



TRIETHYLAMINE

CAS number: 121-44-8

Synonyms: N,N-Diethylethanamine, (diethylamino)ethane

Chemical formula: C₆H₁₅N

Workplace exposure standard (amended)

TWA: 1 ppm (4.2 mg/m³)

STEL: 2 ppm (8.4 mg/m³)

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 1 ppm (4.2 mg/m³) is recommended to protect for visual disturbances in exposed workers.

A STEL of 2 ppm (8.4 mg/m³) is recommended to protect for visual disturbances and acute irritation in exposed workers.

Discussion and conclusions

Triethylamine is used in the production of pharmaceuticals, pesticides, resins and polyurethane foam.

The critical effects of exposure are reversible corneal changes that cause visual disturbances and higher concentrations cause mucous membrane irritation.

Transient visual disturbances occur before irritation in volunteers and workers exposed by inhalation (ACGIH, 2018; DFG, 1999; SCOEL, 1999). A threshold for reversible visual disturbances, such as blurred vision and decreased contrast sensitivity, is reported in the range between 0.7 and 2.4 ppm in volunteer inhalation studies. This observation is supported by a range of NOAEC of 1 to 2.7 ppm for these effects reported in several workplace studies (ACGIH, 2018; DFG, 1999; SCOEL, 1999). However, “blue haze” following eight-hour exposure at 2.6 ppm is reported in one workplace study. Eye and respiratory tract irritation are associated with concentrations above 10 ppm (ACGIH, 2018).

The TWA of 1 ppm by DFG (1999) and SCOEL (1999) is recommended to be adopted and is expected to be protective of visual disturbances experienced in exposed volunteers and workers. Intensified visual disturbances and mucous membrane irritation are reported in workplace studies above average concentrations of 2.6 ppm. Therefore, a STEL of 2 ppm is also recommended and expected to be protective of peak exposures.

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 due to evidence of dermal absorption and contribution to adverse systemic effects.

DRAFT

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1995	TWA: 2 ppm (8 mg/m³); STEL: 4 ppm (17 mg/m³)
ACGIH	2015	TLV-TWA: 0.5 ppm (2.07 mg/m³); TLV- STEL: 1 ppm (4.14 mg/m³)
TLV-TWA recommended to protect for eye, skin and respiratory tract irritation. TLV-STEL recommended to protect for transient visual disturbances from corneal changes that are produced at higher concentrations. Not classifiable as a human carcinogen (A4) based on results of chronic drinking water study with animals. Skin notation recommended based on low dermal LD₅₀ in rabbits. Summary of information: TLV-TWA and TLV-STEL based on reports of visual disturbances at 3 and 4 ppm and absence of these effects at 1–1.25 ppm. These reports are supported by results of volunteer studies in which a NOAEC of 0.72 ppm and LOAEC of 1.56 ppm were reported for reduced contrast sensitivity. Human data: • Elimination t_{1/2}: 3.2 h calculated from volunteer study with dose group 0, 2.5, 5, 8.5 and 12.5 ppm (n=5, 4 or 8 h) • Visual acuity unchanged at 0.72 and 1.56 ppm and contrast sensitivity decreased at 1.56 and 9.74 ppm in volunteer inhalation study (n=4, 4 h); blurred vision began at 4 h • Transient visual disturbances (foggy vision, blue haze and halo phenomena) reported 47 times in 19 workers exposed at 3 or 4 ppm; no visual symptoms reported at 1–1.25 ppm • Increased complaints of visual disturbance when exposures increased from 5–10 ppm in workplace study; slight eye and respiratory irritation at 10–15 ppm, headaches >15 ppm • No corneal oedema at 2.5 ppm in volunteer inhalation study (8 h). Animal data: • Severely irritating to eyes as vapour (cats, monkeys); reversibility of damage depends on exposure duration; 1.5 min caused reversible changes in monkeys (no further details) • LD₅₀: 420 mg/kg (rabbits, dermal) • LC₅₀: 1,450 ppm (mice, 4 h) • Corneal and pulmonary irritation at 50 and 100 ppm in subchronic inhalation study (rabbits, 7 h/d, 5 d/wk, 6 wk); effects correspond to those observed with ethylamine and diethylamine: ◦ liver, kidney and possible heart degeneration observed • Changes in nervous system function and haematological parameters and chronic lung inflammation at 7–19 ppm in sub-chronic inhalation study (rats, 6 mo, duration and frequency not specified) • NOAEL of 200 ppm of drinking water in chronic 2-generation feeding study; decreased body weight gain at 500 ppm in 3rd generation. Study limited by chronic respiratory disease in these animals (no further details) (rats, 2 yr for each generation); no increased tumorigenicity reported • No toxic effect or increased tumour incidence at 5,000 ppm of diet with 5,000 ppm of sodium nitrate in chronic feeding study (rats, 2 yr) • Non-mutagenic <i>in vitro</i> in bacteria and mammalian cells; increased aneuploidy in bone marrow cells <i>in vivo</i> at 0.2 ppm in subchronic inhalation study (rats, 3 mo, no further details)		



