IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) VALUE PROFILE

FOR

CHLOROACETYL CHLORIDE

[CAS NO. 79-04-9]

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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Foreword

Chemicals are a ubiquitous component of the modern workplace. Occupational exposures to chemicals have the potential to adversely affect the health and lives of workers. Acute or short-term exposures to high concentrations of some airborne chemicals have the ability to quickly overwhelm workers, resulting in a spectrum of undesirable health outcomes that may inhibit the ability to escape from the exposure environment (e.g., irritation of the eyes and respiratory tract or cognitive impairment), cause severe irreversible effects (e.g., damage to the respiratory tract or reproductive toxicity), and in extreme cases, cause death. Airborne concentrations of chemicals capable of causing such adverse health effects or of impeding escape from high-risk conditions may arise from a variety of non-routine workplace situations , including special work procedures (e.g., in confined spaces), industrial accidents (e.g., chemical spills or explosions), and chemical releases into the community (e.g., during transportation incidents or other uncontrolled-release scenarios).

The "immediately dangerous to life or health air concentration values (IDLH values)" developed by the National Institute for Occupational Safety and Health (NIOSH) characterize these high-risk exposure concentrations and conditions [NIOSH 2013]. IDLH values are based on a 30-minute exposure duration and have traditionally served as a key component of the decision logic for the selection of respiratory protection devices [NIOSH 2004]. Occupational health professionals have employed these values beyond their initial purpose as a component of the NIOSH Respirator Selection Logic to assist in developing Risk Management Plans for non-routine work practices governing operations in high-risk environments (e.g., confined spaces) and the development of Emergency Preparedness Plans.

The approach used to derive IDLH values for high priority chemicals is outlined in the NIOSH Current Intelligence Bulletin (CIB) 66: Derivation of Immediately Dangerous to Life or Health Values [NIOSH 2013]. CIB 66 provides 1) an update on the scientific basis and risk assessment methodology used to derive IDLH values, 2) the rationale and derivation process for IDLH values, and 3) a demonstration of the derivation of scientifically credible IDLH values using available data resources.

The purpose of this technical report is to present the IDLH value for chloroacetyl chloride (CAS # 79-04-9). The scientific basis, toxicologic data and risk assessment approach used to derive the IDLH value are summarized to ensure transparency and scientific credibility.

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1 Centers for Disease Control and Prevention

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Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
BMC	benchmark concentration
BMCL	benchmark concentration lower confidence limit
C	ceiling
CAS	chemical abstract service
ERPG	Emergency Response Planning Guidelines
HCl	hydrochloric acid
IDLH	immediately dangerous to life or health
LC_{50}	median lethal concentration
LC_{Lo}	lowest concentration of a chemical that caused death in humans or animals
LEL	lower explosive limit
LOAEL	lowest observed adverse effect level
mg/m^3	milligram(s) per cubic meter
NAC	National Advisory Committee
NAS	National Academy of Sciences
NIOSH	National Institute for Occupational Safety and Health
NOAEL	no observed adverse effect level
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
ppm	parts per million
RD_{50}	concentration of a chemical in the air that is estimated to cause a 50% decrease in the respiratory rate
REL	recommended exposure limit
SCP	Standard Completion Program
STEL	short term exposure limit
TLV	threshold limit value
TWA	time weighted average
UEL	upper explosive limit
WEEL	workplace environmental exposure level

Glossary

Acute Exposure: Exposure by the oral, dermal, or inhalation route for 24 hours or less.

Acute Exposure Guideline Levels (AEGLs): Threshold exposure limits for the general public applicable to emergency exposure periods ranging from 10 minutes to 8 hours. AEGL-1, AEGL 2, and AEGL-3 are developed for five exposure periods (10 and 30 minutes, 1 hour, 4 hours, and 8 hours) and are distinguished by varying degrees of severity of toxic effects ranging from transient, reversible effects to life-threatening effects [NAS 2001]. AEGLs are intended to be guideline levels used during rare events or single once-in-a-lifetime exposures to airborne concentrations of acutely toxic, high-priority chemicals [NAS 2001]. The threshold exposure limits are designed to protect the general population, including the elderly, children or other potentially sensitive groups that are generally not considered in the development of workplace exposure recommendations (additional information available at http://www.epa.gov/oppt/aegl/).

