# Methylene chloride

| CAS number: | 75-09-2 |
| --- | --- |
| Synonyms: | Dichloromethane, DCM, methane dichloride, methylene bichloride |
| Chemical formula: | CH2Cl2 |
| Structural formula: | — |

Workplace exposure standard (retained)

| TWA: | **50 ppm (174 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Carc. 2, Sk.** |
| IDLH: | **2,300 ppm** |
| **Sampling and analysis:** The recommended value is quantifiable through available sampling and analysis techniques. | |

## Recommendation and basis for workplace exposure standard

A TWA of 50 ppm (174 mg/m3) is recommended to protect for elevated carboxyhaemoglobin (COHb) and central nervous system (CNS) effects in exposed workers.

## Discussion and conclusions

Methylene chloride is predominantly used as a solvent, including in paint stripper and degreasers, flavour extraction and as a blowing agent for polyurethane foams. Critical effects of exposure include elevated COHb and CNS effects.

A LOAEC of 200 ppm is reported for acute CNS effects in human volunteers. This LOAEC was derived from three experimental studies involving exposure durations of three hours or more. No chronic CNS effects are identified in workers exposed at concentrations ranging from 100 to 225 ppm (ACGIH, 2018). Occupational medical field observations identified that exposure at 90 ppm produced COHb levels of four per cent, which are considered to be insignificant (DFG, 2014). There is no evidence of adverse effects on health following occupational exposure to approximately 100 ppm for several years. Reversible CNS effects are reported in animals at concentration of 2,000 ppm (SCOEL, 2009). Methylene chloride is considered a weak animal carcinogen but there is no clear association between exposure and cancer in humans.

The TWA of 50 ppm (174 mg/m3) is recommended be retained. It is consistent across most primary sources and on the weight of evidence presented is expected to be protective of effects on the CNS and COHb elevation. The TWA of 50 ppm is considered sufficiently low to protect for effects from transient, acute airborne concentration. Additionally, there is insufficient evidence available to recommend a STEL.

## Recommendation for notations

Classified as a category 2 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.

