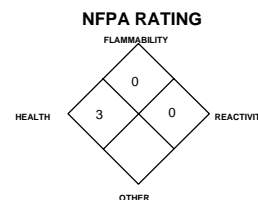
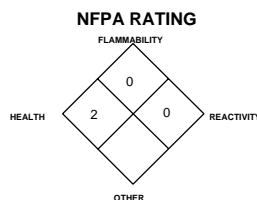
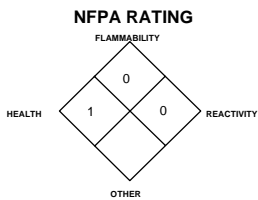




**CARBON DIOXIDE GAS**

**CARBON DIOXIDE SOLID**

**CARBON DIOXIDE LIQUEFIED**



# MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

## PART I *What is the material and what do I need to know in an emergency?*

### 1. PRODUCT IDENTIFICATION

**CHEMICAL NAME; CLASS:** **CARBON DIOXIDE - CO<sub>2</sub>, GASEOUS**  
**CARBON DIOXIDE - CO<sub>2</sub>, CRYOGENIC**  
**CARBON DIOXIDE - CO<sub>2</sub>, SOLID**  
 Document Number: Carbon Dioxide

**PRODUCT USE:** For general analytical/synthetic chemical uses.

**SUPPLIER/MANUFACTURER'S NAME:** MESA Specialty Gases & Equipment  
**ADDRESS:** 3619 Pendleton Avenue, Suite C  
 Santa Ana, CA 92704

**BUSINESS PHONE:** 1-714-434-7102  
**EMERGENCY PHONE:** INFOTRAC: 1-800-535-5053

**DATE OF PREPARATION:** May 10, 1999

### 2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER ppm
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Carbon Dioxide	124-38-9	> 99.8	5000	30,000	5000 10,000 (Vacated 1989 PEL)	30,000 (Vacated 1989 PEL)	40,000	DFG-MAK: 5000 NIOSH REL TWA: 5000 ST: 30000 ppm
Maximum Impurities		< 0.2	None of the trace impurities in this mixture contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established

C = Ceiling Limit.

See Section 16 for Definitions of Terms Used.



NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

### 3. HAZARD IDENTIFICATION



#### Carbon Dioxide Gas and Cryogenic Liquid

**EMERGENCY OVERVIEW:** Carbon Dioxide is a colorless gas, or a colorless, cryogenic liquid. At low concentrations, both the gas and the liquid are odorless. At higher concentrations Carbon Dioxide will have a sharp, acidic odor. The liquid boils rapidly at standard temperatures and pressures. At concentrations between 2 and 10%, Carbon Dioxide can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. If the gas concentration reaches 10% or more, suffocation and death can occur within minutes. Contact with the cold gas can cause freezing of exposed tissue. Moisture in the air could lead to the formation of carbonic acid which can be irritating to the eyes. All forms of Carbon Dioxide are non-combustible. Carbon Dioxide is heavier than air and should not be allowed to accumulate in low lying areas.

#### CARBON DIOXIDE GAS

HAZARDOUS MATERIAL INFORMATION SYSTEM			
<b>HEALTH</b>	(BLUE)	1	
<b>FLAMMABILITY</b>	(RED)	0	
<b>REACTIVITY</b>	(YELLOW)	0	
<b>PROTECTIVE EQUIPMENT</b>		B	
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For routine industrial applications			

#### CARBON DIOXIDE LIQUEFIED

HAZARDOUS MATERIAL INFORMATION SYSTEM			
<b>HEALTH</b>	(BLUE)	3	
<b>FLAMMABILITY</b>	(RED)	0	
<b>REACTIVITY</b>	(YELLOW)	0	
<b>PROTECTIVE EQUIPMENT</b>		X	
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For routine industrial applications			

**SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:** The most significant route of overexposure for this gas is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

**INHALATION:** Carbon Dioxide is an asphyxiant and a powerful cerebral vasodilator. If the concentration of Carbon Dioxide reaches 10% or more, suffocation can occur rapidly. Inhalation of concentrations between 2 and 10% can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Carbon Dioxide initially stimulates respiration and then causes respiratory depression. Inhalation of low concentrations (3-5%) have no known permanent harmful effects. Symptoms in humans at various levels of concentration are as follows:

