IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) VALUE PROFILE

FOR

1,1-DICHLORO-1-FLUOROETHANE (HCFC-141B)

[CAS No. 1717-00-6]

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 HCFC-141B (CAS # 1717-00-6). 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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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
HCFC-141b	1,1-dichloro-1-fluoroethane
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
µg/kg	microgram(s) per kilogram of body weight

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 1,1-Dichloro-1-fluoroethane (HCFC-141b)

IDLH Value: 1,667 ppm (7,974 mg/m^3)

Basis for IDLH Value: Cardiac sensitization is the most sensitive indicator of toxicity and is an appropriate non-lethal endpoint to serve as the basis for the IDLH value for 1,1-dichloro-1-fluoroethane (HFCF-141b). This effect was reported in monkeys exposed to 5,000 ppm for 10 minutes [Hardy et al. 1989] and in a dog exposed to 5,200 ppm for 10 minutes [Mullin 1977]. No time scaling factor was applied, based on data that the threshold for this effect is constant for durations longer than 5-10 minutes. Using the concentration of 5,000 ppm reported in Hardy et al. [1989] as the point of departure and applying a composite uncertainty factor of 3 to account for extrapolation from a severe effect threshold in animals, animal to human differences and human variability, results in an IDLH value for HCFC-141b of **1,667 ppm**.

1.2 Purpose

This *IDLH Value Profile* presents (1) a brief summary of technical data associated with acute inhalation exposures to HCFC-141b and (2) the rationale behind the Immediately Dangerous to Life or Health (IDLH) value for HCFC-141b. 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 HCFC-141b, the in-depth literature search was conducted through February 2014.

1.3 General Substance Information

Chemical: 1,1-Dichloro-1-fluoroethane

CAS No: 1717-00-6

Synonyms: HCFC-141b; Freon-141; CFC 141b*

Chemical category: Aliphatic, saturated, halogenated hydrocarbons; Organic chlorine compounds; Organic fluorine compounds[†]

Structural formula:

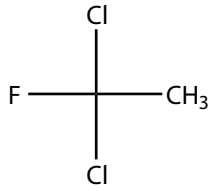

Table 1 highlights selected physiochemical properties of HCFC-141b relevant to IDLH conditions. Table 2 provides alternative exposure guidelines for HFC-141b. Table 3 summarizes the Acute Exposure Guidelines Level (AEGL) values for HFC-141b.

Table 1: Physiochemical Properties of HCFC-141b

Property	Value
Molecular weight	116.95[‡]
Chemical formula	$C_2H_3Cl_2F$
Description	Colorless liquid
Odor	Weak ethereal odor
Odor Threshold	250 ppm[+]
UEL	17.7%[†]
LEL	5.6%[†]
Vapor pressure	600 mmHg at 25°C (77°F)[‡]
Flash point	Not available
Ignition temperature	Not available
Solubility	Slightly soluble in water[†]

Abbreviation: °C – Celsius; °F – Fahrenheit; mmHg – millimeter mercury; LEL – lower explosive limit; UEL – upper explosive limit
[+] Hardy et al. [1989]
[*] NLM [2014]
[†] IFA [2014]
[‡] HSDB [2014]

Table 2: Alternative Exposure Guidelines for HCFC-141b

Organization	Value
Original (SCP) IDLH value [NIOSH 2014]	None
NIOSH REL [NIOSH 2014]	Not available
OSHA PEL	Not available
ACGIH TLV [2014]	Not available
AIHA ERPG [2010]	Not available
AIHA WEEL [2010]	500 ppm, 8 hr TWA

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 Program; PEL – permissible exposure limit; REL – recommended exposure limit; SCP – Standards Completion Program; TWA – time-weighted average; WEEL – workplace environmental exposure level

