



# MATERIAL SAFETY DATA SHEET

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

## SECTION 1. PRODUCT IDENTIFICATION

**PRODUCT NAME:** CARBON MONOXIDE  
**CHEMICAL NAME:** Carbon Monoxide  
**FORMULA:** Carbon Monoxide = CO  
**SYNONYMS:** Carbonic Oxide, Carbon Oxide

**MANUFACTURER:** SPECTRA GASES, INC.  
**ADDRESS:** 3434 Route 22 West  
 Branchburg, NJ 08876, U.S.A.  
**PHONE:** 908/252-9300  
**FAX:** 908/252-0811

**SPECTRA GASES EMERGENCY CONTACT:** 800/932-0624 8:30 am - 7:00 pm (EST)  
**24 HOUR EMERGENCY CONTACT, CHEMTREC:** 800/424-9300, 202/484-7616  
**REVISION DATE:** September 29, 2005  
**MSDS NUMBER:** 1008  
**PRODUCT USE:** Various

## SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

**COMPOSITION:** Carbon Monoxide 100%  
**CAS NUMBER:** Carbon Monoxide: 630-08-0  
**EINECS NUMBER:** Carbon Monoxide: 211-128-3  
**EXPOSURE LIMITS:** (10,000 ppm = 1%)

|                  | OSHA PELs:                           | ACGIH TLVs:  | NIOSH RELs:       |
|------------------|--------------------------------------|--------------|-------------------|
| Carbon Monoxide: |                                      |              |                   |
|                  | TWA = 50 ppm                         | TWA = 25 ppm | TWA = 35 ppm      |
|                  | TWA = 35 ppm (vacated 1989 PEL)      |              | Ceiling = 200 ppm |
|                  | Ceiling = 200 ppm (vacated 1989 PEL) |              | IDLH = 1200 ppm   |

## SECTION 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** Carbon Monoxide is a colorless, odorless, toxic, flammable gas. Overexposure to Carbon Monoxide, a chemical asphyxiant, can cause nausea, dizziness, headaches and collapse. Inhalation overexposures may be fatal. Carbon Monoxide poses a serious fire hazard when accidentally released. Flame or high temperature impinging on a localized area of the cylinder of Carbon Monoxide can cause the cylinder to rupture or burst without activating the cylinder's relief devices. Emergency Responders must protect themselves from inhalation exposures and have adequate fire protection for responders during emergency response situations.

**ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING** - If rescue personnel need to enter an area suspected of having a toxic level of Carbon Monoxide, they should be equipped with Self-Contained Breathing Apparatus (SCBA), and, if available, a full-body chemically resistant suit. Acute overexposure to this gas mixture may cause the following health effects:

**EYE CONTACT:** Release of a high-pressure gas may result in airborne objects.

**INGESTION:** Ingestion of this gas mixture is not a likely route of industrial exposure.

**INHALATION:** Carbon Monoxide can produce significant, adverse health effects at relatively low concentrations. Carbon Monoxide is classified as a chemical asphyxiant, producing a toxic action by combining with the hemoglobin of the blood and replacing the available oxygen. Through this replacement, the body is deprived of the required oxygen, and asphyxiation occurs. Since the affinity of Carbon Monoxide for hemoglobin is about 200-300 times that of oxygen, only a small amount of Carbon Monoxide can cause a toxic reaction to occur. Carbon Monoxide exposures in excess of 25 ppm can produce symptoms of poisoning if breathed for a sufficiently long time.

### SECTION 3. HAZARD IDENTIFICATION (Continued)

**INHALATION (continued):** If inhaled, symptoms from Carbon Monoxide which may develop include those described below.

**CONCENTRATION  
of CARBON MONOXIDE**

All exposure levels:

200 ppm:

400 ppm:

1,000 -2000 ppm:

2000-2500 ppm:

> 2500 ppm:

**EXPOSURE SYMPTOM**

Over-exposure to Carbon Monoxide can be indicated by the lips and fingernails turning bright red.

Slight symptoms (headache, discomfort) after several hours of exposure.

Headache and discomfort experienced within 2-3 hours of exposure.

Within 30 minutes, slight palpitations of the heart occur. Within 1.5 hours, there is a tendency to stagger. Within 2 hours, there is mental confusion, headache, and nausea.

Unconsciousness within 30 minutes.

Potential for collapse and death before warning symptoms are produced.

