# CARBON MONOXIDE
## Safety Data Sheet

## 1. IDENTIFICATION

Product identifier
Product Name CARBON MONOXIDE

Other means of identification
Safety data sheet number LIND-P027
UN / ID no. UN1016
Synonyms Carbonic Oxide; Carbon Oxide; Exhaust Gas; Flue Gas

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).

| | |
|---|---|
| Acute toxicity - Inhalation (Gases) | Category 3 |
| Reproductive toxicity | Category 1A |
| Specific target organ toxicity (repeated exposure) | Category 1 |
| Flammable gases | Category 1 |
| Gases under pressure | Compressed gas |

Label elements

Signal word Danger

Hazard Statements
Extremely flammable gas
Contains gas under pressure; may explode if heated
Toxic if inhaled
May damage fertility or the unborn child
Causes damage to central nervous system through prolonged or repeated exposure.
May form explosive mixtures with air
Asphyxiating even with adequate oxygen

Precautionary Statements - Prevention
Do not handle until all safety precautions have been read and understood
Keep away from heat, sparks, open flames, hot surfaces. — No smoking
Do not breathe gas.
Use and store only outdoors or in a well ventilated place
Wear protective gloves, protective clothing, eye protection, respiratory protection, and / or face protection
Use a backflow preventive device in piping
Do not open valve until connected to equipment prepared for use
Close valve after each use and when empty

Precautionary Statements - Response
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor / physician. IF EXPOSED OR CONCERNED: Get medical advice / attention.
Leaking gas fire: do not extinguish, unless leak can be stopped safely
Eliminate all ignition sources if safe to do so

Precautionary Statements - Storage
Store locked up
Protect from sunlight when ambient temperature exceeds 52°C / 125°F

Precautionary Statements - Disposal
Dispose of contents / containers in accordance with container supplier / owner instructions

Hazards not otherwise classified (HNOC)
Not applicable

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

| Chemical Name | CAS No. | Volume % | Chemical Formula |
|---|---|---|---|
| Carbon monoxide | 630-08-0 | 100 | CO |

## 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. Quick removal from the contaminated area is most important. The administering of oxygen at an elevated pressure (up to 2 to 2.5 atmospheres) has shown to be beneficial as has treatment in a hyperbaric chamber.The physician should be informed that the patient has inhaled toxic quantities of carbon monoxide.

Skin contact — None under normal use. Get medical attention if symptoms occur.

Eye contact — None under normal use. Get medical attention if symptoms occur.

Ingestion — Not an expected route of exposure.

Self-protection of the first aider — Use personal protective equipment as required. Avoid contact with skin, eyes or clothing. Remove all sources of ignition.

Most important symptoms and effects, both acute and delayed

Symptoms — Carbon monoxide is odorless and colorless. There may be no warning of overexposure until symptoms occur. Inhaled carbon monoxide binds with blood hemoglobin to form carboxylhemoglobin, a susbstance that can not take part in the normal oxygen transport. This greatly reduces the blood's ability to transport oxygen. Depending on levels and duration of exposure, symptoms may include headache, dizziness, heart palpitations, weakness, confusion, nausea, convulsions, eventual unconsciousness and death.

Indication of any immediate medical attention and special treatment needed

Note to physicians — Treat symptomatically.

## 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Dry chemical or CO2. Water spray (fog). DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.

Specific extinguishing methods
If possible, stop the flow of gas. Do not extinguish the fire until supply is shut off as otherwise an explosive-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Ventilation fans must be explosion proof. Use non-sparking tools to close container valves.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on

surrounding containers. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Damaged cylinders should be handled only by specialists.

Specific hazards arising from the chemical

Extremely flammable gas. May form explosive mixtures with air. Having almost the same density as air, carbon monoxide will not diffuse by rising. Flammable in air over a very wide range. Will be easily ignited by heat, sparks or flames. Vapors may travel to source of ignition and flash back. Vapors from liquefied gas are initially heavier than air and spread along ground. Vapors may accumulate in confined areas (basement, tanks, hopper / tank cars, etc.). Cylinders may rupture under extreme heat.

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|---|---|
| Hazardous combustion products | None. |

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. As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions.