Acute Reference Concentration (RfC): An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure for an acute duration (24 hours or less) of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors (UFs) generally applied to reflect limitations of the data used. Generally used in USEPA noncancer health assessments [USEPA 2014].

Acute Toxicity: Any poisonous effect produced within a short period of time following an exposure, usually 24 to 96 hours.

Adverse Effect: A substance-related biochemical change, functional impairment, or pathologic lesion that affects the performance of an organ or system or alters the ability to respond to additional environmental challenges.

Benchmark Dose/Concentration (BMD/BMC): A dose or concentration that produces a predetermined change in response rate of an effect (called the benchmark response, or BMR) compared to background [USEPA 2014] (additional information available at http://www.epa.gov/ncea/bmds/).

Benchmark Response (BMR): A predetermined change in response rate of an effect. Common defaults for the BMR are 10% or 5%, reflecting study design, data variability, and sensitivity limits used.

BMCL: A statistical lower confidence limit on the concentration at the BMC [USEPA 2014].

Bolus Exposure: A single, relatively large dose.

Ceiling Value ("C"): U.S. term in occupational exposure indicating the airborne concentration of a potentially toxic substance that should never be exceeded in a worker's breathing zone.

Chronic Exposure: Repeated exposure for an extended period of time. Typically exposures are more than approximately 10% of life span for humans and >90 days to 2 years for laboratory species.

Critical Study: The study that contributes most significantly to the qualitative and quantitative assessment of risk [USEPA 2014].

Dose: The amount of a substance available for interactions with metabolic processes or biologically significant receptors after crossing the outer boundary of an organism [USEPA 2014].

ECt_{50}: A combination of the effective concentration of a substance in the air and the exposure duration that is predicted to cause an effect in 50% (one half) of the experimental test subjects.

Emergency Response Planning Guidelines (ERPGs): Maximum airborne concentrations below which nearly all individuals can be exposed without experiencing health effects for 1-hour exposure. ERPGs are presented in a tiered fashion with health effects ranging from mild or transient to serious, irreversible, or life threatening (depending on the tier). ERPGs are developed by the American Industrial Hygiene Association [AIHA 2006].

Endpoint: An observable or measurable biological event or sign of toxicity ranging from biomarkers of initial response to gross manifestations of clinical toxicity.

Exposure: Contact made between a chemical, physical, or biological agent and the outer boundary of an organism. Exposure is quantified as the amount of an agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut).

Extrapolation: An estimate of the response at a point outside the range of the experimental data, generally through the use of a mathematical model, although qualitative extrapolation may also be conducted. The model may then be used to extrapolate to response levels that cannot be directly observed.

Hazard: A potential source of harm. Hazard is distinguished from risk, which is the probability of harm under specific exposure conditions.

Immediately Dangerous to Life or Health (IDLH) condition: 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 [NIOSH 2004, 2013].

IDLH value: A maximum (airborne concentration) level above which only a highly reliable breathing apparatus providing maximum worker protection is permitted [NIOSH 2004, 2013]. IDLH values are based on a 30-minute exposure duration.

LC_{01}: The statistically determined concentration of a substance in the air that is estimated to cause death in 1% of the test animals.

LC_{50}: The statistically determined concentration of a substance in the air that is estimated to cause death in 50% (one half) of the test animals; median lethal concentration.

LC_{LO}: The lowest lethal concentration of a substance in the air reported to cause death, usually for a small percentage of the test animals.

LD_{50}: The statistically determined lethal dose of a substance that is estimated to cause death in 50% (one half) of the test animals; median lethal concentration.

LD_{LO}: The lowest dose of a substance that causes death, usually for a small percentage of the test animals.

LEL: The minimum concentration of a gas or vapor in air, below which propagation of a flame does not occur in the presence of an ignition source.

Lethality: Pertaining to or causing death; fatal; referring to the deaths resulting from acute toxicity studies. May also be used in lethality threshold to describe the point of sufficient substance concentration to begin to cause death.

Lowest Observed Adverse Effect Level (LOAEL): The lowest tested dose or concentration of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Mode of Action: The sequence of significant events and processes that describes how a substance causes a toxic outcome. Mode of action is distinguished from the more detailed mechanism of action, which implies a more detailed understanding on a molecular level.

No Observed Adverse Effect Level (NOAEL): The highest tested dose or concentration of a substance that has been reported to cause no harmful (adverse) health effects in people or animals.

