# n-Butyl alcohol

| CAS number: | 71-36-3 |
| --- | --- |
| Synonyms: | Butan-1-ol, 1-Butanol, butyl alcohol, n-butanol,  butyl hydroxide butyric alcohol, methylolpropane |
| Chemical formula: | C4H10O |

Workplace exposure standard (amended)

| TWA: | **20 ppm (61 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **—** |
| IDLH: | **1,400 ppm (4,240 mg/m3), 10% LEL** |
| Sampling and analysis: | The recommended value is readily quantifiable through currently available sampling and analysis techniques. |

## Recommendation and basis for workplace exposure standard

A TWA of 20 ppm (61 mg/m3) is recommended to protect for eye and upper respiratory tract irritation in exposed workers.

A STEL or peak limitation is not recommended as the TWA is considered protective of acute irritation effects at concentrations at or above 200 ppm (601 mg/m3).

## Discussion and conclusions

n-Butyl alcohol is used as a solvent in the food industry, cosmetics, gums, dyes, paints and in hydraulic fluids.

Critical effects of exposure are irritation of the eyes and upper respiratory tract. No complaints of irritation were reported for exposures below 100 ppm in an observational human study. Eye and upper airway irritation were reported for exposures above 200 ppm in human experimental studies (ACGIH, 2018). A chamber study with naïve volunteers reported the lowest tolerable concentration for an eight-hour shift was 25 ppm.

The recommended TWA of 20 ppm is expected to protect for potential irritation effects in unacclimated individuals. The recommended TWA is also considered protective for irritant effects observed above 100 ppm in acclimated workers (ACGIH, 2018).

## Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

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

A skin notation is not recommended as there were no systemic effects in animals and insignificant absorption was reported in dermal absorption studies.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1995 Peak limitation: 50 ppm (152 mg/m3) | |
|  |
| ACGIH 2002 TLV-TWA: 20 ppm (61 mg/m3) |
| TLV-TWA expected to be protective of eye irritation reported by naïve volunteers at 25 ppm, which is lower than the eye irritation complaint threshold of acclimated workers (100 ppm).  Unacclimated workers may experience discomfort from odour, which diminishes over time.  Skin notation not warranted due to low skin uptake.  Insufficient data to derive a TLV-STEL or notations for carcinogenicity or sensitisation.  Summary of data:  Human data:   * Comprehensive 10-yr workplace study (n=16–99) reported: * no effects at 100 ppm in breathing zone * complaints of irritation during short exposures >100 ppm (duration and concentration no specified) * lachrymation, blurred vision, photophobia, corneal oedema reported at 200 ppm * Plant study (n=35) with mixed exposure of n-butanol (major) and diacetone alcohol (minor) reported: * lachrymation, eye irritation and reversible eye inflammation in 28/35 workers in areas with the highest concentrations <100 ppm (lower limit not specified; concentrations ranged from 15–100 ppm in the whole plant) * effects reversible within 10 d * No irritant effects in volunteers (n=6) inhaling through mouthpiece at 100 or 197 ppm * 47–48% (at rest) and 37–41% (exercise) absorbed by inhalation * Throat and eye irritation reported in volunteer chamber study at 50 ppm * mild throat and upper respiratory tract irritation at 25 ppm (n=10, 3–5 min) * Study of naïve and acclimated volunteers (n=32/group) reported: * median odour and irritation thresholds of 0.17 and 2,042 ppm respectively * lowest nasal irritation threshold was 289 ppm * naïve subjects reported significantly more subjective irritation below thresholds than acclimated subjects * Recent study reported: * conjunctival hyperaemia in exposed volunteers at 990 ppm (n=8, 1 h) * no effects at 99–314 ppm * none of the tested concentrations produced irritation * Acclimatisation based on subjective irritation responses given in volunteer chamber study at low concentrations (0.8 and 1.5 ppm) compared with high concentrations (3.3 ppm) >90 min, irritation responses possibly confounded by odour perception.   Animal data:   * Oral LD50: 2,510 mg/kg (rat, 24 h), 3,500 mg/kg (rabbit, 24 h); narcosis at 815 mg/kg (rabbit) * LD50: 5,300 mg/kg (rabbits, dermal); dermal penetration rate 8.8 µg/min/cm2 (beagles) * Dose-related decrease in activity and narcotic effects reported in mice at 6,600 ppm (2 h) or 470–965 ppm (4 h) * respiratory depression 50% (RD50): 1,268 ppm (mice), cited study supports the use of an RD50 to establish a TLV within the range of 0.01–0.1 x RD50­ * Non-mutagenic *in vitro* or *in vivo*. |
| DFG 1958 MAK: 100 ppm (300 mg/m3) |
| Summary of additional data:  MAK considered protective of critical effect of eye irritation.  Continuous exposure at the MAK results in 25 mg/kg for 70 kg adult during an 8 h shift, which is 10 times lower than the NOAEL of 250 mg/kg reported for central nervous depression in rats.  Appreciable skin absorption is unlikely at exposures ≤100 ppm; no skin notation is warranted.  BAT: 10 mg/g creatinine (urine: end of shift), 2 mg/g creatinine (beginning of next shift).  Human data:   * Volunteer chamber study (also cited in ACGIH, 2002) considered contradictory to 10 yr observational workplace study * Case study of 6 factories reported: * no symptoms from critical effects at 5–14 ppm in one factory * exposures ranged between 20–115 ppm in other factories, that represented mixed exposures to 2-butanone, ethanol, naphtha or diacetone alcohol * exposures >50 ppm cause eye irritation * systemic intoxication does not occur <100 ppm * uncertainty in data acquisition and interpretation for this study as severe limitation * Maximum levels in blood were 1.3 mg/L after exercise and exposure to 200 ppm through mouthpiece * levels decreased below detection limit by 30 min after exposure * *In vitro* skin penetration rate: 0.048 mg/cm2/h (epidermis) and 0.82 mg/cm2/h (dermis).   Animal data:   * Mainly eliminated by lungs; 80% of inhaled substance exhaled as CO2 within 24 h (rats) * Oral LD50: 2,700 mg/kg (mice); 3,400–5,300 mg/kg (rabbits) * EC50: 7,559 ppm for pain response (rats, 4 h); 617 ppm for behavioural changes in swimming test (mice, 4 h) * Mouse RD50: 1,268 ppm (5 min), 4,784 ppm (10 min), 11,696 ppm (30 min) * Strongly irritating to rabbit eyes as undiluted substance * Contradictory inhalational studies with rats and guinea pigs at 50–100 ppm; inconsistencies with oral exposure data * *In vivo* skin penetration rate: 0.53 mg/cm2/h (dogs) * Contradictory mutagenicity result in one bacterial study dismissed due to likely confounding reactivity of test medium at high substance concentrations (0.1 M) * *In vivo* study reporting increase in polyploid bone marrow cells dismissed due to insufficient evidence of dose-dependence (rats, n=8). |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| HSE |  | 2002 | * STEL: 50 ppm (154 mg/m3); Sk. |
| ECHA |  | 2018 | * Contradictory reports for limit for respiratory tract irritation in humans, cited range: 25–4,163 ppm * An overview of studies (1996) concluded that 50 ppm poses some risk of mild eye irritation in unacclimated persons * Follow-up study (2008) determined limit values for spacecraft and concluded that no central nervous effects expected under 80 ppm * Oral absorption rate: 100%; dermal absorption rate: 50%; inhalation absorption rate: 60%. |
| OECD |  | 2001 | * Different strains of rats may account for high variability in LD50 values * Predictions from the respiratory rate in mice: 13 ppm would have minimal or no effect on humans, 127 ppm would be uncomfortable, and 1,268 ppm would be intolerable. |
| US NIOSH |  | 1994 | * IDLH is based on 10% of the lower explosive limit. |

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | No |
| --- | --- |
| **The chemical is not a non-threshold based genotoxic carcinogen.** |  |

## Notations

| Source | Notations |
| --- | --- |
| SWA | Sk |
| HCIS | — |
| NICNAS | — |
| EU Annex | — |
| ECHA | — |
| ACGIH | — |
| DFG | — |
| SCOEL | NA |
| HCOTN | NA |
| 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 |
| --- |
| |  |  |  |  | | --- | --- | --- | --- | | Adverse effects in human case study: | no |  |  | | Dermal LD50 ≤1000 mg/kg: | no |  |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  |  | **a skin notation is not warranted** | |

### IDLH

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

## Additional information

| Molecular weight: | 74.1 |
| --- | --- |
| 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

American Conference of Industrial Hygienists (ACGIH®) (2018) TLVs® and BEIs® with 7th Edition Documentation, CD-ROM, Single User Version. Copyright 2018. Reprinted with permission. See the [*TLVs® and BEIs® Guidelines section*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2000) n-Butyl alcohol – MAK value documentation.

European Chemicals Agency (ECHA) (2018) Butan-1-ol – REACH assessment.

Tenth Adaptation to Technical Progress Commission Regulation (EU Annex) 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).

Organisation for Economic Cooperation and Development (OECD) (2001) SIDS initial assessment profile – n-butyl alcohol.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – n-Butyl alcohol.