

1. PUBLIC HEALTH STATEMENT FOR TETRACHLOROETHYLENE

This Public Health Statement summarizes the Agency for Toxic Substances and Disease Registry's (ATSDR) findings on tetrachloroethylene, including chemical characteristics, exposure risks, possible health effects from exposure, and ways to limit exposure.

The U.S. Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are sites targeted for long-term federal clean-up activities. The EPA has found tetrachloroethylene in at least 949 of the 1,854 current or former NPL sites. The total number of NPL sites evaluated for tetrachloroethylene is not known. But the possibility remains that as more sites are evaluated, the sites where tetrachloroethylene is found may increase. This information is important because these future sites may be sources of exposure, and exposure to tetrachloroethylene may be harmful.

If you are exposed to tetrachloroethylene, many factors determine whether you'll be harmed. These include how much you are exposed to (dose), how long you are exposed (duration), how often you are exposed (frequency), and how you are exposed (route of exposure). You must also consider the other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

WHAT IS TETRACHLOROETHYLENE?

Tetrachloroethylene is a nonflammable colorless liquid. Other names for tetrachloroethylene include perchloroethylene, PCE, PERC, tetrachloroethene, and perchlor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part in 1 million parts of air (ppm) or more. Tetrachloroethylene is used as a dry cleaning agent and metal degreasing solvent. It is also used as a starting material (building block) for making other chemicals and is used in some consumer products. For more information, see Chapters 4 and 5.

WHAT HAPPENS TO TETRACHLOROETHYLENE WHEN IT ENTERS THE ENVIRONMENT?

Tetrachloroethylene can be released into the air, water, and soil at places where it is produced or used. Most releases of tetrachloroethylene during its use are directly to the atmosphere. Tetrachloroethylene degrades slowly in the atmosphere, with a half-life of about 100 days.

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When tetrachloroethylene is released to surface water or surface soil, it tends to evaporate quickly; however, tetrachloroethylene is also mobile in soil and has the potential to leach below the soil surface and contaminate groundwater and the air space between soil particles. Tetrachloroethylene can also break down to trichloroethylene, dichloroethylene, vinyl chloride, and ethene through reductive dechlorination.

HOW MIGHT I BE EXPOSED TO TETRACHLOROETHYLENE?

Much of the tetrachloroethylene released into the air comes from the dry cleaning industry. Some tetrachloroethylene may be released from dry cleaned or consumer products. Tetrachloroethylene breaks down very slowly in the air and so it can be transported long distances in the air. The average concentration of tetrachloroethylene in the air of the United States is typically less than 1 microgram per cubic meter of air ($\mu\text{g}/\text{m}^3$).

A variety of industries that use tetrachloroethylene (such as metal degreasing and dry cleaning) produce liquid wastes that contain the compound, which may then end up at waste treatment facilities.

Tetrachloroethylene evaporates quickly from water into air, although some tetrachloroethylene may remain in the water. It is generally slow to break down in water. Tetrachloroethylene can migrate through groundwater (or soil) up into the air of homes and buildings through vapor intrusion.

Contamination of soil can occur when tetrachloroethylene at a waste disposal site seeps out of the waste and into the soil. Tetrachloroethylene may evaporate quickly from shallow soils or may filter through the soil and into the groundwater below. It is generally slow to break down in soil.

HOW CAN TETRACHLOROETHYLENE ENTER AND LEAVE MY BODY?

Tetrachloroethylene can enter your body from the air, water, or soil. It can also absorb through the skin if there is direct skin contact with the liquid form of tetrachloroethylene.

Tetrachloroethylene in air can easily enter your body when you breathe it in. Most of the tetrachloroethylene that you breathe in will go into your bloodstream and into other organs, but it also rapidly leaves your body. A small amount of tetrachloroethylene in the air can also move through your skin and into your bloodstream.

When tetrachloroethylene is found in water, it can enter your body when you drink or touch the water or when you breathe in steam from the water. Most of the tetrachloroethylene that you breathe in or drink

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will move from your stomach or lungs into your bloodstream. When you touch water containing tetrachloroethylene, some of it can get through your skin into your body, but not as much as when you breathe or swallow it.

You can be exposed to tetrachloroethylene in soil when small amounts of soil are transferred to your mouth accidentally, when your skin touches the soil, or when you breathe air or dust coming from the soil.

If you have tetrachloroethylene in your blood, you will breathe most of it out very quickly. A small amount of tetrachloroethylene in your blood may get changed into other chemicals that leave your body in urine. It takes about 3 days for half of the tetrachloroethylene in your body to be eliminated.

HOW CAN TETRACHLOROETHYLENE AFFECT MY HEALTH?

Tetrachloroethylene exposure may harm the nervous system, liver, kidneys, and reproductive system, and may be harmful to unborn children. If you are exposed to tetrachloroethylene, you may also be at a higher risk of getting certain types of cancer.

If you are exposed for short time periods (a few hours to less than 14 days), tetrachloroethylene may cause effects on your health. If you breathe in air containing a lot of tetrachloroethylene, you may become dizzy or sleepy, develop headaches, and become uncoordinated; exposure to very large amounts in the air can cause unconsciousness. Some people have died after being exposed in tanks or other small spaces, or after intentionally breathing in a large amount of tetrachloroethylene.

People who are exposed for longer time periods to lower levels of tetrachloroethylene in air may have changes in mood, memory, attention, reaction time, or vision. Studies in animals exposed to tetrachloroethylene have shown liver and kidney effects, and changes in brain chemistry, but we do not know what these findings mean for humans.

