Naval Health Research Center Detachment (Toxicology)

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DERIVATION OF TOXICOLOGY AND RISK ASSESSMENT VALUES FOR AMBIENT AIR TOXICS DETECTED AT NAVAL AIR FACILITY, ATSUGI, JAPAN

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PREFACE

This document reports the results from an investigation of the availability of toxicology and risk assessment information in the scientific literature for chemicals detected in ambient air over Naval Air Facility, Atsugi, Japan. This work was sponsored by the Navy Environmental Health Center under Work Unit No. 63706N-M00095.004.#### and was performed under the direction of CAPT Kenneth R. Still, MSC, USN, Officer-in-Charge NHRC/TD.

The opinions contained herein are those of the authors and are not to be construed as official or reflecting the view of the Department of the Navy or the Naval Services at large.

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EXECUTIVE SUMMARY

PROBLEM

Naval Air Facility, Atsugi, Japan, is located adjacent to a Japanese-owned facility in Kanagawa Prefecture used to incinerate garbage and other municipal waste. Prevailing winds distribute the incinerator plume across NAF Atsugi, on a frequent basis creating health concerns for American service members and their dependents. Two hundred thirty six (236) chemicals have been identified in the emissions; however, adequate toxicology information is not available for all compounds identified, making human health risk assessment efforts difficult.

OBJECTIVE

The objective of this study was to identify toxicology and human health risk assessment information on the chemicals identified from incinerator emissions over NAF Atsugi.

RESULTS

Of the 236 chemicals identified in the ambient air, there were 66 for which neither a Reference Dose (RfD) or Cancer Slope Factor (CSF) were identified and therefore have not been assigned a U.S. Environmental Protection Agency (USEPA) Risk-Based Screening Concentration (RBSC). Twenty-two compounds within this group of 66 have insufficient information at this time to derive an RfD or CSF and none of the 66 were found to have Minimum Risk Levels (MRLs) assigned by the Agency for Toxic Substances and Disease Registry (ATSDR). We also found insufficient information to suspect that any of the 66 compounds have carcinogenic properties. A second group of chemicals had been assigned either a CSF or an RfD, but not both. For these chemicals, the missing value was either found in or derived from toxicology data in the scientific literature. For both groups, alternative methodologies for developing exposure limits were utilized and include the Estimated Permissible Concentration (22 compounds) and Effects Screening Level approaches (39 compounds).

CONCLUSION

Although the data gap of toxicology information for use in human health risk assessment for chemicals identified at NAF Atsugi was large, risk assessment values were identified or derived. For many of the analytes, toxicology information is still absent; however, data identified within this study will assist in increasing the accuracy of the risk assessment effort.

ABSTRACT

The mission of Naval Air Facility Atsugi is to provide facilities, services and material support for U.S. Navy and Marine Corps aviation operations, and to provide logistic support for Carrier Air Wing FIVE. Approximately 8,000 military personnel and dependents are stationed at NAF Atsugi. A population boom in the early 1970s caused massive expansion in the communities surrounding the base and, as a result, the requirement for disposal of municipal and medical wastes also grew. Currently, the Shinkampo Incinerator immediately adjacent to NAF Atsugi burns over 180 tons of waste per day. Prevailing winds blow emissions from the incinerator stack over highly populated areas of NAF Atsugi. Under contract from the Navy Environmental Health Center, a private environmental consulting firm conducted an ambient air toxics study to evaluate the chemical constituency of the incinerator's emissions. This study examined the ambient air concentration of multiple toxics and criteria pollutants. Over 200 chemicals were identified in the air over NAF Atsugi; however, within the scientific literature, toxicology information suitable for use in human health risk assessment could be found for all but 66 of these chemicals. The present report describes the derivation of appropriate risk assessment reference values from data in the scientific literature and summarizes the health effects of each of the chemicals detected at NAF Atsugi.

KEY WORDS

Incinerator, pollutant, NAF Atsugi, emissions, ambient air

LIST OF ABBREVIATIONS

Note common chemical and measurement abbreviations are not included.

ATSDR	Agency for Toxic Substances and Disease Registry
CSF	Cancer Slope Factor
EPC	Estimated Permissible Concentration
ESL	Effects Screening Level
HEAST	Health Effects Assessment Summary Tables
IRIS	Instructional Resources Information System
MRL	Minimum Risk Level
NAF	Naval Air Facility
NEHC	Navy Environmental Health Center
NHRC/TD	Naval Health Research Center Detachment (Toxicology)
RBSC	Risk-Based Screening Concentration
RfC	Reference Concentration
RfD	Reference Dose

LIST OF TABLES

Table 1. Chemicals detected at NAF, Atsugi that have no reported toxicity values—Summarization of information from the literature to assist in deriving RfDs and CSFs

Table 2. Estimated Permissible Concentration (EPCs)with available Effects Screening Levels (ESLs) and RfDs and RfCs.

LIST OF APPENDICES

Appendix 1. Oral toxicity values previously identified by ODU for chemicals at NAF Atsugi

Appendix 2. Inhalation toxicity values previously identified by NEHC for chemicals at NAF Atsugi

Appendix 3. Constituents for which no toxicity information was identified by NEHC in IRIS or HEAST

INTRODUCTION

The 1,249 acres of Naval Air Facility Atsugi lie in the Kanto plain on the main island of Japan, Honshu. The base was originally built in 1938 by the Japanese Imperial Navy but surrendered to American forces in 1945. It was formally commissioned on December 1, 1950 and was strategic throughout the Korean and Vietnam Wars. When USS MIDWAY was forward deployed at Yokosuka in 1972, Atsugi became a support base for her aircraft. The area surrounding Atsugi also experienced a population explosion during this same time frame. In 1991, the USS INDEPENDENCE replaced the MIDWAY field carrier landing practice was moved to the island of Iwo Jima. In August 1998, the USS KITTY HAWK replaced the USS INDEPENDENCE. Atsugi is encircled by the cities of Yamato, Ayase and Ebina and is home to approximately 8,000 personnel.

An increase in the population surrounding Atsugi resulted in a need to dispose of growing amounts of urban waste. As such, incineration is being used as a method of waste disposal. The Shinkampo Incinerator lies in a 15 m valley approximately 150 m from the perimeter of NAF Atsugi. Since the incinerator facility uses 30 m stacks for exhaust, high-rise housing units on the base sit in the direct path of the emissions plume when the incinerator is burning. Over 180 tons of material are burned each day, primarily at temperatures too low to destroy the majority of chemicals known to cause adverse health effects.

In order to provide exposure data for residents of NAF Atsugi, NEHC developed an ambient air toxics monitoring program which passively measured dioxins, acid gases, volatile organic compounds, semi-volatile organic compounds, Hg, particulate matter, heavy metals, pesticides and carbonyl. In addition, several criteria pollutant monitoring stations were set up to quantify levels of CO, SO_2, NO_x, O_3, PM_{10}, and $PM_{2.5}$. Both monitoring programs began in April 1998 and continued through June 1999. Over 200 chemicals were identified in the emissions

plume and ambient air; however, only 66 had neither a RfD nor a CSF. The goal of this project was to assemble adequate information to derive reference values or surrogate reference values for use in human health risk assessment of these 66 chemicals.

EXPERIMENTAL

As this project was aimed at compiling toxicology data on the chemicals of interest, no laboratory experimentation was conducted. However, literature searches included TOXLINE, Envirofacts, the National Institute for Environmental Health Sciences, the Texas Natural Resource Conservation Commission, and other worldwide web sites referenced within the text and tables. Book and journal holdings in several technical and medical libraries were also consulted.

RESULTS

In order to develop reference values for use in human health risk assessment of these 66 chemicals, our efforts focused on derivation of reference values where data from the literature was available. Appendices 1 and 2 summarize toxicity and risk assessment information assembled by Old Dominion University. Appendix 3 lists all chemicals for which the literature was found to be inadequate with respect to toxicity information and/or risk assessment reference values. Table 1 summarizes information from the literature on the chemicals detected at NAF Atsugi that have no reported toxicity values. Moreover, this table includes all information available in the literature and toxicology/risk assessment databases available over the worldwide web. Table 1 indicates that, for 27 of the 66 compounds, the literature provides no evidence of human carcinogenicity. In contrast, for 39 of the compounds, either no information was available on the carcinogenic potential or the carcinogenic potential of these chemicals is unknown. At this

time, there is insufficient information available to suspect that any of these compounds are carcinogens or that a cancer slope factor could be calculated.

Table 1. Chemicals Detected at NAF, Atsugi That Have No Reported Toxicity Values Summarization of Information from the Literature to Assist in Deriving RfDs and CSFs

	CAS NO	FINDINGS
n-Butane	106-97-8	**Source: on-line; Envirofacts, accessed through EPA website (www.epa.gov) Chemical Reference: Scorecard** Human Health Hazard: **Suspected Neurotoxicant** **Not a recognized carcinogen** Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Lacking carcinogenicity & ecotoxicity (either not conducted or are not publicly available) Safety Assessment: Lacking some of national data required for national safety assessment --- **Source: on-line; NIEHS website, National Toxicology Program; Chemical Repository. (August 29, 1991).** Genetic Toxicology: Drosophila & Salmonella negative Toxicity: LC50 inhalation, rat - 658 $g/m^3/4H$ LC50 inhalation, mus - 680 $g/m^3/2H$ Information not available for AQTX, carcinogenicity, mutation, or teratogenicity. **Classified as mildly toxic via inhalation** Genetic Toxicology negative Standards, Regulations & Recommendations: **OSHA: PEL-TWA 800 ppm** **ACGIH: TLV-TWA 800 ppm** NIOSH Criteria Document: None --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 800 ppm (1900 mg/m^3) STEL/C: ------- Narcosis --- **Source: TNRCC (Texas Natural Resource Conservation Commission) www.tnrcc.state.tx.us** Toxicology & Risk Assessment

		Effects Screening Levels (ESLs) are currently used by the TNRCC Toxicology and Risk Assessment Section Staff to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. They are based on data concerning health effects, odor nuisance potential, effects with respect to vegetation, or corrosion effects. If predicted or measured airborne levels of a constituent do not exceed the screening level, no adverse health or welfare effects would be expected to occur. If the airborne constituents exceed these levels a more in-depth review is indicated. For Butane (106-97-8) Short-term ESL (1 hr averaging period): 19,000 ug/m^3 (8,000 ppb) **Long-term ESL: 1,900 ug/m^3 (800 ppb)** --- **Source: TOMES** **Reprotext** • Butane reportedly has practically no toxic effects at concentrations below its flammability limits. Its major hazards are from Fire, Explosion, and Asphyxiation. • No studies were found on the possible carcinogenic activity. • Butane was not mutagenic in the Ames Salmonella/microsome test • No reproductive studies were found for butane itself in humans or experimental animals. **Hazardtext - Hazard Management** • Exposure for 10 minutes to 10,000 ppm (1%) causes drowsiness. • Exposure to moderate airborne concentrations dose not produce irritant effects • Exposure of normal volunteers to concentrations of 1,000 ppm for 8 hours or to 500 ppm for 8 hours daily, 5 days/week did not produce any subjective or abnormal physiological effects. **RTECS** Standards & Regulations Various OELs listed; selected ones follow: Lowest OELs: OEL - Hungary: TWA 300 mg/m^3; STEL 900 mg/m^3 OEL - Denmark, Russia, Japan TWA 500 ppm (1200 mg/m^3) Others: OEL- The Netherlands & UK TWA 600 ppm UK has a STEL of 750 ppm OEL- Australia, Belgium, Finland, France, India, & Switzerland: TWA 800 ppm
1-Butene	106-98-9	**Source: TOMES (Limited information)** **HSDB**

		May be CNS depressant in high concentrations. A simple asphyxiant. Butylene isomers are approximately 4.5 times as toxic as ethylene. **New Jersey Health Hazard Information** Not been tested for carcinogenicity or reproductive toxicity at the time of this report. No chronic health effects known at this time. **LOLI®** Available; data limited --- **Source: Standard Report (TSCATS DATA)** Three reports listed; abstracts unavailable.
c-2-Butene	590-18-1	**Source: on-line Envirofacts, Chemical Reference: Scorecard:** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard or carcinogen Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Lacking acute toxicity, carcinogenicity, chronic toxicity, developmental or reproductive toxicity, ecotoxicity, mutagenicity, & neurotoxicity tests (either not conducted or not publicly available) Safety Assessment: Lacking some of the national data required for safety assessment. --- **Source: Standard Report (TSCATS DATA)** Three studies listed, 1 of which had an abstract: The uptake of cis-2-butene was screened in male rats exposed to graded concentration of either 1, 5, 20, 100, and 500 ppm or 1, 10, 100, 1000, or 5000 ppm by nose-only exposure for 80 minutes at daily intervals [amount of days not mentioned]. The percent absorbed was calculated to be 13.3% at a vapor concentration between 10 and 100 ppm. It was shown that there was little effect of concentration on the fractional uptake. --- **Source: TOMES** LOLI ® Available
t-2-Butene	624-64-6	**Source: on-line Envirofacts, Chemical References, Scorecard:** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard or carcinogen Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Lacking acute toxicity, carcinogenicity, chronic toxicity, developmental or reproductive toxicity, ecotoxicity, mutagenicity, & neurotoxicity tests (either not conducted or not publicly available)

		Safety Assessment: Lacking some of the national data required for safety assessment --- **Source:** TOMES LOLI ® available
n-Butyraldehyde	123-72-8	**Source: on-line Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: **Suspected : Respiratory Toxicant & skin or sense organ toxicant** Hazard Ranking: Less hazardous than most chemicals in 6 ranking systems. Basic Testing: Lacking carcinogenicity, chronic toxicity & developmental or reproductive toxicity testing (either not conducted or not publicly available) Safety Assessment: Lacks some of national data required for safety assessment. --- **Source: Standard Report (TSCATS DATA)** **Source: OPPT Chemical Fact Sheet.** **Butyraldehyde Fact Sheet: Support Document** **(obtained from EPA website www.epa.gov)** Pharmacokinetics: Results from toxicity studies suggest absorption occurs by the oral and inhalation routes. Acute Health Effects: Liquid & vapor form cause damage to the eyes and irritation to the skin. Generally, has low acute lethality to lab animals. **Humans exposed to 230 ppm for 30 minutes reported no eye irritation. Rats exposed to 12, 6-hour inhalation exposure of 1000 ppm showed no signs of toxicity.** **The oral LD50 in the rat ranges from 2.5 to 5.9 g/kg; Inhalation LC50 in the rat is approximately 60,000 ppm.** **No signs of toxicity were observed in rats receiving 12, 6-hour inhalation exposures to 1000 ppm.** Bronchial & alveolar edema occurred in rats exposed by inhalation to high levels [not defined]; Fatal pulmonary edema in mice, guinea pigs, and rabbits exposed by inhalation to high levels [specific levels not defined]. Subchronic / chronic effects: Source reports on doses and observed effects, some of which are: • No information found in the secondary sources regarding the noncarcinogenic subchronic or chronic effects in humans. • High doses (oral or inhalation) administered to animals caused lesions of the stomach and respiratory tract and

decreased body weight.

- Rats treated by gavage with 0, 0.075, 0.15, 0.3, 0.6, or 1.2 g/kg, 5 days/wk, for 13 weeks: dose-related increase in mortality and a decrease in body weight observed; increased incidence of irritation, inflammation, necrosis, hyperplasia and lesions of the forestomach and gastric mucosa with 100% of the males and 90% of the females affected in the high-dose group. [no specific dose-response given]
- Rats exposed by inhalation to concentrations of 2710 mg/m^3 (934 ppm) for 6 hours/day, 5 days/week, for 20 exposures had oral discharge and increased adrenal and lung weights; **No effects were seen at 930 mg/m^3 (320 ppm).**
- Rats, mice, guinea pigs, rabbits, and dogs were exposed by inhalation to 0, 2000, 3100, or 6400 ppm; 6 hours/day, 5 days/week, for 9 days over a 2-week period. **Mortality occurred in all species at 6400 ppm; decreased body weights occurred at 3100 ppm for guinea pigs and mice and at 2000 ppm for rats; decreased relative kidney and liver weights occurred in rats at 2000 ppm**; hemorrhage of the ethmoturbinates occurred in one high dose rat.

Other:

- Carcinogenicity - states insufficient evidence in either humans or animals to classify as a carcinogen.
- Genotoxicity - states results are mixed
- developmental /reproductive toxicity - anomalies in animals; no information on effects in humans.
- Neurotoxicity - causes anesthesia in rats at high levels following inhalation exposure (levels not defined). Due to the distinctive odor and the irritating properties of butyraldehyde, it is believed human exposure levels are unlikely to reach concentrations that might induce anesthesia.
- **Listed as a hazardous air pollutant by the EPA.**
- **AIHA: AIHA WEEL 25 ppm**

Source: on-line, National Toxicology Program; NTP Chemical Repository.

Toxicity:

typ. Dose	mode	specie	amount	units
LD50	scu	rat	10	gm/kg
LD50	scu	mus	2700	mg/kg
LD50	skn	rbt	3560	mg/kg
LC50	ihl	rat	174	gm/m^3/30M
LD50	ipr	rat	800	mg/kg
LC50	ihl	mus	44610	mg/m^3/2H
LD50	ipr	mus	1140	mg/kg

LC50	ihl	mam	64	gm/m^3
LD50	orl	rat	5.89	gm/kg
LD50	orl	rat	2490	mg/kg

SAX Toxicity Evaluation: SEVERE skin and eye irritant. Powerful inhalation irritant in humans. MODERATE via dermal, subcutaneous and oral routes.

Carcinogenicity: Status: NTP carcinogenesis Studies; on test (prechronic studies)

Mutation Data:	test	Lowest dose
	spm-mus-ipr	30 mg/kg
	spm-mus-orl	15 gm/kg/50D

Teratogenicity: Not available

Standards, Regulations, & Recommendations:
OSHA: None
ACGIH: None
NIOSH: no criteria document
NFPA Hazard Rating: Health (H): 2

Other Toxicity Data:

Skin & Eye irritation Data:		
	skn-rbt	410 mg open MLD
	skn-rbt	2 mg/24H SEV
	eye-rbt	75 ug open SEV
	eye-rbt	20 mg/24H MOD
	skn-gpg	100% MOD

Source: EPA/OTS Doc #86-900000054. Health effects assessment for butyraldehyde at the nitro plant (final report) with attachment and cover letter dated 122889 Abstract obtained on-line through National Library of Medicine (NLM)

Abstract summarizes published literature reports:

- Moderately to severely irritating to the eye and skin of rabbits
- **LC50 values ranging from 2660 ppm in the guinea pig to 60,000 ppm in the rat [exposure duration not reported]**
- **Inhalation exposures of rats 6 hours/day for 12 days to 1000 ppm had no observable effects.**
- **Exposure (in rats) to concentrations ranging from 293 to 2710 mg/m^3 for 6 hours/day, 5 days/week, for 4 weeks produced no effects at 930 mg/m^3. At 2710 mg/m^3 oral discharge and increased adrenal & lung weights were**

		observed. • Reports observations from oral administration of 1.2 g/kg/day for 13 weeks in rats (irritation, inflammation and necrosis of gastric mucosa and forestomach). • In mice treated by gavage with 300 mg/kg/day and above, mild inflammatory lesions of the nasal cavity were observed; **the no-effect level was estimated to be 75 mg/kg/day**. • Mice administered a single dose of 30 mg/kg by intraperitoneal injection, or 300 mg/kg/day (author estimated dose) in drinking water for 50 days showed pathologic changes, including chromosomal and meiotic anomalies, in sperm at all stages of development. • Negative in Salmonella assay. In Chinese hamster ovary cells it did not induce chromosomal aberrations, but was positive in a sister chromatid exchange assay. Negative results were obtained in the sex-linked recessive lethal assay with Drosophila and sister chromatid exchange test with human lymphocytes. --- **Source: EPA/OTS Doc #86-900000051 Health effects assessment for butyraldehyde at the Decatur plant (final report) with attachments and cover letter dated 122889. Abstract obtained on-line from NLM** **Human exposure to 230 ppm in air is non-irritating** Covers same observations as noted in prior source (EPA/OTS Doc #86-900000054). --- **Source: EPA/OTS Doc #86-890000097 Butyraldehyde: 9-day repeated vapor inhalation toxicity, vapor inhalation by dogs & rats for 12 & 13 wks, respectively & a 12-wk vapor inhalation study in rats with letter 020689** Subchronic inhalation study in multiple mammals. Discusses exposure concentrations & adverse effects seen. No mention made of a NOAEL. **I. Guinea pigs, mice, rabbits, dogs, rats** Exposure: vapor concentrations of 0, 2000, 3100, and 6400 ppm 6 hour/day, 5 days/week, for 9 days over a 2-week period. Adverse Effects: mortality in the 6400 ppm group (all test species) decreased body weights at 3100 ppm and higher (gp,

mice) and in all rats
decreased relative kidney weight (sprague-dawley rats) and liver weight (fischer 344 rats) in all exposure groups
hemorrhage of the ethmoturbinates in 1 sprague-dawley rat at 6400 ppm.

II. Sprague-Dawley rats (20/sex/group) & dogs (4 males)

Exposure: vapor concentrations of 0, 125, 500, and 2000 ppm
6 hour/day, 5 days/week, for 13 weeks

Adverse Effects: Mortality of 1 rat in the 2000 ppm group
Decreased alkaline phosphatase levels (rats, males, at 500 ppm)
Elevated mean albumin levels (125 ppm dogs)
Altered blood chemistry and decreased RBC and monocyte counts among 125 ppm and higher (rats)
Lesions of nasal epithelium and mild interstitial pneumonia at 125 ppm and higher (rats)
Nasal mucosal lesions at 500 ppm and higher (dogs)

III. Fischer rats (15/sex/group)

Exposure: vapor concentrations of 0, 1.0, 10.0, and 50.0 ppm
similar exposure

Adverse Effects: Increased relative kidney weights among high-dose males.

Source; ANON; Butyraldehyde. New Jersey Department of Health, Right to Know Program. (1996).

May enter the body when breathed in. Irritates or burns the skin, eyes and respiratory tract. May cause lung edema. May cause dizziness and lightheadedness. It is a flammable and reactive liquid and a fire and explosion hazard.

Folder also contains a list of prechronic studies for which toxicity technical reports were not prepared.

Source: TOMES

RTECS

Contains several toxicity, irritation, & genetic effects values (e.g. LCLo, LD50, draize test, DNA damage, etc.)

OEL - Russia: STEL 5 mg/m^3; Skin

HSDB

It has been tested for irritant effect on human eyes at vapor concentrations in air such as might occur in smog [did not give

		specific levels] and has been found nonirritant. Respiration and heart beat were increased in male rabbits exposed to 10-20 ppm. Found to be negative when tested for mutagenicity using the Salmonella/microsome preincubation assay. Source also gave more non-human toxicity excerpts, however, doses were not given. See original source for citations of these studies. **LOLI®** Available --- **Source: TNRCC** Short-term ESL: 14 ug/m^3 (5 ppb) Long-term ESL: 1.4 ug/m^3 (0.5 ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists several studies; selected abstracts follow: 1. Subchronic inhalation study. Rats exposed to 0, 1.0, 10.0, and 50.0 ppm for 6 hrs/day, 5 day/wk, for 12 weeks. Mortality was not observed. There were no compound-related clinical observations, body weight changes, hematology findings, or clinical biochemistry findings. There was a significant increase in the relative kidney weights of males exposed to 51.3 ppm. There were no compound-related gross necropsy or microscopic histopathological findings. 2 & 3. Mice & guinea pigs exposed to 0, 2000, 3100, and 6400 ppm for 6 hours/day, 5 days/wk for 9 days over a 2-wk period. Mortality was observed in all animals at 6400 ppm. Clinical observations included salivation in mice in the 3100 ppm group. Significant decreases in body weights were observed in the 3100 and 6400 ppm groups (mice and guinea pigs). Relative organ weight was not reported. There were no compound-related gross necropsy or histopathological findings. 4. Rabbits exposed to 0, 2000, 3100, and 6400 ppm for 6 hr/day, 5 days/wk, for 9 days over a 2-wk period. Mortality observed in all animals at 6400 ppm. Clinical observations included salivation, lacrimation and clear nasal discharge in animals in all exposure levels. 5. Subchronic inhalation toxicity. Dogs exposed to 0, 2000, 3100, and 6400 ppm for 6 hrs/day, 5 days/wk, for 9 days over a 2 wk period (1 animal/exposure level). Mortality observed in the 6400 ppm dog. Lacrimation, salivation, conjunctivitis, clear nasal discharge (6400 and 3100 ppm). Audible respiration (6400 and 3100 ppm). Dogs exposed to 0, 125, 500, and 2000 ppm for 6 hrs/day, 5 days/wk, for 14 weeks. Mortality was not observed. Clinical observations included lacrimation, salivation and nasal discharge in all animals at all levels. Hematological and clinical biochemistry analysis revealed significantly higher mean albumin

		levels in 500 and 125 ppm animals. Urinalysis, mean body weight and relative organ weight data revealed no compound-related findings. Gross necropsy revealed rhinitis marked with mucosal cell hyperplasia, inflammation, and squamous metaplasia (2000 ppm). Microscopic histopathological findings included hyperplasia of the goblet cells within the nasal mucosa (500 and 2000 ppm).
Cyclohexane	110-82-7	**Source: on-line, Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: **Suspected neurotoxicant** Hazard Ranking: More hazardous than most chemicals in 2 out of 10 ranking systems. Basic Testing: Tests on carcinogenicity have either not been conducted or are not publicly available. Safety & Risk Assessment: Lacks some of the national data required for safety assessment. **** However, Scorecard gives an inhalation noncancer risk value (reference concentration) of 3.9 mg/m^3 **** --- **Source: Standard Report (TSCATS DATA)** Multiple studies listed; the following selected abstracts available: 1. Mutagenicity evaluation: rats exposed via inhalation to 0, 96.6, 307.2, or 1041.6 ppm for 6 hrs/day for 5 days. Significant increases in treated female rats relative to controls were observed in the frequency of numerical aberrations (low and mid-dose levels, no dose-related response observed). There were no significant differences observed between treated and control animals with respect to structural aberration frequency, and percentages of cells exhibiting one or more (or two or more) structural aberrations. --- **Source: OPPT Chemical Fact Sheet prepared by Office of Pollution Prevention & Toxics U.S. EPA 1994** States the following: Breathing large amounts of cyclohexane for short periods of time adversely affects the human nervous system. Effects range from headaches to anesthesia, tremors, and convulsions. Contact with liquid or vapor can damage the eyes. Human health effects associated with breathing or otherwise consuming smaller amounts of cyclohexane over long periods of time are not known. [no exposure concentrations given] **Information regarding carcinogenicity, developmental or reproductive effects either does not exist or is not adequate.** Reports repeat exposure to large amounts in air causes nervous system effects, eye damage, and respiratory effects in animals. In workers exposed to atmospheric cyclohexane, 22.8% of

		the total respiratory intake was absorbed, and a "significant amount" of the absorbed cyclohexane was either retained or metabolized. Acute Health Effects: • Low acute toxicity, producing eye irritation in humans and neurological symptoms, other organ effects, and death in animals at very high doses. • **Humans - detectable by odor and is irritating to the eyes at 300 ppm; ACGIH (1991) suggests 25 ppm as the odor threshold. Undiluted cyclohexane is irritating to the skin.** • Animals - Oral LD50 in rats ranges from 8.0 to 39 ml/kg (both greater than 5 g/kg), depending upon the age of the animals. Oral LD50 for mice is 1.3 g/kg. Oral LD50 in rabbits is 5.5 - 6.0 g/kg; Dermal LD50 in rabbits is > 180 g/kg. • **Exposure of rabbits to 3330 ppm produced no effect [duration not given]**; 18,500 ppm for 8 hours was non-lethal; and 26,600 ppm for 1 hour was lethal. Application of 1.55 g/day to the skin for 2 days produced minimal irritation. Chronic Effects: Administered subchronically, it is of low toxicity, producing neurological effects, ocular, gastrointestinal and respiratory effects in animals at very high, lethal concentrations Humans: No information was found for the subchronic/chronic toxicity. Animals: • **No effects observed in rabbits exposed to 434 ppm for 50, 6-hour periods.** • **No effects observed in rhesus monkeys exposed to 1234 ppm for 50, 6-hour periods.** • Concentrations of 7445 ppm 6 to 8 hours/day for 2 to 26 weeks were lethal to rabbits, producing neurological effects as well as closure of the eyes, conjunctival infection, salivation, labored respiration, cyanosis and diarrhea prior to death. • **Rats exposed by inhalation to 1500 or 2500 ppm for 9 to 10 hours/day, 5 days/week for 7, 14, or 30 weeks exhibited No adverse effects.** Carcinogenicity: No information found Genotoxicity: Negative for viral enhanced cell transformation in hamster embryo cells and for histidine reverse gene mutation in

Salmonella t.;

Developmental/Reproductive Toxicity: No information found for humans or animals.

