m³	945 mg/m³
Rabbit	Sakuramoto 1977	oral	210	-----	1,470 mg/m³	147 mg/m³
Rat	Weiss and Orzel 1967	oral	560	-----	3,920 mg/m³	392 mg/m³

Other animal data	Rats have survived a 4-hr exposure to concentrations exceeding 500 mg/m³ [Smyth 1937-1955].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg/m³
Basis for revised IDLH: The revised IDLH for thiram is 100 mg/m³ based on acute inhalation toxicity data in animals [Marhold 1986]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

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Thiram (continued)

7. Smyth HF Jr [1937-1955]. Unpublished work by Chemical Hygiene Fellowship, Mellon Institute, Pittsburgh, PA. [From ACGIH [1991]. Thiram. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1545-1549.]
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Tin (inorganic compounds, as Sn)

CAS number .... 7440-31-5 (Metal)
NIOSH REL .... 2 mg/m³ TWA
Current OSHA PEL .... 2 mg/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 2 mg/m³ TWA
Description of substance .... Varies
Original (SCP) IDLH .... 400 mg Sn/m³
Basis for original (SCP) IDLH .... The chosen IDLH is based on the toxicity of stannous chloride. ACGIH [1971] indicated that inorganic tin salts are of high acute toxicity. ILO [1972] reported evidence exists that stannous chloride can cause paralysis in animals. No data on acute inhalation toxicity are available on which to base the IDLH. The chosen IDLH is based on the dog intravenous LD_{LO} of 20 mg/kg for stannous chloride [Patenko 1886 as cited by Flury and Zernik 1935] cited by NIOSH. The chosen IDLH is likely to be conservative.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$SnSO_4$						
Rat	Gig Sanit 1986	oral	2,207	-----	8,497 mg Sn/m³	850 mg Sn/m³
Mouse	Gig Sanit 1986	oral	2,152	-----	8,285 mg Sn/m³	829 mg Sn/m³
$SnCl_2$						
Rat	Calvery 1942	oral	700	-----	3,087 mg Sn/m³	309 mg Sn/m³
Rabbit	WHO 1970	oral	10,000	-----	44,100 mg Sn/m³	4,410 mg Sn/m³
Mouse	WHO 1972	oral	250	-----	1,103 mg Sn/m³	110 mg Sn/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 mg Sn/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for inorganic tin compounds. Therefore, the revised IDLH for inorganic tin compounds is 100 mg Sn/m³ based on acute oral toxicity data in animals [WHO 1972]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

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7. Patenko [1886]. Arch de Phys Ser III 7:33. [From Flury F, Zernik F [1935]. Zusammenstellung der toxischen und letalen dosen fur die gebrauchlichsten gifte und versuchstiere. Abder Hand Biol Arbeitsmethod 4:1289-1422 (in German).]
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9. WHO [1972]. Toxicological evaluation of some enzymes, modified starches and certain other substances. Geneva, Switzerland: World Health Organization, Food and Agriculture Organization, WHO Food Additives Series, No. 1, pp. 101-104.

Tin (organic compounds, as Sn)

CAS number	Varies
NIOSH REL	0.1 mg/m³ TWA [skin]
Current OSHA PEL	0.1 mg/m³ TWA
1989 OSHA PEL	0.1 mg/m³ TWA [skin]
1993-1994 ACGIH TLV	0.1 mg/m³ TWA, 0.2 mg/m³ STEL
Description of substance	Varies
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 200 mg Sn/m³ -- see discussion below.]
Basis for original (SCP) IDLH	Patty [1963], Browning [1969], and Deichmann and Gerarde [1969] all indicated that the trialkyltin compounds are generally the most toxic of the organic tin compounds. The only available acute inhalation toxicity data on which to base an IDLH are given by NIOSH [1976] which cited the following mouse LC_{LO} values for tri-n-butyltin iodide, triethyltin bromide, and tri-n-propyltin bromide, respectively: 1340 mg/m³, 1640 mg/m³, and 1650 mg/m³ [NDRC 1942]. The LC_{LO} is the lowest concentration of a substance, other than an LC_{50} in air, that has been reported to cause death in man or to cause death in animals when they have been exposed for 24 hours or less. For this draft technical standard, however, respirators have been assigned on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 0.1 mg Sn/m³ (i.e., 200 mg Sn/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 200 mg Sn/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Tri-n-butyltin iodide Mouse	NDRC 1942	-----	1,340 mg/m³	10 min	263 mg Sn/m³ (0.69)	26 mg Sn/m³
Triethyltin bromide Mouse	NDRC 1942	-----	1,640 mg/m³	10 min	470 mg Sn/m³ (0.69)	47 mg Sn/m³
Tri-n-propyltin bromide Mouse	NDRC 1942	-----	1,650 mg/m³	10 min	412 mg Sn/m³ (0.69)	41 mg Sn/m³

Tin (organic compounds, as Sn) (continued)

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Triphenyltin acetate						
G. pig	Klimmer 1971	oral	21	-----	43 mg Sn/m^3	4.3 mg Sn/m^3
Rabbit	Perkow 1971/1976	oral	30	-----	61 mg Sn/m^3	6.1 mg Sn/m^3
Mouse	Stoner 1966	oral	81	-----	164 mg Sn/m^3	16 mg Sn/m^3
Rat	Hartel 1958	oral	125	-----	254 mg Sn/m^3	25 mg Sn/m^3
Dimethyltin bis(isooctyl-mercaptoacetate)						
Rat	Hazleton 1972	oral	604	-----	903 mg Sn/m^3	90 mg Sn/m^3
Tri-n-butyltin iodide						
Rabbit	Akatsuka 1973	oral	-----	100	196 mg Sn/m^3	20 mg Sn/m^3

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 25 mg Sn/m^3
Basis for revised IDLH: The revised IDLH for organic tin compounds is 25 mg Sn/m^3 based on acute inhalation toxicity data in animals [NDRC 1942]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

REFERENCES:

1. Akatsuka K [1973]. Tetraalkyl lead poisoning. Sangyo Igaku (Japanese Journal of Industrial Health) *15*:3-66.
2. Browning E [1969]. Toxicity of industrial metals. 2nd ed. New York, NY: Appleton-Century-Crofts, p. 291.
3. Deichmann WB, Gerarde HW [1969]. Tin. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., pp. 591-592.
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Titanium dioxide

CAS number	13463-67-7
NIOSH REL	None established; NIOSH considers titanium dioxide to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	15 mg/m³ TWA
1989 OSHA PEL	10 mg/m³ TWA
1993-1994 ACGIH TLV	10 mg/m³ TWA
Description of substance	White, odorless powder.
LEL	Noncombustible Solid
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 7,500 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence that exposure to a high concentration of titanium dioxide would impede escape within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 15 mg/m³ is 7,500 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal or human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 5,000 mg/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of titanium dioxide would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for titanium dioxide is 5,000 mg/m³ based on being 500 times the OSHA PEL of 10 mg/m³ promulgated in 1989 (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates). [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for titanium dioxide at any detectable concentration.]

Toluene

CAS number	108-88-3
NIOSH REL	100 ppm (375 mg/m³) TWA, 150 ppm (560 mg/m³) STEL
Current OSHA PEL	200 ppm TWA, 300 ppm CEILING, 500 ppm 10-minute MAXIMUM PEAK
1989 OSHA PEL	100 ppm (375 mg/m³) TWA, 150 ppm (560 mg/m³) STEL
1993-1994 ACGIH TLV	50 ppm (188 mg/m³) TWA [skin]
Description of substance	Colorless liquid with a sweet, pungent, benzene-like odor.
LEL	1.1% (10% LEL, 1,100 ppm)
Original (SCP) IDLH	2,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH seems reasonable based on the statements by Patty [1963] and ANSI [1973]. Patty [1963] reported that with 600 ppm, extreme fatigue, mental confusion, exhilaration, nausea, headache, and dizziness resulted by the end of 3 hours [von Oettingen et al. 1942]. ANSI [1973] reported that exposures to concentrations greater or longer than 4,000 ppm for 5 minutes might limit self-rescue ability.
Existing short-term exposure guidelines	National Research Council [NRC 1987] Emergency Exposure Guidance Levels (EEGLs): 1-hour EEGL: 200 ppm; 24-hour EEGL: 100 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Benignus 1981	>26,700	-----	1 hr	>33,375 ppm (1.25)	>3,338 ppm
Mouse	Benignus 1981	400	-----	24 hr	1,440 ppm (3.6)	144 ppm
Rabbit	Smyth and Carpenter 1944	-----	55,000	40 min	60,500 ppm (1.1)	6,050 ppm

Other animal data	RD_{50} (mouse), 5,300 ppm [Nielsen and Alarie 1982].
Human data	It has been reported that extreme fatigue, mental confusion, exhilaration, nausea, headache and dizziness resulted from exposures to 600 ppm by the end of 3 hours [von Oettingen et al. 1942]. In addition, the following observations have been made: some workers will tolerate concentrations ranging up to 200 ppm for 6 to 8 hours daily with no demonstrable ill effects; 200 to 500 ppm for 6 to 8 hours will cause tiredness and lassitude in most workers; and concentrations over 500 ppm for 1 to 3 hours are definitely dangerous and will cause symptoms attributable to depression of the central nervous system and the bone marrow [Wilson 1943]. It has also been reported that exposure to concentrations greater than 4,000 ppm for more than 5 minutes might limit self rescue ability [ANSI 1973]. After 20 minutes, exposures to concentrations at 300, 500, or 700 ppm resulted in significant increases in reaction times; a significant decrease in perceptual speed resulted after a 20-minute exposure to 700 ppm [Gamberale and Hultengren 1972].

