



CARBON DIOXIDE

CHEMICAL PRODUCT

PRODUCT NAME: Carbon Dioxide

CHEMICAL NAME: Carbon Dioxide

CHEMICAL FAMILY: Acid Anhydride

SYMBOL: CO₂

SYNONYMS: Carbonic Anhydride, Carbonic acid gas, Carbon Anhydride, Carbon dioxide USP, Dry Ice

USES: Various, beverage carbonation, expendable refrigerant pH control, fire suppression, controlled atmospheres, pressurizing solvent medium, grain fumigation, supercritical extraction, medical respiratory therapy mixtures, chemicals reactant.

INGREDIENT COMPOSITION INFORMATION

INGREDIENTS NAME	PERCENTAGE	OHSA PEL-TWA	ACGIH TLV	ACGIH TLV-STEL
CARBON DIOXIDE	>99%	5000ppm	5000ppm	30000ppm

HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION! High pressure liquid and gas.
 Can cause rapid suffocation.
 Can increase respiration and heart rate.
 Solid and liquid may cause frostbite.
 Avoid breathing the gas.
 Self-contained breathing apparatus may be required by rescue workers.

POTENTIAL HEALTH EFFECTS:

ROUTES OF EXPOSURE:

INHALATION: Carbon dioxide is an asphyxiant and a powerful cerebral vasodilator. Inhaling large quantities causes rapid circulatory insufficiency leading to coma and death. High concentrations of carbon dioxide can asphyxiate quickly without warning with no possibility of self-rescue regardless of the oxygen concentration. Concentrations of 10% or more can produce unconsciousness or death. Lower concentrations may cause headache, sweating, rapid breathing, increased heartbeat, shortness of breath, dizziness, mental depression, visual disturbances and shaking. Repeated inhalation of low(3% to 5%) concentrations have no known irreversible effects.

EYE CONTACT. Contact with solid, liquid or cold vapor can cause freezing of tissue.

SKIN CONTACT: Contact with solid, liquid or cold vapor can cause frostbite. Frostbite effects are evident with a change in the color of the skin to gray or white, possibly followed by blistering.

SKIN ABSORPTION: Not applicable

INGESTION: Ingestion of solid will cause internal frostbite effects

CHRONIC EFFECTS: Not established

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None

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

CARCINOGENICITY: Carbon Dioxide is not listed.

FIRST AID MEASURES

INHALATION: Persons suffering from overexposure should be removed to fresh air. If victim is not breathing, administer artificial respiration. If breathing is difficult administer oxygen. Obtain prompt medical attention.

EYE CONTACT: Contact with solid, liquid or cold vapor can cause freezing of tissue. Gently flush eyes with lukewarm water. Obtain medical attention immediately.

SKIN CONTACT: Remove any clothing that may restrict circulation to frozen area. Do not rub frozen parts as tissue damage may result. As soon as practical place the affected area in a warm water bath which has a temperature not to exceed 105°F (40°C).

Never use dry heat. In case of massive exposure, remove clothing while showering with warm water. Call a physician as soon as possible. Frozen tissue is painless and appears waxy with a possible yellow color. It will become swollen, painful, and prone to infection when thawed. If the frozen part of the body has been thawed by the time medical attention has been obtained, cover the area with dry sterile dressing with a large bulky protective covering.

INGESTION: Not applicable.

NOTES TO PHYSICIAN: Not applicable

FIRE FIGHTING MEASURES

FLASH POINT: Not applicable

AUTOIGNITION: Nonflammable

FLAMMABLE LIMITS IN AIR BY VOLUME:

LOWER: Not applicable

UPPER: Not applicable

EXTINGUISHING MEDIA: Carbon dioxide is nonflammable and does not support combustion. Carbon dioxide is an extinguishing agent for Class B and C fires, but should not be used on Class D fires. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING INSTRUCTIONS: Evacuate personnel from danger area. If possible without risk, remove carbon dioxide cylinders from fire area or cool with water. Self-contained breathing apparatus may be required for rescue workers.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Upon exposure to intense heat or flame a cylinder or bulk container may vent rapidly and /or rupture violently. Most containers are designed to vent contents when exposed to elevated temperatures. Pressure in a container can build up due to heat and it may rupture if pressure relief devices should fail to function.

HAZARDOUS COMBUSTION PRODUCTS: None known

SENSITIVITY TO STATIC DISCHARGE: None

SENSITIVITY TO MECHANICAL IMPACT: None, except as noted above.

ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

CYLINDERS: Evacuate all personnel from the affected area until the area is checked to ensure carbon dioxide levels are below the exposure limits. Shut off the source of carbon dioxide, if possible to do so without risk. Ventilate enclosed areas or remove cylinders to a well-ventilated open area. If leaking occurs from cylinder or its valve, contact your supplier. The cylinder or valve may be very cold after a rapid release of product. Handle the cylinder carefully with leather gloves. Carbon dioxide solid may form and remain in the cylinder until it is warmed.

