

ACRYLONITRILE

CAS number: 107-13-1

Synonyms: Vinyl cyanide, prop-2-enenitrile

Chemical formula: CH₂CHCN

Structural formula:

Workplace exposure standard (amended)

TWA: 0.5 ppb (1.17 µg/m³)

STEL: —

Peak limitation: —

Notations: Carc. 1B, Sk., DSEN

IDLH: —

Sampling and analysis: The recommended value is below the current limit of detection for available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 0.5 ppb (1.17 µg/m³) is recommended to protect for excess cancers in workers exposed to acrylonitrile. The TWA is also considered to be protective of respiratory and central nervous system effects.

Discussion and conclusions

Evidence in animal studies shows that acrylonitrile is carcinogenic with positive results from adequately conducted mutagenicity tests. It is noted that there is an unknown relevance for these carcinogenic effects in humans (SCOEL, 2008). A clear mechanism for tumour formation cannot be determined. However, genotoxicity cannot not be eliminated. As such, acrylonitrile is assumed to be a non-threshold based genotoxic carcinogen (DFG 2007; SCOEL 2008; ACGIH, 2018; ECHA, 2018).

The recommended TWA is associated with a minimal cancer risk. The recommended TWA was calculated applying an inhalation slope factor derived from a relative risk model based on quality of epidemiological data from a large, high-quality study of acrylonitrile exposure in an occupational setting (US EPA, 1987).

Inhalation of acrylonitrile is toxic to the respiratory and central nervous systems (ACGIH, 2018). Additionally, case reports have documented systemic toxicity and death following accidental dermal exposure (ACGIH, 2018). The recommended TWA is protective of these non-cancer health effects.

Recommendation for notations

Classified as a category 1B carcinogen according to the Globally Harmonized System of Classification and Labelling on Chemicals (GHS).

Classified as a skin sensitiser but not a respiratory sensitiser according to the GHS.

A skin notation is recommended based on sufficient evidence in humans demonstrating systemic effects following dermal exposure.

DRAFT

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 2 ppm (4.3 mg/m³)
ACGIH	2016	TLV-TWA: 2 ppm (4.3 mg/m³)
<p>The TLV-TWA is recommended to reduce the potential for headache, nausea, respiratory difficulties and CNS effects.</p> <p>Summary of data:</p> <p>Human data:</p> <ul style="list-style-type: none"> Respiratory and CNS effects are associated with the metabolism of acrylonitrile and the release of cyanide No respiratory or CNS effects observed in rats exposed to 90 ppm for 8 h Application of uncertainty factors (not disclosed) were applied to 90 ppm to support recommended TLV-TWA of 2 ppm Case reports of dermal exposure reported systemic toxicity and death. <p>Animal data:</p> <ul style="list-style-type: none"> NOAEL:15 ppm (rats) for reproductive effects (parental systemic toxicity) Long-term exposures associated with cancer of GIT, mammary gland, CNS and Zymbal's gland in rats; increased incidence of tumours also in mice Female rats exposed to 20 ppm for 2 yr demonstrated increased incidence of glial cell (CNS) tumours Considered weakly mutagenic in several <i>Salmonella typhimurium</i> strains. <p>Various epidemiological studies did not associate occupational exposures with excess cancer mortality including a large robust, cohort of 25,460 acrylonitrile workers.</p> <p>Sufficient data not available to recommended a sensitiser notation or TLV-STEL.</p>		
DFG	2007	NA
<p>No MAK value recommended.</p> <p>Summary of additional information:</p> <ul style="list-style-type: none"> A NOAEC could not be established for inhalation from studies reviewed Classified as a category 2 carcinogen and genotoxicity cannot be excluded Evidence supporting a sensitiser notation. 		
SCOEL	2008	NA
<p>No TWA recommended.</p> <p>Summary of additional information:</p> <ul style="list-style-type: none"> A health-based OEL cannot be derived because: <ul style="list-style-type: none"> established carcinogen in experimental animals a genotoxic mechanism cannot be eliminated epidemiological evidence does not exclude carcinogenicity possibility in humans 2 ppm offers adequate protection against health effects other than carcinogenicity A skin notation is supported by reports of occupational poisonings by skin contact. 		

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

Secondary source reports relied upon

Source	Year	Additional information
HSE	✓ 2005	<ul style="list-style-type: none"> TWA 2 ppm Carcinogen and skin notations.
US EPA	✓ 1987	<ul style="list-style-type: none"> An inhalation unit risk factor was calculated from a relative risk model adjusted for smoking and based on a continuous lifetime equivalent of occupational exposure A trend of increased cancer incidence was seen with increased duration of exposure Relative risk taken from a study reporting statistically significant increase in incidence of lung cancer in exposed workers The study was considered to be sufficiently large with adequate follow up time Additional evidence: observation of brain tumours in rats exposed by various routes (drinking water, gavage and inhalation).
ECHA	✓ 2018	<ul style="list-style-type: none"> Positive mutagenicity in vitro results and in Drosophila indicates genotoxic potential Mode of action for tumour formation not entirely known Most evaluations of acrylonitrile consider it a non-threshold carcinogen. Evidence indicates a threshold mode of action is plausible Proposed a limit of 1 mg/m³ (0.45 ppm) for cancer effects to be sufficiently protective against local irritant effects in the nose Limit derived by applying an assessment factor of 62.5 (interspecies, intraspecies, dose-response and severity) BMDL05 of 60 mg/m³ (27.6 ppm).

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? Yes

Is the chemical carcinogenic with a mutagenic mechanism of action? Yes

The chemical is a non-threshold based genotoxic carcinogen.

Is a cancer slope factor or inhalation unit risk value available? Yes

Inhalation unit risk value (1/(µg/m³)) 6.8 x 10⁻⁵

Calculated TWA value (µg/m³) 1.17

Notations

Source	Notations
SWA	Carc. 1B, Skin., Sen
HCIS	Carcinogenicity – category 1B; Skin sensitisation – category 1.
NICNAS	Carc. Cat. 2
EU Annex	NA
ECHA	Carcinogen 1B, Skin
ACGIH	Carcinogenicity – A3, Skin
DFG	Carcinogenicity – 2; H (skin), Sh (dermal sensitiser)
SCOEL	Carcinogenicity – 2; Skin
HCOTN	NA
IARC	Carcinogenicity – Group 2B
US NIOSH	SK:SYS, SK:SEN
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:	
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, the chemical is a genotoxic carcinogen

Additional information

Molecular weight:	53.06
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"/>

Molecular weight:	53.06
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"/>
A biological exposure index has been recommended by these agencies:	<input type="checkbox"/> ACGIH <input checked="" 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) (2007) Acrylonitrile – MAK value documentation.

European Chemicals Agency (ECHA) (2018) Committee for Risk Assessment RAC Opinion on scientific evaluation of occupational exposure limits for Acrylonitrile ECHA/RAC/ O-0000001412-86-188/F.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2003) Recommendation from the Scientific Committee on Occupational Exposure Limits for acrylonitrile. SCOEL/SUM/104.

International Agency for Research on Cancer (IARC) (1999) Acrylonitrile. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2000) Acrylonitrile: Priority Existing Chemical Assessment Report No. 10.

UK Health and Safety Executive (HSE) (2005) Acrylonitrile – EH64: Summary criteria for occupational exposure limits.

US Environmental Protection Agency (US EPA) (1987) Integrated Risk Information System (IRIS). Chemical Assessment Summary – Acrylonitrile.

US National institute for Occupational Safety and Health (NIOSH) (2011) Skin Notation Profiles: Acrylonitrile.