Revised IDLH: 500 ppm
Basis for revised IDLH: The revised IDLH for toluene is 500 ppm based on acute inhalation toxicity data in humans [Gamberale and Hultengren 1972; von Oettingen et al. 1942; Wilson 1943].

REFERENCES:

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2. Benignus VA [1981]. Health effects of toluene: a review. Neurotoxicol 2:567-588.
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8. von Oettingen WF, Neal PA, Donahue DD [1942]. The toxicity and potential dangers of toluene: preliminary report. JAMA 118:579-584.
9. Wilson RH [1943]. Toluene poisoning. JAMA 123:1106-1108.

Toluene-2,4-diisocyanate

CAS number	584-84-9
NIOSH REL	None established; NIOSH considers toluene-2,4-diisocyanate to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.02 ppm (0.14 mg/m³) CEILING
1989 OSHA PEL	0.005 ppm (0.04 mg/m³) TWA, 0.02 ppm (0.15 mg/m³) STEL
1993-1994 ACGIH TLV	0.005 ppm (0.036 mg/m³) TWA, 0.02 ppm (0.14 mg/m³) STEL
Description of substance	Colorless to pale-yellow solid or liquid (above 71°F) with a sharp, pungent odor.
LEL	0.9% (10% LEL, 900 ppm)
Original (SCP) IDLH	10 ppm
Basis for original (SCP) IDLH	For this draft technical standard, it is assumed that individuals who have developed a sensitivity to TDI will not be allowed to work in a TDI atmosphere. In these sensitized individuals, even concentrations below the OSHA PEL are capable of triggering the allergic response. Therefore, the IDLH has not been based on data obtained from the exposures of individuals or animals sensitized to TDI. The chosen IDLH is based on the 4-hour LC_{50} values for different species of animals, ranging from 9.7 to 13.9 ppm [Duncan et al. 1962 cited by AIHA 1967 and NIOSH 1973].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Duncan et al. 1962	14	-----	4 hr	28 ppm (2.0)	2.8 ppm
G. pig	Duncan et al. 1962	13.9	-----	4 hr	28 ppm (2.0)	2.8 ppm
Mouse	Duncan et al. 1962	9.7	-----	4 hr	19 ppm (2.0)	1.9 ppm
Rabbit	Duncan et al. 1962	11	-----	4 hr	22 ppm (2.0)	2.2 ppm

Other animal data	RD_{50} (mouse), 0.39 ppm [Alarie 1981].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 2.5 ppm
Basis for revised IDLH: The revised IDLH for toluene-2,4-diisocyanate is 2.5 ppm based on acute inhalation toxicity data in animals [Duncan et al. 1962]. Since in sensitized individuals, even concentrations below the OSHA PEL are capable of triggering the allergic response, the revised IDLH has not been based on data obtained from the exposures of individuals or animals sensitized to TDI. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for toluene-2,4-diisocyanate at any detectable concentration.]

REFERENCES:

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o-Toluidine

CAS number	95-53-4
NIOSH REL	None established; NIOSH considers o-toluidine to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990] that may be absorbed through the skin.
Current OSHA PEL	5 ppm (22 mg/m³) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	2 ppm (8.8 mg/m³) TWA [skin], A2
Description of substance	Colorless to pale-yellow liquid with an aromatic, aniline-like odor.
LEL	Unknown
Original (SCP) IDLH	100 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Sax [1975] that 100 ppm is the maximum concentration endurable for 1 hour without serious consequences. No other data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	IARC 1982	oral	670	-----	1,052 ppm	105 ppm
Mouse	IARC 1982	oral	520	-----	816 ppm	82 ppm
Rabbit	IARC 1982	oral	840	-----	1,318 ppm	132 ppm
Rat	Jacobsen 1972	oral	900	-----	1,413 ppm	141 ppm
Rat	Jacobsen 1972	oral	940	-----	1,475 ppm	148 ppm

Other animal data	Rats have survived an 8-hour exposure to saturated vapors of o-toluidine [Smyth et al. 1962].
Human data	It has been reported that a 60-minute exposure to 40 ppm produces severe toxic effects [Goldblatt 1955]. It has been reported that 100 ppm is the maximum concentration endurable for 1 hour without serious consequences [Sax 1975].

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for o-toluidine is 50 ppm based on acute inhalation toxicity data in humans [Goldblatt 1955; Sax 1975]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for o-toluidine at any detectable concentration.]

REFERENCES:

1. Goldblatt MW [1955]. Research in industrial health in the chemical industry. Brit J Ind Med 12:1-20.
2. IARC [1982]. ortho-Toluidine and its hydrochloride. In: IARC monographs on the evaluation of carcinogenic risk of chemicals to humans. Vol. 27. Some aromatic amines, anthraquinones and nitroso compounds, and inorganic fluorides used in drinking-water and dental preparations, pp. 155-175.
3. Jacobsen KH [1972]. Short communication: acute oral toxicity of mono- and di-alkyl ring-substituted derivatives of aniline. Toxicol Appl Pharmacol 22:153-154.
4. Sax NI [1975]. o-Toluidine. In: Dangerous properties of industrial materials. 4th ed. New York, NY: Van Nostrand Reinhold Company, pp. 1173-1176.
5. Smyth HF, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range-finding toxicity data: list VI. Am Ind Hyg Assoc J 23:95-107.

Tributyl phosphate

CAS number	126-73-8
NIOSH REL	0.2 ppm (2.5 mg/m^3) TWA
Current OSHA PEL	5 mg/m^3 TWA
1989 OSHA PEL	0.2 ppm (2.5 mg/m^3) TWA
1993-1994 ACGIH TLV	0.2 ppm (2.2 mg/m^3) TWA
Description of substance	Colorless to pale-yellow, odorless liquid.
LEL	Unknown
Original (SCP) IDLH	125 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the only available data on acute inhalation toxicity of exposure to tributyl phosphate. Patty [1963] reported that 0 of 3 rats succumbed to a 6-hour exposure to 123 ppm (1,337 mg/m^3) [Fassett]. No other quantitative data are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Eller 1937	-----	2,214	5 hr	4,760 ppm (2.15)	476 ppm
Cat	IPCS 1991	227	-----	4-5 hr	454-488 ppm (2.0/2.15)	45-49 ppm
Rat	IPCS 1991	123	-----	6 hr	283 ppm (2.3)	28 ppm
Rat	Kalinina 1971	117	-----	?	?	?
Rat	TSCATS	2,529	-----	1 hr	3,161 ppm (1.25)	316 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Kalinina 1971	oral	1,189	-----	752 ppm	75 ppm
Rat	Smyth and Carpenter 1944	oral	3,000	-----	1,897 ppm	190 ppm

Other animal data	It has been reported that rats survived a 6-hour exposure to 123 ppm (1,337 mg/m^3) [Patty 1963].
Human data	Nausea and headache have been reported in workers exposed to 15 mg/m^3 (1.4 ppm) [Mastromatteo 1964].

Revised IDLH: 30 ppm
Basis for revised IDLH: The revised IDLH for tributyl phosphate is 30 ppm based on acute inhalation toxicity data in animals [IPCS 1991]. This may be a conservative value due to the lack of relevant acute toxicity data in humans exposed to concentrations above 1.4 ppm.

REFERENCES:

1. ACGIH [1991]. Tributyl phosphate. In: Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1600-1601.
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1,1,2-Trichloroethane

CAS number	79-00-5
NIOSH REL	10 ppm (45 mg/m^3) TWA [skin]; NIOSH considers 1,1,2-trichloroethane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	10 ppm (45 mg/m^3) TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	10 ppm (55 mg/m^3) TWA [skin]
Description of substance	Colorless liquid with a sweet, chloroform-like odor.
LEL	6% (10% LEL, 6,000 ppm)
Original (SCP) IDLH	500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1972] report that 500 ppm killed 1 of 6 rats in 4 hours, and 4 of 6 rats in 8 hours.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Arch Hyg Bakteriol 1936	-----	13,100 mg/m^3	4.5 hr	4,957 ppm (2.1)	496 ppm
Rat	Carpenter et al. 1949	-----	2,000 ppm	4 hr	4,000 ppm (2.0)	400 ppm
Rat	UCC 1972	LC_{17}: 500 ppm	-----	4 hr	1,000 ppm (2.0)	100 ppm
Rat	UCC 1972	LC_{67}: 500 ppm	-----	8 hr	1,250 ppm (2.5)	125 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 100 ppm
Basis for revised IDLH: The revised IDLH for 1,1,2-trichloroethane is 100 ppm based on acute inhalation toxicity data in animals [UCC 1972]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 1,1,2-trichloroethane at concentrations above 10 ppm.]

REFERENCES:

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3. UCC [1972]. Toxicology studies: 1,1,2-trichloroethane. New York, NY: Union Carbide Corporation.

Trichloroethylene

CAS number ... 79-01-6

NIOSH REL ... 2 ppm 60-minute CEILING during usage as an anesthetic agent and 25 ppm TWA during all other exposures; NIOSH considers trichloroethylene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL ... 100 ppm TWA, 200 ppm CEILING, 300 ppm 5-minute MAXIMUM PEAK IN ANY 2 HOURS

1989 OSHA PEL ... 50 ppm (270 mg/m^3) TWA, 200 ppm (1,080 mg/m^3) STEL

1993-1994 ACGIH TLV ... 50 ppm (269 mg/m^3) TWA, 10 ppm (537 mg/m^3) STEL, A5

Description of substance ... Colorless liquid (unless dyed blue) with a chloroform-like odor.

LEL (@77°F) ... 8% (10% LEL(@77°F), 8,000 ppm)

Original (SCP) IDLH ... 1,000 ppm

Basis for original (SCP) IDLH ... The chosen IDLH is based on the results of experimental 2-hour exposures by Vernon and Ferguson [1969] of 8 young male volunteers (aged 21 to 30) to concentrations of 0, 100, 300, and 1,000 ppm. On the basis of a number of psychophysiological tests, decrements in performance were reported statistically at only 1,000 ppm. Because the exposure time was 2 hours at 1,000 ppm, a person should be able to escape within 30-minutes without injury or irreversible health effects.

