

ACRYLIC ACID

CAS number: 79-10-7

Synonyms: 2-propenoic acid; ethylene carboxylic acid;
glacial acrylic acid; propene acid; vinyl formic acid

Chemical formula: $C_3H_4O_2$

Structural formula:

Workplace exposure standard (amended)

TWA: 10 ppm (29 mg/m³)

STEL: —

Peak limitation: —

Notations: Sk.

IDLH: —

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

Recommendation and basis for workplace exposure standard

A TWA of 10 ppm (29 mg/m³) is recommended to reduce the risk of irritation of the eyes, nose and skin and altered pulmonary function in exposed workers.

A STEL is not recommended as the TWA is considered protective of acute adverse effects including skin corrosivity and eye damage.

Discussion and conclusions

Acrylic acid is used in many industries including plastics, adhesives, water treatment and textiles. It is irritating to the respiratory tract, corrosive to the skin and can damage the eyes. Evidence in animals (rats) also suggests reproductive effects including gross abnormalities in offspring (ACGIH, 2018; DFG, 2005; SCOEL 2012).

Local irritation dominates the toxic effects of acrylic acid. A sensory irritation threshold (lateralisation threshold) of 30 ppm was determined in a study of 72 male and female volunteers (SCOEL, 2012). A study in rats identified a NOAEL of 25 ppm for local irritant effects of the mucosa and acute exposure to irritant level concentrations also resulted in respiratory function effects (ACGIH, 2018). A study in mice identified a LOAEC of 5 ppm for local effects with a NOAEC of 5 ppm in females only for systemic effects. The NOAEL for developmental toxicity in rats is 200 ppm (SCOEL, 2012; ECHA, 2002).

SCOEL (2012) reports that calculations suggest humans have approximately the same nasal deposition rate as rats. ACGIH (2001) reported that mice were more susceptible to local effects caused by acrylic acid vapour and therefore evidence from rat studies is considered the most appropriate human model. Therefore, given the NOAEL of 25 ppm in rats for local irritation with systemic effects noted above this level, the recommended TWA is considered protective for both

short- and long-term critical health effects in exposed workers. The sensory irritation threshold of 30 ppm in humans supports this recommendation.

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 respiratory sensitiser or skin sensitiser according to the GHS.

A skin notation is recommended based on evidence from animal studies (rabbits) reporting systemic intoxication.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 2 ppm (5.9 mg/m³)
ACGIH	2001	TLV-TWA: 2 ppm (5.9 mg/m³)
<p>TLV-TWA expected to reduce the potential for mucous membrane irritation, ocular and respiratory tract irritation, altered pulmonary function and possible reproductive effects.</p> <p>Summary of data:</p> <ul style="list-style-type: none"> • A NOAEL of 25 ppm reported for rats exposed to acrylic acid vapours in a sub-chronic study (6 h/d, 5 d/wk for 13 wk) • In the same study, very slight focal degeneration of the olfactory mucosa and hyperplasia of the submucosal glands were observed at 75 ppm in mice with a NOAEC for female mice of 5 ppm • Mice considered to be more susceptible to local effects than rats • In rats, acute exposure to irritant level concentrations also resulted in decreased respiratory frequency, tidal volume and minute volume (no further information provided) • Gross abnormalities in offspring were observed from pregnant female rats exposed intraperitoneally on days 5, 10 and 15 of gestation (at 4.7 and 8 mg/kg) • Skin notation based on reported dermal LD₅₀ ranging from 295-950 mg/kg after single skin application in rabbits • Reported to be a skin sensitiser by guinea pig maximisation test • No mutagenic effects reported • Acrylic acid acted as a weak but complete carcinogen in a study with female mice (application of dilute acrylic acid (4% v/v in acetone) to dorsal skin 3 times/wk for 1.5 yr) • The derivation of the TLV-TWA is not transparent. 		
DFG	2005	MAK: 10 ppm (30 mg/m³)
<p>The critical effect of acrylic acid reported as irritation of the skin, eyes and nose.</p> <p>Summary of additional data:</p> <p>MAK of 10 ppm is based on:</p> <ul style="list-style-type: none"> • Assumption that the NOAEC for olfactory epithelium exposure in humans is not higher than in rats (25 mL/m³) • Irritation of olfactory epithelium does not substantially increase with time • Does not have to be metabolised, interindividual differences are likely minor. 		

