



Acetylene

General Information

Key Points

Fire

- Extremely flammable
- Reacts with air, heat and open flames explosively. Reacts violently with oxidants, fluorine and chlorine
- Decomposes on heating causing fire and explosion hazard. Emits hydrogen gas, carbon monoxide and carbon dioxide when heated to decomposition.
- In the event of a fire involving acetylene, use fine water spray and normal fire kit with breathing apparatus

Health

- Toxic by inhalation
- CHIP classification: extremely flammable
- Inhalation may cause excitement, slurred speech, dizziness, nausea and vomiting and headache
- Exposure to high concentrations can lead to difficulty breathing, high blood pressure, fits and abnormal heart rhythms

Environment

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

Background

Acetylene is a colourless, odourless gas. When contaminated with impurities it has a garlic-like odour. It is extremely flammable in the presence of open flames, sparks and heat. Other names for acetylene include ethine and ethyne.

Acetylene is a simple asphyxiant. It reduces the amount of oxygen available in the air.

Inhalation may cause excitement, slurred speech, dizziness, nausea and vomiting and headache. Exposure to high concentrations can lead to difficulty breathing, high blood pressure, fits and heart abnormal rhythms.



Acetylene is used in industry as a raw material in the production of other chemicals such as acetaldehyde and vinyl chloride. It is also used in oxy-acetylene welding and in the production of plastics, synthetic rubbers and modern drugs.



Exposure to acetylene is most likely to occur in an occupational setting where it is produced and used. Acetylene is not used domestically therefore exposure in the home is very unlikely.



Production and Uses

Key Points

- The primary use of acetylene is as a raw material in the chemical industry
- Acetylene is used as a fuel for oxy-acetylene welding
- Small amounts of acetylene are used for lighting purposes in buoys and beacons

Acetylene is primarily produced by either the partial oxidation of natural gas or as a co-product from the steam cracking of ethylene. It is also produced by reacting calcium carbide with water.

The primary use of acetylene is as a raw material in the production of chemicals such as trichloroethylene, vinyl chloride, perchloroethylene, acrylonitrile, acetic acid and acetaldehyde. It is also used as a fuel for oxyacetylene welding, cutting and soldering metals.

Small amounts of acetylene are used for lighting purposes in buoys and beacons and as a fuel in atomic absorption instruments. Acetylene is also used to ripen fruits and to mature trees and flowers. Other uses of acetylene include manufacture of plastics, synthetic rubbers and modern drugs.

In the past acetylene was used as an anaesthetic.

Frequently Asked Questions

What is acetylene?

Acetylene is a colourless, odourless, extremely flammable gas. Its main use is as a raw material in the chemical industry. Acetylene is also used in oxy-acetylene welding.

How does acetylene get into the environment?

Acetylene may be released into the air following its production and use.

How will I be exposed to acetylene?

Exposure is most likely to occur in the workplace where it is made or used.

If there is acetylene in the environment will I have any adverse health effects?

The presence of acetylene in the environment does not always lead to exposure. Clearly, in order for it to cause any adverse health effects you must come into contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact. Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

Inhalation may cause excitement, slurred speech, dizziness, nausea and vomiting and headache. Exposure to high concentrations can lead to difficulty breathing, high blood pressure, fits and heart abnormal rhythms.

Can acetylene cause cancer?

There are no data available to assess the carcinogenicity of acetylene

Does acetylene affect children or damage the unborn child?

There are no data available to assess the reproductive and developmental effects of acetylene. Exposure to acetylene during pregnancy should be avoided because of its general toxic effects.

What should I do if I am exposed to acetylene?

It is very unlikely that the general population will be exposed to a level of acetylene high enough to cause adverse health effects.

This document has been created by the PHE Centre for Radiation, Chemical and Environmental Hazards. The information contained in this document is correct at the time of its publication.



