Styrene

Incident management

Key Points

Fire

- Flammable
- Normally stable. Can react with oxygen, strong oxidisers or acids
- Emits toxic fumes of styrene oxide when heated to decomposition
- In the event of a fire involving styrene, use normal foam and normal fire kit with breathing apparatus

Health

- Toxic by inhalation, ingestion, dermal and ocular exposure.
- Inhalation of styrene causes irritation of mucous membranes, coughing and wheezing
- Styrene inhalation may also lead to "styrene sickness", which includes headache, nausea, vomiting, weakness, fatigue, dizziness and ataxia.
- Exposure via any route may result in systemic toxicity characterised by progressive loss of consciousness leading to coma.
- Dermal exposure can cause irritation, itching, dermatitis and erythematous papular dermatitis.
- Styrene is irritating to the eyes.

Environment

- Avoid release into the environment
- Inform Environment Agency of substantial incidents

CRCE HQ, HPA
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Version 3

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes[a]

UN		**2055**	Styrene monomer, stabilised	
EAC		**3Y**	Use normal foam. 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.	
APP		**-**		
Hazards	**Class**	**3**	Flammable liquid	
	Sub risks	**-**		
HIN		**39**	Flammable liquid, which can spontaneously lead to a violent reaction	

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

*Normal fire fighting clothing i.e. fire kit (BS EN 469), gloves (BS EN 659) and boots (HO specification A29 and A30) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

[a] Dangerous Goods Emergency Action Code List 2011. National Chemical Emergency Centre (NCEC). The Stationary Office, London.

Chemical Hazard Information and Packaging for Supply Classification[a]

	Xn	Harmful	
	Xi	Irritant	
Risk phrases	**R10**	Flammable	
	R20	Harmful by inhalation	
	R36/38	Irritating to eyes, respiratory system and skin	
Safety phrases	**S2**	Keep out of the reach of children	
	S23	Do not breathe gas/fumes/vapour/spray (appropriate wording to be specified by the manufacturer)	

Specific concentration limits

Concentration	Classification
C ≥ 12.5 %	Xn; R20
C ≥ 12.5 %	Xi; R36/38

[a] Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.2.
http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed 11/2011)

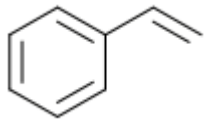
Globally Harmonised System of Classification and Labelling of Chemicals (GHS)[a]

Hazard Class and Category	Flam. Liq. 3	Flammable liquid, category 3	
	Acute Tox. 4	Acute toxicity (inhalation), category 4	
	Eye Irrit. 2	Eye irritation, category 2	
	Skin Irrit. 2	Skin irritant, category 2	
Hazard Statement	**H226**	Flammable liquid and vapour	
	H332	Harmful if inhaled	
	H319	Causes serious eye irritation	
	H315	Causes skin irritation	
Signal Words	WARNING		

Implemented in the EU on 20 January 2009.

[a] Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.1.
http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed 11/2011)

Physicochemical Properties

CAS number	100-42-5
Molecular weight	104
Empirical formula	C_8H_8
Common synonyms	Ethenylbenzene; Styrolene; Phenylethylene; Vinylbenzene
State at room temperature	Liquid
Volatility	Vapour pressure 6.4 mm Hg at 25°C. Styrene vapours are heavier than air at 25°C
Specific gravity	0.9 at 25°C (water = 1)
Flammability	Flammable liquid
Lower explosive limit	0.9%
Upper explosive limit	6.8%
Water solubility	Low solubility in water, 310mg L^{-1} at 20°C. Soluble in ethanol, benzene, acetone and ether
Reactivity	Normally stable when inhibited. Styrene polymerises slowly when uninhibited or at low inhibitor concentrations when at room temperature and on exposure to light and air. Can react with oxygen, strong oxidisers and strong acids
Reaction or degradation products	Emits toxic fumes of styrene oxide when heated to decomposition
Odour	Sweet
Structure	

References[a,b,c]

[a] Styrene (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System, Thomson Micromedex, Greenwood Village, Colorado, USA. (electronic version). RightAnswer.com, Inc., Midland, MI, USA, Available at: http://www.rightanswerknowledge.com/data/dt/dt637.htm (accessed 03/2012).
[b] The Merck Index (14th Edition). Entry 8860: Styrene, 2006.
[c] The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 7, 1999.