**Note:** At high altitudes, individuals may be more susceptible to Carbon Monoxide overexposure. Development of symptoms may also occur more rapidly if individuals are performing demanding physical tasks. Individuals who have heart conditions may also experience a more rapid onset of symptoms. During recovery, victims can experience headaches, vision problems, and memory loss.

**SKIN CONTACT:** Not applicable.

**OTHER HEALTH EFFECTS:** Contact with rapidly expanding gases (which are released from under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain caused by frostbite can quickly subside, masking the injury. In addition, the sudden release of a pressurized gas (such as may occur in the event of a valve failure), presents a severe hazard of mechanical injury.

**HMIS RATINGS:** HEALTH: = 3; FLAMMABILITY: = 4; REACTIVITY: = 0;

PPE: Level B (see Section 8, Exposure Controls/Personal protective Equipment)

**ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:**

**ROUTE OF ENTRY:** Inhalation

**TARGET ORGANS:** Respiratory system, circulatory system, cardiovascular system, central nervous system, reproductive system.

**SYMPTOMS:** Clinical studies indicate that there is a relationship between exposure to Carbon Monoxide in specific occupations (e.g., fire-fighters, foundry workers) and an increased incidence of cardiovascular problems. Carbon Monoxide is a reproductive toxin. Refer to Section 11 (Toxicological Information) of this MSDS for further information.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** Acute or chronic respiratory conditions and cardiac conditions may be aggravated by over-exposure to this gas.

**CARCINOGENICITY:** Carbon Monoxide is not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies..

### SECTION 4. FIRST AID MEASURES

**THERMAL BURNS:** In the event personnel are burned as a result of a Carbon Monoxide release, if burns are first degree or second degree with closed blisters, flush area with cold water until pain subsides. Apply loose, moist, sterile dressings, and bandage. Treat for shock. If burns are second degree with open blisters or third degree, apply loose, dry, sterile dressings and bandage. Treat for shock. Transport victim immediately to hospital or emergency center. Burns over an area of 20% or more of body are life-threatening, medical attention should be immediately sought.

**EYE CONTACT:** Open victim's eyes while under gentle, lukewarm, running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Consultation with an ophthalmologist is suggested if exposure has led to mechanical injury.

**INGESTION:** Ingestion is an unlikely route of exposure for this gas.

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

**SKIN CONTACT:** No adverse effect is expected after skin contact.

**SECTION 4. FIRST AID MEASURES (Continued)**

**NOTES TO PHYSICIANS:** Administer oxygen, if necessary and treat symptoms. Patients with 40% carboxyhemoglobin or more and an uncompensated metabolic acidosis (arterial pH less than 7.4) should be managed aggressively with ventilatory support or hyperbaric oxygenation. Infuse sodium bicarbonate and balanced electrolyte solutions if blood analyses indicate a significant metabolic acidosis. Ancillary therapy for brain edema may be necessary if hypoxia has been severe. Ensure absolute bed rest for at least 48 hours; in severe poisonings, 2-4 weeks in bed may prevent sequelae. Watch for late neurological, psychiatric and cardiac complications.

**SECTION 5. FIRE FIGHTING MEASURES**

**FLASH POINT:** Not Applicable; flammable gas.

**AUTOIGNITION:** 607°C (1125°F)

**FLAMMABLE RANGE:** Lower (LEL): 12.5%; Upper (UEL): 74.2%

**NFPA RATINGS:**

HEALTH: = 2                      FLAMMABILITY: = 4  
 REACTIVITY: = 0                SPECIAL: None

**EXTINGUISHING MEDIA:** Extinguish Carbon Monoxide fires by shutting-off the source of the gas. Use water spray to cool fire-exposed containers, structures, and equipment.

**SPECIAL FIRE-FIGHTING PROCEDURES:** The best fire-fighting technique may be simply to let the burning gas escape from the cylinder or pipeline. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the still-leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. Consider increasing ventilation to prevent flammable or explosive mixture formation.

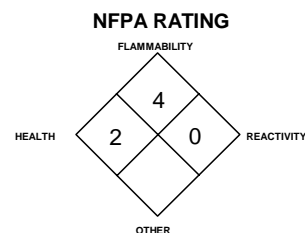
**UNUSUAL FIRE AND EXPLOSION HAZARDS:** An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited.

**DANGER!** Fires impinging (direct flame) on the outside surface of unprotected cylinders of Carbon Monoxide can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

**EXPLOSION SENSITIVITY TO MECHANICAL IMPACT:** Not sensitive.

**EXPLOSION SENSITIVITY TO STATIC DISCHARGE:** Static discharge may cause this gas to ignite explosively. Due to low electrical conductivity, this substance can generate electrostatic charges during handling operations.

