UK Health Security Agency

Liquefied petroleum gas

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

LPG primarily consists of propane, butane or a mixture of the two. It is a colourless gas at room temperature and it is extremely flammable.

LPG is odourless when pure; a stenching agent is added to LPG to give it a characteristic odour, enabling leaks to be easily detected. It also reacts with strong oxidisers.

Health

The major route of exposure is via inhalation.

Inhalation of LPG causes euphoria, agitation, slurred speech, nausea, vomiting, flushing and headache. In severe cases, respiratory depression, hypotension, myocardial infarction, cardiac dysrhythmias, seizures, coma and death may occur.

Dermal exposure to LPG may cause frostbite on the skin.

Casualty decontamination at the scene

Decontamination should not be necessary following exposure to LPG as it exists as a gas at room temperature.

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes [note 1]

UN		1093	Petroleum gases, liquefied	
		1978	Propane	
		1011	Butane	
EAC		2YE	Use fine water spray. Wear normal fire kit in combination with breathing apparatus [note 2]. Danger that the 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 3].	
APP		-	-	
Hazards	**Class**	2.1	Flammable gases	
	Sub-risks	-	-	
HIN		23	Flammable gas	

Abbreviations

UN = United Nations number.
EAC = emergency action code.
APP = additional personal protection.
HIN = hazard identification number.

Notes to Table 1

Note 1: Chemicals of different UN number are grouped in this table as they individually carry the same EACs.

Note 2: Normal firefighting clothing is appropriate, that means self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3-Hazmat and structural firefighting [CH – marking for chemical resistance] or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather

boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

Note 3: 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 250 m away from the incident.

References

‘National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. ‘Dangerous Goods Emergency Action Code List’ 2023 (viewed on 07 October 2024)

Table 2a. The GB classification, labelling and packaging (CLP) regulation for Petroleum gases, liquefied, sweetened, petroleum gas [note 1]

CAS number	68476-86-8; 68476-85-7		
Hazard class and category	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
	Muta. 1B	Germ cell mutagenicity, category 1B	
	Carc. 1A	Carcinogenicity, category 1A	
Hazard statement	H220	Extremely flammable gas	
	H340	May cause genetic defects	
	H350	May cause cancer	
Signal words	DANGER		

Notes to Table 2a

Note 1: Chemicals of different CAS numbers are grouped in this table as they carry the same classifications.

This chemical's harmonised classification includes Note K which states "The classification as a carcinogen or mutagen need not apply if it can be shown that the substance contains less than 0.1 % w/w 1, 3-butadiene (EINECS No. 203-450-8). If the substance is not classified as a carcinogen or mutagen, at least the precautionary statements (P102-)P210-P403 should apply. This note applies only to certain complex oil-derived substances in Part 3"

References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 07 October 2024).

Table 2b. The GB classification, labelling and packaging (CLP) regulation for propane and butane [note 1]

CAS number	74-98-6, 106-97-8		
Hazard class and category	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
Hazard statement	H220	Extremely flammable gas	
Signal words	DANGER		

Notes to Table 2b

Note 1: Chemicals of different CAS numbers are grouped in this table as they carry the same classifications.

References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 07 October 2024).

Table 2c. The GB classification, labelling and packaging (CLP) regulation for Butane (containing ≥ 0.1% butadiene (203-450-8))

CAS number	106-97-8		
Hazard class and category	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
	Muta. 1B	Germ cell mutagenicity, category 1B	
	Carc. 1A	Carcinogenicity, category 1A	
Hazard statement	H220	Extremely flammable gas	
	H340	May cause genetic defects	
	H350	May cause cancer	
Signal words	DANGER		

References

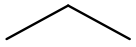
The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 07 October 2024).

Physicochemical properties

Liquid Petroleum Gas (LPG) primarily consists of propane, butane or a mixture of the two.

The physiochemical properties of propane and butane are given below.

Table 3a. Physicochemical properties of propane

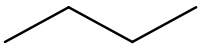
CAS number	74-98-6
Molecular weight	44
Formula	C_3H_8
Common synonyms	n-propane
State at room temperature	Colourless gas
Volatility	Vapour pressure = 7150 mmHg at 25°C
Specific gravity	1.6 (air = 1) heavier than air
Flammability	Extremely flammable. Gas/air mixtures are explosive.
Lower explosive limit	2.1%
Upper explosive limit	9.5%
Water solubility	Slightly soluble
Reactivity	Easily ignited by heat, sparks or flames. Can react vigorously with strong oxidising materials. Forms a potentially explosive reaction with chlorine dioxide. Burns completely, forming carbon dioxide and water when sufficient oxygen is present. Will form carbon monoxide if insufficient oxygen is present.
Odour	Odourless when pure. A stenching agent is added to LPG to give it a characteristic odour, enabling leaks to be detected.
Structure	

References

International Labour Organization (ILO). 'International chemical safety card entry for propane ICSC 0319' 2003. World Health Organization: Geneva. (viewed on 07 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. 'PubChem Compound Summary for CID 6334, Propane (viewed on 07 October 2024)

Table 3b. Physicochemical properties of butane

CAS number	106-97-8
Molecular weight	58
Formula	C_4H_{10}
Common synonyms	n-butane
State at room temperature	Colourless gas
Volatility	Vapour pressure = 1820 mmHg at 25°C
Specific gravity	2.1 (air = 1) heavier than air
Flammability	Extremely flammable. Gas/air mixtures are explosive
Lower explosive limit	1.8%
Upper explosive limit	8.4%
Water solubility	Slightly soluble
Reactivity	Easily ignited by heat, sparks or flames. Will forms explosive mixtures with air. Reacts strong to oxidisers. Emits acrid smoke and fumes when heated to decomposition.
Odour	Odourless when pure. A stenching agent is added to LPG to give it a characteristic odour, enabling leaks to be detected.
Structure	

