

# Tetrachloroethylene – Guidance for Air

The following guidance was developed by the Minnesota Department of Health (MDH) in 2014 in response to vapor intrusion investigations conducted by the Minnesota Pollution Control Agency (MPCA).

For an information sheet about this guidance:

- [Tetrachloroethylene \(PCE, PERC\) in Air \(PDF\)](https://www.health.state.mn.us/communities/environment/hazardous/docs/vapintruspce.pdf)  
(<https://www.health.state.mn.us/communities/environment/hazardous/docs/vapintruspce.pdf>)

## Risk Assessment Advice for Air

July 18, 2014

**Chemical:** Tetrachloroethylene (PCE)

**CAS number:** 127-18-4

**Endpoint:** Cancer

**Chronic Value:** 2  $\mu\text{g}/\text{m}^3$

**Source:** MADEP, 2014; USEPA, 2012

The Minnesota Department of Health prepared this guidance to evaluate the health risks from breathing tetrachloroethylene (PCE). This advice can be used to evaluate risks from contaminated indoor or outdoor air. PCE is widely used for dry cleaning. PCE is also used for degreasing metal parts and in manufacturing other chemicals. It can be present in consumer products, including some adhesives, automotive parts cleaners, and stain removers. PCE can move from contaminated groundwater into the soil and into the air inside homes or other buildings. See:

- [Vapor Intrusion](https://www.health.state.mn.us/communities/environment/hazardous/topics/vaporintrusion.html)  
(<https://www.health.state.mn.us/communities/environment/hazardous/topics/vaporintrusion.html>)

MDH Risk Assessment Advice (RAA) for PCE in air is 2 micrograms of PCE per cubic meter of air ( $2 \mu\text{g}/\text{m}^3$ ). This concentration is considered safe to breathe 24 hours a day during any period of life, or over a lifetime. MDH considers the PCE air value concentration protective for potentially sensitive populations, such as young children or pregnant women. No actions to reduce exposures are necessary or recommended when PCE concentrations in air are at or below  $2 \mu\text{g}/\text{m}^3$ . Breathing in PCE above  $2 \mu\text{g}/\text{m}^3$  does not mean that health effects will occur. This risk assessment does not allow MDH to predict with any certainty what level in air will affect an individual.

## Basis for the PCE air value

EPA has characterized PCE as “likely to be carcinogenic to humans” based on suggestive evidence of carcinogenicity in epidemiology studies and conclusive evidence that PCE administration to rodents increases tumor incidence.

The RAA of  $2 \mu\text{g}/\text{m}^3$  was derived from an inhalation unit risk of  $3 \times 10^{-6}$  developed by the Massachusetts Department of Environmental Protection (MADEP) and used by MDH in 2014 to develop drinking water guidance for Minnesota. MADEP chose an animal study that showed health effects at the lowest exposure concentration, an inhalation rodent study which showed an increase in mononuclear cell leukemia. The inhalation unit risk was adjusted to take into account the differences between rodents and humans (MADEP, 2014). The resulting air value ( $2 \mu\text{g}/\text{m}^3$ ) is much lower than the PCE exposures in the rodent studies.

Because cancer potency can be greater when children are exposed during early lifestages, MDH used the U.S. EPA method of adjusting cancer potency estimates for early life exposure (U.S. EPA, 2005; MDH, 2010). The equation used follows:

$$\begin{aligned} \text{Age Adjusted Unit Risk (AAUR)} &= 2/70 [(3 \times 10^{-6}) \times 10] + 14/70 [(3 \times 10^{-6}) \times 3] \\ &+ 54/70 [(3 \times 10^{-6}) \times 1] = 5 \times 10^{-6} (\mu\text{g}/\text{m}^3)^{-1} \end{aligned}$$