## 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

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|---|---|
| Personal precautions | ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Evacuate personnel to safe areas. Ensure adequate ventilation, especially in confined areas. Monitor oxygen level. Consider the risk of potentially explosive atmospheres. All equipment used when handling the product must be grounded. Use non-sparking tools and equipment. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. |

Environmental precautions

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|---|---|
| Environmental precautions | Beware of vapors accumulating to form explosive concentrations. Prevent spreading of vapors through sewers, ventilation systems and confined areas. |

Methods and material for containment and cleaning up

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|---|---|
| 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 cylinder to Linde or an authorized distributor. |

## 7. HANDLING AND STORAGE

Precautions for safe handling

| | |
|---|---|
| Advice on safe handling | Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Ground and bond all lines and equipment associated with product system. All equipment should be non-sparking and explosion proof. Separate flammable gas cylinders from oxygen and other oxidizers by a minimum distance of 20 ft. or by a 5 ft. high barrier with a minimum fire resistance rating of a half an hour. "NO SMOKING" signs should be posted in storage and use areas. Carbon monoxide can be handled in all commonly used metals up to approximately 500 psig (3450 kPa). Above that pressure it forms toxic and corrosive carbonyl compounds with some metals. Carbon steels, aluminum alloys, copper and copper alloys, low carbon stainless steel and nickel-based alloys such as Hastelloy A, B, & C are recommended for higher pressure applications.<br><br>Protect cylinders from physical damage; do not drag, roll, slide or drop. Never attempt to lift a cylinder by its valve protection cap. When moving cylinders, even for short distance, use a cart designed to transport cylinders. 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. Use only with adequate ventilation. Use a backflow preventive device in piping. Use only with equipment rated for cylinder pressure. Close valve after |

each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. 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 attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

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.

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. Keep at temperatures below 52°C / 125°F. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. 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. Outside or detached storage is preferred.

Incompatible materials: Oxidizing agents.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

| Chemical Name | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|---|---|---|---|
| Carbon monoxide<br>630-08-0 | TWA: 25 ppm | TWA: 50 ppm<br>TWA: 55 mg / m³<br>(vacated) TWA: 35 ppm<br>(vacated) TWA: 40 mg / m³<br>(vacated) Ceiling: 200 ppm<br>(vacated) Ceiling: 229 mg / m³ | IDLH: 1200 ppm<br>Ceiling: 200 ppm<br>Ceiling: 229 mg / m³<br>TWA: 35 ppm<br>TWA: 40 mg / m³ |

*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*

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: Explosion proof ventilation systems. Local exhaust ventilation to prevent accumulation of high concentrations and maintain air-oxygen levels at or above 19.5%. Consider installation of leak detection systems in areas of use and storage. Systems under pressure should be regularly checked for leakages.

Individual protection measures, such as personal protective equipment

Eye / face protection: Wear safety glasses with side shields (or goggles).

Skin and body protection: Work gloves and safety shoes are recommended when handling cylinders. Wear fire / flame resistant / retardant clothing. Take precautionary measures against static discharge.

Respiratory protection: 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 eat, drink or smoke

when using this product. Wash hands before breaks and immediately after handling the product. Regular cleaning of equipment, work area and clothing is recommended.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

| | |
|---|---|
| Physical state | Gas |
| Appearance | Colorless. |
| Odor | Odorless. |
| Odor threshold | No information available |
| pH | No data available |
| Melting point | -205.1 °C / -337.1 °F |
| Evaporation rate | Not applicable |
| Fire Hazard | Yes |
| Lower flammability limit: | 12.5% |
| Upper flammability limit: | 74% |
| Flash point | Not applicable |
| Autoignition temperature | 639 °C / 1182 °F |
| Decomposition temperature | No data available |
| Water solubility | Very slight |
| 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 monoxide | 28.01 | -191.5 °C | Above critical temperature | 0.97 | 1.16 | -138.7 °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 | Yes. |

Possibility of Hazardous Reactions
May form explosive mixtures with air.

Conditions to avoid
Heat, flames and sparks.

Incompatible materials
Oxidizing agents.

Hazardous Decomposition Products
Carbon dioxide ($CO_2$).

