



# Liquefied Petroleum Gas

## Incident Management

### Key Points

#### General

- LPG primarily consists of propane, butane or a mixture of the two
- colourless gas at room temperature
- extremely flammable
- odourless when pure; a stenching agent is added to LPG to give it a characteristic odour, enabling leaks to be easily detected
- reacts with strong oxidisers

#### Health effects


- inhalation is the main route of exposure
- inhalation 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



### Standard (UK) dangerous goods emergency action codes (see note)

<b>UN</b>		<b>1075</b>	<b>Petroleum gases, liquefied</b>		
		<b>1978</b>	<b>Propane</b>		
		<b>1011</b>	<b>Butane</b>		
<b>EAC</b>		2YE	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 should be prevented from entering drains and watercourses. There may be a public safety hazard outside the immediate area of the incident†		
<b>APP</b>		–	–		
<b>Hazards</b>	<b>Class</b>	2.1	Flammable gases		
	<b>Sub-risks</b>	–	–		
<b>HIN</b>		23	Flammable gas		
<p><b>Note</b> Chemicals of different UN number are grouped in this table as they individually carry the same EACs  UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Normal firefighting clothing is appropriate, i.e. breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, firefighters' gloves conforming to BS EN 659 and firefighters' boots conforming to Home Office specification A29 or A30</p> <p>† 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</p> <p><b>Reference</b>  Dangerous Goods Emergency Action Code List. National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2019.</p>					





**Classification, labelling and packaging (CLP)\* (see notes)*****Petroleum gases, liquefied***

<b>Chemical names</b>	<b>Petroleum gases, liquefied, sweetened; petroleum gases, liquefied</b>		
<b>CAS number</b>	<b>68476-86-8; 68476-85-7</b>		
<b>Hazard class and category</b>	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
	Muta. 1B	Germ cell mutagenicity, category 1B	
	Carc. 1A	Carcinogenicity, category 1A	
<b>Hazard statement</b>	H220	Extremely flammable gas	
	H340	May cause genetic defects	
	H350	May cause cancer	
<b>Signal words</b>	Danger		
<p><b>Notes</b> 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 (Table 3.1) or the S-phrases (2-)9-16 (Table 3.2) should apply. This note applies only to certain complex oil-derived substances in Part 3"</p> <p>* Implemented in the EU on 20 January 2009</p> <p><b>Reference</b>  European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 03/2019).</p>			

**Propane and butane**

<b>Chemical names</b>	<b>Propane; butane</b>		
<b>CAS number</b>	<b>74-98-6; 106-97-8</b>		
<b>Hazard class and category</b>	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
<b>Hazard statement</b>	H220	Extremely flammable gas	
<b>Signal words</b>	Danger		
<p><b>Note</b> Chemicals of different CAS number are grouped in this table as they carry the same classifications</p> <p>* Implemented in the EU on 20 January 2009</p> <p><b>Reference</b></p> <p>European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 03/2019).</p>			

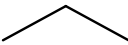
**Butane (containing  $\geq 0,1$  % butadiene (203-450-8))**

<b>Chemical name</b>	<b>Butane (containing <math>\geq 0,1</math> % butadiene (203-450-8))</b>		
<b>CAS number</b>	<b>106-97-8</b>		
<b>Hazard class and category</b>	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gases, category 1	
	Muta. 1B	Germ cell mutagenicity, category 1B	
	Carc. 1A	Carcinogenicity, category 1A	
<b>Hazard statement</b>	H220	Extremely flammable gas	
	H340	May cause genetic defects	
	H350	May cause cancer	
<b>Signal words</b>	Danger		
* Implemented in the EU on 20 January 2009			
<b>Reference</b>			
European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 03/2019).			

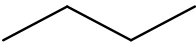
## Physicochemical Properties

Liquid Petroleum Gas (LPG) primarily consists of propane, butane or a mixture of the two. The physicochemical properties of propane and butane are given below.

