

MATERIAL SAFETY DATA SHEET

CARBON DIOXIDE, REFRIGERATED LIQUID

1. PRODUCT AND COMPANY INFORMATION

Product: Carbon Dioxide, Refrigerated Liquid
Trade Name: Carbon Dioxide Liquefied, Bulk Carbon Dioxide
Chemical Name: Carbon Dioxide
Common Name: Liquefied Carbon Dioxide

Formula: CO₂
Manufacturer's Name: Ferus Inc
Manufacturer's Address: Suite 916-401-9 Avenue S.W.
Calgary, Alberta Canada T2P-3C5

Supplier's Name: Ferus Inc
Supplier's Address: Suite 916-401-9 Avenue S.W.
Calgary Alberta Canada T2P-1G9

24 Hr Emergency Phone Numbers:

Ferus	1-403-340-2990
Toll Free	1-877-923-3787
CANUTEC (collect)	1-613-996-6666

Production Identification Number: UN 2187
WHMIS Classification: A
TDG Classification: 2.2

2. COMPOSITION/INFORMATION ON INGREDIENTS

EXPOSURE LIMITS¹:

INGREDIENT	% VOLUME	8-HOUR OCCUPATIONAL EXPOSURE LIMIT ²	15-MINUTE or CEILING (c) OCCUPATIONAL EXPOSURE LIMIT ²	LD(50) (Route- Species)	LC(50) (Route- Species)
Carbon Dioxide CAS: 124-38-9	>99%	9000 mg/m ³	54000 mg/m ³	N/A	N/A

¹ Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As listed in the Occupational Health and Safety Act, Regulation and Code of Alberta under OHS Code Schedule 1 (Table 2 Occupational exposure limits for chemical substances).

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER! Odourless, colourless, non-flammable gas. Simple Asphyxiant— This product does not contain oxygen and may cause asphyxia if released in a confined area. Maintain oxygen levels above 19.5%. Carbon Dioxide acts as a weak narcotic at high concentrations (30,000 ppm). Inhalation of high concentrations of Carbon Dioxide can cause reduced hearing acuity, changes in respiration and increased blood pressure and pulse. Contact with liquid product may cause frostbite or freezing burns in exposed tissues. Contents under pressure. Use and store below 52°C.

4. FIRST AID MEASURES

GENERAL: Always remove the victim from the source of contamination. Medical attention should be prompt in all cases of over-exposure to Liquid Carbon Dioxide. Rescue personnel should be equipped with Self-Contained Breathing Apparatus. Also note that there is no specific antidote, and treatment of over-exposure should be directed at the control of symptoms and the clinical condition. Take a copy of label and MSDS to physician or other health professional with victim(s).

EYES:

Never introduce oil or ointment into the eyes without medical advice! In case of freezing or cryogenic “burns” caused by rapidly evaporating liquid do not wash the eyes with hot or even tepid water. Remove victim from the source of contamination. If the victim cannot tolerate light, protect eyes with dark glasses. The use of bandages is not recommended for keeping the eyelids closed as exerting pressure on the eyelid may cause further damage.

SKIN:

Remove contaminated clothing and flush affected area with luke warm water and soap. DO NOT USE HOT WATER. A physician should see the patient promptly if frostbite has occurred.

INGESTION:

A physician should see the patient promptly if frostbite has occurred.

INHALATION:

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO CARBON DIOXIDE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. FIRE OR EXPLOSION HAZARDS

FLASH POINT (test method): Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS IN AIR: LOWER: Not applicable, **UPPER:** Not applicable

CONDITIONS OF FLAMMABILITY: Non-flammable.

EXTINGUISHING MEDIA: This material cannot catch fire.

SPECIAL FIRE FIGHTING PROCEDURES:

UNUSUAL FIRE AND EXPLOSION HAZARDS: Heat from a fire can build pressure in containers and cause them to rupture. No part of a container should be subjected to a temperature higher than 125°F (51.1°C). Liquid Carbon Dioxide containers are equipped with pressure relief devices.

HAZARDOUS COMBUSTION PRODUCTS:

Carbon Dioxide cannot burn therefore, upper and lower flammable limits and auto ignition temperatures are not applicable.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT:

Avoid impact against container.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not applicable.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

CAUTION! High-pressure gas. Evacuate area. Use protective clothing and wear a Self-Contained Breathing Apparatus when entering the area. Shut off the flow if it can be done so without risk. Ventilate the area or move the container to a well-ventilated area. Before reentry test for sufficient, ensuring it is at least 19.5%.

7. HANDLING AND STORAGE

ELECTRICAL CLASSIFICATION: Non-hazardous.