References

International Labour Organization (ILO). 'International Chemical Safety Card entry for Butane. ICSC 0319, 2003. World Health Organization: Geneva. (viewed on 07 October 2024)

PubChem Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. PubChem Compound Summary for CID 7843, Butane; (viewed on 07 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation

Chemical	ppm	mg/m^3	Exposure duration	Signs and symptoms	Reference
Butane	10,000	23,700	10 minutes	Mild drowsiness	a
Propane	100,000	180,000	2 minutes	Vertigo	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 Research Council. 'Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 12'. 2012 (viewed on 07 October 2024)

Published emergency response guidelines

Table 5a. Acute exposure guideline levels (AEGLs) for butane

	Concentration (ppm)				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	10,000 [note 5]	6,900 [note 4]	5,500 [note 4]	5,500 [note 4]	5,500 [note 4]
AEGL-2 [note 2]	24,000 [note 6]	17,000 [note 5]	17,000 [note 5]	17,000 [note 5]	17,000 [note 5]
AEGL-3 [note 3]	77,000 [note 6]	53,000 [note 6]	53,000 [note 6]	53,000 [note 6]	53,000 [note 6]

Notes to Table 5a

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.

Note 4: >10% of the lower explosive limit of 19,000. Safety considerations against the hazard(s) of explosion(s) must be taken into account.

Note 5: >50% of the lower explosive limit of 19,000. Extreme safety considerations against the hazard(s) of explosion(s) must be taken into account.

Note 6: >100% of the lower explosive limit of 19,000. Extreme safety considerations against the hazard(s) of explosion(s) must be taken into account.

Reference

US Environmental Protection Agency (EPA) ‘Acute Exposure Guideline Levels’ 2024 (viewed on 07 October 2024)

Table 5b. Acute exposure guideline levels (AEGLs) for propane

	Concentration (ppm)				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	10,000 [note 4]	6,900 [note 4]	5,500 [note 4]	5,500 [note 4]	5,500 [note 4]
AEGL-2 [note 2]	17,000 [note 5]	17,000 [note 5]	17,000 [note 5]	17,000 [note 5]	17,000 [note 5]
AEGL-3 [note 3]	33,000 [note 6]	33,000 [note 6]	33000 [note 6]	33,000 [note 6]	33,000 [note 6]

Notes to Table 5b

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.

Note 4: >10% of the lower explosive limit of 23,000. Safety considerations against the hazard(s) of explosion(s) must be taken into account.

Note 5: >50% of the lower explosive limit of 23,000. Extreme safety considerations against the hazard(s) of explosion(s) must be taken into account.

Note 6: >100% of the lower explosive limit of 23,000. Extreme safety considerations against the hazard(s) of explosion(s) must be taken into account.

Reference

US Environmental Protection Agency (EPA) ‘Acute Exposure Guideline Levels’ (viewed on 07 October 2024)

Exposure standards, guidelines or regulations

Table 6a. Occupational standards for LPG

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m³	ppm	mg/m³
WEL	1000	1750	1250	2180

Table 6b. Occupational standards for butane

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m³	ppm	mg/m³
WEL	600	1450	750	1810

Abbreviations

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

Reference

Health and safety Executive. ‘EH40/2005 Workplace Exposure Limits . Fourth Edition’ 2020. (viewed on 07 October 2024)

Table 7. Public health standards and guidelines

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

Health effects

Asphyxiant gases acting mainly by displacing oxygen from the atmosphere; this reduces the oxygen concentration in inspired air leading to hypoxaemia. Low dose accidental exposures are unlikely to cause toxicity.

Table 8. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation/ Ingestion	Features include euphoria, agitation, decreased alertness, slurred speech, decreased visual acuity, memory loss, nausea, vomiting, flushing and headache. Increased respiratory rate and tachycardia are often early compensatory features. Ataxia, paraesthesia and progressive impairment of consciousness may develop. Respiratory depression, hypotension, myocardial infarction, cardiac dysrhythmias, pulmonary oedema, seizures, coma and death may occur if exposure is prolonged or if inhaled concentrations are high. In high concentrations loss of consciousness and hypoxia can develop within minutes.
Dermal/Eyes	Direct skin and eye contact with liquefied gases directly from container may cause cold burns and frostbite

Reference

National Poisons Information Service. TOXBASE Liquefied petroleum gas (LPG) August 2022 (viewed 07 October 2024)

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.

Decontamination should not be necessary following exposure to LPG as it exists as a gas at room temperature. LPG is stored as a liquid under pressure in cylinders; this liquid will rapidly volatilise if released, though it may cause thermal burns on contact with skin.

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, Chemicals and Environment Directorate using the 24- hour chemical hotline number: 0344 892 0555.

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

Decontamination is unlikely to be required for LPG as it exists as a gas at room temperature.

Dermal exposure

Treat cold burns and frostbite conventionally.

Other supportive measures as indicated by the patient's clinical condition.

Inhalation

Maintain a clear airway and ensure adequate ventilation.

In the event of cardiac arrest in hospital or witnessed out of hospital cardiac arrest with bystander CPR, resuscitation should be continued for at least 1 hour and only stopped after discussion with a senior clinician. Prolonged resuscitation for cardiac arrest is recommended following poisoning as recovery with good neurological outcome may occur.

Administer oxygen to achieve adequate oxygenation.

Monitor vital signs an check capillary blood sugar.

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

Other supportive measures as indicated by the patient's clinical condition.

Clinical decontamination and first aid references

National Poisons Information Service. TOXBASE (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Liquefied petroleum gas' 2022. (viewed on 07 October 2024)

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 and Environment Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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