Product Safety Assessment

*Perchloroethylene*

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**Names**
- CAS No. 127-18-4
- Perchloroethylene
- Tetrachloroethylene
- Tetrachloroethene
- Ethylene tetrachloride
- Perc
- PCE
- Perchloroethylene DG
- Perchloroethylene Industrial Grade
- Perchloroethylene Technical Grade
- Perchloroethylene SVG double stabilized
- DOWPER™ Solvent
- DOWPER™ N Solvent
- DOWPER™ LM Solvent
- DOWPER™ MC Solvent
- DOWPER™ Pure Power Solvent
- ISOFORM™ Isomerization Grade Perchloroethylene
- ISOFORM™ Reforming Grade Perchloroethylene

**Product Overview**
- Perchloroethylene is a clear, heavy, colorless, nonflammable, volatile liquid with a distinctive ether-like odor.¹ See Product Description.
- Perchloroethylene is the primary solvent used in commercial and industrial dry cleaning. Its other major uses are as a chemical intermediate in the production of several fluorinated compounds, as a surface preparation and cleaning solvent, and in oil refineries for catalyst regeneration.² See Product Uses.
- The people most likely to be exposed to increased levels of perchloroethylene in the air are those who work in facilities where it is made or used. The use of closed systems is recommended to minimize emissions and potential exposures.³ See Exposure Potential.
- Eye contact with perchloroethylene may cause pain and slight temporary irritation. Brief skin contact may cause irritation with local redness. Repeated skin contact may result in pain, severe local redness, swelling, and tissue damage. The symptoms of overexposure to perchloroethylene vapors are central nervous system effects typical of anesthesia, which generally disappear when the individual is removed from exposure. Perchloroethylene is not believed to pose a measurable carcinogenic risk to people when handled as recommended. Perchloroethylene has been toxic to the fetus in laboratory animals at doses toxic to the mother, and effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.⁴ ⁵ See Health Information.

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Perchloroethylene is not readily biodegradable. It does not accumulate in the aquatic food chain. It is moderately toxic to aquatic organisms on an acute basis.

The U.S. Environmental Protection Agency has determined that perchloroethylene is often an acceptable alternative for ozone-depleting solvents whose production has been phased out by the federal Clean Air Act.\(^6\)

Perchloroethylene can thermally decompose upon exposure to open flames or hot surfaces, possibly resulting in the formation of toxic gases such as chlorine, hydrogen chloride, and phosgene.\(^7\) See Physical Hazard Information.

### Manufacture of Product

- **Capacity**\(^6,9\) – Total U.S. demand for perchloroethylene in 2004 is estimated to have been 161,000 metric tons (355 million pounds). European usage in 2005 is estimated to have been 56,000 metric tons (123 million pounds). Dow produces perchloroethylene in the United States, Brazil and Germany.

- **Process**\(^10,11\) – Dow produces perchloroethylene by a direct chlorination (‘Per Tet’ or perchlorination) process. The perchlorination process involves the reaction of chlorine with ethylene dichloride (EDC) and various C\(_1\)-C\(_3\) chlorocarbons to produce perchloroethylene and the co-product carbon tetrachloride. Adjusting the reaction conditions allows the producer to operate the PerTet plant to make essentially 100% perchloroethylene or 100% carbon tetrachloride, or a mixture of both. The reaction forms a crude product, which is purified by distillation to yield perchloroethylene.

Using EDC as a feedstock, the reaction is as follows:

\[
3 \text{C}_2\text{H}_4\text{Cl}_2 + 11\text{Cl}_2 \rightarrow 2 \text{CCl}_4 + 2 \text{C}_2\text{Cl}_4 + 12 \text{HCl}
\]

**Product Description**\(^12,13\)

Perchloroethylene is a member of a family of aliphatic halogenated hydrocarbons. It is a colorless, heavy, volatile liquid with a distinctive ether-like odor. It is essentially nonflammable; it has no measurable flashpoint. Stabilizers are normally added to perchloroethylene to prevent decomposition during storage and use. Due to its high stability, perchloroethylene requires less stabilizer than other chlorinated solvents. Dow markets this material in several grades, including products under the trade names DOWPERS\(^\text{TM}\) solvent and ISOFORM\(^\text{TM}\) perchloroethylene.

**Product Uses**\(^14,15,16\)

Perchloroethylene is the primary solvent used in commercial and industrial dry cleaning. Since being introduced to the dry cleaning industry in the late 1930’s, it replaced most other solvents because of its effectiveness, relatively low toxicity and lack of flammability. The largest use for perchloroethylene is as a chemical intermediate in the production of several others.
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Perchloroethylene is a basic raw material in the manufacture of hydrofluorocarbons (HFC) 134a and 125, alternatives to chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants. Perchloroethylene is also used to produce CFC-113, which is a feedstock for fluoropolymers. Other minor applications include the use of perchloroethylene for surface preparation, as a cleaning solvent and in oil refineries for catalyst regeneration.