**HAZARDOUS COMBUSTION PRODUCTS:** If involved in a fire, Carbon Monoxide will decompose to form oxides of carbon and carbon dioxide between 400-700°C (752-1292°F).



**See Section 16 for  
 Definition of Ratings**

**SECTION 6. ACCIDENTAL RELEASE MEASURES**

**FIRST RESPONSE:** In the event of a leak of this product, operator should close the gas source, if possible to do so safely. Evacuate area in the event of a significant release. The North American Emergency Response Guidebook (Guide # 115) recommends 0.5 mile.

**TRAINED RESPONSE TEAM:** Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus**. Locate and seal the source of the leaking gas. Use water spray to protect personnel attempting shut-off. Use only non-sparking tools and equipment. Eliminate any possible sources of ignition and provide maximum explosion-proof ventilation. If shut-off is not possible, allow the gas to release in-place or remove it to a safe, well-ventilated, area away from sources of ignition, and allow the gas to be released there. Allow the gas to dissipate.

**ENTRY TO AREA:** Monitor area for combustible gas level and oxygen level. (Note that this gas is nearly the density as air and readily mixes with air to form explosive air/gas mixtures). Combustible gas concentration must be below 10% of the LEL (12.5%) prior to entry without proper fire gear and personnel protective equipment. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus (SCBA).

**REPAIR/FOLLOW-UP:** If leak was in user's gas handling equipment or system, ensure cylinder is closed and safely vent all high pressure before attempting repairs. If leak was from the cylinder, cylinder valve, or the valve pressure relief device (PRD), contact your supplier.

**THIS IS AN EXTREMELY FLAMMABLE GAS.** Protection of all personnel and the area must be maintained. Detection systems should be available to monitor for combustible and toxic gas levels.

**SECTION 7. HANDLING AND STORAGE**

**STORAGE:** Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

Storage and use areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment (i.e. sprinkler system, portable fire extinguishers).

Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof. Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals (refer to Section 10, Stability and Reactivity).

**HANDLING: This gas can be dangerous and should only be handled by trained personnel.** Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Carbon Monoxide could occur without any significant warning symptoms. Wearing contact lenses is not recommended when handling this gas. Spectra Gases, Inc., strongly recommends that this gas only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet.

**Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made.** Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty.

Carbon Monoxide detectors are strongly recommended. Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Consideration should be made on the use of a flash arrestor on cylinders of Carbon Monoxide, due to its extreme flammability. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Purge gas handling equipment with inert gas and relieve pressure before attempting repairs.

**SPECIAL PRECAUTIONS:** Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Carbon Monoxide could occur without any significant warning symptoms. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*. Local regulations may require specific equipment for storage and use.

**SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION**

**VENTILATION AND ENGINEERING CONTROLS:** Forced ventilation systems for the general work area should be provided. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. Employee exposure should be monitored and reduced to the lowest practical levels using ventilation or other appropriate engineering controls. If appropriate, install automatic monitoring equipment to detect the level of Carbon Monoxide.

## SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

**RESPIRATORY PROTECTION:** Maintain exposure levels of Carbon Monoxide below the levels listed in Section 2 (Composition / Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Carbon Monoxide levels exceed exposure limits, if oxygen level is below 19.5%, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canada, the European Standard EN166, and EC member states. The following NIOSH respiratory protection recommendations are for Carbon Monoxide.

### CONCENTRATION of CARBON MONOXIDE

### RESPIRATORY EQUIPMENT

|   |  |
|---|--|
| Up to 350 ppm   | Supplied Air Respirator (SAR).   |
| Up to 875 ppm   | SAR operated in a continuous flow mode.  |
| Up to 1200 ppm  | Gas mask with canister to protect against carbon monoxide or full-facepiece Self-Contained Breathing Apparatus (SCBA) or full-facepiece SAR. |
| Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: | Positive pressure, full-facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.                    |
| Escape:   | Gas mask with canister to protect against carbon monoxide or escape-type SCBA.   |

**NOTE:** End of Service Life Indicator (ESLI) required for gas masks. The IDLH concentration for Carbon Monoxide is 1200 ppm.

**EYE PROTECTION:** Use approved safety goggles or safety glasses, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166.

**SKIN PROTECTION:** Work (such as leather) gloves are recommended when handling cylinders of this gas mixture. Natural rubber and neoprene are attacked by Carbon Monoxide. Wear gloves appropriate for the task.

