UK Health Security Agency

Inorganic mercury compounds and elemental mercury

Incident management

Contents

Main points

General

Elemental mercury is an odoulress, shiney, silvery liquid at room temperature.

It reacts violently with ammonia and halogens, acetylene and amines generating a fire and explosion hazard.

It attacks aluminium and many other metals, producing amalgums.

Health

Inhalation is the predominant route of exposure to metallic mercury.

Inhalation of mercury vapour causes cough, breathlessness, mild hypoxaemia and chest pain. Flu-like symptoms with myalgia and fever, nausea and vomiting may also occur.

Ingestion of large amounts of metallic mercury may cause nausea, vomiting and abdominal pain.

Ingestion is the main route of exposure for inorganic mercury compounds. Features for ingestion depend on the specific salt.

Systemic toxicity may include acute tubular necrosis and neurological features.

Casualty decontamination at the scene

Mercuric chloride is a corrosive substance. Therefore, following disrobe, improvised wet decontamination should be considered. For elemental mercury and other inorganic mercury compounds, following disrobe improvised dry decontamination should be considered, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

Environment

Inform the Environment Agency where appropriate.

Spillages and decontamination run-off should be prevented from entering drains and watercourses.

Hazard identification

Table 1a. Standard (UK) dangerous goods emergency action codes codes for mercury liquid compounds packaging group I

UN		2024	Mercury compound, liquid, N.O.S. packing group I	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		B	Gas-tight chemical protective suit in combination with breathing apparatus [note 2]	
Hazards	**Class**	6.1	Toxic substance	
	Sub-risks	–	–	
HIN		66	Highly toxic substance	

Abbreviations

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

Notes to Table 1a

[note 1] Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137.
[note 2] Chemical protective clothing should be gas-tight conforming to BS EN 943 part 2, in combination with breathing apparatus conforming to BS EN 137.

Reference

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

Table 1b. Standard (UK) dangerous goods emergency action codes for mercury liquid compounds packaging group II and III

UN		2024	Mercury compound, liquid, N.O.S. packing group II and III	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP				
Hazards	**Class**	6.1	Toxic substance	
	Sub-risks	–	–	
HIN		60	Toxic or slightly toxic substance	

Abbreviations

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

Notes to Table 1b

[note 1] Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137.

Reference

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

Table 1c. Standard (UK) dangerous goods emergency action codes for for mercury solid compounds

UN		2025	Mercury compound, solid, N.O.S	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. 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 substance/toxic or slightly toxic substance	

Abbreviations

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

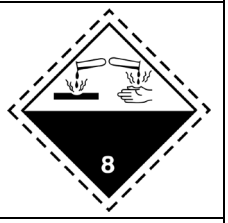
Notes to Table 1c

[note 1] Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137.

Reference

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

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

UN		2809	Mercury	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP				
Hazards	**Class**	8	Corrosive substance	
	Sub-risks	6.1	Toxic substance	
HIN		66/60	Highly toxic substance/toxic or slightly toxic substance	

Abbreviations

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

Notes to Table 1d

[note 1] Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137.

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	Acute Tox. 2	Acute toxicity (inhalation), category 2	
	Repr. 1B	Toxic to reproduction, category 1B	
	STOT RE 1	Specific target organ toxicity following repeated exposure, category 1	
	Aquatic Acute 1	Acute hazard to the aquatic environment, category 1	
	Aquatic Chronic 1	Chronic hazard to the aquatic environment, category 1	
Hazard statement	H330	Fatal if inhaled	
	H360D	May damage 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		

Reference

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed May 2022)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	7439-97-6
Molecular weight	200.6
Formula	Hg
Common synonyms	Quicksilver, liquid silver
State at room temperature	Liquid
Volatility	Vapour pressure = 0.002 mmHg (at 25°C)
Specific gravity **Vapour density**	13.5 at 25°C (water =1) 6.93 (air = 1)
Flammability	Non-combustible but enhances combustion of other substances
Lower explosive limit	-
Upper explosive limit	-
Water solubility	None
Reactivity	Reacts violently with ammonia and halogens, acetylene and amines generating a fire and explosion hazard
Reaction or degradation products	Attacks aluminium and many other metals, this produces amalgums. When heated will emit highly toxic fumes
Odour	Odourless

References

International Programme on Chemical Safety. 'International chemical safety card entry for Mercury'. ICSC 0056, 2019. World Health Organization (WHO) Geneva

PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. PubChem Compound Summary for CID 23931, Mercury (viewed May 2022)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation (mercury vapour)

mg/m^3	Duration	Signs and symptoms	Reference
>44.3	4 to 8 hours	Chest pain, haemoptysis, dyspnoea, cough and impairment of lung function	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. WHO. Elemental and inorganic mercury compounds: human health aspects. 'Concise International Chemical Assessnent Document (CICAD) 50'. (2003) Geneva

Table 5. Exposure by ingestion (mercuric chloride)

mg/kg bw	Signs and symptoms	Reference
20 to 30 (adults)	Vomiting, diarrhoea, severe abdominal pain, oropharyngeal pain, ulceration and haemorrhages throughout the length of the gastrointestinal tract	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. WHO. Elemental and inorganic mercury compounds: human health aspects. 'Concise International Chemical Assessnent Document (CICAD) 50'. (2003) Geneva

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs) showing concentrations in mg/m^3

	Concentration (mg/m^3)				
	10 min	**30 min**	**60 min**	**4 hours**	**8 hours**
AEGL-1 [note 1]	NR	NR	NR	NR	NR
AEGL-2 [note 2]	3.1	2.1	1.7	0.67	0.33
AEGL-3 [note 3]	16	11	8.9	2.2	2.2

Notes to Table 6

[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.

