# Persulfates, Ammonium- and alkali metal salts

| CAS number: | 7727-54-0 (Ammonium persulfate)  7727-21-1 (Potassium persulfate)  7775-27-1 (Sodium persulfate) |
| --- | --- |
| Synonyms: | NH4/K/Na - peroxydisulfate, peroxydisulphate, persulphate |
| Chemical formula: | (NH4)2S2O8 (Ammonium persulfate)  K2S2O8 (Potassium persulfate)  Na2S2O8 (Sodium persulfate) |

Workplace exposure standard (retained)

| TWA: | **0.1 mg/m3 (as persulfate, S2O8)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **RSEN, DSEN** |
| IDLH: | **—** |
| Sampling and analysis: | There is uncertainty regarding quantification of the recommended value with currently available sampling and/or analysis techniques. |

## Recommendation and basis for workplace exposure standard

A TWA of 0.1 mg/m3, as measured by the persulfate ion, is recommended for persulfate (ammonium and alkali salts) to protect for dermal and respiratory tract irritation, including skin rashes and dermatitis.

## Discussion and conclusions

The persulfate ion is an oxidising agent and its salts are commonly employed in bleaching or etching applications. The critical effects of ammonium (NH4), potassium (K) and sodium (Na) persulfate exposure are irritation to the skin and respiratory tract, which may cause dermatitis, eczema or asthma (ACGIH, 2001; DFG, 2002). These persulfate salts have been grouped for this recommendation due to the commonalities of their applications, chemical structures and critical effects.

A NOAEL of 1 mg/m3 for symptoms of lung inflammation, oedema or loss of body weight is reported from an inhalation study in animals with ammonium persulfate (ACGIH, 2018). Human case studies involving bakers, hairdressers, laboratory workers and persulfate production workers suggest that repeat exposures can cause dermal and respiratory sensitisation. These findings are supported by positive skin prick and patch tests in humans and trials in animals involving NH4 persulfate (1% in water) (ACGIH, 2018; DFG, 2002).

A TWA of 0.1 mg/m3 (as measured by the persulfate ion), is recommended for persulfate (ammonium and alkali salts), as assigned by ACGIH (2018). The recommended TWA is protective for dermal and respiratory tract irritation, including skin rashes and dermatitis.

## Recommendation for notations

Not classified as carcinogens according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Classified as a skin sensitiser and a respiratory sensitiser according to the GHS.

A skin notation is not warranted as there is no evidence of systemic effects resulting from skin absorption.

# Appendix

### Primary sources with reports

| **Source Year set Standard** |
| --- |
| SWA Year TWA: 0.1 mg/m3 | |
|  |
| ACGIH 2001 TLV-TWA: 0.1 mg/m3 (as persulfate) |
| TLV-TWA for persulfate salts (NH4; K; Na) recommended to minimise the potential for dermal and respiratory tract irritation, which is considered distinct to potential systemic toxicity. Na and K salts are expected as potentially irritating as NH4salt and are included in the recommendation as measured by persulfate concentration. Derivation of TLV-TWA not explained; but presumably derived based on the NOAEL of 1 mg/m3 and applying a 10-fold uncertainty factor for interspecies differences.  Summary of data:  Human data:   * Case studies of workers producing ammonium and potassium persulfate reported frequent occurrence of skin rashes that caused both dermatitis and hypersensitivity reactions in the subjects: * rashes reduced by use of protective clothing and improved dust removal measures * Skin prick test studies with hairdressers (salt not specified) induced asthma and local wheal (no further information provided) * Asthma induced by blowing 0.1 mg into the nose (salt or concentration not specified) * Asthma reported in hairdressers, induced through persulfate exposure.   Animal data:   * No sub-chronic toxicity studies available for ammonium- or K- persulfate. * Repeat feeding study (rats, 13 wk) reported no significant differences between treated and untreated groups as measured by organ weights, body weight ratios, blood chemistry, haematological and urinary parameters: * dose range 0, 300 or 3,000 ppm in diet for 13 wk in one group and 1,000 ppm for 8 wk and 5,000 ppm for 5 wk in second group (feeding period unspecified).   Insufficient data to recommend a carcinogenicity, skin sensitisation notation for any salts. |
| DFG 2002 — |
| Summary of additional data:  Respiratory and dermal sensitiser notations (Sa and Sh) recommended.  Human data:   * Workplace study at persulfate production plant with 32 exposed workers reported no higher incidences of asthma, rhinitis, conjunctivitis or dermatitis compared with control group * Personal air monitoring for persulfate salts (NH4 and Na) returned indoor air concentrations <1 mg/m3 and peak concentrations ranging from 1.4–3.6 mg/m3 (no further information provided) * No evidence for non-specific histamine release response in human skin prick test studies (Na and K, no data available for NH4) * Single positive reaction in skin prick and patch tests (NH4 and K mixtures of 2–2.5% in water or Vaseline).   Animal data:   * Persulfate salts (Na and K) shown to elicit non-specific histamine release response *in vitro* * Maximisation test (unspecified animal, 10 repeat doses, alternating days) carried out with aqueous solutions of ammonium persulfate * 20/20 positive reactions after challenge by intradermal injection of 0.1% saline solution (unspecified concentration expression) * 16/20 positive reactions after dermal challenge with 1% aqueous solution (unspecified concentration expression). |
| 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 |  | 2016 | * ~50 mg/m3 NH4 salt induced airway hyper-responsiveness in occupational lung disease study (rabbits, 4 h). |
| NTP |  | 2001 | * LD50: 819.3 mg/kg (rats, oral) as NH4 salt. |
| OECD |  | 2005 | * Aqueous solutions of NH4 salt irritating to humans at concentrations >5% * Irritation in 8/46 subjects with 17.5% aqueous solution of persulfate (ions not specified) under occlusive wrap (4 h) * LD50: 495 and 700 mg/kg (female rats, oral) * LD50: 742 mg/kg (male rats) * LD50: >2,000 mg/kg (rats/rabbits, dermal) as NH4 salt * LD50: >10,000 mg/kg (rats/rabbits, dermal) as Na / K salt * LC50: >2,950 mg/m3 (4 h, rats, acute). |

### 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 | Sen |
| HCIS | Skin sensitisation – category 1; Respiratory sensitisation – category 1 |
| NICNAS | Sensitisation – Category 1 |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | — |
| DFG | Sh (dermal sensitiser); Sa (respiratory sensitiser |
| 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: | no |  |  |  |  |  | | 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? | No |
| --- | --- |

## Additional information

| Molecular weight: | Ammonium persulfate: 228.18  Potassium persulfate: 270.32  Sodium persulfate: 238.10 |
| --- | --- |
| 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) (2002) Ammoniumpersulfat und Alkalipersulfate –MAK value documentation German language edition.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2016) Persulfates. Human health tier II assessment – IMAP report.

National Toxicology Program (NTP) (2001) Guidance Document on Using In Vitro Data to Estimate In Vivo Starting Doses for Acute Toxicity.

Organisation for Economic Cooperation and Development (OECD) (2005) SIDS initial assessment report for SIAM 20 – Persulfates.