Occupational Exposure Limit (OEL): Workplace exposure recommendations developed by governmental agencies and non-governmental organizations. OELs are intended to represent the maximum airborne concentrations of a chemical substance below which workplace exposures should not cause adverse health effects. OELs may apply to ceiling, short-term (STELs), or time-weighted average (TWA) limits.

Peak Concentration: Highest concentration of a substance recorded during a certain period of observation.

Permissible Exposure Limit (PEL): Occupational exposure limits developed by OSHA (29 CFR 1910.1000) or MSHA (30 CFR 57.5001) for allowable occupational airborne exposure concentrations. PELs are legally enforceable and may be designated as ceiling, STEL, or TWA limits.

Point of Departure (POD): The point on the dose–response curve from which dose extrapolation is initiated. This point can be the lower bound on dose for an estimated incidence or a change in response level from a concentration-response model (BMC), or it can be a NOAEL or LOAEL for an observed effect selected from a dose evaluated in a health effects or toxicology study.

RD_{50}: The statistically determined concentration of a substance in the air that is estimated to cause a 50% (one half) decrease in the respiratory rate.

Recommended Exposure Limit (REL): Recommended maximum exposure limit to prevent adverse health effects based on human and animal studies and established for occupational (up to 10-hour shift, 40-hour week) inhalation exposure by NIOSH. RELs may be designated as ceiling, STEL, or TWA limits.

Short-Term Exposure Limit (STEL): A worker's 15-minute time-weighted average exposure concentration that shall not be exceeded at any time during a work day.

Target Organ: Organ in which the toxic injury manifests in terms of dysfunction or overt disease.

Threshold Limit Values (TLVs®): Recommended guidelines for occupational exposure to airborne contaminants, published by the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs refer to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse effects. TLVs may be designated as ceiling, short-term (STELs), or 8-hr TWA limits.

Time-Weighted Average (TWA): A worker's 8-hour (or up to 10-hour) time-weighted average exposure concentration that shall not be exceeded during an 8-hour (or up to 10-hour) work shift of a 40-hour week. The average concentration is weighted to take into account the duration of different exposure concentrations.

Toxicity: The degree to which a substance is able to cause an adverse effect on an exposed organism.

Uncertainty Factors (UFs): Mathematical adjustments applied to the POD when developing IDLH values. The UFs for IDLH value derivation are determined by considering the study and effect used for the POD, with further modification based on the overall database.

Workplace Environmental Exposure Levels (WEELs): Exposure levels developed by the American Industrial Hygiene Association (AIHA) that provide guidance for protecting most workers from adverse health effects related to occupational chemical exposures expressed as a TWA or ceiling limit.

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1.0 Introduction

1.1 IDLH Value for Chloroacetyl Chloride

IDLH Value: 1.3 ppm (66 mg/m^3)

Basis for IDLH Value: The IDLH value for chloroacetyl chloride is based on potentially escape-impairing effects including clinical signs of severe ocular and respiratory irritation in rats exposed to 32 ppm for one hour [Dow 1986]. The equivalent 30-minute exposure duration value is 40 ppm. Applying a composite uncertainty factor of 30 to account for extrapolation from a potentially escape impairing effect in animals, animal to human differences and human variability, results in an IDLH value of 1.3 ppm.

1.2 Purpose

This *IDLH Value Profile* presents (1) a brief summary of technical data associated with acute inhalation exposures to chloroacetyl chloride and (2) the rationale behind the Immediately Dangerous to Life or Health (IDLH) value for chloroacetyl chloride. IDLH values are developed based on the scientific rationale and logic outlined in the NIOSH Current Intelligence Bulletin (CIB) 66: Derivation of Immediately Dangerous to Life or Health (IDLH) values [NIOSH 2013]. As described in CIB 66, NIOSH performs in-depth literature searches to ensure that all relevant data from human and animal studies with acute exposures to the substance are identified. Information included in CIB 66 on the literature search includes pertinent databases, key terms, and guides for evaluating data quality and relevance for the establishment of an IDLH value. The information that is identified in the in-depth literature search is evaluated with general considerations that include description of studies (i.e., species, study protocol, exposure concentration and duration), health endpoint evaluated, and critical effect levels (e.g., NOAELs, LOAELs, LC_{50} values). For chloroacetyl chloride, the in-depth literature search was conducted through February 2014.

