

Methylene Chloride - A Common Air Pollutant

Background

Dichloromethane (CH_2Cl_2 , CAS Number 75-09-2), also known as methylene chloride, is a common volatile organic compound (VOC) frequently found in the indoor air where levels range from 2- 100 $\mu\text{g}/\text{m}^3$. Methylene chloride is a nonflammable, colorless VOC with a pleasant, sweet odor. Its sources are numerous and include adhesives, paint products, and propellants in aerosols.

It is one of the most frequently found VOCs in new construction.

It is often used to clean metals; therefore, new electronics may release residual methylene chloride into the air. It has been found in the air around 3D printers using some filaments including ABS, PLA, and nylon. Potable water sources that have been disinfected with chlorinated systems are an unexpected source of methylene chloride. Use of this water, especially in hot showers, can result in evaporation of methylene chloride into the air.¹⁻⁴

Health Concerns

Acute and chronic exposures to methylene chloride affect the central nervous system, leading to headaches, tingling of extremities, nausea, dizziness, and memory loss. Although human data is inconclusive regarding cancer, it is considered a probable carcinogen and is regulated by CA Proposition 65 as a carcinogen. Exposure should be limited. Children may be more prone to harmful, accidental exposure than adults because methylene chloride vapors are found lower to the ground, since it is denser than air.⁵⁻⁶