Threshold Toxicity Values

EXPOSURE VIA INHALATION			
ppm	**mg m^{-3}**	**SIGNS AND SYMPTOMS**	**REFERENCE**
100	**420**	Irritation of mucous membranes, eyes and upper respiratory tract	a
200	**840**	Irritating to eyes and nose, central nervous system effects, drowsiness, nausea, disturbed balance, tendency of impairment of reaction time	a
350	**1488**	Marked effects on central nervous system and definite impairment of coordination and motor function	a
600 - 800	**2520 - 3360**	Strong immediate irritation of eyes and respiratory tract	a

[a] International Programme on Chemical Safety, Environmental Health Criteria 26: Styrene, 1983.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values[(a)]

	Listed value (ppm)	Calculated value (mg m^{-3})
ERPG-1*	50^	213
ERPG-2**	250	1065
ERPG-3***	1000	4260

^ Odor should be detectable near ERPG-1.
* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
*** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

Interim Acute Exposure Guideline Levels (AEGLs)[(b)]

	ppm				
	10 min	**30 min**	**60 min**	**4 hr**	**8 hr**
AEGL-1†	20	20	20	20	20
AEGL-2††	230	160	130	130	130
AEGL-3†††	1900◊	1900◊	1100◊	340	340

† The level of the chemical in air at or above which the general population could experience notable discomfort.
†† The 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.
††† The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

Lower Explosive Limit (LEL) = 9000 ppm
◊ ≥ 10 % LEL
Level of Distinct Odour Awareness = 0.54 ppm

[a] American Industrial Hygiene Association (AIHA). 2011 Emergency Response Planning Guideline Values. http://www.aiha.org/insideaiha/GuidelineDevelopment/ERPG/Documents/2011erpgweelhandbook_table-only.pdf (accessed 03/2012).
[b] U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, http://www.epa.gov/oppt/aegl/pubs/chemlist.htm (accessed 01/2012).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL[a] http://www.hse.gov.uk/	LTEL (8 hour reference period): 100 ppm (430 mg m^{-3})
	STEL (15 min reference period): 250 ppm (1080 mg m^{-3})

Public health guidelines

DRINKING WATER QUALITY GUIDELINE[b] http://www.who.int/en/	0.02 mg L^{-1}
AIR QUALITY GUIDELINE[c] http://www.who.int/en/	0.26 mg m^{-3} (weekly average) 70 μg m^{-3} as a 30 minute average (based on odour threshold)
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline value specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

[a] EH40/2005 Workplace Exposure Limits (second edition, published 2011). http://www.hse.gov.uk/pubns/priced/eh40.pdf (accessed 01/2012)
[b] Guidelines for Drinking-Water Quality, Fourth Edition. WHO, Geneva. 2011.
[c] Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.

Health Effects

Major route of exposure[(a)]

- Toxic by inhalation, ingestion, dermal and ocular exposure

Immediate Signs or Symptoms of Acute Exposure

- Inhalation may cause irritation of mucous membranes, coughing and wheezing.
- Inhalation by workers has been reported to cause "styrene sickness", the features of which include headache, nausea, vomiting, weakness, fatigue, dizziness and ataxia.
- Inhalation may cause systemic toxicity characterised by progressive loss of consciousness leading to coma. Pulmonary oedema and cardiac arrhythmias may occur.
- Styrene is absorbed via the GI tract; systemic toxicity including CNS depression is possible.
- Dermal contact may cause irritation, itching, dermatitis and erythematous papular dermatitis. As styrene is absorbed via the skin, systemic toxicity including CNS depression is possible.
- Eye exposure causes irritation. Systemic toxicity is possible

TOXBASE - http://www.toxbase.org (accessed 03/2012)
[a] TOXBASE: Styrene, 2012.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Flammability warning: prevent exposure to all sources of ignition such as naked flames, electrical equipment, oxidising chemicals and the smoking of tobacco products.

Dermal exposure[(a)]

- 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 copious amounts of water under low pressure for at least 10-15 minutes. The earlier irrigation begins, the greater the benefit.
- Pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears.
- Observe for at least 4 hours after exposure.
- Manage as per inhalation.
- Other measures as indicated by the patient's clinical condition.

Ocular exposure[(a)]

- Remove contact lenses if present and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes. Continue until the conjunctival sac pH is normal (7.5 - 8.0), retest after 20 minutes and use further irrigation if necessary.
- Any particles lodged in the conjunctival recesses should be removed.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.
- If features of systemic toxicity are present, manage as per inhalation.
- Other measures as indicated by the patient's clinical condition.

Inhalation[(a)]

- Maintain a clear airway and ensure adequate ventilation.
- Ensure a clear airway and adequate ventilation.
- If appropriate, remove from source of exposure and give high flow oxygen to symptomatic patients.
- Perform a 12 lead ECG and measure the QRS duration and QT interval.
- Other measures as indicated by the patient's clinical condition.

TOXBASE - http://www.toxbase.org (accessed 03/2012)
[a] TOXBASE: Styrene, 2012.

Ingestion[(a)]

- Maintain a clear airway and ensure adequate ventilation
- Observe for at least 4 hours after ingestion.
- Manage as per inhalation.
- Other measures as indicated by the patient's clinical condition.

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

TOXBASE - http://www.toxbase.org (accessed 03/2012)
[a] TOXBASE: Styrene, 2012.