CODE OF PRACTICE
DRY ICE

IGC Document 150/08/E
CODE OF PRACTICE
DRY ICE

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1 Introduction

Dry ice is CO₂ in its solid form, produced by expanding liquid CO₂ to atmospheric pressure. The product can be supplied as either blocks, slices or pellets and is generally packed into plastic, paper or composite bags that are stored and transported in insulated containers. Some products (particularly pellets) can also be supplied "loose" in containers, with no wrapping. Dry ice is used in practically all types of industries, mainly because of its cooling properties. It is particularly interesting for applications where "spot cooling" is needed. The most common uses are:

- **Cooling**
  - Cooling of catering trolleys in airplanes, trains...
  - Cooling of food, pharmaceutical products, etc. during transport without direct contact between product and dry ice (to maintain the "cold chain")
  - Cooling of food with direct contact between dry ice and the product (meat, grapes,...)
  - Direct application in food mixing processes in order to maintain the temperature
  - Cooling metal

- **Blast cleaning with dry ice**

- **Bacteriostatic use**
  - Modified atmosphere packaging in food to produce a protective, bacteriostatic atmosphere.(gasphase)

When dry ice is added directly to food, it is important to consider its possible role as a carrier of contamination. The quality of the raw material (liquid CO₂) shall conform to the purity criteria for food additive (E290).

2 Scope

This guide covers the entire supply chain of all dry ice products, from the receipt of bulk liquid carbon dioxide to the delivery of finished products to end-users.

The document provides specific guidelines for safe and hygienic handling of product, equipment and containers throughout the production and supply chain.

In the gases industry, dry ice is the only solid product and, unlike other food gas products, is not kept in a closed pressurised system. It therefore requires that specific attention be paid to food hygiene.

3 Definitions

"Cold chain"
Temperature control system for food transport.
Control measure
Action or activity that can be used to prevent or eliminate a hazard.

Dry ice
Solid carbon dioxide.

Dry ice - food application
Application in which dry ice is in direct contact with food during the manufacturing process. An example would be the direct use of dry ice as a cooling agent in a meat grinding or mixing application.

Dry ice – non food application
Application in which dry ice does not come into direct contact with food. An example would be the use of packaged dry ice as a refrigerant for indirect cooling of food in insulated transport containers.

HACCP

4 Dry Ice Production

Liquid CO₂ is supplied from road tankers, rail tankers, or directly from the CO₂-production plant into the storage tanks.

The usual working pressure is 15 bar g.

The liquid CO₂ is injected into appropriate presses with snow towers or chambers and expanded to approx. 1 bar g. Approximately 50 % CO₂-snow and 50 % cold CO₂-gas (-78,5°C) is generated.

The CO₂-snow is pressed hydraulically into blocks, pellets, or slices. Slices of special sizes are produced by sawing up blocks. Despatch, packed or unpacked, is done in special insulated containers.

In smaller dry ice plants production often is done without recovery of the CO₂-gas. For larger production plants where recovery is required, the cold gas is compressed by means of compressors, condensed in the CO₂-liquefier, and then recycled into the dry ice process. The necessary refrigeration is by a closed loop refrigeration system using a refrigerant gas.

5 Properties and Hazards

5.1 Properties

Gaseous state
At normal temperature (+15°C) and atmospheric pressure CO₂ has a density of 1,87 kg/m³ and is 1,5 times heavier than air. It is a colourless and odourless gas (with a slightly pungent odour at higher concentrations) and spreads along the ground, collecting in low-lying areas such as pits and cellars.
Carbon Dioxide is classified as a non toxic gas but it does start to affect breathing at a concentration of approximately 1 % with effects becoming more serious with increasing concentrations.

Carbon Dioxide is non-flammable.

**Liquid state**
CO₂ can exist as liquid below the critical temperature of 31°C and above the triple point with a temperature of -56,6°C and 4,18 bar gauge (barg). CO₂ is transported, stored and handled in liquid form, either at ambient temperature (in cylinders or uninsulated storage tanks at a pressure of 45 - 65 barg) or refrigerated (in insulated tankers and storage tanks) at a temperature range of -35 to -15°C and a pressure range of 12 to 25 barg. The CO₂ in this state is liquid at its boiling point.

Below the triple point 4,18 barg and -56,6°C CO₂ can only exist in the solid and the gas phase.