1.3 General Substance Information

Chemical: Chloroacetyl chloride

CAS No: 79-04-9

Synonyms: Chloroacetic acid chloride; Chloroacetic chloride; Monochloroacetyl chloride[*]

Chemical category: Substituted carboxylic acid halides; Organic chlorine compounds[†]

Structural formula:

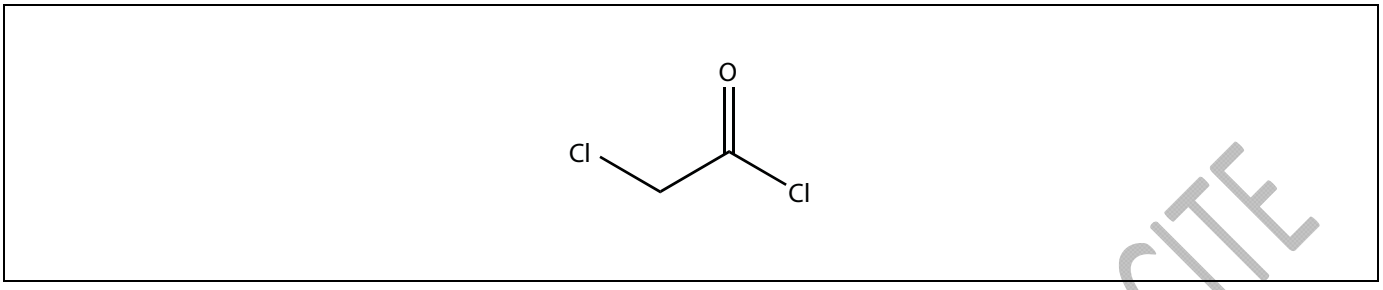

Table 1 highlights selected physiochemical properties of chloroacetyl chloride relevant to IDLH conditions. Table 2 provides alternative exposure guidelines for chloroacetyl chloride. Table 3 summarizes the Acute Exposure Guidelines Level (AEGL) values for chloroacetyl chloride.

Table 1: Physiochemical Properties of Chloroacetyl Chloride

Property	Value
Molecular weight	112.94[‡]
Chemical formula	$C_2H_2Cl_2O$
Description	Colorless to yellow liquid
Odor	Pungent
Odor Threshold	Strongly detectable at 0.140 ppm; barely detectable at 0.023 ppm; undetectable at 0.011 ppm,[‡]
UEL	Not available[§]
LEL	Not available[§]
Vapor pressure	25.2 mmHg at 25°C (77°F)[‡]
Flash point	Non-combustible[†]
Ignition temperature	Non-combustible[†]
Solubility	Violent decomposition in water[†]

Abbreviation: °C – Celsius; °F – Fahrenheit; mmHg – millimeter mercury; LEL – lower explosive limit; UEL – upper explosive limit
[*] NLM [2014]
[†] IFA [2014]
[‡] HSDB [2014]
[§] OSHA [2014]

Table 2: Alternative Exposure Guidelines for Chloroacetyl Chloride

Organization	Value
Original (SCP) IDLH value [NIOSH 2014]	None
NIOSH REL [2014]	0.05 ppm (0.23 mg/m^3), TWA
OSHA PEL [2014]	0.05 ppm (0.23 mg/m^3), TWA 8-hour
ACGIH TLV [2014]	0.05 ppm (0.23 mg/m^3), TWA 0.15 ppm (0.69 mg/m^3) STEL
AIHA ERPG [2010]	ERPG-1: 0.05 ppm ERPG-2: 0.5 ppm ERPG-3: 10 ppm
AIHA WEEL [2010]	Not available

Abbreviation: ACGIH – American Conference of Governmental Industrial Hygienists; AIHA – American Industrial Hygiene Association; ERPG – Emergency Response Preparedness Guidelines; IDLH – immediately dangerous to life or health; NIOSH – National Institute for Occupational Safety and Health; OSHA – Occupational Safety and Health Administration; PEL – permissible exposure limit; REL – recommended exposure limit; SCP – Standards Completion Program; STEL – short-term exposure limit; TWA – time-weighted average; WEEL – workplace environmental exposure level

