

## 2-METHOXYETHANOL

**CAS number:** 109-86-4

**Synonyms:** EGME, 2-Me, Dwanol EM, ethylene glycol monomethyl ether, methyl-cellosolve, monomethyl ether of ethylene glycol

**Chemical formula:**  $C_3H_8O_2$

**Structural formula:** —

### Workplace exposure standard (amended)

**TWA:** 0.1 ppm (0.3 mg/m<sup>3</sup>)

**STEL:** —

**Peak limitation:** —

**Notations:** Sk.

**IDLH:** 200 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 0.1 ppm (0.3 mg/m<sup>3</sup>) is recommended to protect for haematological, developmental and reproductive toxicity effects in exposed workers.

### Discussion and conclusions

2-Methoxyethanol (EGME) is used as a solvent additive in dyes, resins, varnishes and timber stains. Glycol ethers are used as de-icing additives in fuels. Regularly found in material coating and printing industries, pesticides, detergents, plastic and electronics industries.

Critical effects of exposure include anaemia and developmental and reproductive effects.

Anaemia was reported in workers with inhalational exposure to EGME at 35.7 ppm. Dermal exposure through unprotected hands was also reported along with inhalation exposure in this study, although no further information was presented. Anaemia did not occur once airborne exposure concentrations were lowered to 0.55 ppm and dermal exposure was reduced (ACGIH, 2018). No haematological effects were identified in workers exposed *via* inhalation at 2.3 ppm (SCOEL, 2006). An increased prevalence of reduced sperm cells was noted in workers exposed at mean workplace airborne concentrations of 0.8 ppm (2.6 mg/m<sup>3</sup>) EGME (TWA concentration of 5.6 ppm) along with co-exposure at 21.5 ppm of 2-ethoxy-ethanol (NICNAS, 2014). A LOAEC of 3 ppm for haematological effects and a benchmark dose (10%) of 1.3 ppm (4.1 mg/m<sup>3</sup>) EGME relating to delayed ossification in fetuses was derived in an inhalation study in pregnant rats (HCOTN, 2011).

Given the absence of anaemia in workers at 0.55 ppm, effects on workers sperm production at 0.88 ppm and developmental effects in animals at 10 ppm, the TWA of 0.1 ppm (0.5 mg/m<sup>3</sup>) derived by ACGIH (2018) is recommended. Although the same developmental study in animals was used by the HCOTN (2011) to recommend a revised TWA of 0.16 ppm, ACGIH (2018) took into consideration

evidence in humans and therefore, the recommendation by ACGIH (2018) is considered more appropriate. The recommended TWA is expected to be protective for haematological, developmental and reproductive effects in exposed workers.

## **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 recommended based on evidence of dermal uptake and systemic effects in humans.

## APPENDIX

### Primary sources with reports

Source	Year set	Standard
<b>SWA</b>	<b>1991</b>	<b>TWA: 5 ppm (16 mg/m<sup>3</sup>)</b>
<b>ACGIH</b>	<b>2006</b>	<b>TLV-TWA: 0.1 ppm (0.3 mg/m<sup>3</sup>)</b>
<p>TLV-TWA recommended to protect for haematological and reproductive toxicity effects with value assigned also protective of depression of the CNS and effects on immune system organs.</p> <p>Summary of data:</p> <p>2-methoxyethanol or ethylene glycol monomethyl ether is known to be readily absorbed through the skin and can elicit systemic response. Lack of dermal irritation may contribute to the risk of skin exposure in workers.</p> <p>TLV-TWA is based on 0.55 ppm in humans (the NOAEC) which protects for anaemia and the reproductive effects in rodents at 10 ppm (LOAEL in rabbits); no further information on derivation of TLV-TWA.</p> <p>Human data:</p> <ul style="list-style-type: none"> <li>Encephalopathy, leukopenia and anaemia linked to industrial exposures of solvents containing EGME</li> <li>Multiple case studies indicate: <ul style="list-style-type: none"> <li>anaemia in workers exposed via inhalation to EGME at 35.7 ppm; dermal exposure of the hands also reported along with the inhalation exposure (no further information is presented); the anaemias did not occur once airborne concentration were lowered to 0.55 ppm (used as NOAEC) and dermal exposure reduced</li> <li>encephalopathy and pancytopenia associated with inhalation exposures at ≈8 ppm (large dermal contact assumed as principal exposure)</li> <li>changes to sperm production observed in shipyard workers at 0.8 ppm (average); maximum concentration of 5.6 ppm; no further details</li> </ul> </li> <li>Women exposed to dermal EGME during pregnancy had increased risk of children with dysmorphic features and persistent chromosomal (one) cytogenetic damage</li> <li>PBPK modelling of predicted absorption and distribution suggests humans experience toxic effects 13 times lower than effects observed in rodents</li> <li>Skin notation applied due to observed systemic effects of dermal exposure – BEI recommended as more reliable estimate of exposure than air monitoring alone.</li> </ul> <p>Animal data:</p> <ul style="list-style-type: none"> <li>Sufficient data supporting systemic effects of inhalation and dermal exposures</li> <li>LC<sub>50</sub>: 1,480 ppm (mice, 7 h) with lung and kidney damage leading to death</li> <li>Inhalation LOAEC: 3 ppm (pregnant Fisher rats, 6 h/d), haematological effects noted; however, NOAEC of 100 ppm in other studies with less relevance</li> <li>CNS effects noted at higher levels (&gt;800 ppm)</li> <li>Mice exposed at 7,500 ppm for 3 h had 50% reduction in testis weight, with bilateral atrophy of seminiferous tubules at lower doses (≈625 ppm)</li> <li>Reduction in body, thymus and testicular weight observed (Wistar rats) inhaling 300 ppm (6 h/d for 10 d)</li> <li>Reduced packed cell volume and white blood cell, haemoglobin, platelet and serum protein concentrations reported in rats and rabbits exposed (inhalation) for 13 wk at 300 ppm EGME; none of these effects occurred at 30 ppm; no further information</li> </ul>		



