CARBON DIOXIDE, REFRIGERATED LIQUID

Safety Data Sheet

1. IDENTIFICATION

Product identifier

Product Name	CARBON DIOXIDE, REFRIGERATED LIQUID

Other means of identification

Safety data sheet number	LIND-P024
UN / ID no.	UN2187
Synonyms	Carbonic Anhydride, Refrigerated Liquid

Recommended use of the chemical and restrictions on use

Recommended Use	Industrial and professional use.
Uses advised against	Consumer use

Details of the supplier of the safety data sheet

Linde Gas Singapore Pte Ltd
50 Jurong Island Highway, Singapore 627877

Phone: +65 68678998
www.linde.com.sg

For additional product information contact your local customer service.

Emergency telephone number

Company Phone Number	+65 68670860

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Gases under pressure	Refrigerated liquefied gas
Simple asphyxiants	Yes

Label elements

Signal word Warning

Hazard Statements
Contains refrigerated gas; may cause cryogenic burns or injury
May displace oxygen and cause rapid suffocation

May increase respiration and heart rate

Precautionary Statements - Prevention
Do not handle until all safety precautions have been read and understood
Use and store only outdoors or in a well ventilated place
Wear cold insulating gloves, face shield, and eye protection
Use a backflow preventive device in piping
Do NOT change or force fit connections
Close valve after each use and when empty
Always keep container in upright position

Precautionary Statements - Response
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Get medical attention / advice.
IF ON SKIN:. Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice / attention.

Hazards not otherwise classified (HNOC)
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Volume %	Chemical Formula
Carbon dioxide	124-38-9	100	CO_2

4. FIRST AID MEASURES

Description of first aid measures

General advice	Show this safety data sheet to the doctor in attendance.
Inhalation	Remove to fresh air and keep comfortable for breathing. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately.
Skin contact	For dermal contact or suspected frostbite, remove contaminated clothing and flush affected areas with lukewarm water. DO NOT USE HOT WATER. A physican should see the patient promptly if contact with the product has resulted in blistering of the dermal surface or in deep tissue freezing.
Eye contact	If frostbite is suspected, flush eyes with cool water for 15 minutes and obtain immediate medical attention.
Ingestion	Not an expected route of exposure.
Self-protection of the first aider	RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Most important symptoms and effects, both acute and delayed

Symptoms	Simple asphyxiant. May cause suffocation by displacing the oxygen in the air. Exposure to oxygen-deficient atmosphere (<19.5%) may cause dizziness, drowsiness, nausea, vomiting, excess salivation, diminished mental alertness, loss of consciousness and death. Exposure to atmospheres containing 8-10% or less oxygen will bring about unconsciousness without warning and so quickly that the individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death. Depending on concentration and duration of exposure to carbon dioxide may cause increased respirations, headache, mild narcotic effects, increased blood pressure and pulse, and asphyxiation. Symptoms of overexposure become more apparent when atmospheric oxygen is decreased to 15-17%. Contact with liquid may cause cold burns / frostbite.

Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Specific extinguishing methods
Continue to cool fire exposed cylinders until flames are extinguished. Damaged cylinders should be handled only by specialists.

Specific hazards arising from the chemical
Non-flammable gas. Cylinders may rupture under extreme heat.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA / NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Evacuate personnel to safe areas. Ensure adequate ventilation, especially in confined areas. Monitor oxygen level. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. Use personal protection recommended in Section 8.
Other Information	When in contact with refrigerated / cryogenic liquids, many materials become brittle and are likely

to break without warning.

Environmental precautions

Environmental precautions — Prevent spreading of vapors through sewers, ventilation systems and confined areas.

Methods and material for containment and cleaning up

Methods for containment — Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.

Methods for cleaning up — Return Portable Cryogenic Container to Linde or an authorized distributor.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling — Never allow any unprotected part ot the body to touch uninsulated pipes or vessels that contain cold fluids. The extremely cold metal will cause moist flesh to stick fast and tear when one attempts to withdraw from it. Do NOT change or force fit connections. For applications with moist Carbon Dioxide, 316, 309 and 310 stainless steels may be used as well as Hastelloy® A, B, & C and Monel®. Ferrous nickel alloys are slightly suspectible to corrosion. At normal temperatures carbon dioxide is compatible with most plastics and elastomers.

Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Never attempt to lift a cylinder by its valve protection cap. Never insert an object (e.g. wrench, screwdriver, pry bar,etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Use only with adequate ventilation. Use a backflow preventive device in piping. Close valve after each use and when empty. Ensure the complete gas system has been checked for leaks before use.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Never attempt to refill a compressed gas cylinder without the owner's written consent.

Only experienced and properly instructed persons should handle gases under pressure. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers. Use only with equipment rated for cylinder pressure.

For additional storage recommendations, consult Compressed Gas Association's Pamphlets P-1,AV-7, G-6, G-6.1, G-6.2, G6.3, G-6.5, G-6.7, G-6.9, PS-5,TB-10, and SB-2.

Conditions for safe storage, including any incompatibilities

Storage Conditions — Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Keep at temperatures below 52°C / 125°F. Full and empty cylinders should be segregrated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Stored containers should be periodically checked for general condition and leakage.

Incompatible materials — Certain reactive metals, hydrides, moist cesium monoxide, or lithium acetylene carbide diammino may ignite. Passing carbon dioxide over a mixture of sodium peroxide and aluminum or magnesium may explode.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Carbon dioxide 124-38-9	STEL = 30000 ppm TWA: 5000 ppm	TWA: 5000 ppm TWA: 9000 mg / m^3 (vacated) TWA: 10000 ppm (vacated) TWA: 18000 mg / m^3 (vacated) STEL: 30000 ppm (vacated) STEL: 54000 mg / m^3	IDLH: 40000 ppm TWA: 5000 ppm TWA: 9000 mg / m^3 STEL: 30000 ppm STEL: 54000 mg / m^3

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health Immediately Dangerous to Life or Health.

