# Formic acid

| CAS number: | 64-18-6 |
| --- | --- |
| Synonyms: | Methanoic acid, carbonous acid, formylic acid |
| Chemical formula: | CH2O2 |
| Structural formula: | — |

Workplace exposure standard (retained)

| TWA: | **5 ppm (9.4 mg/m3)** |
| --- | --- |
| STEL: | **10 ppm (19 mg/m3)** |
| Peak limitation: | — |
| Notations: | — |
| IDLH: | **30 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 5 ppm (9.4 mg/m3) is recommended to protect for potential liver changes in exposed workers.

A STEL of 10 ppm (19 mg/m3) is recommended to protect for acute irritation of the eyes, skin, mucous membrane and respiratory tract in exposed workers.

## Discussion and conclusions

Formic acid is used in the dyeing and finishing of textiles and paper, the treatment of leather, electroplating, brewing, silvering glass and as an intermediate in the production of chemicals.

Critical effects of exposure include irritation of the eyes, skin and respiratory tract and potential liver damage.

The available data on irritant effect concentrations are conflicting. A sub-chronic inhalation study of rats and mice reports a NOAEC of 16 ppm for histopathological and systemic effects (changes to liver weights) and 32 ppm for lesions of the nasal epithelium (DFG, 2003). Based on an acute inhalation study in guinea pigs, HCOTN (2005) report that an increase in airway resistance would occur at an exposure concentration of 2 to 5 mg/m3 (1 to 2.8 ppm) whilst maintaining the existing TWA. However, this study is not considered suitable due to the sensitivity of guinea pigs to irritant substances (DFG, 2003).

A TWA of 5 ppm is consistent across primary sources. In absence of any other data, a TWA of 5 ppm and STEL of 10 ppm are recommended. This recommendation is considered sufficiently low to minimise potential for liver changes and irritation of the skin, eyes and respiratory system in exposed workers.

## 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: 5 ppm (9.4 mg/m3); STEL: 10 ppm (19 mg/m3) | |
|  |
| ACGIH 2001 TLV-TWA: 5 ppm (9.4 mg/m3); STEL: 10 ppm (19 mg/m3) |
| TLV-TWA and TLV-STEL recommended to minimise the potential for irritation of the eyes, skin, mucous membrane and respiratory tract in exposed workers.  Summary of data:  TLV-TWA and TLV-STEL are based on referenced recommended levels (details not provided).  Insufficient data to recommend a carcinogen, skin or sensitiser notation.  Human data:   * Primary reported symptom is mucous membrane, eyes and skin irritation * Ingestion of 50 g resulted in salivation, vomiting and burning in the mouth and pharynx and severe pain potentially followed by circulatory collapse and death * Worker splashed in face at an elevated temperature resulted in dyspnoea, difficulty swallowing and death within 6 h. No further information on main route of exposure * TLV based on referenced threshold limits, details not provided. |
| DFG 2003 MAK: 5 ppm (9.5 mg/m3) |
| Summary of additional data:  There are no studies of dermal absorption or of allergenic effects.  Human data:   * A case-control study on patients with tumours was inadequate to draw conclusion and not applicable to occupational exposure setting.   Animal data:   * LC50: 7,400 mg/m3 (rats, 4 h) * LD50: 730–1,830 mg/kg (rats and mice, oral) * Guinea pigs showed increased airway resistance and reduced dynamic compliance at concentrations between 0.34–42.5 mL/m3, 1 h exposure: * guinea pigs considered very sensitive to irritant substances and react with bronchoconstriction; quantitative comparison with humans not possible at present * NOAEC: 16 mL/m3 (rats and mice, 13 wk, inhalation) for histopathological and systemic effects (changes to liver weights), 32 mL/m3 (32 ppm) for lesions of the nasal epithelium * NOAEL: 160 mg/kg/d (rats, 27 wk, oral) * NOAEC: 128 ml/m3 (rats and mice, 13 wk, inhalation) for sperm motility, sperm concentration, testis or epididymis weights and the oestrus cycle * *In Vitro* developmental studies in rats suggested embryotoxic potential * *In Vivo* developmental study on rats for 5 generations at 0.2% and 2 generations at 0.4% (150–200 mg/kg), no evidence of effects on fertility, development of the embryos, the number of litters or the body weight gains of the offspring * No convincing evidence that formic acid is mutagenic in *in vitro* assays   No evidence of carcinogenicity in short or long-term studies. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2005 TWA 8 hours: 5 ppm (9 mg/m3) |
| HCOTN recommends a 15-minute OEL of 2.5 ppm (5 mg/m3) to avoid bronchoconstriction observed in Guinea pigs during 1 h exposure. Combined with applying an assessment factor of 6 to the NOAEL of 16 ppm for local irritant and systematic effects in mice and rats and rounding up according to HCOTN methodology.  Additional data:   * 50% increase in airway resistance occur at an exposure concentration of formic acid between 2–5 mg/m3 (1–2.8 ppm, 1 h, guinea pigs). Similar bronchoconstriction response possible in humans. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2013 | * Not shown to be a skin sensitiser in a Buehler study * Sensitisation in human reported when the patient had been previously sensitised to formaldehyde. |

### 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 | — |
| EU Annex | NA |
| ECHA | — |
| ACGIH | — |
| DFG | — |
| SCOEL | NA |
| HCOTN | — |
| 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 |
| --- |
| Insufficient data to assign a skin notation. |

### IDLH

| Is there a suitable IDLH value available? | Yes |
| --- | --- |

## Additional information

| Molecular weight: | 46.03 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = 1.88 mg/m3; 1 mg/m3 = 0.532 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*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2003) Formic Acid – MAK value documentation.

European Chemicals Agency (ECHA) (2016) formic acid – REACH assessment.

Health Council of the Netherlands (HCOTN) (2005) Formic acid. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/149.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2013) Formic 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 – formic acid.