Neurotoxicity: CNS is a major target organ. High concentrations produce various effects ranging from trembling to death.

Humans: At high concentrations is a CNS depressant and may cause dizziness and unconsciousness.

Animals: Source gives various exposure levels and the observed effects. **No** NOELs given. Some of the observations are as follows:

Mice exposed to 50 mg/L (14,500 ppm) for 2 hours exhibited minimal narcotic effects; exposure to 18,000 ppm produced trembling within 6 minutes, disturbed equilibrium within 15 minutes, and complete recumbency within 30 minutes. Concentrations of 7445 ppm, 6 to 8 hours/day, for 2 to 26 weeks were lethal to rabbits, producing convulsions, tremors, narcosis, and paresis of the legs.

Regulations, Standards, and Recommendations

Classified as a hazardous air pollutant in the Clean Air Act Amendments of 1990.

OSHA: PEL-TWA 300 ppm (1050 mg/m^3)

NIOSH: 300 ppm recommended TWA

ACGIH TLV-TWA (1993-1994): 300 ppm

Source: NIEHS on-line website; National Toxicology Program accessed chemical repository

Toxicity data:

typ dose	mode	specie	amount	units
LD50	orl	rat	12705	mg/kg
LD50	orl	mus	813	mg/kg
LCLo	ihl	mus	70	g/m^3/2H
LDLo	orl	rbt	5500	mg/kg
LDLo	ivn	rbt	77	mg/kg

SAX Toxicity Evaluation: Poison by IV route, moderately toxic by ingestion, systemic irritant by inhalation and ingestion, skin irritant.

Carcinogenicity & teratogenicity: not available

Mutation data: test "dnd-esc"; lowest dose 10 umol/L

Other Toxicity Data:

Skin and eye irritancy data: skin-rabbit, 1548 mg/2D-I

IDLH value: 10,000 ppm

Standards & Recommendations:
OSHA: PEL-TWA 300 ppm
ACGIH: TLV-TWA 300 ppm
NIOSH criteria document: none
NFPA Hazard Rating: Health (H): 1

Genetic Toxicology: Salmonella - negative

Source: EPA/OTS Doc #FYI-AX-0682-0142. Mutagenicity Evaluation of Certified Cyclohexane.

Inhalation exposure of rats to cyclohexane. Discusses observations; states no dose-related response observed. Inhalation exposure to : 0, 96.6, 307.2, or 1041.6 ppm for 6 hours/day, for 5 days. Significant increases in treated female rats relative to controls were observed in the frequency of numerical aberrations. No significant differences observed between treated and control animals with respect to structural aberration frequency, and percentages of cells exhibiting one or more structural aberrations.

Source: Criteria group for occupational standards (1984). Scientific basis for Swedish occupational standards.

In liquid form chemical can irritate the skin

No visible toxic effects were noted in rabbits exposed to 11,230 mg/m^3 for 300 hours. Exposure to 2,650 mg/m^3 for 300 hours caused microscopic changes in liver and kidney of rabbits, but no changes were noted with exposure to 1,460 mg/m^3

Source: Directorate-General of Labour, the Netherlands; RA 15/90. Health-based recommended occupational exposure limits for cyclohexane. (1990)

Presents some data on effects to animals with exposure. States no long term, carcinogenicity, or reproduction and teratogenicity data available. States human data are only available on mixed exposure. No inhalatory LC50 is available.

A NAEL was found at 1470 mg/m^3 (rabbits); 4280 mg/m^3 (primate) at exposures of 6 hr/day during 50 days. A NAEL was found at 8750 mg/m^3 (rats) for 10 hr/day, 6 days/wk for 30 weeks. Effects at higher concentration (rabbits) were unspecified microscopic changes in kidney and liver, slight narcosis, increased respiration, salivation, loss of coordination, convulsions and death.

An occupational exposure limit of 875 mg/m^3 (250 ppm) TWA 8 hr is recommended.

		Source: Gupta KP; Mehrotra NK (1990). <u>Mouse skin ornithine decarboxylase induction and tumor promotion by cyclohexane.</u> Chemical assessed for tumorigenic potential on mouse skin. Found effective as a stage II tumor promoter over mouse skin; possibly affects the biochemical events at the molecular level. **Source: Yasugi, et al. (1994) <u>Exposure Monitoring and Health Effect Studies of Workers Occupationally Exposed to Cyclohexane Vapor.</u>** Epidemiological study of 38 workers occupationally exposed (glue application activities). Geometric mean cyclohexane air level in the breathing zone was measured as 27 ppm with a maximum level of 274 ppm. Study identified existence of dose response relationships between levels in blood serum and urine. No significant differences seen between exposure groups and control for hematological or biochemical parameters or the incidence of sister chromatid exchanges in peripheral lymphocytes. Exposed subjects reported an increased incidence of dimmed vision and unusual smell. **Source: ACGIH TLV/ BEI Booklet (1999)** TWA: 300 ppm STEL/C: ----- Irritation ***(Notice of intended changes: TWA 200 ppm; STEL/C 400 ppm; Irritation, kidney) **Source: TNRCC** Short-term ESL: 1435 ug/m^3 (415 ppb) Long-term ESL: 143.5 ug/m^3 (41.5 ppb) **Source: TOMES** **REPROTEXT** Low acute toxicity: oral LD50 in rats of 29,820 mg/kg **In rabbits, a concentration of 3,300 ppm produced no visible effects**; 12,600 caused lethargy, increased respiration rate, convulsions, and narcosis, and 26,600 ppm was lethal after 1 hour. A concentration of 18,000 ppm produced trembling, disturbed equilibrium, and recumbency in mice, rabbits and guinea pigs. <u>Effects of chronic exposure:</u> **No effects on the peripheral nervous system were seen in a group of 18 workers exposed to 5 to 211 ppm for a median of 2.8 years.**

		A total of 50 repeated exposures to 1243 ppm for 6 hours produced no gross or microscopic abnormalities in a monkey. No nerve damage was seen in rats exposed to 2500 ppm for 9 to 10 hours/day, 5 to 6 days/week, for 7 to 30 weeks. Microscopic changes in the liver and kidney were seen in rabbits exposed by inhalation to 786 ppm for 50 periods of 6 hours each. Genetic effects: "It is possibly genotoxic in a limited number of short-term genetic tests, but negative in other test systems." **RTECS** Source gives several acute toxicity doses, some of which are: LCLo: mouse, inhalation, 70 gm/m^3/2H LCLo: mouse, inhalation, 89600 mg/m^3/1H LC50: mammal, inhalation, 70 gm/m^3 LD50: rat, oral, 12705 mg/kg TCLo: rat, inhalation, 300 ppm/6H/2W intermittent TCLo: rat, inhalation, 2000 ppm/13W intermittent TCLo: rabbit, inhalation, 9220 ppm 6H/5W intermittent TCLo: rabbit, inhalation, 7444 ppm/6H/2W intermittent Standards & Regulations: Lowest OELs: OEL-Poland: TWA 80 mg/m^3 OEL - Russia & Japan: TWA 150 ppm (520 mg/m^3) Others: OEL - Australia, Austria, Belgium, Denmark, Finland, France, Germany, Sweden, Switzerland, The Netherlands, the Philippines, Turkey, UK, & the USA : TWA 300 ppm (1050 mg/m^3) **HSDB** Microscopic changes occurred in liver & kidneys of rabbits exposed to 786 ppm for 50 periods of 6 hours. **No toxic changes were found in the tissues of rabbits after exposure for the same period to a concentration of 434 ppm.** **LOLI®** Available --- **Source: DHHS - Occupational Health Guideline for Cyclohexane** The CNS depressant effect is from exposure to concentrations above 12,000 ppm; prolonged or repeated exposure to concentrations above 300 ppm produces a mild irritation of the eyes and upper respiratory tract.

Cyclohexene	110-83-8	**Source: on-line Envirofacts; Chemical Reference: Scorecard** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Data on whether basic tests have been conducted on this chemical is not available. Safety Assessment: Lacks required data --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 300 ppm (1015 mg/m^3) STEL/C: ------- Irritation --- **Source: TNRCC** Short-term ESL: 604 ug/m^3 (180 ppb) Long-term ESL: 60 ug/m^3 (18 ppb) --- **Source: Standard Report (TSCATS DATA)** Studies listed; abstracts unavailable. --- **Source: TOMES** **HSDB** Non-Human Toxicity Excerpts: Lab animals seriously affected at 8850 ppm & lethal at 14800 ppm in single exposures. Chronic inhalation study with rats, guinea pigs, and rabbits at 150, 300 or 600 ppm 6 hr/day, 5 days/wk, for 6 months. Although a significant increase in serum alkaline phosphatase occurred in all three groups & rats showed a decrease in body weight gain at 600 ppm, most of the parameters in the hematologic and the biochemical profile were within normal limits. **RTECS** LD50: rat, oral, 2400 uL/kg LD50: rat, unreported route, 2 gm/kg LD50: mouse, oral, >3200 uL/kg LC: rat, inhalation, >6370 ppm/4H TCLo: rat, inhalation, 600 ppm/6H/26W intermittent Standards & Regulations: All nations (USA included) have a TWA of 300 ppm (1015 mg/m3) with the exception of Russia which has only a STEL of 50 mg/m^3 **LOLI® available**
Cyclopentane	287-92-3	**Source: on-line Envirofacts; Chemical Reference: Scorecard**

		Human Health Hazard: **Suspected Neurotoxicant** Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: Lacking carcinogenicity, chronic toxicity, developmental or reproductive toxicity, & Mutagenicity studies (either not conducted or are not publicly available). Safety & Risk Assessment: Lacking some of the required data. --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 600 ppm STEL/C: ------ Irritation, narcosis --- **Source: TNRCC** Short-term ESL: 3400 ug/m^3 (1190 ppb) Long-term ESL: 340 ug/m^3 (119 ppb) --- **Source: Standard Report (TSCATS DATA)** Studies listed; abstract not available. --- **Source: TOMES** **REPROTEXT** Chronic exposure: No studies available on humans. In experimental animals, repeated exposure resulted in decreased body weight gains; slight erythema and dryness were noted with repeated application to the skin of guinea pigs. **RTECS** OEL-Denmark: TWA 300 ppm (850 mg/m^3) Jan 93 OEL - Australia, Belgium, France, Switzerland & The Netherlands: TWA 600 ppm (1720 mg/m^3) **HSDB** Experiments with mice have demonstrated that no safety margin exists between minimal CNS depressant concentration, loss of reflexes, and lethal dose, all occurring at 110 mg/L. Inhalation effects (8110 mg/L , 6 hr/day for 12 weeks) resulted in decreased body weight gains in female rats. OSHA STANDARDS: TWA 600 PPM Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. **MEDITEXT - Medical Management** Concentrations of 38,000 ppm are lethal in mice. Minimal narcotic effects, loss of reflexes, and death have all been reported in mice exposed to concentrations of 38.3 ppm

		"Concentrations of 10 to 15 ppm or 0.029 to 0.043 mg/L were reported as tolerable for humans". **No effects were observed in male and female rats exposed to inhalation doses of 112 to 1,139 ppm 6 hours/day for 3 weeks. However, decreased body weight gains in female rats were reported at 8,110 ppm given for 6 hours/day for 12 weeks.** **LOLI®** Available
Cyclopentene	142-29-0	**Source: on-line Envirofacts; Chemical Reference: Scorecard** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether or not tests have been conducted on this chemical is not available. Safety & Risk Assessment: Data lacking. --- **Source: TOMES** **RTECS** LCLo: rat, inhalation, 16,000 ppm /4H LD50: rat, oral 2,140 ul/kg LD50: rabbit, skin, 1590 uL/kg --- **Source: TNRCC** Short-term ESL: 8150 ug/m^3 (2930 ppb) Long-term ESL: 815 ug/m^3 (293 ppb) --- **SOURCE: Standard Report (TSCATS DATA)** Two studies listed; no abstracts available.
n-Decane	124-18-5	**Source: on-line Envirofacts; Chemical Reference: Scorecard** Human Health Hazard: None specified Basic Testing: Lacking tests on chronic toxicity, developmental or reproductive toxicity, & neurotoxicity. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Safety & Risk Assessment: Lacks data. --- **Source: on-line NIEHS data base; National Toxicology Program. (last updated 6/22/99)** Genetic toxicology: Salmonella--mixed (inconclusive & negative) Toxicity: typ dose: LC50 — mode: ihl — specie: mus — amount: 72300 — units: mg/m^3/2H

SAX Toxicity Evaluation: simple asphyxiant; narcotic in high concentrations; experimental equivocal tumorigenic agent

Tumorigenic Data: TDLo: skn-mus 25 gm/kg/52W-I

Mutation and teratogenicity: data not available

Standards, Regulations & Recommendations:
OSHA: None
ACGIH: None
NIOSH Criteria Document: None
NFPA Hazard rating: Health : None

Source: TNRCC
Short-term ESL: 10,000 ug/m^3 (1750 ppb)
Long-term ESL: 1,000 ug/m^3 ----------

Source: Nordic expert group (1987). N-Decane and n-undecane.

Stated that it was impossible to recommend any threshold limits based on the existing knowledge and pointed out the need for further investigations.

Source: Kristiansen & Nielson (1988). Activation of the sensory irritant receptor by C7-C11 alkanes.

Mice with tracheal cannulas were exposed head only to n-octane, n-nonane, n-decane, or n-undecane vapors at concentrations up to approximately 25000 ppm for up to 50 minutes. Respiration rates and body movements were monitored. Cessation of body movement was taken to indicate that the compounds were exerting anesthetic effects on the CNS; decreases in respiratory rate were taken as evidence of a sensory irritation effect occurring. **The minimum threshold dose for inducing respiratory effects for n-decane was 22 ppm.**

Source: TOMES

RTECS

Tumorigenic effects:
TDLo - mouse, skin, 25 gm/kg/52 W intermittent. Equivocal tumorigenic agent by RTECS criteria. Skin and Appendages - tumors. Tumors at site of application.

HSDB

Rats showed a significant weight gain and an increase in total leukocyte count after exposure to 540 ppm decane for 18 hr/day, 7 days/wk for 123 days; however, there were no signs of organ toxicity based on gross and microscopic examinations. No bone marrow changes were observed.

		LOLI® Available
m-Diethylbenzene	141-93-5	**Source: TOMES** **RTECS** LDLo: Rat, oral, 5 gm/kg **HSDB** Human Toxicity Excerpts: Men exposed to 1000 ppm experienced eye irritation which rapidly diminished in intensity on continued exposure. A concentration of 2000 ppm caused immediate, severe eye irritation, lacrimation, and irritation of the mucous membranes of the nose. 5000 ppm causes intolerable irritation of eyes, nose. "Summary toxicity statement: Low to moderate via oral route." Non-human Toxicity Excerpts: Tested by drop on a rabbit eye caused transient symptoms of irritation, but no injury was detectable by fluorescein staining. Chronic toxicity: Rats, rabbits, guinea pigs, and monkeys exposed to concentrations of 400 ppm, to 2200 ppm 7 to 8 hr/day, 5 days a week for as long as 6 months. The guinea pigs, rabbits, and monkeys were not affected. A slight increase in average weight of kidneys and livers in rats exposed to 400 ppm for 186 days occurred. **LOLI ® Available**; limited data --- **Source: Standard Report (TSCATS DATA)** Source lists 2 reports; abstracts unavailable.
2,3-Dimethylbutane	79-29-8	**Source: on-line Envirofacts; Chemical Reference: Scorecard** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Information not available Safety & Risk Assessment: Lacks sufficient data --- **Source: on-line NIEHS; National Toxicology Program.** Genetic Toxicology: Salmonella; negative Toxicity: not available Carcinogenicity: not available Mutation data: not available Teratogenicity: not available SAX Toxicity Evaluation: probably an irritant and narcotic in high concentrations. Standards, Regulations & Recommendations: OSHA: PEL-TWA 500 ppm; STEL 1000 ppm ACGIH: TLV-TWA 500 ppm; STEL 1000 ppm NIOSH: Recommended exposure limit to this type of compound

		in air: TWA 100 ppm; Ceiling Limit 510 ppm/15M NFPA Hazard Rating: Health (H) 1 --- **Source: TOMES** **RTECS** Dose Toxicity Data: TDLo: rat, oral, 10 gm/kg/4W intermittent (toxic effects: changes in tubules (including acute renal failure, acute tubular necrosis)). [Toxicology & Industrial Health. Princeton Scientific Pub. Co. POB (1 (3), 67, 1985). **LOLI ® available** German MAK 200 ppm; 720 mg/m^3 --- **Source: Standard Report (TSCATS DATA)** Reports listed; abstracts unavailable.
2,5-Dimethylhexane	92-13-2	**Source: Serve et al. (1991). <u>The metabolism of 2,5-Dimethylhexane in male fischer 344 rats.</u>** Male Fischer 344 rats were dosed by gavage with 0.8 g/kg every other day for 2 weeks. **Dimethylhexane yielded derivatives which were capable of producing a hyaline droplet type of nephropathy at a diminished level from the previously evaluated nephrotoxic hydrocarbons (2,2,4-trimethylpentane & 2,3,4-trimethylpentane)**. Diols, which have not been indicated to bind with alpha-2microglobulin, were the principal urinary metabolites of 2,5-DMH and this may account for the reduced nephrotoxicity. **Moderate hyaline droplet formation in the renal proximal tubule.**
2,3-Dimethylpentane	565-59-3	**Source: Standard Report (TSCATS DATA)** Three reports listed; no abstracts available. --- **Source: TOMES (data limited)** **Health Hazard Data** TDLo: rat, oral, 10 g/kg/4W intermittent (toxic effects: changes in tubules, including acute renal failure and acute tubular necrosis; death). [Princeton Scientific Pub. Co. POB 2155 (1 (3), 67, 1985)] **LOLI® Available**; data limited
2,4-Dimethylpentane	108-08-7	**Source: on-line Envirofacts; Chemical Reference: <u>Scorecard</u>** <u>Human Health Hazard:</u> Not classified as a "recognized" or "suspect" human health hazard. <u>Hazard Ranking:</u> More hazardous than most chemicals in 1 ranking system. <u>Basic Testing:</u> Information on testing not available. <u>Safety & Risk Assessment:</u> Data lacking. ---

		Source: TOMES **LOLI® available; data limited**
Ethanol	64-17-5	**Source: on-line Envirofacts; Chemical Reference: Scorecard** Human Health Hazard: **Suspected: Carcinogen; Cardiovascular or blood toxicant; Developmental Toxicant; Endocrine toxicant; Gastrointestinal or Liver Toxicant; Neurotoxicant; Respiratory Toxicant; & Skin or Sense Organ Toxicant.** Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: All eight basic test to ID chemical hazards have been conducted and are publicly available for this chemical. (acute toxicity, chronic toxicity, neurotoxicity, developmental or reproductive toxicity, mutagenicity, carcinogenicity, ecotoxicity, environmental fate). Safety & Risk Assessment: lacks at least some of the national data required for safety assessment. --- **Source: on-line NIEHS website, National Toxicology Program** Genetic Toxicity: Salmonella Negative Organ Systems Toxicity: Continuous breeding study with Swiss mice. Male (negative); Female (positive). 120 day minimum treatment; Unable to determine dose/response. References NTIS # PB86-144979/AS Toxicity: Gives 34 total of LDLo, TDLo, LC50 & LD50, some of which follow: typ. Dose / mode / specie / amount / units LDLo orl chd 2000 mg/kg TDLo orl man 50 mg/kg TDLo orl man 1430 ug/kg TDLo orl wmn 256 gm/kg/12W LDLo orl hmn 1400 mg/kg LDLo scu inf 19440 mg/kg TDLo orl man 700 mg/kg LC50 ihl rat 20000 ppm/10H LC50 ihl mus 39 gm/m^3/4H SAX Toxicity evaluation: Moderate to low via oral, IV & dermal routes; probably also via inhalation. Mutation data. Rapidly oxidized in the body to carbon dioxide and water; no cumulative effect occurs. Concentrations below 1000 ppm

usually produce no signs of intoxication. It is a CNS depressant in humans. It causes teratogenic effects, equivocal tumorigenic effects, GI effects and glandular effects in humans.

