NITRIC ACID

CAS number: 7697-37-2

Synonyms: —

Chemical formula: HNO_3

Workplace exposure standard (amended)

TWA: **2 ppm (5.2 mg/m^3)**

STEL: **—**

Peak limitation: **—**

Notations: **—**

IDLH: **25 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 2 ppm (5.2 mg/m^3) is recommended to protect for eye and respiratory tract irritation in exposed workers.

A STEL is not recommended as there is no evidence of acute adverse effects evident within ten times the TWA concentration.

Discussion and conclusions

Nitric acid is used to dissolve metals and to make nitrates and nitro compounds.

The critical effects of exposure are eye, nose and respiratory tract irritation. It also causes severe burns on contact with skin. Humans inhaling 84 ppm did not tolerate exposure for more than two to three minutes (DFG 1992, SCOEL 2001). Heated acid vapour concentrations around 12 ppm are not tolerated for longer than one hour, with 1.6 ppm tolerated for 10 minutes with no ill effects in humans (DFG 1992, SCOEL 2001). No visible toxic effects reported in six-month animal inhalation study at 4 ppm (DFG 1992). Effects observed on both the conducting and respiratory airways at concentrations as low as 0.05 ppm in a four-week inhalation study in rabbits (NICNAS, 2015). Due to the limitations of this study and the weight of evidence to the contrary, the SWA TWA of 2 ppm (5.2 mg/m^3) is recommended and considered protective of irritant effects as reported by ACGIH (2018) and DFG (1992).

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.

There are insufficient data to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 2 ppm (5.2 mg/m^3); STEL: 4 ppm (10 mg/m^3)***
ACGIH	***2001***	***TLV-TWA: 2 ppm (5.2 mg/m^3); TLV-STEL: 4 ppm (10 mg/m^3)***

TLV-TWA recommended to minimise the risk of eye, skin, mucous membrane and upper respiratory tract irritation in exposed workers.

Summary of data:

Human data:

- Severe burns observed on dermal contact, diluted solutions produce irritation
- Multiple fatalities resulted from acute inhalation exposure (unknown concentration):
  - death can be delayed for several days
- Acute occupational exposure in combination with NO_2 and NO led to a variety of respiratory tract irritation effects:
  - sustained higher concentrations leading to pulmonary oedema
- Chronic inhalation exposure may result in bronchitis and chemical pneumonitis (concentration not noted)
- Reported link between inhalation exposure and dental erosion
- A maximum allowable concentration is suggested at 10 ppm (no justification provided).

Animal data:

- Exposure at 63 mg/m^3 (rats, inhalation) produced no observable adverse effects, no details of study provided
- Red fuming nitric acid more toxic than concentrated nitric acid due to potentiation into NO_2
- LC_{50}: 334 ppm (rats, 30 min), 244 ppm measured as NO_2.

Insufficient data to recommend skin, sensitiser or carcinogen notation.

DFG	***1990***	***MAK: 2 ppm (5 mg/m^3)***

Few studies have investigated the effects at concentrations in the range of the MAK value and these studies do not meet present-day requirements. The MAK is considered provisional.

Summary of additional data:

- In a human volunteer study, vapours at 84 ppm could not be inhaled for longer than 2–3 min
- Human dermal exposure at 0.01 mL of 39% solution for 2 min produced transient erythematous reaction for 15–30 min:
  - 5 min exposure caused blisters and erythema
- Exposure at 4 ppm of red fuming nitric acid (mice, rats, guinea pigs, 4 h/d, 5 d/wk, 6 mo, inhalation) produced no visible toxic effects
- Negative results in mutagenicity assays
- Exposure at 0.27 ppm aerosol (rats, 6 h, 6 exposures, inhalation) produced no carcinogenic effects.

Source	Year set	Standard
SCOEL	***2001***	***STEL (15 mins): 1 ppm (2.6 mg/m³)***
The NOAEL of 1.6 ppm for local short-term (10 min) effects is considered to provide a basis for assigning a STEL. Summary of additional data: • Vapours from heated nitric acid in concentrations of 11.5–12.2 ppm could not be inhaled >1 h without causing health effects in humans • Exposure at 1.6 ppm (human, inhalation) for 10 min had no effect on pulmonary function in healthy volunteers, study was limited to 5 subjects and 1 concentration • No evidence of mutagenicity was found in bacterial studies.		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2015	• Inhalation exposure at 0.2 ppm cause no respiratory effects in humans • Exposure at 0.05, 0.15 and 0.45 mg/m³ (rabbits, 4 h/d, 3 d/wk, 4 wk) produced a reduction of superoxide levels and a reduction in bronchial response to pharmacologic agents indicating effects on both the conducting and respiratory airways: ○ systemic effects not reported.
ECHA	✓	2011	• Aerosol fraction LC_{50}: >2,650 mg/m³ (rats, 4 h) • Negative results in *in vitro* mutagenicity assays • Inconclusive results in *in vivo* genotoxicity *assay*.

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	NA
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	NA

Source	Notations
ACGIH	NA
DFG	NA
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

Insufficient data to assign a skin notation.

IDLH

Is there a suitable IDLH value available?	Yes

Additional information

Molecular weight:	63.02
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) (1992) nitric acid – MAK value documentation.

European Chemicals Agency (ECHA) (2011) nitric acid – REACH assessment.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2001) Recommendation from the Scientific Committee on Occupational Exposure Limits for nitric acid. SCOEL/SUM/61.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2015) Nitric acid: Human health tier II assessment – IMAP report

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