<b><u>CONCENTRATION</u></b>	<b><u>SYMPTOMS OF EXPOSURE</u></b>
1%:	Slight increase in breathing rate.
2%:	Breathing rate increases to 50% above normal; exposure cause headache, tiredness.
3%:	Breathing increases to twice normal rate and becomes labored. Weak narcotic effect. Impaired hearing, headache, increase in blood pressure and pulse rate.
4-5%:	Breathing increases to approximately four times normal rate, symptoms of intoxication become evident and slight choking may be felt.
5-10%:	Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment and ringing in the ears. Judgment may be impaired, followed by loss of consciousness.
50-100%:	Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.

High concentrations of this gas can also cause an oxygen-deficient environment. However, the asphyxiating properties of Carbon Dioxide will be reached before oxygen-deficiency is a factor.

### 3. HAZARD IDENTIFICATION (Continued)

**OTHER POTENTIAL HEALTH EFFECTS:** Contact of the cold gas with the skin can lead to frostbite or dermatitis (red, cracked, irritated skin), depending upon concentration and duration of exposure. Contact of the cold gas with the eyes can cause pain, redness, burns, and severe exposure could cause blindness. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with cold gas can quickly subside. Moisture in the air could lead to the formation of carbonic acid, which can be irritating to the eyes.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE:** An Explanation in **Lay Terms**. Overexposure to Carbon Dioxide may cause the following health effects:

**ACUTE:** Inhaling high concentrations of Carbon Dioxide can lead to coma or death. At low concentrations, inhalation of Carbon Dioxide can cause nausea, dizziness, visual disturbances, shaking, headache, mental confusion, sweating, increased heartbeat, and elevated blood pressure and respiratory rate. High concentrations of the gas in air may cause eye irritation or damage.

**CHRONIC:** Reversible effects on the acid-base balance in the blood, blood pressure, and circulatory system may occur after prolonged exposure to elevated carbon Dioxide levels.

**TARGET ORGANS:** Respiratory system, cardiovascular system, eyes.

#### Carbon Dioxide Solid



**EMERGENCY OVERVIEW:** Solid Carbon Dioxide (dry ice), is a white, opaque solid which releases colorless, gas. This solid sublimates to gas quickly at standard temperatures and pressures, forming a fog in air. As a result, the main hazards associated with Carbon Dioxide are related to Carbon Dioxide gas formation and the cold temperature of the solid and evolved gas. At concentrations between 2 and 10%, Carbon Dioxide can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. If the gas concentration reaches 10% or more, suffocation and death can occur within minutes. Contact with the solid can cause freezing of exposed tissue. Moisture in the air could lead to the formation of carbonic acid which can be irritating to the eyes. Carbon Dioxide is heavier than air and should not be allowed to accumulate in low lying areas.

**SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:** The most significant routes of overexposure for Carbon Dioxide are by inhalation of Carbon Dioxide gas, and skin or eye contact with the solid or gas. Symptoms of such exposure are as follows:

**INHALATION:** Carbon Dioxide is an asphyxiant and a powerful cerebral vasodilator. If the concentration of Carbon Dioxide reaches 10% or more, suffocation can occur rapidly. Inhalation of concentrations between 2 and 10% can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Carbon Dioxide initially stimulates respiration and then causes respiratory depression. Inhalation of low concentrations (3-5%) have no known permanent harmful effects. Symptoms in humans at various levels of concentration are as follows:

<b>CONCENTRATION</b>	<b>SYMPTOMS OF EXPOSURE</b>
1%:	Slight increase in breathing rate.
2%:	Breathing rate increases to 50% above normal; exposure causes headache, tiredness.
3%:	Breathing increases to twice normal rate and becomes labored. Weak narcotic effect. Impaired hearing, headache, increase in blood pressure and pulse rate.
4-5%:	Breathing increases to approximately four times normal rate, symptoms of intoxication become evident; slight choking may be felt.
5-10%:	Labored breathing, headache, visual impairment, ringing in the ears, impaired judgment, followed by loss of consciousness.
50-100%:	Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.

