

# Carbon Dioxide, Refrigerated Liquid Safety Data Sheet

Ferus Inc.

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## CARBON DIOXIDE, REFRIGERATED LIQUID

### SAFETY DATA SHEET

#### 1. PRODUCT AND COMPANY INFORMATION

Product: Carbon Dioxide, Refrigerated Liquid

Manufacturer's Name: Ferus Inc.  
Manufacturer's Address: 11647 - 99 Ave, Ft. Saskatchewan, AB  
01-08-70-11-W6, Grande Prairie County, AB  
02-05-44-01-W5, Ponoka County, AB

Supplier's Name: Ferus Inc.  
Supplier's Address: Suite 1220, 401-9th Ave SW  
Calgary, Alberta Canada T2P 3C5

**24 Hr Emergency Phone Numbers:**

<b>Ferus Canada</b>	<b>1-877-923-3787</b>
<b>Ferus USA</b>	<b>1-855-903-3787</b>
<b>CANUTEC</b>	<b>1-613-996-6666</b>

#### RECOMMENDED USES:

Refrigerant, provides an inert atmosphere for fire extinguishers, refinery products, petroleum products, displacing oxygen, in high pressure applications, oil well stimulation, as fertilizer, hardening of molds for metal castings.

Refrigeration, aerosol propellant, chemical intermediate (carbonates, synthetic fibers, p-xylene, etc.), low-temperature testing, fire extinguishing, inert atmospheres, fracturing and acidizing of oil wells, miscible pressure source, hardening of foundry molds and cores, shielding gas for welding, cloud seeding, moderator in some types of nuclear reactors, special lasers, blowing agent, as demulsifier in tertiary oil recovery, possible source of methane, (liquid) carrier for powdered-coal slurry.

#### 2. HAZARDS IDENTIFICATION

Production Identification Number: UN 2187  
WHMIS Classification: A – Compressed Gas  
Class: 2 – Gases  
Division: 2.2 – Non-flammable, non-toxic gases

#### WHMIS CLASSIFICATION:

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A (compressed gas)

## NFPA 704 RATING:

HEALTH HAZARD	(Blue - left)	0
FLAMMABILITY HAZARD	(Red - top)	0
PHYSICAL HAZARD	(Yellow - right)	0
OTHER	(White - bottom)	N/A



## WARNING!

Cold liquid and gas under pressure. Container may explode if heated. Use and store below 51.1°C (125°F).

When in contact with refrigerated liquids, many materials become brittle and are likely to break without warning.

In the event that a hydrate formation (ice plug) occurs, the pressure behind the plug can cause the plug to become a trajectory and can result in serious injury or death.

Exposure to carbon dioxide (including vapour) may result in:

- Reduced hearing acuity
- Increased respiration and heart rate
- Dizziness and / or drowsiness
- Suffocation without warning
- Damage to the nervous system
- Frostbite

Maintain oxygen levels above 19.5%.

All early effects may decrease ability for self-rescue from the toxic environment.

**SUMMARY OF EXPOSURE (ACUTE EXPOSURE):** Simple asphyxiants are inert gases or vapours that displace oxygen from the air and as such may result in hypoxia. Four stages are described, depending on the arterial oxygen saturation.

- 1.) INDIFFERENT STAGE (Oxygen saturation: 90%):** Decreased night vision
- 2.) COMPENSATORY STAGE (Oxygen saturation: 82% to 90 %):** Compensatory increase in respiratory rate, compensatory increase in heart rate, night vision is decreased further, mildly reduced performance ability, mildly reduced alertness, other symptoms may develop in those with significant preexisting cardiac, pulmonary, or hematologic diseases
- 3.) DISTURBANCE STAGE (Oxygen saturation: 64% to 82%):** Compensatory mechanisms become inadequate, air hunger, fatigue, tunnel vision, dizziness, headache, belligerence, euphoria, reduced visual acuity, numbness and tingling

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of extremities, hyperventilation, poor judgment, memory loss, cyanosis, decreased ability for escape from toxic environment

**4.) CRITICAL STAGE (Oxygen saturation: 60% to 70% or less):** Deterioration in judgment and coordination may occur in 3 to 5 minutes or less, total incapacitation and unconsciousness follow rapidly

**CARDIOVASCULAR (ACUTE EXPOSURE):** An increased pulse rate may occur. Cardiac manifestations of prolonged or severe hypoxia may include atrial or ventricular dysrhythmias, hypotension, myocardial ischemia, myocardial infarction, and eventual asystole. "Sudden sniffing death", or cardiac arrest, has been reported following intentional inhalation of hydrocarbons.

