PRODUCT SAFETY DATA SHEET **Substance identification (UN) No. 1013 2187**

BULK LIQUID CARBON DIOXIDE Hazchem code: 2RE

Introduction

Carbon dioxide is supplied in bulk as a liquefied gas for customers who have a large requirement for the gas or who are using carbon dioxide in cooling applications or as a liquid under pressure.

Liquid carbon dioxide can be supplied by road tanker into special well insulated bulk storage vessels. Normally a refrigeration system is incorporated into the storage plant in order to maintain the stored liquid at a set temperature (-17°C) and therefore set pressure (20.7 bar).

For all applications liquid CO2 is drawn off from the vessel and used as such or converted to gas using a number of different types of vaporisers. The necessary heat supplied to the vaporiser to convert the liquid to gas can be obtained from steam, hot water, electricity or ambient air.

General properties

1. Liquid carbon dioxide cannot exist at ambient temperatures and pressure. When the liquid under pressure is released to the atmosphere, the discharge will consist of gaseous and solid carbon dioxide.

2. Gaseous carbon dioxide is colourless, odourless and has a biting taste. It is heavier than air and will accumulate at low levels. Under certain conditions of temperature and humidity the gas may appear as a white mist.

3. Solid carbon dioxide will “sublime” directly to gas and has a surface temperature of –78.5°C.

4. Carbon dioxide is not flammable. It is generally regarded as an inert gas, although under certain conditions of pressure and temperature it can react with other substances.

5. In the presence of water, carbon dioxide is corrosive to certain of the common metals.

6. Carbon dioxide does not support life and can act as an asphyxiant by displacing the oxygen in the atmosphere.

You should ensure that you understand the properties of carbon dioxide and know how to handle it safely.

Specification and typical analysis

Bulk liquid carbon dioxide supplied by Distillers MG Limited will meet the following specifications:
BS 4105: 1990 Type 2 EEC Council Directive 65/66 EEC E290
Miscellaneous Additives in Food Regulation 1980

	Specification	Typical analysis
Residual gases	0.025% v/v	0.005%
Water	50 mg/kg	9 mg/Kg
Oil	2 mg/Kg	0.2 mg/Kg
Sulphur compounds	0.5 mg/Kg	< 0.1 mg/Kg
Oxides of nitrogen	1 mg/Kg	< 0.1 mg/Kg
Copper	*	< .01 mg/Kg
Zinc	25 ppm *	< 0.1 mg/Kg
Carbon monoxide	passes the E290 test	< 1.0 mg/Kg
Total hydrocarbons		1.5 mg/Kg
Halogens		< 0.1 mg/Kg
Ammonia		< 1.0 mg/Kg
Arsenic		< 0.001 mg/Kg
Cadmium		< 0.1 mg/Kg
Mercury		< 0.01 mg/Kg
Lead		< 0.1 mg/Kg
Soda water taste	satisfactory	satisfactory
Odour of solid CO2	satisfactory	satisfactory

* The total concentration of copper and zinc together shall not exceed 50 ppm.

Physical properties (pure)

Molecular weight	44.01
Vapour pressure (15°C)	50.85 bar
Density of gas (15°C, 1 bar)	1.8474 g/l
Specific gravity, gas (air = 1)	1.528
Critical temperature	31.1°C
Critical pressure	73.825 bar
Triple point (5.185 bar)	-56.6°C
Solubility of gas in water (15°C, 1 bar)	1.9786 g/l

Colourless
Odourless

Note: All pressures are absolute

WARNING: EXTREMELY COLD, ASPHYXIANT VAPOUR

Hazardous properties

Toxicity:	Occupational exposure standard (OES) 5,000 vpm
Short term exposure limit:	15,000 vpm (1.5%) calculated as a 10 minute time – weighted average.
Asphyxiant vapour:	Vapour heavier than air.

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Liquefied gas in a pressure vessel under a vapour pressure:	Approx. 20.7 bar g.

Note:
Carbon dioxide cannot exist as a liquid at atmospheric pressure.

Large volume increase on phase change – one volume of liquid will instantly produce 250 volumes of gas plus a further 250 volumes once the solid has sublimed to gas under ambient conditions.

Slightly corrosive in the presence of moisture.

Solid carbon dioxide or cold vapour may cause cold burns or frost bite.

Safety Precautions

Responsibility:	All users of bulk liquid dioxide should possess a copy of the Health & Safety Executive Guidance Note CS9 entitled 'Bulk Storage and Use of Liquid Carbon Dioxide Hazards and Procedures' which states that the person in control of a carbon dioxide installation is responsible for its safety whether the plant is owned, hired, leased or loaned. The user should therefore familiarise himself with the recommendations made in CS9 and ensure that the carbon dioxide plant is properly maintained and operated in a correct and safe manner. Distillers MG Limited may refuse to make deliveries into any storage installation which has been modified or inadequately maintained and which is considered to be unsafe for continuing operation.
Fire and explosion hazards:	Carbon dioxide is not flammable and does not constitute a fire hazard. However, bulk liquid carbon dioxide is stored under pressure in liquid storage vessels and it is recommended that precautions are taken to lessen the risk of fire in the vicinity of the storage vessel. eg. Combustible materials should not be stored near the vessel. Should a fire occur then, if the refrigeration plant associated with the vessel is unable to offset any heat ingress, the pressure within the storage vessel will rise and ultimately the pressure relief valves will operate.
Material compatibility:	Normal materials of construction are suitable for dry gas at ambient temperature. Below –

30°C only use low temperature carbon steel, austenitic stainless steels, aluminium and copper and their alloys. If carbon dioxide is dissolved in water particularly at elevated pressures, and in the presence of oxygen, use materials resistant to carbonic acid, eg. 18-8 stainless steel or Monel®

Leak detection:

Large leaks can usually be heard or can be detected by noting the build up of frost at the discharge point. For the detection of smaller leaks, apply soap solution to suspect sites on gas lines and equipment. Bubbling will indicate leaks.