#### CARBON DIOXIDE SOLID

<b>HAZARDOUS MATERIAL INFORMATION SYSTEM</b>			
<b>HEALTH</b>		(BLUE)	2
<b>FLAMMABILITY</b>		(RED)	0
<b>REACTIVITY</b>		(YELLOW)	0
<b>PROTECTIVE EQUIPMENT</b>			B
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For routine industrial applications			

**See Section 16 for Definition of Ratings**

### 3. HAZARD IDENTIFICATION (Continued)

**INHALATION (Continued):** High concentrations of this gas can also cause an oxygen-deficient environment. However, the asphyxiating properties of Carbon Dioxide will be reached before oxygen-deficiency is a factor.

**OTHER POTENTIAL HEALTH EFFECTS:** Contact with solid Carbon Dioxide can cause frostbite to skin, eyes, and other exposed tissue. Contact of the cold gas generated from the solid with the skin can lead to frostbite or dermatitis (red, cracked, irritated skin), depending upon concentration and duration of exposure. Contact of the cold gas with the eyes can cause pain, redness, burns, and severe exposure could cause blindness. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with cold gas or solid can quickly subside. Moisture in the air could lead to the formation of carbonic acid, which can be irritating to the eyes.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE:** An Explanation in **Law Terms**. Overexposure to Carbon Dioxide may cause the following health effects:

**ACUTE:** Contact with solid Carbon Dioxide or cold gas can cause frostbite to skin, eyes, and other exposed tissue. Carbon Dioxide gas evolved from the sublimation of the solid is an asphyxiant and a powerful cerebral vasodilator. Inhaling high concentrations of Carbon Dioxide can lead to coma or death. At low concentrations, inhalation of Carbon Dioxide can cause nausea, dizziness, visual disturbances, shaking, headache, mental confusion, sweating, increased heartbeat, and elevated blood pressure and respiratory rate. High concentrations of the gas in air may cause eye irritation or damage.

**CHRONIC:** There are currently no known adverse health effects associated with chronic exposure to solid Carbon Dioxide or the gas which is generated by sublimation.

**TARGET ORGANS:** Respiratory system, cardiovascular system, eyes.

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## PART III *How can I prevent hazardous situations from occurring?*

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### 4. FIRST-AID MEASURES

**RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus Personal Protective equipment should be worn.**

Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

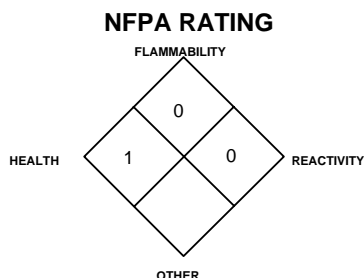
In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

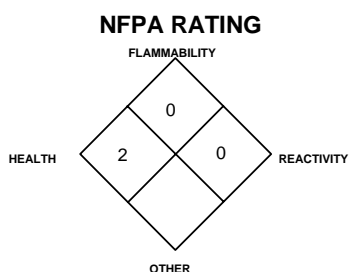
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### 5. FIRE-FIGHTING MEASURES

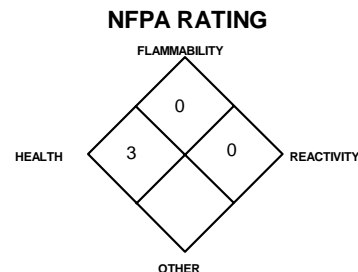
#### CARBON DIOXIDE GAS



#### CARBON DIOXIDE SOLID



#### CARBON DIOXIDE LIQUEFIED



**See Section 16 for Definition of Ratings**

**FLASH POINT:** Not Applicable.

**AUTOIGNITION TEMPERATURE:** Not Applicable.

**FLAMMABLE LIMITS (in air by volume, %):** Lower: Not Applicable.  
Upper: Not Applicable.

## 5. FIRE-FIGHTING MEASURES (Continued)

**FIRE EXTINGUISHING MATERIALS:** Carbon Dioxide is commonly used as an extinguishing agent, and therefore, should not present a problem when trying to control a blaze. Use extinguishing media appropriate for surrounding fire.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Carbon Dioxide does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Dusts of various reactive 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.

