



## 2-BUTOXYETHANOL

**CAS number:** 111-76-2

**Synonyms:** n-Butoxyethanol, butyl oxitol, glycol ether EB, butyl cellosolve, EGBE, ethanol, 2-butoxy, ethylene glycol monobutyl ether

**Chemical formula:**  $C_6H_{14}O_2$

### Workplace exposure standard (amended)

**TWA:** 10 ppm (49 mg/m<sup>3</sup>)

**STEL:** 40 ppm (196 mg/m<sup>3</sup>)

**Peak limitation:** —

**Notations:** Sk.

**IDLH:** 700 ppm

#### Sampling and analysis:

There is uncertainty regarding quantification of the recommended value with available sampling and/or analysis techniques.

### Recommendation and basis for workplace exposure standard

A TWA of 10 ppm (49 mg/m<sup>3</sup>) and a STEL of 40 ppm (196 mg/m<sup>3</sup>) are recommended to protect for irritation of the eyes and nose in exposed workers. The STEL is also considered to protect for reported neurological effects (nausea and headaches) at concentrations that cause irritation.

### Discussion and conclusions

2-Butoxyethanol is used in various hard-surface cleaning products, cosmetic products and hair dyes and colours. It is also used as a solvent in water and organic solvent-based coatings.

Rodents are considered the sensitive species with red blood cell haemolysis and related systemic toxicity reported as the critical effects. Studies indicate that human red blood cells are less susceptible to haemolytic effects than in sensitive animal species. However, irritant effects are considered more relevant in humans (ACGIH, 2018; DFG 2010, SCOEL, 1996). No clinical signs of adverse effects or complaints were reported after seven men were exposed to 20 ppm for two hours during light exercise. Eight hour exposure of 100 or 200 ppm in human volunteers caused immediate and continued eye and nose irritation (ACGIH, 2018).

The selected TWA is based on a two year rat inhalation study in which a LOAEC of 31.2 mg/m<sup>3</sup> (6.5 ppm) was reported for increased incidences of irritation of the nose (DFG, 2010). The effect was concentration dependent and statistically significant at 13 ppm and above. Because rats breathe only through the nose, the irritant effects were considered as an increase in incidence with no increase in the severity; consequently irritant effects of same sensitivity are unlikely to happen in humans (DFG, 2010). Therefore, a TWA of 10 ppm is considered protective for irritant effects in exposed workers. A STEL of 40 ppm is recommended as the irritation reported at 100 ppm is immediate and accompanied by neurological effects including nausea and headache based on the weight of evidence.

## Recommendation for notations

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

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

A skin notation is recommended based on animal data and the potential contribution to systemic effects in exposed workers.

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# APPENDIX

## Primary sources with reports

Source	Year set	Standard
<b>SWA</b>	<b>1991</b>	<b>TWA: 20 ppm (96.9 mg/m<sup>3</sup>); STEL: 50 ppm (242 mg/m<sup>3</sup>)</b>
<b>ACGIH</b>	<b>2003</b>	<b>TLV-TWA: 20 ppm (97 mg/m<sup>3</sup>)</b>
<p>TLV-TWA recommended to minimise the potential for irritant effects in exposed workers.</p> <p>Summary of data:</p> <p>Rodents considered sensitive species with RBC haemolysis and related systemic toxicity considered critical effects. Human RBC are less susceptible as demonstrated in <i>in vivo</i> and <i>in vitro</i> studies validated by PB-PK modelling of data. Irritation effects considered more relevant in humans.</p> <p>Human data:</p> <ul style="list-style-type: none"> <li>• 2-butoxyacetic acid identified as a significant urinary metabolite (produces effects in RBC of rats and other sensitive species)</li> <li>• Studies indicated human RBC much less susceptible to 2-butoxyacetic acid-induced haemolysis than RBC from sensitive animal species (rats, mice, hamsters, rabbits and baboons)</li> <li>• Volunteers exposed for 8 h at 100 or 200 ppm reported immediate and continued eye and nose irritation: <ul style="list-style-type: none"> <li>○ no evidence of systemic toxicity even though urinary excretion of metabolic noted</li> <li>○ nausea and headache reported during 7–24 h following exposure</li> </ul> </li> <li>• No clinical signs of adverse effects or complaints in 7 males exposed to 20 ppm for 2 h during light exercise</li> <li>• Based on PB-PK model estimates dermal absorption amounts not sufficient to cause RBC haemolysis in humans</li> <li>• Negative results in back patch skin sensitisation test on 201 volunteers.</li> </ul> <p>Animal data:</p> <ul style="list-style-type: none"> <li>• LD<sub>50</sub>: 400 mg/kg (rabbits, dermal)</li> <li>• LC<sub>50</sub>: 700 ppm in mice; 486 ppm in rats</li> <li>• NOEL 25 ppm for RBC effects and increased liver weight (inhalation study in rats 6 h/d, 5 d/wk for 90 d)</li> <li>• Limited evidence of carcinogenicity in rats and mice</li> <li>• Limited evidence of reproductive or developmental toxicity at below maternal toxicity levels.</li> </ul> <p>Lack of overall <i>in vitro</i> and <i>in vivo</i> genotoxic activity.</p> <p>Insufficient data to recommend a TLV-STEL.</p>		
<b>DFG</b>	<b>2010/2019</b>	<b>MAK: 10 ppm (49 mg/m<sup>3</sup>)</b>
<p>MAK recommended to protect for irritant effects in exposed workers.</p> <p>Summary of additional data:</p> <ul style="list-style-type: none"> <li>• LOAEC of 31.2 mg/m<sup>3</sup> (6.5 ppm) in rats for increased irritation of the nose in histological testing (2 yr inhalation study): <ul style="list-style-type: none"> <li>○ concentration dependent increase in hyaline degeneration of olfactory epithelium significant at ≥62.5 mL/m<sup>3</sup> (13 ppm)</li> <li>○ rat breathes only through nose therefore considered increase in incidence not severity</li> <li>○ assume humans do not react with same sensitivity so the MAK value of 10 mL/m<sup>3</sup> (10 ppm) is obtained by lowering LOAEC of 31.2 mg/m<sup>3</sup></li> </ul> </li> <li>• No clinical findings of skin sensitisation or respiratory sensitisation.</li> </ul>		

