

AMMONIA

CAS number: 7664-41-7

Synonyms: Nitrogen trihydride, trihydridonitrogen, hydrogen nitride

Chemical formula: NH_3

Structural formula:

Workplace exposure standard (amended)

TWA: 20 ppm (14 mg/m³)

STEL: 35 ppm (24 mg/m³)

Peak limitation: —

Notations: —

IDLH: 300 ppm

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 20 ppm (14 mg/m³) is recommended to protect for eye and respiratory tract irritation in exposed workers. A STEL of 35 ppm (24 mg/m³) is recommended to protect for acute exposures and minimise irritation effects and discomfort.

Discussion and conclusions

Ammonia is used as a fertiliser in ammoniated fertilisers. It is also used in the manufacture of nitric acid, hydrazine hydrate, hydrogen cyanide and acrylonitrile. Other applications of ammonia include its use as a refrigerant, as a condensation catalyst for polymers and it is also used in nitriding of steel. Exposure to airborne ammonia is associated with irritant effects of the eyes and respiratory tract (ACGIH, 2018).

A LOAEL of 50 ppm (36 mg/m³) for mild irritation is reported in humans (SCOEL, 1992). A NOAEL of 13.6 mg/m³ (approximately 20 ppm) for both decreased lung function and respiratory effects is reported in workers (US EPA, 2016). It is expected that the recommended TWA will protect for irritant effects in exposed workers and the STEL will provide a margin of safety for acute 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.

Insufficient data available to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 25 ppm (17 mg/m³); STEL: 35 ppm (24 mg/m³)
ACGIH	2001	TLV-TWA: 25 ppm (17 mg/m³); TLV-STEL: 35 ppm (24 mg/m³)
TLV-TWA recommended to minimise the potential for eye and respiratory tract irritation. TLV-STEL recommended to provide a greater margin of safety against the acute sensory effects. Summary of data: Ammonia is used as a fertiliser in ammoniated fertilisers. It is also used in the manufacture of nitric acid, hydrazine hydrate, hydrogen cyanide and acrylonitrile. Other applications of ammonia include its use as a refrigerant, as a condensation catalyst for polymers and it is also used in nitriding of steel. Human data: • Temporary blindness and intolerable irritation reported following exposure to high concentrations (no further information) • Severe damage and irritation of the glottis reported following exposure to high concentrations (no further information) • Chronic airway hyperactivity and asthma and associated obstructive pulmonary function reported following massive exposures • Limit of detection reported <5 ppm, and complaint level of 20–25 ppm • 20 ppm caused complaints and discomfort in uninured (unaccustomed) workers ◦ irritation of respiratory tract and mucous membranes of the eye in workers breathing 100 ppm • 20–25 ppm reported as the maximum acceptable concentration without serious complaints in workers exposed to blueprinting and copying machines • US Navy maximum limit for continuous exposure in submarines of 25 ppm. Animal data: • 3 ppm for 7–8 min stopped rat respiratory tract cilia from beating • Significant response in ciliary activity in rabbits at 100 ppm ◦ combined effect of co-exposure with carbon particles greater than ammonia alone • Reduced feed consumption (but no reduction in the efficiency of feed conversion) in pigs exposed to 103 and 145 ppm continuously for 5 wk.		
DFG	1999	MAK: 20 ppm (14 mg/m³)
MAK recommended to reduce irritation in the mucous membranes. Summary of additional data: • Previous MAK based on evidence from animal experiments and human experience indicate irritation of the mucous membranes occur at ≈50 ppm • Long-term exposure to 10 ppm produced no effects in workers • Sensitivity in humans to first-time exposure • MAK was derived with consideration of the limited knowledge about habituation and its mechanisms.		

Source	Year set	Standard
SCOEL	1992	TWA: 20 ppm (14 mg/m³); STEL: 50 ppm (36 mg/m³)
TWA and STEL recommended to prevent irritation in exposed workers.		
Summary of additional data:		
TWA derived by applying uncertainty factor of 2 to LOAEL (36 mg/m³ [50 ppm] for mild irritation in humans) and adjusted to preferred integer of 2.		
OARS/AIHA	NA	NA
No report.		
HCOTN	NA	NA
No report.		

Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ 2014	- Not expected to cause specific reproductive or developmental toxicity - Corrosive to the respiratory tract.
US EPA	✓ 2016	NOAEL 13.6 mg/m³ for decreased lung function and respiratory effects in workers (adjusted to continuous exposure: 4.9 mg/m³).

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	NA
EU Annex	NA
ECHA	NA
ACGIH	—
DFG	—
SCOEL	—
HCOTN	NA
IARC	NA

Source	Notations
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:	no
Dermal LD ₅₀ ≤ 1000 mg/kg:	no
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 not warranted	

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	17.03
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:	☐
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) Ammonia – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1992) Recommendation from the Scientific Committee on Occupational Exposure Limits for ammonia. SEG/SUM/20.

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

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

US Environmental Protection Agency (US EPA) (2016) Toxicological Review of Ammonia Noncancer Inhalation.