# Paraquat (respirable)

| CAS number: | 4685-14-7 |
| --- | --- |
| Synonyms: | 1,1-Dimethyl-4,4-bipyridinium ion,  paraquat dichloride (ISO) |
| Chemical formula: | C12H14N2 |
| Structural formula: | — |

Workplace exposure standard (amended)

| TWA: | **0.05 mg/m3** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Sk.** |
| 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 0.05 mg/m3 is recommended to protect for lung damage and respiratory tract irritation in exposed workers.

## Discussion and conclusions

Paraquat is a quick-acting, non-selective herbicide used for broad spectrum control of broadleaf weeds, grasses and aquatic weeds.

Critical effects of exposure are lung damage and upper respiratory tract irritation. Exposure may also be associated with liver and kidney damage, eye irritation and effects on central nervous system (CNS).

Limited or no quantitative exposure information is available in relation to airborne exposure concentrations and adverse health effects. Skin irritation and rashes are reported in a study comparing exposed workers with controls. No significant differences in pulmonary, renal, liver or hematologic functions are found in this study. No associations are identified between an average airborne paraquat concentration of 0.218 mg/m3 from spraying and urine paraquat concentrations in workers. A NOAEC of 0.1 mg/m3 is identified in a three week inhalation study in rats based on pulmonary irritation (ACGIH, 2018). A one year dietary study in dogs reported a NOEL of 0.45 mg/kg/day based on pulmonary lesions associated with chronic pneumonitis. The eight-hour human inhalation equivalent to this concentration is 3.15 mg/m3 based on generic conversion factors.

A TWA of 0.05 mg/m3 is recommended as derived by ACGIH (2018). This TWA is expected to be protective of lung damage reported in animals. This concentration provides a suitable margin of safety based on the NOEL in animals.

## 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 in humans of severe systemic effects following dermal exposure.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 0.1 mg/m3 | |
|  |
| ACGIH 2018 TLV-TWA: 0.05 mg/m3 (Inhalable particulate matter) |
| TLV-TWA recommended to minimise the potential for lung damage and upper respiratory tract irritation. Stated to also be protective of liver and kidney damage, eye irritation and potential effects on the CNS.  Summary of data:  No derivation provided; based on NOAEC of 0.1 mg/m3 (pulmonary irritation) in rats.  Human data:   * Limited or no quantitative exposure information in relation to airborne exposure concentrations and adverse health effects * 5 accidental deaths attributed to dermal occupational exposure: * symptoms included irritation and ulceration of the skin within 3 d * kidney, liver and respiratory symptoms within 5 d * diffuse alveolar damage was found post-mortem in all cases * No significant differences in pulmonary, renal, liver or hematologic functions found in a comparison of 27 plantation workers (>5 yr of paraquat experience) with a group of unexposed workers * skin irritation and rashes reported * Large cohort of registered pesticide applicators (Agricultural Health Study): paraquat use correlated with self-reported wheeze in the previous 12 mo; no further information * No associations with airborne paraquat concentration on spraying days of 0.218 mg/m3 (0.002–1.032 mg/m3) and urine paraquat concentrations * Mixed conclusions about the potential role of paraquat to initiate or potentiate the development of Parkinson’s Disease.   Animal data:   * LD50: 80 mg/kg (male rats, dermal) * No induction of dermal sensitisation in guinea pigs * In rats, single 6 h exposure at 1.3 mg/m3 resulted in death * not reported at 0.75 mg/m3 * repeated daily 6 h exposures at 0.75 mg/m3; caused shallow, rapid breathing after 2 d; mortality after 4 d of exposures * NOAEC of 0.1 mg/m3 in rats based on clinical signs of wheeze and pulmonary irritations; 3 wk inhalation study, daily 6 h exposures; daily 1 h exposure at 0.65 mg/m3 induced pulmonary haemorrhage * NOAEL of 4.74 mg/kg/d (paraquat ion), 13 wk dietary intake in rats * LOAEL of 14.2 mg/kg/d for alveolar epithelial hypertrophy and decreased body weight; no further information * NOAEL of 8.33 mg/kg ion/d (paraquat ion) 13 wk dietary intake in mice * LOAEL of 25.9 mg/kg/d (paraquat ion); no further details * No neurobehavioral or neurotoxic effects identified following 13 wk continuous dietary exposure in mice to ~10 mg/kg/d; no further information * No clear evidence of carcinogenicity in animals * Non- genotoxic * Low teratogenic potential in mice *via* gavage or IP injection.   Insufficient evidence to recommend a TLV-STEL. |
| DFG NA NA |
| No report. |
| 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 |
| --- | --- | --- | --- |
| APVMA |  | 2016 | * NOEC of 0.01 mg/m3; 21 d rat whole body exposure; no further information * Concludes that “despite some positive weak trend data, the available epidemiology data is insufficient to conclude any association between paraquat exposure and neurotoxicity (including Parkinson’s disease) in the occupational environment” * 1 yr dog study, dietary daily; M/F: 0, 0.45/0.48, 0.9/10 or 1.5/1.6 mg/kg/d; NOEL of 0.45 mg/kg/d; LOEL of 0.9 mg/kg/d pulmonary lesions associated with chronic pneumonitis; lowest NOEL and LOEL of all dietary studies reviewed * Australian ADI is 0.004 mg/kg/d; established by application of a 100-fold safety factor to the NOEL of 0.45 mg/kg/d. |

### 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: | 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? | No |
| --- | --- |

## Additional information

| Molecular weight: | 257.18 |
| --- | --- |
| 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.

Australian Pesticides and Veterinary Medicines Authority (APVMA) Summary Report: Paraquat; Agricultural and Veterinary Chemical Assessment Team Review. Canberra (2016).