Existing short-term exposure guidelines ... National Research Council [NRC 1988] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 200 ppm
24-hour EEGL: 10 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Human	Bell 1951	-----	2,900	?	?	?
G. pig	Davis et al. 1959	-----	37,200	40 min	53,196 ppm (1.43)	5,320 ppm
Mouse	Friberg et al. 1953	8,450	-----	4 hr	114,075 ppm (13.5)	11,408 ppm
Cat	Lehmann et al. 1936	-----	5,952	2 hr	33,688 ppm (5.66)	3,369 ppm
Rat	NRC 1988	-----	8,000	4 hr	108,000 ppm (13.5)	10,800 ppm
Rat	Vernot et al. 1977	26,300	-----	1 hr	62,594 ppm (2.38)	6,259 ppm
Rabbit	WHO 1970	-----	11,000	?	?	?

*Note: Conversion factor (CF) was determined with "n" = 0.8 [ten Berge et al. 1986].

Other human data ... Exposure of eight volunteers for 2 hours to 1,000 ppm resulted in decrements in visual perception and motor skills, but 2-hour exposures to 100 and 300 ppm did not [Vernon and Ferguson 1969]. Tachypnea and ventricular arrhythmias have been equated with inhaled concentrations greater than 15,000 ppm during usage as an anesthetic [Vernon and Ferguson 1969].

Revised IDLH: 1,000 ppm [Unchanged]
Basis for revised IDLH: Based on acute inhalation toxicity data in volunteers [Vernon and Ferguson 1969], the original IDLH for trichloroethylene (1,000 ppm) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for trichloroethylene at concentrations above 25 ppm.]

REFERENCES:

1. Artusio JF, ed. [1963]. Clinical anesthesia halogenated anesthetics. Philadelphia, PA: F.A. Davis Co., pp. 43-65.
2. Bell A [1951]. Death from trichlorethylene in a dry-cleaning establishment. N Z Med J *50*:119-126.
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4. Friberg L, Kylin B, Nystrom A [1953]. Toxicities of trichlorethylene and tetrachlorethylene and Fujiwara's pyridine-alkali reaction. Acta Pharmacol Toxicol *9*:303-312.
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Trichloronaphthalene

CAS number	1321-65-9
NIOSH REL	5 mg/m^3 TWA [skin]
Current OSHA PEL	5 mg/m^3 TWA [skin]
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	5 mg/m^3 TWA [skin]
Description of substance	Colorless to pale-yellow solid with an aromatic odor.
LEL	Unknown
Original (SCP) IDLH*	Unknown [*Note: "Effective" IDLH = 50 mg/m^3 -- see discussion below.]
Basis for original (SCP) IDLH	No toxicological data are available concerning the effects of acute exposures to trichloronaphthalene. For this draft technical standard, however, an analogy with other chloronaphthalenes was used, and the respirators were selected on the basis of the assigned protection factor afforded by each device up to 10 × the OSHA PEL of 5 mg/m^3 (i.e., 50 mg/m^3); only the "most protective" respirators are permitted for use in concentrations exceeding 50 mg/m^3.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	Rats and mice exposed to a single 2-hour exposure to 200 mg/m^3 had no adverse effects [Shakahnovskava 1953].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: Unknown [Unchanged]
Basis for revised IDLH: Due to a lack of relevant acute toxicity data, the IDLH for trichloronaphthalene remains "Unknown." The "most protective" respirators will continue to be recommended for concentrations exceeding 50 mg/m^3 based on being 10 times the NIOSH REL and OSHA PEL of 5 mg/m^3 (10 is an assigned protection factor for respirators and was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for trichloronaphthalene). This may be a conservative value due to the lack of relevant acute toxicity data for workers at concentrations above 50 mg/m^3 for trichloronaphthalene.

REFERENCE:

1. Shakahnovskava FB [1953]. Toxicology of chlorinated naphthalenes. Farmakol Toksikol *16*:43-47 (translated).

1,2,3-Trichloropropane

CAS number 96-18-4

NIOSH REL .... 10 ppm (60 mg/m^3) TWA [skin]; NIOSH considers 1,2,3-trichloropropane to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL .... 50 ppm (300 mg/m^3) TWA

1989 OSHA PEL .... 10 ppm (60 mg/m^3) TWA

1993-1994 ACGIH TLV .... 10 ppm (60 mg/m^3) TWA [skin]

Description of substance .... Colorless liquid with a chloroform-like odor.

LEL (@248°F) .... 3.2% (10% LEL(@248°F), 3,200 ppm)

Original (SCP) IDLH .... 1,000 ppm

Basis for original (SCP) IDLH .... UCC [1973] reported that 5 of 6 rats died following a 1-hour exposure to 5,600 ppm. Because several mice died following only a 20-minute exposure to 5,000 ppm [McOmie and Barnes 1949 as cited by ACGIH 1971], 5,000 ppm has not been chosen as the IDLH. The chosen IDLH is based on the rat 4-hour LC_{LO} of 1,000 ppm [Smyth et al. 1962 cited by NIOSH 1976].

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Izmerov et al. 1982	555	-----	2 hr	888 ppm (1.6)	89 ppm
Mouse	McOmie and Barnes 1949	-----	5,000	20 min	4,350 ppm (0.87)	435 ppm
Rat	McOmie and Barnes 1949	LC_{100}: 700	-----	4 hr	1,400 ppm (2.0)	140 ppm
Mouse	McOmie and Barnes 1949	LC_{100}: 700	-----	4 hr	1,400 ppm (2.0)	140 ppm
Mouse	McOmie and Barnes 1949	LC_{100}: 340	-----	4 hr	680 ppm (2.0)	68 ppm
Rat	Smyth et al. 1962	LC_{33}: 1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm
Rat	UCC 1973	LC_{83}: 5,600	-----	1 hr	7,000 ppm (1.25)	700 ppm

Human data .... It has been reported that objectionable ocular and mucosal irritation were experienced after 15 minutes of exposure to 100 ppm [Silverman et al. 1946].

Revised IDLH: 100 ppm

Basis for revised IDLH: The revised IDLH for 1,2,3-trichloropropane is 100 ppm based on acute inhalation toxicity data in humans [Silverman et al. 1946]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 100 ppm. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for 1,2,3-trichloropropane at concentrations above 10 ppm.]

REFERENCES:

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3. McOmie WA, Barnes TR [1949]. Acute and subchronic toxicity of 1,2,3-trichloropropane in mice and rabbits. Fed Proc *8*:319.
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6. Smyth HF Jr, Carpenter CP, Weil CS, Pozzani UC, Striegel JA [1962]. Range finding toxicity data: list VI. Am Ind Hyg Assoc J *23*:95-107.
7. UCC [1973]. Toxicology studies: 1,2,3-trichloropropane. New York, NY: Union Carbide Corporation.

1,1,2-Trichloro-1,2,2-trifluoroethane

CAS number 76-13-1
NIOSH REL .... 1,000 ppm (7,600 mg/m³) TWA, 1,250 ppm (9,500 mg/m³) STEL
Current OSHA PEL .... 1,000 ppm (7,600 mg/m³) TWA
1989 OSHA PEL .... 1,000 ppm (7,600 mg/m³) TWA, 1,250 ppm (9,500 mg/m³) STEL
1993-1994 ACGIH TLV .... 1,000 ppm (7,670 mg/m³) TWA, 1,250 ppm (9,590 mg/m³) STEL
Description of substance .... Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations.
LEL .... Unknown
Original (SCP) IDLH .... 4,500 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the statement by AIHA [1968] and ACGIH [1971] that a 2.75-hour exposure to 4,500 ppm significantly impaired the psychomotor performance of human volunteers [Stopps and McLaughlin 1967].
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 1,500 ppm
24-hour EEGL: 500 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Burns et al. 1961	-----	250,000	1.5 min	92,500 ppm (0.37)	9,250 ppm
Rat	Clayton 1962	-----	87,000	6 hr	200,100 ppm (2.3)	20,010 ppm

Other animal data .... Dogs appear to tolerate 1,000 ppm, regardless of duration of exposure but exhibit cardiac abnormalities when exposed to 2,000 ppm for 6 hours and immediately challenged with epinephrine [Aviado 1975]. Also, dogs exposed for 5 minutes to 2,500 ppm or higher and then challenged with epinephrine developed cardiac sensitization [Reinhardt et al. 1973]. Others have reported that dogs exposed while running on a treadmill (to increase their own epinephrine concentration) were not sensitized at concentrations up to 20,000 ppm [Trochimowicz et al. 1974].
Human data .... Human volunteers exposed to 2,500 ppm had subjective symptoms of diminished concentration, somnolence, and head heaviness within 30 minutes of initiation of exposure and slight but definite further significant decrements at exposures for 2.75 hours at 4,500 ppm [Stopps and McLaughlin 1967]. No adverse changes were noted in volunteers exposed to 500 or 1,000 ppm for 6 hours per day, 5 days per week for 2 weeks [Reinhardt et al. 1971].

Revised IDLH: 2,000 ppm
Basis for revised IDLH: The revised IDLH for 1,1,2-trichloro-1,2,2-trifluoroethane is 2,000 ppm based on acute inhalation toxicity data in volunteers [Reinhardt et al. 1971; Stopps and McLaughlin 1967].