Table 3: AEGL Values for HCFC-141b

Classification	10-min	30-min	1-hour	4-hour	8-hour	
AEGL-1	1,000 ppm (4,850 mg/m^3)	1,000 ppm (4,850 mg/m^3)	1,000 ppm (4,850 mg/m^3)	1,000 ppm (4,850 mg/m^3)	1,000 ppm 4,850 mg/m^3)	No effect in humans [Utell et al. 1997]
AEGL-2	1,700 ppm (8,245 mg/m^3)	1,700 ppm (8,245 mg/m^3)	1,700 ppm (8,245 mg/m^3)	1,700 ppm (8,245 mg/m^3)	1,700 ppm 8,245 mg/m^3)	Threshold for cardiac arrhythmia in the dog [Mullin 1977]
AEGL-3	3,000 ppm (14,550 mg/m^3)	3,000 ppm (14,550 mg/m^3)	3,000 ppm (14,550 mg/m^3)	3,000 ppm (14,550 mg/m^3)	3,000 ppm (14,550 mg/m^3)	Threshold for severe cardiac response in the dog [Hardy et al. 1989a]

Abbreviation: AEGL – acute exposure guideline levels; mg/m^3 – milligrams per cubic meter; min – minute; ppm – parts per million
* **References**: NAS [2002]

2.0 Animal Toxicity Data

Acute inhalation toxicity tests were performed in rats and mice. A 4-hour rat LC_{50} value was reported for male and female rats at 58,931 and 64,991 ppm, respectively, with a combined LC_{50} of 61,647 ppm [de Rooij 1989; Brock et al. 1995]. Brock et al. [1995] also reported a 6-hour LC_{50} value of 56,700 ppm in rats. Both studies reported reduced motor activity, shallow breathing with rapid respiration, and anesthesia at concentrations greater than 29,000 ppm; tremors, incoordination, and convulsions were noted in some animals above 50,000 ppm.

A 30-minute LC_{50} value of 100,000 ppm in mice was reported by Davies et al. [1976] with effects including narcosis. In a second study in mice [Vlachos 1988], the authors reported a 60% mortality in mice exposed to 80,000 ppm for 6 hours. No clinical signs of exposure were observed up to 30,000 ppm. Lethargy and tremors were observed at 41,000 ppm, and narcosis occurred within 15 minutes at 80,000 ppm. Deaths were attributed to deep anesthesia.

Cardiac sensitization tests were conducted in rats, dogs and monkeys. A response in this cardiac sensitization assay is considered a sensitive measure of a severe effect. Arrhythmia in these cases is not produced by HCFC-141b; rather, it is the result of the potentiation of endogenous epinephrine (adrenalin) by the chemical. NAS [2014] described an unpublished study in which Sprague-Dawley rats were exposed to 5,000, 10,000, or 20,000 ppm of HCFC-141b for 30 minutes and administered 12 µg/kg epinephrine. NAS [2014] reported that marked arrhythmia was observed in 4/11 animals at 5,000 ppm.

Mullin [1977] exposed dogs to 2,600, 5,200, 10,000, or 21,600 ppm for 5 minutes followed by an intravenous dose of 8 µg/kg epinephrine. Cardiac sensitization was induced in 1/10 dogs at 5,200 ppm; deaths occurred at higher concentrations. The authors also reported a no-effect level at 2,600 ppm. In a second cardiac sensitization study, dogs were exposed to 9,000, 12,000, 13,000, 14,000, 15,000, 18,000, 19,000, or 20,000 ppm for 5 minutes followed by challenge with 10 µg/kg of intravenous epinephrine [Hardy et al. 1989]. A marked cardiac response was reported in 1/2 dogs at 9,000 ppm, but there was no response in eight other trials at 9,000 – 13,000 ppm. The one dog exposed to 20,000 ppm and then challenged with epinephrine developed severe ventricular fibrillation and died. Monkeys were exposed to 0, 3,000, 5,000, or 10,000 ppm for 10 minutes [Hardy et al. 1989]. After 5 minutes of exposures, the monkeys received epinephrine. No electrocardiogram effects were seen in the monkey exposed to 3,000 ppm, but the authors reported a marked cardiac response at 5,000 ppm.