**OTHER PROTECTIVE EQUIPMENT:** Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require use of chemically impervious clothing.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

**MOLECULAR WEIGHT:** 28.01

**GAS DENSITY @ 21.1°C (70°F):** 0.0725 lb./ft<sup>3</sup> (1.161 kg/m<sup>3</sup>)

**VAPOR PRESSURE @ 20°C (68°F):** > 760 mm Hg (> 1 atm)

**BOILING POINT @ 1 atm:** -191.5°C (-312.7°F)

**FREEZING/MELTING POINT @ 1 atm:** -207°C (-340.6°F)

**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 0.9676

**SOLUBILITY IN WATER vol/vol at 20°C (68°F):** 2.3 mL

**SPECIFIC VOLUME @ 21.1°C (70°F):** 13.8 lb/ft<sup>3</sup> (0.862 m<sup>3</sup>/kg)

**CRITICAL PRESSURE:** 507.5 psia (3499 kPa abs)

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

**ODOR THRESHOLD:** Not applicable.

**APPEARANCE, ODOR AND STATE:** Colorless, odorless gas.

**WARNING PROPERTIES FOR THIS GAS MIXTURE:** There are no distinct warning properties. Installation of monitors for levels of Carbon Monoxide and oxygen should be considered.

## SECTION 10. STABILITY AND REACTIVITY

**CHEMICAL STABILITY:** Stable.

**CONDITIONS TO AVOID:** Cylinders should not be exposed to temperatures in excess of 125°F (52°C).

**MATERIALS WITH WHICH GAS MIXTURE IS INCOMPATIBLE:** Carbon Monoxide is incompatible with strong oxidizers (e.g., chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride). Carbon Monoxide is also incompatible with the following substances: metal oxides, chromium, alkali and alkaline earth metals, aluminum powder, iodine heptafluoride, sulfur, bromine, bromine trifluoride, bromine pentafluoride, chlorine dioxide, peroxodisulfuryl difluoride. Carbon Monoxide is mildly corrosive to nickel and iron (especially at high temperatures and pressures). Natural rubber and neoprene are attacked by Carbon Monoxide.

### **REACTIVITY:**

**A) HAZARDOUS DECOMPOSITION PRODUCTS:** None, other than combustion products (see Section 5, Fire-Fighting Measures).

**B) HAZARDOUS POLYMERIZATION:** Will not occur.

## SECTION 11. TOXICOLOGICAL INFORMATION

**TOXICITY DATA:****CARBON MONOXIDE:**

LC<sub>50</sub> (Inhalation-Rat) 3760 ppm (DOT)  
 LC<sub>50</sub> (Inhalation-Rat) 1807 ppm/4 hours  
 LC<sub>50</sub> (Inhalation-Mouse) 2444 ppm/4 hours  
 LC<sub>50</sub> (Inhalation-Guinea Pig, adult) 5718 ppm/4 hours  
 LCLo (Inhalation-Man) 4000 ppm/30 minutes  
 LCLo (Inhalation-Human) 5000 ppm/5 minutes  
 LCLo (Inhalation-Dog, adult) 4000 ppm/46 minutes  
 LCLo (Inhalation-Rabbit, adult) 4000 ppm  
 LCLo (Inhalation-Mammal) 5000 ppm/5 minutes  
 TCLo (Inhalation-Man) 650 ppm/45 minutes: Central nervous system effects, Blood effects  
 TCLo (Inhalation-Man) 600 mg/m<sup>3</sup>/10 minutes  
 TCLo (Inhalation-Rat) 1800 ppm/1 hour/14 days-intermittent: Cardiac  
 TCLo (Inhalation-Rat) 30 mg/m<sup>3</sup>/8 hours/10 weeks-intermittent: Brain and Coverings: other degenerative changes; Behavioral: muscle contraction or spasticity  
 TCLo (Inhalation-Rat) 96 ppm/24 hours/90 days-continuous: Blood: pigmented or nucleated red blood cells, other changes  
 TCLo (Inhalation-Rat) 250 ppm/5 hours/20 days-intermittent: Blood: pigmented or nucleated red blood cells, changes in other cell count (unspecified), changes in erythrocyte (RBC) count  
 TCLo (Inhalation-Rat) 150 ppm/24 hours: female 1-22 day(s) after conception: Reproductive: Specific Developmental Abnormalities: cardiovascular (circulatory) system  
 TCLo (Inhalation-Rat) 150 ppm/24 hours: female 1-22 day(s) after conception: Reproductive: Effects on Newborn: growth statistics (e.g. %, reduced weight gain), behavioral  
 TCLo (Inhalation-Mouse) 65 ppm/24 hours (female 7-18 days post): Reproductive effects