**RESPIRATORY (ACUTE EXPOSURE):** Hyperventilation may develop. Cyanosis may occur. Bronchoconstriction and respiratory depression may be seen. Pulmonary edema and lung congestion may occur.

**NEUROLOGIC (ACUTE EXPOSURE):** Various disturbances including headache, dizziness, mood disturbances, numbness of the extremities, sleepiness, mental confusion, poor judgment and coordination, and memory loss may occur. Prolonged or severe hypoxia has resulted in unconsciousness. Prolonged asphyxia may produce CNS injury. Hemiparesis has been reported with volatile substance abuse. Cerebral edema with brainstem herniation may occur. Seizures have been reported following intentional inhalation.

**GASTROINTESTINAL (ACUTE EXPOSURE):** Nausea, vomiting, and gastrointestinal hemorrhage may develop.

**ACID-BASE (ACUTE EXPOSURE):** Hypercapnia may be seen.

**DERMATOLOGIC (ACUTE EXPOSURE):** Dermal exposure may cause frostbite injury. Severe tissue burns have been reported.

**MUSCULOSKELETAL (ACUTE EXPOSURE):** Rhabdomyolysis and seizures have been reported.

**REPRODUCTIVE HAZARDS:** Sequelae of oxygen deprivation in the unborn are controversial. Cerebral palsy, previously thought to be due to acute hypoxia during labor and/or childbirth, remains poorly understood.

**CARCINOGENICITY:** CAS124-38-9 is not listed as a carcinogen (IARC, 2004).

### 3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS RN	CONCENTRATION
Carbon Dioxide	124-38-9	>99%

Trade Name:

Carbon Dioxide Liquefied, Bulk Carbon Dioxide

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Chemical Name: Carbon Dioxide  
Common Name: Liquefied Carbon Dioxide  
Formula: CO<sub>2</sub>

### 4. FIRST AID MEASURES

**GENERAL:** Remove the victim from the source of contamination. Medical attention should be prompt in all cases of over-exposure to 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 the label and SDS to physician or other health professional with victim(s).

**EYES:** Remove victim from the source of contamination. Never introduce oil or ointment into the eyes without medical advice. Irrigate exposed eyes with copious amounts of room temperature water for at least 15 minutes. 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. If irritation, pain, swelling, or other symptoms persist, the patient should be seen by a health care physician.

**SKIN:** Clothing frozen to the skin should be thawed prior to removal. Remove contaminated clothing and flush affected area with lukewarm water. **DO NOT USE HOT WATER.** Keep victim warm and quiet. A physician should see the patient promptly if frostbite has occurred.

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

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

### 5. FIREFIGHTING MEASURES

**SPECIAL CONSIDERATIONS:** Non-combustible gas. 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 51.1°C (125°F). Liquid Carbon Dioxide containers are equipped with pressure relief devices. If tank, rail car or tank truck is involved in a fire, **ISOLATE** for 800 meters (1/2 mile) in all directions

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**FIRE FIGHTING:** Self-contained breathing apparatus with a full face-piece operated in pressure-demand or other positive pressure mode.

**IF MATERIAL IS ON FIRE OR INVOLVED IN FIRE:** Material itself does not burn or burns with difficulty. Extinguish fire using agent suitable for type of surrounding fire. Cool affected containers with flooding quantities of water. Do not use water on material itself or near pressure relief devices. Apply water from as far a distance as possible.

## 6. ACCIDENTAL RELEASE MEASURES

**STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: CAUTION!** High-pressure gas. Large spill –Consider initial downwind evacuation for at least 100 meters (330 feet) in all directions. Use appropriate protective clothing and wear a Self-Contained Breathing Apparatus when entering the area. Shut off the flow of product if safe to do so. Ventilate area or move the container to a well-ventilated area. Test for sufficient oxygen and ensure oxygen level is at least 19.5% prior to re-entry.

