# LPG (liquEfied petroleum gas)

| CAS number: | 68476-85-7 |
| --- | --- |
| Synonyms: | Petroleum gas, bottled gas |
| Chemical formula: | — |
| Structural formula: | — |

Workplace exposure standard (interim)

| TWA: | **1,000 ppm (1,800 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Carc. 1B** |
| IDLH: | **2,000 ppm** |
| **Sampling and analysis:** The recommended value is quantifiable through available sampling and analysis techniques. | |

## Recommendation and basis for workplace exposure standard

A TWA of 1,000 ppm (1,800 mg/m3) is recommended to protect for potential kidney damage and asphyxiation in exposed workers.

A priority review of the additional data sources is recommended in the next scheduled review.

## Discussion and conclusions

Liquefied petroleum gas (LPG) is a by-product of petroleum refinement and is used as a fuel. It consists primarily of propane and butane mixtures with smaller components of C1–C7 hydrocarbons.

Critical effects of exposure to the major components are potential kidney damage and asphyxiation at high concentrations due to oxygen displacement. Narcotic effects are reported in humans as a result of accidental or intentional overexposures for which quantitative exposure data are limited. Animal studies with mixtures of butane and pentane isomers indicate kidney damage may occur above sub-chronic NOAEL between 4,489 and 5,770 ppm in rats. These studies do not conclusively demonstrate exposure dependence of these effects. Narcotic effects appeared transiently at the highest tested doses and incidences were not statistically significant compared to controls (HCOTN, 2004).

Depending on the composition of the LPG product, hazardous unsaturated hydrocarbon contaminants such as 1,3-butadiene, isoprene and benzene, which represent a potential carcinogenic risk may be present in small quantities (ECHA, 2019; NICNAS, 2016). Presently, the carcinogenicity notation of the substance is inconsistent with the entry found in the HCIS database, which assigns a carcinogenicity – category 1A notation based on the properties of these potential carcinogenic impurities (NICNAS, 2016).

Due to the uncertainty regarding the presence of carcinogenic impurities in the composition of LPG fuel streams, the current TWA of 1,000 ppm (1,800 mg/m3) is recommended to be retained in the interim as it is considered sufficiently low compared to the NOAELs between 4,489 and 5,770 ppm for kidney damage in rats exposed to butane and pentane.

However, a detailed examination of chronic substance-specific exposure studies and the impact of potential carcinogenic contaminants in LPG fuel streams should be prioritised in subsequent reviews to assess the suitability of the interim WES. A review of the carcinogenicity classification by NICNAS is also recommended.

## Recommendation for notations

Classified as a category 1B carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). A review of carcinogenicity classification is recommended due to inconsistencies in carcinogenicity notations.

Not classified as a skin sensitiser or respiratory sensitiser according to the GHS.