This liquefied gas is non-corrosive and may be used with all common structural materials. Use only in well-ventilated areas. Use a pressure reducing regulator when connecting cylinder to lower pressure piping or systems. Do not heat cylinder or vessels by any means to increase the discharge rate of product.

Stationary customer site vessels should be operated in accordance with the manufacturer's and Ferus's instructions. Do not attempt to repair, adjust or in any other way modify the operation of these vessels. If there is a malfunction or other type of operations problem with the vessel, contact the closest Ferus location immediately for assistance.

Liquid Carbon Dioxide is delivered into stationary vacuum jacketed vessels at the customer's location. Consult manufacturer's instructions.

STORAGE PRECAUTIONS: Store and use with adequate ventilation. Do not store in a confined space. Storage areas should be clean and dry, free of oils and dust, which collect on condensing coils and impair their efficiency. Temperature should not exceed 52°C. Cryogenic containers are equipped with a pressure relief device and a pressure-controlling valve. Under normal conditions these containers will periodically vent product to control internal pressure. Use adequate pressure relief devices in systems and piping to prevent pressure buildup; entrapped liquid can generate extremely high pressures.

HANDLING PRECAUTIONS: Avoid inhalation of any kind when venting the gas. Always stay up stream of the venting and stay out of low lying areas where gas pockets could accumulate. Avoid any contact of unprotected parts of your body with un-insulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and will tear when you try to pull free. When mixing carbon dioxide with one or more gases or liquefied gases, additional unexpected hazards can be created.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST – Preferred. Local exhaust to control air contaminants to at or below acceptable exposure guidelines and maintain atmospheric oxygen at 19.5%.

MECHANICAL (general) – General exhaust ventilation may be acceptable if it can maintain an adequate supply of air.

SPECIAL – Not applicable.

OTHER – Not applicable.

EYE/FACE PROTECTION: CSA (standard Z94.3-99 or Z94.3-02) approved safety glasses and full face shields are required to be utilized at all times when working with and / or around this product.

SKIN PROTECTION: Protective gloves of any material appropriate for the job. Insulated gloves are recommended for cryogenic liquids.

RESPIRATORY PROTECTION: Use air supplied respirators where local or general exhaust ventilation is inadequate. CSA (standard Z94.4-02) approved supplied air/self contained air respirators must be used in confined spaces, oxygen deficient atmospheres and rescue situations where oxygen levels are below 19.5%.

OTHER/GENERAL PROTECTION: Safety shoes, emergency showers.

9. PHYSICAL AND CHEMICAL DATA

Parameter	Value	Units
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PHYSICAL STATE	Liquid	-
MOLECULAR WEIGHT	44.01	g/mol
SPECIFIC GRAVITY (Air = 1)(1.1013 bar and 21°C)	1.521	-
VAPOUR PRESSURE (at 20°C)	58.5	bar
LIQUID DENSITY (at 21.1°C)	763.12	kg/m ³
VAPOR DENSITY (at 21.1°C)	1.833	kg/m ³
EVAPORATION RATE (nBuAc=1)	High	-
BOILING POINT	-78.5	°C
FREEZING POINT	-56.57	°C
pH:	3.7(Carbonic Acid)	-
COEFFICIENT WATER/OIL DISTRIBUTION(Gas @ 15°C)	1.0106	-
SPECIFIC VOLUME (1.013 bar and 21 °C)	0.547	m ³ /kg

ODOUR AND APPEARANCE: Carbon Dioxide refrigerated liquid is colourless, odourless and converts to white crystalline snow like particles when discharged from a container to the atmosphere. The gas is slightly acidic and in some cases is felt to have a slight pungent odor and biting taste.

ODOUR THRESHOLD: Not Applicable. Odourless

10. REACTIVITY AND STABILITY DATA

CHEMICAL STABILITY: Relatively non-reactive.

INCOMPATIBLE MATERIALS: Alkali metals, alkaline earth metals, metal acetylides, chromium, titanium above 550 °C, uranium above 750 °C.

CONDITIONS OF REACTIVITY TO AVOID: None known.

HAZARDOUS DECOMPOSITION PRODUCTS: Electrical discharges and high temperatures decompose carbon dioxide into carbon monoxide and oxygen.

11. TOXICOLOGICAL INFORMATION

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

ROUTES OF ENTRY:

-INHALATION: Carbon dioxide gas is an asphyxiant with effects due to lack of oxygen. It is also physiologically active, affecting circulation and breathing. Moderate concentrations may cause headache, drowsiness, dizziness, stinging of the nose and throat, excitation, rapid breathing and heart rate, excess salivation, vomiting, and unconsciousness. It is the most powerful cerebral vasodilator known.

