ISOPROPYL ALCOHOL

CAS number: 67-63-0

Synonyms: Isopropanol, 2-propanol, n-propan-2-ol

Chemical formula: C_3H_8O

Structural formula: —

Workplace exposure standard (amended)

TWA: **200 ppm (491 mg/m^3)**

STEL: **400 ppm (984 mg/m^3)**

Peak limitation: **—**

Notations: **—**

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 200 ppm (491 mg/m^3) is recommended to protect for eye and upper respiratory tract irritation in exposed workers.

A STEL of 400 ppm (984 mg/m^3) is recommended to protect for acute nasal irritation in exposed workers.

Discussion and conclusions

Isopropyl alcohol is used as a solvent, a disinfectant, as an ingredient in consumer cosmetics and as raw material in chemical manufacture.

Critical effects of exposure are irritation of the eyes, nose and throat as observed in volunteers and workers (ACGIH, 2018; DFG, 2018). A range of NOAECs between 150 and 190 ppm for eye and upper respiratory tract irritation is presented in volunteer studies, which is supported by a NOAEC of 227 ppm reported for chronically exposed workers (DFG, 2018). Mild upper respiratory tract irritation is reported in volunteers during short exposures at approximately 400 ppm (ACGIH, 2018; NICNAS, 2013). Bioaccumulation or dermal absorption are unlikely under workplace conditions (DFG, 2018).

The recommended TWA of 200 ppm, as derived by ACGIH (2018), is considered protective of irritant effects based on the range of NOAECs reported in studies of volunteers and workers. DFG (1996) derived the same MAK value by applying a different approach. The recommended STEL of 400 ppm is expected to be protective of peak exposures associated with the onset of upper respiratory tract irritation in volunteers.

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 based on the available evidence.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 400 ppm (983 mg/m^3); STEL: 500 ppm (1,230 mg/m^3)***
ACGIH	***2006***	***TLV-TWA: 200 ppm (491 mg/m^3); TLV-STEL: 400 ppm (984 mg/m^3)***

TLV-TWA and TLV-STEL intended to protect for irritation of mucous membranes, CNS depression, and at high concentrations, narcosis.

Not classified as a human carcinogen based on negative results in animal studies and confounding evidence in available epidemiological studies.

Skin notation not warranted due to low skin permeability.

Summary of data:

TLV recommendations based on a combination of a LOAEL of 400 ppm for mild eye, nose, and throat irritation in humans; a NOAEL of 500 ppm for chronic renal disease in rodents; and a sub-chronic LOAEL of 500 ppm for upper respiratory tract irritation with a corresponding NOAEL of 100 ppm.

Major metabolite, acetone, can potentiate exposures to chlorinated solvents.

Human data:

- Odour threshold: 11 ppm for naïve volunteers, 39 ppm in acclimated volunteers:
  - nasal irritation threshold >400 ppm, nasal congestion begins at 400 ppm
- Poisoning occurred at 20 mL ingestion; inferred lethal oral dose 240 mL
- High concentrations cause ataxia, oliguria, kidney failure and death from respiratory failure
- Epidemiological studies of production plant workers in the 1940s-80s (n=262 and 1,031) could not associate excess risk of respiratory cancers due to isopropyl alcohol due to confounding exposures to acid mists and by-products with known carcinogenic potential.

Animal data:

- LC_{50} >12,000 ppm (rats, 4 h); lethal >8 h
- Ataxia, prostration, and narcosis at 3,250 ppm (mice, 460 min)
- Upper respiratory tract and eye irritation at 400–800 ppm (unspecified species or duration):
  - NOAEL of 500 ppm for reduced motor activity (rats, 6 h)
- Median respiratory depression (RD_{50}): 5,000–17,693 ppm (mice, 5–10 min):
  - corresponding TLV calculated at 150–530 ppm
- Metabolic saturation at ≈700 ppm in blood (rats, exposed to 5,000 ppm); peak blood concentration reached at 6 h, circulating levels decreased to 75 ppm after further 6 h:
  - blood half-time 0.6–2 h (mice, rats)
- Tolerance acquired after 7 mo in repeat feeding study (dogs, 4% in drinking water)
- Sub-chronic and chronic inhalation studies with treatment range: 100–5,000 ppm (rats, mice, 6 h/d, 5 d/wk, 13 wk or 2 yr) reported:
  - increased bw gain and narcosis at 1,500 ppm; recovery from narcosis within minutes after exposure cessation
  - kidney damage in males at 5,000 ppm (13 wk)
  - LOAEL: 500 ppm for nasal encrustation; NOAEL: 100 ppm (13 wk)
  - chronic renal disease and sedation at 2,500 ppm (2 yr); NOAEL: 500 ppm (2 yr)
  - no evidence for carcinogenicity in both sub-chronic and chronic studies