Table 3: AEGL Values for Chloroacetyl Chloride

Classification	10-min	30-min	1-hour	4-hour	8-hour	Endpoint [reference]
AEGL-1	0.04 ppm 0.19 mg/m^3	0.04 ppm 0.19 mg/m^3	0.040 ppm 0.19 mg/m^3	0.04 ppm 0.19 mg/m^3	0.04 ppm 0.19 mg/m^3	NOEL for conjunctivitis in rats [Dow 1982]
AEGL-2	2.9 ppm 13.0 mg/m^3	2.0 ppm 9.2 mg/m^3	1.6 ppm 7.4 mg/m^3	0.40ppm 1.8 mg/m^3	0.20 ppm 0.92 mg/m^3	NOEL for inability to escape due to eye irritation in rats [Dow 1986]
AEGL-3	95.0 ppm 440.0 mg/m^3	66.0 ppm 300.0 mg/m^3	52.0 ppm 240.0 mg/m^3	13.0 ppm 60.0 mg/m^3	6.5 ppm 30.0 mg/m^3	Threshold for lethality in male rats [Dow 1986]

Abbreviation: AEGL – acute exposure guideline levels; mg/m^3 – milligrams per cubic meter; min – minute; ppm – parts per million

* **References**: NAS [2007]

2.0 Animal Toxicity Data

Chloroacetyl chloride decomposes in water to produce chloroacetic acid and hydrochloric acid (HCl), releasing heat in the process. Both chloroacetyl chloride and its hydrolysis products are irritants. Several modern studies [Dow 1982, 1986] reported analytical concentrations substantially lower than nominal concentrations (analytical concentrations about 25-50% of nominal). This difference has been attributed to both hydrolysis and incomplete volatilization of the test chemical. Since the total concentration of irritant chemicals in the air (including HCl) may have been higher than the analytical concentration of chloroacetyl chloride, use of the analytical concentration is a conservative approach. In light of the difference between nominal and analytical concentrations, the true concentrations (and associated LC_{50} values) in some of the older acute studies may have been lower than the reported nominal concentrations.

In a static-exposure study, Carpenter et al. [1949] reported an approximate 4-hour LC_{50} value of 1,000 ppm in rats. No further experimental results were provided. Younger Labs [1969] exposed rats to "concentrated" chloroacetyl chloride; all died within two hours. The exposure concentration was not specified, although information suggested a saturated atmosphere (25,000 ppm at 20°C) [AIHA 2000]. Immediately upon exposure, the rats showed signs of irritation including pawing at the face and mouth, and tightly shut eyes. Within 10 minutes, rats had reddened eyes with nasal and salivary excretion and gasping, and within 30 minutes they had opaque corneas, and death occurred after 90 (3/4 rats) or 120 (4/4) minutes. Severely hemorrhaged lungs were seen at necropsy [Younger Labs 1969].

Studies conducted by Dow Chemical Company in rats [Dow 1986] provide the most informative data for deriving the IDLH value. F344 rats were exposed whole-body to 32, 208, 522, or 747 ppm chloroacetyl chloride for 1 hour, followed by observation for 14 days. Clinical signs observed during exposure included squinting and lacrimation at all concentrations (32 to 747 ppm), and shallow or labored breathing at 208 ppm and higher. Stress-related clinical signs were also observed at the higher concentrations; these included lethargy (≥208 ppm), salivation, and stained eyes and face. Gross pathological examination of the rats that died during the 2-week post exposure period showed lung and nasal tissue congestion. Death occurred only at 747 ppm, in 5/6 males and 1/6 females, yielding an LC_{50} value of 645 ppm for males. The LC_{50} value for females could not be calculated, but was greater than 747 ppm. The effects at 32 ppm were considered potentially escape impairing. Results in mice and guinea pigs [Herzog 1959] support the determination that respiratory tract irritation is the key effect from exposure to chloroacetyl chloride, but the results are limited by the use of a static exposure protocol and the

absence of monitoring of analytical concentrations. Results from a 2-minute exposure study by Herzog [1959] support the conclusion that the onset of irritation is rapid.

Table 4 summarizes the LC data identified in animal studies and provides 30-minute equivalent derived values for chloroacetyl chloride. Table 5 provides non-lethal data reported in animal studies with 30-minute equivalent derived values. Information included in these tables includes species of test animals, toxicological metrics (i.e., LC, BMCL, NOAEL, LOAEL), adjusted 30-minute concentration, and the justification for the composite uncertainty factors applied to calculate the derived values.

