ETHYLENEDIAMINE

CAS number: 107-15-3

Synonyms: 1,2-Diaminoethane, EDA

Chemical formula: $C_2H_8N_2$

Structural formula: —

Workplace exposure standard (retained)

TWA: **10 ppm (25 mg/m^3)**

STEL: **—**

Peak limitation: **—**

Notations: **Sk., DSEN, RSEN**

IDLH: **1,000 ppm**

Sampling and analysis: The recommended value is quantifiable through available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

The current TWA of 10 ppm (25 mg/m^3) is recommended to protect for irritant effects in exposed workers.

Discussion and conclusions

Ethylenediamine (EDA) is used as an intermediate in the manufacture of chelating agents, fungicides, synthetic waxes, polyamide resins, and corrosion inhibitors. It causes irritation of skin, mucous membrane and respiratory tract. Undiluted form is corrosive to skin and causes permanent damage to eyes.

No human exposure data are available. EDA is reported to cause irritation and allergenic effects in studies of workers. Exposure can contribute to dermatitis and cause allergenic effects on the respiratory tract of susceptible individuals. Occupational exposure has also been linked to asthma (ACGIH, 2018, DFG, 2003). EDA is corrosive to the skin of rabbits. A NOAEC of 59 ppm was reported in inhalational studies in rats (ACGIH, 2018). The ACGIH recommend a TLV-TWA of 10 ppm for occupational exposure.

In the absence of additional data, it is recommended that the current TWA be retained in-line with recommendations from the ACGIH (2018).

Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Classified as a skin sensitiser and respiratory sensitiser according to the GHS.

A skin notation is warranted based on percutaneous absorption in animals.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 10 ppm (25 mg/m^3)***
ACGIH	***2001***	***TLV-TWA: 10 ppm (25 mg/m^3)***

TLV-TWA recommended to minimise potential for skin, mucous membrane and respiratory tract irritation. TWA based on no adverse effects observed in study of rats administered 23 mg/kg/d and inhalation study of rats exposed to 59 ppm.

Summary of data:

Human data:

- Study of workers over 4 yr period following exposure to a mixture of ethylene amines including EDA (concentration not provided) found ethylene amines:
  - were an important cause of dermatitis
  - were irritative and allergenic and
  - can cause allergenic effect on respiratory tract of susceptible individuals
- Report of fatal poisoning following dermal and inhalation exposure:
  - exposure resulted in lysis of RBC causing tubulonephritis with anuria and lethal hyperkalaemia (elevated potassium in the blood)
  - death 55 h after the exposure from cardiac collapse
- 100 ppm in vapour reported irritating to humans and caused severe eye injury
- Occupational exposure linked to asthma and produced cough, wheezing, chest tightness and 26% reduction in forced expiratory volume >4 h in a respiratory provocation study of the worker.

Animal data:

- 100% mortality in 6 rats exposed to 4,000 ppm for 8 h; 2,000 ppm produced no lethality. Vapour was irritating to eyes, mucous membranes and respiratory tract
- LD_{50}: 657 mg/kg (rabbits, dermal)
- LD_{50}: 1,160 mg/kg (rats, oral)
- Undiluted EDA corrosive to rabbit skin with complete tissue destruction after 6–12 min:
  - 10% solution moderately irritating
  - 1% solution produced slight irritation and
  - 0.1% solution caused no irritation
- Undiluted EDA produced permanent eye damage in rabbits:
  - 15% solution causing corneal damage and
  - 5% solution only minor injury
- Repeated inhalation study of rats, exposed for 7 h/d, 5 d/wk for 30 d at 0, 59, 132, 225, or 484 ppm produced:
  - 100% lethality at 484 ppm
  - 80% lethality and liver and kidney effects at 225 ppm
  - depilation only at 132 ppm
  - no effects at 59 ppm
- Studies of dihydrochloride salt of EDA found hydrogen chloride moiety did not influence the toxicity of EDA following oral administration
- NOAEL: 23 mg/kg/d (rats, dietary, 90 d); 100 mg/kg/d (mice, oral gavage, 90 d); 59 ppm (rats, 30 d)

Source	Year set	Standard
• No carcinogenic response in dermal (mice) or dietary (rats) administration of EDA • No mutagenicity reported in five strains of *Salmonella*, *in vivo* or *in vitro* tests. A skin notation is recommended based on percutaneous absorption in animals. Insufficient data to recommend SEN notation or TLV-STEL, although based on link to asthma in worker exposed to EDA, the recommended TLV may not be protective of possible sensitisation or allergic reaction in susceptible workers.		
DFG	***2003***	***Not assigned***
Summary of additional data: • Human study identified 6 subjects from plastics industry developed occupational bronchial asthma following sensitisation and re-exposure: o bronchial provocation test with 0.1% in saline produced immediate reaction o a range of investigations were performed on the individuals with results indicating they had been sensitised • Positive results in intracutaneous test, Prausnitz-Küstner test, and delayed reaction from bronchial provocation provide evidence of immunological mechanism.		
SCOEL	***NA***	***NA***
No report.		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2019	• Additional uses include fabric softeners, surface treatment products, adhesives and binding agents, photographic agent, construction materials and electroplating chemical • TWA 10 ppm (25 mg/m^3). No STEL available • Respiratory effects (EDA-associated rhinitis, coughing and wheezing) following workplace exposure of ≈1 ppm.
US EPA	✓	1991	• Derivation of inhalation RfC not determined as health effects data deemed inadequate.
US NIOSH	✓	1994	• TWA 10 ppm (25 mg/m^3) • IDLH value may be conservative due to lack of relevant acute toxicity data for workers exposed to concentrations between 1,000 and 2,000 ppm.

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	Sen
HCIS	Skin sensitisation – category 1, Respiratory sensitisation – category 1
NICNAS	—
EU Annex	NA
ECHA	Skin Sens. 1, Resp. Sens. 1
ACGIH	Carcinogenicity – A4, Skin
DFG	Sa (respiratory sensitiser), Sh (dermal sensitiser)
SCOEL	NA
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:	yes
Dermal LD_{50} ≤1000 mg/kg:	yes
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 warranted

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	60.1
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 2.55 mg/m^3; 1 mg/m^3 = 0.408 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) (2003) Ethylenediamine – 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).

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2019) 1,2-Ethanediamine: Human health tier II assessment – IMAP report.

US Environmental Protection Authority (US EPA) (1991) Integrated Risk Information System (IRIS) Chemical Assessment Summary – Ethylene diamine; CASRN 107-15-3.

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