Source	Year set	Standard
• NOAEL: 3,500 ppm for teratogenicity; LOAEL: 7,000 ppm in inhalational developmental study (rats, 7 h/d, GD 1–19); values agree with extrapolated air concentrations from comparable repeat oral dose studies • Non-genotoxic in standard short-term assays. Insufficient data to assign a sensitiser notation.		
DFG	***1996***	***MAK: 200 ppm (500 mg/m^3)***
Summary of additional information: MAK intended to protect for critical narcotic effect and derived from a LOAEL of 2,500 ppm for narcosis in chronically exposed rats. A corresponding NOAEL is calculated by applying a factor of 3 to arrive at 833 ppm, an additional factor of 4 is applied and rounded down to account for translation to human exposure and for increased respiratory volume to afford the MAK of 200 ppm. Skin and sensitiser notations not considered necessary due to low dermal absorption rate and low potential for sensitisation in humans, respectively. Human data: • Male workers exposed at 260 ppm had no substance in the circulation: o up to 15.6 mg/L of acetone present in blood o in females, up to 10 mg/L isopropyl alcohol reported in blood and 40 mg/L acetone at end of shift • Excreted primarily in exhaled air, substance half-life: 2.5–6.4 h, acetone half-life: 11–22.4 h • Mean blood concentrations of isopropyl alcohol, acetone or ethyl alcohol did not increase during occlusive volunteer patch test (males, n=14, 1 h) • No exposure-related effects ≤227 ppm in worker case study (females, n=60, up to 17 yr) • No signs of eye irritation, reduced lung function or nasal inflammation at 150 ppm in volunteer inhalation study (males, females, n=28, 2–3 h): o some irritation, likely due to odour perception, scored 15/100 in average volunteer responses • No substance-related effects at 35 or 190 ppm in inhalation study (males, n=24, 4 h) • Worker case study (n=21) reported impaired balance at personal exposure 6–73 ppm, but could not be reproduced in follow-up study; not included in MAK evaluation due to small study size. Animal data: • Chronic inhalation study with treatment range: 100–5,000 ppm (rats, mice, 6 h/d, 5 d/wk, 2 yr, also cited by ACGIH, 2018) reported: o increased testes weight in rats and decreased testes weight in mice at 500 ppm, statistically significant at 2,500 ppm o interstitial hyperplasia in testes at 2,500 ppm dismissed due to low incidence and not considered evidence for carcinogenic activity.		
SCOEL	***NA***	***NA***
No report.		
OARS/AIHA	***NA***	***NA***
No report.		

Source	Year set	Standard
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2013	• Mild irritation of the eyes, nose and throat reported in humans at 400 ppm (3–5 min) • Severe irritation and corneal abrasion from direct contact with the liquid.
IARC	✓	1999	• 50% of absorbed dose excreted via urine and exhaled air in humans • Non-genotoxic *in vitro* or *in vivo* • Inadequate evidence for the carcinogenicity of isopropanol in humans and experimental animals.
ECHA	✓	2019	• 13 wk and 2 yr inhalation studies (also cited in ACGIH, 2018; DFG, 2018) used to calculate DNEL; DNEL calculated in alignment with DFG MAK derivation • LD_{50}: 12,890 mg/kg (rabbit, dermal) • Non-genotoxic based on negative results *in vitro* and *in vivo*.

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	—
NICNAS	—
EU Annex	—
ECHA	—
ACGIH	Carcinogenicity – A4
DFG	—
SCOEL	NA
HCOTN	NA
IARC	Carcinogenicity – Group 3

Source	Notations
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 LD_{50} ≤1000 mg/kg:	no
Dermal repeat-dose NOAEL ≤200 mg/kg:	
Dermal LD_{50}/Inhalation LD_{50} <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:	60.10
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 2.46 mg/m^3; 1 mg/m^3 = 0.4 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* on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2018) 2-propanol – MAK value documentation, German language edition.

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European Chemicals Agency (ECHA) (2019) Propan-2-ol – REACH assessment.

International Agency for Research on Cancer (IARC) (1999) Isopropyl alcohol. IARC Monographs on the evaluation of the carcinogenic risk to humans, volume 71.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2013) 2-Propanol: Human health tier II assessment – IMAP report.

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