Table 4: Lethal Concentration Data for Chloroacetyl Chloride

Reference	Species (sex)	LC_{50} (ppm)	LC_{Lo} (ppm)	Time (min)	Adjusted 30-min Concentration* (ppm)	Composite Uncertainty Factor	Derived Value (ppm)†
Herzog [1959]	Mouse	1,066	--	120	1,692	30‡	56
Dow [1986]	Rat (female)	--	747	60	941	10±	94
Dow [1986]	Rat (male)	645	--	60	813	30‡	27

Abbreviation: LC – lethal concentration; LC_{50} – median lethal concentration; LC_{Lo} – lowest concentration of a chemical that caused death in humans or animals; min – minute; ppm – parts per million

* For exposures other than 30 minutes the ten Berge et al. [1986] relationship is used for duration adjustment (C^n x t = k); no empirically estimated n values were available, therefore the default values were used, n = 3 for exposures greater than 30 minutes and n = 1 for exposures less than 30 minutes.
†The derived value is the result of the adjusted 30-minute concentration divided by the composite uncertainty factor.
‡Composite uncertainty factor to account for adjustment of LC_{50} values to LC_{01} values, use of lethal concentration threshold in animals, interspecies differences and human variability.
±Composite uncertainty factor to account for lethal concentration threshold in animals, interspecies differences and human variability.

Table 5: Non-lethal Concentration Data for Chloroacetyl Chloride

Reference	Species (reference)	NOAEL (ppm)	LOAEL (ppm)	Time (min)	Adjusted 30-min Concentration* (ppm)	Composite Uncertainty Factor	Derived Value (ppm)†
Dow [1986] [+]	**Rat**	**--**	**32**	**60**	**40**	**30**[±]	**1.3**

Abbreviation: NOAEL – no observed adverse effect level; min – minute; LOAEL – lowest observed adverse effect level; ppm – parts per million

[*] For exposures other than 30 minutes the ten Berge et al. [1986] relationship is used for duration adjustment (Cn x t = k); no empirically estimated n values were available, therefore the default values were used, n = 3 for exposures greater than 30 minutes and n = 1 for exposures less than 30 minutes.
[†]The derived value is the result of the adjusted 30-minute concentration divided by the composite uncertainty factor.
[+]Identified study is the primary basis of the IDLH value for chloroacetyl chloride.
[±]Composite uncertainty factor assigned to account for adjusting from a LOAEL to NOAEL, interspecies differences, human variability and extrapolation to an escape-impairing effect.

3.0 Human Data

No reports of human deaths resulting from inhalation of chloroacetyl chloride were located. Exposure for an undefined time period (likely a few minutes) to an air concentration of 0.011 ppm chloroacetyl chloride was undetectable by odor; 0.023 ppm was "barely detectable," and 0.14 ppm was considered a "strong" odor to an industrial hygienist [Dow 1988a]. Ocular irritation was not experienced at these concentrations, but 0.91 ppm was painful to the eyes and caused lacrimation [Dow 1988a]. This study is not appropriate as the basis for an IDLH value because insufficient information was provided about the exposure conditions, but the study does provide information on the range of exposure levels that are irritating.

The medical department of a chemical company reported that six workers who received "mild" inhalation exposures of chloroacetyl chloride (exposures not stated) experienced dyspnea and cough, and that three workers that received "moderate" inhalation exposures had cyanosis and cough [Dow 1988b].

4.0 Summary

Available human and animal data demonstrated the ability of chloroacetyl chloride to act as a potent irritant, causing ocular and respiratory tract irritation, respiratory tract pathology and death depending on the exposure concentration and duration. Concentrations that induce potentially escape-impairing and significant irritant effects appear to be well below the estimated LC_{50} values summarized in Table 4. Studies reporting non-lethal effects, such as Dow [1988a], provide evidence that painful eye irritation and lacrimation occurred in humans exposed to 0.91 ppm for an undisclosed duration. Dow [1986] reported significant irritation at 32 ppm as a LOAEL in rats. Taking into account the potential for significant irritant effects at concentrations well below reported LC_{50} values, the LOAEL of 32 ppm in rats is an appropriate basis for deriving the IDLH value. Duration adjustment to a 30-minute equivalent concentration yields a concentration of 40 ppm. Application of a composite uncertainty factor to account for extrapolation from a potentially escape-impairing effect in animals, animal to human differences and human variability results in an IDLH value for chloroacetyl chloride of 1.3 ppm. This value is expected to protect against both lethality and severe ocular and respiratory irritation that might impair escape.

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