



# Magnesium

## Incident Management

### Key Points

#### Fire

- highly flammable
- reacts violently with many substances including oxidising agents, chlorine, bromine, iodine and acids, causing fire and explosion hazard
- reacts with water or dilute acids to form hydrogen
- reacts with aqueous solutions of ammonium salts to form a double salt
- magnesium powder may spontaneously ignite on contact with air, liberating irritating or toxic fumes
- in the event of a fire involving magnesium, use dry agent and normal fire kit with breathing apparatus; water **MUST NOT** be allowed to come into contact with substance

#### Health

- ingestion and inhalation are the main routes of exposure
- inhalation may cause metal fume fever, symptoms include cough, dyspnoea, sore throat, chest tightness, headache, fever, rigors, myalgia and arthralgia
- ingestion can cause nausea, vomiting, diarrhoea and abdominal colic; in susceptible patients hypermagnesaemia may develop with flushing, thirst, drowsiness, lethargy, slurred speech, confusion, CNS depression, muscular weakness, depression of deep tendon reflexes, breathlessness and respiratory depression


#### Environment

- avoid release to the environment, inform the Environment Agency of substantial incidents



## Hazard Identification

### Standard (UK) dangerous goods emergency action codes



#### Magnesium granules, coated

<b>UN</b>		2950	Magnesium granules, coated	
<b>EAC</b>		4Y	Use dry agent. Water <b>MUST NOT</b> be allowed to come into contact with substance. Wear normal fire kit in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
<b>APP</b>		–	–	
<b>Hazards</b>	<b>Class</b>	4.3	Substances which in contact with water emit flammable gases	
	<b>Sub-risks</b>	–	–	
<b>HIN</b>		423	Solid which reacts with water, emitting flammable gas, or flammable solid which reacts with water, emitting flammable gases or self-heating solid which reacts with water, emitting flammable gases <sup>†</sup>	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Normal firefighting clothing is appropriate, ie 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</p> <p><sup>†</sup> Water not to be used except by approval of experts</p> <p><b>Reference</b>            Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.</p>				


**Magnesium powder or magnesium alloys, powder packing group I**

<b>UN</b>		1418	Magnesium powder or magnesium alloys, powder packing group I	
<b>EAC</b>		4W <sup>(1)</sup>	Use dry agent. Water <b>MUST NOT</b> be allowed to come into contact with substance. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
<b>APP</b>		–	–	
<b>Hazards</b>	<b>Class</b>	4.3	Substances which in contact with water emit flammable gases	
	<b>Sub-risks</b>	4.2	Substances liable to spontaneous combustion	
<b>HIN</b>		–	–	
<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 the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137</p> <p><sup>(1)</sup> Not applicable to the carriage of dangerous goods under RID or ADR</p> <p><b>Reference</b> Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.</p>				



**Magnesium powder or magnesium alloys, powder packing group II & III**

<b>UN</b>	1418	Magnesium powder or magnesium alloys, powder packing group II & III		
<b>EAC</b>	4W	Use dry agent. Water <b>MUST NOT</b> be allowed to come into contact with substance. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off should be prevented from entering drains and watercourses		
<b>APP</b>	–	–		
<b>Hazards</b>	<b>Class</b>	4.3	Substances which in contact with water emit flammable gases	
	<b>Sub-risks</b>	4.2	Substances liable to spontaneous combustion	
<b>HIN</b>	423	Solid which reacts with water, emitting flammable gas, or flammable solid which reacts with water, emitting flammable gases or self-heating solid which reacts with water, emitting flammable gases†		
<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 the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137</p> <p>† Water not to be used except by approval of experts</p> <p><b>Reference</b></p> <p>Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.</p>				




**Magnesium or magnesium alloys with more than 50% magnesium in pellets, turnings or ribbons, coated**

<b>UN</b>		1869	Magnesium or magnesium alloys with more than 50% magnesium in pellets, turnings or ribbons, coated	
<b>EAC</b>		1Z	Use coarse water spray. Wear normal fire clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
<b>APP</b>		–	–	
<b>Hazards</b>	<b>Class</b>	4.1	Flammable solids, self-reactive substances and solid desensitised explosives	
	<b>Sub-risks</b>	–	–	
<b>HIN</b>		40	Flammable solids, or self-reactive substance, or self-heating substance	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Normal firefighting clothing is appropriate, ie 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</p> <p><b>Reference</b>  Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.</p>				