1,1,2-Trichloro-1,2,2-trifluoroethane (continued)

REFERENCES:

1. ACGIH [1971]. 1,1,2-Trichloro-1,2,2-trifluoroethane. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 267-268.
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3. Aviado DM [1975]. Toxicology of aerosol propellants in the respiratory and circulatory systems. X. Proposed classification. Toxicology *3*:321-332.
4. Burns THS, Hall JM, Bracken A, Gouldstone G, Newland DS [1961]. An investigation of new fluorine compounds in anaesthesia. Anaesthesia *16*:3-18.
5. Clayton JW [1962]. The toxicity of fluorocarbons with special reference to chemical constitution. J Occup Med *4*:262-273.
6. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 2. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 46-50.
7. Reinhardt CF, McLaughlin M, Maxfield ME, Mullin LS, Smith PE Jr [1971]. Human exposure to fluorocarbon 113 (1,1,2-trichloro-1,2,2-trifluoroethane). Am Ind Hyg Assoc J *32*:143-152.
8. Reinhardt CF, Mullin LS, Maxfield ME [1973]. Epinephrine-induced cardiac arrhythmia potential of some common industrial solvents. J Occup Med *15*(12):953-955.
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10. Trochimowicz HJ, Azar A, Terrill JB, Mullin LS [1974]. Blood levels of fluorocarbon related to cardiac sensitization: part II. Am Ind Hyg Assoc J *35*:632-639.

Triethylamine

CAS number	121-44-8
NIOSH REL	The 1989 OSHA PEL may not be protective to workers.
Current OSHA PEL	25 ppm (100 mg/m^3) TWA
1989 OSHA PEL	10 ppm (40 mg/m^3) TWA, 15 ppm (60 mg/m^3) STEL
1993-1994 ACGIH TLV	5 ppm (12 mg/m^3) TWA, 15 ppm (36 mg/m^3) STEL
Description of substance	Colorless liquid with a strong, ammonia-like odor.
LEL	1.2% (10% LEL, 1,200 ppm)
Original (SCP) IDLH	1,000 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the UCC [1970] report that a 4-hour exposure to 1,000 ppm killed 1 of 6 rats.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Carpenter et al. 1948	LC_{33}: 1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm
Mouse	Izmerov et al. 1982	-----	1,425	2 hr	2,280 ppm (1.6)	228 ppm
Rat	Smyth et al. 1951	LC_{17}: 1,000	-----	4 hr	2,000 ppm (2.0)	200 ppm

Other animal data	RD_{50} (mouse), 184 ppm [Nielsen and Yamagiwa 1989].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 200 ppm
Basis for revised IDLH: The revised IDLH for triethylamine is 200 ppm based on acute inhalation toxicity data in animals [Carpenter et al. 1948; Izmerov et al. 1982; Nielsen and Yamagiwa 1989; Smyth et al. 1951]. This may be a conservative value due to the lack of acute inhalation toxicity data for workers.

REFERENCES:

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3. Nielsen GD, Yamagiwa M [1989]. Structure-activity relationships of airway irritating aliphatic amines. Receptor activation mechanisms and predicted industrial exposure limits. Chem Biol Interact *71*(2-3):223-244.
4. Smyth HF Jr, Carpenter CP, Weil CS [1951]. Range-finding toxicity data: list IV. AMA Arch Ind Hyg Occup Med *4*:119-122.
5. UCC [1970]. Toxicology studies: triethylamine. New York, NY: Union Carbide Corporation.

Trifluorobromomethane

CAS number 75-63-8
NIOSH REL .... 1,000 ppm (6,100 mg/m^3) TWA
Current OSHA PEL .... 1,000 ppm (6,100 mg/m^3) TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 1,000 ppm (6,090 mg/m^3) TWA
Description of substance .... Colorless, odorless gas.
LEL .... Nonflammable Gas
Original (SCP) IDLH .... 50,000 ppm
Basis for original (SCP) IDLH .... Hine et al. [1968] observed that "an exposure for 20 to 25 minutes to 50,000 ppm produced a minimal decrease in judgment and skill in some subjects, and stated that a 5-minute exposure to 70,000 ppm or less can be expected to produce a negligible central nervous system effect. A 3-minute exposure to 60,000 ppm has been shown to produce very slight dizziness." Based on these data, an IDLH of 50,000 ppm has been assumed for this draft technical standard.
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

30-minute EEGL: 40,000 ppm
1-hour EEGL: 25,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Chambers et al. 1950	-----	834,000	15 min	658,860 ppm (0.79)	65,886 ppm
Cat	NRC 1984	LC_{100}: 370,000	-----	7 hr	888,000 ppm (2.4)	88,000 ppm
G. pig	NRC 1984	LC_{100}: 370,000	-----	7 hr	888,000 ppm (2.4)	88,000 ppm
Mouse	NRC 1984	LC_{80}: 370,000	-----	7 hr	888,000 ppm (2.4)	88,000 ppm
Rat	NRC 1984	LC_{40}: 370,000	-----	7 hr	888,000 ppm (2.4)	88,000 ppm
Rabbit	NRC 1984	LC_{100}: 370,000	-----	7 hr	888,000 ppm (2.4)	88,000 ppm

Other animal data .... Dogs and rats exposed daily for 18 weeks at an average concentration of 23,000 ppm showed no toxic signs and no pathologic changes observable at autopsy [Comstock et al. 1953].
Human data .... Volunteers exposed to 70,000 ppm for 3 minutes experienced lightheadedness and disturbances in balance and ability to respond to visual stimulus [Reinhardt and Reinke 1972]; 3 hours to 70,000 ppm caused decrements in mental performance tests [Harrison et al. 1982]. Exposure to 50,000 ppm for 20 to 25 minutes caused drowsiness, light-headedness, and a slight effect on judgment [Hine et al. 1968]. Three volunteers experienced mild nose and throat discomfort after 28 minutes of exposure to 71,000 ppm [Stewart et al. 1978]. Others reported that a 30-minute exposure at 43,000 to 45,000 ppm caused dizziness, light-headedness, euphoria, and disturbances in equilibrium and coordination [Stewart et al. 1978].

Revised IDLH: 40,000 ppm
Basis for revised IDLH: The revised IDLH for trifluorobromomethane is 40,000 ppm based on acute toxicity data in humans [Harrison et al. 1982; Hine et al. 1968; Reinhardt and Reinke 1972; Stewart et al. 1978].

Trifluorobromomethane (continued)

REFERENCES:

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5. NRC [1984]. Emergency and continuous exposure limits for selected airborne contaminants. Vol. 3. Bromotrifluoromethane. Washington, DC: National Academy Press, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, pp. 1-22.
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2,4,6-Trinitrotoluene

CAS number	118-96-7
NIOSH REL	0.5 mg/m³ TWA [skin]
Current OSHA PEL	1.5 mg/m³ TWA [skin]
1989 OSHA PEL	0.5 mg/m³ TWA [skin]
1993-1994 ACGIH TLV	0.5 mg/m³ TWA [skin]
Description of substance	Colorless to pale-yellow, odorless solid or crushed flakes.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 3,000 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	Most of the data reported in the literature about trinitrotoluene (TNT) poisoning concern the effects caused by chronic exposures. The available toxicological data contain no evidence that an acute exposure to a high concentration of TNT would impede escape or cause irreversible health effects within 30 minutes. AIHA [1964] reported that both the short exposure tolerance to TNT and the atmospheric concentration immediately hazardous to life are not important parameters. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 2,000 × the OSHA PEL of 1.5 mg/m³ (i.e., 3,000 mg/m³; only the "most protective" respirators are permitted for use in concentrations exceeding 3,000 mg/m³).
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Dilley et al. 1982	oral	795	-----	5,565 mg/m³	557 mg/m³
Mouse	Dilley et al. 1982	oral	660	-----	4,620 mg/m³	462 mg/m³
Rabbit	MRC 1921	oral	-----	500	3,500 mg/m³	350 mg/m³
Cat	MRC 1921	oral	-----	1,850	12,950 mg/m³	1,295 mg/m³

Human data .... The probable lethal dose has been reported to be 2 grams [Deichmann and Gerarde 1969]. [Note: An oral dose of 2 grams is equivalent to a worker being exposed to about 1,300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 500 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for 2,4,6-trinitrotoluene. Therefore, the revised IDLH for 2,4,6-trinitrotoluene is 500 mg/m³ based on acute oral toxicity data in humans [Deichmann and Gerarde 1969] and animals [Dilley et al. 1982; MRC 1921]

REFERENCES:

1. AIHA [1964]. 2,4,6-Trinitrotoluene (TNT). In: Hygienic guide series. Am Ind Hyg Assoc J 25:516-519.
2. Deichmann WB, Gerarde HW [1969]. Trinitrotoluene (TNT). In: Toxicity of drugs and chemicals. New York, NY: Academic Press, Inc., Inc., p. 610.
3. Dilley JV, Tyson CA, Spanggord RJ, Sasmore DP, Newell GW, Dacre JC [1982]. Short-term oral toxicity of 2,4,6-trinitrotoluene in mice, rats, and dogs. J Toxicol Environ Health 9:565-585.
4. MRC [1921]. Special report series. Medical Research Council, Special Report Series, 58:32.

