# Thallium, soluble compounds (as Tl)

| CAS number: | 7440-28-0 |
| --- | --- |
| Synonyms: | — |
| Chemical formula: | Tl |

Workplace exposure standard (amended)

| TWA: | **0.02 mg/m3** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Sk.** |
| IDLH: | **15 mg/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 0.02 mg/m3 is recommended to protect for gastrointestinal and neurological disturbances, peripheral neuropathy and alopecia in exposed workers.

## Discussion and conclusions

Thallium is used in the electronics and semiconductor industries; some of its soluble salts were formerly used as pesticides. It is present in certain flue dusts and ashes, which may be used in the manufacture of cement and bricks.

Critical effects of both acute and chronic exposures are gastrointestinal and abdominal pain, peripheral neuropathy, nausea, anorexia, sleep disorders and alopecia.

Mean urinary levels of approximately 0.5 µg/L in exposed workers are not associated with adverse effects. The same study correlated these urinary levels with air concentrations between 0.014 and 0.022 mg/m3, which are considered a NOAEC for the critical effects (ACGIH, 2018). Urinary levels above 0.9 µg/L are associated with adverse neurological symptoms in separate studies, that did not determine the equivalent air concentrations (ACGIH, 2018).

The TWA of 0.1 mg/m3 is not supported by the available occupational exposure data (ACGIH, 2018). The NOAEC of 0.022 mg/m3 estimated from occupational air and urinary measurements, is used as a basis for the recommended TWA of 0.02 mg/m3 by ACGIH (2018). The recommended TWA is protective for adverse effects in exposed workers.