NR = not recommended due to insufficient data.

Reference

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

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m^3	ppm	mg/m^3
WEL	-	0.02	-	-

Values relate to mercury and divalent inorganic compounds including mercuric oxide and mercuric chloride (measured as mercury)

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 8. Public health guidelines and standards

UK drinking water standard	1 µg/L
WHO guideline for drinking water quality	6 µg/L (inorganic mercury)
WHO air quality guideline	1 µg/m^3 (annual average)

References

The Private Water Supplies (England) Regulations (2016) and The Private Water Supplies (Wales) Regulations (2017)

The Water Supply (Water Quality) Regulations (2018) (Water, England and Wales)

WHO. 'Guidelines for Drinking-water Quality, 4th Edition Incorporating First Addendum', 2017. WHO: Geneva

WHO Regional Office for Europe. 'Air Quality Guidelines for Europe, European Series, No. 91, 2nd Edition', 2000. WHO: Copenhagen

Health effects

Major route of exposure

Inhalation is the predominant route of exposure to metallic/elemental mercury.

Ingestion is the main route of exposure for inorganic mercury compounds. Divalent mercuric (Hg^{2+}) salts are substantially more corrosive than monovalent mercurous (Hg^{+}) salts to the gastrointestinal tract.

Table 9a. Immediate signs or symptoms of acute exposure to elemental mercury

Route	Signs and symptoms
Inhalation	Elemental mercury is volatile, particularly when the ambient temperature is high, and is absorbed rapidly. Patients may develop flu-like symptoms with myalgia and fever. Nausea and vomiting may also occur. Acute inhalation of mercury vapour causes cough, breathlessness, mild hypoxaemia and non-specific chest pain within a few hours of exposure. Erosive bronchitis and bronchiolitis have been observed. Diffuse infiltrates consistent with pulmonary oedema may be found on chest X-ray. Acute respiratory destress syndrome has been reported. Proteinuria and renal failure secondary to acute tubular necrosis, nephrotic syndrome and hyperchloraemia may occur. Hypertension has been reported rarely. Thrombocytopenia, leucocytosis and neutrophilia have been reported. Personality changes, memory loss and hallucinations may also occur in acute mercury vapour poisoning.
Ingestion	Ingestion of small amounts of elemental mercury is unlikely to cause features. If large amounts of elemental mercury are ingested, patients may develop nausea, vomiting and abdominal pain. Aspiration of mercury is likely during substantial ingestion or as a complication of vomiting or gastric lavage. Features similar to those seen following inhalation of mercury vapour may follow. Sequestration of ingested mercury in the appendix has caused appendicitis.
Dermal	Discoid eczema, hyperhidrosis, skin erythema and pruritis can develop following dermal exposure to elemental mercury.
Ocular	Exposure to mercury vapour may lead to conjunctivitis and ocular irritation. The eyes may develop grey or brown lens discolouration. Blurred vision, photophobia and reduction of the visual field are also possible. Reduction in colour and depth of vision may also occur.

Reference

TOXBASE. Mercury (metallic). June 2020 (viewed May 2022)

Table 9b. Immediate signs or symptoms of acute exposure to inorganic mercury compounds

Route	Signs and symptoms
Inhalation	Inhalational exposures are unusual. However, occupational dermal and inhalational exposure have led to systemic toxicity, particularly the nephrotic syndrome.
Ingestion	**Mercuric salts** Features include burning of the mouth and throat, abdominal pain, nausea, vomiting, haematemesis and (sometimes bloody) diarrhoea. Dehydration, acute colitis, intestinal mucosal necrosis, circulatory collapse, coma and death may ensue. Other features described in acute poisoning include ECG changes (atrial fibrillation, broadening of the QRS complex), transient pancytopaenia and increased transaminase, amylase and creatine kinase activities, although these are likely, at least in part, to be secondary to the metabolic disturbances present rather than direct inorganic mercury toxicity Patients surviving the acute gastrointestinal or renal phase of mercuric mercury poisoning may go on to develop renal glomerular and neurological damage (see systemic toxicity). **Mercurous salts** Mercurous chloride (calomel) causes “pink disease” (acrodynia) which is a hypersensitivity reaction characterised by fever, irritability, photophobia, an erythematous desquamating rash, hyperkeratosis of the palms and soles, and lymphadenopathy. Systemic features of mercury poisoning may occur following acute exposure.
Dermal	Inorganic mercuric compounds, notably ‘cinnabar’ (mercuric sulphide) used as a red dye in tattoos, have caused contact dermatitis and granulomatous reactions. Skin lightening creams and soaps containing mercurous chloride or mercuric chloride cause systemic mercury toxicity, particularly after repeated exposures.
Ocular	Pain, watering, conjunctivitis, oedema and photophobia may occur.
Systemic	Systemically absorbed mercuric ions (Hg^{2+}) accumulate predominantly in proximal tubular cells causing acute tubular necrosis (exacerbated after mercuric salt ingestion by hypovolaemic shock). Substantial or repeated exposure may result in glomerular damage, nephrotic syndrome with

