# Molybdenum, soluble compounds (as mo)

| CAS number: | 7439-98-7 |
| --- | --- |
| Synonyms: | — |
| Chemical formula: | Mo |
| Structural formula: | — |

Workplace exposure standard (amended)

| TWA: | **0.5 mg/m3 (respirable)** |
| --- | --- |
| 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 0.5 mg/m3 (respirable fraction) is recommended to protect for adverse lung effects in exposed workers.

## Discussion and conclusions

Soluble molybdates are used in corrosion control in ceramic glazes, enamels and pigments and as a reagent for chemical analysis. Molybdenum salts can be found in fertilisers for leguminous crops. Molybdenum is an essential element necessary for human health. This evaluation refers to soluble molybdenum compounds with most of the data being for molybdenum trioxide (MoO3). There is a separate evaluation for metallic and insoluble molybdenum compounds.

Data in humans and animals are limited. One case-control study linked occupational exposure with an increased risk of lung cancer. However, possible confounding between molybdenum and other potential carcinogens was noted (ACGIH, 2018). A NOAEC of 10 mg/m3 for molybdenum trioxide is reported in a two-year inhalation study in rats for chronic alveolar inflammation. This NOAEC is the basis for the ACGIH (2018) TWA of 0.5 mg/m3. In a review of the OEL for molybdenum and molybdenum compounds, HCOTN (2013) recommends a TWA of 0.1 mg/m3 (molybdenum trioxide) based on a BMDL of 0.29 mg/m3 derived from the same two-year study in rats cited by ACGIH (2018).

A TWA of 0.5 mg/m3 is recommended as assigned by ACGIH (2018). This TWA is sufficiently low to protect for adverse effects on the lungs as reported in animals. The TWA recommended by HCOTN (2016) is considered unnecessarily low.

## 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.

There are insufficient data to recommend a skin notation.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 5 mg/m3 | |
|  |
| ACGIH 2003 TLV-TWA: 0.5 mg/m3(Respirable particulate mass) |
| TLV-TWA recommended for soluble compounds to minimise adverse lung effects.  Summary of data:  Relates to soluble molybdenum compounds including molybdenum trioxide, ammonium molybdate, ammonium paramolybdate, sodium molybdate, calcium molybdite.  Human data:   * Essential mineral for human health; deficiency can result in adverse health effects * A 44 yr old man exposed to MoO3 at 6 to 19 mg/m3 for 4 yr complained of a dry cough * Case-control study linked occupational exposure with an increased risk of lung cancer; age, socioeconomic status, smoking, and pack-years were considered, as well as addressing exposures and possible confounding between molybdenum and other potential carcinogens.   Animal data:   * No effects in rats exposed to MoO3 at 12–15 g/m3 for 1 h * Irritation of the upper respiratory passages and conjunctivae occurred after exposure to ammonium paramolybdate at 3–5 g/m3 for 1 h * Guinea pigs exposed to 205 mg/m3 MoO3 dust (as Mo) showed a small to moderate amount of alveolar and bronchial exudate on histological examination of the lungs * Rats exposed 1 h/d for 30 d: * 8–10 g/m3 MoO3; lungs showed macroscopic haemorrhages, marked perivascular oedema, and large areas of haemorrhage into the alveolar spaces * 0.5–2.5 g/m3 ammonium paramolybdate dust; same effects as MoO3 and all animals died * NOAEL of 10 mg/m3 MoO3 (~6.8 mg/m3 Mo) in rats for chronic alveolar inflammation; 2 yr inhalation study; male rats showed an exposure-related increase in alveolar/bronchiolar adenomas or carcinomas * Sodium and ammonium molybdite reported as possibly genotoxic based on evidence in human and mice cell assays and *in vivo* in mice.   TLV-TWA based on NOAEL for alveolar inflammation with UF of 10 and adjusting for 8-h workday from 6 h exposures used in the animal study.  Insufficient evidence to recommend a skin or sensitiser notation and TLV-STEL. |
| DFG 2000 Not assigned |
| Insufficient information to establish MAK for molybdenum and its compounds, except for MoO3.  MAK not assigned for MoO3 based on evidence on animals of carcinogenic effects and a mechanism is not understood.  Summary of additional data:   * Long-term carcinogenicity MoO3 study in rats and mice; 0, 10, 30, or 100 mg/m3, 6 h/d, 5 d/wk for 104 wk (cited by ACGIH, 2018): * number of male mice with lung tumours (carcinoma or adenomas plus carcinoma) increased significantly from the lowest exposure concentration of 10 mg/m3; increase was not dose-dependent * incidence of lung adenomas was significantly increased in female mice exposed to 30 and 100 mg/m3 * female mice, significant increase in adenomas plus carcinomas in the 100 mg/m3 group * in male rats a marginally significant positive trend towards an increase in the incidence of adenomas plus carcinomas; incidences within historical control range values * no increases in lung tumour incidence observed in female rats * No information available on molybdenum or its compounds and dermal absorption in humans. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2013 Not assigned |
| Insufficient data to recommend soluble group health-based OEL, not including MoO3 or sodium molybdate.  Summary of additional data:   * Benchmark dose-analysis performed to derive the following recommendations * MoO3: BMDL of 0.29 mg/m3 from 2 yr chronic inhalation study (cited by ACGIH, 2018): * based on squamous metaplasia in the epiglottis (larynx) in both species and in both sexes; and hyaline degeneration in the nose, and chronic inflammation and metaplasia in the lungs * a TWA of 0.1 mg/m3 (0.07 mg/m3 Mo) recommended based on BMDL * Sodium molybdate: BMDL of 41.2 mg/m3 (Mo) from 90 d oral study: * based on reduction in body weight * a TWA of 9.9 mg/m3 (4.6 mg/m3 Mo) recommended based on BMDL. |

### Secondary source reports relied upon

NIL.

### 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 | NA |
| HCIS | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A3 |
| 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 |
| --- |
| Insufficient data to assign a skin notation |

### IDLH

| Is there a suitable IDLH value available? | No |
| --- | --- |

## Additional information

| Molecular weight: | 95.95 |
| --- | --- |
| 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  \*excluding MoO3 |

## 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) (2002) Molybdenum and its compounds – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2013) Molybdenum and molybdenum compounds. Health-based recommended occupational exposure limit. The Hague: Health Council of the Netherlands; publication no. 2013/30.