Source	Year set	Standard
Insufficient data to recommend a sensitiser notation.		
DFG	1999	MAK: 1 ppm (4.2 mg/m³)
Summary of additional information: Critical effect is subjective visual disturbance. MAK based on NOAEC of 2.4 ppm for visual disturbance in volunteer inhalation study and NOAEC range of 1.44–2.7 ppm for the same effect reported in workplace studies. Based on uncertainty in the range of NOAEC in humans, MAK of 1 ppm considered to be protective of critical effects; mucous membrane irritation not expected at this exposure based on inhalation experiments with animals. A Peak limitation (category V) of 2 ppm is set due to the intensive odour of the substance. Uncertain if low dermal LD₅₀ in rabbits was due to caustic or systemic action of the substance. Therefore, insufficient data to recommend skin notation. Human data: • No adverse effects at 2.4 ppm (8 h) or 4.32 ppm (4 h) in volunteer inhalation study with dose groups 0, 2.4, 4.32, 8.16 and 11.52 ppm (n=2, 4 or 8 h, also cited by ACGIH, 2018): ◦ severity of visual changes and oedema of cornea increased above 4.32 ppm ◦ latency of effects 4–6 h • Peak NOAEC of 2.16 (15 min) and 8.8 ppm (duration not specified) reported in 2 studies (n=33 and 82) of foundry workers with corresponding LOAEC of 11.4 and 12.4 ppm: ◦ 8-h NOAEC of 1.44 and 2.7 ppm calculated for each study, respectively ◦ defatting of skin reported in workers handling substance ◦ no evidence for sensitisation in patch test (n=33) • No epidemiological studies available of workers exposed to substance alone. Animal data: • Non-sensitising in mouse ear-swelling test with 0.1 mL of 1% solution (induction) and 0.01 mL undiluted substance (challenge). Insufficient data to recommend notations for carcinogenicity or sensitisation.		
SCOEL	1999	TWA: 1 ppm (4.2 mg/m³); STEL: 3 ppm (12.6 mg/m³)
Summary of additional information: Recommended OEL based on NOAEC of 0.7 ppm and LOAEC of 1.5 ppm for slight visual disturbances reported in a volunteer inhalation study (also cited by ACGIH, 2018). Agency considers study well-conducted and applies no UF to the NOAEC to derive an 8 h TWA of 1 ppm. Recommended STEL based on reports of visual disturbance in 3/4 workers at a TWA of 2.6 ppm with peak exposure at 5.7 ppm in workplace study. Proposed limits are not contradicted by results of subchronic animal studies. Skin notation recommended as dermal absorption could significantly contribute to overall body burden. Human data: • Odour threshold: 0.6 ppm • “Blue haze” in vision reported by 3/4 workers exposed to average air concentration of 2.6 ppm and peak concentration of 5.7 ppm; no signs of permanent eye damage • Minimal to moderate blurred vision and contrast sensitivity and mild corneal changes (not specified) in 3/4 volunteers in volunteer inhalation study with dose groups 0.7, 1.5 and 9.6 ppm (n=4, 4 h, also cited by ACGIH, 2018).		



Source	Year set	Standard
OARS/AIHA	NA	NA
No report.		
HCOTN	NA	NA
No report.		

Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ 2016	- Grouped assessment with other tertiary aliphatic amines due to structural and toxicological similarities - Acutely toxic following dermal exposure in OECD-compliant dermal application study (rats) - Dermal LD₅₀: 580 mg/kg undiluted (rats): - dermal necrosis and scabs observed at application site - darkened lungs, kidneys and mottled/pale liver and spleen observed at necropsy.
OECD	✓ 2012	- Grouped assessment with other tertiary aliphatic amines due to structural and toxicological similarities - No histopathological changes to reproductive organs at 22.7 or 231.8 ppm in sub-chronic inhalation reproductive study (rats, 6 h/d, 5 d/wk, 28 wk) - No carcinogenicity data available for chemicals in the group.
US NIOSH	✓ 1994	IDLH based on acute inhalation toxicity data in 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	—
NICNAS	—
EU Annex	—
ECHA	—
ACGIH	Carcinogenicity – A4, Skin
DFG	—
SCOEL	Skin



Source	Notations
HCOTN	NA
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

Adverse effects in human case study:
 Dermal LD₅₀ ≤ 1000 mg/kg:
 Dermal repeat-dose NOAEL ≤ 200 mg/kg:
 Dermal LD₅₀/Inhalation LD₅₀ < 10:
In vivo dermal absorption rate > 10%:
 Estimated dermal exposure at WES > 10%:

yes

yes

consider assigning a skin notation

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	101.19
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 4.14 mg/m ³ ; 1 mg/m ³ = 0.24 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) (1999) Triethylamine – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1999) Recommendation from the Scientific Committee on Occupational Exposure Limits for Triethylamine. SCOEL/SUM/55.



National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2016) Short chain (C2-3) alkyl amines: Human health tier II assessment – IMAP report.

Organisation for Economic Cooperation and Development (OECD) (2002) SIDS initial assessment profile – Tertiary Amines

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

DRAFT