



PFOS and PFOA

Incident Management

Key Points

Fire

- PFOS (potassium salt) emits vapours of sulphur oxide and fluorine when heated to decomposition
- PFOA decomposes on heating above 300°C producing toxic and corrosive gases including hydrogen fluoride

Health

- PFOS and PFOA are of low toxicity following acute exposure

Environment

- hazardous to the environment; inform the Environment Agency of substantial incidents where appropriate

Hazard Identification

Standard (UK) dangerous goods emergency action codes

UN		Not given
EAC		
APP		
Hazards	Class	
	Sub-risks	
HIN		
UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number		

Classification, labelling and packaging (CLP)*

Pentadecafluorooctanoic acid

Hazard class and category	Acute Tox. 4	Acute toxicity (inhalation, oral), category 4	
	Eye Dam. 1	Serious eye damage/ eye irritation, category 1	
	Carc. 2	Carcinogen, category 2	
	Lact.	Effects on or via lactation	-
	STOT RE 1	Specific target organ systemic toxicity following repeated exposure, category 1	
	Repr. 1B	Toxic to reproduction, category 1B	
Hazard statement	H302	Harmful if swallowed	
	H318	Causes serious eye damage	
	H332	Harmful if inhaled	
	H351	Suspected of causing cancer	
	H362	May cause harm to breast-fed children	
	H372	Causes damage to the liver through prolonged or repeated exposure	
	H360D	May damage the unborn child	
Signal words	DANGER		

* Implemented in the EU on 20 January 2009

Reference

European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <http://echa.europa.eu/information-on-chemicals/cl-inventory-database> (accessed 08/2018).

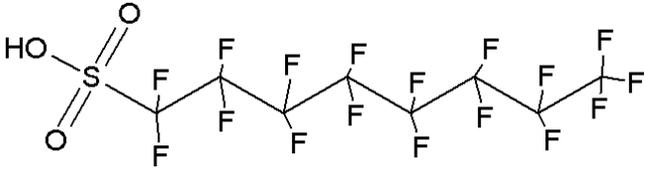
Potassium perfluorooctanesulfonate (PFOS potassium salt)

Hazard class and category	Acute Tox. 4	Acute toxicity (inhalation, oral), category 4	
	Carc. 2	Carcinogen, category 2	
	Lact.	Effects on or via lactation	-
	STOT RE 1	Specific target organ systemic toxicity following repeated exposure, category 1	
	Aquatic Chronic 2	Hazardous to the aquatic environment, long-term (chronic), category 2	
	Repr. 1B	Toxic to reproduction, category 1B	
	Hazard statement	H302	Harmful if swallowed
H332		Harmful if inhaled	
H351		Suspected of causing cancer	
H362		May cause harm to breast-fed children	
H372		Causes damage to organs through prolonged or repeated exposure	
H411		Toxic to aquatic life with long lasting effects	

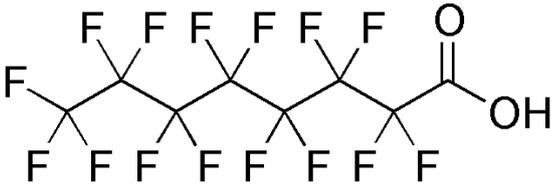
	H360D	May damage the unborn child
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Physicochemical Properties

PFOS (*potassium salt*)

