



Safety Services Guidance



Guidance on the First Aid Treatment of Cyanide, Hydrofluoric acid and Phenol Exposure

Key word(s) : First Aid, Cyanides, Hydrofluoric Acid, Phenol, Inhalation, Skin contact, Eye Contact, Diphoterine[®], Oxygen Therapy, Calcium gluconate, Hexafluorine[®]

Target audience : PIs, Researchers. First Aiders

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Introduction

1. Exposure to certain chemicals requires specialist first aid treatment. This document gives guidance to those who work with, or who may want to work with these substances on the first aid requirements needed in the event of exposure to the following:
 - [Cyanide and its compounds](#)
 - [Hydrofluoric acid](#)
 - [Phenol](#)
2. The information below is to be read and any necessary arrangements be made before the work commences so that any users are prepared and aware of what action to take. The risk assessment (which may also be called a COSHH assessment or a chemical risk assessment) must take into account this guidance and other aspects of safe working with these substances.
3. This guidance makes reference to the commercial preparations Diphoterine^{®1,2} and Hexafluorine^{®3}. Diphoterine[®] has been shown in a number of studies and review articles to be safe and more efficacious in the treatment of many ocular and cutaneous chemical injuries than standard treatment with running water.
4. Hexafluorine[®] was designed for use explicitly with HF. A review has shown it to be very effective in the treatment of ocular injuries, but the evidence on cutaneous injuries is not clear. Therefore the recommendation is that its use on cutaneous injuries should be in conjunction with the application of Calcium gluconate gel.

Cyanide and its compounds

5. Cyanide preparations are commonly used in many chemical experiments and with few exceptions almost all cyanide compounds are extremely toxic (poisons). Cyanide may be absorbed into the body by mouth, inhalation or absorption through intact skin.

¹ The Safety and Efficacy of Diphoterine for Ocular and Cutaneous Burns in Humans; Darren D Lynn, Leonid M Zukin. Robert Dellavalle; Cutaneous and Ocular Toxicology, 2017, **36(2)**, 185-92

² Is it time for a change in the approach to chemical burns? The role of Diphoterine[®] in the management of cutaneous and ocular chemical injuries; C J Lewis, A Al-Mousawi. A Jha, K P Allison; Journal of Plastic, Reconstruction and Aesthetic Surgery, 2017, **70(5)**. 563-537

³ Treatment of hydrofluoric acid exposure to the eye; K Atley. E Ridyard; Int. Journal of Ophthalmology, 2015, **8(1)**, 157-161

6. Prior to use, PIs and line managers must assure themselves that the use of cyanide is essential and that the desired outcomes cannot be achieved using safer alternatives. The decision to use (or produce as a by-product) must not be taken lightly and a detailed risk assessment of the specific risks in each situation where cyanide is to be used or produced must be carried out and appropriate control measures identified. Anyone needing to use cyanides must be given adequate information and training on the hazards it poses and the precautions to take to avoid them.

Procedure

7. Details of the work to be undertaken must first be discussed with the School Safety Advisor (who may seek further advice from Safety Services) before work commences.
8. Each group that plans to use cyanides must first ensure that a First Aid at Work and Oxygen therapy trained first aider will be available for the duration of the experiment. The first aider will have a first aid kit and medical oxygen available for use in the event of exposure.
9. When dealing with a case of suspected cyanide exposure, speed of response is essential. In all cases of suspected cyanide exposure, the first course of action is to **telephone for an ambulance** (9-999 from an internal phone, 999 from a mobile) and **tell security** (69966 from an internal phone or 0161 306 9966 from a mobile) that an ambulance is on its way.
10. Signs and symptoms of suspected cyanide poisoning are:
 - Irritation of eyes, nose and throat
 - Dizziness, nausea, general weakness, headache, flushing or occasionally pale skin, palpitations
 - A feeling of suffocation followed by deep breathing, (which might have a characteristic smell of almonds), sudden unconsciousness, cessation of breathing and heart function.

Principles of first aid for suspected cyanide exposure include: -

11. Protect yourself and the casualty from further exposure and contamination during decontamination and treatment. Gloves and other appropriate personal protective equipment should be worn during the procedure.

12. Do not enter the room if you suspect that gaseous hydrogen cyanide is present. The casualty would need to be rescued by someone wearing self-contained breathing apparatus (in practice, this will be the Fire and Rescue Service).
13. Maintain the casualty's airway, breathing and circulation. If the casualty is breathing give oxygen via mask. If the casualty is not breathing, resuscitation will be required via a bag and mask.
14. Provide copies of risk assessments, safety data sheets and other relevant documentation to be taken to hospital with the casualty.