Acetylene

Incident management

Key Points

Fire

- Extremely flammable gas
- Reacts violently with oxidants, fluorine and chlorine.
- Decomposes on heating to include hydrogen gas (flammable) and carbon.
- In the event of a fire involving acetylene, use fine water spray and normal fire kit with breathing apparatus

Health

- Toxic by inhalation
- Inhalation initially causes euphoria, excitement, slurred speech, nausea, vomiting, flushing and headache
- Ataxia, dysarthria and progressive impairment of consciousness may develop
- Respiratory depression, hypoxia, hypotension, convulsions, pulmonary oedema and cardiac dysrhythmias may develop at high concentrations or if exposure is prolonged

Environment

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

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

UN		1001	Acetylene, dissolved	
EAC		2SE	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must however still be exercised to avoid unnecessary pollution to watercourses. There may be a public safety hazard outside the immediate area of the incident**.	
APP		-	-	
Hazards	Class	2.1	Flammable gas	
	Sub risks	-	-	
HIN		239	Flammable gas, which can spontaneously lead to violent reaction	

UN		3374	Acetylene, solvent free	
EAC		2SE	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must however still be exercised to avoid unnecessary pollution to watercourses. There may be a public safety hazard outside the immediate area of the incident**.	
APP		-	-	
Hazards	Class	2.1	Flammable gas	
	Sub risks	-	-	
HIN		-	-	

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

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

*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).

** People should stay indoors with windows and doors closed, ignition sources should be eliminated and ventilation stopped. Non-essential personnel should move at least 250 m away from the incident.

Chemical Hazard Information and Packaging for Supply Classification^(a)

Classification	F+	Extremely Flammable	
Risk phrases	R5	Heating may cause an explosion	
	R6	Explosive with or without contact with air	
	R12	Extremely flammable	
Safety phrases	S2	Keep out of the reach of children	
	S9	Keep container in a well-ventilated place	
	S16	Keep away from sources of ignition - No smoking	
	S33	Take precautionary measures against static discharges	

^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 02/2013)

Globally Harmonised System of Classification and Labelling of Chemicals (GHS)^(a)*

Hazard Class and Category	Flam. Gas. 1	Flammable gas, category 1	
	Press. Gas	Gas under pressure	
Hazard Statement	H220	Extremely flammable gas	
Suppl. Hazard Statement	EUH006	Explosive with or without contact with air.	
Signal Words	DANGER		

* 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 02/2013)

Physicochemical Properties

CAS number	74-86-2
Molecular weight	26.0
Empirical formula	C ₂ H ₂
Common synonyms	Ethenylene, Ethine, Ethyne, C ₂ H ₂ , Vinylene
State at room temperature	Gas
Volatility	Vapour pressure; 5240 mm Hg at 25°C
Specific gravity	0.9 (air = 1)
Flammability	Will form explosive mixtures with air. Extremely flammable. Will ignite or explode in the presence of open flames, sparks, heat and with air and/or oxidizing materials.
Lower explosive limit	2.5 %
Upper explosive limit	100 %
Water solubility	Slightly soluble; 0.106 g/100 ml at 20 °C; Soluble in most organic solvents.
Reactivity	Reactions with oxidants are usually violent or explosive if uncontrolled.
Reaction or degradation products	Decomposes on heating and increased pressure, causing fire and explosion hazard. Its decomposition products include hydrogen gas (flammable) and carbon. Strong reducing agent and reacts violently with oxidants and with fluorine or chlorine under influence of light, causing fire and explosion hazard. Reacts with copper, silver, and mercury or their salts, forming shock-sensitive compounds (acetylides).
Odour	Odourless, although garlic-like or unpleasant odour due to trace impurities
Structure	$\text{H}-\text{C}\equiv\text{C}-\text{H}$

Table references^(a,b,c)

^a Acetylene (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> (accessed 02/2013).

^bThe Merck Index (134th Edition). Entry 92: Acetylene, 2001.

