UK Health Security Agency

White phosphorus

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

White phosphorus is a white to yellow waxy solid with a garlic-like odour (not to be confused with red phosphorus, which is a less reactive allotrope). It is highly flammable and spontaneously ignites on contact with air, this produces toxic fumes of white phosphorus oxides. White phosphorus reacts violently with oxidants, halogens and sulphur, generating an explosion hazard. Reacts with strong bases, forming phosphine gas.

Health

Highly toxic by ingestion and toxic by inhalation and skin contact.

Inhalation causes irritation of the upper respiratory tract and headache and systemic effects may occur

Ingestion: stage 1, may be delayed for 24 hours, nausea, vomiting, abdominal pain and burns to the pharynx, oesophagus and stomach; stage 2, symptom-free period during which the patient appears to recover; stage 3, multi-organ failure.

Dermal exposure causes partial and full thickness burns (both chemical and thermal) and may cause systemic toxicity if absorbed through broken skin.

Ocular exposure may cause irritation, blepharospasm, photophobia, lacrimation, and conjunctivitis and particles may cause corneal perforation

Casualty decontamination at the scene

White phosphorus spontaneously ignites in air. It may cause deep and painful burns (thermal and chemical) and may be absorbed through the skin. Therefore, following disrobe, improvised wet decontamination should be considered.

Environment

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

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.

Hazard identification

Table 1a. Standard (UK) dangerous goods emergency action codes for phosphorus, white or yellow, dry or under water or in solution

UN		1381	Phosphorus, white or yellow, dry or under water or in solution	
EAC		1WE	Use course water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Substance can be violently or explosively reactive. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident [note 2].	
APP		-	-	
Hazards	**Class**	4.2	Substances liable to spontaneous combustion	
	Sub-risks	6.1	Toxic substances	
HIN		46	Flammable or self-heating solid, toxic	

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 conforming to BS EN 137.

Note 2: People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be

eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250m away from the incident.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. 2025 (viewed on 26 February 2025)

Table 1b. Standard (UK) dangerous goods emergency action codes for white phosphorus, white molten

UN		2447	Phosphorus, white molten	
EAC		1WE	Use course water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Substance can be violently or explosively reactive. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident [note 2].	
APP		A(h)	Fire kit with gas tight chemical protective suit with breathing apparatus [note 3].	
Hazards	**Class**	4.2	Substances liable to spontaneous combustion	
	Sub-risks	6.1	Toxic substances	
HIN		446	Flammable solid, toxic in the molten state at an elevated temperature	

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 conforming to BS EN 137.

Note 2: People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250m away from the incident.

Note 3: Normal fire kit in combination with gas-tight chemical protective clothing conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137. Suitable thermal resistant gloves should be worn, such as those conforming to BS EN511 or BS EN407.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. 2025 (viewed on 26 February 2025)

Table 2. The GB classification, labelling and packaging (CLP) regulation for white phosphorus

Hazard class and category	Pyr.Sol.1	Pyrophoric solids, category 1	
	Acute Tox. 2	Acute Toxicity (Inhalation, oral), category 2	
	Skin Corr. 1A	Skin Corrosion / irritation, category 1A	
	Aquatic Acute 1	Hazardous to the aquatic environment, short term (Acute), category 1	
Hazard statement	H250	Catches fire spontaneously if exposed to air	
	H330	Fatal if inhaled	

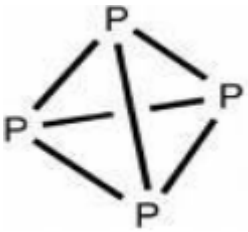
	H300	Fatal if swallowed
	H314	Causes severe skin burns and eye damage
	H400	Very toxic to aquatic life
Signal words	DANGER	

References

The Health and Safety Executive (HSE). ‘GB CLP Regulation’ (viewed on 26 February 2025)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	12185-10-3
Molecular weight	31
Formula	P
Common synonyms	White phosphorus
State at room temperature	White-to-yellow transparent crystalline solid with waxy appearance. Turns dark on exposure to light.
Volatility	Vapour pressure: 0.026 mm Hg at 20°C
Specific gravity	Density: 1.8 Vapour density: 4.42 (air = 1)
Flammability	Highly flammable.
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Insoluble in water
Reactivity	White phosphorus spontaneously ignites on contact with air, this produces toxic fumes of phosphorus oxides. White phosphorus reacts violently with oxidants, halogens and sulphur, generating an explosion hazard. Reacts with strong bases, forming phosphine gas.
Odour	Garlic-like
Structure	