Therefore liquid CO₂ cannot exist at atmospheric pressure. When the liquid CO₂ is depressurised below the triple point pressure of 4,18 barg to atmospheric pressure it is transformed to dry ice and gas, consequently when the liquid CO₂ is released to the atmosphere a dense white fog of powdery solid carbon dioxide particles and vapour is produced.

**Solid state (Dry ice)**
The expansion of liquid CO₂ to atmospheric pressure is used to produce CO₂ snow at a temperature of -78,5°C. The snow is compressed to form dry ice blocks, slices or pellets.
5.2 Hazards

Asphyxiation
Carbon Dioxide is classified as a non-flammable, non-toxic liquefied gas. It is normally present in atmospheric air at a level of approximately 380 parts per million (0.038%). It is a normal product of metabolism being held in bodily fluids and tissues where it forms part of the body’s normal chemical environment. In the body it acts in the linking of respiration, circulation and vascular response to the demands of metabolism both at rest and in exercise.

The effects of inhaling low concentrations of carbon dioxide are physiological reversible but in high concentrations the effects are toxic and damaging.

Note: The effects of carbon dioxide are entirely independent of the effects of oxygen deficiency.

The oxygen content in the atmosphere is therefore not an effective indication of the danger. It is possible to have an acceptable low oxygen content of 18% and a high carbon dioxide content, 14% being very dangerous.

Individual tolerances can vary widely, dependent on the physical condition of the person and the temperature and humidity of the atmosphere, but as a general guide, the effects of inhaling varying concentrations of carbon dioxide are likely to be as follows:

Concentrations by volume - likely effects:

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Likely Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1.5%</td>
<td>Slight effect on chemical metabolism after exposure of several hours.</td>
</tr>
<tr>
<td>3%</td>
<td>The gas is weakly narcotic at this level, giving rise to deeper breathing, reduced hearing ability, coupled with headache, an increase in blood pressure and pulse rate.</td>
</tr>
<tr>
<td>4-5%</td>
<td>Stimulation of the respiratory centre occurs resulting in deeper and more rapid breathing. Signs of intoxication will become evident after 30 minutes exposure.</td>
</tr>
<tr>
<td>5-10%</td>
<td>Breathing becomes more laborious with headache and loss of judgement.</td>
</tr>
<tr>
<td>10-100%</td>
<td>When the carbon dioxide concentration increases above 10% unconsciousness will occur in under one minute and, unless prompt action is taken, further exposure to these high levels will eventually result in death.</td>
</tr>
</tbody>
</table>

The recommended operational exposure limit for carbon dioxide is 5,000 parts per million (0.5%) by volume, calculated on an 8 hour time weighted average concentration in air.

Depending on regulations in individual countries, carbon dioxide concentration peaks up to 30,000 parts per million (3%) in air are allowed, whereby the duration of exposure is between 10 minutes and 1 hour.

Cardiac or respiratory defects are likely to increase the hazards of inhalation. Wherever any doubt exists, the recommended exposure limit of 5000 parts per million carbon dioxide in air should be regarded as the maximum level of the individual concerned.

Low temperature of product: Extreme cold
Dry ice is extremely cold (-78,5°C) and may cause frostbite if touched without protection. If dry ice particles come into contact with the eyes, severe eye injury may result.

Touching pipes and installations containing liquid carbon dioxide may cause frostbite.

Where there has been a major release of gas, visibility is likely to be limited due to the fog formed by the condensation of water vapour in the air and there is a risk of asphyxiation. These factors can make escape or rescue difficult.

6 Specific requirements for dry ice for food applications

Note: The following applies specifically to food application. For non-food applications there are no specific requirements.
The use of dry ice in a food application requires compliance with EU food safety regulations. The main elements necessary for a food safe process are:

- Food safety risk assessment of the entire sourcing, manufacturing and distribution process.
- Traceability of finished product back through production to raw material supply.

### 6.1 Raw materials

The fitness for purpose of the liquid carbon dioxide used as the raw material for dry ice manufacture is guaranteed by:

- Compliance with the applicable legal requirements and European specifications defined in Annex I.
- Operation in accordance with the requirements of an auditable quality management standard.
- Reference to recommendations on the management of the carbon dioxide supply chain issued by the European Industrial Gases Association (EIGA), relevant documents are listed in Annexe II.

