UK Health Security Agency

Carbon monoxide

Incident management

Contents

Main points

General

Carbon monoxide is a colourless and odourless gas at room temperature.

It is extremely flammable and may react vigorously with oxygen, acetylene, chlorine, fluorine or nitrous oxide. Carbon monoxide mixes well with air and explosive mixtures are easily formed.

Health

Inhalation is the major route of exposure.

Inhalation of carbon monoxide may initially cause headache, nausea and vomiting, irritability, weakness and tachypnoea, followed by dizziness, confusion, ataxia, agitation, syncope, hypotension, seizures, impairment of consciousness and respiratory failure.

In serious cases, cerebral oedema and metabolic acidosis may develop

Casualty decontamination at the scene

Decontamination should not be necessary following exposure to carbon monoxide as it exists as a relatively unreactive gas at room temperature.

Environment

Avoid release to the environment.

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes

UN		1016	Carbon monoxide, compressed	
EAC		2SE	Use fine water spray. Wear normal fire kit in combination with breathing apparatus [note 1]. Danger that the substance can be violently or explosively reactive. 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. There may be a public safety hazard outside the immediate area of the incident [note 2].	
APP		–	–	
Hazards	**Class**	2.3	Toxic gas	
	Sub-risks	2.1	Flammable gases	
HIN		263	Toxic gas, flammable	

Abbreviations

UN = United Nations number.
EAC = emergency action code.
APP = additional personal protection.
HIN = hazard identification number.

Notes to Table 1

[note 1] Normal firefighting clothing is appropriate, that is, 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.
[note 2] People should stay indoors with windows and doors closed, ignition sources should be eliminated and ventilation stopped. Non-essential personnel should move at least 250 metres away from the incident.

Reference

'Dangerous Goods Emergency Action Code List'. National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office (2021)

Table 2. The GB classification, labelling and packaging (CLP) regulation

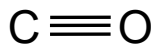
Hazard class and category	Press. Gas	Compressed gas	
	Flam. Gas 1	Flammable gas	
	Acute Tox. 3	Acute toxicity (inhalation), category 3	
	Repr. 1A	Reproductive toxicity, category 1A	
	STOT RE 1	Specific target organ toxicity following repeated exposure, category 1	
Hazard statement	H220	Extremely flammable gas	
	H331	Toxic if inhaled	
	H360D	May damage the unborn child	
	H372	Causes damage to organs	
Signal words	DANGER		

Reference

The Health and Safety Executive (HSE). ‘GB CLP Regulation’ (viewed February 2022)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	630-08-0
Molecular weight	28
Formula	CO
Common synonyms	–
State at room temperature	Gas
Volatility	Vapour pressure > 760 mmHg at 20°C
Vapour density	0.97 at 20°C (air = 1)
Flammability	Extremely flammable
Lower explosive limit	12.5%
Upper explosive limit	74.2%
Water solubility	Slightly soluble in water
Reactivity	May react vigorously with oxygen, acetylene, chlorine, fluorine or nitrous oxide. Mixes well with air. Explosive mixtures are easily formed. Easily penetrates through walls and ceilings.
Reaction or degradation products	-
Odour	Odourless
Structure	

References

- International Programme on Chemical Safety. ‘International chemical safety card entry for carbon monoxide’. ICSC 0023, 2007. World Health Organization (WHO) Geneva
- PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. ‘PubChem Compound Summary for CID 281, Carbon monoxide’ (viewed February 2022)

Reported effect levels from authoritative sources

No authoritative reports were found.

Published emergency response guidelines

Table 4. Acute exposure guideline levels (AEGLs) (interim)

'NR' indicates 'not recommended' due to insufficient data.

	Concentration (ppm)				
	10 min	**30 min**	**60 min**	**4 hours**	**8 hours**
AEGL-1 [note 1]	NR	NR	NR	NR	NR
AEGL-2 [note 2]	420	150	83	33	27
AEGL-3 [note 3]	1,700	600	330	150	130

Notes to table 4

[note 1] Level of the chemical in air at or above which the general population could experience notable discomfort.

[note 2] 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.

[note 3] Level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

Reference

US Environmental Protection Agency. Acute Exposure Guideline Levels (viewed in February 2022)

Exposure standards, guidelines or regulations

Table 5. Occupational standards

		LTEL (8-hour reference period)		STEL (15-min reference period)	
		ppm	mg/m^3	ppm	mg/m^3
WEL		20	23	100	117
	Limits applicable to underground mining and tunnelling industries only until 21 August 2023	30	35	200	232

Abbreviations

WEL = workplace exposure limit.
LTEL = long-term exposure limit.
STEL = short-term exposure limit.

