# Arsine

| CAS number: | 7784-42-1 |
| --- | --- |
| Synonyms: | Arsenic hydride, arsenic trihydride, arsenous hydride, hydrogen arsenide, arseniuretted hydrogen |
| Chemical formula: | AsH3 |

 Workplace exposure standard (interim)

| TWA: | **0.005 ppm (0.016 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
|  Notations: | **Carc. 1A**  |
| IDLH: | **3 ppm (9.6 mg/m3)** |
| 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/m3) 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/m3) |
|  |
| ACGIH 2007 TLV-TWA: 0.005 ppm (0.016 mg/m3) |
| 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 AsH3 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
	+ AsH3 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 AsH3 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; AsH3 exposure is expected to have similar critical effects due to metabolic generation of As from AsH3
	+ 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:* AsH3 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.
 |
| DFG 2001 Not assigned |
| Summary of additional data:* Previous MAK of 0.05 ppm (0.16 mg/m3) 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 | * AsH3 distinct from other As compounds in toxicology but sparsely discussed
* AsH3 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 AsH3 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.
 |
| US NIOSH |  | 1994 | * IDLH based on acute inhalation toxicity data in humans.
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### 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/m3; 1 mg/m3 = 0.313 ppm |
| This chemical is used as a pesticide: |[ ]
| This chemical is a biological product: |[ ]
| This chemical is a by-product of a process: |[x]
| A biological exposure index has been recommended by these agencies: | [x]  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) (2001) Arsine – MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (2002) Arsen und anorganische Arsenverbindungen (mit Ausnahme von Arsenwasserstoff) – MAK value documentation German language edition.

Deutsche Forschungsgemeinschaft (DFG) (2014) Arsenic and its inorganic compounds (with the exception of arsine) – MAK value documentation.

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Health Council of the Netherlands (HCOTN) (2008) Arsine. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2008/05OSH.

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.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2013) Arsine: Human health tier II assessment: Human health tier II assessment – IMAP report.

US Environmental Protection Agency (US EPA) (1994) Arsine CASRN 7784-42-1

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