# Fluorides (as F)

| CAS number: | 16984-48-8 |
| --- | --- |
| Synonyms: | — |
| Chemical formula: | F |
| Structural formula: | — |

Workplace exposure standard (interim)

| TWA: | **2.5 mg/m3** |
| --- | --- |
| STEL: | — |
| Peak limitation: | — |
| Notations: | **Sk.** |
| IDLH: | **250 mg F/m3** |
| **Sampling and analysis:** The recommended value is quantifiable through available sampling and analysis techniques. | |

## Recommendation and basis for workplace exposure standard

An interim TWA of 2.5 mg/m3 is recommended to protect for irritation of the eyes and respiratory tract and minimise the potential for fluorosis in exposed workers.

Given the data available from the primary sources, it is recommended that a review of additional sources be conducted at the next scheduled review.

## Discussion and conclusions

Fluorides comprise simple to complex compounds of fluorine (F) with other chemical elements and are used in a wide range of commercial and domestic uses including as an additive to drinking water (sodium fluoride) to reduce dental caries.

The critical effects of exposure are irritation of the eyes and respiratory tract and bone changes due to skeletal fluorosis. Complaints of eye and respiratory passage irritation and nausea associated with concentrations of 5 mg/m3 have been reported. Nosebleeds are reported following exposure to fumes containing greater than 10 mg/m3, but no effects at below 2.5 mg/m3. No bone changes are identified in a group of workers exposed to fluoride averaging 2.65 mg/m3 (ACGIH, 2018). No skeletal fluorosis is reported with 8 mg per day in drinking water. The DFG (2005) cited the US EPA (1983) with a recommendation of an upper limit total intake of 10 mg per day, stating that this dose is equivalent to an airborne concentration of 1 mg/m3 per eight hour shift, assuming inhaling 10 m3 (DFG, 2005).

Based on the weight of evidence presented, the TWA of 2.5 mg/m3 is recommended to be retained in the interim to protect for irritation effects in exposed workers. It is, however, recommended that an investigation of additional data sources is undertaken at the next scheduled review to better understand total body burden.

## 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 evidence in animals of dermal uptake and systemic effects.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 2.5 mg/m3 | |
|  |
| ACGIH 2001 TLV-TWA: 2.5 mg/m3 |
| TLV-TWA recommended to minimise the potential for disabling bone changes due to fluorosis and protect against irritation of the eyes and respiratory tract.  Summary of data:  Human data:   * Magnesium foundry fumes containing fluoride at >10 mg/m3 reported to be irritating and caused nosebleeds: * no effects reported at <2.5 mg/m3; author suggested limit of 2 mg/m3 * No bone changes reported in a group of workers exposed at an average of 2.65 mg/m3: * increase in bone density detected in 17 workers with exposures averaging 3.38 mg/m3 (considered minimum threshold) * Complaints of eye and respiratory passage irritation and nausea associated with concentrations of 5 mg/m3; no further details * Osteosclerosis may be caused by absorption of 0.2–0.35 mg/kg/d (14–25 mg/d) over several years.   Animal data:   * 2 yr NaF drinking water study reported equivocal and weak carcinogenic association of osteosarcomas in male rats; absence of any carcinogenicity in male and female rats and mice.   TLV-TWA based on the observed minimum increase in bone density associated with exposure to 3.38 mg/m3; no specific derivation provided.  Insufficient data to recommended skin or sensitiser notations or STEL. |
| DFG 2005 MAK: 1 mg/m3 |
| Summary of additional data:  Human data:   * Skeletal fluorosis is the most important systemic effect of all fluoride compounds * Fluorides in gaseous and particle form are absorbed completely by the respiratory tract * >2.4–6 mg/m3 or 3.4 mg/m3 (8.7 mg/l or 5.18 mg/l urine) resulted in skeletal fluorosis in workers exposed for ≥10 yr (cited by ACGIH, 2018) * 20 mg/d for 20 yr resulted in skeletal fluorosis * No skeletal fluorosis at 4 mg/L drinking water: * corresponds to 8 mg/d assuming water intake of 2 L/d * US EPA (1985) recommended upper limit of 10 mg/d * 10 mg/d ≡1 mg/m3 per 8 hr shift assuming inhaling 10m3.   Animal data:   * Rats displayed reduced bone strength following ≥3.2 mg/kg/d; no further details: * NOAEL of 0.94 mg/kg/d; corresponds to 3 mg/L drinking water for humans * LD50: 330 mg/kg in (mice, dermal), as NaF. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

NIL.

### 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 | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A4 |
| DFG | H (skin) |
| SCOEL | NA |
| HCOTN | NA |
| IARC | Carcinogenicity – Group 3 |
| 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: |  |  |  | | Dermal LD50 ≤1000 mg/kg: | yes | 3.00 |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  | 3 | **consider assigning a skin notation** | |

### IDLH

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

## Additional information

| Molecular weight: | 18.99 |
| --- | --- |
| 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) (2006) Fluorides – MAK value documentation.

International Agency for Research on Cancer (IARC) (1987) Fluorides (inorganic, used in drinking-water). IARC Monographs on the evaluation of the carcinogenic risk to humans.

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