**Classification, labelling and packaging (CLP)\*****Magnesium powder (pyrophoric)**

<b>Hazard class and category</b>	Water-react. 1	Substances and mixtures, which in contact with water, emit flammable gases, category 1	
	Pyr. Sol. 1	Pyrophoric solid, category 1	
<b>Hazard statement</b>	H260	In contact with water releases flammable gases which may ignite spontaneously	
	H250	Catches fire spontaneously if exposed to air	
<b>Signal words</b>	DANGER		
<p>* Implemented in the EU on 20 January 2009</p> <p><b>Reference</b></p> <p>European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 05/2015).</p>			

**Magnesium, powder or turnings**

<b>Magnesium, powder or turnings</b>			
<b>Hazard class and category</b>	Flam. Sol. 1	Flammable solid, category 1	
	Self-heat. 1	Self-heating substances and mixtures, category 1	
	Water-react. 2	Substances and mixtures, which in contact with water, emit flammable gases, category 2	
<b>Hazard statement</b>	H228	Flammable solid	
	H252	Self-heating in large quantities; may catch fire	
	H261	In contact with water releases flammable gases	
<b>Signal words</b>	DANGER		
* Implemented in the EU on 20 January 2009			
<b>Reference</b>			
European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 12/2015).			

## Physicochemical Properties

<b>CAS number</b>	7439-95-4
<b>Molecular weight</b>	24.30
<b>Formula</b>	Mg
<b>Common synonyms</b>	–
<b>State at room temperature</b>	Silvery white metal
<b>Volatility</b>	Vapour pressure = 1 Pa at 428°C
<b>Specific gravity</b>	1.74 at 20°C
<b>Flammability</b>	Flammable
<b>Lower explosive limit</b>	Data not available
<b>Upper explosive limit</b>	Data not available
<b>Water solubility</b>	Insoluble in cold water
<b>Reactivity</b>	Reacts violently with many substances including oxidising agents, chlorine, bromine, iodine and acids causing fire and explosion hazard. Reacts vigorously with anhydrous methyl alcohol
<b>Reaction or degradation products</b>	May spontaneously ignite on contact with air liberating irritating or toxic fumes. Reacts with water or dilute acids to form hydrogen. Reacts with aqueous solutions of ammonium salts forming a double salt
<b>Odour</b>	None
<b>References</b>	
<p>Hazardous Substances Data Bank [Internet]. Bethesda MD,US: National Library of Medicine (US); [Last Revision Date 12/09/2003; cited 05/2015]. Magnesium; Hazardous Substances Databank Number: 654. <a href="http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB">http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB</a> (as accessed 05/2015).</p> <p>The Merck Index (14<sup>th</sup> Edition). Entry 5653: Magnesium, 2006.</p> <p>International Programme for Chemical Safety (IPCS). International Chemical Safety Card (ICSC) entry for Magnesium (Powder). ISCS 0289, 2011. World Health Organization: Geneva.</p>	



## Reported Effect Levels from Authoritative Sources

### Exposure by ingestion (*see note*)

mg	Signs and symptoms	Reference
>2500	Toxic hypermagnesaemia	a
<p>Note: not elemental magnesium, equivalent dose from ingested supplements or medicines            These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values</p> <p><b>Reference</b></p> <p>a SCF. Opinion of the Scientific Committee on Food on the Tolerable Upper Intake Level of Magnesium, 2001.</p>		

## Published Emergency Response Guidelines

### Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m <sup>3</sup> )
<b>ERPG-1*</b>	Data not available	
<b>ERPG-2<sup>†</sup></b>		
<b>ERPG-3<sup>‡</sup></b>		
<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><sup>†</sup> 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><sup>‡</sup> 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>		

### Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
<b>AEGL-1*</b>	Data not available				
<b>AEGL-2<sup>†</sup></b>					
<b>AEGL-3<sup>‡</sup></b>					
<p>* Level of the chemical in air at or above which the general population could experience notable discomfort</p> <p><sup>†</sup> 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><sup>‡</sup> Level of the chemical in air at or above which the general population could experience life-threatening health effects or death</p>					