## 7. STORAGE AND HANDLING

**STORAGE PRECAUTIONS:** Store and use with adequate ventilation. Temperature should not exceed 52°C or 125.6°F. Containers are equipped with a pressure relief device and a pressure-controlling valve. Under normal conditions these containers may periodically vent product to control internal pressure. Use adequate pressure relief devices in systems and piping to prevent pressure buildup as trapped liquid can generate extremely high pressures.

Liquid Carbon Dioxide is stored in insulated vessels. Storage vessels must meet applicable governmental standards. Use vessels in accordance with equipment manufacturer's operating instructions. Do not attempt to repair, adjust or in any other way modify the operation of these vessels.

**HANDLING PRECAUTIONS:** 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. Avoid inhalation of vapours when venting the gas. Always stay upstream of the venting and stay out of low lying areas where gas pockets could accumulate. Avoid any contact of unprotected parts of the body with un-insulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and may 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.

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## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### NIOSH RECOMMENDED EXPOSURE LIMITS:

10 Hr Time-Weighted Avg: 5,000 ppm (9,000 mg/cu m)  
15 Min Short-Term Exposure Limit: 30,000 ppm (54,000 mg/cu m)

### OSHA RECOMMENDED EXPOSURE LIMITS:

Permissible Exposure Limit: Table Z-1 8-hr Time Weighted Avg: 5000 ppm (9000 mg/cu m).

Vacated 1989 OSHA PEL TWA 10,000 ppm (18,000 mg/cu m); STEL 30,000 ppm (54,000 mg/cu m) is still enforced in some states.

**IDLH:** 40,000 ppm

Compressed gases may create low temperatures when they expand rapidly. Leaks and uses that allow rapid expansion may cause a frostbite hazard. Wear appropriate personal protective clothing to prevent the skin from becoming frozen.

Wear appropriate eye protection to prevent eye contact with Carbon Dioxide (which may result in burns or tissue damage from frostbite).

Quick drench facilities and/or eyewash fountains should be provided within the immediate work area for emergency use where there is any possibility of exposure to liquids, solids or gases that are extremely cold or rapidly evaporating.

### RESPIRATOR RECOMMENDATIONS:

#### UP TO 40,000 PPM:

Assigned Protection Factor (APF)	Respirator Recommendation
APF = 10	Any supplied-air respirator.
APF = 50	Self-contained breathing apparatus with a full face-piece.

### EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS:

Assigned Protection Factor (APF)	Respirator Recommendation
APF = 10,000	Any self-contained breathing apparatus that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode.

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	Any supplied-air respirator that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.
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**ESCAPE CONDITIONS:** Any supplied-air respirator that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

## **VENTILATION/ENGINEERING CONTROLS:**

**LOCAL EXHAUST** – Preferred. Use 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:** OSHA approved safety glasses and full face shields are required to be utilized at all times when working with 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. OSHA 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 footwear and coveralls/other suitable protective clothing and equipment are to be utilized in accordance with the hazards of the task and site.

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

**COLOUR:** Carbon Dioxide refrigerated liquid is colourless and converts to white crystalline snow-like particles when discharged from a container to the atmosphere.

**ODOUR:** Odourless. Contact with water may result in a faintly pungent odour.

**TASTE:** Faint acid taste

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**pH:** Varies from 3.7 at 101 kPa (1 atm) to 3.2 at 2370 kPa (23.4 atm)

**MELTING POINT:** -69.84°F (-56.58°C) (triple point)

**FREEZING POINT:** -69.83°F (-56.57°C)

**BOILING POINT:** -109.3°F (-78.5°C) sublimation

**FLASHPOINT:** N/A

**EVAPORATION RATE (nBuAc=1):** High

**CONDITIONS OF FLAMMABILITY:** Non-flammable.

**UPPER / LOWER FLAMMABILITY / EXPLOSIVE LIMITS:** N/A

**VAPOUR PRESSURE:** 4.83X10+4 mm Hg at 77°F (25°C)

**VAPOUR DENSITY:** 1.53 at 172.76°F (78.2°C) (Air = 1)

**DENSITY SPECIFIC GRAVITY:** Absolute density: 0.1146 lb/cu ft at 25°C (77°F); density: (gas at 0°C [32°F]) 1.976 g/L at 760 mm Hg; (liq at 0°C [32°F]) 0.914 at 34.3 atm; (solid) at -56.6°C (-69.88°F) 1.512; critical density: 0.464

