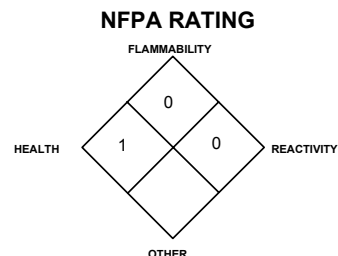


## MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards



### **PART I** *What is the material and what do I need to know in an emergency?*

#### 1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **OCTAFLUOROCYCLOBUTANE - C<sub>4</sub>F<sub>8</sub> HALOCARBON C-318**

PRODUCT USE: Document Number: 001056  
For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.

ADDRESS: 259 N. Radnor-Chester Road  
Suite 100  
Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253

EMERGENCY PHONE: CHEMTREC: 1-800-424-9300  
International: 703-527-3887 (Call Collect)

DATE OF PREPARATION: October 15, 1996

SECOND REVISION: January 30, 1998

#### 2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Octafluorocyclobutane	115-25-3	100	There are no specific exposure limits for Octafluorocyclobutane. Octafluorocyclobutane is an asphyxiant. Oxygen levels should be maintained above 19.5%.					

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

### 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** Octafluorocyclobutane is a colorless, odorless, non-flammable, liquefied gas. Octafluorocyclobutane is an asphyxiant and presents a significant health hazard by displacing the oxygen in the atmosphere. Frostbite can be caused by contact with rapidly expanding gases or the liquefied gas. This gas is not flammable or reactive in normal emergency response situations. However, if involved in a fire, Octafluorocyclobutane can decompose to produce toxic gases (e.g., hydrogen fluoride, carbonyl fluoride).

#### SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:

The most significant route of overexposure for Octafluorocyclobutane is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

**INHALATION:** High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. The skin of a victim of overexposure may have a blue color. Under some circumstances of overexposure, death may occur. The effects associated with various levels of oxygen are as follows:

#### CONCENTRATION

12-16% Oxygen:

10-14% Oxygen:

6-10% Oxygen:

Below 6%:

#### SYMPTOMS OF EXPOSURE

Breathing and pulse rate increased, muscular coordination slightly disturbed.

Emotional upset, abnormal fatigue, disturbed respiration.

Nausea and vomiting, collapse or loss of consciousness.

Convulsive movements, possible respiratory collapse, and death.



**OTHER POTENTIAL HEALTH EFFECTS:** Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE:** An Explanation in **Lay Terms.** Overexposure to Octafluorocyclobutane may cause the following health effects:

**ACUTE:** The most significant hazard associated with Octafluorocyclobutane is inhalation of oxygen-deficient atmospheres. Symptoms of such exposures include respiratory difficulty, ringing in ears, headache, dizziness, indigestion, nausea, and possible death. Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite.

**CHRONIC:** There are currently no known adverse health effects on humans associated with chronic exposure to the components of this compressed gas.

**TARGET ORGANS:** Respiratory system.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	1
FLAMMABILITY		(RED)	0
REACTIVITY		(YELLOW)	0
PROTECTIVE EQUIPMENT			B
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

**See Section 16 for Definition of Ratings**

## **PART II** *What should I do if a hazardous situation occurs?*

### 4. FIRST-AID MEASURES

**RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO OCTAFLUOROCYCLOBUTANE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Personal Protective equipment should be worn.**

Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

## 4. FIRST-AID MEASURES (Continued)

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

## 5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS: Non-flammable gas. Use extinguishing media appropriate for surrounding fire.

Water Spray: YES

Carbon Dioxide: YES

Dry Chemical: YES

Halon: YES

Foam: YES

Other: Any "ABC" Class

UNUSUAL FIRE AND EXPLOSION HAZARDS: Although

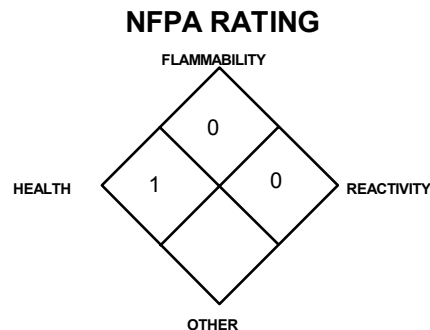
Octafluorocyclobutane is a non-flammable gas, it can present minor health hazards to firefighters. When involved in a fire, this material may decompose and produce toxic gases (e.g., hydrogen fluoride and carbonyl fluoride).

Octafluorocyclobutane does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. In the event of fire, cool containers of Octafluorocyclobutane with water to prevent failure. Use a water spray or fog to reduce or direct vapors. If cylinders are exposed to heat, the cylinder may rupture or burst and release the contents. It may be prudent to remove potentially heat-exposed cylinders from the area surrounding a fire, if it is safe for firefighters to do so.