Source	Year set	Standard
SCOEL	2012	TWA: 10 ppm (29 mg/m³); STEL (1 min) 20 ppm (59 mg/m³)
TWA established to protect for histological changes and nasal irritation. Summary of additional data: <ul style="list-style-type: none"> Local irritation dominates the toxic effects of acrylic acid As per ACGIH, NOAEL of 25 ppm for effects on the olfactory epithelium in rats In mice: LOAEL of 5 ppm; NOAEL for systemic toxicity of 5 ppm (females); LOAEL for systemic toxicity of 25 ppm (females) The NOAEL for developmental toxicity in rats is 200 ppm Stated that a nasal irritation threshold will not greatly change when extrapolating from experimentally-tested sub-chronic exposure to chronic exposure and that calculations suggest that humans have approximately the same deposition rate as rats Therefore, based on the NOAEL of 25 ppm in rats, a TWA of 10 ppm is considered appropriately protective. <p>STEL of 20 ppm (1 min) was based on a sensory threshold (trigeminal nerve) identified at 30 ppm reported in a study in 72 male and female volunteers</p> <ul style="list-style-type: none"> A skin notation was not warranted No evidence that pure acrylic acid causes respiratory or skin sensitisation. 		
OARS/AIHA	NA	NA
No report		
HCOTN	NA	NA
No report		

Secondary source reports relied upon

Source	Year	Additional information
HSE	✓ 2018	<ul style="list-style-type: none"> Adopted SCOEL TWA of 10 ppm (29 mg/m³) and 1 min STEL of 20 ppm (59 mg/m³).
NICNAS	✓ 2014	<ul style="list-style-type: none"> LD₅₀: 640 mg/kg (rabbits, dermal) Not considered to be a skin sensitiser The critical health effects include systemic acute effects (by oral, dermal and inhalation exposure) and local effects (corrosivity).
ECHA	✓ 2002	<ul style="list-style-type: none"> LOAEL in mice for local effects of 5 ppm, focal degeneration of the nasal olfactory epithelium (6 h/d, 5 d/wk for 90 d) NOAEL in female mice for systemic effects of 5 ppm, lower body weight gain (6 h/d, 5 d/wk for 90 d) (further information as per ACGIH).

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic?

No

Notations

Source	Notations
SWA	Sk.

Source	Notations
HCIS	—
NICNAS	NA
EU Annex	—
ECHA	—
ACGIH	Carcinogenicity – A4; Skin
DFG	—
SCOEL	—
HCOTN	NA
IARC	—
US NIOSH	SK:SYS

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:	
<i>In vivo</i> dermal absorption rate > 10%:	
Estimated dermal exposure at WES > 10%:	
a skin notation is warranted	

IDLH

Is there a suitable IDLH value available? No

Additional information

Molecular weight:	72.06
Conversion factors at 25°C and 101.3 kPa:	1 ppm = Number mg/m ³ ; 1 mg/m ³ = Number ppm
This chemical is used as a pesticide:	<input type="checkbox"/>
This chemical is a biological product:	<input type="checkbox"/>
This chemical is a by-product of a process:	<input type="checkbox"/>
A biological exposure index has been recommended by these agencies:	<input type="checkbox"/> ACGIH <input type="checkbox"/> DFG <input type="checkbox"/> 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) (2005) Acrylic acid – MAK value documentation.

European Chemicals Agency (ECHA) (2002) European Union Risk Assessment Report. EINECS No: 201-177-9

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2011) Recommendation from the Scientific Committee on Occupational Exposure Limits for acrylic acid. SCOEL/SUM/128

UK Health and Safety Executive, (HSE) (2018) *Acrylic Acid* – EH40/2005 Workplace Exposure Limits: Summary criteria for occupational exposure limits.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2014) 2-Propenoic acid: Human health tier II assessment – IMAP report.

US National Institute for Occupational Safety and Health (NIOSH) (1987) NIOSH Skin Notation Profiles: acrylic acid.

UK Health and Safety Executive (HSE) (2018) Acrylic acid – EH64: Summary criteria for occupational exposure limits.