^c International Programme on Chemical Safety (IPCS). Acetylene. International Chemical Safety Card (ICSC): 0089, 1999, WHO: Geneva.

Threshold Toxicity Values

EXPOSURE VIA INHALATION		
%	SIGNS AND SYMPTOMS	REFERENCES
10	Slight intoxication	a
20	Ataxia	a
30	General incoordination	a
33	Unconsciousness in 7 minutes	a
80	Complete anaesthesia, hypertension and increased respiration	a

TOXBASE - <http://www.toxbase.org> (accessed 01/2013)

^a TOXBASE: Acetylene, 2003

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values

	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	Data not available	
ERPG-2**		
ERPG-3***		

* 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.

Acute Exposure Guideline Levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1 [†]	Data not available				
AEGL-2 ^{††}					
AEGL-3 ^{†††}					

[†] 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.

Exposure Standards, Guidelines or Regulations

Occupational Standards

WEL	LTEL(8 hour reference period): No guideline value specified
	STEL(15 min reference period): No guideline value specified

Public Health Guidelines

DRINKING WATER QUALITY GUIDELINE	Data not available
AIR QUALITY GUIDELINE	Data not available
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	Data not available

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

Health Effects

Major Route of Exposure

- Toxic by inhalation

Immediate Signs or Symptoms of Acute Exposure^(a)

- Inhalation results in initial effects such as euphoria, excitement, slurred speech, nausea, vomiting, flushing and headache. Ataxia, dysarthria and progressive impairment of consciousness may develop.
- In severe cases or following prolonged exposure respiratory depression, hypoxia, hypotension, convulsions, pulmonary oedema and cardiac dysrhythmias may develop.

TOXBASE - <http://www.toxbase.org> (accessed 02/2013)

^a TOXBASE: Acetylene, 2003

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.

Dermal Exposure

- Not applicable

Ocular Exposure

- Not applicable

Inhalation^(a)

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give oxygen (maximum concentrations).
- Correct hypotension by raising the feet and/or by expanding the intravascular volume.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ingestion

- Not applicable

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TOXBASE - <http://www.toxbase.org> (accessed 02/2013)

^a TOXBASE: Acetylene, 2003



Acetylene

Toxicological Overview

Key Points

Kinetics and metabolism

- There are no data available on the kinetics and metabolism of acetylene

Health effects of acute exposure

- Acetylene is a simple asphyxiant
- Symptoms of inhalation include dizziness, headache, fatigue, tachycardia, tachypnoea, nausea and vomiting
- Exposure to high concentrations may cause loss of consciousness and death

Health effects of chronic exposure

- There are no data available on the health effects of chronic exposure to acetylene in humans
- There are limited data available on the health effects of chronic exposure to acetylene in animals. Organ damage was not observed in animals repeatedly exposed to acetylene

Toxicological Overview

Summary of Health Effects

In general industrial practice, acetylene is not considered to be a serious toxic hazard. However, it is a serious fire hazard and an explosion hazard. There are many reports of deaths due to acetylene explosions, in the literature.

Acetylene is a simple asphyxiant. Symptoms of exposure include dizziness, headache, fatigue, tachycardia, tachypnoea, nausea and vomiting. Exposure to high concentrations may cause loss of consciousness and death.

There are currently no data available on the health effects of chronic exposure to acetylene.

There are limited data available on the health effects of chronic exposure to acetylene in animals. In a study reported in 1993, organ damage was not observed in animals repeatedly exposed to acetylene.

Kinetics and Metabolism

There are no data available on the kinetics and metabolism of acetylene in humans or animals.

Sources and Route of Human Exposure

Inhalation of acetylene is the major route of exposure. Exposure to acetylene is most likely to occur in the workplace where it is produced and used in wide range of industrial processes including chemical synthesis. Oxy-acetylene welding is also a potential source of exposure to acetylene [1].