Inhalation

- Quickly remove casualty from scene of exposure, preferably to fresh air
- Keep them warm and at rest
- Oxygen should be given if first aider has been trained to do so
- If breathing has stopped, apply artificial respiration using a bag and mask resuscitator if trained in its use
- DO NOT USE MOUTH TO MOUTH OR MOUTH TO NOSE RESUSCITATION OR YOU MAY BE CONTAMINATED

Skin Contact

- Remove all contaminated clothing immediately
- Wash the skin with Diphoterine[®] (a 100ml spray can will provide sufficient treatment for a hand or cheek, a 200ml spray can will provide sufficient treatment for a face or thigh, provided that the can is completely used up).
- If there is no Diphoterine[®] available, wash skin with plenty of water for at least 10 minutes
- Treat the casualty as for inhalation

Eye Contact

- Immediately irrigate with Diphoterine[®] eyewash
- If there is no Diphoterine[®] immediately irrigate with plenty of water for at least 10 minutes
- Treat casualty as for inhalation

Ingestion

- Do not give anything by mouth
- Treat as for inhalation

15. Training in how to use oxygen is an additional skill for the first aider. Course costs will be recharged back to the administrative units but should be booked through the Training Catalogue. A waiting list will be maintained if necessary, though if there is an urgent need, please speak to the First Aid Administrator.

16. Training in the use of Diphoterine[®] may be covered by your School Safety Advisor as part of the induction process. It is, however, very important that the Diphoterine[®] is applied as soon after exposure as possible, as this is when it is most effective.

Hydrofluoric Acid (HF)

17. Hydrofluoric acid is an extremely corrosive inorganic acid which can cause severe burns to the skin and eyes. If it comes into contact with the skin the fluoride ions readily penetrate into the deep tissue layers causing liquefaction necrosis and decalcification and corrosion of the bone. The tissue destruction is accompanied by severe and excruciating pain.
18. Contact with dilute solutions of HF can result in delayed effects which can occur up to 24 hours after exposure to the solution.
19. Prior to use, Pls and line managers must assure themselves that the use of HF is essential and that the desired outcomes cannot be achieved using safer alternatives. The decision to use HF must not be taken lightly and the detailed risk assessment must state precautions to be taken when using it and will include a safe system of work. Anyone needing to use HF must be given adequate information and training on the hazards to health it poses (from life threatening to delayed burns) and the precautions to take to avoid them. They must also be given details of first aid treatment which may need to be started by themselves or other people in the vicinity before the first aider arrives.
20. Anyone intending to use HF should:-
 - Produce a risk assessment (which could be called a COSHH or chemical risk assessment) for the work being undertaken and identify suitable control measures to deal with any hazards
 - Always use the control measures, including appropriate personal protective equipment (eg check chemical permeation charts to identify suitable protective materials for gloves and ensure they are available) identified in the risk assessment
 - Test gloves for pinholes using a method advised by manufacturers before putting them on.
 - Always wash gloves and anything that has been handled by the gloved hands before removing them.
 - Wash other impervious clothing before removal
 - Always wash hands before leaving the work area
 - Provide calcium gluconate gel to take home in the event of delayed symptoms from low concentration burns

Procedure

21. Details of the work to be undertaken must be discussed with the School Safety Advisor (who may seek further advice from Safety Services) prior to work commencing.
22. Where HF is to be used, a First Aid at Work and oxygen therapy trained first aider must be available for the duration of the experiment/procedure. There should be a first aid kit, high flow running water, medical oxygen and a plentiful supply of calcium gluconate gel immediately available. The First Aider should also be provided with appropriate Personal Protective Equipment. If a decision has been made to use Hexafluorine[®] as a decontaminant / treatment it should also be readily available.

Principles of first aid for suspected HF exposure include: -

23. Protect yourself and the casualty from further exposure and contamination with HF during decontamination and treatment. Use appropriate PPE before approaching the casualty – for decontamination this may include eye/face protection, gloves, impermeable apron etc.
24. If the casualty is unresponsive or breathing abnormally **telephone for an ambulance** (9-999 from an internal phone, 999 from a mobile) and **tell security** (69966 from an internal phone or 0161 306 9966 from a mobile) that an ambulance is on its way.
25. Commence life support using a bag and mask resuscitator. DO NOT USE MOUTH TO MOUTH OR MOUTH TO NOSE RESUSCITATION OR YOU MAY BE CONTAMINATED
26. Decontamination is the immediate priority if the patient is responsive.
27. Provide copies of risk assessments, safety data sheets, other [relevant documentation](#) along with calcium gluconate gel and hexafluorine to accompany the casualty to hospital.

