# Silicon carbide (Fibres)

| CAS number: | 409-21-2 |
| --- | --- |
| Synonyms: | Carborundum, Carbonite, Electroln, Moissanite, SIC |
| Chemical formula: | SiC |

Workplace exposure standard (interim)

| TWA: | **0.1 fibres/mL (respirable fibres)** |
| --- | --- |
| 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

A TWA of 0.1 fibres/mL (respirable fibres) is recommended to protect for the risk of lung and pleural cancer 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

Silicon carbide (SiC) is used as an artificial abrasive and in the refractory, foundry, ceramic and filler industries.

The critical effects of exposure to respirable fibres is lung cancer with the potential for mesothelioma.

HCOTN (2012) concluded that fibrous SiC (whisker fibres) may cause cancer with a non-stochastic mechanism and should be classified as ‘carcinogenic to humans’ (category 1A). However, the evidence is based on animals and similarities to asbestos. Mesothelioma in rats following intrapleural injections and outcomes of *in vitro* experiments indicate silicon carbide fibres have a mechanism of action like crocidolite asbestos fibres and similar toxicity (ACGIH, 2018).

The TWA 0.1 fibres/mL for silicon carbide fibres (whiskers) is recommended in the interim as experimental data indicates fibres are a likely cause of lung cancer in humans and there are indications of mesothelioma in rats following intrapleural injections (ACGIH, 2018).

A priority review of the data on fibrous silicon carbide in the next scheduled review of the workplace exposure standards is recommended.

## Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). A review of this classification is recommended due to *in vitro* evidence supporting similar toxicity to crocidolite asbestos fibres.

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 mg/m3 | |
|  |
| ACGIH 2003 TLV-TWA: 0.1 f/cc (respirable fibres) |
| TLV-TWA’s (fibrous and non-fibrous) recommended based on particle morphology and is intended to reduce the potential for lung fibrosis, cancer and possible mesothelioma.  TLV-TWA for respirable fibres defined as <5 µm diameter and >20 µm length (known as “whiskers”) recommended to be limited to the same level set for crocidolite asbestos fibres due to similar toxic properties observed *in vitro*.  Carcinogenic A2 designation is recommended for all fibrous forms based on case reports and one cohort mortality study.  There is insufficient data to determine skin or sensitiser notations.  Summary of data:  Human data:   * *Carborundum pneumoconiosis* is recognised disease specific to long-term silicon carbide production workers: * consists of interstitial disease including irregular, nodular lesions * accumulations of macrophage, monocytes and neutrophils containing particles * Retrospective cohort mortality study identified increased SMR for non-malignant disease and lung cancers among exposed workers * Epidemiological evidence of lung disease including fibrosis, cancer and mesothelioma consistent with animal data * Two men studied both developed breathlessness and reticulonodular opacities with histological and lung biopsy samples confirming silicon carbide particles and ferruginous bodies normally associated with asbestos exposures * One worker (42 years in vicinity of SiC plant) identified as evidence of chronic occupational exposures leading to lung lobectomy for epidermoid carcinoma with large volumes of fibres present (>5 µm/mg dry lung).   Animal data:   * *In vitro* tests comparing cytotoxic effects of SiC with equivalent crocidolite asbestos concentrations identified similar cytotoxicity within 24 h in cultured embryonic mouse cells: * thinner SiC fibres more toxic then thicker samples on a mass per surface area in the same tests * however, cytotoxicity more dependant on number of fibres than size * Rats exposed via intratracheal installation (5 mg/100 mL/min) experienced immediate pulmonary oedema, haemorrhages and collapsed bronchioles with alveolar atelectasis allowing fibre penetrations to underlying *lamina propria* * Bronchoalveolar retention of fibrous material found to be less than angular non-fibrous material suggesting increased body burden from respirable dust * Consistent evidence of significant biological activity from fibrous (whisker) exposures compared to relative inert non-fibrous material. |
| DFG 1998 MAK: 1.5 mg/m3 |
| MAK value assigned to “fibre free” exposures.  No other additional information available. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| The committee concluded fibrous SiC (whisker fibres) may cause cancer with a non-stochastic mechanism and should be classified as ‘carcinogenic to humans’ (category 1A).  Experimental data supports mesothelioma evidence in animals but not identified in humans. SiC has not been evaluated by IARC.  Human data:   * Epidemiological evidence of lung disease including fibrosis, cancer and mesothelioma consistent with animal data – no further information * Possible increase risk of stomach cancer in case studies amongst workers in refinery where SiC products were crushed and packed. * Data questioned due to total dust exposure for workers with lung cancer in SiC industries in Canada.   Animal data:   * Fibrous form induces tumours on inhalation and intraperitoneal and intrapleural injection * No data on mutagenicity in prokaryotes and yeast identified * No *in vivo* genotoxicity data identified. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | N.D. | * Tier I Human Health Assessment – domestic final * No further information. |
| ECHA |  | 2020 | Limited information:   * Inhalation exposures (acute / short term) - DNEL – 94 mg/m3 * No further information. |

### 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 | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A2 |
| DFG | — |
| SCOEL | NA |
| HCOTN | Carcinogenicity – category 1A (fibrous) |
| IARC | Carcinogenicity – Group 2A |
| 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: | 40.11 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = Number mg/m3; 1 mg/m3 = Number 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*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2009) Siliziumcarbid (faserfrei) – MAK value documentation.

European Chemicals Agency Regulation (ECHA) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Health Council of the Netherlands (HCOTN) (2012) Silicon carbide. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2012/29.

International Agency for Research on Cancer (IARC) (2017) Silicon carbide whiskers. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (N.D.) Silicon Carbide: Human health tier I assessment – IMAP report.