Other Information — Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Appropriate engineering controls

Engineering Controls — Local exhaust ventilation to prevent accumulation of high concentrations and maintain air-oxygen levels at or above 19.5%. Oxygen detectors should be used when asphyxiating gases may be released.

Individual protection measures, such as personal protective equipment

Eye / face protection — Wear safety glasses with side shields (or goggles). If splashes are likely to occur, wear:. Goggles. Face-shield.

Skin and body protection — Work gloves and safety shoes are recommended when handling cylinders. Wear cold insulating gloves when handling liquid.

Respiratory protection — Use positive pressure airline respirator with escape cylinder or self contained breathing apparatus for oxygen-deficient atmospheres (<19.5%). If exposure limits are exceeded or irritation is experienced, NIOSH / MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations — Handle in accordance with good industrial hygiene and safety practice. Do not get in eyes, on skin, or on clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Refrigerated liquefied gas
Appearance	Colorless.
Odor	Odorless.
Odor threshold	No information available
pH	No data available
Melting point	No data available
Evaporation rate	Not applicable
Lower flammability limit:	Not applicable
Upper flammability limit:	Not applicable
Flash point	Not applicable
Autoignition temperature	No data available
Decomposition temperature	No data available
Water solubility	Very soluble
Partition coefficient	No data available
Kinematic viscosity	Not applicable

Chemical Name	Molecular weight	Boiling point	Vapor Pressure	Vapor density (air =1)	Gas Density kg / m³@20°C	Critical Temperature
Carbon dioxide	44.01	-78.5 °C (Sublimes)	838 psig (5778 kPa) @ 21.1°C	1.522	1.839	31.1 °C

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions

Chemical stability
Stable under normal conditions.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions
None under normal processing.

Conditions to avoid
Due to the presence of Carbon dioxide, Carbonic acid is formed in the presence of moisture.

Incompatible materials
Certain reactive metals, hydrides, moist cesium monoxide, or lithium acetylene carbide diammino may ignite. Passing carbon dioxide over a mixture of sodium peroxide and aluminum or magnesium may explode.

Hazardous Decomposition Products
Oxygen. Carbon monoxide (CO).

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation — Acidosis, adrenal cortical exhaustion, and other metabolic stresses have resulted from prolonged continuous exposure to 1-2% carbon dioxide (10,000 ppm-20,000 ppm). The ACGIH TLV of 5,000 ppm is expected to provide a good margin of safety from asphyxiation and undue metabolic stress provided sufficient oxygen levels are maintained in the air. Increased physical activity, duration of exposure, and decreased oxygen content can affect systemic and respiratory effects resulting from exposure to carbon dioxide.

Skin contact — Contact with liquid may cause cold burns / frostbite.

Eye contact — Contact with liquid may cause cold burns / frostbite.

Ingestion — Not an expected route of exposure.

Information on toxicological effects

Symptoms — Depending on concentration and duration of exposure to carbon dioxide may cause increased respirations, headache, mild narcotic effects, increased blood pressure and pulse, and asphyxiation. Symptoms of overexposure become more apparent when atmospheric oxygen is decreased to 15-17%.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Not classified.
Sensitization Not classified.
Germ cell mutagenicity Not classified.

Carcinogenicity	This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP.
Reproductive toxicity	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Chronic toxicity	Chronic harmful effects are not known from repeated inhalation of concentrations below PEL / TLV.
Target Organ Effects	Central Vascular System (CVS), Respiratory system.
Aspiration hazard	Not applicable.

Numerical measures of toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50	Inhalation LC50 (CGA P-20)
Carbon dioxide 124-38-9	-	-	470,000 ppm (Rat)	-

Product Information

Oral LD50	
Dermal LD50	No information available.
Inhalation LC50	TCLo - 10,000 ppm (Rat) 24 hours / 30 days-continuous
Inhalation LC50	No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity
No known acute aquatic toxicity.

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Other adverse effects
Can cause frost damage to vegetation.

Global warming potential (GWP) 1

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes: Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Linde for proper disposal.

14. TRANSPORT INFORMATION

DOT

UN / ID no.	UN2187
Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.2
Special Provisions	T75, TP5
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.2
Emergency Response Guide Number	120

TDG

UN / ID no.	UN2187

Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.2
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.2

MEX

UN / ID no.	UN2187
Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.3
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.3

IATA

UN / ID no.	UN2187
Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.2
ERG Code	2L
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.2

IMDG

UN / ID no.	UN2187
Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.2
EmS-No.	F-C, S-V
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.2

ADR

UN / ID no.	UN2187
Proper shipping name	Carbon dioxide, refrigerated liquid
Hazard Class	2.2
Classification code	3A
Tunnel restriction code	(C / E)
Special Provisions	593
Description	UN2187, Carbon dioxide, refrigerated liquid, 2.2, (C / E)

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL / NDSL	Complies
EINECS / ELINCS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL / NDSL - Canadian Domestic Substances List / Non-Domestic Substances List
EINECS / ELINCS - European Inventory of Existing Chemical Substances / European List of Notified Chemical Substances

16. OTHER INFORMATION

NFPA	Health hazards 3	Flammability 0	Instability 0	Physical and Chemical Properties Simple asphyxiant

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

Issue Date	17-Feb-2015
Revision Date	17-Feb-2015
Revision Note	Initial Release.

General Disclaimer

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End of Safety Data Sheet