**CARBON MONOXIDE (continued):**

TCLo (Inhalation-Rat) 75 ppm/24 hours: female 0-20 day(s) after conception: Reproductive: Specific Developmental Abnormalities: immune and reticuloendothelial system  
 TCLo (Inhalation-Rat) 1 mg/m<sup>3</sup>/24 hours: female 72 day(s) pre-mating: Reproductive: Maternal Effects: menstrual cycle changes or disorders, parturition, Fertility: female fertility index (e.g. # females pregnant per # sperm positive females; # females pregnant per # females mated)  
 TCLo (Inhalation-Rat) 150 ppm/24 hours: female 0-20 day(s) after conception: Reproductive: Effects on Newborn: behavioral  
 TCLo (Inhalation-Mouse) 8 pph/1 hour (female 8 days post): Teratogenic effects  
 TCLo (Inhalation-Mouse) 65 ppm/24 hours: female 7-18 day(s) after conception: Reproductive: Effects on Newborn: behavioral  
 TCLo (Inhalation-Mouse) 250 ppm/7 hours: female 6-15 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants), Reproductive: Specific Developmental Abnormalities: musculoskeletal system  
 TCLo (Inhalation-Mouse) 125 ppm/24 hours: female 7-18 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)  
 TCLo (Inhalation-Mouse) 8 pph/1 hour: female 8 day(s) after conception: Reproductive: Fertility: litter size (e.g. # fetuses per litter; measured before birth), Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

**CARBON MONOXIDE (continued):**

TCLo (Inhalation-Mouse) 8 pph/1 hour: female 8 day(s) after conception: Reproductive: Specific Developmental Abnormalities: Central Nervous System  
 TCLo (Inhalation-Mouse) 180 ppm/24 hours: female 1-30 day(s) after conception: Reproductive: Effects on Newborn: stillbirth, viability index (e.g., # alive at day 4 per # born alive)  
 Micronucleus Test (Inhalation-Mouse) 1500 ppm/10 minutes  
 Sister chromatid Exchange (Inhalation-Mouse) 2500 ppm/10 minutes  
 TCLo (Inhalation-Rabbit) 200 mg/m<sup>3</sup>/3 hours/13 weeks-intermittent: Brain and Coverings: other degenerative changes; Cardiac: other changes, Blood: hemorrhage  
 TCLo (Inhalation-Rabbit) 50 ppm/24 hours/8 weeks-continuous: Blood: changes in platelet count  
 TCLo (Inhalation-Guinea Pig) 200 mg/m<sup>3</sup>/5 hours/4 weeks-intermittent: Endocrine: hyperglycemia  
 TCLo (Inhalation-Guinea Pig) 200 mg/m<sup>3</sup>/5 hours/30 weeks-intermittent: Cardiac: arrhythmias (including changes in conduction), EKG changes not diagnostic of specified effects, pulse rate increase, without fall in BP  
 TCLo (Inhalation-Guinea Pig) 200 ppm/24 hours/90 days-continuous: Blood: pigmented or nucleated red blood cells, other changes  
 TCLo (Inhalation-Monkey) 200 ppm/24 hours/90 days-continuous: Blood: pigmented or nucleated red blood cells, other changes  
 LD<sub>50</sub> (Inhalation-Bird-wild species) 1334 ppm  
 TDLo (Subcutaneous-Rat) 5983 mg/kg/18 weeks-intermittent: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)

**CARCINOGENICITY:** Carbon Monoxide has not been found to be carcinogenic.

**IRRITANCY OF PRODUCT:** Carbon Monoxide is not expected to irritate contaminated tissue.; however, contact with rapidly expanding gases can cause frostbite to exposed tissue.

**SENSITIZATION OF PRODUCT:** Carbon Monoxide is not known to cause sensitization in humans.

**REPRODUCTIVE TOXICITY INFORMATION:** Listed below is information concerning the effects of this gas mixture and its components on the human reproductive system.

Mutagenicity: Carbon Monoxide is not expected to cause mutagenic effects in humans.

Embryotoxicity: Carbon Monoxide is not expected to cause embryotoxic effects in humans. Animal embryotoxic data are available for Carbon Monoxide; these data were obtained during clinical studies on specific animal tissues exposed to this compound.