Carcinogenicity:

Tumorigenic Data: TDLo orl, mus 320 mg/kg/50W-I
TD orl, mus 400 gm/kg/57W-I
TDLo rec, mus 120 gm/kg/18W-I

IARC Cancer Review: Animal inadequate evidence
IARC human carcinogen (Group 1)

Mutation data (lowest dose); Teratogenicity (TDLo)-- several listed, please see original source for all; selected ones follow:

Mutation:	test	lowest dose
	cyt-hmn:fbr	12000 ppm
	cyt-hmn:lym	1160 gm/L
	dni-hmn:lym	220 mmol/L
	cyt-hmn:leu	1 pph/72H-C
	sce-hmn:lym	500 ppm/72H-C

Teratogenicity:

TDLo:	orl-wmn	41 gm/kg	(41W preg)
TCLo:	ihl-rat	20000 ppm/7H	(1-22D preg)
TDLo:	orl-mam	31500 mg/kg	(15-35 D preg)

Other Toxicity Data:

Skin & eye irritation data:	skn-rbt	400 mg open MLD
	skn-rbt	500 mg/24 H SEV
	eye-rbt	79 mg
	eye-rbt	100 mg/24H MOD
	eye-rbt	100 mg/4S rns MOD

Standards, Regulations, & Recommendations:
OSHA: PEL-TWA 1000 ppm
ACGIH: TLV-TWA 1000 ppm
NIOSH Criteria Document: None
NFPA Hazard Rating: Health (H): 0

Source: TNRCC
Short-term ESL: 18,800 ug/m^3 (10,000 ppb)
Long-term ESL: 1,880 ug/m^3 (1,000 ppb)

Source: Standard Report (TSCATS DATA)

Source lists several studies; selected abstract follows:

1. Neurotoxicity evaluation. Rats exposed to 0, 4000, 8000, 16000, or 32000 ppm for 4 hours. Rats were hyperactive during the first hour at 4000 and 8000 ppm and the first half hour at 16000 ppm. All tests were passed (except for 1 vertical bar

		failure at 4 hours) at 4000 ppm. Failures in grip, lift, and vertical bar were observed after exposure to 8000 ppm at all times after 1 hour, with ataxia after 2 hours. At 16000 ppm every rat failed grip, lift, bar and ataxia at 4 hours. At 2 hours after exposure to 32000 ppm all rats were failing most tests. Two animals died by 4 hours at 32000 ppm. Recovery from concentrations up to 16000 ppm took less than 1 hour; recovery at the 32000 level was slow and rats continued to fail grip, lift, bar, ataxia, pinna tactile reflex, and muscle tone at 18 hours post exposure. --- **Source: Study Number: RACB84095** **NTIS #PB86144979/AS** Reproductive effects of ethanol were evaluated using CD-1 mice. Gives information regarding findings; no detailed dose-response data presented. --- **Source: Nelson, BK, et al. (1985). <u>Teratological assessment of methanol and ethanol at high inhalation levels in rats.</u>** **Ethanol was administered by inhalation to rats at concentrations of 20,000 ppm, 10,000 ppm, 5,000 ppm & 0 ppm for 7 hr/day on days 1-19 of gestation. No definitive increases in malformations at any level of ethanol, although the incidence in the 20,000 ppm group was of borderline significance.** --- **Source: Pastino et al. (1997). <u>A comparison of physiologically based pharmacokinetic model predictions and experimental data for inhaled ethanol in male and female B6C3F1 mice, F344 rats, and humans.</u>** **Concentrations in study: 600 ppm for 6 hr; 200 ppm for 30 minutes; 50 ppm . Measured blood ethanol concentration (BEC) after exposure. Findings: inhalation of ethanol at or above the concentrations expected to occur upon <u>refueling</u> results in minimal BEC and are unlikely to result in toxicity.** --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 1000 ppm (1880 mg/m^3) STEL/C: ------- Irritation A 4 - not classified as a human carcinogen --- **Source: TOMES** **Hazardtext - Hazard Management** Generally reported lethal dose (oral route): Adult 5-6 g/kg in the nontolerant adult Pediatric - 3 g/kg

		Source states that it is a confirmed human carcinogen (chronic ingestion of alcoholic beverages). IARCs Cancer Review: "human sufficient evidence" ; "animal inadequate evidence" **Inhalation exposure: Human exposure to concentrations below 1000 ppm is considered safe for a working environment. Concentrations of 1000 to 5000 ppm produce some symptoms of irritation. Exposure at 5000 to 10,000 ppm has caused transient although strong irritation of the eye and nose as well as produced cough. At 15,000 ppm, effects were continuous lacrimation and cough. A level of 20,000 ppm was judged as barely tolerable. Above this level, the atmosphere was described as suffocating even for brief exposures.** Following an estimated ingestion of up to 60 mL, all but one out of 119 children (ages not specified) were asymptomatic. Slurred speech and ataxia developed in 2 out of 4 children who ingested an estimated 60 to 105 mL. **Reprotext System** Inhalation exposure at an airborne concentration of 14 to 28 mg/L over a 10 day period was sufficient to produce chemical dependence in rats; 1.4 mg/L for 1 to 2 weeks produced dependency in rats. Ethanol itself is not mutagenic in the Ames test, but its metabolite, acetaldehyde, is mutagenic. Ethanol can affect male fertility and produce reduced birth weight in newborns through paternal exposure, but is not known to be teratogenic through the father. **Men occupationally exposed to ethanol at airborne concentrations within recommended occupational exposure limits had normal sperm counts.** Ethanol inhibited the production of testosterone when given to male rats at 1000 ppm; this effect may be due to its metabolite, acetaldehyde. Source discussed consumption (mostly oral consumption) and resulting reproductive and carcinogenic effects (please see original source for further details). **HSDB** Various toxicity excerpts presented, quite a number dealing with ingestion and blood alcohol levels. Item #6: Human volunteers exposed to alcohol vapor have observed at concentrations of 0.7 to 1% vapor the smell of alcohol was at first almost unbearable, although unpleasant later, and that the eyes began to burn with increased intensity after several minutes. **A vapor concentration of 0.25% had no notable effect on the eyes.** Item # 28: Blood concentrations of 400 mg/dL or more produce dangerous or lethal depression of respiration; usually fatal.

		Item # 55: The handling of motor vehicles was impaired by 100 mg/100 mL of alcohol in the blood, stupor might result from 300 mg/100 mL, and respiratory failure and sometimes death from 400 mg or more per 100 mL. Item # 56: Guinea pig: inhalation, no signs of intoxication: 6400 ppm, 8 hr; 3000 ppm 64X4hr Rat: inhalation, no signs of intoxication: 10750 ppm, 0.5 hr; 3260 ppm, 6 hr. Pharmacokinetics (section of HSDB) 1. Vaporized alcohol can be absorbed through the lung 3. The distribution of alcohol between alveolar air and blood depends on its speed of diffusion, and its vapor pressure at the prevailing temp & concentration of alcohol in the lung capillaries. Empirical determinations have yielded rather different values for this distribution ratio, but a commonly accepted value is 1:2100. **LOLI® available**
Freon 114	76-14-2	**Source: on-line Envirofacts, Chemical Reference: Scorecard Human Health Hazard: Suspected neurotoxicant** Hazard Ranking: Less hazardous than most chemicals in 4 ranking systems. Basic Testing: Lacking carcinogenicity, chronic toxicity, developmental or reproductive toxicity, & mutagenicity testing (either not completed or not publicly available) Safety & Risk Assessment: Lacking some of the required data for assessment. --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 1000 ppm (6990 mg/m^3) STEL/C: ------ CVS, narcosis, asphyxiation A 4 - not classifiable as a human carcinogen --- **Source: TNRCC** Short-term ESL: 69,900 ug/m^3 (10,000 ppb) Long-term ESL: 6,990 ug/m^3 (1,000 ppb) --- **Source: Standard Report (TSCATS DATA)** This source gives an index to various unpublished, nonconfidential studies. The studies are available through the EPA ($). Please see hard copy in file. A few have abstracts. Those that do are presented below (the numbers are used as abstract identifiers). This same format will be used throughout the data base. 1. Acute inhalation toxicity was evaluated in dogs that were exercised on a treadmill for 21 minutes prior to Freon 114

		exposure (concentration levels: 2.5, 5.0, and 10.0% in air for 1 to 16 minutes). No mortality observed. Clinical observations included bigeminal rhythm and multiple ventricular beats. Gross necropsy results were not reported. 2. Dogs exposed to vapor concentrations of 2.5 or 5% for 5 minutes. A control injection of epinephrine preceded exposure to the compound. After exposure the dogs received a challenge injection of epinephrine. A marked response (e.g. life-threatening arrhythmia) following the challenge injection was observed in 8.3 and 58.3% of dogs exposed to the low and high doses. It was concluded that Freon 114 can sensitize the heart to epinephrine, and should be classified as an active sensitizing agent. --- **Source: DHHS- Occupational Health Guideline for Dichlorotetrafluoroethane (Refrigerant 114)** Respiratory irritant & causes asphyxia at extremely high concentrations. Exposure to 200,000 ppm for 16 hours was fatal to dogs, while single 8-hour exposures produced tremors and convulsions but no fatalities. Repeated exposures at 140,000 to 160,000 ppm for 8 hours caused incoordination, tremors, and occasionally convulsions, but all dogs survived. At 47,000 guinea pigs developed respiratory irritation. --- **Source: TOMES** **LOLI ® available**
Heptanal	111-71-7	**Source: on-line; Envirofacts, Chemical Reference - Scorecard.** Human Health Hazard: **Suspected: Neurotoxicant** Hazard Ranking: Less hazardous than most chemicals in 1 ranking system Basic Testing: Testing either has not been conducted or the results are not publicly available on the following: Carcinogenicity, Chronic Toxicity, & Developmental or reproductive toxicity. Safety & Risk Assessment: Lacking data. --- **Source: TNRCC** Short-term ESL: 240 ug/m^3 (50 ppb) Long-term ESL: 24 ug/m^3 (5 ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists 4 reports. --- **Source: on-line, National Toxicology Program: NTP Chemical Repository.** Genetic Toxicology: Salmonella - negative

		Toxicity: typ. Dose / mode / specie / amount / units LD50 / orl / rat / 14 / gm/kg LD50 / orl / mus / 20 / gm/kg SAX Toxicity Evaluation: Mildly toxic by ingestion. Carcinogenicity: Not available Mutation Data: Not available Teratogenicity: Not available Standards, Regulations, & Recommendations: OSHA: None ACGIH: None NIOSH: No criteria document NFPA Hazard Rating: Health (H): None --- **SOURCE: TOMES** **RTECS:** typ dose / route / specie / amount / units LC50 / inhalation / rat / >18400 / $mg/m^3/4H$ LD50 / oral / rat / 3200 / mg/kg LD50 / oral / mouse / 3200 / mg/kg LD50 / skin / rabbit / >5.0 / gm/kg Standard Draize Test: rabbit, eyes, 100 uL; Severe Reaction **Hazardous Substances Data Bank** Gives 6 TSCA test submissions: 1. Evaluated for acute inhalation toxicity in rats with an average concentration of 4.7 mg/L for 4 hrs. Gives observations briefly, no dose-response or NOAELs presented (source is an EPA doc) 2. Evaluated for dermal sensitization on the forearms of humans; it was stated that "dosage not indicated". It was reported to produce no contact-sensitization (source is an EPA doc) 3. Evaluated for dermal sensitization in the guinea pig. (source EPA doc) 4. Test substance was considered to be nonmutagenic in mouse lymphoma forward mutation assay. (EPA doc) 5. Did not consistently increase the reverse gene mutation rates at concentrations up to 4000 ug/mL (EPA doc) 6. Evaluation for mutagenic activity in liquid cultures of Saccharomyces cerevisiae found no consistent increase in mitotic gene conversion (EPA doc) **LOLI® available; data limited**
1-Heptene	592-76-7	**Source: on-line, Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: not classified as a "recognized" or

		"suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether tests have been conducted is not available Safety & Risk Assessment: Lacking required data. --- **Source: TOMES** **HSDB** A study on mutagenic activity using Ames test with Salmonella t. found heptene to be inactive as a mutagen. **LOLI® available**; data very limited --- **Source: TNRCC** The cas no was not given for this compound; the ESLs were listed solely under "heptene" Short-term ESL: 16 ug/m^3 (----------ppb) Long-term ESL: 1.6 ug/m^3 (----------ppb)
Hexanal	66-25-1	**Source: on-line Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: Information on whether tests have been conducted on this chemical is not available. Safety & Risk Assessment: Lacking required data. --- **Source: TOMES** **RTECS** typ dose / specie / route / amount / units LCLo / rat / inhalation / 2000 / ppm/4H LD50 / rat / oral / 4890 / mg/kg LD50 / mammal / oral / 3700 / mg/kg TDLo / rat / oral / 33600 / ug/kg/28D cont. TDLo / rat / oral / 25200 / mg/kg/3W cont. Skin-Standard Draize Test: rabbit, skin, 500 mg/24H; Mild Reaction Skin-Open Draize Test: rabbit, skin, 14178 ug/24H; Mild Reaction Eye-Standard Draize Test: rabbit, eye, 500 mg/24H; Mild Reaction rabbit, eye, 100 mg/24H; Mild Reaction **LOLI® available; data limited**
1-Hexene	592-41-6	**Source: on-line Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: Not specified

		Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic testing: Lacking tests on carcinogenicity, chronic toxicity, developmental or reproductive toxicity, ecotoxicity, mutagenicity, & neurotoxicity (either not done or information not publicly available). Safety & Risk Assessment: Lacking required data. --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 30 ppm STEL/C: ----- Irritation --- **Source: TNRCC** Short-term ESL: 70 ug/m^3 (20 ppb) Long-term ESL: 7 ug/m^3 (2 ppb) **Source: TOMES** **RTECS** typ dose / specie / route / amount / units LC50 / rat / inhl / 32000 / ppm/4H LD / rat / oral / >10 / gm/kg LD / rabbit / skin / >10 / gm/kg **LOLI® available**; data limited --- **Source: Standard Report (TSCATS DATA)** One study listed; abstract unavailable.
c-2-Hexene	7688-21-3	**Source: TOMES** Only basic data on health effects (e.g. inhalation or contact may irritate or burn skin & eyes; fire may produce irritating, corrosive and/or toxic gases. Vapors may cause dizziness or suffocation). **LOLI® available**; data very limited
t-2-Hexene	4050-45-7	**None found at this time; still researching**
Hydrofluoric Acid	7664-39-3	**Source: on-line Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: **Suspected: Cardiovascular or blood toxicant; Developmental toxicant; Gastrointestinal or liver toxicant; Musculoskeletal toxicant; Neurotoxicant; Reproductive toxicant; Respiratory toxicant; Skin or sense organ toxicant.** Hazard Ranking: **More hazardous than most chemicals in 4 out of 5 ranking systems. Ranked as one of the most hazardous compounds (worst 10%) to human health.** Basic Testing: Lacking three of eight basic tests (either not

		conducted or are not publicly available) Safety & Risk Assessment: Lacking some of the data required for national assessment. **Scorecard, however, has an inhalation noncancer risk value (reference concentration) of 30 ug/m^3** --- **Source: on-line, United Air Toxics website (UATW) under EPA/ Office of Air Quality Planning & Standards (OAQPS) Hydrogen Fluoride (and related compounds).** Document gives a hazard summary (acute, chronic, & reproductive/developmental effects). This substance has not been classified with respect to potential carcinogenicity by the EPA. **RfC & RfD are at present under review by the EPA.** **LC50 Guinea Pigs 3,541 mg/m^3** **LC50 monkeys 1,452 mg/m^3** **LC50 rats 1,044 mg/m^3** **LC50 rats 280 mg/m^3** **(for HF 1 ppm = 0.82 mg/m^3)** ACGIH TLV, NIOSH REL, OSHA PEL, & MSHA standard - 2.5 mg/m^3 --- **Source: Nordic Expert Group; Jahr, J. (1983) 41. Hydrogen fluoride.** **Exposure to 2-3 mg/m^3 causes slight skin and eye irritation, for some, also nose irritation. Exposure to less than 1.7 mg/m^3 (air) has little or no effect on skin or mucous membranes.** For the establishment of a hygienic standard, they recommend a sensation of mucous membrane irritation; if no such irritation occurs, they state that no other negative effects are likely. Also talks briefly on fluorosis (long term exposure (years) may cause bone fluorsis -- no concentrations mentioned). --- **Source: Berge, et al. (1986). Concentration-time mortality response relationship of irritant and systemically acting vapours and gases.** A re-evaluation of the raw data of previously published acute inhalation toxicity studies of some volatile industrial chemicals. Attempting to obtain original. --- **Source: Dutch expert committee for occupational standards. (1989). Health-based recommended occupational exposure limits fro fluorine, hydrogen fluoride and inorganic fluoride compounds.**

		Volunteer study: **HF at 2.1 mg/m^3 in air --no local immediate effect** **HF at 7.0 mg/m^3 in air -- "discomfort"** **Stated the estimated NAEL is 2,000 ppm (did not say if was strictly HF or fluorides in general)** Carcinogenicity: At present, the data do not suggest an increased risk of carcinogenicity --- **Source: National Institute for Public Health and Environmental Protection, the Netherlands; Report No 758474010 (1989). Integrated criteria document fluorides.** Insufficient data available to drive a recommended concentration for fluoride in the ambient air. **One study found effects on pulmonary function at concentrations of 98 ug/m and higher. Another study found gaseous fluorides up to a concentration of 16 ug/m^3 had no measurable effect on the lung function of children.** --- **Source: Stavert et al. (1991). Relative acute toxicities of hydrogen fluoride, hydrogen chloride, and hydrogen bromide in nose and pseudo-mouth-breathing rats.** Inhalation exposure to 1300 ppm hydrogen fluoride for 30 minutes did not cause any deaths in nose breathing rats. In mouth breathing rats 25% mortality occurred. Other observations resulting from the exposure were presented (such as epithelial necrosis, submucosal necrosis). --- **Source: Meldrum (1993). Toxicology of substances in relation to major hazards -- Hydrogen fluoride.** Abstract -- **suggests that the "Dangerous Toxic Load" for hydrogen fluoride, 12,000 ppm/min, be used in risk analysis.** Source contents are reported to contain toxicological data that is available on animals and humans; and observations from single exposure inhalation studies in animals. Details are not given. Attempts are being made to obtain the source. --- **Source: Lund et al. (1997). Exposure to hydrogen fluoride: An experimental study in humans of concentrations of fluoride in plasma, symptoms, and lung function.** The absorption of inhaled hydrogen fluoride was studied by measuring the concentrations of fluoride in plasma and in the breathing zone of 20 healthy nonsmoking men (ages 21 to 44 years) during exposure. Three exposure levels and symptoms discussed. Exposure was for one hour to constant HF

		concentrations that ranged from 0.2 to 5.2 mg/m^3 ; symptoms were only stated as "from the eyes and the upper and lower airways". Did mention lung function (forced expiratory volume & Forced vital capacity), but no specifics given. **Recommendations to keep occupational HF concentrations well below 2.5 mg/m^3 to avoid symptoms.** --- **Source: Dalbey et al. (1998). <u>Acute effects of 10-minute exposure to hydrogen fluoride in rats and derivation of a short-term exposure limit for humans.</u>** A series of inhalation exposures in rats performed. From the resulting data, it is **predicted that an exposure level of 130 ppm for 10 minutes would not result in severe or irreversible health effects (for most individuals). Irritation is predicted to occur at this level; reversible effect.** --- **Source: Dalby et al. (1998). <u>Short-term exposures of rats to airborne hydrogen fluoride.</u>** Series of acute inhalation exposures: 2 or 10 minutes long; concentrations ranged from 135 to 8621 ppm. Three additional exposures at 20 to 48 ppm for 60 minutes performed. Observed changes were reported to be concentration related and more pronounced in the major airways near the point of entry. **Exposures of mouth breathing animals for 60 min to 20 or 48 ppm did not result in observable adverse effects.** --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: ----- STEL/C: C 3 ppm Irritation; burns; bone, teeth fluorosis BEI --- **Source: DHHS-Occupational Health Guideline for Hydrogen Fluoride** NIOSH has recommended that the PEL be changed to 2.5 mg/m^3 averaged over a work shift not to exceed 10 hours/day, 40 hours/week, with a ceiling level of 5 mg/m^3 averaged over a 15 minute period. Animals repeatedly exposed to 17 ppm showed damage to the lungs, liver, and kidneys, but at 8.6 ppm there was only occasional lung injury. In human subjects, 120 ppm was the highest concentration that could be tolerated for 1 minute because of the onset of conjunctival and respiratory irritation with stinging of the skin. Repeated experimental human exposures to 2 ppm for 6 hours daily caused a slight stinging of the eyes and skin of the face, with

		nasal irritation. Repeated exposures to low concentrations at work may produce chronic irritation of the nose, throat, and bronchi. --- **Source: TNRCC** ** (3 hr) Short-term ESL: 4.9 ug/m^3 (3.5 ppb) Long-term ESL: 0.5 ug/m^3 (0.35 ppb) The ** signifies that this constituent has "disaster potential". The "3 hr" for this constituent designates that the short-term ESL is averaged over 3 hours (instead of the usual 1), and the long-term ESL is for evaluation from the standpoint of effects on vegetation. This constituent is to be evaluated only for its contribution to total hydrogen fluoride. --- **Source: TOMES** **RTECS** Various acute toxicity doses given, following are a selected few: TCLo: man, inhalation, 100 mg/m^3/1M TDLo: man, oral, 143 mg/kg LCLo: human, inhalation, 50 ppm/30M LDLo: rat, intraperitoneal, 25 mg/kg LC50: rat, inhalation, 1276 ppm/1H LC50: guinea pig, inhalation, 4327 ppm/15M LC50: monkey, inhalation, 1774 ppm/1H Irritation: Eye -Standard Draize Test: Human, 50 mg; Severe Reaction Reproductive effects: TCLo: rat, inhalation, 470 ug/m^3/4H; duration, 1-22 D of pregnancy (toxic effects: pre-implantation & post-implantation mortality) TCLo: rat, inhalation, 4980 ug/m^3/4H, 1-22 D of pregnancy (toxic effects: fetal death) <u>Standards & Regulations:</u> Various ones listed; a selected few follow: <u>Lowest</u> OEL - Denmark: TWA 2 ppm (1.6 mg/m^3) OEL - Hungary & Poland: TWA 0.5 mg/m^3 OEL - Switzerland: TWA 1.8 ppm (1.5 mg/m^3); STEL 3.6 ppm (3 mg/m^3) <u>Others</u> OEL - Australia, Belgium, France, Germany, Japan, Russia, The Netherlands, The Philippines, Turkey, United Kingdom, OSHA:

		TWA 3 ppm **Meditext - Medical Management** Death has occurred after ingestion of 1.5 g of HF (concentration unknown) within 6.5 hours of ingestion. **Estimates of the lowest lethal inhalation concentrations range from 50 to 250 ppm for 5 minute exposure and are based on accidental, voluntary and occupational exposure information.** **Reprotext System** **Repeated exposure to airborne concentrations of 3 ppm or less could be tolerated with no apparent ill effects for 6 hr/day for up to 50 days; redness of the skin and irritation and burning of the eyes and nose were noted at airborne concentrations between 3 ppm and 4.7 ppm. No significant changes in pulmonary function occurred with occupational exposure to airborne levels averaging 1.03 ppm.** HF has been reported to cause chromosome aberrations in bone marrow cells when inhaled by rats at an airborne concentration of 1 mg/m^3 6 hours daily for one month. Chromosome aberrations in bone marrow cells of rats exposed to 1 mg/m^3 (length of time not specified). **In female rats, concentrations of 0.1 or 0.2 mg/m^3 increased preimplantation deaths and was embryotoxic and teratogenic at the higher dose, while no effects were observed at a concentration of 0.0025 mg/m^3.** **HSDB** Various human toxicity & non-human toxicity excerpts were given. A select few are presented below: **"Dose-effect relations: 3 ppm; good warning properties. MAC 8 hours, 10 ppm MAC 0.5 - 1 hour, 30 ppm sour taste smarting eyes, 60 ppm; burn pain may be delayed up to 1 hour. Apparent irritation of nose, and eyes, 120 ppm irritation of skin, respiratory; vapors can cause ulcers of respiratory tract 50 - 250 ppm dangerous with short exposure, 1500 ppm fatal to animals in tract, 5-minutes; concentration of 50-250 ppm can be dangerous even for brief exposures."** **Gas is potentially corrosive @ 20 ppm & can be tolerated for 1 min @ 120 ppm but is irritating.** Inhalation of the fumes of concentrated (60 to 100%) solution results in oropharyngeal irritation, coughing, and retro sternal burning. More severe exposures may produce laryngeal edema, bronchospasm, and pulmonary edema. Guinea pigs and rabbits died within 5 min when they inhaled air containing 1500 mg/m^3. All animals exposed to 500 mg/m^3 for 15 min or more showed signs of weakness and ill-health; concentration below 100 mg/m^3 could be tolerated for 5

		hours without causing death. Rabbits & guinea pigs: at concentrations of not more than 50 mg/m^3 HF induced coughing; inhaled in greater concentrations, respirations slowed and discharge from nose & eyes. **Repeated inhalation of 17 ppm resulted in damage to the lungs, liver, and kidneys of animals, but similar inhalation of 8.6 ppm failed to elicit significant pathologic change in these tissues.** **Acute effects experienced by rabbits and guinea pigs exposed to concentrations of 24 - 8,000 mg/m^3 for periods ranging from 41 hr to 5 minutes were presented. Evidence of eye and respiratory tract irritation was noticeable in all animals at all concentrations, although for those animals exposed at 50 and 24 mg/m^3 for 5-15 minutes, signs were mild and not immediate.** See original source for more details; no NOAELs found. Thirty day exposures of 5 lab species to levels that "bracketed the maximal and minimal effects....8.6 and 30 ppm in 6 hour, daily exposures." Exposure at the higher concentration was lethal to all the rats and mice, but not to guinea pigs, rabbits, and dogs. Among the surviving animals, the rabbits showed a slight reduction in body weight, the dogs were apparently unaffected, and the guinea pigs began to lose weight after the third week of exposure. Exposure at 8.6 ppm for 6 hr/day failed to alter significantly normal weight gains in any of the animals except rabbits. **LOLI® available** --- **Source: Standard Report (TSCATS DATA)** Source lists several reports.
Indan	496-11-7	**Source: on-line Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: Information on testing not available Safety & Risk Assessment: lacking required data. --- **Source: TOMES** **RTECS** LDLo: rat, oral, 5 gm/kg
Indene	95-13-6	**Source: ACGIH TLV / BEI Booklet (1999)** TWA: 10 ppm (48 mg/m^3) STEL/C: ------ Irritation, liver, kidney ---

		Source: Standard Report (TSCATS DATA) Source lists 1 report. --- **Source: TNRCC** Short-term ESL: 71 ug/m^3 (15 ppb) Long-term ESL: 7.1 ug/m^3 (1.5 ppb) --- **Source: TOMES** **RTECS** LC50: rat, inhalation, 14 gm/m^3 LD50: rat, route unreported, 2300 mg/kg LD50: mouse, route unreported, 1800 mg/kg LD50: mammal, oral, >5 gm/kg TCLo: rat inhalation, 3 mg/m^3/24H/15W continuous Standards & Regulations: OEL - Australia, Belgium, Denmark, Finland, France, Switzerland, The Netherlands, United Kingdom, & U.S. : TWA 10 ppm (45 mg/m^3) STEL for Finland 20 ppm (95 mg/m^3) STEL for United Kingdom 15 ppm (70 mg/m^3) **HSDB** Non-Human Toxicity Excerpts: **Liver damage & occasionally splenic & renal injury were found in rats exposed to 800-900 ppm for 6, 7-hr periods.** Severe hemorrhagic liver necrosis occurred in some rats; histologic changes in the kidneys consisted of focal necrosis resembling small infarcts. No changes in blood constituents or in the adrenals, pancreas, pituitary, ovaries, or testes were found. No specific NOAELs or dose response information presented in this source. (original reference is ACGIH, 1991) **Adult rabbits tolerated 1 g in a single, oral dose with no evidence of systemic toxicity.** **Fatty livers and fatalities resulted when 1 g was injected sc in rats.** **Rats subjected for 105 days to fumes in 0.6 & o.15 mg/m^3 did not show any hygienically significant changes; no evidence of toxicity was observed at 0.6 mg/m^3.** At 3 mg/m^3, an increase in urinary sulfate index & cholinesterase activity & decrease in catalase activity. Hemodynamic changes were observed in viscera. **No local cutaneous or generalized systemic toxicity developed from painting the shaved skin of rats one to eight times with 0.1 mL of indene liquid. Guinea pigs were similarly unaffected by three applications of 0.5 mL of indene.** TDLo: rat, inhalation, 200 mg/m^3, approximately 42 ppm