### Propane

<b>CAS number</b>	74-98-6
<b>Molecular weight</b>	44.1
<b>Formula</b>	C <sub>3</sub> H <sub>8</sub>
<b>Common synonyms</b>	n-propane
<b>State at room temperature</b>	Colourless gas
<b>Volatility</b>	Vapour pressure = 7150 mmHg at 25°C
<b>Specific gravity</b>	1.6 (air = 1) heavier than air
<b>Flammability</b>	Extremely flammable
<b>Lower explosive limit</b>	2.1%
<b>Upper explosive limit</b>	9.5%
<b>Water solubility</b>	Slightly soluble
<b>Reactivity</b>	Easily ignited by heat, sparks or flames. Can react vigorously with strong oxidising materials. Forms a potentially explosive reaction with chlorine dioxide
<b>Reaction or degradation products</b>	Burns completely, forming carbon dioxide and water when sufficient oxygen is present. Will form carbon monoxide if insufficient oxygen is present
<b>Odour</b>	Odourless when pure. A stenching agent is added to LPG to give it a characteristic odour, enabling leaks to be easily detected
<b>Structure</b>	
<b>References</b>	
Hazardous Substances Data Bank. Propane. HSDB No. 1672 (last revision date 04/06/2007). US National Library of Medicine: Bethesda MD. <a href="http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB">http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB</a> (accessed 03/2019).	
International Programme on Chemical Safety. International chemical safety card entry for propane. ISCS 0319, 2003. World Health Organization: Geneva.	

**Butane**

<b>CAS number</b>	106-97-8
<b>Molecular weight</b>	58.12
<b>Formula</b>	C <sub>4</sub> H <sub>10</sub>
<b>Common synonyms</b>	n-butane
<b>State at room temperature</b>	Colourless gas
<b>Volatility</b>	Vapour pressure = 1,820 mmHg at 25°C
<b>Specific gravity</b>	2.1 (air = 1) heavier than air
<b>Flammability</b>	Extremely flammable
<b>Lower explosive limit</b>	1.8%
<b>Upper explosive limit</b>	8.4%
<b>Water solubility</b>	Slightly soluble in water
<b>Reactivity</b>	Easily ignited by heat, sparks or flames. Will form explosive mixtures with air. Reacts strong oxidisers
<b>Reaction or degradation products</b>	Combustion of butane produces carbon dioxide and carbon monoxide. Emits acrid smoke and fumes when heated to decomposition
<b>Odour</b>	Odourless in pure form. A stenching agent is added to LPG to give it a characteristic odour enabling leaks to be easily detected
<b>Structure</b>	
<b>References</b>	
Hazardous Substances Data Bank. Butane. HSDB No. 944. (last revision date 30/06/2014). US National Library of Medicine: Bethesda MD. <a href="http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB">http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB</a> (accessed 03/2019).	
International Programme on Chemical Safety. International chemical safety card entry for butane. ISCS 0232, 2003. World Health Organization: Geneva.	

## Reported Effect Levels from Authoritative Sources

### Exposure by inhalation

Chemical	ppm	mg/m <sup>3</sup>	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.



## Published Emergency Response Guidelines

### Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m <sup>3</sup> )
<b>ERPG-1*</b>	Data not available	
<b>ERPG-2†</b>		
<b>ERPG-3‡</b>		
<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)