Triorthocresyl phosphate

CAS number	78-30-8
NIOSH REL	0.1 mg/m^3 TWA [skin]
Current OSHA PEL	0.1 mg/m^3 TWA
1989 OSHA PEL	0.1 mg/m^3 TWA [skin]
1993-1994 ACGIH TLV	0.1 mg/m^3 TWA [skin]
Description of substance	Colorless to pale-yellow, odorless liquid or solid (below 52°F).
LEL	Unknown
Original (SCP) IDLH	40 mg/m^3
Basis for original (SCP) IDLH	No data on acute inhalation toxicity are available on which to base an IDLH for triorthocresyl phosphate. The chosen IDLH has been estimated from oral toxicity data cited by ACGIH [1971]. ACGIH [1971] reported that serious paralysis has been produced in man by an oral dose of the order of 6 to 7 mg/kg [Patty 1963].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Bleiberg and Johnson 1965	oral	900	-----	6,300 mg/m^3	630 mg/m^3
Rabbit	Gross and Grosse 1932	oral	-----	100	700 mg/m^3	70 mg/m^3
Rat	Veronesi et al. 1984	oral	1,160	-----	8,120 mg/m^3	812 mg/m^3

Human data .... It has been reported that serious paralysis has been produced by an oral dose of about 6.6 mg/kg [Deichmann and Gerarde 1969] and that the probable lethal dose is greater than 28 mg/kg [Patty 1963]. [Note: Oral doses of 6.5 or 28 mg/kg are equivalent to a 70-kg worker being exposed to about 300 or 1,300 mg/m^3, respectively, for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 40 mg/m^3 [Unchanged]
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for triorthocresyl phosphate. However, based on acute oral toxicity data in humans [Deichmann and Gerarde 1969; Patty 1963], the original IDLH for triorthocresyl phosphate (40 mg/m^3) is not being revised at this time.

REFERENCES:

1. ACGIH [1971]. Triorthocresyl phosphate. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 271-272.
2. Bleiberg MJ, Johnson H [1965]. Effects of certain metabolically active drugs and oximes on tri-o-cresyl phosphate toxicity. Toxicol Appl Pharmacol 7:227-235.
3. Deichmann WB, Gerarde HW [1969]. Tricresyl phosphates. In: Toxicology of drugs and chemicals. New York, NY: Academic Press, Inc., Inc., p. 604.
4. Gross E, Grosse A [1932]. A contribution on the toxicology of ortho-tri-cresyl-phosphates. Arch Exp Pathol Pharmakol *168*:473-514 (in German).
5. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1920.
6. Veronesi B, Newland D, Inman A [1984]. The effect of metabolic interference on rodent-sensitivity to tri-ortho-cresyl phosphate (TOCP). Toxicologist *4*:55 [Abstract].

Triphenyl phosphate

CAS number	115-86-6
NIOSH REL	3 mg/m³ TWA
Current OSHA PEL	3 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	3 mg/m³ TWA
Description of substance	Colorless, crystalline powder with a phenol-like odor.
LEL	Unknown
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 1,500 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	The available toxicological data contain no evidence of an IDLH for triphenyl phosphate. AIHA [1970] reported that concentrations of triphenyl phosphate aerosol high enough to produce acute toxic effects in man have not been achieved. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL (500 × 3 mg/m³ is 1,500 mg/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 1,500 mg/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Antonyuk 1974	oral	1,320	-----	9,240 mg/m³	924 mg/m³
Rat	Hierholzer et al. 1957	oral	3,500	-----	24,500 mg/m³	2,450 mg/m³

Human data .... Workers exposed to an average air concentration of 3.5 mg/m³ for as long as ten years showed no evidence of adverse clinical effects [Sutton et al. 1960].

Revised IDLH: 1,000 mg/m³
Basis for revised IDLH: The revised IDLH for triphenyl phosphate is 1,000 mg/m³ based on acute oral toxicity data in animals [Antonyuk 1974].

REFERENCES:

1. AIHA [1970]. Triphenyl phosphate. In: Hygienic guide series. Am Ind Hyg Assoc J *31*:388-390.
2. Antonyuk OK [1974]. Hygienic evaluation of plastificator triphenylphosphate, a component of polymer compositions. Gig Sanit *39*(8):98-99 (in Russian).
3. Hierholzer K, Noetzel H, Schmidt L [1957]. Vergleichende toxikologische untersuchung von triphenylphosphat und trikresylphosphat. Arzneimittel-Forschung (Drug Research) 7:585-588.
4. Sutton WL, Terhaar CJ, Miller FA, Scherberger RF, Riley EC, Roudabush RL, Fassett DW [1960]. Studies on the industrial hygiene and toxicology of triphenyl phosphate. Arch Environ Health *1*:33-46.

Turpentine

CAS number	8006-64-2
NIOSH REL	100 ppm (560 mg/m³) TWA
Current OSHA PEL	100 ppm (560 mg/m³) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	100 ppm (556 mg/m³) TWA
Description of substance	Colorless liquid with a characteristic odor.
LEL	0.8% (10% LEL, 800 ppm)
Original (SCP) IDLH	1,500 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the known human lethal concentration of 1,878 ppm [Albaugh 1915 in Jacobs as cited by AIHA 1971], the mouse LC_{50} of 1,620 ppm, and the reported effects to human subjects after several hours of exposure to 750 to 1,000 ppm [Lehmann and Flury 1943 as cited by ACGIH 1971]. AIHA [1967] reported that 1,878 ppm for 1 to 4 hours is definitely toxic to man [Jacobs 1949]. The effects of turpentine on the eyes and central nervous system at concentrations above 1,500 ppm might impede escape in the event of respirator failure.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Sperling and Collins 1964	29,000 mg/m³	-----	2 hr	8,212 ppm (1.6)	821 ppm
Rat	Sperling et al. 1967	12,000 mg/m³	-----	6 hr	4,885 ppm (2.3)	489 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Skramlik 1959	oral	5,760	-----	7,136 ppm	714 ppm

Human data .... Exposure of volunteers for several hours at 750 to 1,000 ppm resulted in irritation of the eyes, headache, dizziness, nausea, and acceleration of the pulse [Lehmann and Flury 1943]. The lethal concentration has been reported to be 1,878 ppm [Albaugh 1915].

Revised IDLH: 800 ppm
Basis for revised IDLH: The revised IDLH for turpentine is 800 ppm based on acute toxicity data in humans [Lehmann and Flury 1943] and animals [Skramlik 1959; Sperling and Collins 1964]. Also, this value is 10% of the lower explosive limit of 0.8%.

REFERENCES:

1. ACGIH [1971]. Turpentine. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, p. 274.
2. AIHA [1967]. Turpentine. In: Hygienic guide series. Am Ind Hyg Assoc J *28*:297-300.
3. Albaugh [1915]. Ohio Public Health J *6*:512.
4. Jacobs MB [1949]. The analytical chemistry of industrial poisons, hazards and solvents. 2nd ed. New York, NY: Interscience Publishers, Inc., p. 553.
5. Lehmann KB, Flury F, eds. [1943]. Toxicology and hygiene of industrial solvents. Translated by E. King and H.F. Smyth, Jr. Baltimore, MD: Williams & Wilkins Company, pp. 295-297.
6. Skramlik EV [1959]. Über die giftigkeit und verträglichkeit von ätherischen ölen. Pharmazie *14*:435-445 (in German).
7. Sperling F, Collins C [1964]. Inhalation and intravenous toxicity of turpentine in mice. Toxicol Appl Pharmacol *6*:360 [Abstract].
8. Sperling F, Marcus WL, Collins C [1967]. Acute effects of turpentine vapor on rats and mice. Toxicol Appl Pharmacol *10*:8-20.

Uranium (insoluble compounds, as U)

CAS number	7440-61-1 (Metal)
NIOSH REL	0.2 mg/m³ TWA, 0.6 mg/m³ STEL; NIOSH considers insoluble uranium compounds to be a potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.25 mg/m³ TWA
1989 OSHA PEL	0.2 mg/m³ TWA, 0.6 mg/m³ STEL
1993-1994 ACGIH TLV	0.2 mg/m³ TWA, 0.6 mg/m³ STEL
Description of substance	Varies
Original (SCP) IDLH	30 mg U/m³
Basis for original (SCP) IDLH	ILO [1972] stated that "insoluble compounds tend to be deposited and retained in tissues and organs for long periods. Prolonged irradiation of the thorax, at sites of uranium accumulation, may eventually result in osteosarcoma and pulmonary cancer. Experimental inhalations of uranium oxide (31 to 91 mg/m³) for 5 days led to the appearance of pneumosclerosis 16 months later at points where alpha-tracks were concentrated. After 22 to 23 months, there was hyperplasia of the bronchial epithelium, and, after 56 months, lung cancer was diagnosed." Both the chemical and radioactive properties of the metal must be considered.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	Inhalation of 31 to 91 mg/m³ of uranium oxide for 5 days led to the appearance of pneumosclerosis 16 months later at points where alpha-tracks were concentrated; after 22 to 23 months, there was hyperplasia of the bronchial epithelium, and, after 56 months, lung cancer was diagnosed [ILO 1972].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg U/m³
Basis for revised IDLH: The revised IDLH for insoluble uranium compounds is 10 mg U/m³ based on subchronic inhalation toxicity data in animals [ILO 1972] and to be consistent with soluble uranium compounds which have a revised IDLH of 10 mg U/m³. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for insoluble uranium compounds at concentrations above 0.2 mg/m³.]

REFERENCE:

1. ILO [1972]. Uranium, alloys, compounds. In: Encyclopaedia of occupational health and safety. 2nd ed. Vol. II (L-Z). Geneva, Switzerland: International Labour Office, pp. 1452-1454.