		TD: rat , inhalation, 800-900 ppm for 7H/6D -- liver damage, some renal and splenic injury. **LOLI® available**
Isobutane	75-28-5	**Source: Envirofacts, Chemical Reference: Scorecard.** **Human Health Hazard: Suspected Neurotoxicant** Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Lacking tests on carcinogenicity, developmental or reproductive toxicity, & ecotoxicity. Safety & Risk Assessment: Lacking data for national requirements. --- **Source: TNRCC** Short-term ESL: 4845 ug/m^3 (---------ppb) Long-term ESL: 484.5 ug/m^3 (--------ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists several reports; abstracts unavailable. --- **Source: NIOSH Appendices to On-line NIOSH Pocket Guide to Chemical Hazards** Recommended exposure limits (not in effect) TWA 800 ppm (1900 mg/m^3) --- **Source: TOMES** **RTECS** typ dose / specie / route / amount / units LCLo / mouse / inhl / 1041 / gm/m^3/2H LC50 / rat / inhl / 57 / pph/15M Standards & regulations: OEL - Germany: TWA 1000 ppm (2350 mg/m^3) Jan 1993 OEL - Switzerland: TWA 800 ppm (1900 mg/m^3) Jan 1993 OEL - United Kingdom: TWA 600 ppm (1430 mg/m^3); STEL 750 ppm **HazardText ® Hazard Management** 6.1 Minimum Lethal Exposure Inhalation exposure to a concentration of 350,000 ppm (35%) caused death in 60% of exposed mice, and concentrations of 520,000 ppm (52%) were lethal to 100 % of exposed mice in a 28 minute period. Exposure to concentrations of 550,000 ppm (55%) was lethal in dogs. 6.2 Maximum Tolerated Exposure Exposure of normal Volunteer subjects to concentrations of

		1,000 ppm for 8 hours or to 500 ppm for 8 hrs daily, 5 days/week did not produce any subjective or abnormal physiological effects. Exposure to a 25% concentration each of isobutane, n-butane, n-pentane, and isopentane at concentrations ranging from 4 to 4,437 ppm 6 hrs daily, 5 days/week, for 3 weeks did not produce any nephrotoxicity in rats. No deaths were observed in mice exposed to isobutane in concentrations of 350,000 ppm (35%) Mice were lightly anesthetized after exposure to isobutane in concentrations of 150,000 to 230,000 ppm (15 to 23%). In dogs, inhalation exposure to concentrations of 450,000 ppm (45%) caused anesthesia. A decreased myocardial threshold to the arrhythmogenic effects of injected epinephrine was seen in dogs and mice exposed to 50,000 ppm (5%) and 200,000 (20%), respectively. Serious ventricular arrhythmias were noted in dogs exposed to 150,000 to 900,000 ppm (15 to 90 %) concentrations of isobutane when epinephrine was injected. In anesthetized monkeys, inhalation in concentrations of 50,000 to 100,000 ppm (5 to 10%) caused tachycardia, cardiac arrhythmias, a decreased cardiac output, and hypotension. Subchronic exposure (90 days) to a consumer product containing 22 % isobutane caused no pathological effects in rabbits. Monkeys exposed for 90 days to 4,000 ppm of isobutane, or to an aerosol spray containing 65 % combined isobutane and propane also showed no pathological effects. LC50 (inhl) mouse: 520,000 ppm for 2H. **Hazardous Substances Data Bank** **Human Toxicity Excerpts:** 1. Human volunteers, exposed to 2500 or 1000 ppm for 1 min to 8 hr and 500 ppm for 1 to 8 hr/day for 10 days showed no deleterious effects. 2. Toxicologically, the vapor exerts no effect on skin and eyes, except as a liquid in direct contact, where it produces chemical burns. 3. Exposure to isobutane (250, 500 or 1000 ppm) for periods of 1 min to 8 hr produced no untoward physiological effects as determined by methods which include serial EKGs & continuous monitoring of modified V5 by telemetry. 4. No untoward effects were observed in eight adults, males and females, exposed to 250 -1000 ppm in controlled-environment chamber for periods of 1 min, 2 min, 1 hr, 2 hr, & 8 hr. Also no untoward effects occurred after chronic exposures to 500 ppm. Source also gives some non-human toxicity excerpts. Some

		of which follow: In the mouse it is a CNS depressant at 15% in 60 min and at 23% in 26 min. At 22 to 27 % it is anesthetic in the mouse in 8.7 min. but caused respiratory arrest in 15 min. In the dog, anesthesia occurs at 45% in 10 min. Exposure of rats to a blend containing 25% each of n-butane, n-pentane, isobutane, and isopentane by inhalation at concentrations of 0, 44, 434, or 4437 ppm for 6 hr/day, 5 days/wk for 3 weeks found no clinical signs of toxicity; no gross or histopathological lesions; and no evidence of nephrotoxicity. **Reprotext** Chronic inhalation may produce liver and kidney damage. **HazardText (R)- Hazard Management** Isobutane is considered to be less toxic than n-butane. Isobutane can be absorbed systemically following inhalation exposure in humans. **NIOSH Pocket Guide** REL: 10 hr. TWA 800 ppm (1900 mg/m^3) **LOLI® available**
Isobutene	115-11-7	**Source: TNRCC** Short-term ESL: 1403 ug/m^3 (----------ppb) Long-term ESL: 140 ug/m^3 (----------ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists 3 studies; pertinent abstracts unavailable. --- **Source: TOMES** **RTECS** LC50: rat, inhalation, 620 g/m^3/4H LC50: mouse, inhalation, 415 g/m^3/2H **HSDB** Butylene isomers are similar in pharmacological activity as asphyxiants and weak anesthetics; about 4.5 times as toxic as ethylene. **CHRIS -Chemical Hazard Response Information System** Symptoms after exposure: inhalation of moderate concentrations causes dizziness, drowsiness and unconsciousness. Contact with eyes or skin may cause irritation. TLV 1000 ppm (8 hr) **LOLI® available; data limited**
Isobutylbenzene	538-93-2	**Source: Envirofacts, Chemical Reference: Scorecard**

		Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: Testing information lacking (either not done or not publicly available) on carcinogenicity, chronic toxicity, neurotoxicity. Safety & Risk Assessment: Lacking some of the data required for safety assessment. --- **Source: TOMES** **RTECS** LDLo: rat, oral, 5 gm/kg **LOLI® available**; data very limited --- **Source: Standard Report (TSCATS DATA)** Source lists 2 reports; abstracts unavailable. --- **Source: TNRCC** I could not find isobutylbenzene (538-93-2) in their list. However, they did have "butyl benzene, all isomers"; Cas Nos not specified. If isobutylbenzene can be considered an isomer, then the following ESLs apply: Short-term ESL: 2740 ug/m^3 (500 ppb) Long-term ESL: 274 ug/m^3 (50 ppb)
Isodrin	465-73-6	**Source: Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: Information on whether tests have been conducted is not available. Safety & Risk Assessment: Lacks data for national assessment. --- **Source: TNRCC** Short-term ESL: 3.2 ug/m^3 (--------ppb) Long-term ESL: 0.32 ug/m^3 (-------ppb) --- **Source: TOMES** **Reprotext** • Isodrin is a chlorinated hydrocarbon insecticide in the cyclodiene family. • From its acute oral LD50 of 7 mg/kg in rats, isodrin is an extremely toxic substance. It can be absorbed by inhalation,

		ingestion, and skin contact. • **Because it is lipid-soluble and may accumulate in body fat, cumulative toxicity may occur with repeated exposure.** • Neurologic effects of chronic isodrin exposure are expected to be similar to those of acute exposure. • No studies on the potential carcinogenic activity, genetic effects were found at the time of this study. • Isodrin was more toxic to chick embryos than most other organochlorines. Aldrin, a closely related compound, has affected fertility and has been fetotoxic and teratogenic in several species of experimental animals. The actual human reproductive hazard is unknown. **RTECS** LD50: rat, oral 7 mg/kg LD50: rat, skin, 23 mg/kg LD50: mouse, oral, 8800 ug/kg LD50: mammal, route unreported, 7 mg/kg **Meditext - Medical Management** Gives a lot of the acute and chronic effects, however, a lot of the review is based on the properties of chlorinated hydrocarbon insecticides in general, no doses are discussed. LDLo: mouse, intraperitoneal, 6400 mcg/kg **HSDB** Has human toxicity excerpts, however, nothing contained seemed pertinent to the study at hand. It was noted that isodrin is related to aldrin, but at least twice as toxic in laboratory rodents. This substance is on the CERCLA reportable quantities list; when there is a release of this substance in an amount equal to or greater than 1 lb or 0.454 kg, it is required to be reported. **Hazardtext - Hazard Management** **The probably oral lethal dose for humans is in the range of 5 to 50 mg/kg (between 7 drops and 1 teaspoon for a 150 lb person)** **LOLI® available**
Isoheptane	591-76-4	**Source: Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether tests have been conducted is not available.

		Safety & Risk Assessment: Lacking some of national data required. --- **Source: TNRCC** Source did not specify a Cas No for this compound; it was solely listed under "isoheptane" Short-term ESL: 3070 ug/m^3 (750 ppb) Long-term ESL: 307 ug/m^3 (75 ppb) --- **Source: Standard Report (TSCATS DATA)** Two reports listed; no abstracts available. --- **Source: TOMES** **RTECS** LCLo: rat, inhalation, 19500 ppm/4H toxic effects: tremor, dyspnea, changes in structure or function of salivary glands TDLo: rat, oral, 10 gm/kg/4W intermittent toxic effects: kidney, ureter, and bladder- changes in tubules (including acute renal failure, acute tubular necrosis) **LOLI® available**
Isohexane	73513-42-5	None available at this time; still researching. **Source: TNRCC** **???** Isohexane is found on the source list, however, the Cas No on their list differs from the one on our list. Their Cas No. is 107-83-5. I have therefore concluded that this is a different compound. However, I have included their ESLs here, just in case. Short-term ESL: 289 ug/m^3 (------ppb) Long-term ESL: 29 ug/m^3 (------ppb) --- **Source: TOMES** **LOLI® is available, <u>HOWEVER</u>**, the Cas no again, is 107-83-5
Isopentane	78-78-4	**Source: Envirofacts, Chemical Reference: <u>Scorecard.</u>** <u>Human Health Hazard</u>: Not classified as a "recognized" or "suspect" human health hazard. <u>Hazard Ranking</u>: Less hazardous than most chemicals in 1 ranking system. <u>Basic Testing</u>: Lacking testing or information not publicly available on the following tests: carcinogenicity; chronic toxicity; developmental or reproductive toxicity; ecotoxicity; neurotoxicity. <u>Safety & Risk Assessment</u>: Lacking at least some of the required data. ---

Source: on-line, National Toxicity Program

Genetic toxicology: negative in drosophila & salmonella

Toxicity:

typ dose	mode	specie	amount	units
LCLo	ihl	mus	419	$gm/m^3/2H$

SAX Toxicity evaluation: probably mildly toxic and narcotic by inhalation.

Carcinogenicity: not available

Mutation data: not available

Teratogenicity: not available

Standards, Regulations, & Recommendations:

OSHA: Transitional limit PEL-TWA 1000 ppm for a closely related compound

Final Limit PEL-TWA 600 ppm; STEL 750 ppm for a closely related compound

ACGIH: TLV-TWA 600 ppm; STEL 750 ppm for a closely related compound

NIOSH Criteria Document: REL to this type of compound - air:
10 H TWA 350 mg/m^3
Ceiling Limit 200 $mg/m^3/15M$

NFPA Hazard Rating: Health (H) 1 (materials only slightly hazardous to health)

Source: Standard Report (TSCATS DATA)

Source lists reports; abstracts unavailable.

Source: TOMES

Reprotext

The toxicity of isopentane is thought to be similar to that of pentane; however, little is known about the toxicity of isopentane.

Inhalation of an airborne concentration of 500 ppm has been reported to produce no ill effects in humans (length of exposure was not given)

Isopentane was twice as toxic as pentane in acute inhalation exposures in mice.

Was not found to be mutagenic in the Ames Salmonella microsome assay.

RTECS

LCLo: mouse, inhalation, 419 $gm/m^3/2H$ (toxic effects: excitement)

TDLo: rat, oral 10 gm/kg/4W intermittent (toxic effects: weight loss or decreased weight gain; death)

Standards & Regulations:

OEL - Denmark: TWA 500 ppm (1500 mg/m^3) Jan 93

HSDB

		Human Toxicity Excerpts: • May be a CNS depressant between 270 and 400 mg/L, similar to pentane and is a weak cardiac sensitizer. • Inhalation of up to 500 ppm appears to have no effect on humans. Non-human Toxicity Excerpts: • Pentane causes CNS depression in 5-60 min at concentration range of 90,000 - 120,000 ppm in air. Only a narrow margin exists between the concentration which cause CNS depression and death in mice. • Light anesthesia occurred in mice when exposed to 90,000 ppm for 11.6 minutes. At 110,000 and 120,000 ppm the onset of the narcotic effect was observed within 3.9 and 2.2 minutes. • 120,000 ppm was required to induce light anesthesia in dogs. • Source gives other levels at which death occurred in mice and dogs. However, no NOAELs or dose response given. **LOLI® available**
Isoprene	78-79-5	**Source: on-line Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: **Recognized: Carcinogen (however, source also states that National safety assessment is "no" for cancer risk if exposed via inhalation or ingestion).** **Suspected: Neurotoxicant** **Respiratory Toxicant** Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: Eight basic tests have been conducted and are publicly available (acute toxicity, chronic toxicity, neurotoxicity, developmental or reproductive toxicity, mutagenicity, carcinogenicity, ecotoxicity, & environmental fate). Safety & Risk Assessment: Lacking at least some of the national data required. --- **Source: on-line, National Toxicology Program** Toxicity: typ dose / mode / specie / amount / units LC50 / ihl / mus / 139 / gm/m^3/2H LC50 / ihl / rat / 180 / gm/m^3/4H SAX Toxicity evaluation: Moderate irritation to the skin, eyes and mucous membranes. Concentrations of 2% in air are

not narcotic to mice but produce bronchial irritation. Concentrations of 5% are fatal to mice. No data on human exposures.

Carcinogenicity: NTP carcinogenesis studies; on test (prechronic studies) October 1987

Mutation data not available.

Teratogenicity: not available.

Acute/Chronic Hazards: Toxic by ingestion or inhalation. It may also be harmful by skin absorption. It is an irritant of the skin, eyes and respiratory tract. It is narcotic in high concentrations. When heated to decomposition it emits toxic fumes of carbon monoxide and carbon dioxide. [no specific levels were given]

Standards & Recommendations:
OSHA: None
ACGIH: None
NIOSH: no criteria document
NFPA Hazard Rating: Health (H) 2; Materials hazardous to health, but areas may be entered freely with full-face mask self-contained breathing apparatus which provides eye protection.

Source: TNRCC
Short-term ESL: 14 ug/m^3 (5 ppb)
Long-term ESL: 1.4 ug/m^3 (0.5 ppb)

Source: Standard Report (TSCATS DATA)

Source listed several studies, one with an abstract:

1. The ability of isoprene to induce chromosomal aberrations in bone marrow and micronuclei in erythrocytes in bone marrow and in peripheral blood was evaluated in mice. Exposure: 438, 1750, 7000 ppm 6 hr/day for 12 exposures over 16 days. At all levels significant dose-related increases were seen in frequency of micronucleated polychromatic and normochromatic erythrocytes, but not of chromosomal aberrations.

Tice et al. (1988). Chloroprene and isoprene: cytogenetic studies in mice.

Groups of male mice exposed to isoprene (438, 1750, & 7000 ppm) for 12 days. Exposure induced significant increases at all concentrations in the frequency of sister chromatid exchanges (SCE) in bone marrow cells and in the levels of micronucleated polychromatic erythrocytes (PCE) and of micronucleated

		normochromatic erythrocytes in peripheral blood. A significant lengthening of the bone marrow average generation time and a significant decrease in the percentage of circulating PCE was detected. Exposure did not induce in bone marrow a significant increase in the frequency of chromosomal aberrations nor did the exposure significantly alter the mitotic index. **The dose-response curves for SCE and micronuclei induction were non-linear, appearing to saturate at 438 and 1750 ppm, respectively. These results suggest that inhaled isoprene can be expected to induce tumors at multiple sites in mice.** --- **Source: Mast et al. (1990). Inhalation developmental toxicity of isoprene in mice and rats.** (full-text on request). Developmental toxicity was assessed in sprague-dawley rats & Swiss mice. Exposure to isoprene vapors: 0, 280, 1400, or 7000 ppm for 6 H/day, 7 days/wk, 6-17 days of gestation for mice and 6-19 for rats. Findings: No significant effects upon body weights or reproductive indices at any exposure level in rats, nor was there a significant increase in the incidence of fetal malformations or variations. An exposure-correlated increase in the incidence of reduced vertebral ossifications (centra) in the 7000 ppm group suggests this level may be at or near a developmental toxicity threshold. Pregnant mice in the 7000 ppm group had a significant reduction in maternal body weight gain and uterine weight. Developmental toxicity was evident in mice as a reduction in fetal body weight which became statistically significant at 280 ppm for females and at 1400 ppm for males. There was a statistically significant increase in the incidence of supernumerary ribs in mice for the 7000 ppm group. Although there was **no** significant increase in the incidence of malformations, two fetuses with cleft palate were found, one in each of the two highest exposure groups. **The results indicate that 1400 ppm isoprene is a NOEL in the rat for both maternal and developmental toxicity. In mice, 1400 ppm is a maternal NOEL; however, a NOEL for developmental toxicity in the mouse cannot be assigned based on the results of this study.** --- **Author: Anonymous (1994). Isoprene ;IARC Monographs on the evaluation of the carcinogenic risk of chemicals to humans.** "Inadequate evidence in humans for the carcinogenicity of isoprene. There is sufficient evidence in experimental animals for the carcinogenicity of isoprene..Isoprene is possibly carcinogenic to humans." --- **Source: on-line National Toxicology Program (1995). Toxicity studies of isoprene. Administered by inhalation to**

		F344/N rats and B6C3F1 mice. Two week and 13-week inhalation studies. Exposures given & observations related to exposures. **NOAELs given:** **1. 70 ppm for nonresponsive, macrocytic anemia; decreased hindlimb grip strength; olfactory epithelial degeneration; decreases in: epididymal weights, spermatid head counts, sperm concentration, and sperm motility.** **2. 220 ppm for forestomach epithelial hyperplasia** **3. 700 ppm for increased estrous cycle length** **4. 2,200 ppm for testicular atrophy, sciatic nerve degeneration, and muscle atrophy.** **A NOAEL was not achieved for spinal cord degeneration (less than 70 ppm) or developmental toxicity (less than 280 ppm).** **Clear evidence of carcinogenity.** --- **Cox et al. (1996): Isoprene cancer risk and the time pattern of dose administration.** Inhalation study with mice exposed to up to 2,200 ppm isoprene for 4 to 8 hours per day for up to 80 weeks. Exposure to high concentrations of isoprene led to increased overall and site specific tumor risk. Among male mice, these sites included the lung, liver, forestomach, heart, and Harderian gland. The lowest observed effect levels were 70 and 140 ppm. The NOEL was 10 ppm. Lengthy exposure duration was not consistently associated with elevated tumor risks. Survival curves were not significantly altered by the doubling or quadrupling of exposure durations at low and high concentrations. However, at intermediate concentrations of isoprene, death rates were significantly affected by increasing the weeks of exposure. Although the cumulative dose remained the same, both tumor and mortality risks increased when the exposure duration was decreased with a proportional increase in the isoprene concentration. Tumor and mortality risks increased when exposure duration was reduced with a proportional increase in the daily exposure time. Thus, the cumulative dose was not considered a sufficient predictor of tumor risk. Tumor risk was not the product of the power of exposure concentration and other exposure factors. Tumor incidences at various sites were sometimes statistically related to each other. The authors concluded that isoprene risk assessment founded on equivalent dose metrics may offer misleading results; the development of more complex, biologically based models may be necessary to elucidate the dose time response relations of

		isoprene. --- **Placke et al. (1996). Chronic inhalation oncogenicity study of isoprene in B6C3F1 mice.** The effects of exposure duration and concentration on the oncogenicity of chronically inhaled isoprene in mice were examined. Dose were mentioned as well as observed effects; however, no NOELs were given. Male mice were exposed to up to 2200 ppm of nebulized isoprene for 4 or 8 hours per day, 5 days/week, for 20 to 80 weeks. Female mice were exposed to 0 to 70 ppm isoprene for 8 hours per day for 80 weeks. After 80 weeks of exposure, mice exposed to greater than 280 ppm had lower survival rates than mice exposed to less than 280 ppm. However, from the study, the authors concluded that despite clear, oncogenic threshold effect levels, tumor incidence is not adequately predicted by isoprene concentration, daily exposure duration, or exposure length. --- **Melnick et al. (1996). Inhalation toxicity and carcinogenicity of isoprene in rats and mice: Comparisons with 1,3-Butadiene.** No dose information given. Observations regarding findings such as cytogenetic effects, hematologic effects, etc. were given. Authors concluded that isoprene is a carcinogen in mice and a possible carcinogen in humans. --- **Source: on-line through National Toxicology Program: TR-486; Toxicology and Carcinogenesis Studies of Isoprene (CAS No. 78-79-5) in F344/N Rats (Inhalation Studies).** A two year study in which groups of 50 male & 50 female rats were exposed to 220, 700, or 7,000 ppm isoprene by inhalation, 6 hrs/day, 5 days/wk, for 104 weeks. Source describes pathologic findings. Authors conclude that there is **clear evidence of carcinogenic activity in males** (based on increased incidences of mammary gland neoplasms, renal tubule adenoma, and testicular adenoma); **some evidence of carcinogenic activity in females** (based on increased incidences and multiplicity of mammary gland fibroadenoma). --- **Source: TOMES** **HSDB** • **In human volunteers, the average odor perception occurred at 10 mg/m^3 and at 160 mg/m^3 they experienced slight irritation of the upper respiratory mucosa, larynx, and pharynx.**

		• **The agent is possibly carcinogenic to humans.** • At a concentration of 20000 ppm (2%) did not cause CNS depression in mice exposed for a 2 hr period. Deep CNS depression resulted from exposure to 35,000 to 40,000 ppm and death followed exposure to 50,000 ppm (5%). • In tests, isoprene was not found to be mutagenic • Inhalation exposure of rats & mice to 0, 438, 875, 1750, 3500, or 7000 ppm for 6 hr/day, 5 days/wk for 2 weeks had no effect on survival, body weight gain, clinical signs, hematological parameters or clinical chemical measurements and did not produce gross or microscopic lesions, however, male mice had reduced body weight gain, atrophy of the thymus and testis (7000 ppm only), olfactory epithelial degeneration (at 1750 or >), vacuolized liver cytoplasma and forestomach epithelial hyperplasia (at > or = to 438). The last effect was also seen in female mice. • Mice and rats were exposed to 0, 280, 1400, 7000 ppm for 6 hr/day, 7 days/week on days 6-17 (mice) or days 6-19 (rats) of gestation. **In mice, exposure to 7000 ppm reduced maternal weight gain, and exposure to any dose reduced fetal body weight.** An increase in the incidence of supernumerary ribs was observed at 7000 ppm, but there was no increase in fetal malformations. **In rats, there was no adverse effect on the dams or on any reproductive index at any dose level, and there was no increase in the incidence of either fetal malformations or variations, other than reduced ossification of the vertebral centra at 7000 ppm.** • Listed are various additional tests (e.g. toxicity, carcinogenic). No NOAELs. Please see original source. **Shepard's Catalog of Teratogenic Agents** Mice & rats were exposed to doses of up to 7,000 ppm 6 hr/day during organogenesis. At the highest dose maternal toxicity and fetal skeletal variations occurred. No significant teratogenic activity was found. **RTECS** Toxicity values: TCLo: rat, inhalation, 3400 mg/m^3/22W intermittent (changes in brain, lung, and kidney weights) TCLo: mouse, inhalation, 3400 mg/m^3/17W intermittent (changes in psychophysiological tests) TCLo: guinea pig, inhalation, 3400 mg/m^3/17W intermittent (alteration of classical conditioning; changes in leukocyte count) Standards & Regulations:

		OEL - Poland: TWA 100 mg/m^3 Jan 93 OEL- Russia: STEL 40 mg/m^3 Jan 93 Reviews: IARC Cancer Review: Animal sufficient evidence IARC Cancer Review: Group 2B; Human inadequate evidence **OHM/TADS** Narcotic in high concentrations. **2% can cause bronchial irritation in mice.** 5% in air is fatal to mice "Chronic threshold doses for rats: .25 mg/kg or 5 mg/L. Warm-blooded animals .5 mg/L - no effect; rabbit - 2.5 mg/kg daily for 2 months. Change in catalase activity; rat - .25 mg/kg daily. Change in conditioned reflexes." **ReproTox System** "Isoprene was not teratogenic in rats or mice at up to 7000 ppm by inhalation. In this study, high doses of isoprene did reduce fetal body weight and increase the incidence of supernumerary ribs in exposed mice, but such effects probably reflect generalized toxicity rather than effects specific for development." **LOLI® available** AIHA WEEL 50 ppm TWA; 139 mg/m^3 TWA
p-Isopropyltoluene	99-87-6	**Source: on-line Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: Testing on carcinogenicity, chronic toxicity, & neurotoxicity have not been done or the results are not publicly available. Safety & Risk Assessment: lacking some of the data required. **Source: TOMES** **RTECS** LD50: rat, oral 4750 mg/kg Skin-Standard Draize Test: rabbit, skin, 500 mg/24H; Moderate Standards & Regulations: OEL - Russia: STEL 10 mg/m^3; Skin OEL - Sweden: TWA 25 ppm (140 mg/m^3); STEL 35 ppm (190 mg/m^3) **HSDB** Vapor (gas) are nonirritating to eyes and throat.