Source	Year set	Standard
<ul style="list-style-type: none"> <li>Gestational exposures to EGME: <ul style="list-style-type: none"> <li>delayed ossification in rabbits at 10 ppm and in rats at 25 ppm</li> <li>50 ppm resulted in major congenital malformations occur in rabbits; no further information</li> </ul> </li> <li>Vapours irritating to mucous membranes at high (no value stated) concentrations; however, no dermal irritation noted</li> <li>Pain and irritation when installed in eyes of rabbits (corneal cloudiness cleared &gt;24 h)</li> <li>Dermal exposure associated with testicular and developmental toxicity and teratogenicity in rats</li> <li>Topical NOAEL: 250 mg/kg (rats, single dose) rodent development</li> <li>No mutagenic effects in <i>S. typhimurium</i> strains.</li> </ul>		
<b>DFG</b>	<b>2008</b>	<b>MAK: 1 ppm (3.2 mg/m<sup>3</sup>)</b>
<p>Summary of additional data:</p> <ul style="list-style-type: none"> <li>NOAEL 10 ppm (rats, developmental toxicity) basis for PBPK modelling to determine NOAEL for humans as 12 ppm</li> <li>Safety factors for pharmacodynamic interspecies and pharmacokinetic intraspecies applied to obtain MAK of 0.9 ppm (rounded up).</li> </ul>		
<b>SCOEL</b>	<b>2006</b>	<b>TWA: 1 ppm (3.2 mg/m<sup>3</sup>)</b>
<p>TWA assigned to protect for critical effects identified as toxic effects on reproduction and blood formation.</p> <p>Summary of Additional data:</p> <p>Biologic Limit Value (BLV) – 8 mg; 2-Methoxyacetic acid (MAA)/g creatinine – urine sampled at end of work week (at least two weeks of work).</p> <p>Human exposures reported in semiconductor and circuit board manufacturing, printing, automobile and ship painting, furniture finishing, paint production and automobile repair industries.</p> <p>Human data:</p> <ul style="list-style-type: none"> <li>Anaemia in 26% of workers exposed at average of 4 ppm EGME; no further information; additional study identified no effects at 2.3 ppm; basis for TWA of 1 ppm</li> <li>Respiratory uptake measured at 76% of amount inhaled</li> <li>Epidermis uptake <i>in vitro</i> 2.8 mg/cm<sup>2</sup>/h</li> <li>No evidence of skin irritation, eye irritation or sensitisation reports.</li> </ul>		
<b>OARS/AIHA</b>	<b>NA</b>	<b>NA</b>
No report.		
<b>HCOTN</b>	<b>2011</b>	<b>TWA: 0.3 ppm (1 mg/m<sup>3</sup>)</b>
<p>A revised health based OEL, TWA of 0.16 ppm (0.5 mg/m<sup>3</sup>) is recommended to protect against chronic and sub-chronic effects on reproductive system and reduction in haematological parameters.</p> <p>Summary of additional data:</p> <p>Human data:</p> <ul style="list-style-type: none"> <li>Reduction in exposure is directly proportional to the return of haematological to normal values.</li> </ul> <p>Animal data:</p>		



