

Sources of Exposure

Toxicokinetics and Biomonitoring

Biomarkers/Environmental Levels

ToxGuide™

for

1,1,1-
Trichloroethane

$C_2H_3Cl_3$

CAS# 71-55-6

March 2024

U.S. Department of Health and
Human Services
Public Health Service
Agency for Toxic Substances
and Disease Registry
www.atsdr.cdc.gov



General Populations

- Exposure to 1,1,1-trichloroethane is expected to be low, as production and use has decreased in the United States; however, it is possible that some old household products could contain 1,1,1-trichloroethane.
- The general population may be exposed to 1,1,1-trichloroethane through the inhalation of contaminated ambient air or ingestion of contaminated water. Dermal absorption of 1,1,1-trichloroethane is dependent on exposure conditions (i.e., immersion or topical application), skin type, and size of exposed area.
- High levels of exposure could occur in people who intentionally inhale 1,1,1-trichloroethane vapors from imported or older products, as in glue-sniffing or solvent abuse.
- Exposure can also occur to the general population living near Superfund sites where 1,1,1-trichloroethane is found.

Occupational Populations

- Even though the use of this chemical has significantly decreased in the United States, workers may encounter some exposure in occupational settings.
- Workers who produce or formerly produced 1,1,1-trichloroethane, handle waste, or used metal degreasing agents, paints, glues, or cleaning products that contained 1,1,1-trichloroethane could have been exposed.

Toxicokinetics

- 1,1,1-Trichloroethane is rapidly and efficiently absorbed by the lungs, skin, and gastrointestinal tract.
- Absorbed 1,1,1-trichloroethane is distributed via blood to tissues and organs throughout the body, especially to fatty tissues. It is also distributed to developing fetuses.
- Only a small portion of absorbed 1,1,1-trichloroethane is metabolized. At low rates, it is metabolized oxidatively to trichloroethanol and trichloroacetic acid. Other minor metabolites are carbon dioxide and acetylene.
- Exhalation is the main route of elimination for 1,1,1-trichloroethane. Elimination occurs rapidly.

NHANES Biomonitoring

For survey years 2009–2010, 1,1,1-trichloroethane was measured in the blood for the total U.S. population and ranged from 0.0071 to 0.197 $\mu\text{g/L}$. In the last three cycles of the survey, the mean blood concentration of 1,1,1-trichloroethane in the total population each cycle was below the limit of detection (0.010 ng/mL).

Biomarkers

- 1,1,1-Trichloroethane in blood, urine, and expired breath could be a reliable biomarker of recent 1,1,1-trichloroethane exposure.
- The metabolites, trichloroethanol and trichloroacetic acid (in blood, urine, and expired breath), may also be effective biomarkers of recent exposure, although trichloroacetic acid in urine is not unique to 1,1,1-trichloroethane.
- There are no specific biomarkers of effect.

Environmental Levels

Air

- Mean maximum ambient air concentrations monitored by EPA's Air Quality System ranged from 0.03 ppbv in 2020 to 0.48 ppbv in 2018. In 2022, the maximum concentration was 0.05 ppbv.
- In indoor air, median values range from 0.05 to 150 ppbv (1981–2004).

Water

- Groundwater: In 2023, the average was 0.29 ppb and the maximum was 0.42 ppb.
- Surface water: Not detected in 2023.
- Drinking water: 0.0002 ppbv to 500 ppb (2006–2011).

Sediment and soil

- Non-detectable to 1.1–1,600 ppb (2006–2011).

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2024. Toxicological Profile for 1,1,1-Trichloroethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

1,1,1-Trichloroethane is a Colorless Liquid

- Trichloroethane is a man-made chemical that is not found naturally in the environment.
- Production of 1,1,1-trichloroethane in the United States was intended to be cut incrementally as per 1990 amendments to Section 604 of the Clean Air Act and phased out by January 2002.
- As per the ozone depletion agreements from the Montreal Protocol, production of 1,1,1-trichloroethane in the United States was meant to end in 2012. 1,1,1-Trichloroethane production has decreased in the United States since 2012 but has not ended.
- In the past, 1,1,1-trichloroethane was primarily used in cold-cleaning, vapor degreasing, and ultrasonic cleaning to remove oil, grease, and wax from metal parts. It was also used as an ingredient in products such as spot cleaners, glues, and aerosol sprays.
- 1,1,1-Trichloroethane is a volatile organic compound with slight water solubility and has a sweet and sharp smell.
- 1,1,1-Trichloroethane exists in the atmosphere in the vapor phase.
- At concentrations of 75,000–125,000 ppm in the air, 1,1,1-trichloroethane can easily burn if it comes into contact with a spark or flame.

- Inhalation – Inhalation of contaminated air could occur at low levels via environmental contamination. In occupational settings, even though the use of this chemical has significantly decreased in the United States, workers could encounter high exposure levels.
- Oral – Oral exposure can occur through contaminated drinking water, which may be a greater risk for those living or working near former industrial sources or hazardous waste sites.
- Dermal – Dermal exposure is a likely route of exposure in the workplace for workers manufacturing 1,1,1-trichloroethane or using products containing the chemical. Workers still involved in processes using this compound are at higher exposure risk.

1,1,1-Trichloroethane in the Environment

- 1,1,1-Trichloroethane evaporates quickly and becomes a vapor; it is most commonly found in the vapor form in the environment.
- In the atmosphere, it slowly degrades via interaction with photochemically-produced hydroxyl radicals in a process that takes about 6 years.
- 1,1,1-Trichloroethane dissolves slightly in water. It has slight water solubility and is readily volatilized from water.
- 1,1,1-Trichloroethane is expected to have high mobility in soil. It could leach into groundwater, but volatilization from soil to the atmosphere is expected to occur.

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- An acute-duration (≤ 14 days) inhalation MRL of 1 ppm was derived for 1,1,1-trichloroethane.
- An intermediate-duration (15–364 days) inhalation MRL of 0.7 ppm was derived for 1,1,1-trichloroethane.

Oral

- An intermediate-duration oral MRL of 2 mg/kg/day was derived for 1,1,1-trichloroethane.

Health Effects

- The health effects of 1,1,1-trichloroethane have been evaluated in epidemiological studies, controlled human trials, and experimental animal studies.
- Neurological effects are a known health effect with inhalation exposure. Impaired manual dexterity, hand-eye coordination, perceptual speed, and decreased reaction time have been observed in humans. Increased tiredness and disturbances of equilibrium and bodily coordination have also been observed in humans. Animals exposed to 1,1,1-trichloroethane showed signs of central nervous system depression and neurophysiological changes.

- Hepatic effects are a presumed health effect with inhalation exposure. Studies of animals support hepatic toxicity as a sensitive endpoint following inhalation and oral exposure. After inhalation exposure, fatty changes in the liver, swelling of hepatocytes, hepatocellular adenomas and carcinomas, and changes in relative liver weight were observed in animals. Data from case reports on individuals exposed to high levels of 1,1,1-trichloroethane suggest that exposure produces hepatic effects in humans such as changes in liver enzymes and progressive liver disease.
- The Department of Health and Human Services (HHS) has not classified the carcinogenicity of 1,1,1-trichloroethane.
- The U.S. Environmental Protection Agency (EPA) has not classified the carcinogenicity status of 1,1,1-trichloroethane on the basis that there is not enough data.
- The International Agency for Research on Cancer (IARC) classifies 1,1,1-trichloroethane as probably carcinogenic to humans (Group 2A).

Children's Health

- Studies in animals indicate that children may be more susceptible than adults to 1,1,1-trichloroethane.