Health Effects of Acute / Single Exposure

Human Data

General toxicity

The principal toxic effect of exposure to acetylene is asphyxiation as it displaces oxygen from the air which results in hypoxia. Symptoms of exposure include dizziness, headache, fatigue, tachycardia, tachypnoea, nausea and vomiting. In severe cases exposure may cause convulsions, loss of consciousness and death [2, 3].

In general industrial practice acetylene is not considered to be a serious toxic hazard. The main hazards associated with acetylene are fire and explosion. Deaths due to explosions of acetylene have been reported in the literature [4].

In a number of occupational case studies in which injury or death has been reported following exposure to acetylene, the adverse health effects have been associated with the presence of toxic impurities [1]. Common impurities of technical grade acetylene include ammonia, arsine, hydrogen sulphide and phosphine [1, 4].

Inhalation

Acetylene is not acutely toxic at concentrations below the lower explosive limit of 2.5% (25,000 ppm) [3]. When administered with oxygen at concentrations of 10% (100,000 ppm) and above acetylene produces varying degrees of temporary and reversible narcosis [1, 3]. Inhalation of 33% or 35% (330,000 or 350,000 ppm) acetylene resulted in unconsciousness within 7 and 5 minutes, respectively. Exposure to up to 80% acetylene (800,000 ppm) can cause complete anaesthesia, hypertension and stimulated respiration [1].

Animal and In-Vitro Data

Inhalation

There are currently no recent data available on the health effects of chronic exposure to acetylene in animals.

In a study investigating the toxic effects of exposure to acetylene in air animals tolerated a concentration of 10% (100,000 ppm). Exposure to 25% (250,000 ppm) acetylene for 30-60 minutes was reported to be toxic and exposure to 50% (500,000 ppm) for 5-10 minutes was fatal [1].

Several studies have reported a rise in blood pressure in cats administered acetylene with oxygen at concentrations greater than 20% (200,000 ppm). Studies investigating the effects of acetylene on the respiratory system have produced inconsistent results; both stimulation and depression of the respiratory function have been observed [1].

Health Effects of Chronic / Repeated Exposure

Human Data

Inhalation

There are currently no data available on the health effects of chronic exposure to acetylene in humans.

Genotoxicity

There are currently no data available on the genotoxicity of acetylene in humans.

Carcinogenicity

There are currently no data available on the carcinogenicity of acetylene in humans.

Reproductive and developmental toxicity

There are currently no data available on the reproductive and developmental effects of acetylene in humans.

Animal and In-Vitro Data

Inhalation

There are currently no recent data available on the health effects of chronic exposure to acetylene in animals.

In a study reported in 1933, animals (rats, mice, guinea pigs, rabbits and dogs) were exposed to acetylene at concentrations of 25%, 50% or 80% (250,000, 500,000 or 800,000 ppm) in oxygen for 1-2 hours day⁻¹ for up to 93 hours. There was no evidence of damage to parenchymatous cells of the heart, lungs, liver, kidneys or spleen [1].

Genotoxicity

There are currently no data available on genotoxicity of acetylene in animals.

Carcinogenicity

There are currently no data available on the carcinogenicity of acetylene in animals.

Reproductive and developmental toxicity

There are currently no data available on the reproductive and developmental effects of acetylene in animals.

References

- [1] National Institute for Occupational Safety and Health (1976). Criteria for a Recommended Standard. Occupational Exposure to Acetylene. Washington, DC: U.S. Department of Health, Education and Welfare; Public Health Service; Center for Disease Control.
- [2] HAZARDTEXT® Hazard Management Acetylene.
- [3] Canadian Centre for Occupational Health and Safety (CCOHS) (1997). Acetylene dissolved, Cheminfo.
- [4] Williams, N. R. and Whittington, R. M. (2001). Death due to inhalation of industrial acetylene. *J Toxicol Clin Toxicol* **39**, 69-71.

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 in this document.