### 6.2 Product quality

The specified product quality is achieved by means of the correct production equipment and procedure. Following approval of a liquid source, the quality of the raw material should, as a minimum, be measured by periodic analysis to demonstrate conformance.

The finished product (dry ice) should be checked on a periodic basis for taste, odor, colour and residual non-volatiles.

See also some other EIGA documents: "Doc 120/XX – Guide to the supply of gases for use in foods" and "Doc 126/XX – Minimum specifications for food gas applications".

### 6.3 Quality management system

The complete supply chain from sourcing, through production to delivery should operate within the framework of a formal quality management system such as ISO 9001 or more specifically ISO 22000.

### 6.4 HACCP

The complete production and supply chain, including manufacturing and distribution systems, shall be covered by HACCP studies.

### 6.5 Traceability & management of non-conforming product

The operation shall maintain records which provide full traceability of the dry ice from the collection of liquid, from the liquid production source, through to delivery of dry ice to the customer. Suppliers of dry ice for food applications shall have a documented Critical Action Plan that covers product recall situations.

### 7 Requirements for dry ice premises

Note: the following applies to the production of dry ice for food applications, for non-food applications there are no specific hygiene requirements:

By means of the plant HACCP study, factors affecting food hygiene shall be identified and suitably controlled. These factors will be broadly associated with either the workplace, the people working within that workplace or the management of the operation. The following is a non-exhaustive list of pre-requisite factors that should be considered and controlled to manage food safety risk:

#### Workplace

- Preventative measures to limit the ingress of contamination into the production and packaging areas (automatic operating doors, air intake filtration, electrically powered vehicles, conveyor covers, receipt, storage and handling of packaging).
- Suitability of equipment and buildings for cleaning and cleaning regimes (access for cleaning of buildings and equipment, cleaning materials, frequencies, cleaning methods, etc.)
• Staff and visitor welfare arrangements (availability of separate eating, drinking, rest, smoking restrictions, toilets, washing facilities and the provision of anti-bacterial soap).
• Pest control arrangements (for rodents, birds and insects). Insect contamination can be controlled by installing fly screen, UV light "zappers" or other equipment.
• Waste management procedures (from welfare facilities, production operations, PPE renewal, container cleaning etc).
• Register of acceptable engineering materials permitted for operational use (food safe lubricants, glass and plastic, conveyor surface and other contact materials, etc).
• Use of metal detectors based on risk analysis.

Management
• Set of food safety risk management policies covering personal hygiene, jewelry, hair, use of plastic, wood, glass etc. It is recommended that the policies should be sensitive to the application and not attempt to create a fully compliant “food factory” regime.
• Food safety to be considered when planning engineering tasks, modifications or maintenance via a permit-to-work system.
• Suitable procedures to ensure the correct use, renewal frequency, type and specification of personal protective equipment (PPE). Overalls should be food type with no external pockets and with a routine laundering regime. Gloves; in order to offer effective thermal and mechanical protection it is not likely that gloves will be food safe, therefore an effective regime of renewal and specification of clean job gloves and dirty job gloves will be required.
• Routine plant inspections and audits of the management / operating system.

Safety: CO₂ monitoring system
There must be a system in place to ensure that OEL levels are correctly monitored. The work area shall be equipped with continuous CO₂ monitoring and, if necessary, the staff shall carry a personal monitoring device.

8 Production equipment requirements

Note: The following apply specifically to food applications. For non-food applications there are no specific requirements.

8.1 Storage vessels for liquid CO₂

Materials of construction shall be compatible with the dry ice manufacturing process and shall not introduce contaminants that would present a risk to food safety.

Formalised systems should be in place to ensure that when storage vessels are transferred from one service to another, or new storage vessels are installed, product quality is assured and / or maintained.

Prior to first filling, storage vessels and liquid distribution piping system should be sufficiently purged by CO₂ until the correct quality is obtained.

8.2 Recovery plant

The CO₂ recovery system shall not introduce contaminants that would present a risk to food safety.

8.3 Production, handling and packaging equipment

The design and construction of extruders, presses, chutes, conveyors, saws, packaging and other equipment used for the production of dry ice should minimise the opportunity for contamination that would produce a risk to food safety. Their condition should be guaranteed by regular inspection.
Restrict the use of external fork lift trucks within the packaging area. Use internal fork lift trucks for container movements from delivery point to fill point.

