Public Health England

Protecting and improving the nation's health

Carbon Dioxide

Incident Management

Key Points

Fire

- non-flammable
- dusts of various metals including magnesium, zirconium, titanium, aluminium, chromium and manganese are ignitable and explosive when suspended in carbon dioxide
- decomposition of carbon dioxide may produce carbon monoxide
- in the event of a fire involving carbon dioxide, use fine water spray and normal fire kit with breathing apparatus

Health

- inhalation may cause headache, dizziness, sweating, shortness of breath, hyperventilation, tachycardia, drowsiness, muscle twitching and loss of consciousness
- dermal exposure to dry ice may cause frost bite

Environment

- avoid release to the environment; inform the Environment Agency of substantial incidents

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Hazard Identification

Standard (UK) dangerous goods emergency action codes

Carbon dioxide

UN		1013	Carbon dioxide	
EAC		2T	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		–	–	
Hazards	**Class**	2.2	Non-flammable non-toxic gases	
	Sub-risks	–	–	
HIN		20	Asphyxiant gas or gas with no subsidiary risk	

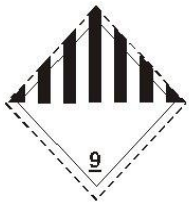
UN – United Nations number, EAC – emergency action code; APP – additional personal protection, HIN – hazard identification number

* Normal firefighting clothing is appropriate, ie breathing apparatus conforming to BS EN137 worn in combination with fire kit conforming to BS EN 469, firefighters' gloves conforming to BS EN 659 and firefighters' boots conforming to Home Office specification A29 or A30

Reference

Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.

Carbon dioxide, solid (dry ice)

UN		1845	Carbon dioxide, solid (dry ice)	
EAC		2T[(1)]	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		–	–	
Hazards	**Class**	9	Miscellaneous dangerous substances and articles	
	Sub-risks	–	–	
HIN		–	–	

UN – United Nations number, EAC – emergency action code; APP – additional personal protection, HIN – hazard identification number

* Normal firefighting clothing is appropriate, ie breathing apparatus conforming to BS EN137 worn in combination with fire kit conforming to BS EN 469, firefighters' gloves conforming to BS EN 659 and firefighters' boots conforming to Home Office specification A29 or A30

(1) Not applicable to the carriage of dangerous goods under RID or ADR

Reference

Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.

Carbon dioxide, refrigerated liquid

UN		2187	Carbon dioxide, refrigerated liquid	
EAC		2T	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		–	–	
Hazards	**Class**	2.2	Non-flammable non-toxic gases	
	Sub-risks	–	–	
HIN		22	Refrigerated liquefied gas. Asphyxiant	

UN – United Nations number, EAC – emergency action code; APP – additional personal protection, HIN – hazard identification number

* Normal firefighting clothing is appropriate, ie breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, firefighters' gloves conforming to BS EN 659 and firefighters' boots conforming to home office specification A29 or A30

Reference

Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.

Classification, labelling and packaging (CLP)

Hazard class and category	No harmonised classification
Hazard statement	
Signal words	

Physicochemical Properties

CAS number	124-38-9
Molecular weight	44.01
Formula	CO_2
Common synonyms	Carbonic acid gas, carbonic anhydride
State at room temperature	Colourless gas
Volatility	4.83×10^4 mmHg at 25ºC
Specific gravity	1.527 (air = 1)
Flammability	Non-combustible
Lower explosive limit	–
Upper explosive limit	–
Water solubility	Dissolves in water to form carbonic acid
Reactivity	Carbon dioxide does not react with common materials. Dusts of various metals including magnesium, zirconium, titanium, aluminium, chromium and manganese are ignitable and explosive when suspended in carbon dioxide. Carbon dioxide is incompatible with acrylaldehyde, aziridine, metal acetylides and sodium peroxide
Reaction or degradation products	Decomposes above 2000ºC producing carbon monoxide
Odour	Odourless
Structure	O═C═O

References

Hazardous Substances Data Bank [Internet]. Bethesda MD, US: National Library of Medicine (US); [Last Revision Date 30/04/2010; cited 05/2015]. Carbon Dioxide; Hazardous Substances Databank Number: 516. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 05/2015).