Table 4 summarizes the LC data identified in animal studies and provides 30-minute equivalent derived values for HCFC-141B. 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, 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 HCFC-141b

Reference	Species	LC_{50} (ppm)	LC_{Lo} (ppm)	Time (min)	Adjusted 30-min LC value*	Composite Uncertainty Factor	Derived Value (ppm)†
Davies et al. [1976]	Mouse	100,000	--	30	100,000	30‡	3,333
Brock et al. [1995]	Rat	56,700	--	360	128,739	30‡	4,291
Brock et al. [1995]	Rat (M+F)±	61,647	--	240	123,294	30‡	4,101

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 ($C^n \times t = k$); 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-min value divided by the composite uncertainty factor. The composite uncertainty factor used varies for each study based on the nature and severity of the endpoint observed.
‡Composite uncertainty factor to account for adjustment of LC50 values to LC01 values, use of lethal concentration threshold in animals, interspecies differences and human variability.
± M+F – males and females combined

Table 5: Non-lethal Concentration Data for HCFC-141b

Reference	Species	NOAEL (ppm)	LOAEL (ppm)	Time (min)	Adjusted 30-min Concentration*	Composite Uncertainty Factor	Derived Value (ppm)†
Mullin [1977]	Dog	5,200	--	10	5,200‡	3±	1,733
Hardy et al. [1989]	**Monkey**	**5,000**	**--**	**10**	**5,000‡**	**3±**	**1,667**

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 (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-min value divided by the composite uncertainty factor. The composite uncertainty factor used varies for each study based on the nature and severity of the endpoint observed.

‡ The cardiac sensitization response is a concentration-dependent threshold effect; dogs exposed to similar chemicals for longer durations responded in a similar manner, so no time adjustment was applied.

± Composite uncertainty factor assigned to account for extrapolation from a severe effect threshold in animals, animal to human differences and human variability.

3.0 Human Data

Information regarding lethality in humans is limited to a single case report. Astier and Paraire [1997] reported a worker was found dead with a bluish-purple coloration and edema of the face inside a degreasing tank in which pure HCFC-141b was used as the degreasing solvent. The concentration and exposure duration were not reported. In an experimental study [Utell et al. 1997] eight volunteers were exposed to 0, 250, 500, or 1,000 ppm for 4 hours with three 20 minute exercise periods. Endpoints evaluated included clinical chemistry, hematology, EKG, and spirometry. No effects were reported on these sensitive measures during exposures (aside from the expected response to exercise). In addition, two of the volunteers were exposed at 0 or 500 ppm for 6 hours and one volunteer was exposed to 1,000 ppm for 6 hours, and performed computerized neurobehavioral testing during the last 2 hours of exposure. No effects were seen.

4.0 Summary

Limited human data are available on HCFC-141b. Multiple animal studies revealed the onset of cardiac sensitization to HCFC-141b. This non-lethal and potentially irreversible effect is the basis of the IDLH value. Monkeys exposed to 5,000 ppm for 10 minutes [Hardy et al. 1989] and a dog exposed to 5,200 ppm for 10 minutes [Mullin 1977] both demonstrated cardiac responses. NAS [2002] determined that the cardiac sensitization response is a concentration-dependent threshold effect; animals exposed to similar chemicals for longer durations responded in a similar manner. Therefore, a duration adjustment for time scaling is not applied, thus the reported exposure concentration is used instead of a 30-minute equivalent. The 5,000 ppm concentration reported by Hardy et al. [1989] is used as the point of departure and basis of the IDLH value for HCFC-141b. Application of an uncertainty factor of 3 to account for extrapolation given consideration of animal to human differences and human variability results in an IDLH value of 1,667 ppm.

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