# Tin, organic compounds (as Sn)

| CAS number: | N/A |
| --- | --- |
| Synonyms: | Tri-n-butyltin, n-octyltin, n-butyltin, di/tri-ethyltin and di/tri-methyl and di/tri-phenyl tin compounds. |
| Chemical formula: | N/A |
| Structural formula: | RnSnX4-n |

Workplace exposure standard (amended)

| TWA: | **0.1 mg/m3** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Sk.** |
| IDLH: | **25 mg Sn/m3** |
| **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 mg/m3 for organic tin compounds (as Sn) is recommend to protect for central nervous system (CNS) and other systemic effects in exposed workers.

## Discussion and conclusions

Organometallic tin compounds or organotins, are those compounds having at least one covalent carbon–tin bond. Organotins are numerous, existing in both the alkyl and aryl classes, each of which include mono, di-, tri- and tetra-derivatives. They are used commercially in three major applications: thermal and light stabilisers for polyvinyl chloride (PVC) polymers; catalysts for a variety of chemical reactions including the production of polyurethane foams; and industrial and agricultural biocides such as antifouling paints and disinfectants on surfaces such as hospital floors.

The critical effects of exposure are adverse effects on immune function and the CNS.

Complaints of headaches, memory defects and other CNS effects including severe mental confusion and generalised epileptic seizures are reported in workers following exposure to the vapour of dimethyl- and trimethyltin chloride over a three-month period. ACGIH (2018) report a NOAEC or LOAEC in the range 0.3 to 0.4 ppm (2 to 4 mg/m3) based on changes in the lungs, heart, liver, kidney, nervous system and reproductive system in inhalation studies in rodents of tri-n-butyl tin chloride or bromide. A LOAEL of 0.4 mg/kg/day for triethyltin bromide is reported for effects on the CNS in a 21‑day drinking water study in rats (ACGIH, 2016). A NOAEC of 0.16 mg/m3 (for tri-n-butyltin vapour) is reported in a four-week inhalation study in rats. The next higher concentration investigated was 2.8 mg/m3 (aerosol) with mortality, inflammations of the respiratory tract, thymus atrophy and lymphocyte depletion in the thymus-dependent regions of spleen and lymph nodes (DFG, 2008).

A TWA of 0.1 mg/m3 is recommended to be retained based on the NOAEC of 0.16 to 2 mg/m3 in animals. The recommended TWA is considered protective for effects on the CNS and other systems. A STEL is not recommended due to insufficient data relating to acute exposures.

## 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 recommended based on evidence of severe adverse effects in humans following dermal exposure.