Butane	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
<b>AEGL-1*</b>	— <sup>(2)</sup>	6,900 <sup>(1)</sup>	5,500 <sup>(1)</sup>	5,500 <sup>(1)</sup>	5,500 <sup>(1)</sup>
<b>AEGL-2†</b>	— <sup>(3)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>
<b>AEGL-3‡</b>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>
<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> <p>Lower explosive limit (LEL) = 19,000 ppm</p> <p>(<sup>1</sup>) = &gt;10% LEL, (<sup>2</sup>) = &gt;50% LEL, (<sup>3</sup>) = &gt; 100% LEL</p> <p>AEGL-1: 10 min = <sup>(2)</sup> 10,000 ppm</p> <p>AEGL-2: 10 min = <sup>(3)</sup> 24,000 ppm; 30 min, 60 min, 4 h and 8 h = <sup>(2)</sup> 17,000 ppm</p> <p>AEGL-3: 10 min = <sup>(3)</sup> 77,000 ppm; 30 min, 60 min, 4 h and 8 h = <sup>(3)</sup> 53,000 ppm</p> <p>For values denoted as <sup>(1)</sup> safety considerations against the hazard(s) of explosion(s) must be taken into account</p> <p>For values denoted as <sup>(2)</sup> and <sup>(3)</sup> extreme safety considerations against the hazard(s) of explosion(s) must be taken into account</p> <p><b>Reference</b></p> <p>US Environmental Protection Agency. Acute Exposure Guideline Levels. <a href="http://www.epa.gov/oppt/aegl/pubs/chemlist.htm">http://www.epa.gov/oppt/aegl/pubs/chemlist.htm</a> (accessed 03/2019).</p>					

Propane	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
<b>AEGL-1*</b>	10,000 <sup>(1)</sup>	6,900 <sup>(1)</sup>	5,500 <sup>(1)</sup>	5,500 <sup>(1)</sup>	5,500 <sup>(1)</sup>
<b>AEGL-2†</b>	— <sup>(2)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>	— <sup>(2)</sup>
<b>AEGL-3‡</b>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>	— <sup>(3)</sup>

\* Level of the chemical in air at or above which the general population could experience notable discomfort  
† 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  
‡ 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) = 23,000 ppm  
<sup>(1)</sup> = >10% LEL, <sup>(2)</sup> = >50% LEL, <sup>(3)</sup> = >100% LEL  
AEGL-2: 10 min, 30 min, 60 min, 4 h and 8 h = <sup>(2)</sup> 17,000 ppm  
AEGL-3: 10 min, 30 min, 60 min, 4 h and 8 h = <sup>(3)</sup> 33,000 ppm  
For values denoted as <sup>(1)</sup> safety considerations against the hazard(s) of explosion(s) must be taken into account  
For values denoted as <sup>(2)</sup> and <sup>(3)</sup> extreme safety considerations against the hazard(s) of explosion(s) must be taken into account

**Reference**  
US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 03/2019).

## Exposure Standards, Guidelines or Regulations

### Occupational standards

LPG	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
<b>WEL</b>	1,000	1,750	1,250	2,180

Butane	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
<b>WEL</b>	600	1,450	750	1,810

WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit

**Reference**

Health and Safety Executive (HSE). EH40/2005 Workplace Exposure Limits, 3<sup>rd</sup> Edition, 2018.

### Public health guidelines

<b>Drinking water standard</b>	No guideline values specified
<b>Air quality guideline</b>	No guideline values specified

## Health Effects

### Major route of exposure

- inhalation is the major route of exposure

### Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
<b>Inhalation</b>	<p>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</p> <p>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</p> <p>In high concentrations loss of consciousness and hypoxia can develop within minutes</p>
<b>Dermal/Ocular</b>	Direct skin and eye contact with liquefied gases directly from container may cause cold burns and frostbite
<p><b>References</b></p> <p>TOXBASE. Liquefied petroleum gas (LPG), 12/2018. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 03/2019).</p>	

## 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.

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.

## Clinical Decontamination and First Aid

Detailed information on clinical management can be found on TOXBASE – [www.toxbase.org](http://www.toxbase.org).

### 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 and 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

### Health effects and decontamination references

TOXBASE <http://www.toxbase.org> (accessed 03/2019)

TOXBASE Liquefied petroleum gas, 12/2018

TOXBASE Asphyxiant gas, 11/2018

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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