Consideration should be given to exposed sections of the production line to prevent airborne contamination / foreign bodies whilst allowing easy access for maintenance and cleaning.

“Food grade” lubricants shall be used wherever there is a risk that lubricants could come into contact with the dry ice.

Dry ice production, particularly at start up, presents a risk of high CO₂ concentration in the production building. The necessary precautionary measures shall be taken to provide adequate ventilation either by natural or forced ventilation. The appropriate pictograms for asphyxiation hazard must be displayed at the entrances of the production area. Special attention shall be given to low lying areas where CO₂ can concentrate.

Saws, conveyors and presses shall be adequately guarded in accordance with local regulations enacting the Machinery Directive.

Equipment must be interlocked to prevent operation when guards are removed.

When dry ice manufacturing equipment uses hydraulic power, the necessary measures must be taken to protect the environment and personnel from the release of hydraulic fluid.

Where there is a requirement for manual handling (wrapping dry ice, manual loading of containers,...) a specific risk assessment shall be performed, including a review of the job ergonomics, and appropriate control measures applied to minimise the risk of any sustained occupational injury, e.g. position container to minimise bending twisting to reduce potential for back injuries.

8.4 Cleaning regimes

Chutes, conveyors, weighing systems and packaging equipment shall be regularly inspected and cleaned. Only food compatible detergent and suitable quality water shall be used.

Equipment should be designed and manufactured to be easily cleanable and avoid dirt traps.

Design should provide for water run-off from plant due to both condensation and as a result of cleaning.

9 Containers

Containers shall be made of materials that are compatible with the chemical and physical properties of dry ice. Containers shall be well maintained to ensure that they do not pose a risk to operators or customers. Mechanisms to prevent accidental closure of container doors and lids may be required.

Note: The following applies specifically to food application. For non-food applications there are no specific requirements.
Dry ice containers shall be constructed of easily cleanable and maintainable materials e.g. stainless steel, fibreglass and epoxy, plastic or non-ferrous alloys. The use of disposable plastic container liners should be considered, especially for "loose" product, which has no primary wrapping. Containers (full or empty) should be kept closed, whenever possible, and always kept closed if stored outside in the open air.

Dry ice containers shall be inspected and, if necessary, cleaned before each use. Only food compatible detergent and suitable quality water should be used.

The cleaning area should be separated from the production area.

Uncleaned containers should be stored clearly separated from cleaned containers.

Returned dry ice shall not be re-used for food grade applications.

An anti-tampering device or indicator shall be used to ensure product integrity.

10 Wrapping and packaging

Wrapping, packaging and labels must be suitable for use at low temperature (down to -78.5ºC). The packaging shall be designed to prevent pressure buildup due to sublimation. It is advisable to print safety instructions on the packaging material.

For food application, wrapping and packaging shall be made from food-compatible materials. All wrapping and packaging material shall be transported and stored in suitable conditions to reduce the risk of contamination. Reference should be made to the wrapping and packaging requirements of Regulation 852/2004 on the hygiene of foodstuffs and Regulation 1935/2004 on materials and articles intended to come into contact with food.

11 Transport

The distribution of the containers should be the subject of a HACCP study. Special attention shall be paid to the securing of the cargo.

Dry ice is not subject to ADR/RID regulations but can constitute a asphyxiation hazard when transported in closed vehicles. Therefore it is advised to ensure that the vehicles are well ventilated, or to use gas detection systems during transport.

For transportation by air (ICAO), dry ice is listed in class 9 ("Miscellaneous"). There are two Proper Shipping Names either of which can be used on all documents: “UN 1845 CARBON DIOXIDE, SOLID” or “UN 1845 DRY ICE”.

Shipper’s Declaration requirements are only applicable when the dry ice is used as a refrigerant for dangerous goods that require a Shipper’s Declaration.

When a shipper's Declaration is not required the following information must be shown on the box:

![UN 1845 CARBON DIOXIDE, SOLID
Net Quantity .... Kg](image)

When a Shipper’s Declaration is not required, the following information must be shown on the airway bill:

![UN 1845 CARBON DIOXIDE, SOLID, Class 9; .... Kg](image)

or

![UN 1845 DRY ICE, Class 9; .... Kg](image)

The maximum allowable net quantity per package will be dependent on the carrier.