-SKIN CONTACT: No harm expected from vapor. Prolonged contact with carbon dioxide crystals (snow) could cause frostbite. Cold gas, or liquid or solid carbon dioxide may cause severe frostbite.

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-INGESTION: An unlikely route or exposure. This product is a gas at normal temperature and pressure. But severe frostbite of the lips and mouth may result from contact with the liquid or solid.

-EYE CONTACT: No harm expected from vapor. Cold gas, or liquid or solid carbon dioxide may cause severe frostbite.

EFFECT CONCENTRATION:

CO₂ CONCENTRATION

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 becomes 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%
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 accompanied by rigidity and tremors occur in less than 1 minute	15%

EFFECTS OF ACUTE EXPOSURE TO PRODUCT: Carbon Dioxide is the most powerful cerebral vasodilator known. If large concentrations are inhaled it will result in rapid circulatory insufficiency leading to coma and death. The effects of frostbite include a change in the skin color to gray or white possibly followed by blistering.

EFFECTS OF CHRONIC EXPOSURE TO PRODUCT: No harm expected to healthy individuals. Where competent medical authority deems that such illness would be aggravated by exposure to carbon dioxide, persons in ill health should be restricted from working with or handling this product.

OTHER EFFECTS OF OVEREXPOSURE: Damage to retinal or ganglion cells and central nervous system may occur.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: The toxicology and the physical and chemical properties of carbon dioxide suggest that overexposure is unlikely to aggravate existing medical conditions.

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

TERATOGENICITY: Not listed as a teratogen.

CARCINOGENICITY: Not listed as a carcinogen.

MUTAGENICITY: Not listed as a mutagen.

REPRODUCTIVE TOXICITY: Not listed.

IRRITANCY OF PRODUCT: None.

SENSITIZATION TO PRODUCT: None.

NAME OF TOXIOLOGICAL SYNERGISTIC PRODUCTS: None.

12. ECOLOGICAL INFORMATION

No adverse ecological effects expected. Carbon Dioxide does not contain any Class I or Class II ozone depleting chemicals. Carbon Dioxide is not listed as a marine pollutant by DOT.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD:

Necessary measures should be taken to prevent waste from contaminating the surrounding environment while ensuring personnel are out of harms way. Any product, residue, disposable container, or liner should be discarded of in an environmentally safe manner, in full compliance with federal, provincial, and local regulations. If necessary, call your local supplier for assistance.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Carbon Dioxide, refrigerated liquid
SHIPPING LABEL(S):	Non-flammable, non-corrosive, non-poisonous gas
PRIMARY CLASS:	2.2
PACKING GROUP:	N/A
UN NUMBER:	2187
ERG (2004) NUMBER:	120

SPECIAL TRANSPORT INFORMATION: Containers should be in a secure position when transported, and in a well-ventilated vehicle. Containers transported in an enclosed, non-ventilated vehicle can present a serious safety hazard.

OTHER TRANSPORT INFORMATION: Ensure that drivers are aware of load characteristics, and through TDG training, know what to do in the event of an accident or emergency. Ensure all shipments are moved within the applicable regulations.

15. REGULATORY INFORMATION

WHMIS CLASSIFICATION:

A (compressed gas)



HMIS RATINGS:

0 = Minimal Hazard
1 = Slight Hazard
2 = Moderate Hazard
3 = Serious Hazard
4 = Severe Hazard

HEALTH HAZARD	(Blue)	3
FLAMMABILITY HAZARD	(Red)	0
PHYSICAL HAZARD	(Yellow)	2

CANADIAN DOMESTIC SUBSTANCES LIST: Carbon Dioxide is listed on the DSL inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT: Carbon Dioxide is not listed on the CEPA priorities substances list.

OTHER CANADIAN REGULATIONS: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

U.S. TOXIC SUBSTANCE CONTROL ACT: Carbon Dioxide is on the TSCA inventory.

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

16. OTHER INFORMATION

Carbon Dioxide processes have been known to create aromatic organic liquids known as BTEX in minute quantities that are considerably below quantities required to be reported on Material Safety Data Sheets. BTEX contains: Benzene CAS 71-43-2, Toluene 108-88-3, Ethylbenzene 100-41-4 and Xylene 1330-20-7. These components are known to be irritants to eyes, skin and respiratory systems. These components are toxic to the central nervous system with the following effects: dizziness, drowsiness, headaches, tearing of the eyes and muscle weakness. Benzene is a known cancer causing agent that affects bone marrow and blood formation.

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(2) Ferus Inc asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.