UK Health Security Agency

# Lead

## Incident management

This document provides information needed for response to a chemical incident, such as physicochemical properties, health effects and decontamination advice.

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# Contents

# Main points

## General

Lead is a metallic solid at room temperature. It is odourless, non-combustible and reacts with strong oxidants and strong acids, generating a fire and explosion hazard. It is moderately explosive in the form of dust when exposed to heat or flame.

## Health

Toxicity most frequently results from ingestion or inhalation and rarely from dermal exposure.

Exposure may cause metallic taste and gastrointestinal upset with black stools if acute massive exposure.
In children, changes in behaviour, loss of developmental milestones and language delay may be seen.

Encephalopathy with headache, confusion, drowsiness, coma and seizures secondary to cerebral oedema may occur; lead encephalopathy is more common in children.

## Casualty decontamination at the scene

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

## Environment

Inform the Environment Agency where appropriate and avoid release into the environment.

# Hazard identification

**Table 1. Standard (UK) dangerous goods emergency action codes for for lead compound, soluble, N.O.S.**

| | | | | |
|---|---|---|---|---|
| **UN** | | 2291 | Lead compound, soluble, N.O.S. | |
| **EAC** | | 2Z | Use fine water spray. Wear normal fire kit in combination with breathing apparatus [note 1]. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters | |
| **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.

### Note to Table 1

Note 1: Normal firefighting clothing is appropriate: self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3- Hazmat and structural firefighting [CH – marking for chemical resistance] or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

### Reference

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. The Stationery Office 2023 (viewed on 28 October 2024)

**Table 2a. The GB classification, labelling and packaging (CLP) regulation for lead powder (particle diameter < 1mm)**

| | | | |
|---|---|---|---|
| **Hazard class and category** | Lact. | Additional reproductive toxicity category for effects on or via lactation | - |
| | Repr. 1A | Reproductive toxicity, category 1A |  |
| | Aquatic Acute 1 | Acute hazard to the aquatic environment, category 1 |  |
| | Aquatic Chronic | Chronic hazard to the aquatic environment, category 1 |  |
| **Hazard statement** | H362 | May cause harm to breast-fed children | |
| | H360FD | May damage fertility. May damage the unborn child | |
| | H400 | Very toxic to aquatic life | |
| | H410 | Very toxic to aquatic life with long lasting effects | |
| **Signal words** | DANGER | | |

**Table 2b. The GB classification, labelling and packaging (CLP) regulation specific concentration limits for lead powder (particle diameter < 1 mm)**

| **Concentration** | **Hazard class and category** | **Hazard statement** | |
|---|---|---|---|
| C ≥ 0.03 % | Repr. 1A | H360D | May damage the unborn child |

## Reference

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 28 October 2024)

**Table 2c. The GB classification, labelling and packaging (CLP) regulation for lead massive (particle diameter ≥ 1mm)**

| | | | |
|---|---|---|---|
| **Hazard class and category** | Lact. | Additional reproductive toxicity category for effects on or via lactation | - |
| | Repr. 1A | Reproductive toxicity, category 1A |  |
| **Hazard statement** | H362 | May cause harm to breast-fed children | |
| | H360FD | May damage fertility. May damage the unborn child | |
| **Signal words** | DANGER | | |

## References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 28 October 2024)

# Physicochemical properties

**Table 3. Physicochemical properties**

| | |
|---|---|
| **CAS number** | 7439-92-1 |
| **Molecular weight** | 207 |
| **Formula** | Pb |
| **Common synonyms** | - |
| **State at room temperature** | Solid |
| **Volatility** | Non-volatile at 20°C |
| **Specific gravity** | 11.34 at 20°C (water =1) |
| **Flammability** | Non-combustible |
| **Lower explosive limit** | Not applicable |
| **Upper explosive limit** | Not applicable |
| **Water solubility** | None |
| **Reactivity** | Reacts with strong oxidants and strong acids. This generates a fire and explosion hazard.<br>Moderately explosive in the form of dust when exposed to heat or flame. |
| **Reaction or degradation products** | Decomposes upon heating, producing irritating or toxic fumes |
| **Odour** | Odourless |

## References

World Health Organization. International Programme on Chemical Safety.'International chemical safety card entry for lead. ICSC 0052', 2019. (viewed on 28 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. 'PubChem Compound Summary for CID 5352425, Lead' (viewed 28 October 2024)

# Reported effect levels from authoritative sources

No data available

# Published emergency response guidelines

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

| | Concentration | | | | |
|---|---|---|---|---|---|
| | **10 min** | **30 min** | **60 min** | **4 hours** | **8 hours** |
| **AEGL-1** [note 1] | No data available | | | | |
| **AEGL-2** [note 2] | | | | | |
| **AEGL-3** [note 3] | | | | | |

### 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.

# Exposure standards, guidelines or regulations

**Table 5. Occupational standards**

| Standard | Occupational exposure limit ($mg/m^3$) [note 1] | Blood lead concentration (µg/dL) suspension levels | | |
|---|---|---|---|---|
| | | Any other employee | Women of reproductive capacity | Young persons (aged 16 and 17) |
| **Control of Lead at Work (CLAW)** | 0.15 | 60 | 30 | 50 |

### Notes to table 5

Note 1: Time-weighted average over an 8-hour period.