12 Personnel requirements and safety

The various jobs should be the subject of risk assessments. The following personal protective equipment should be considered for workers:

- Hand protection (Suitable gloves)
- Eye protection (Safety glasses)
- Protective footwear (Safety shoes)
- Hearing protection
- Protective clothing

Hand protection
Dry ice is extremely cold (-78.5°C) and may cause frostbite if touched with bare hands. There are other risks present: mechanical (wrapping, container handling), chemical (cleaning agents)...

All hand protection is made for specific purposes and should be selected on risk basis and should conform to the requirements of a recognized standard such as: EN 388 Protective gloves against mechanical risks; EN 511 Gloves Giving Protection from Cold. (ISO 13997).

Eye protection
If dry ice particles come into contact with the eyes, severe eye injury may result. High pressure hydraulic and liquid CO₂ system also present a risk to workers. All eye protection should conform to the requirements of a recognised standard such as: EN 166 Personal eye protection.

Regular glasses must never be considered as eye protection. (ISO 8980).

Protective footwear
Due to the risk involved in the handling of blocks and containers, and the movement of fork lift trucks,… protective footwear is necessary. All safety shoes should conform to the requirements of a recognised standard such as: EN ISO 20345 Personal Protective Equipment – Safety footwear. (See also EN ISO 20344).

Hearing protection
Dry ice production should be the subject to the noise risk assessment which will identify the requirements for the wearing of hearing protection. All hearing protection should conform to the
requirements of a recognised standard such as: EN 352 Hearing Protectors. Safety requirements and testing. Ear –muffs. (ISO 11904)
The Choice of the hearing protection (e.g. ear defenders, helmet-mounted ear defenders, earplugs etc) should be determined by taking into consideration both separately and in combination:

- Frequency of use
- Noise level
- Duration of exposure
- Ambient noise level
- Noise frequency
- Additional PPE required for work activity (e.g. gloves, helmet, goggles etc);

Protective clothing
For safety and hygiene reasons the wearing of protective clothing is advisable. Cotton is recommended.

Note: The following applies specifically to food application. For non-food applications there are no specific requirements.

General personal hygiene:
In food applications dry ice plant workers will be required to comply with hygiene policy which may involve the following:

- Working clothes must be clean and laundered on a regular basis.
- Overalls should be food type with no external pockets
- Restrictions on the wearing of jewellery.
- The condition and length of hair and nails.

13 Safety information
All dry ice packaging, plastic, paper or composite bags/wrapping and insulated containers, must be suitably labelled with all relevant safety information.

“Safety Data Sheet” See appendix IV.

14 Training of personnel
Instruction, training and supervision of all control measures associated with food safety to all 'relevant' persons (operations, maintenance, external contractors, hauliers, visitors).

Particular attention should be given to:
- the risks and hazards of carbon dioxide and dry ice
- personal hygiene standards
- impact of the job to food safety
- the critical control points of the process.

Training records should be maintained for all personnel.

Special attention should be given to the training needs of new employees.
Appendix I: Relevant European Legislation

Commission Directive 96/77 of 2 December 1996, laying down specific purity criteria on food additives other than colours and sweeteners.

**E 290 CARBON DIOXIDE**

**Synonyms**
- Carbonic acid gas
- Dry ice (solid form)
- Carbonic anhydride

**Definition**
- **Chemical name**: Carbon dioxide
- **EINECS**: 204-696-9
- **Chemical formula**: CO₂
- **Molecular weight**: 44.01
- **Assay**: Content not less than 99 % v/v on the gaseous basis
- **Description**: A colourless gas under normal environmental conditions with a slight pungent odour. Commercial carbon dioxide is shipped and handled as a liquid in pressurized cylinders or bulk storage systems, or in compressed solid blocks of ‘dry ice’. Solid (dry ice) forms usually contain added substances, such as propylene glycol or mineral oil, as binders

**Identification**
- **A. Precipitation**
  - **(Precipitate formation)**: When a stream of the sample is passed through a solution of barium hydroxide, a white precipitate is produced which dissolves with effervescence in dilute acetic acid

**Purity**
- **Acidity**: 915 ml of gas bubbled through 50 ml of freshly boiled water must not render the latter more acid to methylorange than is 50 ml freshly boiled water to which has been added 1 ml of hydrochloric acid (0.01 N)
- **Reducing substances, hydrogen phosphide and sulphide**: 915 ml of gas bubbled through 25 ml of ammoniacal silver nitrate reagent to which has been added 3 ml of ammonia must not cause clouding or blackening of this solution
- **Carbon monoxide**: Not more than 10 µl/l
- **Oil content**: Not more than 0.1 mg/l

