# Borate compounds

| CAS number: | 1330-43-4 (sodium borate, anhydrous)  12179-04-3 (sodium borate, pentahydrate)  1303-96-4 (sodium borate, decahydrate)  10043-35-3 (boric acid) |
| --- | --- |
| Synonyms: | Sodium borate: borax anhydrous, disodium borate, sodium tetraborate decahydrate, sodium pyroborate, boron sodium oxide  Boric acid: trihydrooxidoboron, boracic acid,  boron trihydroxide |
| Chemical formula: | Na2B4O7.XH2O(sodium borate)  H3BO3 (boric acid) |

Workplace exposure standard (amended)

| TWA: | **0.75 mg/m3** |
| --- | --- |
| 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 0.75 mg/m3 for borate compounds (as boron) is recommended to protect for irritation of the mucous membranes in exposed workers. The TWA is also expected to reduce the risk of possible reproductive (birth rate) effects in humans.

## Discussion and conclusions

Anhydrous borates are commonly used in the glass industry and as an algicide. Pentahydrate and decahydrate forms are used mostly in herbicides and household cleaning products. Boric acid is commonly used as a pesticide. Borate salts and boric acid have been grouped for this recommendation based on commonalities of applications, the parent compound (boron), hydrolysis to related ions and critical effects.

A NOAEC for irritant nasal symptoms is reported at 5 mg/m3 for sodium tetraborate (pentahydrate) which equates to 0.75 mg/m3 of boron. This concentration is considered to be sufficiently low to protect for nasal irritation in exposed workers and therefore recommended as a TWA for all borate compounds.

While the ACGIH (2018) recommend a STEL of 6 mg/m3, there is no evidence the irritation leads to a severe, chronic health effect and little evidence to suggest the irritation as acutely severe or intolerable. Therefore, the TWA is considered protective and a STEL is not recommended.

## 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.

A skin notation is not recommended based on the available evidence. Acute dermal toxicity effects are low. Caution is advised where exposed skin is damaged due to increased uptake.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 1 mg/m3 (Anhydrous);  TWA: 1 mg/m3 (Pentahydrates);  TWA: 5 mg/m3 (Decahydrates) | |
|  |
| ACGIH 2005 TLV-TWA: 2 mg/m3; TLV-STEL: 6 mg/m3 |
| TLV-TWA recommended to minimise acute irritant effects of borate compounds (inorganic) when in contact with mucous membranes, respiratory tract and skin. The TLV-TWA value is also considered to be protective for any potential reproductive and developmental effects following systemic absorption.  TLV-TWA based on calculations of potential underestimation of boron exposures during testing.  TLV-STEL specifically assigned for minimising upper respiratory tract symptoms.  Sufficient analytical methods for speciation of borate compounds in airborne field samples are not available to enable separation of borate compounds.  Summary of data:  Human data:   * Inorganic borate compounds rapidly absorbed by oral routes with half-life of ≈20 h * Chronic exposure (oral) to H3BO3 may result in dermatitis, loss of appetite, nausea or vomiting * Airborne H3BO3 and dusts are irritating to the respiratory tract and eyes in acute and chronic exposures * Infrequent irritation observed at 1.1 mg/m3 with significant increase in symptoms when total dust concentrations >4 mg/m3 * No relationship found between chronic exposures (7 yr) and pulmonary functions * Suggestion of reproductive effects (birth numbers) observed in one study at high exposures (mean 23 mg/m3) * Data not available to assign a skin or sensitiser notation.   Animal data:   * Negative mutagenicity tests of boric acid with Salmonella typhimurium * Negative animal (mouse, rat and hamster) mutagenicity testing for borax * Decahydrate noted to cause mild skin irritation (24 h) * Pentahydrate skin tests (guinea pigs and rabbits) considered non-irritating (24 h) * No evidence for carcinogenicity of boric acid in mice at either 2,500 ppm (0.25%) or 5,000 ppm (0.5%) doses * In mice and rats NOAEL (oral exposures) for reproductive toxicity range between 9.6–21.8 mg/kg bw. |
| DFG 2017 MAK: 5 mg/m3 for sodium tetraborate pentahydrate (0.75 mg/m3 as boron); MAK: 10 mg/m3 (boric acid, 1.8 mg/m3 as boron)  MAK: 0.75 mg/m3 (other tetraborates and hydrates as boron); |
| MAK recommended to protect for acute irritant effects.  Studies with sodium tetraborates (anhydrous or as pentahydrate or decahydrate) may also be used for the assessment of the systemic effects of boric acid as undissociated H3BO3 is formed when tetraborate anions are hydrolysed in water.  Concentration of 1 mg H3BO3 contains 0.18 mg boron; 1 mg sodium tetraborate pentahydrate contains 0.15 mg boron, the boron content is used as the reference.  Summary of additional data:  No evidence of sensitisation to H3BO3 and tetraborates in humans or animal studies.  No evidence of carcinogenicity or mutagenicity.  H3BO3 and borates are poorly absorbed through the skin and are not sensitising, genotoxic or carcinogenic.  Skin notation not warranted; however caution to avoid contact with damaged skin.  Human data:   * No irritation found among 12 subjects exposed to H3BO3 concentrations up to 10 mg/m3 (1.8 mg/m3, as B) * NOAEC of 5 mg/m3 (0.75 mg/m3, as B) derived from evidence of nasal discharge significantly increased (compared with control condition) from sodium tetraborate (pentahydrate) inhalation.   Animal data:   * H3BO3 teratogenic in mice, rabbits and rats * mechanism of action for fertility effects is unclear * Absent (or shortened) 13th ribs in offspring is an observed developmental toxicity effect from doses of boric acid (as boron**)** at 13.3 and 176 mg/kg/d (rats and mice) * LD50: >2,000 mg/kg (rabbits, dermal); borax and H3BO3. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2019 | Human health tier II assessment   * Inorganic borate toxicity is driven predominantly by boron * Not likely to have a mutagenic or genotoxic potential * Critical health effects for risk characterisation include reproductive and developmental toxicity * Not likely to be skin sensitiser. |

### 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 | NA |
| HCIS | — |
| NICNAS | — |
| EU Annex | NA |
| ECHA | — |
| ACGIH | Carcinogenicity – A4 |
| DFG | — |
| SCOEL | NA |
| HCOTN | NA |
| 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: | 201.22 (anhydrous) |
| --- | --- |
| 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) (2017) Boric acid and tetraborates – MAK value documentation.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2017) Salts of boric acid: Human health tier II assessment – IMAP report.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2019) Boric acid and precursors to boric acid: Human health tier II assessment – IMAP report.