Tetrachloroethylene may have effects on pregnancy and unborn children. Studies in people are not clear on this subject, but studies in animals show problems with pregnancy (such as miscarriage, birth defects, and slowed growth of the baby) after oral and inhalation exposure.

Exposure to tetrachloroethylene for a long time (years) may lead to a higher risk of getting cancer, but the type of cancer that may occur is not well-understood. Studies in humans suggest that exposure to

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tetrachloroethylene may lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma. In animals, tetrachloroethylene has been shown to cause cancers of the liver, kidney, and blood system. It is not clear whether these effects might also occur in humans, because humans and animals differ in how their bodies handle tetrachloroethylene.

The EPA considers tetrachloroethylene to be "likely to be carcinogenic to humans by all routes of exposure" based on suggestive evidence in human studies and clear evidence of mononuclear cell leukemia in rats and liver tumors in mice exposed for 2 years by inhalation or stomach tube.

The International Agency for Research on Cancer considers tetrachloroethylene "probably carcinogenic to humans" based on limited evidence in humans and sufficient evidence in animals.

The National Toxicology Program considers tetrachloroethylene to be "reasonably anticipated to be a human carcinogen."

HOW CAN TETRACHLOROETHYLENE AFFECT CHILDREN?

This section discusses potential health effects of tetrachloroethylene exposure in humans from when they're first conceived to 18 years of age.

It is not known whether children are more susceptible than adults to the effects of tetrachloroethylene. There are very few studies available to answer this question, and many more studies are needed.

We do not know for sure whether tetrachloroethylene can cause birth defects in humans. A few studies in humans have suggested that exposure to tetrachloroethylene increased the numbers of babies with heart, oral cleft, or neural tube defects, but these studies were not large enough to clearly answer the question. Studies in animals exposed by inhalation or stomach tube have not shown clear evidence of specific birth defects.

HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO TETRACHLOROETHYLENE?

If your doctor finds that you have been exposed to significant amounts of tetrachloroethylene, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate. You may also contact the state or local health department with health concerns.

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Tetrachloroethylene has the potential to contaminate foods, although the levels found in food are generally low. Contact local drinking water authorities and follow their advice if you have any concerns about the presence of tetrachloroethylene in your drinking water. Tetrachloroethylene can be present in the indoor air of homes and apartments above dry cleaning facilities. To minimize risks associated with breathing in contaminated vapors, ensure that the area is well ventilated.

Tetrachloroethylene can also be present in groundwater and soil underneath a building or a home, resulting in above-ground vapors through vapor intrusion (movement of vapors from groundwater or soil into air). If you think that you may have groundwater contaminated with tetrachloroethylene, contact your local state health department. In addition, a depressurization system, an increase in the air exchange rate between indoor and outdoor air, or vapor barriers can reduce exposure to tetrachloroethylene from vapor intrusion. Prevent children from playing in dirt or eating dirt if you live near a waste site that has tetrachloroethylene.

Tetrachloroethylene is widely used as a scouring solvent that removes oils from fabrics, as a carrier solvent, as a fabric finish or water repellent, and as a metal degreaser/cleaner. Follow instructions on product labels to minimize exposure to tetrachloroethylene. Storing these items in a shed or an outside location may reduce exposure and decrease the impact on indoor air.

ARE THERE MEDICAL TESTS TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO TETRACHLOROETHYLENE?

Tetrachloroethylene and its breakdown products (metabolites) can be measured in blood and urine. Although the detection of tetrachloroethylene or its metabolites cannot predict the kind of health effects that might develop from that exposure, if tetrachloroethylene is detected, that would indicate a level of exposure that might be associated with a health effect. Because tetrachloroethylene and its metabolites leave the body fairly rapidly, the presence or absence of them in the urine is not an accurate measure of long-term exposure.

For more information on the different substances formed by tetrachloroethylene breakdown and on tests to detect these substances in the body, see Chapters 3 and 7.

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WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but are not enforceable by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed as “not-to-exceed” levels; that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value usually based on levels that affect animals; levels are then adjusted to help protect humans. Sometimes these not-to-exceed levels differ among state and federal organizations. Different organizations use different exposure times (e.g., an 8-hour workday or a 24-hour day), different animal studies, or emphasize some factors over others, depending on their mission.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with federal or state agencies or organization that issued the regulation or recommendation.

EPA set a maximum contaminant level (MCL) of 0.005 milligrams per liter (mg/L; 5 ppb) as a national primary drinking standard for tetrachloroethylene and noted liver problems and increased risk of cancer as potential health effects from long-term exposure above the MCL.

OSHA has set an 8-hour time-weighted average (TWA) permissible exposure limit of 100 ppm, an acceptable ceiling exposure limit of 200 ppm, and a maximum peak of 300 ppm (not to be exceeded for more than 5 minutes of any 3-hour period).

NIOSH recommends that workplace exposure to tetrachloroethylene be minimized due to concerns about its carcinogenicity.

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WHERE CAN I GET MORE INFORMATION?

If you have any questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below. You may also contact your doctor if experiencing adverse health effects or for medical concerns or questions. ATSDR can also provide publicly available information regarding medical specialists with expertise and experience recognizing, evaluating, treating, and managing patients exposed to hazardous substances.

- Call the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636) or
- Write to:
Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE
Mailstop S102-1
Atlanta, GA 30329-4027

Toxicological profiles and other information are available on ATSDR's web site:

<http://www.atsdr.cdc.gov>.