Uranium (soluble compounds, as U)

CAS number	Varies
NIOSH REL	0.05 mg/m^3 TWA; NIOSH considers soluble uranium compounds to be potential occupational carcinogens as defined by the OSHA carcinogen policy [29 CFR 1990].
Current OSHA PEL	0.05 mg/m^3 TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	0.2 mg/m^3 TWA, 0.6 mg/m^3 STEL
Description of substance	Varies
Original (SCP) IDLH	20 mg U/m^3
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by Patty [1963] that $UO_2(NO_3)_2 6H_20$ of respirable particle size and dusts and mists of UF_6, UO_2F_2, and UCl_4 were generally fatal to most laboratory species when exposed daily for 1 month at 20 mg/m^3 [Wilson et al. 1953]. No useful data on acute inhalation toxicity are available on which to base the IDLH.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$UO_2(NO_3)_2{\cdot}6H_2O$						
Dog	Spector 1956	oral	-----	12	84 mg/m^3	8.4 mg/m^3
Cat	Spector 1956	oral	-----	238	1,666 mg/m^3	167 mg/m^3

Other animal data	No grossly observable signs or symptoms were induced in mice, rats, guinea pigs, rabbits, or dogs following the first day of exposure to 20 mg/m^3 of UF_6 (13.5 mg U/m^3), UO_2F_2 (15.5 mg U/m^3), UCl_4 (12.5 mg U/m^3), or $UO_2(NO_3)_2{\cdot}H_2O$ (9.5 mg U/m^3) [Wilson et al. 1953].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 10 mg U/m^3
Basis for revised IDLH: The revised IDLH for soluble uranium compounds is 10 mg U/m^3 based on chronic toxicity data in animals [Wilson et al. 1953]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for soluble uranium compounds at concentrations above 0.05 mg U/m^3.]

REFERENCES:

1. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1167.
2. Spector WS, ed. [1956]. Handbook of toxicology. Vol. I. Acute toxicities. Philadelphia, PA: W.B. Saunders Company, p. 310.
3. Wilson HB, Stokinger HE, Sylvester GE [1953]. Acute toxicity of carnotite ore dust. AMA Arch Ind Hyg Occup Med 7:301-309.

Vanadium dust

CAS number	1314-62-1
NIOSH REL	0.05 mg V/m³ 15-minute CEILING
Current OSHA PEL	0.5 mg V_2O_5/m³ (respirable dust) CEILING
1989 OSHA PEL	0.05 mg V_2O_5/m³ (respirable dust) TWA
1993-1994 ACGIH TLV	0.05 mg V_2O_5/m³ (respirable dust) TWA
Description of substance	Yellow-orange powder or dark-gray, odorless flakes dispersed in air.
LEL	Noncombustible Solid
Original (SCP) IDLH	70 mg/m³ (as V_2O_5)
Basis for original (SCP) IDLH	The chosen IDLH is based on the statement by ACGIH [1971] that vanadium pentoxide dust at 70 mg/m³ is fatal to animals within a few hours [Hudson 1964]. AIHA [1957] reported that rabbits succumb from edema of the lungs at 200 mg/m³ after one 7-hour exposure [Sjoberg 1950].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Cat	Faulkner 1964	-----	500 mg/m³	23 min	256 mg V/m³ (0.915)	26 mg V/m³
Rat	Izrael'son 1963	-----	70 mg/m³	2 hr	63 mg V/m³ (1.6)	6.3 mg V/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Arch Toxikol 1956	oral	10	-----	39 mg V/m³	3.9 mg V/m³
Mouse	Izmerov et al. 1982	oral	23	-----	90 mg V/m³	9.0 mg V/m³

Human data .... Respiratory irritation following exposures to V_2O_5 ranging from 1 to 48 mg V/m³ has been described in workers [Sjoberg 1955]. Vanadium intoxication (i.e., rhinorrhea, sneezing, lacrimation, and sore throat) has been reported in workers exposed to concentrations of V_2O_5 during the workshift ranging from 10 to 33 mg/m³ [Williams 1952]. Concentrations of V_2O_5 exceeding 56 mg V/m³ have resulted in local respiratory effects [Vintinner et al. 1955]. Other workers exposed intermittently to 56 mg V/m³ showed no evidence of intoxication [McTurk et al. 1956].

Revised IDLH: 35 mg V/m³
Basis for revised IDLH: Based on acute inhalation toxicity data in workers [McTurk et al. 1956; Sjoberg 1955; Vintinner et al. 1955; Williams 1952], the revised IDLH for vanadium dust is 35 mg V/m³.

REFERENCES:

1. ACGIH [1971]. Vanadium (as V). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 275-276.
2. AIHA [1957]. Vanadium pentoxide. In: Hygienic guide series. Am Ind Hyg Assoc Q *18*:172-173.
3. Arch Toxikol [1956]; *16*:182-189 (in German).
4. Faulkner TG [1964]. Vanadium toxicology and biological significance. New York, NY: Elsevier Science Publishing Co., p. 72.

5. Hudson TGF [1964]. Vanadium: toxicology and biological significance. New York, NY: Elsevier Publishing Company, p. 75.
6. Izmerov NF, Sanotsky IV, Sidorov KK [1982]. Toxicometric parameters of industrial toxic chemicals under single exposure. Moscow, Russia: Centre of International Projects, GKNT, p. 119.
7. Izrael'son ZI, ed. [1963]. Toxicology of the rare metals. Jerusalem, Israel: Israel Program for Scientific Translations.
8. McTurk LC, Hirs CHW, Eckard RE [1956]. Health hazards of vanadium-containing residual oil ash. Ind Med Surg *25*:29-36.
9. Sjoberg S-G [1950]. Vanadium pentoxide dust: a clinical and experimental investigation on its effect after inhalation. Acta Med Scand Suppl *238*:81-99.
10. Sjoberg SG [1955]. Vanadium bronchitis from cleaning oil-fired boilers. AMA Arch Ind Health *11*:505-512.
11. Vintinner FJ, Vallenas R, Carlin CE, Weiss R, Macher C, Ochoa R [1955]. Study of the health of workers employed in mining and processing of vanadium ore. AMA Arch Ind Health *12*:635-642.
12. Williams N [1952]. Vanadium poisoning from cleaning oil-fired boilers. Brit J Ind Med *9*:50-55.

Vanadium fume

CAS number	1314-62-1
NIOSH REL	0.05 mg V/m^3 15-minute CEILING
Current OSHA PEL	0.1 mg V_2O_5/m^3 CEILING
1989 OSHA PEL	0.05 mg V_2O_5/m^3 CEILING
1993-1994 ACGIH TLV	0.05 mg V_2O_5/m^3 (respirable fume) TWA
Description of substance	Finely divided particulate dispersed in air.
LEL	Noncombustible Solid
Original (SCP) IDLH	70 mg/m^3 (as V_2O_5)
Basis for original (SCP) IDLH	The available data concerning the physiological effects of vanadium pentoxide (V_2O_5) refer either to V_2O_5 dust or just to V_2O_5, and do not specifically mention V_2O_5 fume. Patty [1963] stated that the lower limit for a V_2O_5 fume is based on the recognized greater toxicity of fume compared with dusts of larger particle size. Because no quantitative data are available specifically for V_2O_5 fume, the chosen IDLH is based on the report by ACGIH [1971] that 70 mg/m^3 V_2O_5 dust is a lethal concentration for animals after a few hours of exposure [Hudson]. A margin of safety is present in the IDLH for the dust, because the exposure is for a few hours. Therefore, although based on an analogy with V_2O_5 dust, the IDLH for the fume is probably reasonable.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Animal data	It has been reported that 70 mg/m^3 V_2O_5 dust is a lethal concentration after a few hours of exposure [Hudson].
Human data	None relevant for use in determining the revised IDLH.

Revised IDLH: 35 mg V/m^3
Basis for revised IDLH: The revised IDLH for vanadium fume is 35 mg V/m^3 based on an analogy to vanadium dust which has a revised IDLH of 35 mg V/m^3.

REFERENCES:

1. ACGIH [1971]. Vanadium (as V). In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 275-276.
2. Hudson TGF [1964]. Vanadium, toxicology and biological significance. New York, NY: Elsevier Publishing Company, p. 75.
3. Patty FA, ed. [1963]. Industrial hygiene and toxicology. 2nd rev. ed. Vol. II. Toxicology. New York, NY: Interscience Publishers, Inc., p. 1182.

Vinyl toluene

CAS number	25013-15-4
NIOSH REL	100 ppm (480 mg/m^3) TWA
Current OSHA PEL	100 ppm (480 mg/m^3) TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	50 ppm (242 mg/m^3) TWA, 100 ppm (483 mg/m^3) STEL
Description of substance	Colorless liquid with a strong, disagreeable odor.
LEL	0.8% (10% LEL, 800 ppm)
Original (SCP) IDLH	5,000 ppm
Basis for original (SCP) IDLH	Because no data on acute inhalation toxicity are available on which to base an IDLH for vinyl toluene, the chosen IDLH has been based on an analogy with styrene, which has an IDLH of 5,000 ppm.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Krynskaya et al. 1969	615	-----	4 hr	1,230 ppm (2.0)	123 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Krynskaya et al. 1969	oral	-----	3,160	4,505 ppm	451 ppm
Rat	Yang and Mackerer 1990	oral	-----	2,255	3,215 ppm	322 ppm

Other animal data	RD_{50} (mouse), 16.4 ppm [DeCeaurriz et al. 1981].
Human data	Although eye and nasal irritation have been noted, 400 ppm has been considered a safe concentration [ACGIH 1986].

Revised IDLH: 400 ppm
Basis for revised IDLH: The revised IDLH for vinyl toluene is 400 ppm based on acute inhalation toxicity data in humans [ACGIH 1986]. This may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 400 ppm.

REFERENCES:

1. ACGIH [1986]. Vinyl toluene. In: Documentation of the threshold limit values for substances in workroom air. 3rd ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 275-276.
2. DeCeaurriz JC, Micillino JC, Bonnet P, Guenier JP [1981]. Sensory irritation caused by various industrial airborne chemicals. Toxicol Lett *9*:137-143.
3. Krynskaya IL, Petrova LI, Guricheva ZG, Robachevskaya EG, Bukevich GM [1969]. Toxicity of vinyltoluene and its determination in air. Gig Sanit *34*(7-9):334-339 (translated).
4. Yang JJ, Mackerar CR [1990]. Acute toxicologic testing of para-methylstyrene using rats and dogs. J Am Coll Toxicol, Part B *1*:77 [Abstract].