These levels are not considered fully protective of human health, adverse health effects may occur below these concentrations. These are concenrations at which action must be taken to reduce exposure to employees.

### Reference

Health and safety Executive (HSE). ‘Health effects from exposure to lead’ 2012 (viewed on 28 October 2024)

Health and safety Executive (HSE). ‘Control of lead at work (Third edition)’ 2002 (viewed on 28 October 2024)

**Table 6. Public health standards and guidelines**

| | |
|---|---|
| **Drinking water standard** | 10 µg/L |
| **WHO guideline for drinking water quality** | 10 µg/L(provisional) |
| **WHO air quality guideline** | 0.5 µg/$m^3$ (annual average) |

## References

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

The Private Water Supplies (England) Regulations (2016) and The Private Water Supplies (Wales) Regulations (2017) (viewed on 28 October 2024)

World Health Organization (WHO). 'Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addenda', 2022. (viewed on 28 October 2024)

World Health Organization Regional Office for Europe. 'Air Quality Guidelines for Europe, European Series, No. 91, 2nd Edition', 2000. WHO: (viewed on 28 October 2024)

# Health effects

Toxicity most frequently occurs from ingestion and inhalation and rarely from skin exposure. Features of poisoning are the same, irrespective of the route of exposure

**Table 7. Signs or symptoms of acute exposure**

| Signs and symptoms |
| --- |
| Metallic taste, GI upset (with black stools if acute massive exposure), constipation and vomiting may occur. Toxic megacolon has been reported rarely<br><br>Headaches, irritability, fatigue, insomnia, depression, peripheral neuropathy (predominantly motor, for example wrist and finger extensor weakness) and arthropathy. In children, changes in behaviour, loss of developmental milestones and language delay may be seen.<br><br>Proximal renal tubular dysfunction and renal tubular acidosis may occur.<br><br>Encephalopathy with headache, confusion, drowsiness, coma and seizures secondary to cerebral oedema may occur. Lead encephalopathy is more common in children and is more likely to occur at blood lead concentrations ≥ 100 micrograms/dL.<br><br>Anaemia, reticulocytosis, basophilic stippling and abnormal liver function tests may occur.<br><br>A bluish ‘lead-line’ on gums is seen rarely |

## Reference

National Poisons Information Service (NPIS). TOXBASE. ‘Lead’ 2024 (viewed on 28 October 2024)

# 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 lead unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

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 (UKHSA) Radiation, Chemicals, Climate and Environmental Hazards 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, disrobing should be conducted at the scene and by the casualty themselves. Disrobing should be systematic to prevent transfer of contaminant from clothing to skin. Clothing should not be pulled over the head if possible.

Clothing stuck to the casualty by the contaminant should not be forcefully removed, as this risks causing further harm.

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.

# 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.

Unprotected first responders and members of the public should not approach casualties incapacitated by exposure to administer improvised decontamination, as they may be exposed to contaminants and become a casualty themselves.

Important note: Improvised decontamination should continue until more structured interventions such as Interim or Specialist Operational Response are present.

# 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 first and then rubbed, starting with the face, head, and neck, and moving down and away from the body.

Blotting and rubbing should not be too aggressive, as it could drive contamination further into the skin.

Casualties should also blow their nose to remove contaminants from the nasal cavities.

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 copious amounts of water from any available source such as taps, showers, water bottles, fixed installation hose-reels and sprinklers to gently rinse the affected skin. Other natural sources of water may be considered unless this creates greater risks to the individuals affected. Wet wipes or baby wipes may be used as an effective alternative.

Improvised decontamination should not involve overly aggressive methods to remove contamination as this could further damage affected tissues and 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.

When vulnerable people are affected by a hazardous substance, they may need additional support to remove themselves, their clothing or the substance.

Casualties should remain in the area and should not leave to seek care at a hospital, as this presents a contamination risk. Further care will be administered on site by the appropriate emergency services.

## Interim wet decontamination

Interim decontamination is the use of standard Fire and Rescue Service 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 2015 (viewed on 28 October 2024)

National Health Service England. ‘Emergency Preparedness, Resilience and Response (EPRR): Guidance for the initial management of self-presenters from incidents involving hazardous materials.’ 2019 (viewed on 28 October 2024)

Joint Emergency Service Interopearablity Programme. ‘Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’ 2023 (viewed on 28 October 2024)

# 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.

For comprehensive clinical advice consult TOXBASE directly.

## 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

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 or an eye dropper as an alternative.

In hospital, 1,000 mL 0.9% saline at room temperature by an infusion bag with a giving set is appropriate, irrigate for 10 to 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.

# Ingestion and Inhalation

The most important aspect of management is cessation of exposure. Involve public health and occupational health services as required.

Where the practical expertise exists, consider gastric aspiration or lavage in adults within 1 hour of a potentially life-threatening overdose, providing the airway can be protected. See TOXBASE for further advice.

Monitor vital signs and check the capillary blood glucose.

Check and record pupil size.

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

Detailed information on clinical management can be found on TOXBASE.

# Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE. 'Lead' 2024 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE ‘skin decontamination - irritants’ 2019 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE ‘Eye irritants’ (2022) (viewed on 28 October 2024)

# 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 health 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: May 2016
Full document update: August 2019
Full document update: October 2024

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Publishing reference: GOV-17531