

ETHYL SILICATE

CAS number: 78-10-4

Synonyms: Silicic acid tetraethyl ester, tetraethoxysilane, tetraethyl orthosilicate, tetraethyl silicate

Chemical formula: $C_8H_{20}O_4Si$

Workplace exposure standard (amended)

TWA: 5 ppm (44 mg/m³)

STEL: —

Peak limitation: —

Notations: —

IDLH: 700 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 (44 mg/m³) is recommended to protect for eye and nose irritation and chronic kidney damage in exposed workers.

Discussion and conclusions

Ethyl silicate is used in coating applications as a weatherproofing and acid-proofing agent for cement, and in heat-resistant paint production.

Critical effects of exposure are irritation of the eyes and nose. Prolonged exposure may cause kidney damage as reported in animal studies (ACGIH, 2018). Chronic animal inhalation studies report a NOAEC for reduced kidney weights at 50 ppm in mice (ACGIH, 2018; DFG, 2000); other test species did not show comparable changes at 88 or 164 ppm (ACGIH, 2018). A LOAEC of 50 ppm for nasal inflammation is reported in mice; the relevance of this effect to humans is questioned due to interspecies anatomical differences in the nasal cavities (SCOEL, 2008). These interspecies differences are supported by volunteer studies with brief exposures at 85 ppm that did not cause any irritation; 250 ppm was required to elicit slight eye and nose irritation (DFG, 2000).

A TWA of 5 ppm is adopted from SCOEL (2008) which was derived by dividing the NOAEC for kidney damage and the LOAEC for nasal inflammation in mice of 50 ppm by an uncertainty factor of ten for the absence of an experimentally defined NOAEL for nasal inflammation. The TWA is considered to be protective for irritation to the eye and nose, and for kidney damage 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: 10 ppm (85 mg/m³)
ACGIH	2001	TLV-TWA: 10 ppm (85 mg/m³)
<p>TLV-TWA intended to minimise potential for irritation to eyes and mucous membranes and kidney damage at higher concentrations.</p> <p>Summary of data:</p> <p>TLV-TWA based on reports of eye and mucous membrane irritation in humans and kidney damage near 100 ppm in studies with rats. An uncertainty factor of 10 appears to be applied to the latter to derive the TLV-TWA; a detailed derivation of this value is not provided.</p> <p>Human data:</p> <ul style="list-style-type: none"> Reported odour threshold: 17 ppm Causes eye irritation at 250 ppm and lachrymation at 1,200 ppm (no further details provided). <p>Animal data:</p> <ul style="list-style-type: none"> Threshold causing serious disturbances (not specified) in guinea pigs is 2,000 ppm (1 h) or 500 ppm (>1 h) Mortality and severe kidney, liver and lung damage at 400 ppm (rats, 7 h/d, 30 d) Decreased kidney weight reported in sub-chronic inhalation study, treatment groups: 23, 50, 88 ppm (mice, rats, guinea pigs, 7 h/d, 90 d); effect only observed in mice of 88 ppm group, significance of effect questioned by agency <ul style="list-style-type: none"> NOAEL of 50 ppm for kidney damage and histopathological changes in mice No body weight increase at 165 ppm in sub-chronic inhalation study (undocumented species, 8 h/d, 5 d/wk, 17 d) Adverse effects on kidney reported to be cumulative with repeated exposures (rats) <ul style="list-style-type: none"> kidney damage and slight lung irritation at 500 ppm exposure (3–5 x 7 h) body weight loss and kidney/lung changes at 250 ppm (4–10 x 7 h) slight to moderate kidney damage at 125 ppm (5–10 x 7 h) No carcinogenicity or reproductive studies presented. <p>Insufficient data to recommend a TLV-STEL or notations for carcinogenicity, sensitisation, or skin absorption.</p>		
DFG	2000	MAK: 10 ppm (86 mg/m³)
<p>Summary of additional data:</p> <p>Previous MAK of 100 ppm lowered to 20 ppm in 1990 to account for NOAEL of 50 ppm for kidney damage in 90 d mouse inhalation study.</p> <p>Derivation of the current MAK (10 ppm) is not discussed, but the documentation of the current value is presented with results of an additional sub-chronic inhalation study in mice with a LOAEL of 50 ppm for nasal inflammation.</p> <p>Human data:</p> <ul style="list-style-type: none"> Brief exposures in volunteer study (durations not specified) reported: 		