Source	Year set	Standard
<b>SCOEL</b>	<b>1996</b>	<b>TWA: 20 ppm (98 mg/m<sup>3</sup>); STEL: 50 ppm (246 mg/m<sup>3</sup>)</b>
TWA recommended to protect for haematological effects in exposed workers. STEL recommended to protect for irritation effects in exposed workers. Summary of additional data: <ul style="list-style-type: none"> <li>TWA is based on NOAEL of 25 ppm for haematological effects in rats <ul style="list-style-type: none"> <li>human resistance to RBC effects negates the need for uncertainty factor</li> <li>rounded down as per SCOEL methodology</li> </ul> </li> <li>STEL based on 4 or 8 h volunteer study for irritation; 100 ppm and 200 ppm irritation effects (same as ACGIH).</li> </ul>		
<b>OARS/AIHA</b>	<b>NA</b>	<b>NA</b>
No report.		
<b>HCOTN</b>	<b>NA</b>	<b>NA</b>
No report.		

## Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ 1996	No further information.
IARC	✓ 2006	No further information.

## 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	NA
HCIS	NA
NICNAS	—
EU Annex	NA
ECHA	NA
ACGIH	Carcinogenicity – A3
DFG	H (skin)
SCOEL	Skin
HCOTN	NA
IARC	Carcinogenicity – Group 3

Source	Notations
US NIOSH	SK: SYS
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
<p>Adverse effects in human case study:</p> <p>Dermal LD<sub>50</sub> ≤ 1000 mg/kg: <b>yes</b></p> <p>Dermal repeat-dose NOAEL ≤ 200 mg/kg:</p> <p>Dermal LD<sub>50</sub>/Inhalation LD<sub>50</sub> &lt; 10:</p> <p><i>In vivo</i> dermal absorption rate &gt; 10%:</p> <p>Estimated dermal exposure at WES &gt; 10%:</p> <p style="text-align: right;"><b>consider assigning a skin notation</b></p>

## IDLH

Is there a suitable IDLH value available? Yes

## Additional information

Molecular weight:	118.17
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 4.83 mg/m <sup>3</sup> ; 1 mg/m <sup>3</sup> = 0.27 ppm
This chemical is used as a pesticide:	<input type="checkbox"/>
This chemical is a biological product:	<input type="checkbox"/>
This chemical is a by-product of a process:	<input type="checkbox"/>
A biological exposure index has been recommended by these agencies:	<input checked="" type="checkbox"/> ACGIH <input type="checkbox"/> DFG <input type="checkbox"/> SCOEL

## Workplace exposure standard history

Year	Standard
Click here to enter year	

## References

American Conference of Industrial Hygienists (ACGIH®) (2018) TLVs® and BEIs® with 7<sup>th</sup> Edition Documentation, CD-ROM, Single User Version. Copyright 2018. Reprinted with permission. See the [TLVs® and BEIs® Guidelines section](#) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2010) 2-Butoxyethanol (ethylene glycol monobutyl ether) – MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (2019) 2-Butoxyethanol (ethylene glycol monobutyl ether) – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1996) Recommendation from the Scientific Expert Group on Occupational Exposure Limits for 2-Butoxyethanol. SEG/SUM/70.

International Agency for Research on Cancer (IARC) (2006) Volume 88 Formaldehyde, 2-Butoxyethanol and 1-tert-Butoxypropan-2-ol. IARC Monographs on the evaluation of the carcinogenic risk to humans.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – 2-Butoxyethanol.

US National Institute for Occupational Safety and Health (NIOSH) (2011) Skin Notation Profiles: 2-Butoxyethanol (BE).

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