Warfarin

CAS number 81-81-2
NIOSH REL .... 0.1 mg/m³ TWA
Current OSHA PEL .... 0.1 mg/m³ TWA
1989 OSHA PEL .... Same as current PEL
1993-1994 ACGIH TLV .... 0.1 mg/m³ TWA
Description of substance .... Colorless, odorless, crystalline powder.
LEL .... Unknown
Original (SCP) IDLH* .... 350 mg/m³ [*Note: "Effective" IDLH = 200 mg/m³ -- see discussion below.]
Basis for original (SCP) IDLH .... No data on acute inhalation toxicity are available on which to base the IDLH for warfarin. The IDLH of 350 mg/m³, therefore, is estimated from the rat oral lethal dose of 50 mg/kg [Sax 1975]. Because of the assigned protection factor afforded by each device, however, 2,000 × the OSHA PEL of 0.1 mg/m³ (i.e., 200 mg/m³) is the concentration above which only the "most protective" respirators are permitted. The chosen IDLH is probably conservative, because the rat is particularly susceptible to warfarin, and single doses are not usually as harmful as small, repeated doses.
Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Coumafene 1989	oral	3	-----	21 mg/m³	2.1 mg/m³
Dog	Coumafene 1989	oral	3	-----	21 mg/m³	2.1 mg/m³
Cat	Coumafene 1989	oral	6	-----	42 mg/m³	4.2 mg/m³
Rat	Hayes 1967	oral	1.6	-----	11 mg/m³	1.1 mg/m³
Rat	Sax 1975	oral	-----	50	350 mg/m³	35 mg/m³

Human data .... The sodium salt of warfarin has been used as an anticoagulant drug with a loading dose of 30 to 60 mg [ACGIH 1991] [Note: This is equivalent to a worker being exposed to 20 to 40 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]. It has been reported that 6.667 mg/kg is the lethal oral dose [Yakkyoku 1977] [Note: This is equivalent to a worker being exposed to about 300 mg/m³ for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.].

Revised IDLH: 100 mg/m³
Basis for revised IDLH: No inhalation toxicity data are available on which to base an IDLH for warfarin. Therefore, the revised IDLH for warfarin is 100 mg/m³ based on acute toxicity data in humans [Yakkyoku 1977]. This may be a conservative value due to the lack of acute inhalation toxicity data for workers.

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Xylene (o-, m-, p-isomers)

CAS numbers .... 95-47-6 (o-isomer), 108-38-3 (m-isomer), 106-42-3 (p-isomer)
NIOSH REL .... 100 ppm (435 mg/m^3) TWA, 150 ppm (655 mg/m^3) STEL
Current OSHA PEL .... 100 ppm (435 mg/m^3) TWA
1989 OSHA PEL .... 100 ppm (435 mg/m^3) TWA, 150 ppm (655 mg/m^3) STEL
1993-1994 ACGIH TLV .... 100 ppm (434 mg/m^3) TWA, 150 ppm (651 mg/m^3) STEL
Description of substance .... Colorless liquid with an aromatic odor.
LEL .... 0.9-1.1% (10% LEL, 900-1,100 ppm)
Original (SCP) IDLH .... 1,000 ppm
Basis for original (SCP) IDLH .... The chosen IDLH is based on the following statements by ANSI [1971]. "Exposure at 1,000 ppm for 5 minutes or less will probably allow self-rescue with no irreversible injury. Higher concentrations or longer exposure periods can cause eye and respiratory tract irritation, and the beginning of narcotic effects which may limit self-rescue ability. This information is based on human experience and extrapolation from animal data."
Existing short-term exposure guidelines .... National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 200 ppm
24-hour EEGL: 100 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
o-Xylene						
Rat	Cameron et al. 1938	-----	6,125	12 hr	73,500 ppm (2.9)	7,350 ppm
Human	Gekkan Yakuji 1980	-----	6,125	12 hr	73,500 ppm (2.9)	7,350 ppm
m-Xylene						
Mouse	Cameron et al. 1938	-----	2,010	24 hr	7,236 ppm (3.6)	724 ppm
Rat	Smyth et al. 1962	-----	8,000	4 hr	16,000 ppm (2.0)	1,600 ppm
p-Xylene						
Mouse	Arch Exp Pathol Pharmacol 1929	-----	3,401	?	?	?
Rat	Harper et al. 1977	4,550	-----	4 hr	9,100 ppm (2.0)	910 ppm
Xylene						
Human	Morley et al. 1970	-----	10,000	18 hr	33,000 ppm (3.3)	3,300 ppm
Rat	NPIRI 1974	5,000	-----	4 hr	10,000 ppm (2.0)	1,000 ppm
G. pig	Smyth and Smyth 1928	-----	450	?	?	?

Other animal data .... RD_{50} (mouse): 1,467 ppm [DeCeaurriz et al. 1981].
Other human data .... It has been reported that 1,000 ppm for 5 minutes or less will probably allow self-rescue with no irreversible injury [ANSI 1971]. Volunteers found 200 ppm to be definitely irritating to the eyes, nose, and throat [Nelson et al. 1943]. Reaction time was not affected in 23 volunteers exposed to 100 or 200 ppm for 3 to 7 hours [Ogata et al. 1970]. No noticeable changes in reaction time or short-term memory tests were seen in 15 volunteers exposed to 100 or 300 ppm for 70 minutes [Gamberale et al. 1978].

Revised IDLH: 900 ppm
Basis for revised IDLH: The revised IDLH is 900 ppm based on acute inhalation toxicity data in animals [Cameron et al. 1938; DeCeaurriz et al. 1981; Harper et al. 1977; NPIRI 1974]. Although this may be a conservative value due to the lack of relevant acute toxicity data for workers exposed to concentrations above 300 ppm, this value would have otherwise been selected for safety considerations (i.e., being 10% of the lower explosive limit of 0.9% for o-xylene).

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2. ANSI [1971]. American national standard, acceptable concentrations of xylene (dimethyl benzene). New York, NY: American National Standards Institute, Inc., ANSI Z37.10-1971, p. 7.
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Xylidine

CAS number	1300-73-8 (mixed isomers)
NIOSH REL	2 ppm (10 mg/m^3) TWA [skin]
Current OSHA PEL	5 ppm (25 mg/m^3) TWA [skin]
1989 OSHA PEL	2 ppm (10 mg/m^3) TWA [skin]
1993-1994 ACGIH TLV	0.5 ppm (2.5 mg/m^3) TWA [skin], A2
Description of substance	Pale-yellow to brown liquid with a weak, aromatic, amine-like odor.
LEL	1.0% (10% LEL, 1,000 ppm)
Original (SCP) IDLH	150 ppm
Basis for original (SCP) IDLH	The chosen IDLH is based on the mouse 7-hour LC_{50} of 149 ppm [von Oettingen et al. 1947 cited by ACGIH 1971].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mice (2,4-)	von Oettingen et al. 1947	149	-----	7 hr	358 ppm (2.4)	36 ppm

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rabbit	Deichmann and Gerarde 1969	oral	-----	600	833 ppm	83 ppm
Rat	Treon et al. 1949	oral	-----	610	847 ppm	85 ppm
Rat (2,3-)	Vernot et al. 1977	oral	-----	930	1,292 ppm	129 ppm
Mouse (2,3-)	Vernot et al. 1977	oral	-----	1,070	1,486 ppm	149 ppm
Rat (2,4-)	Vernot et al. 1977	oral	-----	470	653 ppm	65 ppm
Mouse (2,4-)	Vernot et al. 1977	oral	-----	250	347 ppm	35 ppm
Rat (2,4-)	Lindstrom et al. 1969	oral	-----	1,259	1,749 ppm	175 ppm
Rat (2,5-)	Vernot et al. 1977	oral	-----	1,300	1,806 ppm	181 ppm
Mouse (2,5-)	Vernot et al. 1977	oral	-----	840	1,167 ppm	117 ppm
Rat (2,6-)	Vernot et al. 1977	oral	-----	1,230	1,708 ppm	171 ppm
Mouse (2,6-)	Vernot et al. 1977	oral	-----	710	986 ppm	99 ppm
Rat (2,6-)	Short et al. 1983	oral	-----	1,050	1,458 ppm	146 ppm
Rat (3,4-)	Vernot et al. 1977	oral	-----	810	1,125 ppm	113 ppm
Mouse (3,4-)	Vernot et al. 1977	oral	-----	710	986 ppm	99 ppm
Rat (3,5-)	Vernot et al. 1977	oral	-----	710	986 ppm	99 ppm
Mouse (3,5-)	Vernot et al. 1977	oral	-----	420	583 ppm	58 ppm

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 50 ppm
Basis for revised IDLH: The revised IDLH for xylidine is 50 ppm based on acute toxicity data in animals [Deichmann and Gerarde 1969; Treon et al. 1949; Vernot et al. 1977; von Oettingen et al. 1947]. This may be a conservative value due to the lack of relevant acute toxicity data for workers.

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Xylidine (continued)

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Yttrium compounds (as Y)

CAS number	7440-65-5 (Metal)
NIOSH REL	1 mg/m³ TWA
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	Same as current PEL
1993-1994 ACGIH TLV	1 mg/m³ TWA
Description of substance	Varies
Original (SCP) IDLH*	No Evidence [*Note: "Effective" IDLH = 500 mg Y/m³ -- see discussion below.]
Basis for original (SCP) IDLH	From the data given by ACGIH [1971], it does not appear that exposure to a high concentration of yttrium could impede escape within 30 minutes. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 500 × the OSHA PEL of 1 mg Y/m³ (i.e., 500 mg Y/m³); only the "most protective" respirators are permitted for use in concentrations exceeding 500 mg Y/m³.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Y_2O_3						
Rat	Spassky 1978	oral	-----	>10,000	>55,300 mg Y/m³	>5,530 mg Y/m³
Mouse	Spassky 1978	oral	-----	> 6,000	>33,180 mg Y/m³	>3,318 mg Y/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 500 mg Y/m³
Basis for revised IDLH: The available toxicological data contain no evidence that an acute exposure to a high concentration of yttrium compounds would impede escape or cause any irreversible health effects within 30 minutes. However, the revised IDLH for yttrium compounds is 500 mg Y/m³ based on being 500 times the NIOSH REL and OSHA PEL of 1 mg Y/m³ (500 is an assigned protection factor for respirators and was used arbitrarily during the Standards Completion Program for deciding when the "most protective" respirators should be used for particulates).