Source	Year set	Standard
		<ul style="list-style-type: none">o odour threshold at 85 ppmo slight eye/nose irritation at 250 ppmo burning sensation and pungent odour at 700 ppmo lachrymation at 1,200 ppmo strong eye/nose irritation at 3,000 ppmo cited study states that 700 ppm could not be tolerated for <30 min.
Animal data:		
<ul style="list-style-type: none">• LC₅₀: <1,837 ppm (rats, 4 h); no deaths at this concentration during 1 h exposure, 90 and 100% mortality during 6 h and 8 h exposure, respectively:<ul style="list-style-type: none">o exposure caused eye/nose irritation, trembling, salivation and respiratory distress• LD₅₀: 6,270 mg/kg (rats, oral)• Systemic lung damage reported for IV and IP administration routes; in non-fatal cases haemolysis and haematuria, and tissue damage in kidney, heart, lung and brain observed (no further information provided)• Reversible skin irritation effects reported for percutaneous injection of 0.1 mL in rabbits; reversible severe eye irritation observed when 0.2 mL applied to eye• LOAEL of 50 ppm for nasal inflammation in sub-chronic inhalation study (mice, 6 h/d, 5 d/wk, 2 wk); lower concentrations not tested• Lung, liver and kidney damage at 400 ppm in sub-chronic inhalation study (rats, 30 d):<ul style="list-style-type: none">o tissue damage characterised by pulmonary oedema, alveolar bleeding, cloudy swelling/congestion in liver, marked degeneration and necrosis in kidneys, blood in urine without signs of irritation in bladder or urethra• Dose-dependent kidney damage and urinary calculi reported in multiple feeding studies; treatment range 0.5–2% (400–1,600 mg/kg/d) in diet (rats, 8 wk):<ul style="list-style-type: none">o NOAEL: 400 mg/kg/d for kidney damage and urinary calculio LOEL: 800 mg/kg/d for urinary calculi and 1,200 mg/kg/d for kidney damage• Equivocal mutagenicity results show no evidence for SCE or point mutations in Chinese hamster ovary cells<ul style="list-style-type: none">o increased DNA synthesis in rat hepatocyte cells• No animal or human carcinogenicity studies presented.		
SCOEL	2008	TWA: 5 ppm (44 mg/m³)
Summary of additional data:		
TWA is derived from a LOAEL of 50 ppm for nasal inflammation in a sub-chronic inhalation study with mice (also described in DFG, 2000). Acknowledges mice more susceptible to nasal inflammation than humans due to interspecies anatomical differences in the nasal airways. A factor of 10 is applied to account for the absence of an experimentally defined NOAEL for nasal inflammation to afford the TWA of 5 ppm.		
The agency suggests that a STEL is required but with insufficient data to recommend a value. Insufficient data available to recommend a skin notation.		
Animal data:		
<ul style="list-style-type: none">• Dose and time-dependent silicate accumulation in stomach and kidneys and kidney necrosis observed in repeat acute oral dose study, treatment range:<ul style="list-style-type: none">o 1,300–3,900 mg/kg/d (rats, 4 d)• No carcinogenicity or reproductive toxicity data presented.		



Source	Year set	Standard
OARS/AIHA	NA	NA
No report.		
HCOTN	2004	TWA: 10 ppm (85 mg/m³)
<p>Summary of additional data:</p> <p>Current administrative 8 h TWA of 10 ppm considered too high; health-based assessment suggests a value of 1.2 ppm is more appropriate. The suggested value is derived from a NOAEL for nephrotoxicity and LOAEL for nasal irritation, both of 50 ppm in mice to which an overall assessment factor of 36 is applied to account for uncertainty in deriving a NOAEL from the irritational LOAEL, intra- and interspecies differences and differences in experimental and workplace exposures.</p> <p>Animal data:</p> <ul style="list-style-type: none"> • LD₅₀: 5,880 mg/kg (rabbits, dermal) • LOAEL of 100 ppm for nephrotoxicity in repeat inhalation study (mice, 14–28 d, 6 h/d, 5 d/wk, also cited by DFG, 2000 and SCOEL, 2008) • Kidney and lung lesions and urinary excretion of WBC and albumin in sub-chronic exposure study at 960–3,000 ppm (guinea pigs, 20–30 min/d, 30 d); no mortality observed at these concentrations, no effect on eyes or liver • No carcinogenicity or reproductive toxicity data presented. 		

Secondary source reports relied upon

Source	Year	Additional information
HSE	✓ 2002	• 8 h TWA: 5 ppm (44 mg/m ³)
US NIOSH	✓ 1994	• IDLH based on acute inhalation toxicity data in humans.

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	—
ECHA	—
ACGIH	—



Source	Notations
DFG	—
SCOEL	—
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:	208.33
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 8.5 mg/m ³ ; 1 mg/m ³ = 0.118 ppm
This chemical is used as a pesticide:	<input type="checkbox"/>
This chemical is a biological product:	<input type="checkbox"/>
This chemical is a by-product of a process:	<input type="checkbox"/>
A biological exposure index has been recommended by these agencies:	<input type="checkbox"/> ACGIH <input type="checkbox"/> DFG <input type="checkbox"/> 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.

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European Chemicals Agency (ECHA) (2019) Ethyl silicate – REACH assessment.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2008) Recommendation from the Scientific Committee on Occupational Exposure Limits for tetraethylsilicate. SCOEL/SUM/64.

Health Council of the Netherlands (HCOTN) (2004) Tetraethyl orthosilicate. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/131.

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

DRAFT