**Explosion Sensitivity to Mechanical Impact:** Not sensitive, except as noted above.

**Explosion Sensitivity to Static Discharge:** Not Sensitive.

**SPECIAL FIRE-FIGHTING PROCEDURES:** Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move fire-exposed cylinders if it can be done without risk to firefighters. Otherwise, cool containers with hose stream and protect personnel. Withdraw immediately in case of rising sounds from venting safety device or any discoloration of tanks due to the fire.

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## 6. ACCIDENTAL RELEASE MEASURES

**SPILL AND LEAK RESPONSE:** Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a spill, clear the affected area and protect people. Minimum Personal Protective Equipment should be **Level B: protective clothing, mechanically-resistant gloves and Self-Contained Breathing Apparatus**. Locate and seal the source of the leaking gas.

Allow the gas, which is heavier than air, to dissipate. Monitor the surrounding area for Carbon Dioxide and oxygen levels. Colorimetric tubes are available for Carbon Dioxide. The levels of Carbon Dioxide must be below those listed in Section 2 (Composition and Information on Ingredients) and the atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

**RESPONSE TO CRYOGENIC RELEASE:** Clear the affected area and allow the liquid to evaporate and the gas to dissipate. After the gas is formed, follow the instructions provided in the previous paragraph. If the area must be entered by emergency personnel, SCBA, Kevlar gloves, and appropriate foot and leg protection must be worn.

**RESPONSE TO SOLID RELEASE:** Pick-up and immediately place solid pieces of dry ice in an appropriate, thermally-insulated, vented container. Alternatively, allow the solid to sublime and the gas which is generated to dissipate.

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## **PART III** *How can I prevent hazardous situations from occurring?*

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### 7. HANDLING and STORAGE

**WORK PRACTICES AND HYGIENE PRACTICES:** As with all chemicals, avoid getting Carbon Dioxide IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness, fatigue, or any exposure symptom described in Section 3 (Hazard Identification); exposures to fatal concentrations of Carbon Dioxide could occur without any significant warning symptoms.

**STORAGE AND HANDLING PRACTICES:** Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Containers of Carbon Dioxide can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Store containers away from process and production areas, away from elevators, building and room exits or main aisles leading to exits. Containers should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight. Protect containers against physical damage. Isolate from other non-compatible chemicals (refer to Section 10, Stability and Reactivity).

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS:** Protect cylinders against physical damage. Store in cool, dry, well-ventilated, fireproof area, away from flammable materials and corrosive atmospheres. Store away from heat and ignition sources and out of direct sunlight. Do not store near elevators, corridors or loading docks. Do not allow area where cylinders are stored to exceed 52°C (125°F). Use only storage containers and equipment (pipes, valves, fittings to relieve pressure, etc.) designed for the storage of Solid, Gaseous or Liquefied Carbon Dioxide. Do not store containers where they can come into contact with moisture.

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS (Continued):** Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Liquefied Carbon Dioxide must be stored and handled under positive pressure or in a closed system to prevent the infiltration and solidification of air or other gases. The following rules are applicable to situations in which cylinders are being used :

**Before Use:** Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap in-place (where provided) until cylinder is ready for use.

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**During Use:** Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

**After Use:** Close main cylinder valve. Replace valve protection cap (where provided). Mark empty cylinders "EMPTY".

**NOTE:** Use only DOT or ASME code containers. In the event of an electrical discharge, Carbon Dioxide gas will produce carbon monoxide and oxygen. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner.

**SPECIAL PRECAUTIONS FOR HANDLING PRESSURIZED CONTAINERS OF LIQUID CARBON DIOXIDE:** Cold liquids can present significant safety hazards. Never allow any unprotected part of the body to touch uninsulated pipes or vessels which contain cold fluids. The extremely cold metal of the container will cause moist flesh to stick fast and tear when one attempts to withdraw from it. The following rules are applicable to work situations in which liquid containers are being used.

