# Polyvinyl chloride

| CAS number: | 9002-86-2 |
| --- | --- |
| Synonyms: | Chloroethylene homopolymer,  chloroethylene polymer, chlororethene polymer, polycholoroethylene, vinyl chloride homopolymer,  vinyl chloride polymer, PVC |
| Chemical formula: | (C2H3Cl)*n* |
| Structural formula: | — |

Workplace exposure standard (new)

| TWA: | **1 mg/m3 (as respirable dust)** |
| --- | --- |
| 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 1 mg/m3 as respirable dust is recommended to protect for pneumoconiosis, lower respiratory tract irritation and lung function impairment.

## Discussion and conclusions

Polyvinyl chloride (PVC) is produced through the polymerisation of vinyl chloride. PVC is mainly used in the building and construction industries, automotive parts, consumer goods, packaging and electrical wire insulation.

Critical effects of exposure are pneumoconiosis, lower respiratory tract irritation and pulmonary function changes. Pure PVC dust is relatively insoluble in water and tissue fluids and generally not systemically available. PVC particles accumulate locally in the lungs where they may exert adverse effects (ACGIH, 2018; DFG, 2015).

Evidence from occupational epidemiology studies indicates a potential for lung function impairment and the development of pneumoconiosis following exposure at concentrations greater than 10 mg/m3 (DFG, 2015). Cumulative exposure (years x mg/m3) in workers exposed to greater than 10 mg/m3 -years is associated with a low grade of pneumoconiosis as seen radiographically, respiratory symptoms and slight decrements in pulmonary function (ACGIH, 2018). Septal thickening, slight interstitial inflammation, proliferation of connective tissue and granulomatous foci in lymph nodes reported in rats exposed to 8 and 20 mg/m3 *via* nose-only inhalation for eight months. These effects were not seen in the 3.2 mg/m3 exposure group (ACGIH, 2018).

The TWA of 1 mg/m3 derived by ACGIH (2018) is recommended. This TWA is expected to be protective of effects in the lungs based on evidence in humans and 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.

There are insufficient data to recommend a skin notation.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA NA NA | |
| No report. |
| ACGIH 2008 TLV-TWA: 1 mg/m3 |
| TLV-TWA recommended to minimise the potential for pneumoconiosis, lower respiratory tract irritation and pulmonary function changes.  Applies only to the polymerised form of vinyl chloride and not the vinyl chloride monomer.  Summary of data:   * PVC is generally made by polymerising vinyl chloride monomer: * PVC dust may contain other components from ingredients used in the polymerisation process that play some role in effects and confounding of study results * PVC particles are relatively insoluble in water and tissue fluids: * the available evidence from experimental animals and from humans indicates that pure PVC is not metabolised in mammals.   Human data:   * Large number of epidemiological studies in workers * A study involving 1,216 PVC workers; 20 cases of PVC pneumoconiosis as radiographic changes; exposure over 5 yr, average 12 yr; no exposure; 60% of airborne levels >10 mg/m3 measured as total dust * Cross sectional studies of workers consider cumulative exposure above 10 mg/m3-yr (yr x mg/m3 measured as respirable dust) as indicative of heavy exposure * 2 studies in workers showed exposure at 10 mg/m3-yr associated with a low grade of pneumoconiosis as seen radiographically, respiratory symptoms and slight decrements in pulmonary function * Studies involving PVC workers identified increase in risk of pulmonary function changes and low-grade pneumoconiosis associated with respirable dust exposures at >10 mg/m3 respirable dust * Insufficient data to conclude that PVC is carcinogenic to humans.   Animal data:   * Rats exposed at 50–60 mg/m3 of PVC particles 1.2 µm for 1 h/d, 1–3 d; following 30 d recovery lungs mostly cleared of PVC; some dust in lymphatics and bronchiolar epithelium * Scattered lung lesions but no significant changes in pulmonary function observed in rats exposed at 10 mg/m3 6 h/d, 5 d/wk for 15 wk: * lesions characterised by aggregates of PVC-loaded macrophages; hypercellularity of alveolar walls near the aggregates still present after a 15 wk recovery period * minimal increase in collagen and reticular fibre formation but no evidence of an extensive fibrotic reaction * Rats exposed at 0 or 12 mg/m3 for 7 h/d, 5 d/w for 7 mo; no significant pulmonary lesions observed; slight proliferation of reticulum fibres without progression; PVC dust particles found in pulmonary macrophages * Rats, guinea pigs and monkeys exposed at 0 or 13 mg/m3 6 h/d, 5 d/w for 22 mo; no fibrosis, cellular inflammation, deficits in pulmonary function or cancers: * PVC particles were found in the macrophages of the 3 test species but more commonly in monkeys * Rats exposed nose-only route for 5 h/d, 5 d/wk for 8 mo at 0, 3.2, 8, or 20 mg/m3; septal thickening, slight interstitial inflammation, proliferation of connective tissue and granulomatous foci in lymph nodes occurred in the 8 and 20 mg/m3 groups but not in the 3.2 mg/m3 group.   Insufficient evidence to recommend a skin or sensitiser notation or TLV-STEL. |
| DFG 2015 MAK: 0.3 mg/m3(respirable fraction) x material density (g/cm3) |
| MAK value for general threshold value for dust.  Summary of additional data:   * Effects of PVC particles (without additives, with a monomer content <1 ppm) act due to general particle effect of biopersistent granular dusts: * recommended ‘general threshold limit value for dust’ of 0.3 mg/m3 established for a material density of 1 g/cm3 * Multiplied by a PVC density of 1.4 g/cm3 a value of 0.4 mg/m3 is obtained; no further information * Previous MAK of 5 mg/m3 based on evidence indicating workers employed in the PVC industry exposed at >10 mg/m3 for long periods, risk lung function impairment and the development of pneumoconiosis demonstrated in radiographs (UF of 2 applied) * Biopersistent granular dusts generally not systemically available, accumulate locally in the lungs, adverse effects only in lungs. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2013 Not assigned |
| Summary of additional data:   * Evaluation of the carcinogenicity and genotoxicity * Epidemiological studies available showed no consistent evidence for carcinogenicity of PVC in humans * Data on PVC are insufficient to evaluate the carcinogenic properties. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | ND | * Human health tier I assessment * Identified as low concern to human health by application of expert validated rules * No further information. |

### 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 |
| DFG | Carcinogenicity – 4 |
| SCOEL | NA |
| HCOTN | Carcinogenicity – category 3 |
| IARC | Carcinogenicity – Group 3 |
| 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: | 62.50 |
| --- | --- |
| 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) (2017) Polyvinyl chloride (PVC) – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2013) Polyvinyl chloride. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2013/22.

International Agency for Research on Cancer (IARC) (1987) Polyvinyl chloride. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (No date) Ethane, chloro-, homopolymer: Human health tier I assessment – IMAP report.