REFERENCES:

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Zinc chloride fume

CAS number	7646-85-7
NIOSH REL	1 mg/m³ TWA, 2 mg/m³ STEL
Current OSHA PEL	1 mg/m³ TWA
1989 OSHA PEL	1 mg/m³ TWA, 2 mg/m³ STEL
1993-1994 ACGIH TLV	1 mg/m³ TWA, 2 mg/m³ STEL
Description of substance	White particulate dispersed in air.
LEL	Noncombustible Solid
Original (SCP) IDLH*	4,800 mg/m³ [*Note: "Effective" IDLH = 2,000 mg/m³ – see discussion below.]
Basis for original (SCP) IDLH	The chosen IDLH is based on the 30-minute human TC_{LO} of 4,800 mg/m³ zinc chloride [Ferry 1974 cited by NIOSH 1976]; and the toxic effects involved the respiratory system. No other data on acute inhalation toxicity are available on which to base the IDLH for zinc chloride fume. Because of the assigned protection factor afforded by each device, however, 2,000 × the OSHA PEL (i.e., 2,000 mg/m³) is the concentration above which only the "most protective" respirators are permitted.
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Rat	Karlsson et al. 1986	LC_{61}: 1,960 mg/m³	-----	10 min	1,352 mg/m³	135 mg/m³
Rat	Marrs et al. 1983	1,260 mg/m³	-----	30 min	1,260 mg/m³	126 mg/m³
Rabbit	Marrs et al. 1983	LC_{70}: 1,260 mg/m³	-----	30 min	1,260 mg/m³	126 mg/m³
Mouse	Marrs et al. 1983	11,80 mg-min/m³	-----	-----	393 mg/m³	39 mg/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Rat	Calvery 1942	oral	350	-----	2,450 mg/m³	245 mg/m³
Mouse	Calvery 1942	oral	350	-----	2,450 mg/m³	245 mg/m³
G. pig	Calvery 1942	oral	200	-----	1,400 mg/m³	140 mg/m³
Rat	Domingo et al. 1988	oral	1,100	-----	7,700 mg/m³	770 mg/m³
Mouse	Domingo et al. 1988	oral	1,250	-----	8,750 mg/m³	875 mg/m³

Other animal data	It has been reported that 90 mg/m³ is the no observed adverse effect level (NOEL) for rat intratracheal fibrosis [Richards et al. 1989].
Human data	A 30-minute exposure to 4.8 mg/m³ has been reported to produce respiratory distress [Ferry 1974]. Exposure to 80 mg/m³ has caused nausea and coughing and 120 mg/m³ for 2 minutes has caused nose and upper respiratory system irritation [Cullumbine 1957].

Revised IDLH: 50 mg/m³
Basis for revised IDLH: The revised IDLH for zinc chloride fume is 50 mg/m³ based on acute toxicity data in humans [Cullumbine 1957] and animals [Richards et al. 1989].

REFERENCES:

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Zinc oxide

CAS number 1314-13-2

NIOSH REL .... Fume: 5 mg/m^3 TWA, 10 mg/m^3 STEL; Dust: 5 mg/m^3 TWA, 15 mg/m^3 CEILING

Current OSHA PEL .... Fume: 5 mg/m^3 TWA; Dust: 15 mg/m^3 (total dust) TWA, 5 mg/m^3 (respirable dust) TWA

1989 OSHA PEL .... Fume: 5 mg/m^3 TWA, 10 mg/m^3 STEL; Dust: 10 mg/m^3 (total dust) TWA, 5 mg/m^3 (respirable dust) TWA

1993-1994 ACGIH TLV .... Fume: 5 mg/m^3 TWA, 10 mg/m^3 STEL; Dust: 10 mg/m^3 TWA

Description of substance .... White, odorless solid.

LEL .... Noncombustible Solid

Original (SCP) IDLH* .... No Evidence* [*Note: "Effective" IDLH = 2,500 mg/m^3) -- see discussion below.]

Basis for original (SCP) IDLH .... The available toxicological data contains no evidence that an acute exposure to a high concentration of zinc oxide fume would impede escape within 30 minutes or cause any irreversible health effects. For this draft technical standard, therefore, respirators have been selected on the basis of the assigned protection factor afforded by each device. However, for some particulate substances for which no evidence of an IDLH exists, the determination of allowable respiratory protection based on protection factors may result in the assignment of respirators for concentrations that are not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only the "most protective" respirators are permitted for use in concentrations exceeding 500 × the OSHA PEL of 5 mg/m^3 (i.e., 2,500 mg/m^3).

Short-term exposure guidelines .... None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Takahashi 1976	2,500 mg/m^3	-----	?	?	?
G. pig	Turner and Thompson 1926	-----	2,500 mg/m^3	3-4 hr	4,500-5,000 mg/m^3 (1.8/2.0)	450-500 mg/m^3

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
Mouse	Gig Sanit 1986	oral	7,950	-----	55,650 mg/m^3	5,565 mg/m^3

Zinc oxide (continued)

Human data .... Workers exposed to zinc concentrations between 320 to 580 mg/m^3 for 1-3 hours have experienced nausea on the job, and chills, shortness of breath, and severe chest pains 2 to 12 hours later [Hammond 1944]. Two men exposed to about 600 mg/m^3 for 10.5 to 12 minutes experienced headaches, chills, and fever with cough and a decrease in vital capacity which persisted for 15 hours after exposure [Sturgis and Thompson 1927]. When air concentrations approach 600 mg/m^3, it has been reported that visibility is occluded [Turner and Thompson 1926]. The lethal oral dose has been reported to be 500 mg/kg [Gekkan Yakuji 1980]. [Note: An oral dose of 500 mg/kg is equivalent to a 70-kg worker being exposed to about 23,300 mg/m^3 for 30 minutes, assuming a breathing rate of 50 liters per minute and 100% absorption.]

Revised IDLH: 500 mg/m^3
Basis for revised IDLH: The revised IDLH for zinc oxide is 500 mg/m^3 based on acute inhalation toxicity data in humans [Hammond 1944; Sturgis and Thompson 1927].

REFERENCES:

1. Gekkan Yakuji (Pharmaceuticals Monthly) [1980]; *22*:291-298 (in Japanese).
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Zirconium compounds (as Zr)

CAS number	7440-67-7 (Metal)
NIOSH REL	5 mg/m³ TWA, 10 mg/m³ STEL
Current OSHA PEL	5 mg/m³ TWA
1989 OSHA PEL	5 mg/m³ TWA, 10 mg/m³ STEL
1993-1994 ACGIH TLV	5 mg/m³ TWA, 10 mg/m³ STEL
Description of substance	Varies
Original (SCP) IDLH	500 mg Zr/m³
Basis for original (SCP) IDLH	The available toxicological data indicate that zirconium compounds possess a low order of toxicity. The chosen IDLH has been based on the citation by NIOSH [1976] that a 30-minute exposure to 500 mg/m³ of zirconium nitrate is the lowest concentration of this substance which has been shown to be lethal to rats [Mogilevskaya 1967].
Short-term exposure guidelines	None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC_{50}	LC_{Lo}	Time	Adjusted 0.5-hr LC (CF)	Derived value
$Zr(NO_3)_2$ Rat	Mogilevskaya 1967	-----	500 mg/m³	30 min	212 mg Zr/m³ (1.0)	21 mg Zr/m³

Lethal dose data:

Species	Reference	Route	LD_{50} (mg/kg)	LD_{Lo} (mg/kg)	Adjusted LD	Derived value
$ZrF_4 \cdot 2K$						
Mouse	Shalganova 1967	oral	98	-----	221 mg Zr/m³	22 mg Zr/m³
$Zr(SO_4)_2$						
Rat	Cochran et al. 1950	oral	3,500	-----	7,886 mg Zr/m³	789 mg Zr/m³
$ZrOCl_2$						
Mouse	Delongeas et al. 1983	oral	1,227	-----	4,398 mg Zr/m³	440 mg Zr/m³
Rat	Klimmer and Doll 1964	oral	2,950	-----	10,573 mg Zr/m³	1,057 mg Zr/m³
$ZrCl_4$						
Rat	ACGIH 1986	oral	1,688	-----	4,643 mg Zr/m³	464 mg Zr/m³
Mouse	ACGIH 1986	oral	655	-----	1,801 mg Zr/m³	180 mg Zr/m³
ZrF_4						
Rat	ACGIH 1986	oral	98	-----	374 mg Zr/m³	37 mg Zr/m³

Human data .... None relevant for use in determining the revised IDLH.

Revised IDLH: 25 mg Zr/m³
Basis for revised IDLH: The revised IDLH for zirconium compounds is 25 mg Zr/m³ based on acute toxicity data in animals [ACGIH 1986; Mogilevskaya 1967; Shalganova 1967]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers.

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Zirconium compounds (as Zr) (continued)

3. Delongeas JL, Burnel D, Netter P, Grignon M, Mur JM, Royer RJ, Grignon G [1983]. Toxicité et pharmacocinétique de l'oxychlorure de zirconium chez la souris et chez le rat. J Pharmacol *14*(4):437-447 (in French).
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