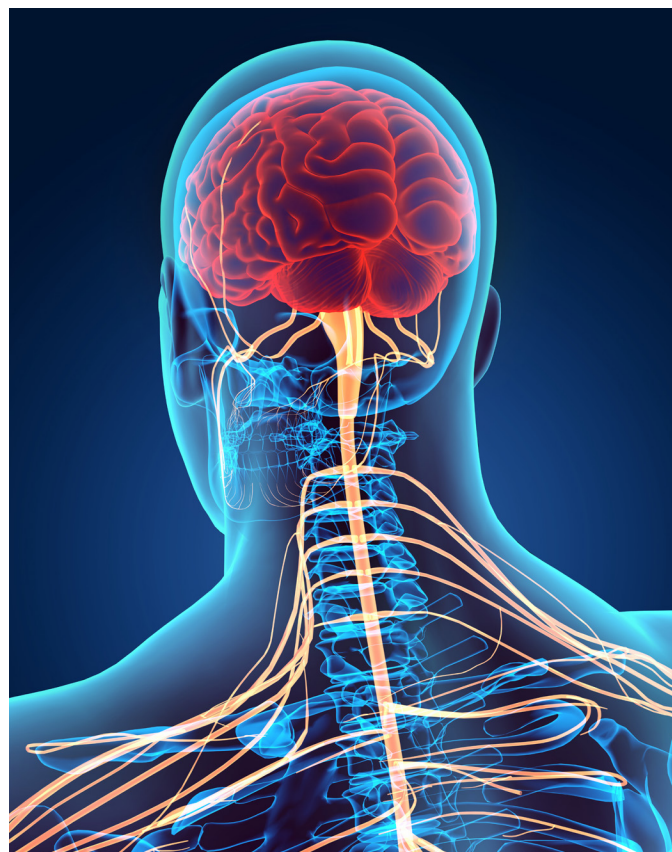


TABLE 1: METHYLENE CHLORIDE EXPOSURE AND EMISSIONS STANDARDS

Organization or Standard	Application	Exposure Limit	Additional Information
CA 01350 Specification (CDPH SM 01350)	Product emissions	200 µg/m ³	CDPH SM 01350 requires that emission levels for dichloromethane from building products and materials be equal to or less than 200 µg/m ³ within 14 days after installation. Certification programs like Collaborative for High Performance Schools, GREENGUARD gold, and Business and Institutional Furniture Manufacturers Association have adopted this requirement.
California Office of Environmental Health Hazard Assessment (OEHHA)	General air/ Indoor air	400 µg/m ³	Reference exposure levels (RELs) address non-cancer health effects of volatile organic compounds (VOCs) and provide concentrations below which these health effects have been observed in studies. Dichloromethane acute REL: 14000 µg/m ³ , and chronic REL: 400 µg/m ³ .
American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)	General air/ Indoor air	400 µg/m ³	ASHRAE defines indoor air quality (IAQ) requirements for VOCs as general guidance for building design, diagnostics, and ventilation system design in ASHRAE 189.1. The maximum concentration of dichloromethane relevant to IAQ should be 400 µg/m ³ .
U.S. Green Building Council Leadership in Environment and Energy Design (LEED)	Indoor air	400 µg/m ³	The LEED rating system specifies a maximum acceptable concentration of dichloromethane for the clearance testing of air levels before a building or school is occupied, which is 400 µg/m ³ .
CA Proposition 65	Daily exposure	NSRL: 200 µg/day	Prop 65 lists carcinogens as having a no significant risk level (NSRL) and a maximum allowable dose level (MADL). Any measurement of dichloromethane exceeding the NSRL of 200 µg/day is considered unacceptable.
CDC's Agency for Toxic Substances and Disease Registry (ATSDR)	General air/ Indoor air	Inhalation: 0.6 ppm (acute), 0.3 ppm (intermediate), 0.3 ppm or 1040 µg/m ³ (chronic) Oral: 0.2 (acute), 0.06 (chronic) mg/kg/day	The CDC's Agency for Toxic Substances and Disease Registry (ATSDR) has developed Minimal Risk Levels (MRLs) which estimate the daily level to which a substance may be exposed without the likelihood of adverse, non-cancer health effects. MRLs are derived for acute (1 - 14 days), intermediate (>14 - 364 days), and chronic (365 days and longer) exposure durations. The dichloromethane MRL is 0.6 ppm (2.1 mg/m ³) for acute, 0.3 ppm (1.0 mg/m ³) for intermediate, 0.3 ppm (1040 µg/m ³) for chronic inhalation exposure, and 0.02 mg/kg/day for oral chronic exposure.

Organization or Standard	Application	Exposure Limit	Additional Information
National Institute of Occupational Safety and Health (NIOSH)	Occupational	25 ppm (86.8 mg/m ³) ST: 125 ppm	NIOSH has a recommended exposure limit (REL) of 25 ppm for dichloromethane with a short-term exposure limit (ST) of 125 ppm.
Occupational Safety and Health Administration (OSHA)	Occupational	25 ppm (86.8 mg/m ³) STEL: 125 ppm	Permissible exposure limits (PELs) are how OSHA defines the maximum concentration of chemicals to which a worker may be exposed. PELs are defined in two ways: STEL (15-minute time-weighted average [TWA] not to be exceeded) or an eight-hour TWA, which is an average value of exposure over an eight-hour work shift. The OSHA TWA PEL for dichloromethane is 25 ppm based on an 8-hour day, 40-hour workweek. The OSHA STEL based on a 15-minute time period is 125 ppm.
California The Division of Occupational Safety and Health (Cal/OSHA)	Occupational	25 ppm (86.8 mg/m ³) ST: 125 ppm	Ceiling permissible exposure limit (PEL) for dichloromethane is 25 ppm and short-term exposure limit (ST) is 125 ppm.
American Conference of Governmental Industrial Hygienists (ACGIH)	Occupational	50 ppm (174 mg/m ³)	Threshold Limit Values (TLV@s) are guidelines for the level of exposure that the typical worker can be exposed to without adverse health effects. They are not quantitative estimates of risk at different exposure levels or by different routes of exposure. The dichloromethane TLV-8-hr time weighted average is 50 ppm.

REFERENCES:

1. NIH. Dichloromethane. Accessed March 7, 2022. <https://pubchem.ncbi.nlm.nih.gov/compound/Dichloromethane>
2. US EPA. Fact Sheet: Methylene Chloride or Dichloromethane (DCM).
3. ATSDR. *Toxicological Profile for Methylene Chloride*; CDC: Atlanta, GA.
4. Davis, A.Y.; Zhiang, Q.; Wong, J.P.S.; Weber, R.J.; Black, M.S. Characterization of Volatile Organic Compound Emissions from Consumer Level Material Extrusion 3D Printers. 2019, 160, 106209. <https://doi.org/10.1016/j.buildenv.2019.106209>.
5. NIOSH. DHHS (NIOSH) Publication Number 86-114. Accessed March 7, 2022. <https://www.cdc.gov/niosh/docs/86-114/>.
6. IRIS. *Dichloromethane; CASRN 75-09-2*; Chemical Assessment Summary; US EPA.