ARSINE

CAS number: 7784-42-1

Synonyms: Arsenic hydride, arsenic trihydride, arsenous hydride, hydrogen arsenide, arseniuretted hydrogen

Chemical formula: AsH_3

Workplace exposure standard (interim)

TWA: **0.005 ppm (0.016 mg/m^3)**

STEL: **—**

Peak limitation: **—**

Notations: **Carc. 1A**

IDLH: **3 ppm (9.6 mg/m^3)**

Sampling and analysis: There is uncertainty regarding quantification of the recommended value with currently available sampling and/or analysis techniques.

Recommendation and basis for workplace exposure standard

An interim TWA of 0.005 ppm (0.016 mg/m^3) is recommended to protect for adverse effects to the peripheral nervous system and haemopoietic system in exposed workers.

A review of additional data sources is recommended at the next scheduled review due to the similarity in metabolism of arsine and inorganic arsenic compounds. The review should consider a detailed examination of the carcinogenicity classification and the suitability of the interim TWA.

Discussion and conclusions

Arsine is used in the semiconductor industry and in organoarsenic production. It is a gas under standard conditions and is rapidly absorbed upon inhalation, metabolised and excreted; in contrast to particulate inorganic arsenic compounds, which accumulate in the lungs (ACGIH, 2007; HCTON, 2008). It is unclear if arsine has the same carcinogenic potential as inorganic arsenic compounds, despite the production of similar or identical metabolites upon absorption (ACGIH, 2007; HCOTN, 2008; DFG, 1999). The low pulmonary retention of arsine has been discussed as a property that distinguishes it from other inorganic arsenic compounds (ACGIH, 2017; HCOTN, 2008).

The recommended interim TWA is based on urinary excretion levels that relate to arsine air concentrations below which systemic health effects are not observed in arsenic-exposed workers. The TWA is supported by a haematological NOAEL in rats exposed to arsine (0.025 ppm) to which an uncertainty factor of 5 was applied using a human regression model.

Recommendation for notations

Classified as a category 1A 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.

Insufficient data available to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	**Year**	***TWA: 0.05 ppm (0.16 mg/m^3)***
ACGIH	***2007***	***TLV-TWA: 0.005 ppm (0.016 mg/m^3)***

TLV-TWA recommended to prevent increased risk of haemolysis and haemolysis-related effects on the spleen, liver and kidneys. Relationship of lung cancer risk and exposure established for inorganic As may not apply to AsH_3 exposure due to lower pulmonary retention and rapid metabolism.

TLV-TWA is based on a combination of studies of urinary excretion levels in workers chronically exposed to airborne particulate inorganic arsenic compounds, and a haematological NOAEL in rats (0.025 ppm). An uncertainty factor of 5 was applied, derived from a human regression model.

Insufficient data to derive a TLV-STEL, or notations for carcinogenicity, skin, or sensitisation.

Summary of data:

Human data:

- No data confirming carcinogenicity
- Lethal dose: 250 ppm (30 min); symptoms of poisoning at 1–3.3 ppm (>1 h)
- Estimated acute exposure of 0.4 ppm over 4 h non-fatal (adverse effects not specified) in two reported cases (1 mg As excreted in urine over 6 d)
- Severe anaemia in chronically exposed persons (duration and concentration unspecified); max. average urinary As level 2.3 mg/L, decreased to 0.66 mg/L after 3 d
- Workers exposed to 0–0.015 ppm in breathing zone had mean urinary As levels of 46.3 µg/L
- Urine-As/air-As BEI for As compounds is set at 35 µg/L; noted that BEI is not intended to directly relate to TLV-TWA
    - AsH_3 exposure of 0.005 ppm correlates with urinary As level of 48 µg/L
- Total body As content between 100–150 mg estimated in clinical study of simultaneous AsH_3 poisoning in metal refinery workers (14 cases); none of these cases were fatal; adverse effects included haemolysis and renal damage and oliguria; recovery in all cases; oliguria in severe cases lasted for 40 d, long-term but reversible renal damage noted in 4 cases (duration not specified)
- Remaining reviewed studies are of inorganic As exposure; AsH_3 exposure is expected to have similar critical effects due to metabolic generation of As from AsH_3
    - slight reduction in peripheral nerve conduction in workers with mean daily absorption of 300 µg As versus control group.
    - mean urinary levels in exposed workers was 71 µg/L compared with 7 µg/L in reference group
    - indicators of renal disease increased in exposed workers with urinary As levels of 108.6 µg/L (estimated inhalational exposure and duration not specified).