See Section 16 for Definition of Ratings

## 6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of an accidental release, evacuate all personnel upwind and away from affected area, protect people, and respond with trained personnel.

Minimum Personal Protective Equipment should be **Level B: mechanically-resistant gloves and Self-Contained Breathing Apparatus**. Allow the gas to dissipate. Monitor the surrounding area for oxygen and Octafluorocyclobutane. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Colorimetric tubes can be used to detect the presence of Octafluorocyclobutane. Colorimetric tube readings should indicate that Octafluorocyclobutane is not present in the atmosphere above background levels before non-emergency personnel are permitted to re-enter the area.

Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

## **PART III** *How can I prevent hazardous situations from occurring?*

### 7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Octafluorocyclobutane IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Octafluorocyclobutane could occur without any significant warning symptoms.

## 7. HANDLING and STORAGE (Continued)

**STORAGE AND HANDLING PRACTICES:** Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas. Do not use Octafluorocyclobutane with or near incompatible chemicals, such as the following: polystyrene, alkali, alkaline earth metals and other reactive metals (e.g., sodium, potassium, calcium, magnesium and powdered aluminum). Acceptable materials for construction for equipment used in the handling of Octafluorocyclobutane include most commonly used metals (steel, cast iron, brass, copper, tin, lead, and aluminum).

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS:** Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Use a check valve or trap in the discharge line to prevent hazardous backflow. Post "No Smoking or Open Flame" signs in storage and use areas. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. The following rules are applicable to work situations in which cylinders are being used:

**Before Use:** Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap in-place (if provided), until cylinder is ready for use.

**During Use:** Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

**After Use:** Close main cylinder valve. Replace valve protection cap (if provided). Mark empty cylinders "EMPTY".

**NOTE:** Use only DOT or ASME code containers. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres".

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs.

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## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

**VENTILATION AND ENGINEERING CONTROLS:** Use with adequate ventilation. Local exhaust ventilation is preferred, because it prevents Octafluorocyclobutane dispersion into the work place by eliminating it at its source. If necessary, the work area should be monitored for the level of oxygen and Octafluorocyclobutane.

**RESPIRATORY PROTECTION:** Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen levels are below 19.5% or during emergency response to a release of Octafluorocyclobutane. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards.

**EYE PROTECTION:** Splash goggles or safety glasses, for protection from rapidly expanding gas. Face-shields should be worn if contact with the liquefied gas is anticipated.

**HAND PROTECTION:** Wear mechanically-resistant gloves when handling cylinders of Octafluorocyclobutane. Wear Viton or rubber gloves when using Octafluorocyclobutane.

**BODY PROTECTION:** Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied Octafluorocyclobutane.

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## 9. PHYSICAL and CHEMICAL PROPERTIES

**VAPOR DENSITY:** 5.734 kg/m<sup>3</sup> (0.358 lb/ft<sup>3</sup>)

**SPECIFIC GRAVITY (air = 1):** 1.5

**SOLUBILITY IN WATER:** Negligible.

**EVAPORATION RATE:** Not applicable.

**VAPOR PRESSURE @ 21.1°C (70°F) (psia):** 39.7

**ODOR THRESHOLD:** Not applicable.

**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.

**pH:** Not applicable.

**FREEZING POINT:** -41.4°C (-42.5°F)

**BOILING POINT @ 1 atm:** -6.04°C (21.1°F)

**EXPANSION RATIO:** Not applicable.

**SPECIFIC VOLUME (ft<sup>3</sup>/lb):** 1.9

## 9. PHYSICAL and CHEMICAL PROPERTIES (Continued)

APPEARANCE AND COLOR: Colorless, odorless, non-flammable gas.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties for Octafluorocyclobutane. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

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## 10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: If Octafluorocyclobutane is exposed to fire, it may decompose, yielding toxic products (e.g., hydrogen fluoride and carbonyl fluoride).

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: The following materials are not compatible with Octafluorocyclobutane: polystyrene, alkaline and alkaline earth metals (such as sodium, potassium, lithium, barium, magnesium, and powdered aluminum). Metals such as silver, brass, bronze and copper may enhance the decomposition of Octafluorocyclobutane at elevated temperatures. Octafluorocyclobutane may also decompose in the presence of alloys which contain more than 2% magnesium.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

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## PART IV *Is there any other useful information about this material?*

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## 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is available for Octafluorocyclobutane.

OCTAFLUOROCYCLOBUTANE: Sex Chromosome Loss and Nondisjunction System (*Drosophila melangaster*, inhalation) = 99 pph/10 minutes.

