ALPHA-METHYLSTYRENE

CAS number:	98-83-9
Synonyms:	AMS, Isopropenylbenzene, α-Methylstyrene, 1-methyl-1-phenylethylene, β-phenylpropene, 2-phenylpropene, benzene (1-methylethenyl)
Chemical formula:	C9H10
Structural formula:	—

Workplace exposure standard (retained)

TWA:	**50 ppm (242 mg/m^3)**
STEL:	**100 ppm (483 mg/m^3)**
Peak limitation:	**—**
Notations:	**Carc. 2**
IDLH:	**700 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 50 ppm (242 mg/m^3) is recommended to protect for irritation of the upper respiratory tract and adverse kidney effects in exposed workers.

A STEL of 100 ppm (483 mg/m^3) is not recommended to protect for acute effects in exposed workers.

Discussion and conclusions

α-Methylstyrene (AMS) is used as a polymerisation monomer in the manufacture of polyester, resins and other polymers.

Critical effects of exposure are irritation of the upper respiratory tract and renal (kidney) toxicity.

Volunteers exposed at 200 ppm for a ‘short period’ experienced irritation of the eyes and upper respiratory tract and reported a strong objectionable odour. Irritation is not reported in volunteers exposed at 50 ppm (ACGIH, 2018; DFG, 2004). A NOAEC of 75 ppm for nasal lesions in male rats is reported in a 13-week inhalation study, with the next exposure concentration at 150 ppm (DFG, 2004). A NOAEC of 100 ppm for renal toxicity in female rats is reported in a chronic inhalation study (ACGIH, 2018).

Available evidence suggests no irritation effects in humans at 50 ppm in acute exposures, with irritation observed at 200 ppm. The NOAEC of 100 ppm for kidney effects in rats and nasal effects are reported between 75 ppm and 150 ppm. SWA, DFG (2004) and SCOEL (1995) assign occupational exposure limit (OEL) of 50 ppm. While ACGIH (2018) assign a TLV-TWA of 10 ppm. Current administrative OEL of 50 ppm is in place but health-based OEL of 4 ppm is recommended to be adopted by HCOTN (2003). However, there is uncertainty in decisions and end-points by ACGIH (2018) and HCOTN (2003). Additionally, SCOEL (1995) and SWA assign a STEL of 100 ppm.

Based on this evidence, SWA TWA of 50 ppm and a STEL of 100 ppm are recommended to be retained. The recommended TWA and STEL are considered to protect for adverse effects in exposed workers.

Recommendation for notations

Classified as a category 2 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 evidence in animals.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 50 ppm (242 mg/m^3); STEL: 100 ppm (483 mg/m^3)***
ACGIH	***2010***	***TLV-TWA: 10 ppm (48 mg/m^3)***

TLV-TWA recommended to minimise the potential for irritation of the upper respiratory tract, renal toxicity and adverse reproductive effects.

Summary of data:

Human data:

- Volunteers exposed at 200 ppm for a 'short period' experienced irritation to the eyes and upper respiratory tract and strong objectionable odour:
  - no irritation reported at 50 ppm
  - no detail of exposure duration reported
- Estimated dermal rate not exceeding 0.1 mg/cm^2/d:
  - in contrast, other source reports that skin contact may be an important route of exposure.

Animal data:

- NOAEC of 100 ppm for non-cancer effects; reported in an inhalation study in rats exposed at 0, 100, 300 or 1000 ppm for 6 h/d, 5 d/wk for 105 wk:
  - increased incidence of mineralisation of the renal papilla in females reported at 300 ppm
  - increased incidences of renal tubule adenomas and carcinomas (combined) in male rats exposed at 1,000 ppm
- NOAEC of 300 ppm in a rat 14 wk inhalation study based on elevated markers of kidney toxicity in females (≥600 ppm)
- 14 wk inhalation study in mice; 6 h/d, 5 d/wk at 0, 75, 150, 300, 600 or 1,000 ppm:
  - significantly elevated oestrous cycle lengths in mice at 600 ppm
  - atrophy/metaplasia of olfactory epithelium and Bowman's gland atrophy and hyperplasia occurred at all exposure concentrations
- Inhalation study in male and female mice exposed at 0, 100, 300 or 600 ppm (6 h/d, 5 d/wk for 105 wk):
  - increased hepatocellular carcinoma and eosinophilic foci of the liver in female mice at 600 ppm for 2 yr
  - increased hepatocellular adenomas and carcinomas (combined) at all does in female mice.