*Commission Directive 2002/72/EC of 6 August 2002 relating to plastic materials and articles intended to come into contact with foodstuffs.*


*Regulation (EC) No 1935/2004 Of The European Parliament And Of The Council of 27 October 2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC.*
Appendix II: Relevant EIGA Documents

The European Industrial Gases Association (EIGA) has issued related documents:

Doc 66/XX - Refrigerated CO2 storage at users premises

Doc 68/XX – Prevention of Carbon Dioxide Back-feed Contamination

Doc 70/XX – Carbon Dioxide Source Certification, Quality Standards and Verification.

Doc 120/XX – Guide to the supply of gases for use in foods.

Doc 126/XX – Minimum specifications for food gas applications.

When used together, within an existing quality management system, these documents are intended to provide a basis for quality assurance of the carbon dioxide supply chain.

Note: XX = version date
Appendix III: Safety Information

DRY ICE, SOLID CARBON DIOXIDE
UN 1845
Class 9
Non Toxic, Non Flammable

Extremely cold, -78,5°C
Contact can cause severe frostbite

Carbon dioxide gas can cause asphyxiation
Carbon dioxide is heavier than air

Do not play games with Dry Ice
Do not eat or place in drinks

Gas-tight container shall not be used
Always handle with protective gloves
Store and transport in well ventilated spaces
Appendix IV: Safety Data Sheet

Note: The supplier must add his telephone number and address to the Safety Data Sheet.

<table>
<thead>
<tr>
<th>SAFETY DATA SHEET</th>
<th>EIGA018C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page: 1</td>
<td></td>
</tr>
<tr>
<td>Revised edition no: 2</td>
<td></td>
</tr>
<tr>
<td>Date: 16/4/2007</td>
<td></td>
</tr>
<tr>
<td>Supersedes: 1/4/2004</td>
<td></td>
</tr>
</tbody>
</table>

Carbon dioxide (solid)

### 1 IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND OF THE COMPANY / UNDERTAKING

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Carbon dioxide (solid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical formula</td>
<td>CO2</td>
</tr>
<tr>
<td>Company identification</td>
<td>EIGA</td>
</tr>
<tr>
<td>Address line 1</td>
<td></td>
</tr>
<tr>
<td>Address line 2</td>
<td></td>
</tr>
<tr>
<td>B-1234 Brussels Belgium-Belgium</td>
<td></td>
</tr>
<tr>
<td>Tel.: +12 34 567 890</td>
<td></td>
</tr>
<tr>
<td>Emergency phone nr</td>
<td>+12 34 567 890</td>
</tr>
</tbody>
</table>

### 2 COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Substance / Preparation</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide (solid)</td>
<td>100 %</td>
</tr>
<tr>
<td>CAS No</td>
<td>124-38-0</td>
</tr>
<tr>
<td>EC No</td>
<td>234-699-9</td>
</tr>
</tbody>
</table>

Contains no other components or impurities which will influence the classification of the product.

### 3 HAZARDS IDENTIFICATION

Hazard identification: Refrigerated solidified gas. Contact with product may cause cold burns or frostbite. In high concentrations may cause asphyxiation.

### 4 FIRST AID MEASURES

First aid measures:
- **Inhalation**: In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation. Low concentrations of CO2 cause increased respiration and headache. Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
- **Skin/eye contact**: In case of frostbite spray with water for at least 15 minutes. Apply a sterile dressing. Obtain medical assistance.
- **Ingestion**: Ingestion is not considered a potential route of exposure.

### 5 FIRE-FIGHTING MEASURES

Specific hazards: Exposure to fire may cause containers to rupture/explode.

Hazardous combustion products: None.

Suitable extinguishing media:
- All known extinguishants can be used.

Special protective equipment for fire fighters:
- In confined space use self-contained breathing apparatus.

### 6 ACCIDENTAL RELEASE MEASURES

Personal precautions:
- Evacuate area.
- Use protective clothing.
- Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.
- Ensure adequate air ventilation.

Environmental precautions:
- Try to stop release.