SUSPECTED CANCER AGENT: Octafluorocyclobutane is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Octafluorocyclobutane is not irritating; however, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Octafluorocyclobutane is not known to cause sensitization in humans with prolonged or repeated exposure.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Octafluorocyclobutane on the human reproductive system.

Mutagenicity: Mutation data has been reported for Octafluorocyclobutane during clinical studies involving animals exposed to high concentrations of Octafluorocyclobutane.

Embryotoxicity: No embryotoxic effects have been described for Octafluorocyclobutane.

Teratogenicity: No teratogenicity effects on humans have been described for Octafluorocyclobutane.

Reproductive Toxicity: No reproductive toxicity effects on humans have been described for Octafluorocyclobutane.

*A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.*

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by overexposure to Octafluorocyclobutane.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treat symptoms and eliminate exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Octafluorocyclobutane.

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## 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas. However, all work practice must be directed at eliminating environmental contamination.

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## 12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to adverse effects on exposure to oxygen-deficient environments. The symptoms experienced by over-exposed animals would be similar to those described for exposed humans. No adverse effect is anticipated to occur to plant-life, except for frost produced in the presence of rapidly expanding gases.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of Octafluorocyclobutane on aquatic life.

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## 13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Airgas Inc. Do not dispose of locally.

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## 14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Octafluorocyclobutane  
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-flammable Gas)  
UN IDENTIFICATION NUMBER: UN 1976  
PACKING GROUP: Not applicable.  
DOT LABEL(S) REQUIRED: Non-flammable Gas  
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 126

MARINE POLLUTANT: Octafluorocyclobutane is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

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## 15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Octafluorocyclobutane is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

CANADIAN DSL/NDL INVENTORY STATUS: Octafluorocyclobutane is listed on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Octafluorocyclobutane is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Not applicable

U.S. STATE REGULATORY INFORMATION: Octafluorocyclobutane is covered under specific State regulations, as denoted below:

**Alaska - Designated Toxic and Hazardous Substances:** No.

**California - Permissible Exposure Limits for Chemical Contaminants:** No.

**Florida - Substance List:** No.

**Illinois - Toxic Substance List:** No.

**Kansas - Section 302/313 List:** No.

**Massachusetts - Substance List:** No.

**Michigan Critical Register List:** No.

**Minnesota - List of Hazardous Substances:** Octafluorocyclobutane.

**Missouri - Employer Information/Toxic Substance List:** No.

**New Jersey - Right to Know Hazardous Substance List:**

Octafluorocyclobutane.

**North Dakota - List of Hazardous Chemicals, Reportable Quantities:** No.

**Pennsylvania - Hazardous Substance List:** No.

**Rhode Island - Hazardous Substance List:** No.

**Texas - Hazardous Substance List:** No.

**West Virginia - Hazardous Substance List:** No.

**Wisconsin - Toxic and Hazardous Substances:** No.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Octafluorocyclobutane is not on the California Proposition 65 lists.

## 15. REGULATORY INFORMATION (Continued)

LABELING:

**CAUTION:**

LIQUID AND GAS UNDER PRESSURE.  
CAN CAUSE RAPID SUFFOCATION.  
MAY CAUSE FROSTBITE.  
Store and use with adequate ventilation.  
Do not get liquid in eyes, on skin or clothing.  
Cylinder temperature should not exceed 52°C (125°F).  
Close valve after each use and when empty.  
Use in accordance with the Material Safety Data Sheet.

**FIRST-AID:**

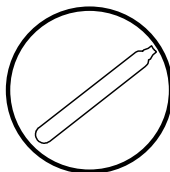
**IF INHALED**, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**IN CASE OF FROSTBITE**, obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

CANADIAN WHMIS SYMBOLS:

**Class A:** Compressed Gases



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## 16. OTHER INFORMATION

**PREPARED BY:**

CHEMICAL SAFETY ASSOCIATES, Inc.  
9163 Chesapeake Drive, San Diego, CA 92123-1002  
619/565-0302

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

## DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

**CAS #:** This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

### EXPOSURE LIMITS IN AIR:

**ACGIH** - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

**TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

**OSHA** - U.S. Occupational Safety and Health Administration.

**PEL** - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

**IDLH** - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called **Recommended Exposure Levels (RELs)**. When no exposure guidelines are established, an entry of **NE** is made for reference.

### HAZARD RATINGS:

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM:** Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

**NATIONAL FIRE PROTECTION ASSOCIATION:** Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

### FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

### TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD<sub>50</sub>** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC<sub>50</sub>** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m<sup>3</sup>** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

### REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDSL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations.