# Phosphoric acid

| CAS number: | 7664-38-2 |
| --- | --- |
| Synonyms: | Orthophosphoric acid, white phosphoric acid |
| Chemical formula: | H3PO4 |
| Structural formula: | — |

Workplace exposure standard (retained)

| TWA: | **1 mg/m3** |
| --- | --- |
| STEL: | **3 mg/m3** |
| Peak limitation: | **—** |
| Notations: | **—** |
| IDLH: | **1,000 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 1 mg/m3 is recommended to protect for irritation in exposed workers.

A STEL of 3 mg/m3 is recommended to protect for acute irritation in exposed workers.

## Discussion and conclusions

Phosphoric acid is used in fertiliser production and as a pH adjuster in cosmetics. It is formed from the hydrolysis of phosphorus pentoxide or products of phosphorus combustion (DFG, 2006).

The critical effect of exposure is irritation of the eyes, skin and upper respiratory tract.

Quantitative substance-specific exposure data are limited. Air concentrations between 0.8 and 5.4 mg/m3 were tolerable to unacclimated workers; whereas 3.6 to 11.3 mg/m3 caused respiratory tract irritation (ACGIH, 2018). A NOAEC of 50 mg/m3 for hydrolysed phosphorus combustion products, equivalent to 37.5 mg/m3 of phosphoric acid, is reported for lung tissue damage with a corresponding LOAEC of 135 mg/m3 (phosphoric acid) from a sub-chronic inhalation study in rats (DFG, 2006).

Due to the limited substance-specific dataset, assessments reported by ACGIH (2018) and DFG (2006) are supported by analogies to sulfuric acid and phosphorus pentoxide, respectively. In view of these assessments, the TWA of 1 mg/m3 and STEL of 3 mg/m3 are recommended to be retained and are expected to protect for irritation. These recommendations are supported by the report of respiratory tract irritation in exposed workers at above 3.6 mg/m3 (ACGIH, 2018) and a NOAEC of 37.5 mg/m3 for lung tissue damage in rats (DFG, 2006).

## 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.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 1 mg/m3; STEL: 3 mg/m3 | |
|  |
| ACGIH 2001 TLV-TWA: 1 mg/m3; TLV-STEL: 3 mg/m3 |
| TLV-TWA and TLV-STEL intended to protect for irritation of the skin, eyes and upper respiratory tract in unacclimated workers. Values are based on the agency’s previous evaluation of sulfuric acid, which has since been reviewed to lower the TLV-TWA to 0.2 mg/m3 and remove the TLV‑STEL (2003) and assign an A2–suspected human carcinogen notation (2004).  Summary of information:  TLV-TWA and TLV-STEL based on analogy to those for sulfuric acid. TLV-TWA is below the threshold for throat irritation in both unacclimated and acclimated workers.  Human data:   * Less hazardous than nitric acid and sulfuric acid, equally corrosive upon ingestion (no further details provided) * Necrosis of the upper and lower digestive tracts and pancreas 19 d after fatal ingestion (no further details provided) * In the presence of moisture, mist is a mild irritant of the eyes, skin and upper respiratory tract * Exposure to fumes at 0.8–5.4 mg/m3 was noticeable, but not uncomfortable: * 3.6–11.3 mg/m3 caused coughing in unacclimated workers, but was tolerable * 100 mg/m3 was intolerable except to acclimated workers (no further details provided).   Animal data:   * None reported.   Insufficient data to recommend notations for carcinogenicity, skin absorption or sensitisation. |
| DFG 2005 MAK: 2 mg/m3 |
| Summary of additional information:  Due to lack of substance-specific exposure data, MAK based on inhalation study in rats exposed to combustion products of phosphorus and analogy to phosphorus pentoxide.  Phosphoric acid is the major hydrolysis product of phosphorus pentoxide, which forms from the combustion of elemental phosphorus.  A NOAEC of 50 mg/m3 of phosphorus combustion products for lung tissue damage is reported in a sub‑chronic inhalation study with rats. The inhaled aerosol contained 75% phosphoric acid, the NOAEC for phosphoric acid and phosphorus pentoxide are therefore estimated at 37.5 mg/m3 and 27 mg/m3, respectively. The MAK for phosphorus pentoxide is 2 mg/m3, which is equivalent to  2.5 mg/m3 phosphoric acid. The MAK for phosphoric acid is therefore rounded to 2 mg/m3 according to the DFG methodology.  Notations for skin absorption and sensitisation not assigned by analogy to phosphorus pentoxide.  Human data:   * None reported.   Animal data:   * Lung tissue damage, particularly within terminal bronchioles, from exposure to phosphorus combustion products and rubber (95:5) reported in 2 sub-chronic inhalation studies (rats, 2.25 h/d, 4 d/wk, 13 wk):   + NOAEC: 50 mg/m3 ≡37.5 mg/m3 phosphoric acid   + LOAEC: 180 mg/m3 ≡135 mg/m3 phosphoric acid; LOAEC (of second study): 300 mg/m3 ≡225 mg/m3 phosphoric acid * Non-mutagenic *in vitro* in bacteria and rat hepatocytes; DNA repair suppression at high concentrations attributed to low pH rather than substance-specific action * Non-mutagenic *in vivo* in recessive lethal mutation assay with *D. melanogaster* * Clastogenic *in vitro* in Chinese hamster ovarian cells at high concentrations due to low pH * No ADME data presented.   Insufficient data to assign carcinogenicity notation. |
| SCOEL 1991 TWA: 0.2 ppm (1 mg/m3); STEL: 0.5 ppm (2 mg/m3) |
| Summary of additional information:  Further data regarding irritation threshold in humans are required for a complete assessment. OEL recommendation adopted from TLV presented by ACGIH (1989).  Human data:   * Occupational exposure not expected to significantly impact total phosphate burden, irritational effects due to substance acidity therefore expected to be critical * Assessments based on phosphorus pentoxide likely to overestimate potential risk due to additional desiccant action. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2016 | * Critical effects are irritation of the eyes, skin, GIT and respiratory tract * Dermal LD50: 1,260 mg/kg (rabbits, 85% phosphoric acid) study limited by number of test animals * LC50 (1 h): 5,337 mg/m3 (rabbits), 3,846 mg/m3 (rats), 856 mg/m3 (mice), 193 mg/m3 (guinea pigs). |
| ECHA |  | 2020 | * DNELs based on NOAEL of 323 mg/kg/d for bw reduction reported in chronic feeding study (dogs, 6 mo):   + long-term systemic DNEL: 10.7 mg/m3   + long-term local irritation DNEL: 1 mg/m3   + short-term local DNEL: 2 mg/m3. |
| OECD |  | 2009 | * No effects on reproduction and development in controlled repeat gavage study with exposure groups 125–500 mg/kg/d (rats, 2 wk). |
| US NIOSH |  | 1994 | * IDLH based on acute oral toxicity data in animals. |

### 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 | — |
| NICNAS | — |
| EU Annex | — |
| ECHA | — |
| ACGIH | — |
| DFG | — |
| SCOEL | — |
| 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: |  |  |  | | Dermal LD50 ≤1000 mg/kg: | no |  |  | | 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 not warranted** | |

### IDLH

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

## Additional information

| Molecular weight: | 97.99 |
| --- | --- |
| 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) (2006) Phosphorsäure (ortho-Phosphorsäure) – MAK value documentation.

European Chemicals Agency (ECHA) (2020) Phosphoric acid – REACH assessment.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1991) Recommendation from the Scientific Committee on Occupational Exposure Limits for Phosphoric acid. SCOEL/SUM/14.

Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2016) Phosphoric acid: Human health tier II assessment – IMAP report.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2016) Phosphoric acid: Human health assessment – IMAP report.

Organisation for Economic Cooperation and Development (OECD) (2009) SIDS initial assessment profile – Phosphoric acid.

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