Source	Year set	Standard
<ul style="list-style-type: none"> <li>Pregnant rabbits exposed at 0, 3, 10 and 50 ppm, 6/d on GD 6–15 (cited by ACGIH, 2018): <ul style="list-style-type: none"> <li>at 50 ppm significantly increased the incidence of malformations, minor variations and resorptions of the offspring, as well as decreased foetal body weight</li> <li>at 10 ppm, the number of implantations resorbed and the number of litters with resorptions increased significantly; a significant increase in delayed ossification of the sternebrae was observed in the offspring</li> <li>at 3 ppm, no effects were observed in the female rabbits or their offspring</li> <li>BMDL<sub>10</sub> of 1.3 ppm (4.1 mg/m<sup>3</sup>) derived from study results</li> </ul> </li> <li>Spermatogenesis affected at oral dose levels of ≥25 mg/kg/d. NOAEL of 12.5 mg/kg/d.</li> </ul> <p>Revised health-based OEL of 0.5 mg/m<sup>3</sup> derived from BMDL<sub>10</sub> of 4.1 mg/m<sup>3</sup> with UF of 3 for interspecies difference and 3 for interindividual differences in humans to obtain a rounded value of 0.5 mg/m<sup>3</sup> (0.16 ppm). This OEL is cited to protect for effects on blood parameters in workers.</p>		

## Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ 2014	<ul style="list-style-type: none"> <li>An increased prevalence of oligospermia and azoospermia was noted in workers exposed to mean work-place concentrations were 0.8 ppm (2.6 mg/m<sup>3</sup>) EGME; TWA concentration of 5.6 ppm (17.7 mg/m<sup>3</sup>); co-exposure at 21.5 ppm, 2-ethoxy-ethanol</li> <li>Adverse developmental effects in several species with multiple exposures (no maternal toxicity noted)</li> <li>Developmental effects were generally observed at lower doses than both reproductive effects and haematological effects</li> <li>NOAEC of 3 ppm (9 mg/m<sup>3</sup>), LOEC of 10 ppm (32 mg/m<sup>3</sup>) EGME in rabbits; delayed ossification.</li> </ul>
US EPA	✓ 1991	<ul style="list-style-type: none"> <li>Inhalation Summary data: <ul style="list-style-type: none"> <li>NOAEC: 30 ppm (rats &amp; rabbits, testicular effects)</li> </ul> </li> </ul>

## 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	Skin
HCIS	—
NICNAS	—
EU Annex	NA



Source	Notations
ECHA	—
ACGIH	Skin
DFG	H (skin)
SCOEL	Skin
HCOTN	Skin
IARC	NA
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

#### Conclusion:

Adverse effects in human case study:	yes
Dermal LD <sub>50</sub> ≤ 1000 mg/kg:	yes
Dermal repeat-dose NOAEL ≤ 200 mg/kg:	
Dermal LD <sub>50</sub> /Inhalation LD <sub>50</sub> < 10:	yes
<i>In vivo</i> dermal absorption rate > 10%:	yes
Estimated dermal exposure at WES > 10%:	yes

**a skin notation is warranted**

## IDLH

Is there a suitable IDLH value available? Yes

## Additional information

Molecular weight:	76.09
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3.11 mg/m <sup>3</sup> ; 1 mg/m <sup>3</sup> = 0.322 ppm
This chemical is used as a pesticide:	✓
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:	✓ ACGIH    ✓ DFG    ✓ SCOEL



## Workplace exposure standard history

Year	Standard
<a href="#">Click here to enter year</a>	

## 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) (2009) 2-Methoxyethanol – MAK value documentation.

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).

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2006) Recommendation from the Scientific Committee on Occupational Exposure Limits for 2-Methoxyethanol. SCOEL/SUM/120.

Health Council of the Netherlands (HCOTN) (2011) Ethyleneglycol monomethyl ether (EGME) and ethyleneglycol monomethyl ether acetate (EGMEA). Health-based recommended occupational exposure limits. The Hague: Health Council of the Netherlands; publication no. 2011/10.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2014) Alkoxyethanols (C1-C2) and their acetates: Human health tier II assessment – IMAP report.

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).

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Methyl Cellosolve®.

US National Institute for Occupational Safety and Health (NIOSH) (2011) NIOSH Skin Notation Profiles: Methyl Cellosolve.