BULK CONTAINERS: Evacuate all personnel from the affected area until the area is checked to ensure carbon dioxide levels are below the exposure limits. Shut off the source of carbon dioxide, if possible without risk. Ventilate enclosed areas. If leaking from a container valve, contact your supplier. Carbon dioxide solid may form and remain in the container until it is warmed. This must only be done by qualified personnel.

DRY ICE (SOLID): Evacuate all personnel from the affected area until the area is checked to ensure carbon dioxide levels are below the exposure limits. Ventilate enclosed areas or remove the solid to a well-ventilated open area secure from contact by passers-by. Handle the solid only with cold-resistant gloves and clothing.

HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Storage containers and equipment should not be located in sub-surfaced or enclosed areas, unless engineered to maintain concentration of carbon dioxide below the exposure limits in the event of a release. Relief valves should be vented to a well ventilated external location. Cylinders should be stored upright with their valve protection cap in place and firmly secured to prevent falling or being knocked over. Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperatures to exceed 125°F (52°C). Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Solid carbon dioxide (dry ice) should be stored in insulated containers with loose fitting covers that allow the evolved gas to escape. Store in a well-ventilated area to prevent accumulation of carbon dioxide vapors above the exposure limits.

PRECAUTIONS TO BE TAKEN IN HANDLING:

CYLINDERS: Use a suitable hand truck for cylinder movement. Never attempt to lift a cylinder by its valve protection cap. Never apply flame or localized heat directly to any part of the cylinder. High temperature may cause damage to a cylinder and/or premature failure of the pressure relief device, which will result in venting of the cylinder contents. If user experience any difficulty operating the cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage the valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

LIQUID: Wear protective clothing, insulated gloves and protective eye glasses or face shields when transferring liquid carbon dioxide. Use a suitable four-wheel hand truck for container movement. Check all hoses and transfer equipment before filling them with liquid. Replace any worn or cut hoses before use. Liquid carbon dioxide is extremely cold and under pressure. A leak will result in the formation of solid particles, which will be forcibly ejected from the system, possibly injuring the operator. A complete hose failure can result in a large carbon dioxide spill and violent movement of the hose and associated equipment, which may cause severe injury or death. Special care must taken when depressurizing and disconnecting hoses.

Releasing the contents of a liquid-filled line to atmospheric pressure may result in the formation of a solid dry ice plug in the line. This will prevent further removal of the liquid behind the plug, resulting in either an unexpected rapid release as its warms, or the catastrophic failure of the line as the liquid warms behind the plug. Sufficient vapor pressure must be applied and maintained behind the liquid before opening a discharge valve. This will prevent the depressurization of the liquid to the point of solid formation before it exits the line.

SOLID: Direct contact with solid carbon dioxide (dry ice) should be avoided. Wear appropriate clothing, safety shoes and insulated gloves. Do not ingest solid carbon dioxide. Wear protective eye glasses or shields when cutting dry ice.

For additional precautions in using carbon dioxide see, Other Information.

EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:

VENTILATION:

Natural or mechanical to prevent accumulation in workers breathing zone above exposure limits. (See Hazards Identification.) Carbon dioxide levels should be monitored to assure levels below exposure limits regardless of oxygen levels. Remove vapor from the lowest possible level and exhaust to a well-ventilated outdoor area. Carbon dioxide accumulates in low-lying areas and areas with limited movement.

RESPIRATORY PROTECTION (SPECIFY TYPE):

General Use: None required

Emergency Use: Self-contained breathing apparatus (SCBA) or positive pressure airline and escape bottle with mask are to be used in oxygen-deficient atmospheres and areas with high carbon dioxide concentrations. Air purifying respirators will not provide protection.

PROTECTIVE GLOVES: Work gloves are recommended when handling cylinders. Leather and/or insulated gloves impervious to cold should be worn when handling liquid or solid carbon dioxide.

EYE PROTECTION: Safety glasses are recommended when handling cylinders, vapor or liquid transfers and solid carbon dioxide. Face shields are recommended for liquid transfer operations.

OTHER PROTECTIVE EQUIPMENT. Safety shoes with metatarsal protection are recommended when handling cylinders or dry ice blocks. Protective clothing as required to avoid skin contact.

