



Carbon monoxide

Incident management

Key Points

Fire

- Flammable gas
- May react violently with other substances
- In the event of a fire involving carbon monoxide, use fine water spray with normal fire-fighting clothing and breathing apparatus

Health



- Toxic by inhalation
- May cause harm to the unborn child
- Inhalation of carbon monoxide may lead to headache, nausea, irritability, weakness and tachypnoea followed by dizziness, ataxia, agitation, impairment of consciousness and respiratory failure

Environment

- Avoid release into environment
- Inform Environment Agency of substantial release incidents

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

UN		1016	Carbon monoxide, compressed	
EAC		2SE	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. Substance can be violently or explosively reactive. There may be a public safety hazard outside the immediate area of the incident**.	
APP		-	-	
Hazards	Class	2.3	Toxic gas	
	Sub risks	2.1	Flammable gas	
HIN		263	Toxic gas, flammable	




UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

* Normal fire fighting clothing i.e. fire kit (BS EN 469), gloves (BS EN 659) and boots (HO specification A29 and A30) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

** 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 m away from the incident.






^a Dangerous Goods Emergency Action Code List, The Stationery Office, 2009.

Chemical Hazard Information and Packaging for Supply Classification^(a)

Classification	F+	Extremely flammable	
	Repr. cat. 1	Category 1 reproductive toxin	
	T	Toxic	
Risk phrases	R61	May cause harm to the unborn child	
	R12	Extremely flammable	
	R23	Toxic by inhalation	
	R48/23	Danger of serious damage to health by prolonged exposure through inhalation	
Safety phrases	S53	Avoid exposure – obtain special instructions before use	
	S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible) This material and its container must be disposed of as hazardous waste	

^a Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.2.
<http://esis.jrc.ec.europa.eu/index.php?PGM=cla> (accessed 11/2011)

Globally Harmonised System of Classification and Labelling of Chemicals (GHS)^(a)

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

Implemented in the EU on 20 January 2009.

^a Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.1.
<http://esis.jrc.ec.europa.eu/index.php?PGM=cla> (accessed 11/2011)

Physicochemical Properties

CAS number	630-08-0
Molecular weight	28
Empirical formula	CO
Common synonyms	Carbonic oxide; Coal gas
State at room temperature	Gas
Volatility	Vapour pressure > 760 mm Hg at 20°C
Vapour density	1.0 at 21°C (air = 1)
Flammability	Extremely flammable
Lower explosive limit	12.5%
Upper explosive limit	74.2%
Water solubility	Slightly soluble in water
Reactivity	Flammable gas under normal conditions
Reaction or degradation products	Data not available
Odour	Odourless
Structure	$C \equiv O$

References^(a,b,c)

^a International Chemical Safety Card (ICSC) Entry for Carbon Monoxide. ISCS 0023. International Occupational Safety and Health Information Centre (CIS), 1994.

^b The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 2, 1999.

^c The Merck Index (14th Edition). Entry 1816: Carbon Monoxide, 2006

Threshold Toxicity Values

EXPOSURE VIA INHALATION		
ppm	mg m⁻³	SIGNS AND SYMPTOMS
~ 100	~ 115	Slight headache, flushing of skin (indefinite exposure)
200 – 300	230 – 345	Headache (5 – 6 hour exposure)
400 – 600	460 – 690	Severe headache, weakness, dizziness, nausea, vomiting (4 – 5 hour exposure)
1100 – 1500	1265 – 1840	Increased pulse and breathing rate, syncope, coma, intermittent seizures (4 – 5 hour exposure)
5000 - 10000	5750 – 11500	Weak pulse, depressed respiration / respiratory failure, death (1 – 2 minutes exposure)

Reference^(a)

^a Carbon monoxide (MEDITEXT® Medical Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 08/2010).

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values^(a)

	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	200	230
ERPG-2**	350	403
ERPG-3***	500	575

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

Acute Exposure Guideline Levels (AEGLs)^(b)

	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1[†]	-	-	-	-	-
AEGL-2^{††}	420	150	83	33	27
AEGL-3^{†††}	1700	600	330	150	130

[†] The level of the chemical in air at or above which the general population could experience notable discomfort.

^{††} The 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.

^{†††} The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

^a American Industrial Hygiene Association (AIHA). Emergency Response Planning Guideline Values and Workplace Environmental Exposure Level Guides Handbook, Fairfax, VA, 2010. (accessed 01/2011).

^b U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 01/2011).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL^(a)	LTEL (8 hour reference period): 30 ppm (35 mg m ⁻³)
	STEL (15 min reference period): 200 ppm (232 mg m ⁻³)

Public health guidelines

DRINKING WATER QUALITY GUIDELINE	No guideline value specified
AIR QUALITY GUIDELINE^(b)	100 mg m ⁻³ (90 ppm) for 15 minutes 60 mg m ⁻³ (50 ppm) for 30 minutes 30 mg m ⁻³ (25 ppm) for 1 hour 10 mg m ⁻³ (10 ppm) for 8 hours
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline value specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

^aList of approved workplace exposure limits (as consolidated with amendments October 2007). <http://www.hse.gov.uk/coshh/table1.pdf> (An update to EH40/2005: Workplace Exposure Limits 2005. The Stationery Office, London) (accessed 01/2011)..

^b Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000 (accessed 01/2011)..

Health Effects

Major route of exposure^(a)

- Toxic by inhalation.

Immediate signs or symptoms of acute exposure^(a)

- Inhalation causes headache, nausea, irritability, weakness and tachypnoea followed by dizziness, ataxia, agitation, impairment of consciousness and respiratory failure. Cerebral oedema and metabolic acidosis may develop in serious cases.
- Less common features include skin blisters, rhabdomyolysis, acute renal failure, pulmonary oedema, myocardial infarction, retinal haemorrhages, cortical blindness, choreoathetosis and mutism.
- While the majority of people exposed to carbon monoxide recover uneventfully, others develop neuropsychiatric features. The onset of these features may be delayed and are more common in those over the age of 40 years and include memory impairment, disorientation, apathy, mutism, irritability, inability to concentrate, personality change, Parkinsonism, including urinary and/or faecal incontinence and gait disturbance are and parietal lobe lesions.

TOXBASE - <http://www.toxbase.org> (accessed 01/2011)

^a TOXBASE: Carbon monoxide (E), 04/2009.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Flammability warning: prevent exposure to all sources of ignition such as naked flames, electrical equipment, oxidising chemicals and the smoking of tobacco products.

Dermal exposure

- Not applicable

Ocular exposure

- Not applicable

Inhalation^(a)

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give oxygen in as high concentration as possible.
- Perform a 12 lead ECG and monitor cardiac rhythm.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ingestion

- Not applicable.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.

TOXBASE - <http://www.toxbase.org> (accessed 01/2011)

^a TOXBASE: Carbon monoxide (E), 04/2009.