EIGA Adress line 1 Adress line 2 B-1234 Brussels Belgium-Belgium Tel.: +12 34 567 890
# Safety Data Sheet

## Carbon Dioxide (solid)

### 6. ACCIDENTAL RELEASE MEASURES (continued)

**Clean up methods**
Ventilate area.

### 7. HANDLING AND STORAGE

**Storage**
Keep container below 50°C in a well-ventilated place.

**Handling**
Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Contact your gas supplier if in doubt. Refer to supplier's container handling instructions.

### 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Personal protection**
Ensure adequate ventilation.

**Occupational Exposure Limits**
Carbon dioxide (solid) / Spitzenbegrenzung / Überschraubungsfaktor AGW - Germany TRGS 900 : 2

### 9. PHYSICAL AND CHEMICAL PROPERTIES

**Physical state at 20 ºC**
Gas.

**Physical state**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Colourless</td>
</tr>
<tr>
<td>Odour</td>
<td>No odour warning properties</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>44</td>
</tr>
<tr>
<td>Melting point [°C]</td>
<td>-56.8</td>
</tr>
<tr>
<td>Boiling point [°C]</td>
<td>-78.5 (s)</td>
</tr>
<tr>
<td>Critical temperature [°C]</td>
<td>30</td>
</tr>
<tr>
<td>Vapour pressure [20°C]</td>
<td>57.3 bar</td>
</tr>
<tr>
<td>Relative density, gas (air=1)</td>
<td>1.52</td>
</tr>
<tr>
<td>Relative density, liquid (water=1)</td>
<td>1.03</td>
</tr>
<tr>
<td>Solubility in water [mg/l]</td>
<td>2900</td>
</tr>
<tr>
<td>FLammability range [vol% in air]</td>
<td>Non flammable.</td>
</tr>
<tr>
<td>Other data</td>
<td>Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.</td>
</tr>
</tbody>
</table>

### 10. STABILITY AND REACTIVITY

**Stability and reactivity**
Stable under normal conditions.

### 11. TOXICOLOGICAL INFORMATION

**Toxicity information**
In high concentrations cause rapid circulatory insufficiency. Symptoms are headache, nausea and vomiting, which may lead to unconsciousness.

### 12. ECOLOGICAL INFORMATION

**Ecological effects information**
When discharged in large quantities may contribute to the greenhouse effect. Can cause root damage to vegetation.

**Global warming potential [CO₂=1]**
1

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EIGA
Adress line 1, Adress line 2 B-1234 Brussels, Belgium/Belgie
Tel.: +32 2 467 800

In case of emergency: +32 34 567 890
SAFETY DATA SHEET

Carbon dioxide (solid)  EIGA018C

13 DISPOSAL CONSIDERATIONS

General: Do not discharge into any place where its accumulation could be dangerous.
Discharge to atmosphere in large quantities should be avoided.
Contact supplier if guidance is required.

14 TRANSPORT INFORMATION

ADR/RID: Not regulated.
Other transport information: Avoid transport on vehicles where the load space is not separated from the driver's
compartment.
Ensure the driver of the vehicle is aware of the potential hazards of the load and knows what
to do in the event of an accident or an emergency.
Before transporting product containers:
- Ensure that containers are firmly secured.
- Ensure there is adequate ventilation.
- Complies with applicable regulations.

15 REGULATORY INFORMATION

EC Classification: Not included in Annex I.
Not classified as dangerous preparation/substance.
EC Labelling: No EC labelling required.
Symbol(s): None.
R Phrase(s): None.
S Phrase(s): None.

16 OTHER INFORMATION

Training advice: Asphyxiant in high concentrations.
May cause frostbite.
Keep container in a well-ventilated place.
Do not breathe the gas.
Ensure all national/local regulations are observed.
The hazard of asphyxiation is often overlooked and must be stressed during
operator training.

Note: This Safety Data Sheet has been established in accordance with the applicable
European Directives and applies to all countries that have translated the Directives
in their national laws.

DISCLAIMER OF LIABILITY

Before using this product in any new process or experiment, a thorough material
compatibility and safety study should be carried out.
Details given in this document are believed to be correct at the time of going to
press. Whilst every care has been taken in the preparation of this document, no
liability for injury or damage resulting from its use can be accepted.

The contents and format of this SDS are in accordance with EC Commission Directive 2001/59/EC.

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End of document

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