# Hydrogen fluoride

| CAS number: | 7664-39-3 |
| --- | --- |
| Synonyms: | Antisal 2B, etching acid, fluorohydric acid, fluoric acid, HF A, hydrofluoric acid |
| Chemical formula: | HF |

Workplace exposure standard (amended)

| TWA: | **0.5 ppm (0.4 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **2 ppm (1.6 mg/m3)** |
| Notations: | **Sk.** |
| 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 0.5 ppm (0.4 mg/m3) is recommended to protect for eye, skin and respiratory tract irritation and to reduce the risk of skeletal fluorosis in exposed workers.

A peak limitation of 2 ppm (1.6 mg/m3) is recommended to protect for acute respiratory tract damage in exposed workers.

## Discussion and conclusions

Hydrogen fluoride (HF) is used in many industrial processes, such as production of aluminium, inorganic fluorides, oil alkylation and etching of glass and ceramics.

The critical effects of exposure include irritation of the respiratory system, eyes and skin and skeletal fluorosis. HF is reported to be corrosive. Volunteers exposed at 2.59 ppm for six hours a day for over 25 days demonstrated symptoms of irritation in the upper respiratory tract and erythema on the facial skin (DFG, 2016). A NOAEC of 0.9 ppm is reported in human volunteers for changes in biochemical and cellular indices in bronchoalveolar lavage (BAL) fluid. The exposure duration for this study was reported as one hour. In another study, human volunteers were exposed at 4.7 ppm for six hours a day for up to 50 days. The effects are reported as tolerable and not severe. In humans, exposure at greater than 3 ppm resulted in redness of the skin and some burning and irritation of the nose and eyes. Rabbits, guinea pigs and pigeons exposed at 3 ppm for 30 days demonstrated no injurious effects (ACGIH, 2018).

Based on the NOAEC of 0.9 ppm, ACGIH derived a TLV-TWA of 0.5 ppm (0.4 mg/m3) which is recommended to be adopted (derivation not reported). Given the evidence of irritation at concentrations greater than 3 ppm and the outcome, it is likely that ACGIH divided the NOAEC by a factor of two. This TWA is considered sufficiently low to protect for irritation in exposed workers and to reduce the risk of skeletal fluorosis.

Given the corrosive nature of HF, a peak limitation of 2 ppm (1.6 mg/m3) is recommended to protect for severe and acute damage to the respiratory tract 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.

A skin notation is recommended based on evidence of dermal uptake and systemic effects in humans.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 Peak limitation: 3 ppm, (2.6 mg/m3) as F | |
|  |
| ACGIH 2005 TLV-TWA: 0.5 ppm, as F; TLV-Ceiling: 2 ppm, as F |
| TLV-TWA recommended to minimise the potential for adverse effects in the respiratory tract, dermal or skeletal fluorosis and irritation of the eyes and skin.  Ceiling recommended due to corrosive nature and to protect for lung damage.  Summary of data:  Human data:   * Human volunteers exposed at 2.6-4.7 ppm 6 h/d, for 10–50 d: * tolerable without severe adverse effects * exposure at >3 ppm resulted in redness of skin and some burning and irritation of the nose and eyes * NOAEC of 0.6 mg/m3 (0.9 ppm) in human volunteers; 1 h exposure; changes in biochemical and cellular indices in BAL fluid * Case reports of accidental combined inhalation and dermal exposure resulting in systemic effects such as cardiac arrhythmias, hypocalcaemia and hypomagnesemia in addition to fatal pulmonary oedema * Elevated bone F measurements reported in a worker exposed for 10 yr; no further information * Evidence of skeletal fluorosis in four workers exposed to a mixture of HF and fluorides * No significant changes in pulmonary function found following occupational exposure average of 1.03 ppm * Threshold for minimal increases (Grade I) in bone density (fluorosis) <3.38 mg/m3 (4.3 ppm); Grade I fluorosis results in no medically recognised dysfunction.   Animal data:   * Reports of brief exposures being able to produce severe injury in test animals; mucous membrane irritation, respiratory distress, corneal opacity, erythema of exposed skin, pulmonary congestion, intra-alveolar oedema, thymic haemorrhage and death * Lethal to guinea pigs and rabbits; 300 ppm for 2 h * Animals tolerated repeated daily exposures of 8.6 ppm 6 h/d for 30 d; mild irritation effects * Rabbits, guinea pigs and pigeons exposed at 3 ppm for 30 d demonstrated no injurious effects.   Insufficient data to recommend a sensitiser or carcinogenicity notation. |
| DFG 2016 MAK: 1 ppm (0.83 mg/m3) |
| Summary of additional data:   * 2001 MAK of 2 ppm based on following evidence: * volunteers exposed at 2.59 ppm for 6 h/d over 25 d or ≥3.0 ppm for 1 h demonstrated symptoms of irritation in the upper respiratory tract and erythema on the facial skin.   MAK reduced to 1 ppm because of systemic effects, to prevent skeletal fluorosis; no further explanation. |
| SCOEL 1998 TWA: 1.5 mg/m3; STEL: 2.5 mg/m3 (3 ppm) |
| Summary of additional data:   * 5 volunteers exposed at 2.6–4.7 ppm (2.1–3.9 mg/m3) for 6 h/d over 10–50 d, showed slight irritation of the facial skin, eyes and nose * 1.42 ppm (1.2 mg/m3) considered to have no effects, other than an unpleasant taste in the mouth * Urinary NOAEL of 8 mg/L F and consideration absorption and kinetics forms basis of TWA; no further information * STEL recommended to protect for a significant increase in the critical body burden, which could result in fluorosis * Pungent, irritating odour, which is detectable at about 0.04 ppm (0.03 mg/m3). |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2009 Not assigned |
| Summary of additional data:   * Evaluation of the effects on reproduction; no indication of effects on development and fertility. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2001 | * No further relevant data. |

### 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 |
| ACGIH | Skin |
| 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

| Calculation |
| --- |
| |  |  |  |  | | --- | --- | --- | --- | | Adverse effects in human case study: | yes | 4.00 |  | | Dermal LD50 ≤1000 mg/kg: |  |  |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  |  | **a skin notation is warranted** | |

### IDLH

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

## Additional information

| Molecular weight: | 20.01 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = Number mg/m3; 1 mg/m3 = 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*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2016) Addendum to Hydrogen Fluoride and Inorganic Fluorine Compounds (Fluorides) – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1998) Recommendation from the Scientific Committee on Occupational Exposure Limits for Fluorine, Hydrogen Fluoride and Inorganic Fluorides (not uranium hexafluoride). SCOEL/SUM/56.

Health Council of the Netherlands (HCOTN) (2009) Hydrogen fluoride and sodium fluoride. Evaluation of the effects on reproduction, recommendation for classification. The Hague: Health Council of the Netherlands; publication no. 2009/04OSH.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2001) Hydrogen Fluoride: Priority Existing Chemical (PEC) report – No 19.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – hydrogen fluoride (as F).