Inhalation

- Remove casualty to fresh air
- Remove any exposed clothes, jewellery and shoes
- Administer 100% oxygen if trained to do so
- Immediately arrange transfer to hospital

- Keep casualty warm and at rest and continue administering oxygen until transfer to hospital

Skin Contact

- Immediately decontaminate with high flow water for a maximum of 1 minute
- Ask others to ensure ample supplies of calcium gluconate gel are obtained (if calcium gluconate gel is not available continue to wash with water or Hexaflourine[®] until it is)
- Rapidly remove contaminated clothing, shoes and jewellery
- Apply calcium gluconate gel and massage into the burnt area whilst wearing appropriate gloves. Continue to massage while repeatedly applying gel until 15 minutes after pain in the burnt area is relieved, if necessary during the ambulance transfer to hospital.
- If skin contamination is extensive and clothing is affected, be aware of the possibility of inhalation.
- Dispose of potentially contaminated clothing and equipment in line with the risk assessment

Eye Contact

- Flush the eyes with copious amounts of water, eye wash solution or Hexafluorine[®] until the ambulance arrives. Do not attempt to remove contact lenses. Irrigation should be continued whilst on route to hospital.
- Remove any exposed clothes, jewellery and shoes.
- DO NOT APPLY CALCIUM GLUCONATE EYEDROPS AS THIS MAY INCREASE OCCULAR DAMAGE

Ingestion

- Do not delay decontamination: remove clothes and shoes
- Seek urgent hospital transfer as ingestion can be rapidly fatal
- DO NOT INDUCE VOMITING. MOUTH AND LIPS MAY BE RINSED WITH WATER ONLY IF CASUALTY IS CONSCIOUS

Transfer to hospital

- Decontamination with high flow water and removal of clothes and shoes should be done prior to loading inside the confines of an ambulance. The administration of calcium gluconate gel can be done en-route to hospital

Phenol

28. Phenol is a white crystalline solid in its pure form, which liquefies on contact with water. It has a characteristic acrid odour and a sharp burning taste. It is used as a starting material for a variety of chemical reactions and other processes. It is corrosive and diluted preparations of phenol solutions may also burn or irritate the skin. Phenol is well absorbed when ingested, inhaled or in contact with the skin, eyes and mucous membranes. It can be absorbed across intact skin. As phenol initially may have anaesthetic effects which last up to 30 minutes, it may have caused extensive damage before the casualty feels any pain.

Procedure

29. In the event of direct contact with phenol, telephone for an ambulance (9-999 from an internal phone, 999 from a mobile) and tell security (69966 from an internal phone or 0161 306 9966 from a mobile) that an ambulance is on its way.
30. The casualty must be sent immediately to the accident and emergency unit along with appropriate risk assessments, safety data sheets and a copy of this guidance.
31. Details of the work to be undertaken must be discussed with the School Safety Advisor (who may seek further advice from Safety Services) prior to work commencing.
32. Each group that plans to use phenol must first ensure that a First Aid at Work trained first aider will be available for the duration of the experiment and that either Diphoterine[®] or PEG300 and running water is available.

Principles of first aid for phenol exposure include:

- Protect yourself and the casualty from further exposure and contamination with phenol during decontamination and treatment.
- Wear appropriate protective gloves and cut off contaminated clothing rather than pulling it off over the head which could spread contamination to the casualty's eyes and face.

Skin Contact – if Diphoterine[®] is available

- After removing contaminated clothing without contaminating unaffected areas, flush the affected skin with Diphoterine[®]. For an injured area the size of a hand or cheek, use a complete 100ml spray; for an area such as an arm, thigh, or face use a 200ml spray as minimum; for larger areas use a 5L mini shower spray.

Skin Contact – no Diphoterine[®]

- After removing contaminated clothing without contaminating unaffected areas, flush the skin with copious amounts of water for a minimum of 10 – 15 minutes to remove any phenol lying on the surface of the skin (not yet absorbed)
- After initial irrigation with water, apply Polyethylene glycol solution (Molecular Weight 300) commonly called PEG300 or Macrogol 300 on a swab, which is changed frequently, for at least 30 minutes or until the casualty receives hospital treatment
- PEG 300 solution (made from 70 parts polyethylene glycol / 30parts methylated spirits) should be available in all labs where phenol is used if Diphoterine[®] is not available

Eye Contact

33. In the event of eye contact there will be severe pain and redness.

- Irrigate the eye with Diphoterine[®] eyewash if available
- If Diphoterine[®] is not available, irrigate the eye with copious amounts of running water or saline
- Send to hospital immediately

Ingestion

- If swallowed, wash out mouth with plenty of water and arrange transport to hospital.

Note for Emergency Personnel / Hospital staff

WARNING: Do not touch affected tissue with bare hands

Patients with corneal ulceration should be referred immediately for an ophthalmological examination / assessment.

Phenol is absorbed through intact skin and this may cause symptoms similar to those adsorbed from inhalation and ingestion of phenol. Diphoterine[®] inactivates any phenol absorbed, as does Polyethylene glycol (Molecular weight 300).

Inhalation of phenol may cause breathlessness and pulmonary oedema for which positive pressure ventilation should be used.

Possible complications of phenol absorption include hyperpyrexia, gut perforation and renal failure.

Document control box	
Title	Guidance on the First Aid Treatment of Cyanide, Hydrofluoric acid and Phenol Exposure
Link to Policy or Chapter	University Health & Safety Arrangements Chapter 19
Date issued:	August 2017
Issued by:	Safety Services
Implementation date:	v2.0 August 2017
Version:	v1.1 Jan 2009 1.0 June 2005
Next review date:	Upon significant change
Owner of this document:	Head of Safety Services
Lead contact:	Safety Services