ISOAMYL ALCOHOL

CAS number: 123-51-3

Synonyms: Isobutylcarbinol, isopentyl alcohol, 3-methyl-1-butanol, primary isoamyl alcohol

Chemical formula: $C_5H_{12}O$

Structural formula: —

Workplace exposure standard (amended)

TWA: **20 ppm (73 mg/m^3)**

STEL: **80 ppm (292 mg/m^3)**

Peak limitation: **—**

Notations: **—**

IDLH: **500 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 20 ppm (73 mg/m^3) is recommended to protect for local irritation effects in exposed workers.

A STEL of 80 ppm (292 mg/m^3) is recommended to protect for irritation in acutely exposed workers.

Discussion and conclusions

Isoamyl alcohol is used as a solvent in the manufacture of photographic and pharmaceutical chemicals. The critical effect of exposure is irritation of the upper respiratory tract and eyes.

The human toxicological database is limited, but the available acute sensory data suggests mild throat irritation begins at 100 ppm followed by eye and upper respiratory tract irritation above 150 ppm (ACGIH, 2018; DFG, 2008; HCOTN, 2003). A NOAEC of 50 ppm for eye irritation with a corresponding LOAEC of 225 ppm are reported in a 90 day inhalation study with rats (DFG, 2008, 2016).

Due to the limited information on human exposure, specifically the absence of a NOAEC for irritational endpoints, the recommended TWA of 20 ppm by DFG (2008, 2016) is based on the NOAEC for eye irritation in rats. Based on the onset of mild irritation in humans at 100 ppm, the recommended STEL of 80 ppm is expected to be protective of these effects.

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.

There are insufficient data to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 100 ppm (361 mg/m^3); STEL: 125 ppm (452 mg/m^3)***
ACGIH	***2001***	***TLV-TWA: 100 ppm (361 mg/m^3); TLV-STEL: 125 ppm (452 mg/m^3)***

TLV-TWA intended to minimise potential for irritation of the eyes and upper respiratory tract and possible corneal damage.

Summary of data:

TLV-TWA based on reports of throat irritation in briefly exposed volunteers above 100 ppm and eye and upper respiratory tract irritation above 150 ppm. Limited exposure data available, the TLV-TWA is therefore supported by analogy to similarly acting *n*-butyl alcohol.

Human data:

- Odour threshold: 0.042 ppm
- Ingestion of 30 mL lethal in adults
- Slight throat irritation at 100 ppm in volunteer study (3–5 min)
    - upper respiratory tract and eye irritation at 150 ppm
    - exposure to *n*-butyl alcohol at 25 ppm caused mild eye, throat and nose irritation; objectionable at 50 ppm.

Animal data:

- Oral LD_{50}: 5,770 mg/kg (rats), 3,440 mg/kg (rabbits)
    - narcosis, stupor and loss of voluntary movement reported at sub-lethal doses
- LC_{50}: >2,000 ppm (rats, 8 h)
- LD_{50}: 3,240 mg/kg (rabbits, dermal); severe burns and corneal damage when applied to eyes
- Carcinomas reported in liver and forestomach and leukaemia in chronic gavage study at 81.3 mg/kg (rats, 2 times/wk, until total dose of 22 g administered ≈2 yr); average survival time: 527 d
- No mutagenicity or ADME data presented.

Insufficient data to recommend notations for carcinogenicity, skin absorption and sensitisation.

DFG	***2008, 2016***	***MAK: 20 ppm (73 mg/m^3)***

Summary of additional data:

Assessment grouped with other pentyl alcohol isomers; 2,2-dimethyl-1-propanol has the most sensitive endpoints. All isomers exhibit local irritation as the critical endpoint. MAK derived from NOAEC of 50 ppm for lachrymation and upper respiratory tract irritation with a corresponding LOAEC of 225 ppm in a sub-chronic inhalation study with rats. The NOAEC is halved and rounded down to account for inter- and intra- species differences and translation from experimental conditions to the workplace. Previous excursion factor of 4 (established in 2007) revised to 2 in 2016 based on analogy to acutely irritating effects of other short-chain aliphatic alcohols.

Human data:

Source	Year set	Standard
• Slight eye irritation at 0.3 ppm in chamber study (n=5, 2 h); no adverse effects to lung function or nasal irritation reported, results of this study not considered substantial enough to warrant re-evaluation of the current MAK • Erythema from occlusive dermal application at 25 µL of 75% aqueous solution (n=12, 5 min) • Some positive sensitisation results from patch test studies do not warrant a dermal sensitiser notation; positive results likely associated with cross-reaction in individuals with ethyl alcohol allergy. Animal data: • Good solubility in muscle, brain, lung, kidney, liver, spleen and blood tissue (rabbits, humans) • Peak blood levels reached after 1 h and elimination within 4 h; blood half-life of 1-pentanol: 12 min, excreted primarily in urine • Sub-chronic inhalation study with exposure groups 50, 225, 1,000 ppm (mice, rats, dogs, 6 h/d, 5 d/wk, 90 d) reported; ○ NOAEC (mice): 1,000 ppm ○ NOAEC (dogs): 225 ppm for lachrymation ○ NOAEC (rats): 50 ppm, LOAEL: 225 ppm for lachrymation after 37th exposure • Limited number of mutagenicity studies suggest pentanol isomers are non-genotoxic *in vitro* or *in vivo*.		