## 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 due to evidence of dermal absorption and contribution to adverse systemic effects.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 0.1 mg/m3 | |
|  |
| ACGIH 2010 TLV-TWA: 0.02 mg/m3 (Inhalable particulate matter as Tl) |
| TLV-TWA intended to protect for gastrointestinal and abdominal pain, peripheral neuropathy, nausea, anorexia, sleep disorders, and alopecia. Soluble Tl compounds include thallium oxide (Tl2O), thallium nitrate (TlNO3), thallium acetate (TlC2H3O2), thallium sulfate (Tl2SO4), and thallium carbonate (Tl2CO3).  Summary of information:  TLV-TWA based on highest NOAEC of 0.022 mg/m3 for critical effects in workplace study. This air concentration produced urinary levels within the range associated with no adverse neurological effects in a separate case study.  Human data:   * Biological t½: 10–30 d; primarily excreted in urine; cited article demonstrates occupational exposure at 20 mg/m3 produces urinary level of 1 µg/L:   + urinary levels in unexposed populations ranged from 0.02–0.7 µg/L * Alopecia, haemorrhagic gastroenteritis, and neuropathy observed in cases of acute poisoning; lethal oral dose ≈14–15 mg/kg of Tl2SO4 * Abdominal pain, fatigue, weight loss, and pain in legs in 12 exposed workers in occupational study (n=15); dermal route suspected as no Tl was detected in air samples; in a severe case, 1 mg/L in blood measured * Alopecia in exposed workers with mean urine levels of 28 µg/L before introduction of occupational hygiene measures in battery production plant; following introduction PPE and administrative controls, mean urine levels decreased to 0.5 µg/L and were associated with air concentrations (static monitoring) of 0.014–0.022 mg/m3:   + 0.022 mg/m3 regarded as NOAEC, agency notes that cited article recommended an OEL of 0.1 mg/m3 on this basis, but without further reasoning * Positive correlation for increased prevalence of sleep and neurological symptoms (headache, nervousness, paraesthesia, muscle/joint pain and Tl urine levels reported in epidemiological study of workers and surrounding residents of cement factory; mean urine levels between 0.9–32.6 µg/L (n=1,191) * No exposure-related adverse effects in workers of cement production plant with median urinary levels of ≈0.8 µg/L (males, n=128, median duration: 19.5 yr).   Animal data:   * LD50: 117 mg/kg of Tl2CO3 (rats, dermal) * Non-significant increased incidences of alopecia, lachrymation, and changes in serum biochemistry at 0.25 mg/kg/d of Tl2SO4 in controlled sub-chronic gavage study with exposure groups 0.01, 0.05, 0.25 mg/kg/d (rats, 90 d); NOAEL: 0.25 mg/kg/d * Adverse developmental effects and teratogenicity observed at doses higher than those required to elicit critical effects, e.g. 2 mg/kg/d IP injection of Tl2SO4 in repeat dose study (rats, no further exposure details provided) * DNA damage *in vitro* in bacteria and mouse embryo cells with TlNO3 and Tl2CO3; positive dominant lethal mutation assay with Tl2CO3 *in vivo* at 0.005–0.5 µg/kg/d (rats, 8 mo); cited review article concludes available data inadequate to determine mutagenicity of Tl due to experimental design and small sample sizes.   Insufficient data to recommend a TLV-STEL or notations for carcinogenicity or sensitisation. |
| DFG 2000 Not established |
| Summary of additional information:  Insufficient data to derive a MAK value. Therefore, previous value of 0.1 mg/m3 withdrawn.  Human studies:   * Symptoms of chronic exposure correspond to those of acute exposure; at higher concentrations, coordination disorders, paralysis of the extremities, hepatic and renal changes and psychoses are reported (no further details provided) * Case study of occupationally exposed battery workers (also cited by ACGIH, 2018) considered insufficiently documented by the agency to derive a MAK, but exposures of some workers were above the withdrawn MAK of 0.1 mg/m3.   Animal studies:   * Slight increase in resorptions at 0.05 and 0.5 µg/kg/d in repeat oral dose dominant lethal assay (rats, 8 mo, also cited by ACGIH, 2018); agency considers this study inadequate to draw conclusions on mutagenicity due to abnormally long duration and very low doses.   Insufficient data to recommend notations for carcinogenicity, skin absorption, and sensitisation. |
| 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 |
| --- | --- | --- | --- |
| US EPA |  | 2009 | * Human carcinogenicity data inadequate to recommend classification; studies considered in assessment rely on workplace medical records (same workplace studies cited by ACGIH, 2018 and DFG, 2000) * Available sub-chronic animal exposure data inadequately designed to detect carcinogenic endpoints * Results of available *in vitro* mutagenicity assays conflicting; agency considers positive result of single dominant lethal gene assay questionable (rats, 8 mo, also cited by ACGIH, 2018 and DFG, 2000). |
| US NIOSH |  | 1994 | * IDLH based on acute oral toxicity data in humans and animals. |

### Carcinogenicity — non-threshold based genotoxic carcinogens

|  |  |
| --- | --- |
| Is the chemical mutagenic? | Insufficient data |
| Is the chemical carcinogenic with a mutagenic mechanism of action? | Insufficient data |
| **Insufficient data are available to determine if the chemical is a non-threshold based genotoxic carcinogen.** |  |

## Notations

| Source | Notations |
| --- | --- |
| SWA | Skin |
| HCIS | — |
| NICNAS | — |
| EU Annex | — |
| ECHA | — |
| ACGIH | Skin |
| 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 |
| --- |
| |  |  |  |  | | --- | --- | --- | --- | | Adverse effects in human case study: | yes | 4.00 |  | | Dermal LD50 ≤1000 mg/kg: | yes | 3.00 |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  | 3 | **a skin notation is warranted** | |

### IDLH

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

## Additional information

|  |  |
| --- | --- |
| Molecular weight: | 204.38 |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = 8.38 mg/m3; 1 mg/m3 = 0.12 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) (2000) Thalliumverbindungen, löslich – MAK value documentation, German language edition.

US Environmental Protection Authority (US EPA) (2009) Integrated Risk Information System (IRIS) Chemical Assessment Summary – Thallium and compounds.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Thallium (soluble compounds, as Tl).