Teratogenicity: Carbon Monoxide is not expected to cause teratogenic effects in humans. Animal teratogenic data are available for Carbon Monoxide; these data were obtained during clinical studies on specific animal tissues exposed to this compound.

Reproductive Toxicity: Carbon Monoxide is not expected to cause adverse reproductive effects in humans. Animal reproductive data are available for Carbon Monoxide; these data were obtained during clinical studies on specific animal tissues exposed to this compound.

**SECTION 11. TOXICOLOGICAL INFORMATION (Continued)**

A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that 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 that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.

**BIOLOGICAL EXPOSURE INDICES (BEIs):** Biological Exposure Indices (BEIs) are applicable for Carbon Monoxide, as follows:

| CHEMICAL DETERMINANT  | SAMPLING TIME                    | BEI                              |
|---|----------------------------------|----------------------------------|
| CARBON MONOXIDE<br>• Carboxyhemoglobin in blood<br>• Carbon monoxide in end-exhaled air | • End of shift<br>• End of shift | • 3.5% of hemoglobin<br>• 20 ppm |

**SECTION 12. ECOLOGICAL INFORMATION**

**ENVIRONMENTAL STABILITY:** Carbon Monoxide will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to Carbon Monoxide.

**CARBON MONOXIDE:** Water solubility = 3.3 ml/100 cc at 0 EC, 2.3 ml at 20 EC. The presence of more than a trace of carbon monoxide is a hazard to fish.

**NITROGEN:** Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C and 1.6 volumes Nitrogen/100 volumes water at 20°C.

**EFFECT OF MATERIAL ON PLANTS or ANIMALS:** Carbon Monoxide may have adverse effects on animal life exposed to very high concentrations.

**EFFECT OF CHEMICAL ON AQUATIC LIFE:** Carbon Monoxide may have adverse effects on aquatic life. Currently, the following aquatic toxicity data are available for Carbon Monoxide:

Lethal (minnows and sunfish) 1-6 hours = 1.5 ppm (fresh water)

**MOBILITY:** Carbon Monoxide will not be mobile in the soil.

**PERSISTENCE AND BIODEGRADABILITY:** Persistence: Carbon Monoxide presents no hazard of persistence. Biodegradation: No data are available on the biodegradation of Carbon Monoxide.

**POTENTIAL TO BIOACCUMULATE:** Carbon Monoxide does not have bioaccumulation or food chain contamination potential.

**OZONE-DEPLETION POTENTIAL:** Carbon Monoxide is not Class I or Class II ozone depleting chemicals (40 CFR Part 82).

**SECTION 13. DISPOSAL CONSIDERATIONS**

**UNUSED PRODUCT / EMPTY CONTAINER:** Do not dispose of residual product. Return residual product in cylinders to: Spectra Gases, Inc., 80 Industrial Drive, Alpha, NJ 08865 or Spectra Gases, Inc., 1261 Activity Drive, Vista, CA 92083.

**DISPOSAL INFORMATION:** Residual product in the system may be burned if suitable burning unit (flair incinerator) is available on-site. This shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

**SECTION 14. TRANSPORT INFORMATION****U.S. SHIPPING INFORMATION:**

**U.S. DOT PROPER SHIPPING NAME:** Carbon Monoxide, compressed  
**HAZARD CLASS NUMBER and DESCRIPTION:** 2.3 (Toxic Gas) [primary hazard]  
 2.1 (Flammable Gas) [secondary hazard]  
**UN IDENTIFICATION NUMBER:** UN 1016  
**U.S. DOT SHIPPING LABEL(S) REQUIRED:** Toxic Gas, Flammable Gas  
**PLACARD (When required):** Toxic Gas

**SPECIAL PROVISION:** Shipments of Carbon Monoxide must be described as "Poison Inhalation Hazard - ZONE D".

**SPECIAL SHIPPING INFORMATION:** Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

**CAUTION:** Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

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| <b>SECTION 14. TRANSPORT INFORMATION (Continued)</b> |
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**CANADIAN SHIPPING INFORMATION:**

**TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:** Carbon Monoxide is considered as dangerous goods; use the above information for the preparation of Canadian Shipments. Shipments of this gas are also subject to Special Provision 102.

**INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):**

**IATA DESIGNATION:** Carbon Monoxide is considered as dangerous goods, per the International Air Transport Association.

**PROPER SHIPPING NAME:** Carbon Monoxide, compressed  
**HAZARD CLASS NUMBER and DESCRIPTION:** 2.3 (Toxic Gas) [primary hazard]  
 2.1 (Flammable Gas) [secondary hazard]  
**UN IDENTIFICATION NUMBER:** UN 1016  
**HAZARD LABEL(S) REQUIRED:** Toxic Gas, Flammable Gas

The following Packaging Information is applicable to this product:

| PASSENGER AND CARGO AIRCRAFT |                  |                     |                  | CARGO AIRCRAFT ONLY |                  |
|------------------------------|------------------|---------------------|------------------|---------------------|------------------|
| Limited Quantity             |                  | Packing Instruction | Max. Qty per Pkg | Packing Instruction | Max. Qty per Pkg |
| Packing Instruction          | Max. Qty per Pkg |                     |                  |                     |                  |
| //////                       | //////           | Forbidden           |                  | 200                 | 25 kg            |

**INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):**

**IMO DESIGNATION:** Carbon Monoxide is considered as dangerous goods, per the International Maritime Organization.

**PROPER SHIPPING NAME:** Carbon Monoxide, compressed  
**HAZARD CLASS NUMBER and DESCRIPTION:** 2.3 (Toxic Gas) [primary hazard]  
 2.1 (Flammable Gas) [secondary hazard]  
**UN IDENTIFICATION NUMBER:** UN 1016  
**HAZARD LABEL(S) REQUIRED:** Toxic Gas, Flammable Gas  
**STOWAGE CATEGORY:** Category "D" - Clear of living quarters.  
**IMDG CODE:** Page 2114

**MARINE POLLUTANT:** Carbon Monoxide is not designated by the IMO to be Marine Pollutants.

**EUROPEAN SHIPPING INFORMATION:**

**EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):** This gas mixture is considered by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

**SUBSTANCE IDENTIFICATION NO.:** 1016  
**NAME OF SUBSTANCE:** Carbon Monoxide, Compressed  
**HAZARD IDENTIFICATION NO.:** 263  
**LABEL:** 6.1 + 3  
**CLASS AND ITEM NUMBER:** 2, 1<sup>o</sup>TF

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| <b>SECTION 15. REGULATORY INFORMATION</b> |
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**U.S. FEDERAL REGULATIONS:****EPA - ENVIRONMENTAL PROTECTION AGENCY:**

**CERCLA:** Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Not applicable.

**SARA TITLE III:** Superfund Amendment and Reauthorization Act

**SECTIONS 302/304:** Emergency Planning and Notification (40 CFR Part 355)

Extremely Hazardous Substances: Not applicable.

Threshold Planning Quantity (TPQ): Not applicable.

Reportable Quantity (RQ): Not applicable.

**SECTIONS 311/312:** Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes                      PRESSURE: Yes

DELAYED HEALTH: No                         REACTIVITY: No

FIRE: Yes

**SECTION 313:** Toxic Chemical Release Reporting (40 CFR 372)

Releases of Carbon Monoxide do not require reporting under Section 313.

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| <b>SECTION 15. REGULATORY INFORMATION (Continued)</b> |
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**CLEAN AIR ACT:**

**SECTION 112 (r):** Risk Management Programs for Chemical Accidental Release  
(40 CFR Part 68)

Carbon Monoxide is listed under Table 1 as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Release Prevention, as a flammable substance.

Threshold Planning Quantity (TPQ): Carbon Monoxide = 10,000 lb (4,553 kg).

**TSCA:** Toxic Substances Control Act

Carbon Monoxide is listed on the TSCA Inventory.

**OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:**

**29 CFR Part 1910.119:** Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): Not applicable

**U.S. STATE REGULATORY INFORMATION:**

**CALIFORNIA PROPOSITION 65:** Carbon Monoxide is on the California Proposition 65 lists. **WARNING:** This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Carbon Monoxide is listed by the following State regulations (more specific regulations exist in some States):