Route	Signs and symptoms
	proteinuria and oedema, and type IV hypersensitivity granulomatous interstitial nephritis. Neurological features including weakness, irritability, weight loss (or failure to thrive in young children), hypersalivation, tremor, paraesthesiae.

Reference

TOXBASE. Mercuric chloride. July 2019 (viewed May 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.

Mercuric chloride is a corrosive substance. Therefore, following disrobe, improvised wet decontamination should be considered. For elemental mercury and other inorganic mercury compounds, following disrobe improvised dry decontamination should be considered, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances (see below for further information).

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.

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.

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.

Where possible, disrobe at the scene should be 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 (for example 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.

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.

Where appropriate, seek professional advice on how to dispose of contaminated water and prevent run-off going into the water system.

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 and so on) 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 or clothes.

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 persons individually.

Detailed information on clinical management can be found on TOXBASE.

Important notes

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.

If the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves.

The area should be well ventilated.

Clinical decontamination following surface contamination

Carry out decontamination after resuscitation.

This should be performed in a well-ventilated area, preferably with its own ventilation system.

Avoid contaminating yourself with this product and wash any exposed area.

Contaminated clothing should be removed, double-bagged, sealed and stored safely.

Decontaminate open wounds first and avoid contamination of unexposed skin.

Any particulate matter adherent to skin should be removed and the patient washed with soap and copious amounts of water under low pressure for at least 10 to 15 minutes.

Pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears.

The earlier irrigation begins, the greater the benefit.

Dermal exposure

Elemental mercury

Decontaminate (as above) the patient following surface contamination.

Patients with major skin exposure may have inhaled a significant amount of vapour. In this case manage as per inhalation.

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

Inorganic mercury compounds

If the patient has been dermally exposed decontaminate (as above).

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

Assess for systemic toxicity particularly renal and neurological features.

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

Ocular exposure

Remove contact lenses if present.

Anaesthetise the eye with a topical local anaesthetic (for example, oxybuprocaine, amethocaine or similar). However, do not delay irrigation if local anaesthetic is not immediately available.

Immediately irrigate the affected eye thoroughly with 1,000 mL 0.9% saline (for example, by an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given.

Irrigate for 10 to 15 minutes irrespective of initial conjunctival pH. Aim for a final conjunctival pH of 7.5 to 8.0. The conjunctivae may be tested with indicator paper. Retest 20 minutes after irrigation and use further irrigation if necessary.

Repeated instillation of local anaesthetics may reduce discomfort and help more thorough decontamination. However, prolonged use of concentrated local anaesthetics is damaging to the cornea.

Patients with corneal damage, those who have been exposed to strong acids or alkalis and those whose symptoms do not resolve rapidly should be discussed urgently with an ophthalmologist.

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

Inhalation

Elemental mercury

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

Perform a 12 lead ECG in all patients that require assessment.

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

Inorganic mercury compounds

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

Assess for systemic toxicity particularly renal and neurological features.

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

Ingestion

Elemental mercury

In the majority of cases supportive treatment is all that is required.

Consider gastric aspiration vai nasogastric tube following substantial ingestions. Further information is available on TOXBASE.

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

Inorganic mercury compounds

Maintain airway and establish haemodynamic stability.

In severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction.

Children are at increased risk of airway obstruction.

Do not attempt gastric lavage. The use of water or milk (maximum initial volume = 100 to 200 mL in an adult, 2 mL/kg in a child) as diluents in the management of corrosive ingestion may be of some symptomatic benefit (but caution is necessary following large ingestions where mucosal damage or perforation may have already developed). Administration of large volumes of fluid should be avoided as they may induce vomiting and increase the risk of oedema.

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

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

Clinical decontamination and first aid references

TOXBASE (viewed in May 2022).

TOXBASE Mercury metallic – features and management (2020)

TOXBASE Mercury inorganic – features and management (2019)

TOXBASE Chemicals splashed or sprayed into eyes – features and management (2020)

TOXBASE Skin decontamination – irritants (2019)

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.

This document from the UKHSA Radiation, Chemicals and Environment Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

First published: June 2016

Full document update: August 2019

Full document update: May 2022

For queries relating to this document, please contact chemcompendium@phe.gov.uk or enquiries@ukhsa.gov.uk

Published: June 2022
Publishing reference: GOV-12416