**SOLUBILITIES:** Miscible with hydrocarbons and most organic liquids.

**COEFFICIENT WATER/OIL DISTRIBUTION (Gas @ 15°C or 59°F):** 1.0106

**AUTOIGNITION TEMPERATURE:** N/A

**DECOMPOSITION:** Decomposes on heating above 2000 °C (3632°F), producing toxic carbon monoxide.

**MOLECULAR WEIGHT:** 44.01 g/mol

**VISCOSITY:** 14.9 uPa-sec at 25°C (77°F)

**EXPLOSION SENSITIVITY TO MECHANICAL IMPACT:** Avoid impact against container.

**EXPLOSION SENSITIVITY TO STATIC DISCHARGE:** N/A

**ELECTRICAL CLASSIFICATION:** Non-hazardous.



### 10. STABILITY AND REACTIVITY

**CHEMICAL STABILITY:** Relatively non-reactive.

**POSSIBILITY OF HAZARDOUS REACTIONS:** Dusts of various metals, such as magnesium, zirconium, titanium, aluminum, chromium & manganese are ignitable and explosive when suspended in carbon dioxide. Liquid or solid carbon dioxide will attack some forms of plastics, rubber and coatings. Forms carbonic acid in water.

**CONDITIONS OF REACTIVITY TO AVOID:** None known.

**INCOMPATIBLE MATERIALS:** Alkali metals, alkaline earth metals, metal acetylides, chromium, titanium above 550 °C (1022 °F), uranium above 750 °C (1382 °F). Incompatible with acrylaldehyde, aziridine, sodium peroxide.

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

### 11. TOXICOLOGICAL INFORMATION

**WARNING!** Carbon dioxide is an asphyxiant which initially stimulates respiration and then causes respiratory depression. High concentrations result in narcosis.

Unconsciousness leading to death can occur when the atmospheric oxygen concentration is reduced to 6% to 8% or less. Signs of asphyxia are often noted when atmospheric oxygen is displaced such that the oxygen concentration is 15% to 16% or less. At increasing altitudes, the decreasing atmospheric pressure decreases the partial pressure of oxygen, decreasing the molecules of oxygen available in stipulated percentages.

Depending on the length of exposure time, adverse symptoms can be expected with exposure to carbon dioxide at concentrations greater than 2%. Effects become more marked as the concentration increases. Death generally occurs after exposure to carbon dioxide concentrations greater than 17%.

#### **SYMPTOMS IN HUMANS ARE AS FOLLOWS:**

**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:** Contact with carbon dioxide may cause severe frostbite.

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**INGESTION:** An unlikely route of exposure as this product is a gas at normal pressure and temperature. Exposure may result in severe frostbite of the lips and mouth.

**EYE CONTACT:** Contact with carbon dioxide may cause severe frostbite.

**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 colour 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.

**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.

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## 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 harm's way. Any product, residue, disposable container, or liner should be discarded of in an environmentally safe manner; and must be in full compliance with all applicable federal, state/provincial, and other applicable local regulations.

## 14. TRANSPORT INFORMATION

<b>PROPER SHIPPING NAME:</b>	Carbon Dioxide, refrigerated liquid
<b>SHIPPING LABEL(S):</b>	Non-flammable, non-corrosive, non-poisonous gas
<b>PRIMARY CLASS:</b>	2.2
<b>PACKING GROUP:</b>	N/A
<b>UN NUMBER:</b>	2187
<b>ERG (2008) NUMBER:</b>	120

**SPECIAL TRANSPORT INFORMATION:** Bulk shipments are transported in pressurized vessels which must meet applicable local regulations and be operated in accordance with manufacturer's operating instructions.

**OTHER TRANSPORT INFORMATION:** Drivers must be aware of load characteristics and through the completion of required Hazmat/TDG training must know what to do in the event of an accident or emergency. All shipments must be transported in accordance with applicable regulations.

## 15. REGULATORY INFORMATION

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

**OTHER U.S. FEDERAL REGULATIONS:** Not applicable.

**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 SDS contains all the information required by the CPR.

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## 16. PREPARATION INFORMATION

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**PREPARATION DATE:** 11/14/2012

**REVISION DATE:** N/A

**EXPIRY DATE:** 11/14/2015

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(2) Ferus Inc. asks users of this product to study this SDS 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 SDS 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.