Check all hoses and transfer equipment before filling them with the liquid. Replace any worn or cut hoses prior to use. Liquid Carbon Dioxide is extremely cold and is under pressure. A leak will result in the formation of "Dry Ice" particles which will be forcibly ejected from the system, possibly injuring the operator. A complete hose failure can result in a large release of Carbon Dioxide and violent movement of the hose and associated equipment, which may cause severe injury or death. Special care must be 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 plug will prevent further removal of the liquid behind the plug, resulting in either an unexpected, rapid release of Carbon Dioxide as the line 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 action will prevent the depressurization of the liquid to the point of solid formation before it exits the line.

High-pressure containers for liquid product are equipped with pressure relief devices to control internal pressure. Under normal conditions, these containers will periodically vent small amounts of product. Some metals such as carbon steel may become brittle at low temperatures and will easily fracture. Prevent entrapment of liquid in closed systems or piping without pressure relief devices.

**SPECIAL PRECAUTIONS FOR HANDLING OF SOLID CARBON DIOXIDE:** Do not handle solid Carbon Dioxide with bare hands. Use heavy gloves or dry ice tongs. Handle blocks of dry ice carefully, as injuries can occur if one is accidentally dropped on the feet. Never store dry ice in a standard refrigerator, cooler, or freezer designed for food storage. Containers of solid Carbon Dioxide should be stored upright and be firmly secured to prevent falling or being knocked-over. Containers should be vented, to prevent the build-up of Carbon Dioxide gas. Carbon Dioxide sublimates at -78.5°C (-109.3°F); containers should be thermally insulated and kept at the lowest possible temperature to maintain the solid and avoid generation of Carbon Dioxide gas. Storage containers and equipment used with Carbon Dioxide should not be located in sub-surface or enclosed areas, unless engineered to maintain a concentration of Carbon dioxide below the TLV (TLV = 5000 ppm in the event of a release. Solid consignment of dry ice in a gas-tight vessel can lead to catastrophic failure of the vessel by over-pressurization. Storage of dry ice should never occur in a gas-tight container.

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., Nitrogen) before attempting repairs.

## **8. EXPOSURE CONTROLS - PERSONAL PROTECTION**

**VENTILATION AND ENGINEERING CONTROLS:** Use with adequate ventilation. Carbon Dioxide accumulates in low-lying areas with limited air movement. Natural or mechanical ventilation should be available in the worker's breathing zone to prevent levels of Carbon Dioxide above exposure limits (see Section 2, Composition and Information on Ingredients). Local exhaust ventilation is preferred, because it prevents dispersion of this gas into the work place by eliminating it at its source. Areas of Carbon Dioxide use should be engineered to remove vapor from the lowest possible level and exhaust vapor to a well-ventilated area or to the outside. Carbon Dioxide levels should be monitored to assure levels are maintained below the TLV. If appropriate, install automatic monitoring equipment to detect the levels of Carbon Dioxide and of oxygen.

**RESPIRATORY PROTECTION:** Maintain Carbon Dioxide levels below those listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Carbon Dioxide levels are above the IDLH (40,000 ppm) or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards. Respiratory selection guidelines from NIOSH for Carbon Dioxide are provided on the following page for further information on respiratory protection.

### **CONCENTRATION**

UP TO 40,000 ppm:

### **RESPIRATORY EQUIPMENT**

Supplied Air Respirator (SAR); or full-facepiece Self-Contained Breathing Apparatus (SCBA).

EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

ESCAPE: Escape-type SCBA.

NOTE: The IDLH concentration for Carbon Dioxide is 40,000 ppm.

**EYE PROTECTION:** Splash goggles, face-shields or safety glasses. Face-shields must be worn when using cryogenic Carbon Dioxide.

**HAND PROTECTION:** Wear mechanically-resistant gloves when handling cylinders of Carbon Dioxide. Recommended use of low-temperature protective gloves (e.g. insulated polyvinyl chloride or insulated nitrile) when working with containers of Liquefied Carbon Dioxide.

**BODY PROTECTION:** Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well provide sufficient insulation from extreme cold.