CAS number	2795-39-3
Molecular weight	538
Formula	C ₈ F ₁₇ KO ₃ S
Common synonyms	Perfluorooctane sulphonate
State at room temperature	White powder
Volatility	Vapour pressure: 3.31 x 10 ⁻⁴ Pa
Specific gravity Vapour density	Data not available
Flammability	Data not available
Lower explosive limit	Data not available
Upper explosive limit	Data not available
Water solubility	519 mg/L at 20°C
Reactivity	Incompatible with strong oxidising agents
Reaction or degradation products	When heated to decomposition emits toxic vapours of sulphur oxides and fluorine
Odour	Data not available
Structure	 <p>The image shows the chemical structure of Perfluorooctane sulfonate (PFOS). It consists of a central sulfur atom (S) double-bonded to two oxygen atoms (O) and single-bonded to a hydroxyl group (OH). The sulfur atom is also single-bonded to the first carbon of an eight-carbon perfluorinated chain. Each carbon in this chain is bonded to two fluorine atoms (F). The chain ends with a carbon atom bonded to three fluorine atoms.</p>
References	<p>European Food Safety Authority. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and their salts. The EFSA Journal (2008) 653, 1-131.</p> <p>Hazardous Substances Data Bank. PFOS HSDB No. 7099 (last revision date 25/10/2016). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 08/2018).</p>

PFOA

CAS number	335-67-1
Molecular weight	414.1
Formula	C ₈ HF ₁₅ O ₂
Common synonyms	Perfluorooctanoic acid, Pentadecafluorooctanoic acid; Perfluoroheptanecarboxylic acid
State at room temperature	White powder
Volatility	0.1 kPa at 20°C
Specific gravity	1.79 at 20°C
Flammability	Non-flammable
Lower explosive limit	Data not available
Upper explosive limit	Data not available
Water solubility	3.4 g/L
Reactivity	Incompatible with bases, oxidising agents and reducing agents
Reaction or degradation products	Decomposes on heating above 300°C producing toxic and corrosive gases including hydrogen fluoride
Odour	Pungent odour
Structure	
References	<p>European Food Safety Authority. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and their salts. The EFSA Journal (2008) 653, 1-131.</p> <p>International Programme on Chemical Safety. International Chemical Safety Card entry for perfluorooctanoic acid. ICSC 1613, 2017. World Health Organization: Geneva.</p>

Reported Effect Levels from Authoritative Sources

No acute exposure effect levels could be found following a review of authoritative sources.

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	Not given	
ERPG-2 [†]		
ERPG-3 [‡]		
<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>[†] 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>[‡] 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
AEGL-1*	Not given				
AEGL-2 [†]					
AEGL-3 [‡]					
<p>* Level of the chemical in air at or above which the general population could experience notable discomfort</p> <p>[†] 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>[‡] 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 ³	ppm	mg/m ³
WEL	Not given			
WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit				

Public health guidelines

Drinking water standard	PFOS: 1 > µg/L* PFOA: 5 > µg/L*
Air quality guideline	Guideline value not given
Soil guideline values and health criteria values	Guideline value not given
<p>* represents a potential breach in the UK regulatory requirement for drinking water to be wholesome- concentrations that may constitute a potential danger to human health</p> <p>Reference Drinking water inspectorate (DWI), Guidance on the Water Supply (Water Quality) Regulations 20001 specific to PFOS (perfluorooctane sulphonate) and PFOA (perfluorooctanoic acid) concentrations in drinking water. 2009.</p>	

Health Effects

Immediate signs or symptoms of acute exposure

PFOS and PFOA are thought to be of low toxicity following acute exposure.

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 PFOS or PFOA, **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 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

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.

Important note

- **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

- decontamination is only required if there is surface contamination
- carry out decontamination after resuscitation
- this should be performed in a well-ventilated area preferably with its own ventilation system
- 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 the 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
- 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
- in hospital – immediately irrigate eye thoroughly with 1,000 mL 0.9% saline or equivalent crystalloid (for example via an infusion bag with a giving set) for minimum of 10 - 15

minutes. Amphoteric solutions are available and may be used. A Morgan Lens may be used if anaesthetic has been given

- 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\ Ingestion

- other supportive measures as indicated by the patient's clinical condition

Health effects and decontamination references

TOXBASE	http://www.toxbase.org (accessed 08/2018)
TOXBASE	Skin decontamination - irritants, 01/2018
TOXBASE	Eye irritants – features and management, 01/2016
TOXBASE	Personal protective equipment and decontamination at the scene or in hospital

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.

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For queries relating to this document, please contact: chemcompendium@phe.gov.uk

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