Animal data:

- AsH_3 intoxication targets haemopoietic system
- NOAEL: 0.025 ppm for haematological changes (rats, mice, and hamsters, inhalation, 90 d); some haematological changes were observed in rats at this concentration, these were considered transient and did not constitute a LOAEL.

Source	Year set	Standard
DFG	***2001***	***Not assigned***

Summary of additional data:

- Previous MAK of 0.05 ppm (0.16 mg/m^3) withdrawn due to insufficient evidence of a NOAEL in animals or humans.

Animal data:

- No data available for acute toxicity, effects on skin, allergenic effects or carcinogenicity
- Considers haematological NOAEL of 0.025 ppm (rats, mice) used to derive TLV-TWA by ACGIH to be a LOAEL due to measurable haematological changes at this concentration.

SCOEL	***NA***	***NA***

No report.

OARS/AIHA	***NA***	***NA***

No report.

HCOTN	***2008***	***—***

Summary of additional data:

- Heavier than air, decomposes on exposure to light or moisture.
- Hydrolyses rapidly in water to other As compounds
- No data available on carcinogenicity and genotoxicity in humans or animals
- Recommends classification as suspected human carcinogen due to known carcinogenicity of other As compounds in humans
- Evidence indicates As compounds can cause clastogenic effects in humans and animals, but results do not suggest mutagenic mechanism of action.

Animal data:

- Inhalational study with exposed rabbits (20–26 mo) reported mesothelioma in one animal (no further information provided); study considered inadequate for evaluation due to insufficient reporting.

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2013	• Substance should be considered carcinogenic to humans based on IARC (2012) evaluation • No acute or chronic dermal toxicity data available.
IARC	✓	2012	• AsH_3 distinct from other As compounds in toxicology but sparsely discussed • AsH_3 produces same metabolites as other As compounds • Overall, As and inorganic As compounds are classified as carcinogenic to humans, regardless of their mechanism of carcinogenic action • The mechanism of carcinogenicity of AsH_3 not discussed.
US EPA	✓		• Clinical signs of acute exposures include abdominal pain, haematuria, jaundice, headache, malaise, weakness and GI distress accompanied by nausea and vomiting.

Source		Year	Additional information
US NIOSH	✓	1994	• IDLH based on acute inhalation toxicity data in humans.

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	Carcinogenicity – Category 1A
NICNAS	Carc. Cat. 1A
EU Annex	—
ECHA	NA
ACGIH	—
DFG	—
SCOEL	NA
HCOTN	Carcinogenicity – category 2
IARC	Carcinogenicity – Group 1
US NIOSH	—

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 available to assign a skin notation.

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	77.95
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3 µg/m^3; 1 mg/m^3 = 0.313 ppm
This chemical is used as a pesticide:	☐
This chemical is a biological product:	☐

Molecular weight:	77.95
Conversion factors at 25°C and 101.3 kPa:	1 ppm = 3 µg/m^3; 1 mg/m^3 = 0.313 ppm
This chemical is used as a pesticide:	☐
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.

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International Agency for Research on Cancer (IARC) (2012) Arsenic, Metals, Fibres and Dust. IARC Monographs on the evaluation of the carcinogenic risk to humans volume 100C.

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