Consistent with MDH policy, an additional lifetime risk level of  $1 \times 10^{-5}$  was divided by the AAUR of  $5 \times 10^{-6} (\mu\text{g}/\text{m}^3)^{-1}$  to calculate the exposure level as shown below:

$$\frac{1 \times 10^{-5}}{5 \times 10^{-6}} = 2 \mu\text{g}/\text{m}^3$$

## Other PCE Values

PCE is toxic to a number of organs and several other non-cancer endpoints have been used to develop health-based guidance values. For example, U.S. EPA developed a reference concentration for PCE of  $40 \mu\text{g}/\text{m}^3$  based on central nervous system toxicity, specifically for changes in color vision, reaction time, and cognitive effects (U.S. EPA, 2012). The MDH RAA for chronic non-cancer effects is  $15 \mu\text{g}/\text{m}^3$ . This is based on changes in color vision reported as a Lowest Observable Adverse Effect Level from a long-term occupational exposure of  $15,000 \mu\text{g}/\text{m}^3$  (Cavalleri et al., 1994; USEPA, 2012). The RAA developed for cancer described above is protective of central nervous system toxicity (including vision changes) and other non-cancer effects.

No new information was reviewed to assess the acute duration exposure scenario. In acute exposures, PCE is an eye and respiratory irritant and can affect the nervous system. MDH recommends use of the existing Health Risk Value of  $20,000 \mu\text{g}/\text{m}^3$  as a safe level for a one-hour averaged exposure concentration.

The Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have occupational limits for PCE (approximately  $680,000$  and  $170,000 \mu\text{g}/\text{m}^3$ , respectively). These values do not apply to workplaces where chemical exposure is not part of the job. MDH does not use these values to describe health risk, because they are too high to be protective of the general population.

Indoor air typically contains volatile organic compounds from consumer products, building materials, and outdoor air. Indoor air concentrations from these sources are referred to as “background” concentrations when assessing the potential for vapor intrusion. Background concentrations of PCE in indoor air may exceed the RAA for cancer. A 1999 study of three communities in the Twin Cities measured the mean, median, and the 90th percentile of PCE in indoor air at 2.9, 0.6, and 3.8  $\mu\text{g}/\text{m}^3$ , respectively (Sexton, et al., 2004).

## Change from previous advice for PCE in air

MDH previously recommended values for PCE of 20  $\mu\text{g}/\text{m}^3$  for cancer risk assessment and 100  $\mu\text{g}/\text{m}^3$  for assessment of potential non-cancer effects. The decrease from past values is due to an improved understanding of PCE as a result of a more current toxicological review by the U.S.EPA.

Follow the links on the air values table (in the table header) to understand exposure durations and the difference between Risk Assessment Advice and other types of guidance that MDH publishes.

## References

- Cavalleri, A., Gobba, F., Paltrinieri, M., Fantuzzi, G., Righi, E., & Aggazzotti, G. (1994). Perchloroethylene exposure can induce colour vision loss. *Neuroscience letters*, 179(1-2), 162-166.
- MADEP (2014) Tetrachloroethylene (Perchloroethylene) Inhalation Unit Risk Value. Massachusetts Department of Environmental Protection Office of Research and Standards. June 25, 2014.
- MDH (2010) [Risk Assessment Advice for Incorporating Early-Life Sensitivity into Cancer Risk Assessments for Linear Carcinogens \(PDF\)](#) (<https://www.health.state.mn.us/communities/environment/risk/docs/guidance/adafrecmd.pdf>). Accessed on July 7, 2014.
- Sexton, K., Adgate, J., Ramachandran, G., Pratt, G., Mongin, S., Stock, T., Morandi, M. (2004) Comparison of Personal, Indoor, and Outdoor Exposures to Hazardous Air Pollutants in Three Urban Communities. *Environmental Science and Technology*, 38 (423-460).
- U.S. EPA (2012). [Toxicological Review of Tetrachloroethylene \(Perchloroethylene\), In Support of Summary Information on the Integrated Risk Information System \(IRIS\)](#) (<https://www.epa.gov/iris>). February 2012. Accessed on May 16, 2014.
- U.S. EPA (2005) [Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens](#) (<https://www.epa.gov/risk/supplemental-guidance-assessing-susceptibility-early-life-exposure-carcinogens>). March 2005. Accessed on June 20, 2014.

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