## Exposure Standards, Guidelines or Regulations

### Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
<b>WEL</b>	No guideline values specified			
WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit				

### Public health guidelines

<b>Drinking water standard</b>	No guideline values specified
<b>Air quality guideline</b>	No guideline values specified
<b>Soil guideline values and health criteria values</b>	No guideline values specified

## Health Effects

### Major route of exposure

- ingestion or by inhalation

### Immediate signs or symptoms of acute exposure

- individual response is variable
- accidental ingestion of small amounts of magnesium salts is unlikely to cause problems in patients with normal renal function

Route	Signs and symptoms
<b>Ingestion</b>	<p>Acute ingestion can cause nausea, vomiting and diarrhoea, and abdominal colic may occur</p> <p>In susceptible patients, hypermagnesaemia may develop with flushing, thirst, drowsiness, lethargy, slurred speech, confusion, CNS depression, muscular weakness, depression of deep tendon reflexes, breathlessness, respiratory depression, hypotension, hypothermia, urinary retention, hypocalcaemia, and hypophosphataemia. Bradycardia, prolongation of PR, QT and QRS intervals, T wave changes, conduction defects, heart block and asystole have been reported</p>
<b>Inhalation</b>	<p>Inhalation may cause metal fume fever, symptoms may occur within 3–10 hours of exposure and usually resolve within 24–48 hours. Cough, dyspnoea, sore throat, chest tightness, headache, fever, rigors, myalgia and arthralgia may occur and sometimes a metallic taste, nausea, vomiting and blurred vision</p>
<p><b>References</b></p> <p>TOXBASE. Magnesium salts (generic), 05/2013. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 11/2016).</p> <p>TOXBASE. Magnesium salts (generic) - features and management, 05/2013. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 11/2016).</p> <p>TOXBASE. Metal fume fever, 03/2005. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 11/2016).</p>	

## Decontamination at the Scene

### Summary

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 magnesium **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.

### 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 (eg 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 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

National Ambulance Resilience Unit. Joint Emergency Services Interoperability Programme (JESIP). Initial operational response to a CBRN incident. Version 1.0, September 2013.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Chemical incidents: planning for the management of self-presenting patients in healthcare settings. April 2015.

## 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](http://www.toxbase.org).

### Important note

- 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

- 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
- if symptoms persist seek medical assistance
- in hospital immediately irrigate the affected eye thoroughly with 0.9% saline 1000 mL (for example via an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given. 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

- remove patient from exposure



- ensure a clear airway and adequate ventilation
- give oxygen to symptomatic patients
- apply other supportive measures as indicated by the patient's clinical condition

## Ingestion

- accidental ingestion of small amounts of magnesium salts is unlikely to cause problems in patients with normal renal function, symptomatic and supportive care only will be required in most cases
- maintain a clear airway and ensure adequate ventilation
- in the event of cardiac arrest in hospital or witnessed out of hospital cardiac arrest with bystander CPR, resuscitation should be continued for at least 1 hour and only stopped after discussion with a senior clinician
- prolonged resuscitation for cardiac arrest is recommended following poisoning as recovery with good neurological outcome may occur
- perform a 12 lead ECG
- for hypothermia rewarm slowly using conventional methods
- other measures as indicated by the patient's clinical condition

## Clinical decontamination and first aid references

- TOXBASE: <http://www.toxbase.org> (accessed 11/2016)
- TOXBASE: Magnesium salts (generic), 05/2013
- TOXBASE: Metal fume fever, 03/2005
- TOXBASE: Skin decontamination – irritants, 05/2012
- TOXBASE: Eye irritants – features and management, 01/2016

This document from the PHE Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

© Crown copyright 2016, [www.gov.uk/phe](http://www.gov.uk/phe)

Re-use of Crown copyright material (excluding logos) is allowed under the terms of the Open Government Licence, visit [www.nationalarchives.gov.uk/doc/open-government-licence/version/3/](http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/) for terms and conditions.

For queries relating to this document, please contact: [generaltox@phe.gov.uk](mailto:generaltox@phe.gov.uk)

First published: October 2015

Update: November 2016 Health Effects, Decontamination at the Scene & Clinical Decontamination and First Aid