Toxicity and symptoms:

Carbon dioxide, which is normally present in atmospheric air at the level of approximately 350 vpm (0.035%), regulates the breathing function and an increase in concentration will cause increased breathing rate. The occupational exposure standard (OES) is 5,000 vpm (0.5%), but changes in the breathing rate may not be noticed until there is a concentration of 20,000 vpm (2%) when the rate will increase to about 50% above the normal level. Prolonged exposure at this level for several hours may cause a headache and a feeling of exhaustion.

At high concentrations carbon dioxide may cause asphyxiation and can paralyse the respiratory centre. Breathing an atmosphere rich in carbon dioxide can cause immediate loss of consciousness and rapid death. Symptoms of asphyxiation may include rapid and gasping respiration, rapid fatigue, nausea, vomiting, cyanosis and may lead to loss of consciousness or death from anoxia.

Cold burns and frost bite:

When bulk liquid carbon dioxide under pressure is released to the atmosphere the discharge will consist of gaseous and solid carbon dioxide at –78.5°C. Exposure to the cold gas or solid carbon dioxide can cause cold burns or frost bite. Local pain usually gives warning of freezing but sometimes no pain is experienced. Shock may occur if the burns are at all extensive. Thawing frozen tissues can cause intense pain.

Precautions

Protective clothing:

Protective clothing is only intended to protect the wearer handling cold equipment or from accidental contact with cold gas or solid carbon dioxide. Non-absorbent insulated gloves, goggles or a face mask should be worn to protect otherwise unprotected parts

of the skin.

Atmosphere:

It is essential that operations involving the use of carbon dioxide, particularly when large quantities are used, are conducted in well ventilated areas to prevent the formation of oxygen deficient atmospheres.
Ideally, carbon dioxide should be vented into the open air well away from areas frequented by personnel. Carbon dioxide should NEVER be released or vented into enclosed areas, pits, cellars or buildings where the ventilation is inadequate.

Carbon dioxide gas at ambient temperatures is denser than air and can accumulate in low lying areas such as pits and trenches.

Before entering areas, vessels or other equipment, for maintenance or other purposes, in which the atmosphere is, or may become, deficient in oxygen, action should be taken to make the equipment safe. Preparatory work will include equipment isolation from hazardous processes, purging and contained ventilation with air as appropriate.

Due to asphyxiation hazards any suspect atmosphere should be monitored for carbon dioxide and lack of oxygen. There are a number of both carbon dioxide and oxygen measuring devices available on the market to detect the level of carbon dioxide and if necessary oxygen in the atmosphere. These devices will help warn the operator if dangerous levels are present.

If it is necessary for a person to enter an oxygen deficient atmosphere for maintenance or other purposes it is essential that he wear and be trained in the use of self contained breathing APPARATUS.

Persons entering an oxygen deficient area are recommended to wear a safety belt with a manned safety line attached. Standby personnel should have ready access to self contained breathing apparatus.

Over pressurisation:

Care must be taken to ensure that all pipes or other closed systems in which bulk liquid carbon dioxide can be trapped are protected by a suitable relief valve. Otherwise, extremely high pressure, well in excess of the safe working pressure of the system will be generated as the system warms up –

creating a dangerous rupture hazard.

Emergency action

Inhalation (asphyxiation conditions):	Minimising personal risk, immediately remove the victim to an uncontaminated area. Ensure there is no obstruction to the airways. If breathing is weak or stopped, apply artificial respiration with simultaneous administration of oxygen, preferably using oxygen resuscitator. Summon am ambulance. Keep warm and rested.
Cold burns and frost bite:	In severe cases summon medical assistance immediately, Apply first aid as follows: Loosen or remove any clothing that may restrict circulation. Flush affected areas with copious amounts of lukewarm (tepid) water or place affected part in a container of lukewarm water. Move person to a warm (not hot) place. Do not apply direct heat to the affected areas. Protect the affected areas with dry, sterile, bulky dressings – loosely applied so as not to restrict circulation. In all cases seek medical attention as soon as possible. Do not give affected persons cigarettes or alcohol.
Hypothermia:	Move person to a warm place and wrap in blankets. Do not apply direct heat. Do not give cigarettes or alcohol. Seek medical attention.
Carbon dioxide leak:	In the event of a serious leak which could give rise to high levels of carbon dioxide: • Evacuate the area • Post warning notices and seal off the area • If it is necessary to enter the area, use appropriate breathing equipment such as self contained breathing apparatus, or other type of independent air supply. Absorptive respirators MUST NOT be used.
Fire fighting:	Carbon dioxide is not flammable and no special fire fighting precautions or equipment are needed. If an outbreak of fire occurs in the vicinity of carbon dioxide storage equipment, the local Fire Brigade should be summoned at once. Effort should be made to keep the heat of the fire away from the carbon dioxide storage vessel.

References

H&SE Guidance Notes CS9: 1985 Bulk Storage and Use of Liquid Carbon Dioxide: Hazards and Procedures.

H&SE Code of Practice
the Operational Provisions of the Dangerous Substances (Conveyance by Road in Road Tankers and Tank Containers) Regulations 1981

H&SE Guidance Note EH40
Occupational Exposure Limits

H&SE Code of Practice
Pressure Systems and Transportable Gas Containers Regulations 1989

British Compressed Gas Association CP9 (1982)
The Safe Filling, Handling, Storage and Distribution of Gases in Transportable Containers.

Distillers MG Limited
Safety Data Book – Bulk Carbon Dioxide