# Appendix

### Primary sources with reports

| Source Year set Standard |
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| SWA 1991 TWA: 0.1 mg/m3; STEL: 0.2 mg/m3 (Organic compounds, as Sn) | |
|  |
| ACGIH 2001 TWA: 0.1 mg/m3; STEL: 0.2 mg/m3 (Organic compounds, as Sn) |
| TLV-TWA intended to minimise the potential for adverse effects on immune function and the CNS.  TLV-STEL recommended to minimise acute symptoms such as eye and upper respiratory tract irritation, headache and nausea.  Summary of data:   * TLV-TWA and TLV-STEL based on the following evidence: * NOAEL or LOAEL of 0.3–0.4 ppm (2–4 mg/m3) based on changes in the lungs, heart, liver, kidney, nervous system and reproductive system reported in inhalation studies in rodents of tri-n-butyl tin chloride or bromide providing * tributyltin oxide 5 ppm (0.4 mg/kg/d) administered in food in a lifetime rodent bioassay suppressed the cellular immune system response; effect was not observed in rats fed 0.5 ppm tributyltin oxide * effect of trimethyltin and triethyltin derivatives on the CNS; LOAEL of 0.4 mg/kg/d reported for triethyltin bromide (exposures up to 5 ppm for 21 d in drinking water) * LOAEL of 0.15 and 0.23 mg/kg/d in rats for effects on the cellular immune system and CNS (considered the most critical organ sites) * concluded humans react in a manner like that observed in rodents, but humans more sensitive to absorbed organic tin * No specific derivation of TLV-TWA reported * TLV-TWA of 0.1 mg/m3 supported by the following: * based on an exposure of 0.1 mg/m3, a 70 kg worker breathing 10 m3 per 8 h workday, assuming complete retention of the inhaled dose, would receive a daily Sn exposure of 14.3 µg/kg.   Human data:   * Irritant contact dermatitis and folliculitis have been reported in workers manufacturing or applying paints containing triphenyl tin fluoride or butyltin compounds: * complete recovery within 1–2 wk * Workers packaging triphenyltin compounds complained of nausea, vomiting, headache, vertigo and transient loss of consciousness and developed skin irritation; no further details * 2 chemists exposed to the vapour of dimethyl- and trimethyltin chloride over a 3 mo period complained of headaches, memory defects, loss of vigilance, insomnia, breathlessness, anorexia and disorientation that progressed to severe mental confusion and generalised epileptic seizures * Stalinon product to treat acne, poisoning outbreak in 1950s; >100/217 known cases of poisoning died after ingestion of an estimated 3 g of triethyltin iodide over 6–8 wk: * estimated adult toxic oral dose 70 mg/8 d * Woman drenched in a slurry of triphenyltin chloride, diphenyltin dichloride, hexane and other chemicals: * death from renal failure occurred 12 d post exposure * Report of irritation of the URT and eyes in 70% of workers using bis(tributyltin) oxide (TBTO): * 32–62 min personal air samples: concentrations of 0.19 and 0.29 mg/m3 of TBTO, as Sn * acute health effects, such as headaches and URT irritation, reported for short-term exposures to organotin compounds at >0.2 mg/m3 * no further information.   Animal data:   * Wide differences in acute toxicity of alkyl tin compounds recognised: * these differences are due, in part, to solubility and corresponding bioavailability * Species-specific responses to the numerous congeners are well recognised and the toxicity of organotin compounds to mammals decreases from the tri- to mono- organotins * LD50: 605 mg/kg (rat, dermal); tri-n-butyltin oxide * No histological changes found in brains of mice following exposure at 2.12 mg/m3 (Sn) as tributyl tin bromide for 6 d * Rats exposed to triethyltin bromide in drinking water at 5, 10 and 20 ppm for 4 wk; average daily doses 0.40, 0.66 and 0.82 mg/kg/d triethyltin: * 2 wk of exposure at 10 ppm/d, activity decreased ≈50%, with effects being reversible within 1 mo * 3 wk exposures at 5 or 10 ppm/d resulted in performance decrements in maze activity, open field behaviour, acoustic startle response and landing foot-spread * LOAEL of 0.4 mg/kg/d (5 ppm/d) * Tributyltin oxide 5 ppm/d (0.4 mg/kg/d) administered in food in a lifetime rodent bioassay suppressed cellular immune system response: * effect not observed in rats fed tributyltin oxide at 0.5 ppm/d; no further information * No carcinogenic effects demonstrated in rats or mice assays.   Insufficient data to recommend a sensitiser notation. |
| DFG 1989 MAK: 0.05 mg/m3 (Tri-n-butyltin compounds)  2009 MAK: 0.02 mg/m3 (n-Octyltin compounds)  2008 MAK: 0.05 mg/m3 (n-Butyltin compounds) |
| Summary of additional data:  DFG does not have a general category for organotin compounds.  Tri-n-butyltin compounds   * No effect on rats exposed at 0.16 mg/m3 TBTO vapour for 1 mo * Based on this a provisional MAK of 0.05 mg/m3, as TBTO (vapour), is established for TBT compounds. * The available data indicates adherence to this value will protect persons exposed at work from adverse effects on health and, in particular, from effects on the immune system because the rat inhales about 5–10 times higher doses, expressed in terms of the body weight, than humans.   n-Octyltin compounds   * Di-n-octyltin compounds have a slight to moderate irritant effect. However, lowest concentration causing local irritant effect after repeated inhalation is considered a LOAEC for these effects * Based on this, the MAK for the more irritating n-butyltin compounds of 0.02 mg/m3 is provisionally adopted to cover both the systemic and local effects.   n-Butyltin compounds   * No suitable data in humans are available to establish a MAK * NOAEC of 0.16 mg/m3 (TBTO vapour) 4 wk, 4 h/d inhalation study in rats as cited above: * the next higher concentration investigated was 2.8 mg/m3 (aerosol) caused mortality, inflammations of respiratory tract, thymus atrophy and lymphocyte depletion in the thymus-dependent regions of spleen and lymph nodes * due to large interval between the NOAEC and LOAEC, the NOAEC could also be higher * A value of 0.05 mg/m3 for TBTO is derived based on a NOAEC of 0.16 mg/m3 and difference of 2-fold for using a NOAEC from animal experiment and rounded down according to DFG methodology * The corresponding MAK value expressed as tin is 0.02 mg/m3; no further details. |
| 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 |  | ND | * Human health tier I assessment |

### 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 | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A4, Skin |
| DFG | NA |
| 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 |
| --- |
| |  |  |  |  | | --- | --- | --- | --- | | Adverse effects in human case study: | yes | 4.00 |  | | Dermal LD50 ≤1000 mg/kg: |  |  |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  |  | **a skin notation is warranted** | |

### IDLH

| Is there a suitable IDLH value available? | Yes |
| --- | --- |

## Additional information

| Molecular weight: | Various |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = N/A; 1 mg/m3 = N/A |
| 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) (2008) n-Butyltin compounds– MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (2009) n-Octyltin compounds – MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (1999) Tri-n-butyltin compounds – MAK value documentation.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (ND) Organotins: Human health tier I assessment – IMAP report.

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