FLUORINE

CAS number: 7782-41-4

Synonyms: —

Chemical formula: F_2

Workplace exposure standard (retained)

TWA: **1 ppm (1.6 mg/m^3)**

STEL: **2 ppm (3.1 mg/m^3)**

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 1 ppm (1.6 mg/m^3) is recommended to protect irritant effects and potential fluorosis in exposed workers.

A STEL of 2 ppm (3.1 mg/m^3) is recommended to protect for acute irritant effects and potential fluorosis in exposed workers.

Discussion and conclusions

Fluorine is encountered during its production and use as a rocket propellant, in the manufacture of various fluorides and fluorocarbons and in various organic and inorganic syntheses.

Critical effects of exposure include irritation of the eyes and skin and potential fluorosis. Due to its extreme reactivity, it rarely occurs in nature as fluorine, but as fluorides. Workers exposed to yearly averages of 0.3 to 1.4 ppm over four years had better health records than the control group of clinic visits (all causes) in terms of respiratory complaints and absences because of respiratory complaints. Tolerable irritation is reported in volunteers reported at concentrations of 10 ppm for fifteen minutes (ACGIH, 2018). A urinary NOAEL in humans of 8 mg/L is reported (SCOEL, 1998). SCOEL (1998) calculated exposure at 1 mg/m^3 over a work shift will result in a urinary concentration of 8 mg/L.

The TWA of 1 ppm (1.6 mg/m^3) and STEL of 2 ppm (3.1 mg/m^3) derived by ACGIH (2001) and SCOEL (1988) and adopted by SWA are recommended based on weight of evidence and are considered sufficiently protective of local and systemic effects.

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: 1 ppm (1.6 mg/m^3); STEL: 2 ppm (3.1 mg/m^3)***
ACGIH	***2001***	***TLV-TWA: 1 ppm (1.6 mg/m^3); TLV-STEL: 2 ppm (3.1 mg/m^3)***
TLV-TWA and TLV-STEL recommended to minimise the potential for eye, skin and mucous membrane irritation. Summary of data: Human data: • Volunteers tolerated concentrations of 10 ppm for 15 min with minimal irritation • Workers exposed to yearly averages of 0.3–1.4 ppm over 4 yr had a better health record than control group of 3,000 in terms of clinic visits (all causes), respiratory complaints and absences because of respiratory complaints. Animal data: • LC_{50}: 150 ppm (mice,1 h) • 60 min exposures at weekly intervals over 4 wk: 55 ppm (mice) to 75 ppm (rats) showed no effects or very slight effects, mainly in the lung, liver and kidney. Derivation of TLV-TWA not described by ACGIH. Insufficient data to recommend skin, sensitiser or carcinogenicity notations.		
DFG	***NA***	***NA***
No report.		
SCOEL	***1998***	***TWA: 1 ppm (1.58 mg/m^3); STEL: 2 ppm (3.16 mg/m^3)***

Summary of additional data:
• TWA and STEL derived from evidence of body burden and fluorosis
• Reported a urinary NOAEL of 8 mg/L; recommended end-of-shift urinary limit value:
  ○ a worker exposed at 1 ppm (1.58 mg/m^3) respiring 1 m^3/h will result in uptake of 1.5 mg assuming total absorption
  ○ by the end of the workday, steady-state conditions will be approximated, with about 0.75 mg being excreted per hour; assuming urinary flow of about 1.5 mL/min; end of the shift urinary limit value of approximately 8 mg/L; based on this, the limit value is not expected to be exceeded by the application of an 8-h TWA of 1 ppm
• STEL is to protect against a significant increase in the critical body burden, which could result in fluorosis; no derivation or evidence supplied.		

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?	Insufficient data
Is the chemical carcinogenic with a mutagenic mechanism of action?	Insufficient data

Insufficient data are available to determine if the chemical is a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	—
HCIS	—
NICNAS	NA
EU Annex	NA
ECHA	—
ACGIH	—
DFG	NA
SCOEL	—
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
Insufficient data to assign 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 = 1.55 mg/m^3; 1 mg/m^3 = 0.643 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.

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. SCOEL/SUM/56.

Health Council of the Netherlands (HCOTN) (2019) Fluorine and inorganic fluorides. Health-based recommendation on occupational exposure limits. The Hague: Health Council of the Netherlands; publication no. 1998/56.

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