GERMANIUM TETRAHYDRIDE

CAS number: 7782-65-2

Synonyms: Germane, germanium hydride

Chemical formula: GeH_4

Structural formula: —

Workplace exposure standard (interim)

TWA: **0.2 ppm (63 mg/m^3)**

STEL: **—**

Peak limitation: **—**

Notations: **—**

IDLH: **—**

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 0.2 ppm (63 mg/m^3) is recommended to protect for potential haemolytic and irritant effects in exposed workers.

Given the limited 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

Germanium tetrahydride is used in the production of solid-state electronic circuits.

Critical effects of acute exposure are haemolysis, damage to kidneys and liver (ACGIH, 2018) and irritation to eyes, skin and respiratory tract. There are no suitable chronic exposure data available in humans or animals (DFG, 2008). The available toxicological dataset is limited to acute- and poorly documented sub-chronic animal exposure studies, which have shown haemolytic action as a critical effect (ACGIH, 2018; HCOTN, 2000). The available data suggest the substance is approximately half as acutely toxic as antimony hydride, which is also primarily a haemolytic agent (ACGIH, 2018).

In the absence of reliable chronic exposure data, an interim TWA 0.2 ppm is recommended based on substance-specific acute exposure information and by analogy to antimony hydride, which is approximately twice as acutely toxic. A detailed examination of the available dataset should be prioritised for subsequent reviews since no reliable long-term exposure or carcinogenicity data were available for this evaluation.

Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). This evaluation found data gaps in the carcinogenicity database for this substance and a review of the classification is recommended.

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: 0.2 ppm (0.63 mg/m^3)***
ACGIH	***2001***	***TLV-TWA: 0.2 ppm (0.6 mg/m^3)***
TLV-TWA intended to minimise potential for haemolytic effects observed in animals. Insufficient data to recommend a TLV-STEL or notations for carcinogenicity, skin absorption or sensitisation. Summary of data: TLV-TWA is based on current TLV-TWA of stibine (antimony hydride), 0.1 ppm, which is considered a similarly acting haemolytic agent. Chronic and sub-chronic animal or human exposure data are not available. Acute animal toxicity data indicate the substance is half as toxic as stibine, the TLV-TWA of which is doubled to arrive at 0.2 ppm. Human data: • None presented. Animal data: • Only acute toxicity data is presented • Limited toxicity data indicate a “moderate” toxicity of germanium tetrahydride, between those of tin hydride and arsine • Non-fatal at 100 ppm (rabbit, n=1, 1 h) • Fatal at 150–185 ppm (mice, 1 h) or 195 ppm (mice, 4 h) • Degenerative changes in liver and kidneys at 445–825 ppm (rodents, unspecified duration) • Neurotoxicity prior to death reported at 635 ppm (mice, unspecified duration) • Unspecified signs of intoxication at 150 ppm (guinea pig, n=1, 1 h); fatal at 185 ppm (1 h), haemoglobinuria noted in exposed guinea pigs.		
DFG	***2008***	***Not assigned***
Summary of additional data: Toxic effects of germanium tetrahydride include irritation (skin, eyes and respiratory tract) and systemic effects on liver, kidney and blood. No data on carcinogenicity, genotoxicity, reproductive toxicity, sensitiser potential or skin absorption are available. Irritation is considered to be the critical effect based on the safety data sheet for the compound, but no data are available to support a threshold concentration. Human data: • Cited SDS suggests irritation to the upper respiratory tract is a critical effect that leads to coughing, chest tightness and suffocation: o longer exposure may cause damage to liver and spleen o irritating to skin and eyes, causing lachrymation and increased blinking • Cited publication reports possible lung damage following inhalation (no further information provided). Animal data: • No substance-specific absorption data is available, other volatile germanium compounds are generally absorbed completely in the lungs and distributed evenly; no accumulation has been observed for such compounds, which are excreted in urine		

Source	Year set	Standard

• No acute animal studies report respiratory tract irritation
• Slight motor delays at ≈22 ppm in repeat inhalation study (rats, duration not specified, 30 d):
  ○ no exposure-related clinical effects observed
  ○ histological changes to brain and haemosiderosis observed (no further details)
  ○ study not used in assessment due to inadequate documentation
• Increase in haemoglobin, RBC and WBC counts (no further information) in repeat inhalation study at 16–80 ppm (rats, duration not specified, 4 mo):
  ○ study not used in assessment due to inadequate documentation.		

SCOEL	***NA***	***NA***
No report.		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***2000***	***TWA: 0.2 ppm (0.6 mg/m^3)***
Summary of additional data: No recommendation on current administrative OEL can be made with current dataset due to its lack of chronic exposure studies and inadequate documentation. Human data: • None presented. Animal data: • LC_{50}: 440 ppm (mice, 2 h); 80–480 ppm (guinea pigs, 4 h); congested organs, haemorrhages, nerve cell vacuolisation, degeneration of some organs (no further details) and breathing difficulties observed • LD_{50}: 1,280 mg/kg (mice, oral) • Some haemorrhaging at 4–53 ppm in repeat inhalation study (rats, 4 h/d, 30 d) • No irritation effect data presented.		

Secondary source reports relied upon

Source		Year	Additional information
HSE	✓	2002	• TWA: 0.2 ppm (0.64 mg/m^3) • STEL: 0.6 ppm (1.9 mg/m^3).

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	NA
NICNAS	NA
EU Annex	NA
ECHA	NA
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?	No

Additional information

Molecular weight:	76.62
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3.15 mg/m^3; 1 mg/m^3 = 0.318 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.

Deutsche Forschungsgemeinschaft (DFG) (2008) Germaniumtetrahydrid – MAK value documentation, German language edition.

Health Council of the Netherlands (HCOTN) (2000) Germanium tetrahydride. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/006.

UK Health and Safety Executive (HSE) (2002) EH40/2005 Workplace exposure limits.