## 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

| | |
|---|---|
| Inhalation | Chemical Asphyxiant-interferes with oxygen transport. |

| | |
|---|---|
| Skin contact | No data available. |
| Eye contact | No data available. |
| Ingestion | Not an expected route of exposure. |

Information on toxicological effects

| | |
|---|---|
| Symptoms | Carbon monoxide is odorless and colorless. There may be no warning of overexposure until symptoms occur. Inhaled carbon monoxide binds with blood hemoglobin to form carboxylhemoglobin, a susbstance that can not take part in the normal oxygen transport. This greatly reduces the blood's ability to transport oxygen. Depending on levels and duration of exposure, symptoms may include headache, dizziness, heart palpitations, weakness, confusion, nausea, convulsions, eventual unconsciousness and death. |

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

| | |
|---|---|
| Irritation | Not classified. |
| Sensitization | Not classified. |
| Germ cell mutagenicity | Genetic changes observed in mammalian cell assay systems at exposures of 1500 to 2500 ppm of carbon monoxide for 10 minutes. |
| Carcinogenicity | This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP. |
| Reproductive toxicity | Category 1A. Overexposure to carbon monoxide may decrease the likelihood of successful pregnancy. In rats treated with carbon monoxide, the rate of successful pregnancy in the control group was 100% whereas the rate of successful pregnancy in animals treated with 30 and 90 ppm of carbon monoxide was 69% and 38% respectively. |
| Developmental Toxicity | Mice exposed to concentrations of carbon monoxide at 65 ppm and higher demonstrated dose-dependent effects on the fetus (increased mortality and decreased weight) with no signs of maternal toxicity. Offspring of rats exposed to 150 ppm carbon monoxide had minor reductions in birth weight and persistent memory deficits which became more pronounced in adulthood. |
| STOT - single exposure | Not classified. |
| STOT - repeated exposure | Category 1. |
| Chronic toxicity | Causes damage to central nervous system through prolonged or repeated exposure. |
| Target Organ Effects | Lungs, Central nervous system (CNS), Blood, Central vascular system (CVS). |
| Aspiration hazard | Not applicable. |

Numerical measures of toxicity

| Chemical Name | Oral LD50 | Dermal LD50 | Inhalation LC50 | Inhalation LC50 (CGA P-20) |
|---|---|---|---|---|
| Carbon monoxide 630-08-0 | - | - | - | 3760 ppm (Rat) 1hr |

Product Information

| | |
|---|---|
| Oral LD50 | No information available |
| Dermal LD50 | No information available |
| Inhalation LC50 | No information available |

## 12. ECOLOGICAL INFORMATION

Ecotoxicity
No known acute aquatic toxicity.

Persistence and degradability
Not applicable.

Bioaccumulation
No information available.

## 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. | UN1016 |
| Proper shipping name | Carbon monoxide, compressed |
| Hazard Class | 2.3 |
| Subsidiary class | 2.1 |
| Special Provisions | 4 |
| Description | UN1016, Carbon monoxide, compressed, 2.3 (2.1) |
| Additional Description: | "Toxic-Inhalation Hazard Zone D" |
| Additional Marking Requirements: | "Inhalation Hazard" |
| Emergency Response Guide Number | 119 |

TDG

| | |
|---|---|
| UN / ID no. | UN1016 |
| Proper shipping name | Carbon monoxide, compressed |
| Hazard Class | 2.3 |
| Subsidiary class | 2.1 |
| Description | UN1016, Carbon monoxide, compressed, 2.3 (2.1) |

MEX

| | |
|---|---|
| UN / ID no. | UN1016 |
| Proper shipping name | Carbon monoxide, compressed |
| Hazard Class | 2.3 |
| Subsidiary class | 2.1 |
| Description | UN1016, Carbon monoxide, compressed, 2.3 (2.1) |

IATA Forbidden

IMDG

| | |
|---|---|
| UN / ID no. | UN1016 |
| Proper shipping name | Carbon monoxide, compressed |
| Hazard Class | 2.3 |
| Subsidiary hazard class | 2.1 |
| EmS-No. | F-D, S-U |
| Description | UN1016, Carbon monoxide, compressed, 2.3 (2.1) |

ADR

| | |
|---|---|
| UN / ID no. | UN1016 |
| Proper shipping name | Carbon monoxide, compressed |
| Hazard Class | 2.3 |
| Classification code | 1TF |
| Tunnel restriction code | (B / D) |
| Description | UN1016, Carbon monoxide, compressed, 2.3 (2.1), (B / D) |
| Labels | 2.1 |

## 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 2 | Flammability 4 | Instability 0 | Physical and Chemical Properties - |

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 | 26-Feb-2015 |
| Revision Date | 26-Feb-2015 |
| Revision Note | Initial Release. |

General Disclaimer

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End of Safety Data Sheet