MATERIAL SAFETY DATA SHEET

**Product:** CARBON DIOXIDE

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Carbon Dioxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Family:</td>
<td>Acid Anhydrides</td>
</tr>
<tr>
<td>Symbol:</td>
<td>CO₂</td>
</tr>
<tr>
<td>Synonyms:</td>
<td>Carbonic Anhydride, Carbonic acid gas, Carbon Anhydride, Carbon dioxide USP, Dry Ice</td>
</tr>
<tr>
<td>Uses:</td>
<td>Various, beverage carbonation, expendable refrigerant pH control, fire suppression, controlled atmospheres, pressurizing solvent medium, grain fumigation, supercritical extraction, medical respiratory therapy mixtures, chemicals reactant</td>
</tr>
</tbody>
</table>

**Ingredient Composition Information**

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENTAGE</th>
<th>OSHA PEL-TWA</th>
<th>ACGIH TLV-TWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBON DIOXIDE</td>
<td>&gt;99%</td>
<td>5000 PPM</td>
<td>5000 PPM</td>
</tr>
</tbody>
</table>

**EMERGENCY OVERVIEW**

**Warning!**
- High pressure liquid and gas
- Can cause rapid suffocation
- Can cause severe frostbite
- Can increase respiration and heart rate

**POTENTIAL HEALTH EFFECTS INFORMATION**

**Routes of Exposure:**

**Inhalation**
Simple asphyxiate 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 has no known irreversible effects

**Eye Contact**
Tissue freezing.

**Skin Contact**
Tissue freezing and frostbites of skin.

**Skin Absorption**
Not applicable

**Ingestion**
Ingestion of solid will cause internal frostbite effect

**Chronic Effects**
Not established
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Medical Conditions Aggravated By Overexposure

None

Other Effects of Overexposure
Damage to retinal ganglion cells and central nervous system may occur

Carcinogenicity
Not listed

First Aid Measures

Inhalation
Persons suffering from overexposure should be immediately removed to fresh air. If victim is not breathing, administer artificial respiration. If breathing is difficult, qualified personnel may give 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 41°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

Fire Fighting Measures

Flash Point
Not applicable

Auto-ignition
Non-flammable

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 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. 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 fail to function.
Hazardous Combustion Products
None

Sensitivity to Static Discharge
None

Sensitivity to Mechanical Impact
Avoid impact against container

Accidental Release Measures

Steps to Be Taken if Material is Released or Spilled:

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

**Cylinders:** Evacuate all personnel from the affected area until the area is checked to ensure carbon dioxide levels below the exposure limits. Use self-contained breathing apparatus where needed. Shut off the source of carbon dioxide, if possible without risk. Ventilate enclosed areas or remove cylinders to a well-ventilated open area. If leaking 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 Tanks:** Evacuate all personnel from the affected area until the area is checked to ensure carbon dioxide levels 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.

Handling and Storage

**Precautions To Be Taken In Storage:** Store 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. 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 52°C. 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.

**Precautions To Be Taken In Handling:**

**Dry Ice** 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.
**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. 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 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 very cold and under pressure. A leak will result in the formation of solid particles, which will be forcibly ejected from the system. 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 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 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.

For additional precautions in using carbon dioxide see, other Information, e.g. CGA (Compressed gas Association), EIGA (European, Industrial, Gas Association) etc.

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**Exposure Control / Personal Protection**

**ENGINEERING CONTROLS:**

**Ventilation**  
Natural or mechanical to prevent oxygen-deficient atmospheres under 19.5% oxygen

**Respiratory Protection**  
None required under normal use. An air-supplied respirator must be used in confined spaces

**General Use**  
None required

**Emergency Use**  
Self-contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmosphere. Air purifying respirators will not function.

**Protective Gloves**  
Loose fitting thermal insulated or cryogenic gloves to be worn when handling liquid or solid CO2. Work gloves are recommended when handling cylinders

**Eye Protection**  
Full face shield is recommended for liquid transfer operations. Safety glasses are recommended when handling cylinders or Dry Ice
Other Protective Equipment  Metatarsal Safety shoes when handling containers or Dry Ice.  
Long-sleeved shirts and trousers without cuffs and protective overall.

| Exposure | CAS Number | 124-38-9 | Exposure Limit | Simple asphyxiate |

Physical and Chemical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>44.01</td>
</tr>
<tr>
<td>Sublimation point at 1 atm</td>
<td>-78.5°C</td>
</tr>
<tr>
<td>Density of the gas at 21.1°C and 1atm</td>
<td>1.833 kg/m³</td>
</tr>
<tr>
<td>Density of the liquid at 21.1°C and 1 atm</td>
<td>762 kg/m³</td>
</tr>
<tr>
<td>Vapour Pressure at 21.1°C</td>
<td>5778 kPa</td>
</tr>
<tr>
<td>Triple Point Temperature</td>
<td>-56.5°C</td>
</tr>
</tbody>
</table>

Appearance, Odour 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.

Stability and Reactivity

Stability: Stable

Conditions to Avoid: None

Incompatibility (Materials to avoid): None, will react with alkaline materials to form carbonates and bicarbonates.

Reactivity:

A) Hazardous Decomposition Products: Carbon monoxide and oxygen at temp above 1648.9°C
B) Hazardous Polymerization: Will not occur
C) 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.
D) General: Will react with alkaline materials to form carbonates and bicarbonates.
Carbon Dioxide is a simple asphyxiate.

**Toxicological Information**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irritancy of Material</td>
<td>None</td>
</tr>
<tr>
<td>Sensitization to Material</td>
<td>None</td>
</tr>
<tr>
<td>Reproductive Effects</td>
<td>None</td>
</tr>
<tr>
<td>Mutagenicity</td>
<td>None</td>
</tr>
<tr>
<td>Teratogenicity</td>
<td>None</td>
</tr>
<tr>
<td>Synergistic Materials</td>
<td>None</td>
</tr>
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</table>

**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 Consideration**

**Waste Disposal Method:** Do not attempt to dispose of residual or unused quantities. For emergency disposal, discharge slowly to the atmosphere in a well-ventilated area or outdoors.

**Transport Information**

### Solid (Dry Ice)

<table>
<thead>
<tr>
<th>DOT/IMO Shipping Name</th>
<th>Carbon Dioxide, Refrigerated Liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard Class</td>
<td>9</td>
</tr>
<tr>
<td>Shipping Label(s)</td>
<td>No label required for road shipment. Air shipment – use class 9 label</td>
</tr>
<tr>
<td>Placard (When required)</td>
<td>No placard required for domestic shipment</td>
</tr>
</tbody>
</table>

### Gas

<table>
<thead>
<tr>
<th>DOT/IMO Shipping Name</th>
<th>Carbon Dioxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard Class</td>
<td>2.2 (Non-flammable Gas)</td>
</tr>
<tr>
<td>Shipping Label(s)</td>
<td>Non-flammable gas</td>
</tr>
<tr>
<td>Placard (When required)</td>
<td>Non-flammable gas.</td>
</tr>
</tbody>
</table>

### Liquid

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<td>Hazard Class</td>
<td>2.2 (Non-flammable Gas)</td>
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</tbody>
</table>

Material Safety Data Sheet – Carbon Dioxide
Shipping Label(s) Non-flammable gas
Placard (When required) Non-flammable gas

Special Shipping Information
Containers should be transported in a secure position, in a well-ventilated truck. The transportation of 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 information of solid dry ice, which may cause blockage of the liquid line.

Mixtures
When two or more gases 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.