Carbon Dioxide (HAZARDTEXT™ Hazard Management). In Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc, Greenwood Village CO, US (electronic version). RightAnswer.com, Inc, Midland MI, US. http://www.rightanswerknowledge.com (accessed 05/2015).

International Programme on Chemical Safety (IPCS). International Chemical Safety Card (ICSC) entry for Carbon Dioxide. ISCS 0021, 2006. World Health Organization: Geneva.

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

%	Signs and symptoms	Reference
2–5	Headache, dizziness, sweating, shortness of breath	a
6–10	Hyperventilation, tachycardia, worsening dizziness	a
11–17	Drowsiness, muscle twitching, loss of consciousness	a
>17	Convulsions, coma and death	a

These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values.

Reference

a TOXBASE: Carbon Dioxide, 2009. http://www.toxbase.org (accessed 05/2015).

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m^3)
ERPG-1*	Data not available	
ERPG-2†		
ERPG-3‡		

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour

† Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action

‡ Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects

Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	Data not available				
AEGL-2†					
AEGL-3‡					

* Level of the chemical in air at or above which the general population could experience notable discomfort

† Level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape

‡ Level of the chemical in air at or above which the general population could experience life-threatening health effects or death

Exposure Standards, Guidelines or Regulations

Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m^3	ppm	mg/m^3
WEL	5,000	9,150	1,5000	27,400

WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit

Reference

EH40/2005 Workplace Exposure Limits (second edition, published 2011). http://www.hse.gov.uk/pubns/priced/eh40.pdf (accessed 06/2015)

Public health guidelines

Drinking water standard	No guideline value specified
Air quality guideline	No guideline value specified
Soil guideline values and health criteria values	No guideline value specified

Health Effects

Major route of exposure

- inhalation

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation may cause headache, dizziness, sweating, shortness of breath, hyperventilation, tachycardia, drowsiness, muscle twitching and loss of consciousness; higher concentrations cause convulsions, coma and death Respiratory features may include coughing, bronchitis, bronchospasm and pneumonitis Additional features that may arise due to asphyxiation include: cyanosis, hypotension, respiratory depression, pulmonary oedema, cerebral oedema, hypercapnia, rhabdomyolysis, myocardial ischemia, atrial or ventricular dysrhythmias and asystole
Dermal	Skin contact with dry ice can cause thermal burns and frost bite

Reference

TOXBASE: Carbon Dioxide, 2009. http://www.toxbase.org (accessed 06/2016).

Decontamination at the Scene

The approach used for decontamination at the scene will depend upon the incident, location of the casualties and the chemicals involved. Therefore, a risk assessment should be conducted to decide on the most appropriate method of decontamination.

Decontamination should not be necessary following exposure to carbon dioxide. Dermal contact with carbon dioxide may cause thermal injury, but not chemical burns.

Emergency services and public health professionals can obtain further advice from Public Health England (Centre for Radiation, Chemical and Environmental Hazards) using the 24-hour chemical hotline number: 0344 892 0555.

Clinical decontamination and First Aid

Detailed information on clinical management can be found on TOXBASE – www.toxbase.org.

Important notes

- decontamination is unlikely to be required for carbon dioxide
- carbon dioxide is heavier than air and pockets of gas may persist

Dermal exposure

- treat dermal and cold injuries conventionally
- other supportive measures as indicated by the patient's clinical condition

Ocular exposure

- not applicable

Inhalation

- remove from source of exposure and give high flow oxygen to symptomatic patients
- ensure a clear airway and adequate ventilation
- monitor pulse, blood pressure, respiration, level of consciousness and oxygen saturation
- perform 12 lead ECG and monitor the cardiac rhythm in symptomatic patients
- other measures as indicated by the patient's clinical condition

Ingestion

- not applicable

Clinical decontamination and first aid references

TOXBASE http://www.toxbase.org (accessed 11/2016)

TOXBASE: Carbon dioxide, 2009

This document from the PHE Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

For queries relating to this document, please contact: generaltox@phe.gov.uk

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