Source	Year set	Standard
SCOEL	***2016***	***TWA: 5 ppm (18 mg/m^3); STEL: 10 ppm (37 mg/m^3)***

Summary of additional data:

Critical effect is local irritation. Recommended OEL based on weight of evidence including reports of human sensory data that suggest irritation occurs at 25 ppm and 100 ppm, the proportionality between increasing carbon chain length and median respiratory depression (RD_{50}) in mice and the irritational potency of longer and shorter chain alcohols.

n-Octanol has an irritation threshold of 6.4 ppm in humans versus *n*-butanol at 25 ppm. Recommended TWA and STEL are therefore set at 5 and 10 ppm, respectively, to protect for local irritation.

Skin notation not warranted for exposure below the recommended OEL.

Human data:

- Throat irritation at 25 ppm during mouth-only exposure (n=3, 3–5 min)
- Chamber study (also cited by DFG, 2016) reported very mild eye irritation at 0.3 ppm (5 mm on 100 mm analogue scale versus 3 mm for fresh air); agency considers 0.3 ppm to be a NOAEL
- No sensitisation in maximisation test with 8% in petrolatum (n=25).

Animal data:

- RD_{50}: 730 ppm (mice)
- Reduced bw gain and eye irritation at 2,725 ppm in developmental study (rabbits, 6 h/d, gestation d 7–19)
  - maternal NOAEL: 681 ppm; foetal NOAEL: 2,725 ppm
- Slight haematological alterations at 1,068 mg/kg/d in repeat feeding study (male rats, drinking water, 90 d)
  - NOAEL: 295 mg/kg/d
- Weight of evidence suggests substance is non-genotoxic *in vitro* and *in vivo*.

Insufficient data to evaluate carcinogenicity.

OARS/AIHA	***NA***	***NA***

No report.

Source	Year set	Standard
HCOTN	***2003***	***TWA 8 hours: 27 ppm (100 mg/m^3)***

Summary of additional data:

Health-based recommended OEL (HBROEL) derived from NOAEL of 1,000 mg/kg/d in repeat gavage study with rats. A factor of 7/5 is applied to translate from a continuous exposure study to intermittent, 5 d/wk workplace exposure, to obtain a NAEL of 1,400 mg/kg. An allometric scaling factor of 4 is applied followed by an overall factor of 18 to account for inter- and intraspecies variation and translation from experimental conditions to the workplace to obtain a NAEL of 19.4 mg/kg. An equivalent inhalational concentration (NOAEC) of ≡27 ppm from this NAEL is calculated assuming 100% absorption in a 70 kg individual with a respiratory volume of 10 m^3 during an 8 h shift.

Human data:

- Volunteer inhalation study (cited in ACGIH, 2018) and mouth-only exposure study (cited in SCOEL, 2016) not considered in assessment due to lack of subjective measurements and methodological shortcomings).

Animal data:

- Repeat gavage study with treatment groups 150, 500 and 1,000 mg/kg/d (rats, 7 d/wk, 17 wk) reported;
  - Slight, but statistically significant, reduction in body weight attributed to decreased food consumption due to high concentrations in feed
  - NOAEL: 1,000 mg/kg/d; body weight reduction not considered substance-related by cited study or by agency
- Equivocal mutagenicity results; increased chromosomal aberrations in bone marrow cells at 1/5 LD_{50} in rats, negative results *in vitro* with and without metabolic activation in bacterial cell lines and in human cell via a Comet assay.

Secondary source reports relied upon

Source		Year	Additional information
ECHA	✓	2019	• Maternal NOAEL of 681 ppm in inhalational developmental study used as starting point for calculating long-term derived no-effect-level (DNEL) ○ conversion to 8 h working exposure affords a NOAEL of 350 ppm ○ factor of 5 was applied for intraspecies differences and a factor of 2.5 for remaining uncertainty in the database to arrive at the DNEL of 28 ppm (100 mg/m^3) ○ agency notes agreement of DNEL with DFG MAK (2008) • Short-term DNEL of 80 ppm adopted from DFG (2008) excursion factor • No indications of a carcinogenic potential from available *in vitro* and *in vivo* genotoxicity data.
US NIOSH	✓	1994	• In absence of suitable inhalational data, IDLH based on acute oral toxicity data in humans and animals.

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	—
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	—
ACGIH	—
DFG	NA
SCOEL	—
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

Additional information

Molecular weight:	88.15
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3.60 mg/m^3; 1 mg/m^3 = 0.278 ppm
This chemical is used as a pesticide:	☐
This chemical is a biological product:	✓
This chemical is a by-product of a process:	☐

Molecular weight:	88.15
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3.60 mg/m^3; 1 mg/m^3 = 0.278 ppm
This chemical is used as a pesticide:	☐
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* on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2016) Pentanole – MAK value documentation, German language edition.

Deutsche Forschungsgemeinschaft (DFG) (2008) Pentanol-Isomeren – MAK value documentation, German language edition.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2016) Recommendation from the Scientific Committee on Occupational Exposure Limits for Isoamyl Alcohol. SCOEL/REC/177.

European Chemicals Agency (ECHA) (2019) 3-methylbutan-1-ol – REACH assessment.

Health Council of the Netherlands (HCOTN) (2003) 3-Methylbutan-1-ol. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/085.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Isoamyl alcohol (primary & secondary).