A skin notation is not warranted based on the available evidence.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 1,000 ppm (1,800 mg/m3) | |
|  |
| ACGIH 2018 Not assigned |
| Agency withdrew its 2002 evaluation, which set a TLV-TWA of 1,000 ppm (1,800 mg/m3) (no further information available). |
| DFG NA NA |
| No report. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2004 TWA: 1,000 ppm (1,800 mg/m3) |
| Summary of data:  LPG contains C1–C7 hydrocarbons, primarily C3–C4 compounds including propane and butane isomers. Assessment presents toxicological data for LPG mixtures, propane and butane. Current administrative OELs for LPG and butane are 1,000 and 600 ppm, respectively (propane not established). Toxicological databases for LPG, propane and butane too weak to recommend a health-based OEL. However, based on studies with mixed exposures of butane and pentane, the current OEL of 600 ppm as an 8 h TWA for butane should be retained. Based on the overall dataset, the agency did not find evidence to support amendment of the current administrative OEL for LPG of 1,000 ppm.  Skin notation not assigned due to high volatility and low potential for dermal penetration of butane or propane. No substance-specific studies are available.  Human data:   * Odour threshold: 5,000–20,000 ppm * Acute hepatitis and reversible abnormal liver function reported in cases of accidental overexposure to LPG as propane and butane mixtures (no further details on exposure) * Very high concentrations (not specified) cause CNS depression and asphyxia; drowsiness reported in volunteers at 10,000 ppm butane (10 min) * 2 cases of maternal overexposure (concentration not specified, but maternally toxic) caused encephalomalacia and hypoplastic kidneys in offspring due to intrauterine anoxia rather than substance-specific toxicity (pregnancy week 27 and 30) * No adverse effects at 0.4–17.8 mg/m3 in exposed workers (males, n=53, 11 yr average).   Animal data:   * Constituent hydrocarbons are metabolically oxidised to corresponding alcohols and carbonyls * No animal exposure data for LPG mixtures; studies of propane and butane are presented * Irregular breathing at 24,000 ppm, tremors at 47,000 ppm in acute inhalation study with propane (guinea pigs, 5–120 min); narcosis at 92,000 ppm, similar observations for butane * No pathological changes at ataxia-inducing levels, 28,000 ppm propane (rats, 10 min) * Epinephrine-induced cardiac arrhythmia above 100,000 ppm with either propane or butane (mice, dogs, 6–10 min); decreased cardiac output at 5,000 ppm (anaesthetised dogs) * Propane and butane both non-mutagenic *in vitro*, butane was negative in a recessive lethal assay in *Drosophila melanogaster*, no *in vivo* studies presented for propane * NOAEL ≈4,489 ppm for histopathological changes in kidneys and clinical abnormalities in mixed exposure study of butane and pentane isomers (rats, duration not specified, 13 wk):   + NOAEL ≈5,770 ppm in similar study with different butane/pentane composition   + both concentrations were the highest tested doses; some transient, statistically non-significant histopathological changes to kidneys were observed in females. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2016 | * Assessment grouped with LPG and “sweetened” LPG (added odourant) * Composition depends on source and manufacturing process; major constituents are usually C3–C4 alkanes: propane and butane and mono-alkenes: 1-butene, 2-butene, propene, 2-methylpropene, which are not expected to pose health risks * Some LPG mixtures may contain 1,3-butadiene (0.1%), benzene (1%) or isoprene (≈0.1%), which pose health risks:   + carcinogenicity notation is derived from these potential components (benzene and 1,3-butadiene are category 1 carcinogens and isoprene is a category 2 carcinogen according to the GHS * All (potential) constituents have low acute toxicity; benzene causes dizziness at 25 ppm in humans (no further details) * Low potential for respiratory irritation from 1,3-butadiene and isoprene due to very low concentrations * Grouped chemicals not considered skin sensitisers * NOAEL of 10,000 ppm (highest tested dose) for clinical, reproductive, central nervous system and histopathological effects (rats, duration/frequency not specified, 13 wk); benzene and 1,3-butadiene concentrations were <10 ppm * LPG (benzene and 1,3-butadiene <10 ppm) was not mutagenic *in vivo* in a mouse micronucleus assay (13 wk) * No LPG-specific carcinogenicity studies available, carcinogenicity notation based on potential for containing carcinogenic compounds. |
| ECHA |  | 2019 | * Due to potential presence of hazardous carcinogenic contaminants in some LPG streams, derived minimum-effect-level (DN(M)EL) is based on the long-term inhalation DN(M)ELs of 1,3-butadiene, benzene, carbon monoxide and hydrogen sulphide and long-term dermal DN(M)EL of benzene * The inhalational DN(M)EL of 1,3-butadiene (1.1 ppm) is based on a non-threshold derivation to minimise excess incidences of leukaemia and is therefore considered a limiting factor; the dermal DN(M)EL of benzene is applied for dermal exposures * Long-term inhalational DN(M)EL for LPG therefore recommended at 1.1 ppm, limited by the DN(M)EL of 1,3‑butadiene. |
| US NIOSH |  | 1994 | * IDLH based on 10% of the LELs of 1.9% for butane and 2.1% for propane. |

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | Insufficient data |
| --- | --- |
| Is the chemical carcinogenic with a mutagenic mechanism of action? | Insufficient data |
| **Insufficient data are available to determine if the chemical is a non-threshold based genotoxic carcinogen.** |  |

## Notations

| Source | Notations |
| --- | --- |
| SWA | Carc. Cat. 1B |
| HCIS | Carcinogenicity – category 1A |
| NICNAS | Carc. Cat. 1 |
| EU Annex | Carcinogenicity – category 1A |
| ECHA | Carcinogenicity – category 1A |
| ACGIH | NA |
| DFG | NA |
| SCOEL | NA |
| HCOTN | — |
| IARC | NA |
| US NIOSH | NA |

NA = not applicable (a recommendation has not been made by this Agency); — = the Agency has assessed available data for this chemical but has not recommended any notations

### Skin notation assessment

| Calculation |
| --- |
| Insufficient data to assign a skin notation |

### IDLH

| Is there a suitable IDLH value available? | Yes, based on LEL |
| --- | --- |

## Additional information

| Molecular weight: | 42.58 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = Number mg/m3; 1 mg/m3 = Number ppm |
| This chemical is used as a pesticide: |  |
| This chemical is a biological product: |  |
| This chemical is a by-product of a process: |  |
| A biological exposure index has been recommended by these agencies: | ACGIH  DFG  SCOEL |

## Workplace exposure standard history

| Year | Standard |
| --- | --- |
| Click here to enter year |  |

## References

European Chemicals Agency Regulation (ECHA) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Health Council of the Netherlands (HCOTN) (2004) Liquefied petroleum gas (LPG). Health-based Reassessment of Administrative Occupational Exposure Limits. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/134.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2016) Liquefied petroleum gases: Human health tier II assessment – IMAP report.

Tenth Adaptation to Technical Progress Commission Regulation (EU) No 2017/776 amending, for the purposes of its adaptation to technical and scientific progress, Regulation (EC) No 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures (the CLP Regulation).

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – L.P.G.