|   |   |   |
|---|---|---|
| <b>Alaska - Designated Toxic and Hazardous Substances:</b> Carbon Monoxide.                 | <b>Massachusetts - Substance List:</b> Carbon Monoxide.                       | <b>North Dakota - List of Hazardous Chemicals, Reportable Quantities:</b> No. |
| <b>California - Permissible Exposure Limits for Chemical Contaminants:</b> Carbon Monoxide. | <b>Michigan - Critical Materials Register:</b> Carbon Monoxide.               | <b>Pennsylvania - Hazardous Substance List:</b> Carbon Monoxide.              |
| <b>Florida - Substance List:</b> Carbon Monoxide.   | <b>Minnesota - List of Hazardous Substances:</b> Carbon Monoxide.             | <b>Rhode Island - Hazardous Substance List:</b> Carbon Monoxide.              |
| <b>Illinois - Toxic Substance List:</b> Carbon Monoxide.                                    | <b>Missouri - Employer Information/Toxic Substance List:</b> Carbon Monoxide. | <b>Texas - Hazardous Substance List:</b> Carbon Monoxide.                     |
| <b>Kansas - Section 302/313 List:</b> No.   | <b>New Jersey - Right to Know Hazardous Substance List:</b> Carbon Monoxide.  | <b>West Virginia - Hazardous Substance List:</b> Carbon Monoxide.             |
|   |   | <b>Wisconsin - Toxic and Hazardous Substances:</b> Carbon Monoxide.           |

**CANADIAN FEDERAL REGULATIONS:**

**CANADIAN DSL INVENTORY STATUS:** Carbon Monoxide is listed on the Canadian DSL Inventory.

**OTHER CANADIAN REGULATIONS:** Carbon Monoxide is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations. Carbon Monoxide is not on the CEPA Priorities Substances Lists.

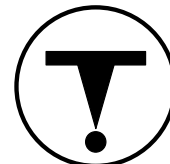
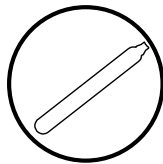
**CANADIAN WHMIS SYMBOLS:**

**Class A:** Compressed Gas

**Class B1:** Flammable Gas

**Class D1A:** Toxic Material/Immediate and Serious Effects

**Class D2A:** Other Toxic Effects

**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:****EC LABELING AND CLASSIFICATION:**

**EC EINECS/ELINCS NUMBER:** 211-128-3

**EC CLASSIFICATION:** Extremely flammable. Toxic. [F+; T]

**EC RISK PHRASES:** Extremely flammable. Toxic by inhalation. Toxic: danger of serious damage to health by prolonged exposure through inhalation. May cause harm to the unborn child. [R: 12, 23-48/23, 61]

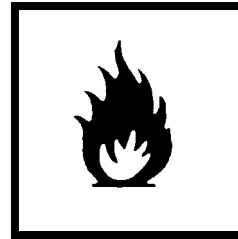
**EC SAFETY PHRASES:** Keep locked up and out of the reach of children.\* *\*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.* Keep container tightly closed and in a well ventilated place. Keep away from sources of ignition - No smoking. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). Avoid exposure; obtain special instructions before use. [S:(1/2-)\* 7/9-16, 45, 53]

**EC COMMENTS:** In mixtures containing Carbon Monoxide, the EC has not assigned specific levels of toxicity according to the percentage of Carbon Monoxide.

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| <b>SECTION 15. REGULATORY INFORMATION (Continued)</b> |
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**EUROPEAN ECONOMIC COMMUNITY REGULATIONS (continued):**

**EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOLS:**



|                                      |
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| <b>SECTION 16. OTHER INFORMATION</b> |
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Information contained in this Material Safety Data Sheet is provided to our customers so they may comply with 29 CFR 1910.1200, Hazard Communication Standard, the Canadian WHMIS Standard, and the requirements of the European Community Directives. The intent of this Material Safety Data Sheet is to provide end users of this product with the health and physical hazards associated with possible exposure to this product. All statements, technical data and recommendations are based on readily available texts and data that Spectra Gases, Inc., believes to be reliable and accurate. Spectra Gases, Inc., makes no warranties, guarantees or representations of any kind with respect to this product or this data. It is the responsibility of the user to obtain and use the most recent version of this MSDS.

Further information about compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

|             |  |
|-------------|--|
| <i>P-1</i>  | <i>"Safe Handling of Compressed Gases in Containers"</i> |
| <i>AV-1</i> | <i>"Safe Handling and Storage of Compressed Gases"</i>   |
|             | <i>"Handbook of Compressed Gases"</i>                    |

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619/565-0302

**Revision History:**

6/7/99 – Date of preparation  
4/405 – General review  
8/25/05 – Sec 14 minor correction  
9/29/05 – Sec 5 - correction of NFPA hazard ratings

## 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 (**STEL**), 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 **TDL<sub>0</sub>**, the lowest dose to cause a symptom and **TCL<sub>0</sub>** 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:

**U.S. and CANADA:** 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. This section also includes information on the precautionary warnings which appear on the material's package label.

**EUROPEAN:** EC is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS**: This is the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning