




MATERIAL SAFETY DATA SHEET

Product Name: Gas Mixture of Ethylene Oxide and Carbon Dioxide			
DOT ID No: UN 1041	DOT Hazard Class: 2.1	Emergency No.: +862 8884 55212	MSDS No: GM-010 Page No. : 1/7
DOT Shipping Label : Flammable Gas			Date last updated: 03/10/2009 Revision No: 00

Chemical Product

Product Name: Flammable Gas Mixture (Carbon Dioxide 10-90% / Ethylene Oxide 90-10%)

1. Hazards Identification
DANGER! Cancer hazard and reproductive hazard. Toxic, extremely flammable liquid and gas under pressure. Can form explosive mixtures with air. Can cause eye and skin burns. Can irritate the respiratory tract. May cause nervous system damage and cataracts. Liquid may cause frostbite. May cause dizziness and drowsiness. Symptoms of exposure may be delayed. Self-contained breathing apparatus must be worn by rescue workers. Ethylene oxide is highly reactive.

ROUTES OF EXPOSURE: Absorbed through skin. Eye contact. Inhalation. Ingestion.

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION: Asphyxiant. Moderate concentrations may cause headaches, drowsiness, dizziness, stinging of the nose and throat, excitation, rapid breathing, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill. Causes irritation of the respiratory tract. Carbon dioxide is also a physiological active, affecting circulation and breathing. Depending on the degree of exposure, there may be coughing, chest tightness, nausea, diarrhea, weakness, cyanosis, loss of coordination, convulsions and coma. May cause lung injury and the delayed onset of pulmonary edema.

SKIN CONTACT: With liquid or solutions in water, there may occur a local erythema, edema, and formation of vesicles. There may be a latent period of several hours prior to the onset of these signs. Liquid may cause frostbite.

SKIN ABSORPTION: Sustained contact with the skin is unlikely, but can cause headache, dizziness, nausea and vomiting. A dilute solution may penetrate skin, producing, a chemical burn.

SWALLOWING: A highly unlikely route of exposure. Will cause severe irritation and ulceration of the mouth and throat, abdominal pain, nausea, vomiting, collapse and coma. Frostbite of the lips and mouth may result from contact with the liquid.

EYE CONTACT: Liquid may cause frostbite and severe irritation with corneal injury. Moderate irritation from high concentrations of vapour.

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:

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Ethylene Oxide: Allergic contact dermatitis may occur in a small proportion of exposed workers. In various reports involving recurrent exposures to high concentrations of ethylene oxide vapour, peripheral neurotoxic effects, and, in some cases, indications of central nervous system toxicity, where described resulting from gross overexposure. In most cases, there was marked improvement on removal from further exposure. A few cases of cataract formation have increased incidence of abortions, the laboratory findings indicated that if adverse reproductive effects are produced by ethylene oxide, these occur only at high exposure concentrations. Several studies on ethylene oxide exposed workers have demonstrated an increased incidence of chromosomal aberrations and sister chromatic exchanges; the relevance of such effects to human health hazards evaluation is currently uncertain. OSHA considers that, at excess levels, Ethylene Oxide may present reproductive, mutagenic, genotoxic, neurologic and sensitization hazards.

Carbon Dioxide: No harm expected.

OTHER EFFECTS OF OVEREXPOSURE:

Ethylene Oxide: May cause cataracts.

Carbon Dioxide: Damage to retinal ganglion cells and central nervous system may occur.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

The toxicology and the physical and chemical properties of this product suggest that overexposure is unlikely to aggravate medical condition.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:

Ethylene Oxide: This component has been shown to produce mutagenic and cytogenic effects in a variety of test systems. Animals exposed to ethylene oxide vapour for up to two years have shown an increase in the incidence of certain malignant tumors in comparison to nonexposed controls. In humans, an increased occurrence of leukemia and stomach cancer has been reported by one group of investigators who pooled results from three Swedish facilities producing or using ethylene oxide, among other materials. Based on experimental and observational data ethylene oxide is a suspect cancer hazard, and should be treated as possible causing cancer in humans. Laboratory studies with mice have shown that acute exposure to ethylene oxide vapour at concentrations of 30 ppm and above cause testicular injury as evidenced by concentrations-related increased embryonic deaths following the mating of exposed males to nonexposed females (Dominant Lethal Test). A recently completed NIOSH study of sterilant workers found an elevated risk of blood cancers among men and breast cancers among women. The elevated risk occurred only at high exposures as defined by a combination of exposure level and years worked. The study showed no elevated cancer or disease risk for sterilant workers overall as compared to the general U.S. population.

In a developmental toxicity study with rats exposed to 225, 125, or 50 ppm of ethylene oxide vapor, there was maternal toxicity at 225 ppm and at 125 ppm. Fetotoxicity was present as reduced fetal body weight at all concentrations, and increased incidents of skeletal variants at 225 ppm indications of embryotoxicity or malformations. In a two-generation oxide vapor for 6 hr/day, 5 day/week, there was parental toxicity at 33 and 100 ppm. Postimplant losses with reduction in litter size and offspring bodyweight were present at 33 and 100 ppm. The no-observed-effects concentrations for adult toxicity, offspring effects, and reproductive effects was 10 ppm.

Carbon Dioxide: A single study has shown an increase in heart defects in rats exposed to 6% carbon dioxide in air for 24 hours at different times during gestation. There is no evidence that carbon dioxide is tetragenic in humans.

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CARCINOGENICITY:

Ethylene Oxide: OSHA considers ethylene oxide to pose a human cancer hazard and a human reproductive hazard. The IARC assigns it to Group 1, "Carcinogenic to humans". The NTP classifies it as "Known to be a human carcinogen".

2. First Aid Measures

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

SKIN CONTACT: Immediately flush affected areas with water for at least 15 minutes while removing contaminated clothing and shoes. Wash with soap and water. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). In case of massive exposure, remove contaminated clothing while showering with warm water. Call a physician. Aerate, wash or clean contaminated clothing. Discard leather goods or shoes.

SWALLOWING: Give two glasses of water. Do not induce vomiting. Call a physician.

EYE CONTACT: Immediately flush eyes with water for at least 15 minutes. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN:

IMPORTANT: In all cases of exposure, get or summon medical treatment immediately. Take victim to a doctor or medical facility at once.

(1) Persons exposed to ethylene oxide may develop severe and intractable vomiting, requiring the use of antiemetics given intravenously.

(2) Prolonged or high vapour concentrations exposure may result in the development of pulmonary edema after a latent phase of several hours. Also, respiratory tract injury caused by ethylene oxide may predispose to the development of a secondary respiratory infection. Individuals exposed to moderately high vapour concentrations of ethylene oxide should be retained for observation.

(3) Following skin contamination, primary irritation and blister formation may be delayed in onset.

(4) When introduced directly into the blood stream ethylene oxide may act as a hapten and lead to the development of anaphylactoid reactions of varying severity. This has been noted in a few haemodialysis and plasmapheresis patients due to desorption of ethylene oxide from the sterilized equipment. There appears to be a close association to the presence of IgE antibodies to albumin/ethylene oxide conjugates.

3. Fire Fighting Measures

FLAMMABLE: Yes.

If Yes Under what conditions: Forms explosive mixtures with air and oxidizing agents.

FLASH POINT: Not Applicable

AUTO IGNITION TEMPERATURE: Not Applicable

FLAMMABLE LIMITS IN AIR: LOWER: 3% **UPPER:** 100% (Ethylene Oxide)

EXTINGUISHING MEDIA: CO2, dry chemical, water spray or fog.

SPECIAL FIRE FIGHTING PROCEDURES:

DANGER! Evacuate all personnel from danger area. Immediately cool cylinders with water spray from maximum distance taking care not to extinguish flames. Remove ignition source if without risk. If flames are accidentally extinguished, explosive re-ignition may occur; therefore, appropriate measures should be taken; e.g., total evacuation. Re-approach with extreme caution.

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Use self-contained breathing apparatus. Stop flow of gas if without risk while continuing cooling water spray. Remove all containers from area if without risk. Allow fire to burn out.

UNUSUAL FIRE AND EXPLOSION HAZARD:

Flammable gas. Forms explosive mixtures with air and oxidizing agents. Container may rupture due to heat of fire. Do not extinguish flames due to possibility of explosive re-ignition. Flammable vapours may spread and spill. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with approved device. No part of a container should be subjected to temperature higher than 52 C (approximately 125 F). Vapours from this product and may travel or be moved by air currents and ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharges, or other ignition sources at locations distant from product handling point. Most containers are provided with a pressure relief device designed to vent contents when they are exposed to elevated temperature.

HAZARDOUS COMBUSTION PRODUCTS: These products are carbon oxides (CO, CO₂).

SENSITIVITY TO IMPACT: Avoid impact against container

SENSITIVITY TO STATIC DISCHARGE: Possible, ground container.

4. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Forms explosive mixtures with air. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus operated in the pressure demand mode and appropriate protective clothing. Remove all sources of ignition if without risk. Reduce vapours with fog or fine water spray. Shut off leak if without risk. Ventilate area of leak or move leaking container to well ventilated area. Flammable vapours may spread from spill. Before entering area, especially confined areas, check atmosphere with appropriate device.

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, provincial, and local regulations. If necessary, call your local supplier for assistance.

5. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Separate flammable cylinders from oxygen, chlorine, and other oxidizers by at least 20 ft. (6.1 m) or use a barricade of non-combustible material. This barricade should be at least 5 ft (1.53 m) high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

PRECAUTIONS TO BE TAKEN IN HANDLING:

Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Electrical equipment must be non-sparking or explosion-proof. Leak check system with soapy water; never use a flame. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to

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remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE:

Flammable high-pressure gas. Use only in a closed system. Use piping and equipment adequately designed to withstand pressures to be encountered. Use only spark-proof tools and explosion-proof equipment. Keep away from heat, sparks and flame.

Gas can cause rapid suffocation due to oxygen deficiency. Store and use with adequate ventilation. Close valve after each use; keep closed even when empty.

Prevent reverse flow. Reverse flow into cylinder may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder.

Never work on a pressurized system. If there is a leak, close the cylinder valve. Blow the system down in an environmentally safe manner in compliance with all federal, provincial, and local laws, then repair the leak.

Never place a compressed gas cylinder where it may become part of an electrical circuit.

6. Personal Protection

RESPIRATORY PROTECTION: Use respirable fume respirator or air supplied respirator when working in confined space or where local exhaust or ventilation does not keep exposure below TLV. Select in accordance with the provincial regulations or guidelines. Selection should also be based on the current CSA standards Z94.4, "Selection, care and use of respirators". Respirators should be approved by NIOSH and MSHA.

SKIN PROTECTION: Butyl rubber. Gloves have a lifetime of approximately one half to one hour after contact with liquid ethylene oxide.

EYE PROTECTION: Wear safety glasses when handling cylinders. Select in accordance with the current CSA standard Z94.3, "Industrial Eye and Face Protection", and any provincial regulations, local bylaws or guidelines.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuffless trousers should be worn outside the shoes.

7. Physical and Chemical properties

Physical state	Gas	Freezing point	- 112.6°C (- 170.7°F) based on data for: Ethylene Oxide.	PH	Acidic
Boiling point	Not Available	Vapor Pressure	675 – 750 psig	Molecular weight	Not applicable
Specific Gravity Liquid (water = 1)	Weighted average of 1.52 (Water = 1)	Solubility in water	Appreciable	Boiling point	Not Available
Specific Gravity Vapor (Air = 1)	Not Available	Evaporation rate	>1 (Ethylene Oxide) compared to (Butyl	Coefficient of Water / Oil Distribution	Not Available

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			Acetate=1)		
Vapor density	The highest known value is > 1 (Air = 1) (Carbon dioxide). Weighted average 1.1 (Air = 1)	% of Volatiles by volume	100%	Odor Threshold	Not Available
Appearance	Colorless		Odor		Ethereal

8. Stability and Reactivity

CONDITIONS OF CHEMICAL INSTABILITY: Pure Ethylene Oxide will decompose violently if exposed to a high enough temperature, commonly accepted to be above 560 C at atmospheric pressure. This temperature can vary depending upon time, pressure, and conditions of the system. The temperature required for decomposition is reduced as pressure and volume-to-surface ratios are increased. Ethylene Oxide is stable at ordinary conditions of temperatures and pressure and in ordinary use, handling and storage.

INCOMPATIBILITY (materials to avoid): Oxidizers, mercaptans, alkali metals, alkaline earth metals, alcohols, metal acetylides, chromium, titanium above 550 C, uranium above 750 C.

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition or burning may produce carbon monoxide/carbon dioxide.

HAZARDOUS POLYMERIZATION: Yes.

CONDITIONS OF REACTIVITY: Trace polymers may be present under ordinary conditions of temperature, pressure, etc. However, Ethylene Oxide will polymerize violently if contaminated with aqueous alkalis, amines, mineral acids, metal chlorides or metal oxides. Avoid exposing stored cylinders to heat or sources of ignition.

9. Toxicology Information

Carbon Dioxide Component: Carbon dioxide is an asphyxiant. It initially stimulates respiration and then causes respiratory depression. High concentrations result in narcosis. Symptoms in humans are as follows:

Effects	Carbon dioxide concentrations
Breathing rate increases slightly.	1%
Breathing rate increases to 50% above normal level. Prolonged exposure can cause headache, tiredness.	2%
Breathing increases to twice normal rate and become labored. Weak narcotic effect. Impaired hearing, headache, increased blood pressure and pulse rate.	3%
Breathing increases to approximately four times normal rate, symptoms of intoxication become evident, and slight choking may be felt.	4 – 5%

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Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment, and ringing in the ears. Judgment may be impaired, followed within minutes by loss of consciousness.	5 – 10%
Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.	10 – 100%

10. Ecological Information

No adverse ecological effects expected. This product does not contain any Class I or Class II ozone-depleting chemicals. The components of this mixture are not listed as marine pollutants by TDG Regulations.

11. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

12. Transport Information

TDG/IMO SHIPPING NAME: Ethylene oxide and carbon dioxide mixtures

HAZARD CLASS: Class 2.1 Flammable Gas

IDENTIFICATION NUMBER: UN 1041

SHIPPING LABEL: Flammable Gas

PLACARD (When required): Flammable Gas

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, non ventilated compartment of vehicle can present serious safety hazards.

13. Other Information

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:

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