



TECHNICAL INFORMATION SHEET 7

GUIDELINES FOR THE SAFE TRANSPORTATION, STORAGE, USE AND DISPOSAL OF SOLID CARBON DIOXIDE (DRY ICE)

At normal temperature and pressure, carbon dioxide (CO₂) is a gas. When cooled, CO₂ solidifies at – 78 °C and is known as solid CO₂ (often referred to as dry ice). At temperatures warmer than – 78 °C it turns directly from a solid into a gas. A small amount of solid CO₂ will produce a large volume of gas, approximately in a ratio of 1 : 800. The gas is heavier than air.



In its solid form it is often used as a refrigerant or coolant when transporting and storing other temperature critical products. Solid CO₂ is manufactured in the shape of pellets, slices or blocks and may be supplied loose or in insulated containers.



Where solid CO₂ is used in association with food and drinks then it shall meet specific quality standards and the packaging and work areas shall meet specific hygiene standards, refer to BCGA GN 14 ^[6].

Where solid CO₂ is used for medical purposes then it shall meet any specific requirements for good manufacturing practice (GMP) and good distribution practice (GDP) as mandated by the *Medicines and Healthcare products Regulatory Agency* (MHRA).

The hazards of solid CO₂ are:

- **Cold - contact.** Contact or close proximity with solid CO₂ (including articles in contact with it) can cause cold burns. Severity will be dependent on factors such as the exposure time. Prolonged exposure may lead to frostbite, hypothermia, etc.;
- **Intoxication.** CO₂ is an intoxicant and is a hazard at low concentrations, for this reason it has been assigned workplace exposure limits, refer to BCGA GN 11 ^[5];
- **Asphyxiation.** CO₂ is an asphyxiant, refer to BCGA GN 11 ^[5];
- **Cold - inhalation.** Inhalation of either the cold gas, or the local cold atmosphere, can damage the lungs and may aggravate existing health conditions. The severity is dependent on the temperature and exposure time;



- **Reduced visibility.** A vapour cloud may form resulting in the potential for confusion, slips, trips and falls;
- **Pressure.** If placed in an unvented container, pressure will build up, potentially resulting in rupture;
- **Cold - ingestion.** Ingestion of solid CO₂ will cause severe damage to internal organs. It has the potential to be fatal.

Intoxication occurs at low concentrations in air and will impair people's balance, awareness and judgement so as to reduce their perception of other hazards in the vicinity. The risk of intoxication and asphyxiation increases in enclosed areas, for example, small rooms, inside vehicles, etc.

Health and safety information is provided in the safety data sheet, available from the Gas Supplier. For additional information, refer to BCGA GN 33 ^[8].

Those using, handling and transporting solid CO₂, or packages containing solid CO₂ as a coolant, shall be familiar with the information in the safety data sheet. All packaging shall have appropriate hazard warnings displayed.

WORKING WITH SOLID CO₂

Before introducing solid CO₂ into the workplace, a suitable and sufficient risk assessment shall be conducted by a competent person(s). The risk assessment shall assess the:

- substance, refer to *The Control of Substances Hazardous to Health Regulations (COSHH)* ^[2];
- workplace, refer to *The Management of Health and Safety at Work Regulations* ^[1];
- proposed activity, refer to *The Management of Health and Safety at Work Regulations* ^[1].

When conducting the workplace and COSHH ^[2] Regulations risk assessments, refer to BCGA GN 11 ^[5]. The risk assessment(s) produced shall include suitable control measures to manage the hazards identified. These controls shall be in place before solid CO₂ is introduced to the workplace. The controls may typically include:

- selection and design of suitable storage and usage locations, including the use of handling aids;
- selection, design and correct operation of suitable insulated storage;
- minimising the quantity of solid CO₂ in the workplace;
- controlled access to solid CO₂ and its immediate environs;
- ensuring adequate ventilation;
- the use of atmosphere monitoring equipment (separate sensors are necessary for carbon dioxide enrichment and for oxygen deficiency, refer to BCGA GN 11 ^[5]);
- thermal insulation;
- provision of information, instruction and training;
- personal protective equipment (as a last resort).

Do not store solid CO₂ in an unvented container, for example, a domestic thermal flask (this type of container does not include pressure relief safety devices and is unlikely to be rated for the temperatures involved).