References

World Health Organization. International Programme on Chemical Safety ‘International Chemical Safety Card entry for phosphorus’ ICSC 0628, 2004 (viewed on 26 February 2025)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. ‘PubChem Compound Summary for CID 5462309, phosphorus’ (viewed on 26 February 2025)

Reported effect levels from authoritative sources

Table 4. Exposure by ingestion

mg/kg	Signs and symptoms	Reference
≥1	Approximate fatal dose for an adult	a
mg	**Signs and symptoms**	**Reference**
3	Fatal in child	a

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. National Poisons Information Service (NPIS). TOXBASE ‘phosphorus white/yellow’ 2020 (viewed on 26 February 2025)

Published emergency response guidelines

Table 5. Acute exposure guideline levels (AEGLs)

	Concentration				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	No values specified				
AEGL-2 [note 2]					
AEGL-3 [note 3]					

Notes to Table 5

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 6. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	**mg/m³**	**ppm**	**mg/m³**
WEL	-	0.1	-	0.3

Abbreviations

WEL = workplace exposure limit.
LTEL = long-term exposure limit.
STEL = short-term exposure limit.

Reference

Health and Safety Executive (HSE). 'EH40/2005 Workplace Exposure Limits Fourth Edition' 2020 (viewed on 26 February 2025)

Table 7. Public health standards and guidelines

Drinking water standard	No values specified
WHO guideline for drinking water quality	No values specified
UK indoor air quality guideline	No values specified
WHO indoor air quality guideline	No values specified
WHO air quality guideline	No values specified

Health effects

Highly toxic, multi-organ toxicity may follow ingestion, inhalational or skin exposures.

Table 8. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Headache, upper respiratory tract irritation, non-cardiogenic pulmonary oedema (which may be delayed in onset). Acute hepatic damage and systemic toxicity may occur.
Ingestion/ systemic toicity	The clinical course of poisoning may occur in three stages; however stages 1 or 2 may be absent or difficult to recognize. The lack of classical features (garlic odour on breath, mucosal burns, phosphorescent (photoluminescent) or smoking vomitus/faeces) does not exclude poisoning. Stage 1 The onset of symptoms after ingestion can occur after a few minutes but may be delayed for up to 24 hours. GI upset predominates in the absence of any laboratory abnormalities. Other features may include garlic odour on breath and faeces, photoluminescent or smoking vomitus/faeces, burns to pharynx, oesophagus and stomach, and restlessness, irritability, lethargy and drowsiness. Rarely, early cardiovascular collapse or death may occur. Stage 2 Symptom-free period, 1 to 7 days (occasionally up to 10 days), during which the patient appears to recover. However, laboratory investigations may become deranged, showing acute liver injury for example. Early improvement in symptoms should not be interpreted as meaning that serious exposure has not occurred. Stage 3 Multi-organ failure from the action of the absorbed white phosphorus. Acute liver failure may necessitate liver transplantation. Potential for either coma or shock, often followed by death. Recovery, if it occurs, is usually over 1 to 2 weeks. **Gastrointestinal**: GI features may progress to haematemesis, massive upper alimentary tract bleeding and DIC.

Route	Signs and symptoms
	Cardiovascular: tachycardia or bradycardia, hypotension, cyanosis, cardiovascular collapse, QRS and QT prolongation, abnormal T waves and ST depression, absent P waves, RBBB, torsades de pointes, ventricular fibrillation and cardiac arrest. Cardiovascular collapse may occur in the first 24 hours. **CNS**: agitation, confusion, depressed consciousness, and coma. Headache, rarely convulsions, and cerebral oedema. Cerebral symptoms may persist for a long time. **Hepatic**: jaundice, cholestasis, hepatomegaly, hepatic necrosis, fulminant hepatic failure, and hepatic encephalopathy. Deranged LFTs and PT/INR, hypoglycaemia. **Renal**: acute kidney injury, often acute tubular necrosis. **Other**: hyperventilation, respiratory distress, pulmonary oedema, initially hyperglycaemia followed by hypoglycaemia, metabolic acidosis, bone marrow suppression (resulting in leucopenia), hyperkalaemia, hypocalcaemia and hypo- or hyper-phosphataemia. Haemorrhage into skin, mucous membranes and viscera may occur due to injury of blood vessels and inhibition of blood clotting. There has been one report of digital gangrene following ingestion.
Eyes	Irritation, blepharospasm, photophobia, lacrimation, and conjunctivitis. Particles may cause corneal perforation.
Skin	Severely painful, partial and full thickness burns (both chemical and thermal) that are slow to heal. White phosphorus may be absorbed through broken skin and cause systemic toxicity.