		Non-Human Toxicity Excerpts: Dogs tolerated doses of 2 g daily with diarrhea as only adverse effect. SC injection of rabbits with 2 mL daily; observed initial slight fall followed by increase in white cells; red cells & hemoglobin showed irregular changes with tendency to fall. **OHM/TADS - Oil and Hazardous Materials/Technical Assistance Data System** Vapors are toxic; **dizziness, headache, nausea at 200 -500 ppm.** Moderate toxicant via all routes. Irritant. 5000 mg/kg lethal in air to rats. **LOLI® available;** data limited
Isovaleraldehyde	590-86-3	**Source: on-line Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: **Suspected: Neurotoxicant, Respiratory Toxicant, & Skin or Sense Organ Toxicant.** Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Information is not available on whether basic tests have been conducted. Safety & Risk Assessment: Lacking some of the required data. --- **Source: TNRCC** Short-term ESL: 1800 ug/m^3 (510 ppb) Long-term ESL: 180 ug/m^3 (51 ppb) --- **Source: TOMES** **RTECS** LDLo: rat, intraperitoneal, 800 mg/kg LDLo: mouse, subcutaneous, 2 gm/kg LC50: rat, inhalation, 42700 mg/m^3/4H (toxic effects: altered sleep time, including change in righting reflex; changes in structure or function of salivary glands) LD50: rat, oral 5600 mg/kg (general depressed activity) LC50: mouse, inhalation, 50770 mg/m^3 LD50: mouse, oral 4750 mg/kg LD50: rabbit, skin 3180 uL/kg LD50: guinea pig, oral 2950 mg/kg LD50: guinea pig, skin, > 8 gm/kg Standard draize test - eye: rabbit, 100 mg/24H; Moderate reaction Standards & Regulations: OEL-Russia: STEL 10 mg/m^3 Jan 93

		HSDB Human Toxicity Excerpts: An instance is reported in which chemists exposed to vapors developed some signs of chest discomfort, nausea, vomiting, and headaches. All recovered without after effects. (no other details given). Aldehydes studied (one of which was isovaleraldehyde). Mice exposed to test atmospheres of five concentrations of each aldehyde to construct a concentration response curve. Would have to get original work for the curve: [Steinhagen WH, Barrow CS; Toxicol and Appl Pharmacol 72 (3): 495-503 (1984)] **LOLI® available**; data limited
3-Methyl-1-Butene	563-45-1	**Source: on-line, Envirofacts; Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Information on whether basic tests have been conducted is not available. Safety & Risk Assessment: Lacking some of the national data. --- **Source: TNRCC** Source gave ESLs for "methyl butene, all isomers"; was uncertain if this would apply for our purposes, but I have included the data here. Short-term ESL: 715 ug/m^3 (250 ppb) Long-term ESL: 71.5 ug/m^3 (25 ppb) --- **Source: TOMES** **LOLI ® available**; data limited
Methylcyclopentane	96-37-7	**Source: on-line, Envirofacts; Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: Information on whether basic tests have been conducted is not available. Safety & Risk Assessment: Lacking at least some of required data. --- **Source: on-line National Toxicology Program; NTP Chemical Repository (August 1991)** Genetic Toxicology: Salmonella; negative Toxicity: **LCLo ihl, mus 95,000 mg/m^3**

		SAX Toxicity Evaluation: Mildly toxic by inhalation. Probably irritating and narcotic in high concentrations. Carcinogenicity: not available Mutation Data: not available Teratogenicity: not available Standards & Recommendations: OSHA: None ACGIH: None NIOSH: no criteria document NFPA Hazard Rating: Health (H) 2; Materials hazardous to health, but areas may be entered freely with full-faced mask self-contained breathing apparatus which provides eye protection. --- **Source: TNRCC** Short-term ESL: 2580 ug/m^3 (750 ppb) Long-term ESL: 258 ug/m^3 (75 ppb) --- **Source: TOMES** **CHRIS - Chemical Hazard Response Information System** Short-term inhalation limits: 300 ppm for 60 minutes. **RTECS** TDLo: rat, oral 10 gm/kg/4W intermittent (toxic effects, weight loss or decreased weight gain) **LOLI® available**
Methylcyclopentene	27476-50-2	Data unavailable at this time; still researching
2-Methylheptane	592-27-8	**Source: ANON (1993). 2-Methylheptane.** Short-term health effects: skin absorption, skin irritation.
3-Methylheptane	589-81-1	**Source: Serve, et al. (1993). The metabolism of 3-methylheptane in male 344 fischer rats.** Dose: 0.8 g/kg by gavage every other day for 2 weeks. Findings: 3Methylheptane is a moderate inducer of hyaline droplet neuropathy.
3-Methylhexane	589-34-4	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether tests have been conducted is lacking. Safety & Risk Assessment: Lacks data. ---

		Source: TOMES **LOLI® available; data very limited**
3-Methylpentane	96-14-0	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether tests have been conducted is lacking. Safety & Risk Assessment: Lacks data. --- **Source: TNRCC** Short-term ESL: 3500 ug/m^3 (1000 ppb) Long-term ESL: 350 ug/m^3 (100 ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists multiple studies, however, the majority of the studies (and all of the available abstracts) are of commercial hexane which is a mixture. --- **Source: SDU Uitgeverij Plantijnstraat et al. (1993). Health-based recommended occupational exposure limits for 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, 2,3-dimethylbutane (hexane isomers).** The Dutch Expert Committee on Occupational Standards reviewed the available published toxicity information. It was concluded that the data available did not enable the recommendation of a health-based OEL. It was stated that more toxicity studies (including subchronic & reproduction, inhalatory studies, mutagenicity studies, and studies on the irritation potential) needed to be carried out before an OEL could be set. (Note: This article also included neohexane (75- 83-2) and 2,3-Dimethylbutane. The same conclusions were drawn for these two substances also (i.e. that further studies were needed prior to being able to recommended any OELs. However, this article was dated 1993; OSHA & ACGIH now have recommended exposure levels for some). --- **Source: TOMES** **LOLI® available; data very limited** Under HEXANE ALL ISOMERS, with the exception of n-Hexane: German MAK 200 ppm; 720 mg/m^3
2-Methyl-1-Pentene	763-29-1	**Source: on-line, Envirofacts; Chemical Reference: Scorecard.** Human Health Hazard: **Suspected: Neurotoxicant, Respiratory Toxicant.**

		Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Information on whether basic tests have been conducted is not available. Safety & Risk Assessment: Lacking some of the required data. --- **Source: TOMES** **RTECS** typ dose / specie / route / amount / units LC50 / rat / inhl / 115 / $g/m^3/4H$ LC50 / mouse / inhl / 127 / $g/m^3/2H$ **LOLI® available**; very limited data
Neohexane	75-83-2	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard Hazard Ranking: More hazardous than most chemicals in 1 ranking system. Basic Testing: Information on whether tests have been conducted is lacking. Safety & Risk Assessment: Lacks data. --- **Source: National Toxicology Program. (on-line)** Genetic Toxicology: Salmonella - negative Toxicity: Not available SAX Toxicity evaluation: **Unknown toxicity**. It is probably an irritant and narcotic in high concentrations. Carcinogenicity: not available Mutation data: not available Teratogenicity: not available Standards, Regulations & Recommendations: OSHA: PEL-TWA 500 ppm; STEL 1000 ppm ACGIH: TLV-TWA 500 ppm; STEL 1000 ppm NIOSH Criteria Document: REL to this type of compound , air: TWA 100 ppm; Ceiling Limit 510 ppm/15M NFPA Hazard Rating: Health (H) 1; Materials only slightly hazardous to health --- **Source: TNRCC** Short-term ESL: 3500 ug/m^3 (1000 ppb) Long-term ESL: 350 ug/m^3 (100 ppb) --- **Source: SDU Uitgeverij Plantijnstraat et al. (1993). Health-**

		based recommended occupational exposure limits for 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, 2,3-dimethylbutane (hexane isomers). (Hard copy filed under 2,3-Dimethylbutane) The Dutch Expert Committee on Occupational Standards analyzed the available published toxicity information. It was concluded that the data available to date did not enable the recommendation of health-based occupational exposure limits. The committee stated that more toxicity studies (including subchronic, reproduction, inhalatory, mutagenicity, and studies on the irritation potential) should be carried out before OELs can be set. --- **Source: TOMES** **HSDB** Concentrations of 100,000 - 250,000 ppm sensitizes the myocardium in dogs to epinephrine-induced cardiac arrhythmias. **LOLI® available** Under Hexane all isomers with the exception of n-Hexane: German MAK 200 ppm; 720 mg/m^3
Neopentane	463-82-1	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Data lacking; not ranked by any system on Scorecard. Basic Testing: Information on whether tests have been conducted is unavailable. Safety & Risk Assessment: Lacks data. --- **Source: TOMES** **RTECS** LCLo: mouse, inhalation, 1097 gm/m^3/2H (excitement) LD50: mouse, intraperitoneal, 100 mg/kg Standards & Regulations: OEL - Denmark: TWA 500 ppm (1500 mg/m^3) **LOLI® available**
n-Nonane	111-84-2	**Source: on line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: **Suspected: Neurotoxicant** Hazard Ranking: More hazardous than most chemicals in 1 ranking system. Basic Testing: The following tests have either not been conducted or the information is not publicly

		available: Carcinogenicity; Chronic toxicity; Developmental or reproductive toxicity; Ecotoxicity; & Mutagenicity. Safety & Risk Assessment: Lacks sufficient data. --- **Source: on-line, National Toxicology Program** Genetic Toxicology: Salmonella- negative Toxicity: LC50 ihl, rat: 3200 ppm/4H LD50 ivn, mus: 218 mg/kg SAX Toxicity Evaluation: Poison by intravenous route. Mildly toxic by inhalation. Irritating to the respiratory tract. Narcotic in high concentrations. Carcinogenicity: not available Mutation Data: not available Teratogenicity: not available Standards & Recommendations: OSHA: PEL-TWA 200 ppm ACGIH: TLV-TWA 200 ppm NIOSH: no criteria document NFPA Hazard Rating: Health (H) 0; Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material Acute/Chronic Hazards: May be harmful by inhalation, ingestion or skin absorption. It is an irritant of the skin and eyes. It is narcotic in high concentrations. When heated to decomposition it emits acrid smoke, irritating fumes and toxic fumes of carbon monoxide, carbon dioxide and various hydrocarbons. --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 200 ppm (1050 mg/m$^{3)}$ STEL/C: --------- CNS, narcosis, dermatitis, lung --- **Source: TNRCC** Short-term ESL: 10500 ug/m^3 (2000 ppb) Long-term ESL: 1050 ug/m^3 (200 ppb) --- **Source: Standard Report (TSCATS DATA)** Source lists 3 studies, of which 1 abstract was available. 1. The uptake of inhaled nonane was screened in rats exposed to graded concentrations of either 1, 5, 20, 100, and 500 ppm or 1,

		10, 100, 1000, and 5000 ppm by nose-only exposure for 80 minutes at daily intervals. The percent of nonane absorbed was calculated to be 38.2% at a vapor concentration between 10 and 100 ppm. A plot of percent absorbed vs vapor concentration was obtained and the slope was not statistically different from zero. Thus it was shown that there was little effect of concentration on the fractional uptake. --- **Source: Kristianses & Nielson (1988). Activation of the sensory irritant receptor by C7-C11 n-Alkanes.** (original filed under n-Decane). The sensory irritation effects of vapors from n-alkanes were studied in mice. Mice were exposed to vapors at concentrations up to approximately 25000 ppm for up to 50 minutes. **The minimum threshold dose for inducing respiratory effects for n-Nonane was 125 ppm.** When compared to the Danish TLV of 200 ppm, it was determined that exposure to the TLV concentration might produce irritation. --- **Source: TOMES** **RTECS** TDLo - Rat, inhalation, 1600 ppm/6H/13W intermittent Standards & Regulations OEL - Denmark, Finland, France, Switzerland, The Netherlands: TWA 200 ppm (1050 mg/m^3) Only 1 STEL reported, Finland, at 250 ppm (1315 mg/m^3) **Hazardtext - Hazard Management & HSDB** • Rats inhaling nonane at an airborne concentration of 1500 ppm for 7 days had mild tremors, loss of coordination, and slight irritation of eyes and extremities. • For **rats** subjected to inhalation of 1600, 590, and 360 ppm for 6 hr/day, 5 days/wk for 13 wk, **a concentration of 590 ppm (3.1 mg/L) is the "NO-ILL-EFFECTS" Level.** • Liver damage and an altered response to drugs were seen in rats given nonane for 2 or 7 days. • Rats tolerated an airborne concentration of 880 ppm of nonane for 4 hours with no apparent ill effects. **LOLI® available**
1-Nonene	124-11-8	**Source: TNRCC** Short-term ESL: 26 ug/m^3 (----------ppb) Long-term ESL: 2.6 ug/m^3 (----------ppb) --- **Source: TOMES** LOLI® available; data very limited
4-Nonene	2198-23-4	Information unavailable at this time; still researching
n-Octane	111-65-9	**Source: on-line; Envirofacts, Chemical Reference:**

		Scorecard. Human Health Hazard: **Suspected: Neurotoxicant** Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: The following tests have either not been conducted or information is not publicly available: Carcinogenicity; Chronic toxicity; Developmental or reproductive toxicity. Safety & Risk Assessment: Lacks data. --- **Source: TNRCC** Short-term ESL: 3500 ug/m^3 (750 ppb) Long-term ESL: 350 ug/m^3 (75 ppb) --- **Source: Kristiansen & Nielson (1988). Activation of the sensory irritant receptor by C7-C11 n-Alkanes.** (original filed under n-Decane). The sensory irritation effects of vapors from n-Alkanes in mice was studied. Vapor concentrations up to approximately 25000 ppm for up to 50 minutes were used. **The minimum threshold dose for inducing respiratory effects for n-octane was 605 ppm**. When compared to the Danish TLV of 300 ppm, the authors concluded that no sensory irritation would be expected to occur at the TLV concentration. --- **Source: Glowa (1991). Behavioral Toxicology of Volatile Organic Solvents V. Comparisons of the Behavioral and Neuroendocrine Effects among n-Alkanes.** Adult male mice were exposed to n-Octane via an inhalation chamber, to determine the effect on task performance and stimulation of hypothalamic pituitary activity. Response behavior was noted to diminish at concentrations greater than 1000 ppm with almost complete nonresponse seen at 5600 ppm. At 10,000 ppm the mice participated in circular locomotive activity. --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 300 ppm (1400 mg/m^3) STEL/C: ------ Irritation, narcosis --- **Source: DHHS - Occupational Health Guideline for Octane** NIOSH has recommended that the PEL be reduced to 75 ppm (350 mg/m^3) averaged over a work shift of up to 10 hours/day, 40 hours/week, with a ceiling level of 385 ppm (1800 mg/m^3) Mice exposed to concentrations of 6600 to 13,700 ppm

		demonstrated signs of narcosis in 30 to 90 minutes. The narcotic concentration is approximately 8000 ppm while the fatal concentration for animals is near 13,500 ppm. No chronic systemic effects have been reported in humans. --- **Source: TOMES** **RTECS** typ dose / specie / route / amount / units LC50 / rat / IV / 428 / mg/kg LC50 / rat / inhl / 118 / g/m^3/4H Standards & Regulations: Lowest OEL: OEL - Sweden TWA 200 ppm (900 mg/m^3); STEL 300 ppm (1400 mg/m^3) Jan 93 Selected OELs from the list: OEL - Australia, Belgium, Finland, United Kingdom: TWA 300 ppm (1450 mg/m^3); STEL 375 ppm (1800 mg/m^3) OSHA GEN IND: TWA 500 ppm (2350 mg/m^3) Highest OELS: OEL - Germany, Hungary, Phillipines, & OSHA (Fed Cont & Gen Indu) 500 ppm **HSDB** Mice exposed at concentrations of 6600 to 13700 ppm demonstrated CNS depression in 30 -90 minutes and respiratory arrest at 16000 (1 of 4) to 32000 ppm (4 of 4) in 5 to 3 minutes, respectively. The CNS depressant concentration was 10000 ppm while a different study put the CNS depressant concentration at 8000 ppm and the fatal concentration at 13500 ppm. Some effects of acute exposure to octane vapors on schedule controlled responding in the mouse are described [Glowa JR, Natale ME; Toxicol Pet Hydrocarbons, Proc Symp, 1st: 354-8 (1983)]. All that was said in HSDB was: "cumulative concentration effect curves were determined by comparing responding before and during exposure; concentration were incrementally increased at 40 min intervals until responding completely ceased. Octane did not generally decrease responding until concentration of approx. 1000 ppm was obtained; responding progressively decreased with increasing concentration up to 7000 ppm . The EC50 for octane was 2844 ppm. **LOLI® available**
1-Octene	111-66-0	**Source: NIEHS: National Toxicology Program (on-line)** Genetic Toxicology: Salmonella- negative --- **Source: TNRCC**

		Source did not have a Cas No listed for this compound; solely found by "octene" Short-term ESL: 20 ug/m^3 (------ppb) Long-term ESL: 2 ug/m^3 (------ppb) --- **Source: ANON (1993). <u>1-Octene.</u>** <u>Short-term exposure effects</u>: neurotoxic effects; lowering of consciousness <u>Long-term exposure effects</u>: dermatitis; defats the skin. No levels / doses mentioned. --- **Source: Department of Environmental and Occupational Medicine, University of Aarhus, Denmark (1999). <u>Time course of sensory eye irritation in humans exposed to N-butanol and 1-octene.</u>** Eight subjects exposed to 1-octene. Exposure concentrations were: 0 mg/m^3; 6000 mg/m^3; 10400 g/m^3; and 18000 mg/m^3. **Threshold for irritation "clearly exceeded" for only the 1-octene 10400 and 18000 exposures.** --- **Source: TOMES** **CHRIS** If inhaled will cause dizziness **OHM/TADS** Acute hazard level details unknown. Low solubility suggests low hazard in water. May be moderately toxic when inhaled. **LOLI® available;** limited data
1-Pentene	109-67-1	**Source: on-line; Envirofacts, Chemical Reference: <u>Scorecard.</u>** <u>Human Health Hazard</u>: Not classified as a "recognized" or "suspect" human health hazard. <u>Hazard Ranking:</u> Data lacking; not ranked by any system in Scorecard. <u>Basic Testing:</u> The following tests have either not been conducted or the information is not publicly available: Acute toxicity; Carcinogenicity; Developmental or reproductive toxicity; Ecotoxicity; Mutagenicity; & Neurotoxicity. <u>Safety & Risk Assessment:</u> Data lacking. --- **Source: TNRCC** No Cas No in source; stated "pentene, all isomers" Short-term ESL: 90 ug/m^3 (30 ppb) Long-term ESL: 9 ug/m^3 (3 ppb) --- **Source: TOMES**

		OHM/TADS Narcotic in high concentrations. Moderately toxic via all routes. Emits toxic vapors when heated to decomposition. **LOLI® available;** data limited
c-2-Pentene	627-20-3	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Information on whether basic tests to identify chemical hazards have been conducted on this chemical is not available. Safety & Risk Assessment: Data lacking. --- **Source: TNRCC** Source just stated "pentene, all isomers;" no cas no. given. Perhaps this could be useful? Short-term ESL: 90 ug/m^3 (30 ppb) Long-term ESL: 9 ug/m^3 (3 ppb) --- **Source: TOMES** **LOLI® available**; data very limited
t-2-Pentene	646-04-8	**Source: on-line, Envirofacts; Chemical Reference - Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard at this time. Hazard Ranking: Data lacking; not ranked by any system in Scorecard. Basic Testing: Information on whether basic tests to identify chemical hazards have been conducted on this chemical is not available. Safety & Risk Assessment: Lacking data. --- **Source: TNRCC** No cas no given in source; stated "pentene, all isomers" Short-term ESL: 90 ug/m^3 (30 ppb) Long-term ESL: 9 ug/m^3 (3 ppb) --- **Source: TOMES** **RTECS** TDLo: rat, oral, 10 gm/kg/4W intermittent (toxic effects: changes in kidney weight) **LOLI® available;** data very limited
a-Pinene	80-56-8	**Source: on-line; Envirofacts, Chemical Reference:**

Scorecard.

Human Health Hazard:

Suspected: Neurotoxicant; Respiratory Toxicant; Skin or Sense Organ Toxicant.

Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems.

Basic Testing: The following tests have either not been conducted or the information is not publicly available: Chronic toxicity & Developmental or reproductive toxicity.

Safety & Risk Assessment: Data lacking.

Source: TNRCC

No Cas no. stated; found under "pinene, all isomers".

Short-term ESL: 64 ug/m^3 (11 ppb)

Long-term ESL: 6.4 ug/m^3 (1.1 ppb)

Source: NIEHS; National Toxicology Program

Toxicity:

typ dose	mode	specie	amount	unit
LD50	orl	rat	3700	mg/kg
LCLo	ihl	rat	625	ug/m^3
LCLo	ihl	mus	364	ug/m^3
LCLo	ihl	gpg	572	ug/m^3

SAX Toxicity Evaluation: Moderate irritant to skin, eyes and mucous membrane and via oral, inhalation and dermal routes.

Carcinogenicity: not available

Mutagenicity: not available

Teratogenicity: not available

Other Toxicity Data:

Skin irritation in man 500 mg SEV

Skin irritation, rabbit 500 mg/24 H MOD

Standards & Recommendations:

OSHA: None

ACGIH: None

NIOSH: no criteria document

NFPA Hazard Rating: None

Source: BIBRA working group (1992). Alpha-Pinene.

Health effects given. Reported that it is of low acute oral and dermal toxicity in the rat and rabbit, however they did not specify any doses or dose-response relationships.

Source: TOMES

HSD- Hazardous Substances Data Bank

		Human Toxicity Excerpts: Fatal dose about 180 g orally as turpentine which contains 58-65% Alpha-Pinene. Has essentially the same toxicity as turpentine. As little as 15 mL (0.5 oz) has proved fatal to a child, but a few children have survived 2 & even 3 oz. Mean lethal dose in adult probably lies between 4 & 6 oz. Toxicokinetics were studied in humans. Eight healthy males (avg. age 31 yrs) were exposed to 0, 10, 225, or 450 mg/m^3. Mean blood concentration at the end of the exposure were linearly related to the inhaled concentration. 5 subjects complained of eye, nose, and throat irritation. No exposure related changes in lung function were seen. At the concentrations tests, the capacity of the liver to metabolize a-pinene was not exceeded. **LOLI® available**; data limited
b-Pinene	127-91-3	**Source; on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: The following tests have either not been conducted or the information is not publicly available: Carcinogenicity; Chronic toxicity; Developmental or reproductive toxicity; Ecotoxicity; Mutagenicity; & Neurotoxicity. Safety & Risk Assessment: Data lacking. --- **Source: TNRCC** No Cas no given for this compound; found under "pinene, all isomers". Short-term ESL: 64 ug/m^3 (11 ppb) Long-term ESL: 6.4 ug/m^3 (1.1 ppb) --- **Source: TOMES** **HSDB** Inhalation may cause palpitation, dizziness, nervous disturbances, chest pain, bronchitis, & Nephritis. (doses not given) About 150 mL may constitute a human oral fatal dose. **Health Hazard Data** LD50: rat, oral, 4700 mg/kg Irritation; Skin-Standard Draize Test: rabbit, skin, 500 mg/24H; Moderate Reaction **LOLI ® available**; data very limited

Propane	74-98-6	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazard: **Suspected: Neurotoxicant** Hazard Ranking: Less hazardous than most chemicals in 1 ranking system. Basic Testing: The following tests have either not been conducted or the information is not publicly available: Carcinogenicity; Chronic toxicity; Ecotoxicity. Safety & Risk Assessment: data lacking --- **Source: ACGIH TLV/ BEI Booklet (1999)** TWA: 2500 ppm STEL/C: --------- Asphyxiation --- **Source: TNRCC** Short-term ESL: 18,000 ug/m^3 (10,000 ppb) Long-term ESL: 1,800 ug/m^3 (1000 ppb) --- **Source: TOMES** **RTECS** OEL- Australia, Belgium, Hungary, The Netherlands, & the United Kingdom: Asphyxiant OEL- Denmark, Germany, Switzerland, The Philippines, & OSHA: TWA 1000 ppm (1800 mg/m^3) OEL - Finland: TWA 800 ppm (1100 mg/m^3) **HSDB** Human Toxicity Excerpts: Eight adult volunteers were exposed to isobutane, propane, or mixtures of the two gases (250-1000 ppm for 1, 5, & 10 min, & 1, 2, & 8 hr/day for 1 day or 2 wk) in a controlled chamber. No untoward subjective responses were reported during or following these exposures. No abnormal physiological responses were observed in any volunteer. Acute exposures to 250, 500, or 1000 ppm for periods of 1 min to 8 hr did not produce any untoward physiological effects. Propane when used as an aerosol propellant with isobutane in deodorant and antiperspirant products has not been shown to cause skin irritation in 125 human volunteers who applied the aerosol products twice daily for 12 wk. Non-Human Toxicity Excerpts: Animal inhalation studies indicate a gas concentration of 89% to be below the anesthetic level but to depress the blood pressure of cats. Guinea pigs were exposed to 24000 - 29000 ppm and 47000

		- 55000 ppm for periods of 5, 30, 60, & 120 minutes. **At the lower concentration irregular breathing was observed and at the higher concentration tremors were evident during the first 5 min of exposure**. Stupor was commonly observed in the animals exposed for longer periods of time (up to 2 hr). All animals recovered from the exposure and there were no pathological signs of organ toxicity at necropsy. **A CNS depressant effect was not seen until exposure levels were about 50000 ppm.** [Other studies showed n-butane caused anesthesia in mice within 1 min at 22000 ppm and caused death in dogs at 20000 - 25000 ppm. Therefore, propane is much less toxic than n-butane.] In the primate, 10% induces some myocardial effects; at 20% aggravation of these parameters & respiratory depression. **Subchronic inhalation studies have been conducted in which monkeys were exposed to approx. 750 ppm propane for 90 consecutive days with no toxicity or abnormalities observed**. Similar inhalation studies conducted using monkeys except that the product tested was an aerosol spray deodorant containing a mixture of propane and isobutane in a concentration of 65% by wt. In these studies, all animals survived and showed no changes in behavior, body wt, hematology, blood chemistry, urinalysis, EKG, and pulmonary function. Gross microscopic exam revealed no evidence of organ toxicity. **Propane was not mutagenic using the Ames Salmonella t. system**. Inhalation represents the major route of systemic absorption. In human volunteers blood levels of propane could be detected after exposure to 250 - 1000 ppm. **Hazardtext - Hazard Management** **Very little physiological reaction is produced by exposure to propane concentrations less than 1000 ppm** Dizziness may occur after a few minutes of exposure to concentrations between 1 and 10 percent. **Exposure to 100,000 ppm (10%) for a few minutes causes slight dizziness but not irritant effects.** **No adverse effects were observed in volunteers breathing 10,000 ppm (1%) for 10 minutes, but vertigo occurred when the concentration was increased to 100,000 ppm (10%) for 2 minutes.** **Volunteers who breathed concentrations of 1000 ppm, 8 hrs/day , 5 days one week and 4 days the following week had no EEG abnormalities or changes in adrenocortical, cardiopulmonary, neurological, cognitive, or visual functions.** Dogs breathing 15 to 90 percent for 10 minutes had a decrease in the myocardial threshold to the arrhythmogenic effects of injected epinephrine. Decreased cardiac output was observed in dogs breathing

		10000 to 33000 ppm. Similar effects were shown in monkeys, who also developed respiratory depression at concentrations of 20000 ppm. **LOLI® available**
2-Propanol	67-63-0	**Source: on-line; Envirofacts, Chemical Reference: Scorecard** Human Health Hazard: **Suspected: Carcinogen, Cardiovascular or Blood Toxicant, Gastrointestinal or Liver Toxicant; Neurotoxicant; Respiratory Toxicant; Skin or Sense Organ Toxicant.** Hazard Ranking: More hazardous than most chemicals in 2 out of 10 ranking systems. Basic Tests: Eight of the basic tests to identify chemical hazards have been conducted and are publicly available for this chemical (acute toxicity, chronic toxicity, neurotoxicity, developmental or reproductive toxicity, mutagenicity, carcinogenicity, ecotoxicity, environmental fate). Safety Assessment: Lacks some of the national data required. **Scorecard has Risk Assessment Data:** **RfC 2000 ug/m^3** **RfD 1.4 mg/kg-day** --- **Source: TNRCC** Short-term ESL: 7856 ug/m^3 (3195 ppb) Long-term ESL: 785 ug/m^3 (320 ppb) --- **Source: Standard Report (TSCATS DATA)** Several studies listed; selected abstracts follow: 1. Acute inhalation toxicity evaluated. Rats exposed to concentrated vapors (99%) for 2, 4, or 8 hours. Mortality was observed in 2/6 rats exposed for 4 hours and in all 6 exposed for 6 hours. An LD50 value was not reported; clinical observations and necropsy evaluations were not reported. 2. Subchronic Toxicity. Rats exposed via inhalation to 0, 1000, 5000, 10000, and 15000 ppm for 9 days over a 12-day period [length of exposure not specified]. Incidence of mortality and clinical sign of toxicity during exposure were not reported. Hyaline droplet nephropathy was observed in animals in 4/5 and 5/5 males in the 1000 and 5000 ppm groups respectively. --- **Source: on-line; National Toxicology Program** Genetic Toxicology: Salmonella - negative Toxicity: Source contains 25 total of various TDLo,

LD50 & LCLo, some off which are the following:

typ. Dose	mode	specie	amount	units
TDLo	orl	hmn	223	mg/kg
LDLo	orl	man	5272	mg/kg
LDLo	unr	man	2770	mg/kg
LDLo	scu	mam	6	mg/kg
TDLo	orl	man	14432	mg/kg
LDLo	orl	hmn	3570	mg/kg
LCLo	ihl	rat	16000	ppm/4H
LCLo	ihl	mus	12800	ppm/3H
LD50	skn	rbt	12800	mg/kg

Sax Toxicity Evaluation: Poison by ingestion and subcutaneous routes. Moderately toxic to humans by an unspecified route. Moderately toxic experimentally by IV and intraperitoneal routes. Mildly toxic by skin contact. Human systemic effects by ingestion or inhalation. Experimental teratogenic and reproductive effects. Mutagenic data. An eye and skin irritant.

Carcinogenicity: Inadequate human and animal evidence; not classifiable as a human carcinogen.

Mutation & Teratogenicity data: Source reports "see RTECS printout for data". At this time still attempting to access RTECS.

Standards, Regulations & Recommendations:
OSHA: PEL-TWA 400 ppm; STEL 500 ppm
ACGIH: TLV-TWA 400 ppm; STEL 500 ppm
NIOSH Criteria Document: REL to this compound - air:
TWA 400 ppm/10 H
Ceiling limit 800 ppm/15M

NFPA Hazard Rating: Health (H) 1; Materials only slightly hazardous to health.

Other Toxicity Data:
Skin & eye irritation: eye-rbt 10 mg MOD
skn-rbt 500 mg MLD
eye-rbt 16 mg
eye-rbt 100 mg/24 H MOD

IDLH value: 20,000 ppm

Source: ACGIH TLV / BEI Booklet (1999)
TWA: 400 ppm
STEL/C: 500 ppm
Irritation
*(On list of Notice of Intended Changes for 1999. TWA: 200 ppm; STEL/C: 400 ppm; A 4 - not classifiable as a human carcinogen)

Source: DHHS - Occupational Health Guideline for Isopropyl Alcohol

The most important toxic effect is narcosis, which occurs in mice at vapor concentrations of 3000 ppm, the effects increasing with the duration of exposure. Exposure to higher concentrations results in ataxia followed by deep narcosis and death.

Human volunteers reported mild irritation of the eyes, nose, and throat after 3 to 5 minutes exposure to vapor at 400 ppm; at 800 ppm the results were not severe, but most subjects found the atmosphere to be objectionable.

No chronic systemic effects have been reported in humans.

Source: Ohashi et al. (1987). Acute effects of isopropyl alcohol exposure on the middle ear mucosa.

Guinea-pigs were exposed to 0, 400 ppm, or 5500 ppm isopropyl alcohol vapors for 24 hours. Specific details given regarding findings (e.g. ciliary activity, mucosa deterioration, cytoplasmic protuberances and vacuolation of epithelial cells and number of goblet cells). It was concluded that a level of 400 ppm causes no significant middle ear disorders, but recommends extensive regular otolaryngeal examinations to workers exposed to higher levels.

Source: Ohashi et al. (1988). Toxicity of isopropyl alcohol exposure on the nasal mucociliary system in the guinea pig.

Guinea-pigs were exposed to 0, 394, or 5440 ppm isopropanol vapor for 24 hours. They were examined for ciliary activity and ultrastructural changes. A synopsis of findings was given. It was concluded that exposure to 400 ppm damages nasal mucosa but recovery occurs within 2 weeks. Exposure to 5500 ppm causes damage that requires more than 2 weeks to recover.

Source: EPA/OTS; Doc #86-920000729. A single generation reproduction and embryotoxicity study with isopropyl alcohol in rats (final report) with attachments and cover letter dated

		013092. Isopropanol was orally administered in doses of 0, 0.5, 1.0, and 2.0% to male and female rats. Treatment length and findings presented (e.g. decreases in food and water intake and body weight; increases in kidney and liver weights; decreases in pup weight gain and survival). **The NOEL for reproductive effects from this study was 1.0%**. --- **Source: Anonymous. (1993). CEC. The toxicology of chemicals. 2. reproductive toxicity; 1 (EUR 14991).** States: Insufficient data to evaluate the effects on endocrine functions, gonadal effects and fertility in male and female animals. One study in the rat indicates no specific risk of inhalation exposure for the developing organism. No data on reproductive toxicity are available for humans. --- **Source: Bates et al. (1994). Developmental neurotoxicity evaluation of orally administered isopropanol in rats.** Pregnant rats were treated with 200, 700, or 1200 mg/kg isopropanol by daily gavage in bolus doses from gestation day six through postnatal day two. No exposure related clinical signs were observed in the dams or their offspring. No dose related effects were observed for: maternal or pup body weight gain; pup sex ratio; pup developmental landmarks; pup survival; motor activity; learning and memory performance; maternal organ weights; or the weights of four regions of the brain in the pups. --- **Source: Bevan et al. (1995). Two-generation reproduction toxicity study with isopropanol in rats.** Rats (P1) were orally dosed once daily with 0, 100, 500, or 1000 mg isopropanol kg-1 for at least 10 weeks prior to mating. Parental animals were mated within groups for up to 3 weeks. Parental females were dosed during mating, gestation and lactation; parental males were dosed during mating through delivery of their last litter sired. The P2 adults were selected from the litter and were dosed for 10-13 weeks before mating to produce a single litter. [The latter dosage was not specified] **The NOEL for reproductive effects in this study, based on the reduced male mating index of the high-dose P2 males, is 500 mg kg-1day-1.** --- **Source: Gill et al. (1995). Isopropanol: Acute vapor**

		inhalation neurotoxicity study in rats. Males & Female rats were exposed for 6 hours to isopropanol vapor at 0, 500, 1500, 5000, or 10000 ppm. Behavioral observations were made. Exposure caused a spectrum of transient effects, among which were: narcosis at 10000 ppm; sedation at 5000 ppm; and minor decreases in motor activity in males at 1500 ppm. **The NOEL for neuro effects was 500 ppm.** --- **Source: Kapp et al. (1996). Isopropanol: Summary of TSCA test rule studies and relevance to hazard identification.** In general, the data showed that IPA has a low order of acute and chronic toxicity; dose not produce adverse effects on reproduction; is neither a teratogen, a selective developmental toxicant, nor a developmental neurotoxicant; and is not genotoxic or an animal carcinogen. However, it is a potential hazard for transient CNS depression at high exposure levels. It produced effects to several rodent toxicity endpoints at high dose levels (i.e. motor activity, male mating index, and exacerbated renal disease) which are of unclear relevance to human health. The data confirm that in mammalian biological systems, isopropanol produces a significant narcotic effect upon exposure at high levels for extended periods of time, with no irreversible effects even after repeated exposure. **Overall, these studies demonstrate that exposure is a low potential hazard to human health.** --- **Source: Burleigh-Flayer et al. (1997). Isopropanol vapor inhalation oncogenicity study in Fischer 344 rats and CD-1 mice.** The carcinogenic potential of isopropanol vapor was studied. Exposure concentrations & dosage: 500, 2500, 5000 ppm vapor for 6 hours/day, 5 days/wk for up to 78 and 104 wk. Findings discussed included deaths, organ weights, renal tubular proteinosis & dilation, and lesions associated with chronic kidney disease. Mentioned was the transient manifestation of narcosis at 2500 or 5000 ppm observed in all animals. The only neoplastic lesion showing an increased incidence was Leydig cell adenomas; this was not considered to be treatment related because of its occurrence in control rats. **It was concluded that chronic renal disease was the major cause of death of male rats exposed to 5000 ppm. The NOEL for isopropanol toxicity in both rats and mice is estimated to be 500 ppm; the NOEL for carcinogenicity is greater than 5000 ppm.** --- **Source: Burleigh-Flayer et al. (1994). Isopropanol 13-Week inhalation study in rats and mice with neurotoxicity**

		evaluation in rats. Study to evaluate the possible subchronic toxicity as well as neurobehavioral effects. Exposure of rats & mice to concentrations of 0, 100, 500, 1500, or 5000 ppm for 6 hr/day, 5 days/wk for 13 weeks. Narcotic effects were noted only during exposures at 1500 and 5000 ppm; signs were typically noted during exposures only (were absent following exposures). The only clinical signs observed included swollen periocular tissue, perinasal encrustation, and ataxia for rats of the 5000 ppm group. Increased motor activity for female rats in the 5000 ppm groups was noted at weeks 9 and 13. Decreases in body weight and body weight gain were observed for rats of the 5000 ppm group at the end of the first week of exposure. During the remaining weeks, increases in body weight and/or body weight gain were observed for rats of the 1500 and 5000 ppm group. No exposure related effects on body weight were noted for male mice; however, increased body weight and body weight gain were noted for female mice of the 5000 ppm group. The only organ weight effect noted was an increased relative liver weight in both sexes of rats and female mice of the 5000 ppm group. No gross lesions determined to be exposure related at necropsy. The only microscopic change observed was hyaline droplets within the kidneys of all male rats (including controls). The size and frequency of the hyaline droplets were increased for the exposure groups compared to the control group. These differences were not clearly concentration related, although this microscopic change was most pronounced in the high-concentration group. Sum: toxic effects produced only at the highest concentration and a kidney change in male rats of unknown biological significance. --- **Source: TOMES** Workers exposed for 8 hours to airborne concentrations of 470 - 493 mg/m^3 had blood isopropanol concentrations below the limits of detection (0.001 g/dL) & blood acetone concentrations of 0.004 to 0.016 g/dL **RTECS** Lists Acute Toxicity information (e.g. many TDLo, LDLo, etc.) some of which may be found above under the National Toxicology Program. Also lists 19 OELs, the highlights of which are: The lowest: OEL - Turkey: TWA 200 ppm (500 mg/m^3) Jan 1993 OEL - Denmark: TWA 200 ppm (490 mg/m^3); Skin Jan 1993 OEL - Sweden: TWA 150 ppm (350 mg/m^3); STEL 250 ppm (600 $mg/m^{3)}$ Jan 1993

Others:

OEL - Australia, Belgium, and the United Kingdom all have a TWA of 400 ppm and a STEL 500 ppm Jan 1993

OEL - France, Germany, Japan, Russia, Netherlands, Philippines, and US have a TWA of 400 ppm and no STEL specified.

Reprotext System

Ingestion of as little as 100 mL may cause death.

Irritation and mild CNS depression are caused by inhalation exposure at airborne concentrations up to 800 ppm

- **The No Effect Level with inhalation exposure has been reported to be 200 ppm /8 hours.**
- As little as 0.5 mg/kg may cause symptoms, but adults have survived oral doses as high as 1 liter.
- **Inhalation exposure to airborne concentrations up to 400 ppm has caused mild eye, nose, and throat irritation, while inhalation of 800 ppm produced more intense signs and symptoms (these were not specified)**
- In **rats exposed by inhalation**, acute neurotoxicity was noted at 1 and 6 hours at 5000 ppm , but only minimal effects were seen at 1500 ppm and the animals recovered within 5 hours. **No toxicity was noted at 500 ppm.**
- Daily ingestion of doses as high as 6.4 mg/kg for 6 weeks produced no apparent ill effects in human volunteers.
- It is not regarded as a human carcinogen
- It has not been genotoxic in a variety of short-term tests
- A Russian study in 1978 in which rats were given 0.18 mg/kg/day orally for 6 months reported decreased fertility; the offspring of pregnant rats given 0.018 to 1008 mg/kg had embryotoxicity and birth defects. The no-effect level in the latter study was 0.015 mg/kg.
- It is reported by Kapp et al, 1996) that isopropanol was neither a reproductive toxin nor a teratogen in extensive animal testing.
- A two-generation study in rats and neurodevelopmental toxicity studies in rats and rabbits exposed to as much as 1200 mg/kg/day found no adverse effects.

HSDB

Lists human toxicity excerpts, some of which are repeats of those mentioned previously.

- Probably lethal oral dose for adult is 8 oz (240 mL), but as little as 20 mL in water can produce symptoms.
- 400 ppm is considered to be low enough not to cause CNS depression, although slight irritation may occur.

		Several non-human toxicity excerpts were presented, the most noteworthy one for our purposes appeared to be the following: Rats exposed continuously for 86 days to air concentration of 8.14 ppm (20 mg/m^3) showed changes in reflex behavior and increased retention of bromosulfophthalein. Post mortem findings include enlarged spleen, some evidence of liver parenchymal cell dystrophy & degenerative changes in cerebral motor cortex. **ReproTox System** Recent teratologic evaluation in rats indicate that this compound only produced adverse developmental effects at inhalation exposures that were maternally toxic. The congenital abnormalities observed were limited to skeletal malformations. Two-generation rat studies only showed 1000 mg/kg/d treatments to have adverse effects on successful matings in first generation males. There was also an increase in postnatal mortality in this generation. No adverse effects were reported at the next lower dose, 500 mg/kg/d. A rat and rabbit developmental toxicity study showed no teratogenic effects at doses that were clearly maternally toxic. In a separate rat study, no evidence of developmental neurotoxicity was associated with gestational exposures to isopropanol as high as 1200 mg/kg/d. **Shepard's Catalog of Teratogenic Agents** Rats exposed for 7 hours daily on day 1-19 to 10000, 7000, or 3500 ppm. **At 3500 ppm no adverse fetal effects were found** while at the higher doses malformations, resorptions, and fetal deaths were increased. Skeletal defects were the main defects. **LOLI® available**
Propionaldehyde	123-38-6	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazards: **Suspected: Gastrointestinal or Liver Toxicant Neurotoxicant** Hazard Ranking: More hazardous than most chemicals in 1 out of 6 ranking systems. Basic Testing: Lacking tests on carcinogenicity & chronic toxicity (either not done or the results are not publicly available). Safety & Risk Assessment: Data lacking for national assessment; no data on risk assessment in Scorecard. --- **Source: TNRCC** Short-term ESL: 21 ug/m^3 (-------ppb)

Long-term ESL: 2.1 ug/m^3 (-----ppb)

Source: Standard Report (TSCATS DATA)

Four reports listed; abstracts unavailable.

Source: on-line; National Toxicology Program.

Genetic Toxicology:

In vitro cytogenetics: positive chromosome aberrations
positive sister chromatid exchanges

Salmonella - negative

Toxicity:

Typ. Dose	mode	specie	amount	units
LDLo	orl	mus	800	mg/kg
LCLo	ihl	rat	8000	ppm/4H
LD50	scu	rat	820	mg/kg
LD50	orl	rat	1410	mg/kg
LD50	scu	mus	680	mg/kg
LD50	skn	rbt	5040	mg/kg
LC50	ihl	mus	21800	mg/m^3/2H
LC50	ihl	mam	21800	mg/m^3

SAX Toxicity: Moderately toxic by skin contact, ingestion and subcutaneous routes. Mildly toxic by inhalation. A skin and severe eye irritant.

Carcinogenicity: not available

Mutation Data: test: msc-ham:lng
lowest dose: 10 mmol/L

Teratogenicity: not available

Standards, Regulations & Recommendations:

OSHA: None

ACGIH: None

NIOSH: no criteria document

NFPA Hazard Rating: Health (H) 2; Materials hazardous to health, but areas may be entered freely with full-faced mask self-contained breathing apparatus which provides eye protection.

Other Toxicity Data:

Skin & Eye Irritation Data:

skn-rbt 500 mg open MLD
eye-rbt 41 mg SEV
eye-rbt 20 mg/24H MOD

Source: on-line; United Air Toxics Website

Hazard Summary:

- Limited information is available on the health effects.
- No information is available on the acute effects in humans.
- Animal studies have reported that exposure to high levels of propionaldehyde, via inhalation, results in anesthesia and

		liver damage, and intraperitoneal exposure results in increased blood pressure. Acute animal tests such as the LC50 and LD50, in rats and mice, have shown it to have moderate acute toxicity from inhalation, oral, and dermal exposures. • No information is available on the chronic effects in animals or humans. • The RfD has not been established. • **The RfC is under review by EPA.** • No information is available on the reproductive/developmental or carcinogenic effects in animals or humans. EPA has not classified propionaldehyde for carcinogenicity. --- **Source: Anonymous (1997). <u>Propionaldehyde.</u> (From Beratergremium fuer umweltrelevante Altstoffe (BUA).** • Values for acute oral toxicity (LD50) lie between 800 and 3300 mg/kg for the rat. • Dermal LD50 for the rabbit lies between 2500 and 4047 mg/kg. • Inhalation LC50 for the mouse is 21800 mg propionaldehyde/m^3 air after a 2-hour exposure. • Inhalation LC50 for the rat is between >4671 and <19363 mg propionaldehyde/m^3 air after a 4-hour exposure. • Depression of the CNS and respiratory tract irritations are mainly observed after acute exposure. • Undiluted it can by highly irritating to the skin and mucosa depending on the exposure period. Animal studies according to OECD guidelines led to results that characterizes it not to be irritating to skin and eyes. • No indications of a sensitizing effect in humans. Experimental sensitization tests on animals were not conducted. • Subchronic inhalation exposure of rats (6 hours/day, 7 days/week for 7 weeks) resulted in an irritation-related damage of the nasal mucosa. This effect was already observed at an exposure to 365 mg/m^3 (151 ppm) for male and female rats. • Systemic effects are not pronounced. (source did not elaborate). • Results of mutagenicity tests vary. • Studies on chronic toxicity or on carcinogenicity are unavailable. • **The NOEC (no observed effect concentration) for reproductive-toxic effects via inhalation was 3683 mg/m^3 (1522 ppm) or above after a 6-hour exposure per day. [Source did state "or above"]**

		• **The NOEC for systemic toxicity was 365 mg/m^3 (151 ppm) for male and female rats.** --- **Source: Driscoll et al. (1992). <u>The OECD screening information data set (SIDS); prioritizing high production volume chemicals for further testing</u>.** (full text on request through ILL) SIDS evaluation conducted on propionaldehyde. Inhalation exposure to concentrations of 0, 500, 1000, 1500, and 2500 ppm for 6 hr/day on days 0-20 of gestation. In the 2500 ppm group there was a statistically significant reduction in fetal body weight. --- **Source: TOMES** **RTECS** gives various toxicity values (e.g. LD50, LCLo, some of which were given above in NTP). **Shepard's Catalog of Teratogenic Agents** Slott and Hales (1985) injected 10, 100, or 1000 ug directly into the day 13 rat amnion and found a dose dependent increase in embryolethality but no significant increase in defects. **HSDB** Acute toxicity of aldehydes in mice, guinea pigs, & rabbits have been studied. All animals exposed to high levels by inhalation developed fatal pulmonary edema. Source did not give doses. (cited original work: Clayton & Clayton (eds.). Patty's Industrial Hygiene and Toxicology) 5-20 mg/kg intraperitoneal in rats increased blood pressure in a dose-related manner. Doses > 20 mg/kg resulted in hypotension and severe bradycardia. (doses/responses not given in source). **Rats tolerated inhalation of 90 ppm for 20 days, 6 hr/day with no obvious pathology, although 1300 ppm for 6 days produced hepatic damage.** Propionaldehyde affected the CNS of animals, chloinesterase of the peripheral blood, and reduced the number of erythrocytes & hemoglobin of blood. **The lowest nonacting exposure level was 0.5 mg/m^3.** The concentration of 3 umol/plate was not mutagenic in the Ames test; not found to be mutagenic using the Salmonella/microsome preincubation assay. The findings from a study of DNA damage in Chinese hamster ovary cells supports the hypothesis of a carcinogenic effect. LC50: rat, inhalation, 26000 ppm/30 min **LOLI® available**
n-Propylbenzene	103-65-1	**Source: on-line; Envirofacts, Chemical Reference: <u>Scorecard.</u>**

		Human Health Hazard: **Suspected: Neurotoxicant** Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems. Basic Testing: Information is not available on whether basic tests to identify chemical hazards has been done. Safety & Risk Assessment: Data lacking. --- **Source: BIBRA working group (1988). n-Propylbenzene.** Article has been requested through ILL Abstract: Acute inhalation or ingestion of n-propylbenzene caused CNS effects in rodents. It was of low acute oral toxicity in rats. No evidence of mutagenicity was seen in Ames bacterial test. --- **Source: TOMES** **HSDB** In 6 month subchronic oral study, rabbits fed 0, 2.5 & 25 mg/kg/day. Hemosiderin was deposited in spleens of high-dose animals indicating red-cell destruction. Individual animals exhibited mild protein dystrophy of liver and kidneys. Of 10 rats orally administered 5.0 mg/kg, 2 died. Inhalation study in mice: a loss of righting response was exhibited at 10 to 15 mg/L (2000-3000 ppm); loss of reflexes at 15 mg/L (3000 ppm); & death at 20 mg/L (4100 ppm). LD50: rat, oral 6040 mg/kg **RTECS** LCLo: mouse, inhalation, 20 gm/m^3 (general anesthetic, respiratory depression, changes in cardiac) LC50: rat, inhalation, 65000 ppm/2H LD50: rat, oral 6040 mg/kg (general depressed activity) **LOLI® available**
Propylene	115-07-1	**Source: on-line; Envirofacts, Chemical Reference: Scorecard.** Human Health Hazards: **Suspected: Respiratory Toxicant** Hazard Ranking: More hazardous than most chemicals in 1 out of 8 ranking systems. Basic Testing: Basic tests on developmental or reproductive toxicity, ecotoxicity, and neurotoxicity have either not been conducted or are not publicly available. Safety & Risk Assessment: Lacks at least some of the data. --- **Source: TNRCC** Short-term ESL: 117,000 ug/m^3 (68120 ppb)

		Long-term ESL: ---------- ----------
		Source: on-line, National Toxicology Program. Toxicity testing results: Not available SAX Toxicity Evaluation: A simple asphyxiant. No irritant effects from high concentrations in gaseous form. Carcinogenicity: Inhalation carcinogenesis studies: no evidence in male and female rat; male and female mouse. **IARC: Not classifiable as a human carcinogen.** Teratogenicity: Not available. Standards, Regulations, & Recommendations: OSHA: None ACGIH: None NIOSH: no criteria document. NFPA Hazard Rating: Health (H) 1
		Source: ACGIH TLV / BEI Booklet (1999) TWA: ----[(c)] STEL/C: ----- **A 4 - not classifiable as a human carcinogen** Asphyxiation
		Source: Standard Report (TSCATS DATA) Reports listed; selected abstracts follow: 1 & 2. Oncogenicty evaluated in rats exposed to 0, 200, 1000, or 5000 ppm for 7 hrs/day, 5 days/wk for 2 years. Also in mice with the same exposure but only for 18 months. Propene did not show any carcinogenic effects in the rats or mice. 3. Uptake of inhaled propene screened in rats exposed to graded concentrations of either 1, 5, 20, 100, and 500 ppm or 1, 10, 100, 1000 and 5000 ppm by nose-only exposure for 80 minutes at daily intervals. The percent of propene absorbed was calculated to be 8.7% at a vapor concentration between 10 and 100 ppm.
		Source: Nordic Expert Group (1995). 117. Propene. (CAS NO 115-07-1) **Classified as an asphyxiant. Human data are scarce.** Inhalation of Propylene on a long-term basis gave rise to no-neoplastic toxic changes in the nasal cavity of rats; in mice, the incidence of chronic focal renal inflammation was increased. In female mice, uterine endometrial stromal polyps increased and, to a lesser extent, hemangiosarcoma as well as hemangiosarcoma and hemangioma combined. Authors state that **as the metabolite (propylene oxide) is carcinogenic to experimental animals, it is**

		not possible at the present time to rule out propylene as a human carcinogen. --- **Source: TOMES** **RTECS** LC: rat, inhalation, > 86 gm/m^3/4H TCLo: rat, inhalation, 5000 ppm/6H/2Y intermittent TCLo: mouse, inhalation, 1250 ppm 6H/14W intermittent Standards & Regulations: OEL - Australia, Belgium, Hungary, The Netherlands, & the United Kingdom: Asphyxiant OEL - Russia: STEL 100 mg/m^3 OEL - Switzerland: TWA 10000 ppm(17500 mg/m^3) **HSDB** Gross inhalation may cause reduced blood pressure & heart arrhythmia. **Humans: At a concentration of 6.4% for 2.25 min, mild intoxication, paresthesias, & inability to concentrate were noted. However, memory was not impaired. At 12.8% in 1 min. the same symptoms were markedly accentuated & at 24 & 33%, unconsciousness followed in 3 minutes. Human exposure to 23% for 3 to 4 min did not produce unconsciousness. Two subjects exposed to 35 & 40% vomited during or after the experiment, & one complained of severe vertigo. Exposure to 40, 50, & 75% (400,000, 500,000, or 750,000 ppm) for a few minutes caused initial reddening of eyelids, flushing of face, lacrimation, coughing, and sometimes flexing of legs. No variation in respiratory or pulse rates or EKGs were noted. A concentration of 50% prompted anesthesia in 2 min. followed by complete recovery without any physiological indications.** Non-Human Toxicity Excerpts: **Dose of 200, 1000, and 5000 ppm were administered to rats & mice for 7 hr/day, 5 days/wk, for 24 months for the rats and 18 months for the mice. No carcinogenic effects were revealed.** **No toxic signs observed when anesthesia was induced in cats with 20 to 31% propylene.** Some subtle effects from 40 to 50% (not elaborated on), at 70% blood pressure decrease & rapid pulse. From 50 to 80% an unusual ventricular ectopic beat occurred. **A concentration of 40% produced light anesthesia in rats with no toxic symptoms within 6 hr.** & an exposure to 55% for 3 to 6 min, 65% for 2 to 5 min, & 70 % for 1 to 3 min resulted in deep anesthesia with no CNS signs or symptoms. Found to be a cardiac sensitizer in the dog.

		Chronic exposure of mice to minimal concentration [not specified] caused moderate to very slight fatty degeneration of the liver. **Propylene is not mutagenic when tested in E. coli**, but conversely, protects against mutation. **Chronic toxicity studies. Rats and mice exposed to either 5000 or 10000 ppm for 6 hr/day, 5 days/wk, for 103 weeks. In exposed rats, increased incidences of non-neoplastic lesions were observed in the nasal cavity; epithelial hyperplasia in female rats exposed to the high concentrations and squamous metaplasia in female rats exposed to both concentrations and in male rats exposed to the low concentration**. In addition, inflammatory changes characterized by an influx of lymphocytes, macrophages, and granulocytes into the submucosa and granulocytes into the lumen occurred in male rats of both exposure groups. **LOLI® available**
Tolualdehyde	529-20-4	**Source: on-line; National Toxicology Program - NTP Chemical Repository.** Genetic Toxicology: Salmonella - negative Toxicity Data: Not available SAX Toxicity Evaluation: Not available Carcinogenicity: Not available Mutation Data: Not available Teratogenicity: Not available Standards, Regulations, & Recommendations: OSHA: None ACGIH: None NIOSH: No criteria document. NFPA Hazard Rating: None --- **Source: BIBRA working group (1990). Tolualdehydes.** (Article was requested through ILL. Abstract: Tolualdehyde was a skin irritant in rabbits. No evidence of skin sensitization was found in volunteers treated with dilute solutions but sensitization reactions were apparently induced in guinea-pigs. In rats, the acute oral and dermal toxicity were low and pituitary gland weight was reduced following repeated oral administration. There was no evidence of mutagenicity in Ames bacterial tests. --- **Source: TOMES** **LOLI® available; but data extremely limited**
2,2,5-Trimethylhexane	3522-94-9	**Source: TOMES (Data very limited)** **Reprotox** No references located on reproductive or lactation effects. **RTECS**

		TDLo: rat, oral, 10 gm/kg/4W intermittent (toxic effects: changes in tubules, including acute renal failure and acute tubular necrosis; weight loss or decreased weight gain). **LOLI® available;** data limited
n-Undecane	1120-21-4	**Source: on-line; Envirofacts, Chemical Reference - Scorecard.** Human Health Hazard: Not classified as a "recognized" or "suspect" human health hazard. Hazard Rating: More hazardous than most chemicals in 1 ranking system. Basic Testing: Testing on Carcinogenicity, Chronic Toxicity, Developmental or Reproductive Toxicity, Ecotoxicity, Mutagenicity, & Neurotoxicity have either not been conducted or are not publicly available. Safety & Risk Assessment: Data lacking. --- **Source: on-line, National Toxicology Program; NTP Chemical Repository.** Toxicity: Not available SAX Toxicity Evaluation: Not available Carcinogenicity: Not available Mutagenicity: Not available Teratogenicity: Not available Standards, Regulations, & Recommendations: OSHA: None ACGIH: None NIOSH: no criteria document NFPA Hazard Rating: Health (H) ; None --- **Source: Nordic expert group (1987). n-decane and n-undecane.** (Hard copy filed under n-decane). Stated that it was impossible to recommend any threshold limits based on the existing knowledge, and pointed out the need for further research. --- **Source: TOMES** **RTECS** LD50: mouse, intravenous, 517 mg/kg **LOLI ® available;** data somewhat limited
1-Undecene	821-95-4	**Source: on-line, Envirofacts; Chemical Reference - Scorecard.** Human Health Hazard: Not classified as recognized or suspect Hazard Ranking: More hazardous than most chemicals in 3 out of 3 ranking systems.

		Basic Testing: Information on whether basic tests to identify chemical hazards have been conducted is not available. Safety & Risk Assessment: Lacking data. --- **Source: TOMES** **LOLI® available**; data extremely limited
Valeraldehyde	110-62-3	**Source: on-line, Envirofacts; Chemical Reference - Scorecard.** Human Health Hazard: Not classified as recognized or suspect Hazard Ranking: Less hazardous than most chemicals in 3 ranking systems. Basic Testing: Testing on Carcinogenicity, Chronic toxicity, Developmental or reproductive toxicity, & Neurotoxicity have either not been conducted or the information is not publicly available. Safety & Risk Assessment: Lacking data. --- **Source: TNRCC** Short-term ESL: 98 ug/m^3 (28 ppb) Long-term ESL: 9.8 ug/m^3 (2.8 ppb) --- **Source: Standard Report (TSCATS DATA)** Two reports listed; abstracts unavailable. --- **Source: on-line, National Toxicological Program; NTP Chemical Repository.** Genetic Toxicology: Salmonella - negative Toxicity Data: typ. Dose / mode / specie / amount / units LD50 / orl / rat / 3200 / mg/kg LCLo / ihl / rat / 4000 / ppm/4H LD50 / orl / mus / 6400 / mg/kg LD50 / skn / rbt / 4857 / mg/kg LD50 / skn / gpg / 20 / gm/kg SAX Toxicity Evaluation: THR = MODERATE via oral route. LOW via dermal route. A mild irritant. Carcinogenicity: Not available Mutation Data: Not available Teratogenicity: Not available. Standards, Regulations, & Recommendations: OSHA: PEL-TWA 50 ppm ACGIH: TLV-TWA 50 ppm NIOSH: no criteria document NFPA Hazard Rating: Health (H) 1; Materials only slightly

		hazardous to health Other Toxicity Data: Skin & Eye Irritation Data: skn-rbt. 500 mg/24H MOD eye-rbt 100 mg/24H SEV skn-gpg 100% SEV --- **Source: ACGIH TLV / BEI Booklet (1999)** TWA: 50 ppm (176 mg/m^3) STEL/C: ----- Irritation --- **Source: TOMES** **RTECS** Lists Acute toxicity data (e.g. LD50) Mutation: Hamster, lung cell, dose 10 mmol/L (no other information given with the exception of the source) Standards & Regulations: OEL- Australia, Belgium, Denmark, France, Switzerland, and The Netherlands all have a TWA of 50 ppm OEL - Finland: TWA 50 ppm (175 mg/m^3); STEL 75 ppm (265 mg/m^3) **NIOSH Pocket guide** Testing has not been completed to determine carcinogenicity. However, the limited studies to date indicate that this substance has chemical reactivity & mutagenicity similar to acetaldehyde. **LOLI® available**

Table 1 contains sufficient information to calculate an Estimated Permissible Concentration (EPC) for 22 compounds and the Effects Screening Level (ESL) is given for 39 compounds. RfCs were available for cyclohexane, hydrofluoric acid, and 2-propanol; the RfC for propionaldehyde is under review by the USEPA. A total of 22 compounds have insufficient information at this time to derive any type reference value. The basis for calculating EPCs and the source of ESLs are described in Table 2. Table 2 contains calculations of reference values made using the Estimated Permissible Concentration (EPC) method described by Williams et al (1994). EPCs have been calculated using the PEL, TLV, and the lowest reported OEL. A description of the Effects Screening Level (ESL) used by the Texas Natural Resource Conservation Commission (TNRCC) is also provided in Table 2.

Derived from occupational exposure limits, an Estimated Permissible Concentration (EPC) is defined as "the concentration of a chemical, which under continuous exposure conditions, is expected to be devoid of all acute and chronic toxicities." This methodology stems from an approach originally outlined by Cleland and Kingsbury (1977). It is proposed, based on a comparative analysis of EPCs and USEPA reference values for 103 chemicals, that EPC values represent a reasonably conservative surrogate value when USEPA or state reference values are unavailable and enable a more complete quantification of human health risks. Currently, 39 states use an EPC-like methodology to derive permissible air emission limits in their air toxics programs.

Basic Equation: $$EPC = \frac{OEL}{4.2 \times 100}$$

Effects Screening Levels (ESLs) are currently used by the Texas Natural Resource Conservation Commission (TNRCC) Toxicology and Risk Assessment Staff to evaluate the potential for adverse health effects to occur as a result of exposure to concentrations of constituents in the air. They are based on data concerning health effects, odor nuisance potential, effects with respect to vegetation, or corrosion effects. If measured airborne levels of a constituent do not exceed the screening level, no adverse health or welfare effects would be expected to occur. If the airborne constituents exceed these levels, a more in-depth review is indicated (TNRCC, 1997).

Table 2. Estimated Permissible Concentration (EPC) Values with Available Effects Screening Levels (ESLs) and RfDs & RfCs.

Analyte	EPC Values, ESLs, and RfDs/RfCs	Reference
n-Butane (106-97-8)	PEL & TLV of 800 ppm (1900 mg/m^3) USA: EPC_{ppm} = 1.9 ppm (1900 ppb) $EPC_{mg/m3}$ = 4.5 mg/m^3 (4500 µg/m^3) Lowest OEL, Hungary: 300 mg/m^3 $EPC_{mg/m3}$ = .71 mg/m^3 (710 µg/m^3) Long term ESL 1900 µg/m^3 (800 ppb) [1.9 mg/m^3 (.8 ppm)]	NTP, 1999 RTECS, 1999 TNRCC, 1997
Butyraldehyde (123-72-8)	Long term ESL 1.4 ug/m^3 (0.5 ppb) [.0014 mg/m^3 (0.0005 ppm)]	TNRCC, 1997
Cyclohexane (110-82-7)	Scorecard RfC 3.9 mg/m^3 [3900 µg/m^3] PEL & TLV of 300 ppm USA: EPC_{ppm} = 0.71 ppm (710 ppb) Using Lowest OELs: Poland, 80 mg/m^3 : EPC = 0.19 mg/m^3 (190 µg/m^3) Russia & Japan, 150 ppm (520 mg/m^3): EPC_{ppm} = 0.36 ppm (360 ppb) $EPC_{mg/m3}$ = 1.24 mg/m^3 (1240 µg/m^3) Long term ESL 143.5 ug/m^3 (41.5 ppb)	EDF, 1999 NTP, 1999 ACGIH, 1999 OPPT, 1999 RTECS, 1999 TNRCC, 1997

	[0.1435 mg/m^3 (0.0415 ppm)	
Cyclohexene (110-83-8)	PEL & TLV 300 ppm (10515 mg/m^3) USA: EPC_{ppm}= 0.71 ppm (710 ppb) $EPC_{mg/m3}$ = 2.42 mg/m^3 (2420 µg/m^3) Long term ESL 60 µg/m^3 (18 ppb) [0.06 mg/m^3 (0.018 ppm]	ACGIH, 1999 RTECS, 1999 TNRCC, 1997
Cyclopentane (287-92-3)	PEL & TLV 600 ppm USA: EPC_{ppm} = 1.43 ppm (1430 ppb) Lowest OEL, Denmark @ 300 ppm (850 mg/m^3): EPC_{ppm} = 0.71 ppm (710 ppb) $EPC_{mg/m3}$ = 2.02 mg/m^3 (2020 µg/m^3) Long term ESL 340 ug/m^3 (119 ppb) [0.34 mg/m^3 (0.119 ppm)]	ACGIH, 1999 RTECS, 1999 RTECS, 1999 TNRCC, 1997
Cyclopentene (142-29-0)	Long term ESL: 815 ug/m^3 (293 ppb) [0.815 mg/m^3 (0.293 ppm)]	 TNRCC, 1997
n-Decane (124-18-5)	Long term ESL: 1000 ug/m^3 [1.0 mg/m^3]	 TNRCC, 1997
2,3-Dimethylbutane (79-29-8)	PEL & TLV 500 ppm USA: EPC_{ppm} = 1.19 ppm (1190 ppb) German MAK 200 ppm (720 mg/m^3): EPC_{ppm} = 0.48 ppm (480 ppb) $EPC_{mg/m3}$ = 1.71 mg/m^3 (1710 µg/m^3) NIOSH REL of 100 ppm:	NTP, 1999 LOLI, 1999 NTP, 1999

	EPC_{ppm} = 0.24 ppm (240 ppb)	
Ethanol (64-17-5)	PEL & TLV of 1000 ppm (1880 mg/ m^3) USA: EPC_{ppm} = 2.38 ppm (2380 ppb) $EPC_{mg/m3}$ = 4.48 mg/m^3 (4480 µg/m^3) Long term ESL : 1,880 ug/m^3 (1000 ppb) [3] [1.88 mg/m^3 (1 ppm)]	NTP, 1999 ACGIH, 1999 TNRCC, 1997
Freon 114 (76-14-2)	TLV/TWA: 1000 ppm (6990 mg/m^3): EPC_{ppm} = 2.38 ppm (2380 ppb) $EPC_{mg/m3}$ = 16.6 mg/m^3 (16,600 µg/m^3) Long term ESL: 6,990 ug/m^3 (1000 ppb) [6.99 mg/m^3 (1 ppm)]	ACGIH, 1999 TNRCC, 1997
Heptanal (111-71-7)	Long term ESL: 24 ug/m^3 (5 ppb) [0.024 mg/m^3 (0.005 ppm)]	
1-Heptene (592-76-7)	Long term ESL: 1.6 ug/m^3 [0.0016 mg/m^3]	TNRCC, 1997
1-Hexene (592-41-6)	USA TLV/TWA 30 ppm: EPC_{ppm} = 0.07 ppm (70 ppb) Long term ESL: 7 ug/m^3 (2 ppb) [0.007 mg/m^3 (.002 ppm)]	ACGIH, 1999 TNRCC, 1997
Hydrofluoric Acid (7664-39-3)	Scorecard RfC : 30 ug/m^3 [0.03 mg/m^3]	EDF, 1999

Hydrofluoric Acid (cont'd)	USA PEL 3 ppm: EPC_{ppm} = .007 ppm (7 ppb)	RTECS, 1999
	Lowest OEL, Hungary & Poland @ 0.5 mg/m^3 : EPC = 0.001 mg/m^3 (1 $\mu g/m^3$)	RTECS, 1999
	RfC and RfD are presently under review by the EPA.	OPPT, 1999
	NIOSH recommends PEL be changed to 2.5 mg/m^3: EPC = 0.006 mg/m^3 (6 $\mu g/m^3$)	LOLI, 1999
	Long term ESL : 0.5 $\mu g/m^3$ (0.35 ppb) [0.0005 mg/m^3 (.00035 ppm)]	TNRCC, 1997
Indene (95-13-6)	PEL & TLV 10 ppm (45 mg/m^3): EPC_{ppm} = .024 ppm (24 ppb) $EPC_{mg/m3}$ = 0.11 mg/m^3 (110 $\mu g/m^3$)	ACGIH, 1999 RTECS, 1999
	Long term ESL: 7.1 ug/m^3 (1.5 ppb) [0.0071 mg/m^3 (0.0015 ppm)]	TNRCC, 1997
Isobutane (75-28-5)	NIOSH REL 800 ppm (1900 mg/m^3): EPC_{ppm} = 1.9 ppm (1900 ppb) $EPC_{mg/m3}$ = 4.5 mg/m^3 (4500 $\mu g/m^3$)	NIOSH, 1999
	Lowest OEL UK 600 ppm (1430 mg/m^3): EPC_{ppm} = 1.43 ppm (1430 ppb) $EPC_{mg/m3}$ = 3.4 mg/m^3 (3400 $\mu g/m^3$)	RTECS, 1999
	Long term ESL: 484.5 ug/m^3 (----ppb)	TNRCC, 1997

	[0.4845 mg/m^3]	
Isobutene (115-11-7)	Long term ESL: 140 ug/m^3 [0.14 mg/m^3]	TNRCC, 1997
Isobutylbenzene (538-93-2)	Long term ESL for all isomers of butyl benzene: 274 ug/m^3 (50 ppb) [0.274 mg/m^3 (0.05 ppm)	TNRCC, 1997
Isodrin (465-73-6)	Long term ESL: 0.32 ug/m^3 [0.00032 mg/m^3]	TNRCC, 1997
Isoheptane (591-76-4)	Long term ESL: 307 ug/m^3 (75 ppb) [0.307 mg/m^3 (0.075 ppm)]	TNRCC, 1997
Isohexane (107-83-5)	Long term ESL: 29 ug/m^3 [0.029 mg/m^3]	TNRCC, 1997
Isopentane (78-78-4)	PEL & TLV 600 ppm: EPC_{ppm} = 1.43 ppm (1430 ppb) Lowest OEL, Denmark @ 500 ppm (1500 mg/m^3): EPC_{ppm} = 1.19 ppm (1190 ppb) $EPC_{mg/m3}$ = 3.57 mg/m^3 (3570 µg/m^3)	NTP, 1999 RTECS, 1999
Isoprene (78-79-5)	Long term ESL: 1.4 ug/m^3 (0.5 ppb) [0.0014 mg/m^3 (0.0005 ppm)] OEL, Poland @ 100 mg/m^3 : $EPC_{mg/m3}$ = 0.24 mg/m^3 (240 µg/m^3)	TNRCC, 1997 RTECS, 1999
p-Isopropyltoluene (99-87-6)	OEL Sweden, 25 ppm (140 mg/m^3): EPC_{ppm} = 0.06 ppm (60 ppb) $EPC_{mg/m3}$ = 0.33 mg/m^3 (330 µg/m^3)	RTECS, 1999
Isovalderaldehyde (590-86-3)	Long term ESL:	

	180 ug/m^3 (51 ppb) [0.18 mg/m^3 (0.051 ppm)]	TNRCC, 1997
3-Methyl-1-Butene (563-45-1)	Long term ESL: 71.5 ug/m^3 (25 ppb) [0.0715 mg/m^3 (0.025 ppm)]	TNRCC, 1997
Methylcyclopentane (96-37-7)	Long term ESL: 258 ug/m^3 (75 ppb) [0.258 mg/m^3 (0.075 ppm)]	TNRCC, 1997
3-Methylpentane (96-14-0)	Long term ESL: 350 ug/m^3 (100 ppb) [0.35 mg/m^3 (0.1 ppm)]	TNRCC, 1997
Neohexane (75-83-2)	PEL & TLV USA 500 ppm: EPC_{ppm} = 1.19 ppm (1190 ppb) Long term ESL: 350 ug/m^3 (100 ppb) [0.35 mg/m^3 (0.1 ppm)] German MAK for Hexane **all isomers** (with the exception of n-Hexane) is 200 ppm (720 mg/m^3): EPC_{ppm} = 0.48 ppm (480 ppb) $EPC_{mg/m3}$ = 1.71 mg/m^3 (1710 µg/m^3)	NTP, 1999 TNRCC, 1997 LOLI, 1999
Neopentane (463-82-1)	OEL Denmark 500 ppm (1500 mg/m^3): EPC_{ppm} = 1.19 ppm (1190 ppb) $EPC_{mg/m3}$ = 3.57 mg/m^3 (3570 µg/m^3)	RTECS, 1999
n-Nonane (111-84-2)	PEL & TLV 200 ppm USA : EPC_{ppm} = 0.48 ppm (480 ppb) Long term ESL: 1050 ug/m^3 (200 ppb) [1.05 mg/m^3 (0.2 ppm)]	NTP, 1999 TNRCC, 1997
1-Nonene (124-11-8)	Long term ESL:	

	2.6 ug/m^3 [0.0026 mg/m^3)	TNRCC, 1997
n-Octane (111-65-9)	Long term ESL: 350 ug/m^3 (75 ppb) [0.35 mg/m3 (0.075 ppm)]	TNRCC, 1997
n-Octane (cont'd)	TWA 300 ppm (1400 mg/m^3): EPC_{ppm} = 0.71 ppm (710 ppb) $EPC_{mg/m3}$ = 3.33 mg/m^3 (3330 µg/m^3)	ACGIH, 1999
	Lowest OEL, Sweden 200 ppm (900 mg/m^3): EPC_{ppm} = 0.48 ppm (480 ppb) $EPC_{mg/m3}$ = 2.14 mg/m^3 (2140 µg/m^3)	RTECS, 1999
	OSHA GEN IND TWA 500 ppm (2350 mg/m^3): EPC_{ppm} = 1.19 ppm (1190 ppb) $EPC_{mg/m3}$ = 5.6 mg/m^3 (5600 µg/m^3)	RTECS, 1999
1-Octene (111-66-0)	Long term ESL: 2 ug/m^3 (---ppb) [0.002 mg/m^3]	TNRCC, 1997
1-Pentene (109-67-1)	Long term ESL: 9 ug/m^3 (3 ppb) [0.009 mg/m^3 (0.003 ppm)]	TNRCC, 1997
c-2-Pentene (627-20-3)	Long term ESL for "pentene all isomers" (source did **not** give this specific Cas No: 9 ug/m^3 (3 ppb) [0.009 mg/m^3 (0.003 ppm)]	TNRCC, 1997
t-2-Pentene (646-04-8)	Long term ESL for "pentene all isomers" (source did **not** give this specific Cas No: 9 ug/m^3 (3 ppb) [0.009 mg/m^3 (0.003 ppm)]	TNRCC, 1997

a-Pinene (80-56-8)	Long term ESL for "pinene, all isomers" (source did **not** give this specific Cas No: 6.4 ug/m^3 (1.1 ppb) [3] [0.0064 mg/m^3 (0.0011 ppm)]	TNRCC, 1997
b-Pinene (127-91-3)	Long term ESL for "pinene, all isomers" (source did **not** give this specific Cas No: 6.4 µg/m^3 (1.1 ppb) ; [0.0064 mg/m^3 (0.0011 ppm)]	TNRCC, 1997
Propane (74-98-6)	USA TWA 2500 ppm EPC_{ppm} = 5.95 ppm (5950 ppb) Lowest OEL, Finland @ 800 ppm (1100 mg/m^3): EPC_{ppm} = 1.9 ppm (1900 ppb) $EPC_{mg/m3}$ = 2.62 mg/m^3 (2620 µg/m^3) Long term ESL: 1800 ug/m^3 (1000 ppb) [1.8 mg/m^3 (1 ppm)]	ACGIH, 1999 RTECS, 1999 TNRCC, 1997
2-Propanol (67-63-0)	Scorecard RfC: 2000 ug/m^3 [2 mg/m^3] Scorecard RfD: 1.4 mg/kg-day [1400 µg/kg-day] Long term ESL: 785 ug/m^3 (320 ppb) [0.785 mg/m^3 (0.320 ppm)] PEL & TLV 400 ppm: EPC_{ppm} = 0.95 ppm (950 ppb) Lowest OEL, Sweden 150 ppm (350 mg/m^3) : EPC_{ppm} = 0.36 ppm (360 ppb) $EPC_{mg/m3}$ = 0.83 mg/m^3 (830 µg/m^3)	EDF, 1999 TNRCC, 1997 NTP, 1999 ACGIH, 1999 RTECS, 1999
Propionaldehyde (123-38-6)	Long term ESL: 2.1 ug/m^3	TNRCC, 1997

	[0.0021 mg/m^3] RfC is under review by the EPA.	 UAT, 1999
Propylene (115-07-1)	<u>OEL Switzerland, 10,000 ppm (17,500 mg/m^3):</u> EPC_{ppm} = 23.8 ppm (23,800 ppb) $EPC_{mg/m3}$ = 41.7 mg/m^3 (41,700 $\mu g/m^3$)	RTECS, 1999
Valeraldehyde (110-62-3)	<u>Long term ESL:</u> 9.8 ug/m^3 (2.8 ppb) [0.0098 mg/m^3 (0.0028 ppm)] <u>PEL & TLV USA 50 ppm (176 mg/m^3):</u> EPC_{ppm} = 0.12 ppm (120 ppb) $EPC_{mg/m3}$ = 0.42 mg/m^3 (420 $\mu g/m^3$)	 TNRCC, 1997 NTP, 1999 ACGIH, 1999

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NOTES

(*) All URLS listed above accessed through Scorecard/ Environmental Defense Fund (EDF), (1999). New York. Available online at http://www.scorecard.org.