SAFE USAGE OF SOLID CO₂

Standard operating procedures shall be established by the user, storer, transporter, etc. Topics for inclusion in the procedures may include:

- the use, restraint and location of solid CO₂ around the articles being cooled;
- control of access;
- management of exposure to gaseous CO₂, for example, when a container is opened;
- management of local atmospheres, including avoiding the accumulation of gaseous CO₂;
- ensuring material compatibility, for example, between (solid) CO₂ and the storage container;
- preventing embrittlement or other deterioration of materials, for example, due to low temperatures and condensation;
- safe handling and movement in the workplace, and during transport;
- preventing cold exposure which may result in, for example, frostbite, hypothermia, etc.;
- establishing emergency plans, including first aid requirements, emergency management and alarms;
- routine maintenance and testing of safety systems, for example, local exhaust ventilation, atmospheric monitoring systems, etc.;
- safe handling for the life of the solid CO₂, including disposal (see below);
- arrangements for quality assurance.

SAFE DISPOSAL

Consider if solid CO₂ may be reused. Overtime, solid CO₂ will evaporate into CO₂ gas and will then disperse into the atmosphere leaving no residue. A suitable and sufficient risk assessment shall be conducted and standard operating procedures developed by a competent person(s) before disposing of solid CO₂. The disposal procedures shall include:

- identification of a safe location, avoiding drains, gulleys, below ground openings into buildings, etc., into which heavier-than-air gases could pass, accumulate or be conveyed elsewhere;
- ensuring sufficient ventilation for the duration of the disposal activity;
- restricting access to the location (including by animals), for the duration of the disposal activity;
- impacts on the environment, for example, avoiding any adverse impact to water courses, drains, the natural environment, etc.;
- where a container is used it shall be specified and be suitable for purpose;
- for frequent disposal operations, consider the benefits of creating a permanent designated facility.

Any left-over packaging shall be disposed of legally and responsibly.

TRANSPORT

Transport of solid CO₂, or of packages using solid CO₂ as a coolant, shall be in accordance with *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* ^[3]. Refer to the *Agreement Concerning the International Carriage of Dangerous Goods* (ADR) ^[4],

Section 5.5.3, for specific packaging, marking, loading and documentation requirements. For further information, refer to BCGA GN 27 ^[7].

Transport solid CO₂, or packages using solid CO₂ as a coolant, in the load space of an open vehicle or a vehicle with ‘curtain sides’. Vans and large enclosed vehicles may be used provided the load space is isolated from the seating area. There shall be adequate ventilation of the load space during transportation.



Do not transport solid CO₂ in the cab of a truck, in a passenger compartment or in the seating area of any vehicle.

Before entering any enclosed load space, in or on a vehicle, secure the load compartment doors in the open position and thoroughly ventilate before entering. No-one shall be allowed to enter a load space unless there is a safe atmosphere. For vehicles with large ‘walk-in’ load compartments, the doors should be capable of being opened from the inside, or being locked in the open position, for the purposes of emergency egress.



For any enclosed load space, a warning label shall be displayed at all access points where it can easily be seen, highlighting the danger of asphyxiation (the letters on which shall be a minimum of 25 mm high).



Unload solid CO₂, or packages using solid CO₂ as a coolant, as soon as possible at the end of the journey and move to a suitable, non-vehicular storage location.

A ‘carbon dioxide (solid)’ safety data sheet should be available in any vehicle carrying solid CO₂.

References:

1. SI 1999, No. 3242, The Management of Health and Safety at Work Regulations 1999.
2. SI 2002, No. 2677, The Control of Substances Hazardous to Health Regulations 2002 (COSHH).
3. SI 2009, No. 1348, The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended).
4. Agreement Concerning the International Carriage of Dangerous Goods (ADR) (as amended).
5. BCGA GN 11, The management of risk when using gases in enclosed workplaces.
6. BCGA GN 14, Production, storage, transport and supply of gases for use in food.
7. BCGA GN 27, Guidance for the carriage of gas cylinders on vehicles.
8. BCGA GN 33, The safe use of gases.

For more information:

British Compressed Gases Association (BCGA)
Medicines and Healthcare products Regulatory Agency (MHRA)

www.bcgaco.uk
www.mhra.gov.uk

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