Reference

National Poisons Information Service (NPIS). TOXBASE ‘phosphorus’ 2020 (viewed on 26 February 2025)

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.

White phosphorus spontaneously ignites in air. It may cause deep and painful burns (thermal and chemical) and may be absorbed through the skin. Therefore, following disrobe, improvised wet decontamination should be considered (see below for details).

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, Chemical,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 a more structured intervention, such as an Interim Operational Response is conducted, 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

Wet decontamination should be used if contamination with a caustic chemical substance is suspected.

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 26 February 2025)

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 26 February 2025)

Joint Emergency Service Interoperability Programme. ‘Initial Operational Response (IOR) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’ 2024 (viewed on 26 Februaryr 2025)

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

Rescuers are reminded not to put themselves at risk: white/yellow phosphorus represents a toxic, fire and explosive hazard.

Prior to decontamination, any solid particles adhering to the skin should be brushed away and stored under water. Adherent liquid should be blotted away.

Soiled clothing should be placed in a water-filled sealed container clearly labelled as a biohazard.

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

Avoid contaminating yourself.

Carry out decontamination after resuscitation. This should be performed in a well-ventilated area, preferably with its own ventilation system.

Soiled clothing should be placed in a water-filled sealed container clearly labelled as a biohazard.

Prior to decontamination, any solid particles adhering to the skin should be brushed away and stored under water.

Wash the patient with 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.

Meticulous surgical debridement of all embedded phosphorus particles is required; consult a burns specialist (store any removed solid particles under water).

Continuous irrigation can prevent further oxidation and allow removal of particles from the skin surface without re-ignition. Alternatively, phosphorus will fluoresce under ultraviolent light, with the exposed areas immersed in water, loose or embedded phosphorus particles that are visualized under UV light can be mechanically but delicately removed safely under water.

Water- or saline-soaked dressings applied to the affected area will allow transportation of patients without re-ignition of the remaining particles.

Burns totalling more than 15% of body surface area in adults (more than 10% in children) will require standard fluid resuscitation as for thermal burns.

Chemical burns should be reviewed by a burns specialist. Excision or skin grafting may be required.

Manage systemic toxicity as per ingestion/inhalation.

Carry out other supportive measures as indicated by the patient’s clinical condition.

Ocular exposure

Remove contact lenses if present.

Aerosols sprayed directly into the eyes may cause corneal damage.

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 1,000mL 0.9% saline or equivalent crystalloid (for example, by an infusion bag with a giving set) for a minimum of 10 to 15 minutes irrespective of initial conjunctival pH. A Morgan Lens may be used if anaesthetic has been given.

Aim for a neutral conjunctival pH of 7 to 7.2. The conjunctivae may be tested with indicator paper. Retest at 15 to 30 minutes after irrigation and use further irrigation if necessary.

Any particles lodges in the conjunctival recesses should be removed.

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.

Carry out other supportive measures as indicated by the patient’s clinical condition.

Ingestion and Inhalation

Maintain a clear airway and ensure adequate ventlaiton.

Administer oxygen to achieve adequate oxygenation.

Avoid giving milk to drink or other fatty substances since this may enhance the absorption of phosphorus.

Monitor vital signs and cardiac rhythm; check the capillary blood glucose.

Check and record pupil size.

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

Other supportive measures as indicated by the patient’s condition.

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE ‘phosphorus white/yellow’ 2020 (viewed on 26 February 2025)

National Poisons Information Service (NPIS). TOXBASE ‘chemicals splashed or sprayed into the eyes - features and clinical management’ 2020 (viewed on 26 February 2025)

National Poisons Information Service (NPIS). TOXBASE ‘skin decontamination - corrosives’ 2020 (viewed on 26 February 2025)

National Poisons Information Service (NPIS). TOXBASE ‘ingestion management’ 2020 (viewed on 26 February 2025)

National Poisons Information Service (NPIS). TOXBASE ‘inhalation management’ 2020 (viewed on viewed on 26 February 2025)

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, Climate and Environmental Hazards Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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

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