No specifics method on derivation of TLV-TWA available.

Insufficient data to recommend a skin or sensitiser notation of STEL.

DFG	***2004***	***MAK: 50 ppm (250 mg/m^3)***

MAK recommended based on kidney effects in rats.

Summary of additional data:

Source	Year set	Standard
• No additional human data • LD_{50}: 14,500 mg/kg (rabbits, dermal) • Previous MAK of 100 ppm considered too high • NOAEC of 75 ppm in male rats based on nasal lesions; 0, 75, 150, 300, 600 or 1000 ppm, 6 h/d, 5 d/wk for 13 wk; justification for lowered MAK value of 50 ppm (derivation not explained) • NOAEL of 200 mg/kg/d developmental and reproduction effects; neonate survival rate, dam survival; oral exposure of males for 43 d, females 14 d before mating until day 3 of lactation • A daily dose of 35 mg/kg/d can be assumed when exposed to MAK 50 ppm over workday; based on 10 m^3 of air per 8 h, 70 kg bw and 100% absorption.		
SCOEL	***1995***	***TWA: 50 ppm (246 mg/m³); STEL: 100 ppm (492 mg/m³)***
TWA and STEL recommended to protect for irritation and systemic effects. Summary of additional data: • NOAEL of 50 ppm for eye irritation in human volunteers (cited by ACGIH, 2010) basis of STEL • NOAEC of 200 ppm reported from repeated exposure inhalation study, rats, guinea pigs, rabbits and monkey; exposed 7 h/d 5 d/wk for 6 mo: o based on reduction in growth and liver and kidney weight increases; basis for TWA; (cited by ACGIH, 2010).		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***2003***	***TWA: 50 ppm (240 mg/m³)***
TWA is current administrative OEL. Health-based TWA of 4 ppm recommended based on nasal lesions in rats. Summary of additional data: • LOAEC of 75 ppm in rats on nasal lesions; 13 wk inhalation study (cited by DFG, 2004 as NOAEC) • Starting with LOAEC of 75 ppm and applying assessment factor of 16 to account for the absence of a NOAEL, intra- and interspecies variation, differences between experimental conditions and the exposure pattern of the worker and the fixed value approach by HCOTN, a health-based OEL of 4 ppm (20 mg/m^3) is proposed.		

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2015	• NOAEC of 150 ppm based on liver and kidney effects in rats; 14 wk inhalation study (cited by ACGIH, 2010) • Inadequate evidence for carcinogenicity in humans; sufficient evidence for carcinogenicity in animals (same evidence as ACGIH, 2010).

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	Carcinogenicity – category 2
NICNAS	Carc. Cat 3
EU Annex	NA
ECHA	NA
ACGIH	Carcinogenicity – A3
DFG	—
SCOEL	—
HCOTN	—
IARC	Carcinogenicity – Group 2B
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:	
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

Additional information

Molecular weight:	118.18

Conversion factors at 25°C and 101.3 kPa:	1 ppm = 4.83 mg/m^3; 1 mg/m^3 = 0.2 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) (2007) 2-Phenylpropen – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1995) Recommendation from the Scientific Committee on Occupational Exposure Limits for 2-Phenylpropene. SCOEL/SUM/68.

Health Council of the Netherlands (HCOTN) (2003) 2-Phenylpropene. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/088.

International Agency for Research on Cancer (IARC) (2013) a-Methylstyrene. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2015) Benzene, (1-methylethenyl)-: Human health tier II assessment – IMAP report.

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