(**) All health effect references for each analyte are listed adjacent to the chemical, with numbers corresponding to the appropriate number in the bibliography.

(***) All health effects (acute, chronic, etc.) are assumed to be human unless otherwise noted.

(****) CAS numbers for each analyte were retrieved from the Grateful Med and Scorecard Internet sites. Available online: http://www.scorecard.org.

(*) Indicates the 66 analytes for which there were no reference doses or other information given as part of the original air sampling data from which this list was made.

(#) The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics AHot Spots@Program (AB2588). Chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans were calculated as total TCDD equivalents in the AB2588 risk assessments. As a result of these equivalent calculations, exposure effects from dibenzofurans will be assumed to be the same as exposure effects from dibenzodioxins. In many of the dioxin and furan compounds listed, no specific health effect information could be located on the individual isomers. Therefore, references 11 and 12 were applied to all the dioxin and furans listed, with additional information provided as other references (particularly 5 and 7) allowed.

APPENDIX 1

Table 1-1
Oral Toxicity Values

Constituent	Oral RfD[a]					Oral Slope Factor[a]		
	mg/kg-day	Endpoint/Target Organ System	Uncertainty Factor	Source[b]	Weight of Evidence	Basis for Carcinogenicity	kg-day/mg	Source[b]
Inorganics								
Chloride	--	--	--	--	--	--	--	--
Aluminum	--	--	--	--	--	--	--	--
Arsenic (inorganic)	0.00030	Hyperpigmentation, keratosis and possible vascular complications.	3	IRIS	A	Based on sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, ...	1.5	IRIS
Barium	0.070	Increased blood pressure	3	IRIS	D	Oral exposure studies in rats and mice did not find significant increases in tumor incidence following chronic exposure. Inhalation exposure and intratrachael studies are inadequate for carcinogenicity evaluation.	--	--
Chromium (III)	1.0	No effects observed	100	IRIS	--	--	--	--
Chromium (VI)	0.0050	No effects reported	500	IRIS	A	Results of occupational epidemiologic studies of chromium-exposed workers are consistent across investigators and study populations. Dose-response relationships have been established for chromium exposure and lung cancer. Chromium-exposed workers .	--	--
Fluoride	--	--	--	--	--	--	--	--
Lead (and compounds) (inorganic)	--	--	--	--	B2	Sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in .	--	--
Manganese (food)	0.14	Central nervous system effects	1	IRIS	D	Existing studies are inadequate to assess the carcinogenicity of manganese.	--	--
Mercury (inorganic)	--	--	--	--	D	No human data are available. Animal and supporting data are inadequate.	--	--
Sulfate	--	--	--	--	--	--	--	--
Thallium[c]	0.00008	Increased levels of SGOT and LDH	3000	IRIS	D	Lack of carcinogenicity data in animals and	--	--

Table 1-1
Oral Toxicity Values

Constituent	Oral RfD[a]					Oral Slope Factor[a]		
	mg/kg-day	Endpoint/Target Organ System	Uncertainty Factor	Source[b]	Weight of Evidence	Basis for Carcinogenicity	kg-day/mg	Source[b]
						humans.		
Vanadium	0.0070	NOAEL	100	HEAST	--	--	--	--
Pesticides/PCBs								
Aroclor 1254	0.000020	Ocular exudate, inflamed and prominent Meibomian glands, distorted growth of finger and toe nails; decreased antibody (IgG and IgM) response to sheep erythrocytes.	300	IRIS	B2	Used slope factor for Polychlorinated biphenyls as a surrogate slope factor for Aroclor 1254.	2.0	IRIS
Chlordane, alpha (as Chlordane)	0.000060	Regional liver hypertrophy in females	1000	IRIS	B2	Sufficient evidence in studies in which benign and malignant liver tumors were induced in four strains of mice of both sexes and in F344 male rats; structurally related to other liver carcinogens.	1.3	IRIS
Chlordane, gamma (as Chlordane)	0.000060	Regional liver hypertrophy in females	1000	IRIS	B2	Sufficient evidence in studies in which benign and malignant liver tumors were induced in four strains of mice of both sexes and in F344 male rats; structurally related to other liver carcinogens.	1.3	IRIS
DDE (p,p'-Dichlorodiphenyldichloroethylene)	--	--	--	--	B2	Increased incidence of liver tumors including carcinomas in two strains of mice and in hamsters and of thyroid tumors in female rats by diet.	0.34	IRIS
DDT (p,p'-Dichorodiphenyltrichloroethane)	0.00050	Liver lesions	100	IRIS	B2	Observations of tumors (generally of the liver) in seven studies in various mouse strains and three in rats. DDT is structurally similar to other probable carcinogens, such as DDD and DDE.	0.34	IRIS
Heptachlor	0.00050	Liver weight increase in males	300	IRIS	B2	Inadequate human data, but sufficient evidence exists from studies in which benign and malignant liver tumors were induced in three strains of mice of both sexes. Several structurally related compounds are liver carcinogens.	4.5	IRIS
Semi-Volatile Organics								
Acenaphthylene	--	--	--	--	D	No human data and inadequate data from animal bioassays.	--	--
Benzo(a)anthracene	--	--	--	--	B2	No human data from animal bioassays. B(a)A	--	--

Table 1-1
Oral Toxicity Values

Constituent	Oral RfD[a]					Oral Slope Factor[a]		
	mg/kg-day	Endpoint/Target Organ System	Uncertainty Factor	Source[b]	Weight of Evidence	Basis for Carcinogenicity	kg-day/mg	Source[b]
						produced tumors in mice exposed by gavage, i.p., subcutaneous, or intramuscular injection & topical application. B(a)A produced mutations in bacteria and mammalian cells, & transformed mammalian cells . .		
Benzo(a)pyrene	--	--	--	--	B2	Human data specifically linking BAP to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating BAP to be carcinogenic following administration by numerous routes. BAP has produced positive . . .	7.3	IRIS
Benzo(b)fluoranthene	--	--	--	--	B2	No human and sufficient data from aniaml bioassays. B(b)F produced tumors in mice after lung implantation, i.p. or subcutaneous injection and skin painting.	--	--
Benzo(g,h,i)perylene	--	--	--	--	D	No human data and inadequate data from lung implant, skin-painting and subcutaneous injection bioassays.	--	--
Bis(2-ethylhexyl)Phthalate (DEHP)	0.020	Increased relative liver weight	1000	IRIS	B2	Orally administered DEHP produced significant dose-related increases in liver tumor repsponses in rats and mice of both sexes.	0.014	IRIS
Carcinogenic PAHs TEQs[d]	--	--	--	--	B2	Human data specifically linking BAP to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating BAP to be carcinogenic following administration by numerous routes. BAP has produced positive . . .	7.3	IRIS
Dibenz(a,h)anthracene	--	--	--	--	B2	No human data & sufficient data from animal bioassays. Produced carcinomas in mice following oral or dermal exposure & injection site tumors in several species folowing subcutaneous or intramuscular administration. Has induced DNA damage . . .	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	B2	No human data and sufficient data from animal bioassays. Produced tumors in mice following lung implants, subcutaneous injection and dermal exposure. Tested	--	--

Table 1-1
Oral Toxicity Values

Constituent	Oral RfD[a]					Oral Slope Factor[a]		
	mg/kg-day	Endpoint/Target Organ System	Uncertainty Factor	Source[b]	Weight of Evidence	Basis for Carcinogenicity	kg-day/mg	Source[b]
						positive in bacterial gene mutation assays.		
Phenanthrene	--	--	--	--	D	No human data and inadequate data from a single gavage study in rats and skin painting and injection studies in mice.	--	--
Dioxins/Furans								
Total Tetrachlorodibenzo-p-dioxin, 2,3,7,8, (TCDD Equivalents)	--	--	--	--	B2		150,000	HEAST

-- No Toxicity Information was available on IRIS (4th Quarter), 1998 or HEAST 1997.

[a]Oral RfDs and Oral Slope Factors were used (unadjusted for gastrointestinal absorption) as surrogate dermal toxicity values.

[b]IRIS, 1998 (4th Quarter) (U.S. Environmental Protection Agency. 1998. Integrated Risk Information System. Online Database) or HEAST 1997 (U.S. Environmental Protection Agency. 1997. Health Effects Assessment Summary Tables (HEAST): FY 1997 Update. EPA/540-R-97-036. PB97-921199. July. OSWER, Washington, D.C.).

[c]Oral RfD is a surrogate value based on Thallium carbonate, thallium chloride, and thallium sulfate.

[d]The following polycyclic aromatic hydrocarbons are considered carcinogenic: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoroanthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.

APPENDIX 2

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	**mg/kg-day**	**Endpoint**	**Uncertainty Factor**	**Source[a]**	**Weight of Evidence**	**Basis**	**kg-day/mg**	**Source**
Acid Gasses								
Sulfuric Acid	--	--	--	--	--	--	--	--
Aldehydes/Ketones								
Acrolein	0.0000057	Squamous metaplasia and neurtorphilic infiltration of nasal epithelium	1,000	IRIS	C	Increased incidence of adrenal cortical adenomas to female rats and carcinogenic potential of an acrolein metabolite. Acrolein is mutagenic in bacteria and is structurally similar to probable or known human carcinogens.	--	--
Crotonaldehyde	--	--	--	--	C	No human data & increased incidence of hepatocellular carcinomas & hepatic nodules (combined) in F344 rats. The possible carcinogenicity of crotonaldeyde is supported by genotoxic activity & the expected reactivity of croton oil & aldehyde. . . .	--	--
Formaldehyde	--	--	--	--	B1	Limited evidence in humans, and sufficient evidence in animals. Human data include nine studies that show statistically significant association between site-specific respiratory neoplasms and exposure to formaldehyde or formaldehyde- . . .	0.046	IRIS
Dioxins/Furans								
Total Dioxin/Furans (2,3,7,8-TCDD TEQs)	--	--	--	--	B2	--	150,000	HEAST
GC/MS								
1,1,2,2-Tetrachloroethane	--	--	--	--	C	Increased incidence of hepatocellualr carcinomas in mice.	0.20	IRIS
1,1,2-Trichloroethane	--	--	--	--	C	Hepatocellular carcinomas and pheochromocytomas in one strain of mice. Carcinogenicity was not shown in rats. 1,1,2-Trichloroethane is structurally related 1,2-dichloroethane, a probable human carcinogen.	0.056	IRIS
1,1-Dichloroethylene	--	--	--	--	C	Tumors observed in one mouse strain after inhalation exposure. Other studies were of inadequate design. Vinylidene chloride is mutagenic, and a metabolite is known to	0.18	IRIS

Table 1-2 Inhalation Toxicity Values

Constituent	Inhalation RfD				Inhalation Slope Factor			
	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
						alkylate and to bind covalently to DNA. It is structurally related to the known		
1,2,3-Trimethylbenzene	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--
1,2-Dibromoethane	0.000057	Sperm - Effects	1,000	HEAST	B2	Increased incidence of a variety of tumors in rats and mice in both sexes by three routes of administration at both sites of application and at distant sites. EDB is mutagenic in various in vitro and in vivo assays. EDB is structurally similar to	0.77	IRIS
1,2-Dichloropropane	0.0011	--	--	IRIS	B2	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--
1,3-Butadiene	--	--	--	--	B2	Inadequate human data and sufficient rodent (mouse and rat) studies in which exposure to airborne concentrations of 1,3-butadiene caused multiple tumors and tumor types. Related compounds are carcinogenic and mutagenic	0.98	IRIS
1-Butanol	--	--	--	--	D	No human and no animal cancer data.	--	--
1-Propanol	--	--	--	--	--	--	--	--
2,2,3-Trimethylpentane	--	--	--	--	--	--	--	--
2,2,4-Trimethylpentane	--	--	--	--	--	--	--	--
2,3,4-Trimethylpentane	--	--	--	--	--	--	--	--
Acetaldehyde	0.0026	Degeneration of olfactory epithelium	1,000	IRIS	B2	Increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.	0.0077	IRIS
Acetone	--	--	--	--	D	Lack of data concerning carcinogenicity in humans or animals.	--	--
Acetonitrile	0.014	Liver - Increased relative weight	3,000	HEAST2 (Table 2), 1997	--	--	--	--
Benzene	--	--	--	--	A	Several studies of increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and some supporting data form the basis for this classification.	0.029	IRIS
c-1,3-Dichloropropene	--	--	--	--	--	--	--	--

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	**mg/kg-day**	**Endpoint**	**Uncertainty Factor**	**Source[a]**	**Weight of Evidence**	**Basis**	**kg-day/mg**	**Source**
Carbon Tetrachloride	--	--	--	--	B2	Carcinogenicity in rats, mice, and hamsters.	0.053	IRIS
Chloroform	--	--	--	--	B2	Based on increased incidence of several tumor types in rats and three strains of mice.	0.081	IRIS
Chloromethane	--	--	--	--	C	--	0.006	HEAST
Dibromochloromethane	--	--	--	--	C	Inadequate human data and limited evidence of carcinogenicity in animals; namely, positive carcinogenic evidence in B6C3F1 mice (males and females), together with positive mutagenicity data, and structural similarity to other trihalomethanes, ...	--	--
Hexachloro-1,3-Butadiene	--	--	--	--	C	Observation of renal neoplasms in male and female rats in one study	0.077	IRIS
m-Ethyltoluene	--	--	--	--	--	--	--	--
Methylene Chloride	0.86	Liver - Toxicity	100	HEAST	B2	Inadequate human data and sufficient evidence of carcinogenicity in animals: increased incidence of hepatocellular neoplasms and alveolar/bronchiolar neoplasms in male and female mice, and increased incidence of benign mammary tumors in both sexes .	0.0016	IRIS
n-Heptane	--	--	--	--	D	No human data and no animal data available.	--	--
n-Pentane	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	D	No human data and inadequate data from animal bioassays.	--	--
o-Ethyltoluene	--	--	--	--	--	--	--	--
p-Ethyltoluene	--	--	--	--	--	--	--	--
p-Xylene + m-Xylene	--	--	--	--	--	--	--	--
t-1,3-Dichloropropene	--	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--	--
Toluene	0.11	Neurological effects	300	IRIS	D	No human data and inadequate animal data. Toluene did not produce positive results in the majority of genotoxic assays.	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Pesticides/PCBs								
4,4'-DDE	--	--	--	--	B2	Increased incidence of liver tumors including carcinomas in two strains of mice and in hamsters and of thyroid tumors in female rats by diet.	--	--

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
4,4'-DDT	--	--	--	--	B2	Observation of tumors (generally of the liver) in seven studies in various mouse strains and three in rats. DDT is structurally similar to other probable carcinogens, such as DDD and DDE.	0.34	IRIS
Aroclor 1254	--	--	--	--	B2	Used slope factor for Polychlorinated biphenyls as a surrogate slope factor for Aroclor 1254.	0.4	IRIS
alpha-Chlordane	--	--	--	--	--	--	--	--
delta-BHC	--	--	--	--	D	Not classifiable as to human carcinogenicity.	--	--
Dieldrin	--	--	--	--	B2	Carcinogenic in seven strains of mice when administered orally. Structurally related to compounds (aldrin, chlordane, heptachlor, heptachlor epoxide, and chorendic acid) which produce tumors in rodents.	16	IRIS
Endosulfan I	--	--	--	--	--	--	--	--
Endrin Ketone	--	--	--	--	--	--	--	--
gamma-BHC	--	--	--	--	B2-C	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	B2	Inadequate human data, but sufficient evidence exists from studies in which benign and malignant liver tumors were induced in three strains of mice of both sexes. Several structurally related compounds are liver carcinogens.	4.6	IRIS
PM10								
Aluminum	--	--	--	--	--	--	--	--
Arsenic	--	--	--	--	A	Based on sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, ...	15	IRIS
Barium	0.00014	Fetus - Fetotoxicity	1000	HEAST	D	Oral exposure studies in rats and mice did not find significant increases in tumor incidence following chronic exposure. Inhalation exposure and intratrachael studies are	--	--

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
						inadequate for carcinogenicity evaluation.		
Beryllium	0.0057	Beryllium sensitization and progression to CBD	10	IRIS	B1	Limited evidence of carcinogenicity in humans exposed to airborne beryllium (lung cancer) and sufficient evidence of carcinogenicity in animals.	8.4	IRIS
Cadmium	--	--	--	--	B1	Limited evidence from occupational epidemiologic studies of cadmium is consistent across investigators and study populations. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous	6.3	IRIS
Chloride	--	--	--	--	--	--	--	--
Chromium (III)	--	--	--	--	--	--	--	--
Chromium (VI)	--	--	--	--	A	Results of occupational epidemiologic studies of chromium-exposed workers are consistent across investigators and study populations. Dose-response relationships have been established for chromium exposure and lung cancer. Chromium-exposed workers .	42	IRIS
Copper	--	--	--	--	D	No human data, inadequate animal data from assays of copper compounds, and equivocal mutagenicity data.	--	--
Fluoride	--	--	--	--	--	--	--	--
Lead (and compounds) (inorganic)	--	--	--	--	B2	Sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in .	--	--
Manganese (food)	0.000014	Impairment of neurobehavioral function	1000	IRIS	D	Existing studies are inadequate to assess the carcinogenicity of managanese.	--	--
Mercury (inorganic)	0.000086	Hand tremor; increases in memory disturbances; slight subjective and objective evidence of	30	IRIS	D	No human data are available. Animal and supporting data are inadequate.	--	--

Table 1-2 Inhalation Toxicity Values

Constituent	Inhalation RfD				Inhalation Slope Factor			
	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
		autonomic dysfunction						
Sulfate	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	D	Lack of carcinogenicity data in animals and humans.	--	--
Vanadium	--	--	--	--	--	--	--	--
PM_{10}[b]	0.014	--	--	NAAQs, 1997	--	--	--	--
Mercury								
Mercury (inorganic)	0.000086	Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction	30	IRIS	D	No human data are available. Animal and supporting data are inadequate.	--	--
Semi-volatile Organic Compounds								
1,4-Dichlorobenzene	0.23	Increased liver weights in P1 males	100	IRIS	C	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--
4-Methylphenol/3-Methylphenol	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	D	No human data and inadequate data from animal bioassays.	--	--
Acetophenone	--	--	--	--	D	No human data and no animal data.	--	--
Benzo(a)anthracene	--	--	--	--	B2	No human data from animal bioassays. B(a)A produced tumors in mice exposed by gavage, i.p., subcutaneous, or intramuscular injection & topical application. B(a)A produced mutations in bacteria and mammalian cells, & transformed mammalian cells . .	--	--
Benzo(a)pyrene	--	--	--	--	B2	Human data specifically linking BAP to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating BAP to be carcinogenic following administration by	--	--

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
						numerous routes. BAP has produced positive . . .		
Benzo(b)fluoranthene	--	--	--	--	B2	No human and sufficient data from animal bioassays. B(b)F produced tumors in mice after lung implantation, i.p. or subcutaneous injection and skin painting.	--	--
Benzo(g,h,i)perylene	--	--	--	--	D	No human data and inadequate data from lung implant, skin-painting and subcutaneous injection bioassays.	--	--
Carcinogenic PAHs TEQs[c]	--	--	--	--	B2	Human data specifically linking BAP to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating BAP to be carcinogenic following administration by numerous routes. BAP has produced positive . . .	--	--
Dibenz(a,h)anthracene	--	--	--	--	B2	No human data & sufficient data from animal bioassays. Produced carcinomas in mice following oral or dermal exposure & injection site tumors in several species folowing subcutaneous or intramuscular administration. Has induced DNA damage . . .	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	B2	No human data and sufficient data from animal bioassays. Produced tumors in mice following lung implants, subcutaneous injection and dermal exposure. Tested positive in bacterial gene mutation assays.	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	B2	Orally administered DEHP produced significant dose-related increases in liver tumor responses in rats and mice of both sexes.	--	--
Isophorone	--	--	--	--	C	No data in humans; limited evidence of carcinogenicity of one tumor type in one sex of one animal species as shown by an increase of preputial gland carcinomas in male rats. The apparent renal tubular cell tumor in the male rat is associated with .	--	--
Phenanthrene	--	--	--	--	D	No human data and inadequate data from a single gavage study in rats and skin painting	--	--

Table 1-2 Inhalation Toxicity Values

	Inhalation RfD				Inhalation Slope Factor			
Constituent	mg/kg-day	Endpoint	Uncertainty Factor	Source[a]	Weight of Evidence	Basis	kg-day/mg	Source
						and injection studies in mice.		

-- No Toxicity Information was available on IRIS (4th Quarter), 1998 or HEAST 1997.

[a] IRIS, 1998 (4th Quarter) (U.S. Environmental Protection Agency. 1998. Integrated Risk Information System. Online Database) or HEAST 1997 (U.S. Environmental Protection Agency. 1997. Health Effects Assessment Summary Tables (HEAST): FY 1997 Update. EPA/540-R-97-036. PB97-921199. July. OSWER, Washington, D.C.).

[b] PM_{10} refers to particulate matter less than 10 microns in diameter. Particles larger than 10 microns are not respirable (i.e., they are too large to reach the lung). The current annual air standard for PM_{10} is 50 ug/m^3. The inhalation RfD was derived as follows: 50 ug/m^3 * 20 m^3/day * 1/70 kg * 1 mg/1000 ug.

[c] The following polycyclic aromatic hydrocarbons are considered carcinogenic: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoroanthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.

APPENDIX 3

Table 1-3 Constituents for Which There Were No Available Toxicity Information on IRIS or HEAST

ANALYTE	CAS_NO
Hydrofluoric Acid	7664-39-3
Isovaleraldehyde	590-86-3
n-Butyraldehyde	123-72-8
Propionaldehyde	123-38-6
Tolualdehyde	529-20-4
Valeraldehyde	110-62-3
1-Heptene	592-76-7
1-Hexene	592-41-6
1-Nonene	124-11-8
1-Octene	111-66-0
1-Pentene	109-67-1
1-Undecene	821-95-4
2,2,5-Trimethylhexane	3522-94-9
2,3-Dimethylbutane	79-29-8
2,3-Dimethylpentane	565-59-3
2,4-Dimethylpentane	108-08-7
2,5-Dimethylhexane	592-13-2
2-Methyl-1-Pentene	763-29-1
2-Methylheptane	592-27-8
2-Propanol	67-63-0
3-Methyl-1-Butene	563-45-1
3-Methylheptane	589-81-1
3-Methylhexane	589-34-4
3-Methylpentane	96-14-0
4-Nonene	2198-23-4
a-Pinene	80-56-8
b-Pinene	127-91-3
c-2-Butene	590-18-1
c-2-Hexene	7688-21-3
c-2-Pentene	627-20-3
p-Isopropyltoluene	99-87-6
Propane	74-98-6
Propylene	115-07-1
t-2-Butene	624-64-6
t-2-Hexene	4050-45-7
t-2-Pentene	646-04-8
Isodrin	465-73-6

ANALYTE	CAS_NO
Cyclohexane	110-82-7
Cyclohexene	110-83-8
Cyclopentane	287-92-3
Cyclopentene	142-29-0
Ethanol	64-17-5
Freon 114	76-14-2
Heptanal	111-71-7
Hexanal	66-25-1
Indan	496-11-7
Indene	95-13-6
Isobutane	75-28-5
Isobutene + 1-Butene	115-11-7/106-98
Isobutylbenzene	538-93-2
Isoheptane	591-76-4
Isohexane	73513-42-5
Isopentane	78-78-4
Isoprene	78-79-5
m-Diethylbenzene	141-93-5
Methylcyclopentane	96-37-7
Methylcyclopentene	27476-50-2
n-Butane	106-97-8
n-Decane	124-18-5
n-Nonane	111-84-2
n-Octane	111-65-9
n-Propylbenzene	103-65-1
n-Undecane	1120-21-4
Neohexane	75-83-2
Neopentane	463-82-1

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13. ABSTRACT *(Maximum 200 words)* The mission of Naval Air Facility Atsugi is to provide facilities, services and material support for U.S. Navy and Marine Corps aviation operations, and to provide logistic support for Carrier Air Wing FIVE. Approximately 8,000 military personnel and dependents are stationed at NAF Atsugi. A population boom in the early 1970s caused massive expansion in the communities surrounding the base and, as a result, the requirement for disposal of municipal and medical wastes also grew. Currently, the Shinkampo Incinerator immediately adjacent to NAF Atsugi burns over 180 tons of waste per day. Prevailing winds blow emissions from the incinerator stack over highly populated areas of NAF Atsugi. Under contract from the Navy Environmental Health Center, a private environmental consulting firm conducted an ambient air toxics study to evaluate the chemical constituency of the incinerator's emissions. This study examined the ambient air concentration of multiple toxics and criteria pollutants. Over 200 chemicals were identified in the air over NAF Atsugi; however, within the scientific literature, toxicology information suitable for use in human health risk assessment could be found for all but 66 of these chemicals. The present report describes the derivation of appropriate risk assessment reference values from data in the scientific literature and summarizes the health effects of each of the chemicals detected at NAF Atsugi.

14. SUBJECT TERMS
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