



Cadmium metal

Incident Management

Key Points

General

- solid at room temperature, insoluble in water
- odourless
- dust explosion possible if in powder or granular form mixed with air

Health effects

- inhalation and ingestion are the main routes of exposure; skin absorption is rare
- effects of inhalation exposure may be delayed 12–36 hours and include hypersalivation, metallic taste, cough, dyspnoea, chest pain and metal fume fever type features
- ingestion of small amounts may cause nausea, vomiting, abdominal pain and diarrhoea
- ingestion of larger amounts may cause corrosive injury to the GI tract, acute kidney injury and hepatotoxicity
- skin contact may cause irritation

Casualty decontamination at the scene


- following disrobe, improvised dry decontamination should be considered for an incident involving cadmium compounds unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances

Environment

- hazardous to the environment; inform the Environment Agency where appropriate
- spillages and decontamination run-off should be prevented from entering watercourses








Hazard Identification


Standard (UK) dangerous goods emergency action codes

UN		2570	Cadmium compound	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		–	–	
Hazards	Class	6.1	Toxic substance	
	Sub-risks	–	–	
HIN		66/60	Highly toxic or slightly toxic/toxic substances	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137</p> <p>Reference Dangerous Goods Emergency Action Code List. National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2019.</p>				








Classification, labelling and packaging (CLP)*

Cadmium (pyrophoric)

Hazard class and category	Pyr. Sol. 1	Pyrophoric solids, category 1	
	Acute Tox. 2	Acute toxicity (inhalation), category 2	
	Muta. 2	Germ cell mutagenicity, category 2	
	Carc. 1B	Carcinogenicity, category 1B	
	Repr. 2	Reproductive toxicity, category 2	
	STOT RE 1	Specific target organ toxicity following repeated exposure, category 1	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	

	Aquatic Chronic 1	Chronic hazards to the aquatic environment, category 1	
Hazard statement	H250	Catches fire spontaneously if exposed to air	
	H330	Fatal if inhaled	
	H341	Suspected of causing genetic defects	
	H350	May cause cancer	
	H361fd	Suspected of damaging fertility. Suspected of damaging the unborn child	
	H372	Causes damage to organs through prolonged or repeated exposure	
	H400	Very toxic to aquatic life	
	H410	Very toxic to aquatic life with long lasting effects	
Signal words	DANGER		
* Implemented in the EU on 20 January 2009			
Reference			
European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. http://echa.europa.eu/information-on-chemicals/cl-inventory-database (accessed 03/2019).			

Cadmium (non-pyrophoric)

Hazard class and category	Acute Tox. 2	Acute toxicity (inhalation), category 2	
	Muta. 2	Germ cell mutagenicity, category 2	
	Carc. 1B	Carcinogenicity, category 1B	
	Repr. 2	Reproductive toxicity, category 2	
	STOT RE 1	Specific target organ toxicity following repeated exposure, category 1	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
	Aquatic Chronic 1	Chronic hazards to the aquatic environment, category 1	
Hazard statement	H330	Fatal if inhaled	
	H341	Suspected of causing genetic defects	
	H350	May cause cancer	

	H361fd	Suspected of damaging fertility. Suspected of damaging the unborn child
	H372	Causes damage to organs through prolonged or repeated exposure
	H400	Very toxic to aquatic life
	H410	Very toxic to aquatic life with long-lasting effects
Signal words	DANGER	
* Implemented in the EU on 20 January 2009		
Reference		
European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. http://echa.europa.eu/information-on-chemicals/cl-inventory-database (accessed 03/2019).		

Physicochemical Properties

CAS number	7440-43-9
Molecular weight	112
Empirical formula	Cd
Common synonyms	–
State at room temperature	Solid
Volatility	Non-volatile at 20°C
Specific gravity	8.6 at 25°C (water = 1)
Flammability	Non-combustible within solid bulk form. Dust explosion possible if in powder or granular form, mixed with air
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Insoluble in water
Reactivity	Dust reacts with oxidants, hydrogen azide, zinc, selenium and tellurium. This generates fire and explosion hazard
Reaction or degradation products	Reacts with acids this produces flammable/explosive gas
Odour	Odourless
References	
Hazardous Substances Data Bank. Cadmium, HSDB No. 282 (last revision date 14/02/2012). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 03/2019).	
International Programme on Chemical Safety. International chemical safety card entry for cadmium. ICSC 0020, 2005. World Health Organization: Geneva.	