Skin notation is recommended based on report of adverse effects in human case study.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 50 ppm (174 mg/m3) | |
|  |
| ACGIH 2001 TLV-TWA: 50 ppm (174 mg/m3) |
| TLV-TWA recommended to minimise the potential for elevation of COHb and CNS depression.  Summary of data:  Human data:   * LOAEC of 200 ppm for acute CNS effects; based on 3 experimental studies ≥3 h exposures * No CNS effects attributable to chronic, low-level exposure within or above 100–225 ppm; possible NOAEL; based on study in airline mechanics: * consistent with evidence of an excess in self-reporting neurological effects from a study in workers exposed to an estimated 75–100 ppm when compared to controls * Epidemiological studies in workers exposed at 140–475 ppm or a mean TWA of 26 ppm; no increase in mortality due to ischemic heart disease or no increase in electrocardiographic abnormalities * Cohort study of 1,013 full-time male workers of same factory; at least 1 yr work in dichloromethane usage areas; mean exposure TWA 26 ppm; control group of 40,000 males: * less than the expected total numbers of deaths and deaths due to hypothesised lung and digestive system cancers were observed * expected pancreatic cancers exceed expected numbers but likely due to other risk factors (diabetes, smoking, alcohol abuse) and effect was not dose-related * Cohort of 1,271 workers employed for at least 3 mo; exposure categories low (140 ppm); medium (280 ppm); high (475 ppm); co-exposures to methanol and acetone; reference population of 948 unexposed workers: * no significant increase in overall mortality or in deaths due to ischemic heart disease or malignant neoplasms compared to US population * increase in mortality due to ischemic heart disease compared to reference population, associated with relatively higher rate of cardiovascular disease in the geographic region of the exposed * an increase in biliary tract cancer associated with estimated TWA 140 to 475 ppm range diminish with longer follow-up * Epidemiology studies failed to indicate an increase in these or other types of cancers.   Animal data:   * LC50: 11,500 ppm (guinea pigs, 6 h) * Acute exposure primarily depresses the CNS; deep narcosis in cats at 10,600 ppm for 293 min; narcosis in monkeys, rabbits and rats at 10,000 ppm for 1 h * Hepatotoxicity associated with acute exposure; disruption of rough endoplasmic reticulum membranes and coalescence of endoplasmic reticular membranes into large vacuoles in mice following continuous exposure at 5,000 ppm * No adverse effects in dogs, rabbits or rats exposed 7 h/d, 5 d/wk for up to 6 mo at 5,000 ppm * Rats exposed 6 h/d, 5 d/wk for 2 yr at 1,000, 2,000 or 4,000 ppm: * increased incidences of hepatic haemosiderosis, cytomegaly, cytoplasmic vacuolisation, necrosis, granulomatous inflammation, and bile duct fibrosis * increased incidences of benign mammary gland lesions (adenomas and fibroadenomas); no increase in malignant neoplasms. * Mice exposed 6 h/d, 5 d/wk for 102 wk at 2,000 or 4,000 ppm: * significantly increased incidence of liver and lung tumours * Mouse cancer response species-specific * Considered weak animal carcinogen * Mutagenic, with and without metabolic activation, in most bacterial assays for point mutation.   Insufficient data to recommend a Skin or sensitiser notation or a TLV-STEL. |
| DFG 2014 MAK: 50 ppm (180 mg/m3) |
| MAK recommended to protect for COHb impacts and potential carcinogenicity.  Summary of additional data:   * Previous MAK of 100 ppm based on COHb level in blood remaining below limit of 5%; occupational medical field observations, exposure at 90 ppm produced COHb levels of about 4% * Exposure at 50 ppm under physical activity; 10 m3 respiratory volume per 8 h; results in an estimated blood dichloromethane level of ~0.51 mg/L; basis for MAK of 50 ppm * Considered a genotoxic carcinogen; publication of a probabilistic PBPK model in the mouse and the risk estimate for humans allows for a risk-based MAK: * tumour risk of 1.4 × 10–10 corresponds to exposure to 1 µg/m3 during the working lifetime (14% of the lifetime) * based on above, calculated exposure to 50 ppm (180 mg/m3) over working lifetime a median tumour risk of 2.5 x 10-5 (2.5 in 100,000) predicted *via* linear extrapolation. * Study in volunteers confirms absorption through skin; no quantitative assessment possible * Report of industrial accident; death of male worker after falling into machine with liquid methylene chloride; extremely high concentrations of methyl chloride in tissues and organs; suspected dermal absorption of vapour contributed. |
| SCOEL 2009 TWA: 100 ppm (353 mg/m3); STEL: 200 ppm (706 mg/m3) |
| TWA and STEL recommended to protect for COHb formation and reversible CNS effects.  Summary of additional data:   * Non-smoking workers exposed at ~250 ppm (800 mg/m3) resulted in blood COHb levels of >8% * Experimental study in humans exposed at 100 ppm for 8 h resulted in 3% COHb * Neurobehavioural changes observed in volunteers exposed at 250 ppm for 1.5–3 h * 1 h exposure at 672 ppm resulted in light-headedness and visual function effects in volunteers * No evidence of adverse effects on health following occupational exposure to ~100 ppm for several years; no further information * No clear association between exposure and cancer in humans * In animals, repeated or long-term exposure to high concentrations associated with reversible CNS effects; the lowest exposure concentration associated with reversible CNS effects is 2,000 ppm, 6 h/d; no effects at 500 ppm * No derivation of TWA and STEL provided. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

NIL.

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | Yes |
| --- | --- |
| 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 | Carc. 2, Skin |
| HCIS | Carcinogenicity – category 2 |
| NICNAS | Carc. Cat 3 |
| EU Annex | Carcinogenicity – category 2 |
| ECHA | Carc. 2 |
| ACGIH | Carcinogenicity – A3 |
| DFG | Carcinogenicity – 5, H (skin) |
| SCOEL | Carcinogenicity – C, Skin |
| HCOTN | NA |
| IARC | Carcinogenicity – Group 2A |
| 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: |  |  |  | | Dermal repeat-dose NOAEL ≤200 mg/kg/d: |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  | |  |  |  | **a skin notation is warranted** | |

### IDLH

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

## Additional information

| Molecular weight: | 84.93 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = 3.53 mg/m3; 1 mg/m3 = 0.29 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) (2015) Dichloromethane – MAK value documentation.

European Chemicals Agency Regulation (ECHA) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2009) Recommendation from the Scientific Committee on Occupational Exposure Limits for Methylene chloride (dichloromethane). SCOEL/SUM/130.

International Agency for Research on Cancer (IARC) Some Chemicals Used as Solvents and in Polymer Manufacture. IARC Monographs – 110.National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2014) Methane, dichloro: Human health tier II assessment – IMAP report.

Tenth Adaptation to Technical Progress Commission Regulation (EU) No 2017/776 amending, for the purposes of its adaptation to technical and scientific progress, Regulation (EC) No 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures (the CLP Regulation).

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