Reference

HSE. ‘EH40/2005 Workplace Exposure Limits. Fourth Edition’ (2020)

Table 6. Public health standards and guidelines

Drinking water standard	No guideline values specified
Indoor air quality guideline	100 mg/m^3 (87 ppm) for 15 minutes 35 mg/m^3 (30 ppm) for 1 hour 10 mg/m^3 (8.7 ppm) for 8 hours 7 mg/m^3 (6.1 ppm) for 24 hours

Reference

‘WHO Guidelines for indoor air quality: selected pollutants’ (2010) WHO Geneva

Health effects

Major route of exposure

Inhalation

Table 7. Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Headache, nausea and vomiting, irritability, weakness and tachypnoea may occur, followed by dizziness, confusion, ataxia, agitation, syncope, hypotension, seizures, impairment of consciousness and respiratory failure. Cerebral oedema and metabolic acidosis may develop in serious cases. Less common features include skin blisters, rhabdomyolysis, compartment syndrome, acute renal failure, pulmonary oedema, dysrhythmias, myocardial infarction, retinal haemorrhages, cortical blindness, choreoathetosis and mutism. Cherry red skin colour rarely seen. An initial carboxyhaemoglobin concentration above 30% is likely to be associated with severe poisoning. Commonly reported symptoms and frequency (%) are as follows: • headache (90%) • nausea and vomiting (50%) • vertigo (50%) • alteration in consciousness (30%) • subjective weakness (20%)
Dermal	Skin contact with rapidly released compressed carbon monoxide may cause cold burns.

Reference

TOXBASE. ‘Carbon monoxide’ June 2021 (viewed in February 2022)

Decontamination at the scene

Chemical specific advice

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 monoxide as it exists as a relatively unreactive gas at room temperature. Carbon monoxide may be stored as a liquid under pressure in cylinders for industrial use. This liquid will rapidly volatilise on release, though it may cause thermal burns on contact with skin.

Emergency services and public health professionals can obtain further advice from the UK Health Security Agency (Radiation, Chemicals and Environment Directorate) using the 24 hour chemical hotline number: 0344 892 0555.

Clinical decontamination and first aid

Clinical decontamination is the process where trained healthcare professionals using purpose designed decontamination equipment treat contaminated persons individually.

Detailed information on clinical management can be found on TOXBASE.

Important notes

Primary responders should not enter a contaminated area without a self-contained breathing apparatus.

Secondary care staff should not need to wear protective equipment other than routine precautions against secondary contamination with vomit and body fluids.

Decontamination should not be necessary following exposure to carbon monoxide. If patients have been exposed due to a house fire also consider the possibility of cyanide poisoning.

Dermal exposure

Treat dermal and cold injuries conventionally.

Other supportive measures as indicated by the patient's clinical condition.

Inhalation

If not already initiated pre-hospital patients should be placed urgently on high flow oxygen irrespective of oxygen saturations until carboxyhaemoglobin level is available and carbon monoxide poisoning excluded.

Maintain a clear airway and adequate ventilation.

Give oxygen in as high a concentration as possible (10 to 15 L/min with trauma mask and non-rebreathing bag). Where available, consider the use of nasal high flow cannulae to deliver oxygen at up to 60 L/min. This should be continued until CO poisoning has been excluded and/or carboxyhaemoglogin is back within the normal range (1 to 2%).

Monitor vital signs and check the capillary blood glucose

Check and record pupil size.

Measure carboxyhaemoglobin (COHb) concentration urgently, using either arterial or venous blood. A carboxyhaemoglobin concentration of 30% or more indicates severe exposure.

However, concentrations less than this do not exclude significant poisoning.

If pulse-oximetry is used to measure COHb concentrations, it is important to use a CO-pulse oximeter since regular oximeters cannot distinguish between different forms of haemoglobin.

Perform a 12 lead ECG and check cardiac rhythm in all patients who require assessment
Other supportive measures as indicated by the patient's clinical condition

Clinical decontamination and first aid references

- TOXBASE (viewed in February 2022)
- TOXBASE Carbon monoxide, 2021

About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation heath secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

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