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
0.92–2.3	0.2–0.5	Metal fume fever like symptoms (cadmium oxide)	a
>0.22	>1	May lead to acute chemical pneumonitis (8-hour exposure)	a
1.09	5	Destruction of lung epithelial cells, resulting in pulmonary oedema, tracheobronchitis and pneumonitis	c
1.87	8.6	Lethal after 5 hours (one fatal case)	b
230	50	Lethal after 1 hour (cadmium oxide)	d

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

References

a International Programme on Chemical Safety. Cadmium. Poisons Information Monograph 089, 1992.

b Scientific Committee on Occupational Exposure Limits. Cadmium and its inorganic compounds. 2017.

c Agency for Toxic Substances and Disease Registry. Toxicological profile for cadmium, 2012.

d International Programme on Chemical Safety. Cadmium. Environmental Health Criteria 134, 1992.

Exposure by skin

%	Signs and symptoms	Reference
2	Skin irritation (calcium chloride solution)	a

This value gives an indication of levels of exposure that can cause adverse effects. It is not a health protective standard or guideline value

Reference

a Agency for Toxic Substances and Disease Registry. Toxicological profile for cadmium, 2012.

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‡		
<p>* 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</p> <p>† 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</p> <p>‡ 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</p> <p>Reference American Industrial Hygiene Association (AIHA). 2016 Emergency Response Planning Guideline Values. https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf (accessed 03/2019).</p>		

Interim acute exposure guideline levels (AEGs)

	Concentration (mg/m ³)				
	10 min	30 min	60 min	4 hours	8 hours
AEG-1*	0.13	0.13	0.10	0.063	0.041
AEG-2†	1.4	0.96	0.76	0.40	0.20
AEG-3‡	8.5	5.9	4.7	1.9	0.93
<p>* Level of the chemical in air at or above which the general population could experience notable discomfort</p> <p>† 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</p> <p>‡ Level of the chemical in air at or above which the general population could experience life-threatening health effects or death</p> <p>Reference US Environmental Protection Agency. Acute Exposure Guideline Levels. http://www.epa.gov/oppt/aegl/pubs/chemlist.htm (accessed 03/2019).</p>					

Exposure Standards, Guidelines or Regulations

Occupational standards (see note)

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	–	0.025	–	–

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

Note Cadmium and cadmium compounds except cadmium oxide fume, cadmium sulphide and cadmium sulphide pigments (as Cd)

Reference
Health and Safety Executive (HSE). EH40/2005 Workplace Exposure Limits, 3rd Edition, 2017).

Public health guidelines

Drinking water standard	5 µg/L
Air quality guideline	5 ng/m ³

References
The Water Supply (Water Quality) Regulations 2018 (Water, England and Wales) 2018.
The Private Water Supplies (England) Regulations 2016 and The Private Water Supplies (Wales) Regulations 2017.
WHO Regional Office for Europe. Air Quality Guidelines for Europe. European Series No. 91, 2nd Edition, 2000. World Health Organization Regional Publications: Copenhagen.

Health Effects

Major route of exposure

- inhalation and ingestion are the main routes of exposure
- skin absorption is rare

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	<p>Features may be delayed 12–36 hours and include hypersalivation, metallic taste, cough, dyspnoea, chest pain and metal fume fever type features. Pneumonitis and pulmonary oedema may develop within 1–4 days. In severe cases, death due to respiratory failure and acute tubular necrosis</p> <p>Metal fume fever symptoms include: cough, dyspnoea, sore throat, chest tightness, headache, fever, rigors, myalgia and arthralgia may occur and sometimes a metallic taste, abdominal pain, nausea, vomiting and blurred vision</p>
Ingestion	<p>Small amounts cause irritation of the GI tract with nausea, vomiting, abdominal pain and diarrhoea, usually within 15–30 minutes. Larger amounts can cause corrosive injury to the GI tract (pharyngeal burns, drooling, pain, dysphagia, vomiting, stridor). Severe poisoning results in hypotension, circulatory failure, acute kidney injury, haemolytic anaemia, hepatotoxicity, and facial and pulmonary oedema</p>
Ocular	Eyeliner (Khol) contaminated with cadmium and lead was reported to cause keratitis
Dermal	Causes irritation, but is not a major route of absorption
<p>Reference</p> <p>TOXBASE. Cadmium compounds, 10/2017. http://www.toxbase.org (accessed 03/2019).</p> <p>TOXBASE. Metal Fume Fever - features and management, 11/2016. http://www.toxbase.org (accessed 03/2019).</p>	

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.

Following disrobe, improvised dry decontamination should be considered for an incident involving cadmium compounds unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

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.