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## 9. PHYSICAL and CHEMICAL PROPERTIES

**GAS DENSITY @ 21°C (70°F) and 1 atm:** 0.1144 lb/ft<sup>3</sup> (1.833 kg/m<sup>3</sup>)

**LIQUID DENSITY @ 21.1°C (70°F) and 838 psig (5778 kPa):** 47.35 lb/ft<sup>3</sup> (761.3 kg/m<sup>3</sup>)

**SOLID DENSITY @ -78.5°C (-109.3°F):** 97.59 lb/ft<sup>3</sup> (1569 kg/m<sup>3</sup>)

**SPECIFIC GRAVITY (gas) @ 21°C (70°F):** 1.52

**SPECIFIC GRAVITY (solid) @ 0°C (32°F):** 1.54

**VAPOR PRESSURE (psia):** 844.7

**SOLUBILITY IN WATER @ 20°C (68°F):** 0.90%

**ODOR THRESHOLD:** Not applicable.

**EXPANSION RATIO:** Not applicable.

**BOILING POINT @ 1 atm (sublimation point):** -78.5°C (-109.3°F)

**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.

**EVAPORATION RATE (nBuAc = 1):** Not applicable

**FREEZING POINT:** -56.6°C (-69.9°F)

**SPECIFIC VOLUME (ft<sup>3</sup>/lb):** 8.8

**TRIPLE POINT @ 60.4 psig (416 kPa):** -56.6°C (-69.9°F)

**pH @ 1 atm:** 3.7 (carbonic acid)

**APPEARANCE AND COLOR:** Carbon dioxide is a colorless to opaque, white solid; a colorless gas; or a colorless cryogenic liquid. All forms of Carbon Dioxide are odorless at low concentrations. At high concentrations, Carbon Dioxide will have a sharp, acidic odor.

**HOW TO DETECT THIS SUBSTANCE (warning properties):** The odor is not a good warning property, as the asphyxiation properties of Carbon Dioxide may present a hazard before the odor at high concentrations is readily detectable. In terms of leak detection for the gas, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation. In conditions of high humidity, the solid form of Carbon Dioxide may release visible vapors.

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## 10. STABILITY and REACTIVITY

**STABILITY:** Normally stable.

**DECOMPOSITION PRODUCTS:** Carbon Dioxide gas in an electrical discharge yields carbon monoxide and oxygen. In the presence of moisture, Carbon Dioxide will form carbonic acid.

**MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE:** Carbon Dioxide will ignite and explode when heated with powdered aluminum, beryllium, cerium alloys, chromium, magnesium-aluminum alloys, manganese, thorium, titanium, and zirconium. In the presence of moisture, Carbon Dioxide will ignite with cesium oxide. Metal acetylides will also ignite and explode on contact with Carbon Dioxide.

**HAZARDOUS POLYMERIZATION:** Will not occur, however Carbon Dioxide acts to catalyze the polymerization of acryldehyde and aziridine.

**CONDITIONS TO AVOID:** Avoid exposing cylinders of Carbon Dioxide to extremely high temperatures, which could cause the cylinders to rupture or burst. Do not store the solid form of Carbon Dioxide in gas-tight containers, which could also cause over-pressurization and rupture of the container.

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## PART IV *Is there any other useful information about this material?*

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### 11. TRANSPORTATION INFORMATION

**THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.**

**For Carbon Dioxide Gas:**

PROPER SHIPPING NAME: Carbon dioxide  
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)  
UN IDENTIFICATION NUMBER: UN 1013  
PACKING GROUP: Not applicable.  
DOT LABEL(S) REQUIRED: Non-Flammable Gas  
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 120

**For Carbon Dioxide Liquefied:**

PROPER SHIPPING NAME: Carbon dioxide, refrigerated liquid  
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)  
UN IDENTIFICATION NUMBER: UN 2187  
PACKING GROUP: Not applicable.  
DOT LABEL(S) REQUIRED: Non-Flammable Gas  
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 120

**For Carbon Dioxide, Solid:**

PROPER SHIPPING NAME: Carbon dioxide, solid **or** Dry ice  
HAZARD CLASS NUMBER and DESCRIPTION: 9 (Miscellaneous Dangerous Goods)  
UN IDENTIFICATION NUMBER: UN 1845  
PACKING GROUP: III  
DOT LABEL(S) REQUIRED: None  
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 120

MARINE POLLUTANT: Carbon Dioxide is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. MESA Specialty Gases & Equipment assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, MESA Specialty Gases & Equipment assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.