PHYSICAL AND CHEMICAL PROPERTIES

MOLECULAR WEIGHT: 44.01

RELATIVE DENSITY, GAS @ 101.325 kpa @ 1°C (Air=1) = 1.53 Sublimation point @ 101.325 kpa -78.4°C

VAPOR PRESSURE at 21.1°C = 58.24 Bar

TRIPLE POINT TEMPERATURE = -56.6°C

ABSOLUTE DENSITY, GAS @ 101.325 kpa 20°C 1.9770 kg/m³

LIQUID DENSITY @ 25°C, 6430 kpa=0.713 kg/ltr (761.338 kg/m³)

EVAPORATION RATE (Butyl Acetate=1): Not applicable

SOLUBILITY IN WATER: @ 101.325 kpa @ 0°C = 0.759 cm³/1 cm water

APPEARANCE, ODOR AND STATE: Colorless and odorless gas. A slightly acid gas, it is felt by some persons to have a slightly pungent odor and biting taste. Clear, colorless volatile liquid. Odorless white solid.

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable

ODOR THRESHOLD: Odorless

STABILITY AND REACTIVITY

STABILITY:

Stable

CONDITIONS TO AVOID:

None

INCOMPATIBILITY (Materials to avoid):

None, Carbon dioxide will react with alkaline materials to form carbonates and bicarbonates.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide and oxygen at temperatures above 3000°F (1648.9°C).

B) HAZARDOUS REACTION CONDITIONS: Dusts of various metals (e.g., magnesium, zircon, titanium alloys), are readily ignited and explode in the presence of carbon dioxide. Mixtures of solid carbon dioxide with sodium and potassium alloys are impact sensitive and explode violently. In the presence of moisture, cesium oxide ignites on contact with carbon dioxide. Metal acetylides or hydrides will also ignite or explode.

C) HAZARDOUS POLYMERIZATION: Will not occur

D) GENERAL: Carbon dioxide will react with alkaline materials to form carbonates and bicarbonates.

TOXICOLOGICAL INFORMATION

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

EFFECT	CONCENTRATION
Slight increase in breathing rate.	1%
Breathing rate increases to 50% above normal level.	2%
Prolonged exposure can cause headache, tiredness.	
Breathing increases to twice normal rate and becomes labored.	3%
Weak narcotic effect. Impaired hearing, headache, increase in blood pressure and pulse rate.	4% to 7%
Breathing increases to approximately four times normal rate, symptoms of intoxication become evident and slight choking may be felt.	
Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment and hearing in the ears. Judgment may be impaired. Followed within minutes by loss of consciousness.	7% to 15%
Unconsciousness occurs more rapidly above the 10% level.	
Prolonged exposure to high concentrations may eventually result in death from asphyxiation or severe acidosis.	Above 15%

IRRITANCY OF MATERIAL:	None	SENSITIZATION TO MATERIAL:	None
REPRODUCTIVE EFFECTS:	None		
TERATOGENECITY:	None	MUTAGENICITY:	None
SYNERGISTIC MATERIALS:	None		

ECOLOGICAL INFORMATION

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

DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD:

CYLINDERS: Do not attempt to dispose of residual or unused quantities. Return containers to the supplier. For emergency disposal, secure the cylinder and slowly discharge gas to the atmosphere in a well-ventilated area or outdoors.

BULK CONTAINERS: Do not attempt to dispose of residual or unused quantities. Contact supplier for disposal.

For emergency disposal, slowly discharge gas to the atmosphere in a well-ventilated area or outdoors.

DRY ICE (SOLID): Do not attempt to dispose of residual or unused quantities. Return containers to the supplier. Handle the solid only with cold-resistant gloves and clothing. For emergency disposal, allow solid carbon dioxide to sublime to a well-ventilated area that is away from general traffic and secure from accidental contact

TRANSPORT INFORMATION

GAS

DOT/IMO/IATA Shipping Name: Carbon Dioxide

Hazard Class: 2.2 (Nonflammable gas)

Shipping Label: Nonflammable gas

Placard: Nonflammable gas

REFRIGERATED LIQUID

DOT/IMO/IATA Shipping Name: Carbon Dioxide, Refrigerated Liquid

Hazard Class: 2.2 (Nonflammable gas)

Shipping Label: Nonflammable gas

Placard: Nonflammable gas

SOLID

DOT/IMO/IATA Shipping Name: Carbon Dioxide, Refrigerated Liquid

Hazard Class: 9

Shipping Label: No label required for highway shipment. If shipped by air or water, use a Class 9 label.

Placard: No placard required for domestic highway shipment.

PRODUCT REPORTABLE QUANTITY (RQ): None

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure upright position in a well-ventilated truck. The transportation of a compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards and should be discouraged.

OTHER INFORMATION

SPECIAL PRECAUTIONS: Use piping and equipment adequately designed to withstand pressures to be encountered. Use a check valve or other protective apparatus in any line or piping from the cylinder to prevent reverse flow. Discharge of liquid carbon dioxide lines to atmospheric pressure will result in formation of solid dry ice, which may cause blockage of the liquid line.

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure upright position in a well-ventilated truck. The transportation of the compressed gas cylinders in automobiles or in closed-body vehicles can prevent serious safety hazard and should be discouraged.

MIXTURES: When two or more 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 that can cause serious injury or death.