General advice on disrobe and decontamination

Disrobe

The disrobe process is highly effective at reducing exposure to HAZMAT/CBRN material when performed within 15 minutes of exposure.

Therefore, disrobe must be considered the primary action following evacuation from a contaminated area.

Disrobing at the scene should be, where possible, conducted by the casualty themselves and should be systematic to avoid transferring any contamination from clothing to the skin. Consideration should be given to ensuring the welfare and dignity of casualties as far as possible.

Improvised decontamination

Improvised decontamination is an immediate method of decontamination prior to the use of specialised resources. This should be performed on all contaminated casualties, unless medical advice is received to the contrary. Improvised dry decontamination should be considered for an incident involving chemicals **unless the agent appears to be corrosive or caustic.**

Improvised dry decontamination

- any available dry absorbent material can be used such as kitchen towel, paper tissues (e.g. blue roll) and clean cloth

- exposed skin surfaces should be blotted and rubbed, starting with the face, head and neck and moving down and away from the body
- rubbing and blotting should not be too aggressive, or it could drive contamination further into the skin
- all waste material arising from decontamination should be left in situ, and ideally bagged, for disposal at a later stage
- where appropriate, seek professional advice on how to dispose of contaminated water and prevent run-off going into the water system

Improvised wet decontamination

- water should only be used for decontamination where casualty signs and symptoms are consistent with exposure to caustic or corrosive substances such as acids or alkalis
- wet decontamination may be performed using any available source of water such as taps, showers, fixed installation hose-reels and sprinklers
- when using water, it is important to try and limit the duration of decontamination to between 45 and 90 seconds and, ideally, to use a washing aid such as cloth or sponge
- improvised decontamination should not involve overly aggressive methods to remove contamination as this could drive the contamination further into the skin

Additional notes

- following improvised decontamination, remain cautious and observe for signs and symptoms in the decontaminated person and in unprotected staff
- if water is used to decontaminate casualties this may be contaminated, and therefore hazardous, and a potential source of further contamination spread
- all materials (paper tissues etc) used in this process may also be contaminated and, where possible, should not be used on new casualties
- the risk from hypothermia should be considered when disrobe and any form of wet decontamination is carried out
- people who are contaminated should not eat, drink or smoke before or during the decontamination process and should avoid touching their face
- consideration should be given to ensuring the welfare and dignity of casualties as far as possible. Immediately after decontamination the opportunity should be provided to dry and dress in clean robes/clothes
- people who are processed through improvised decontamination should subsequently be moved to a safe location, triaged and subject to health and scientific advice. Based on the outcome of the assessment, they may require further decontamination

Interim wet decontamination

Interim decontamination is the use of standard fire and rescue service (FRS) equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

Home Office. Initial operational response to a CBRN incident. Version 2.0, July 2015.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Guidance for the initial management of self presenters from incidents involving hazardous materials. February 2019.

Clinical Decontamination and First Aid

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

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

Important note

- **once body surface contaminants have been removed or if your patient was exposed by ingestion or inhalation the risk that secondary care givers may become contaminated is very low.** Secondary carers should wear standard hospital PPE as a precaution against secondary contamination from vomit and body fluids

Clinical decontamination following surface contamination

- avoid contaminating yourself with this product and wash any exposed area
- any particulate matter adherent to skin should be removed and the patient washed with soap and water under low pressure for at least 10–15 minutes
- pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears

Dermal exposure

- decontaminate (as above) the patient following surface contamination
- other supportive measures as indicated by the patient's clinical condition

Ocular exposure

- if symptomatic, immediately irrigate the affected eye thoroughly
- for patients at home, use lukewarm tap water, trickled into the eye or in a small cup held over the eye socket; an eye dropper is an alternative
- in hospital, using 1,000 mL 0.9% saline at room temperature by an infusion bag with a giving set is appropriate, irrigate for 10–15 minutes
- refer for ophthalmological assessment if there is doubt regarding the management of corneal damage
- other supportive measures as indicated by the patient's clinical condition

Inhalation/ingestion

- maintain a clear airway and adequate ventilation
- give oxygen if required

- other supportive measures as indicated by the patient's clinical condition

Clinical decontamination and first aid references

TOXBASE <http://www.toxbase.org> (accessed 03/2019)

TOXBASE Cadmium compounds, 10/2017

TOXBASE Eye irritants, 01/2016

TOXBASE Skin decontamination – irritants, 01/2018

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

For all other enquiries, please contact: phe.enquiries@phe.gov.uk

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