Dow has established end use guidelines for perchloroethylene and other chlorinated solvents. From a general product stewardship standpoint, Dow does not support applications in which:

- Soil or ground water contamination is likely (such as direct application to the ground, sink drains, sewers, or septic tanks);
- Over-exposure is likely (such as small rooms, confined spaces or where there would be inadequate ventilation and where no adequate personal protective equipment is available and in use);
- Skin contact is likely (such as removing adhesive tape from the skin or as a hand cleaner to remove oils and greases);
- Direct contact with food can occur;
- Vapor concentrations are used in the flammable range without appropriate control equipment;
- Disposal of waste would pose an environmental or health risk;
- Chemical reactivity poses a danger (such as contact with strong alkali or in areas where welding is done); or
- An application would violate any applicable governmental requirements.

Exposure Potential

Perchloroethylene is used in many industrial applications. Based on its uses, people could be exposed through:

- **Workplace exposure** – Exposure can occur either in a perchloroethylene manufacturing facility or in the various industrial and manufacturing facilities that use perchloroethylene. Those working with perchloroethylene as a chemical intermediate in manufacturing operations or catalyst regeneration could be exposed during maintenance, sampling, testing, or other procedures. Exposure is most likely to occur, however, when perchloroethylene is used in surface preparation / cleaning and in dry cleaning applications. Each facility that uses perchloroethylene should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit unnecessary perchloroethylene exposure. Persons working with perchloroethylene should be provided with and instructed in the use of appropriate personal protective clothing and equipment. Adequate ventilation should be provided in the workplace to minimize the possibility of an inhalation hazard. See Health Information.

- **Consumer exposure to products containing perchloroethylene** – The main route of consumer exposure is breathing air that contains fugitive emissions of perchloroethylene from manufacturing facilities or dry cleaning businesses or its use in a limited number of consumer products, such as aerosol brake cleaners. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil and surface or ground water. Keep vapors and liquids out of the sewers. Absorb the material with sawdust-type materials for clean up. Respiratory protection is necessary for cleaning up spills and leaks. Eliminate all sources of ignition immediately. Although perchloroethylene will not burn, heat can decompose the material into hazardous chemicals. Ventilate the area of the leak or spill. Isolate the area until the vapor has dispersed. See Environmental Information, Health Information, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. A positive pressure, self-contained
breathing apparatus (SCBA) with a full-face mask approved by NIOSH is recommended for emergency work. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. In case of fire, deny any unnecessary entry into the area. This material does not burn, but heat can cause perchloroethylene to decompose into hazardous chemicals. If exposed to fire from another source, use a suitable extinguishing agent for that fire. Avoid contact with this material during fire-fighting operations. If contact is likely, change to full chemical-resistant fire-fighting clothing with SCBA. Clear non-emergency personnel from the area. The public should be warned of the potential for downwind vapor exposure hazards. The material should be prevented from entering into soils, ditches, sewers, waterways and/or groundwater. The material will sink in water. Follow emergency procedures carefully. See Environmental Information, Health Information, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

Health Information

Eye contact with liquid or vapor may cause pain and slight temporary irritation. Brief skin contact may cause irritation with local redness. Repeated contact may result in pain, severe local redness, swelling, and tissue damage. Even prolonged skin contact is unlikely to result in absorption of harmful amounts.

Perchloroethylene has very low toxicity if swallowed. However, if the material is swallowed, do not induce vomiting. Aspiration into the lungs may occur, resulting in more rapid absorption and potential injury to other body systems.

Dangerous vapor concentrations are readily obtained. The initial effects of excessive inhalation exposure are dizziness, loss of coordination, and symptoms of anesthesia. Nasal irritation or nausea may accompany these symptoms. Excessive exposure may cause systemic injury or potentially death. Excessive exposure may increase sensitivity to epinephrine and increase the probability of an irregular heartbeat.

Perchloroethylene has been shown to increase the incidence of tumors in certain strains of mice and rats; however, other long-term inhalation studies have failed to show tumorigenic response. Several epidemiology studies have investigated cancer mortality among dry cleaning workers and have shown no consistent link between perchloroethylene exposure and cancer. Perchloroethylene is not believed to pose a measurable carcinogenic risk to people when handled as recommended.

Perchloroethylene has been toxic to the fetus in laboratory animals at doses toxic to the mother. Effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

For more information, see the relevant Safety Data Sheet.

Environmental Information

Perchloroethylene may be released to air from fugitive emissions from manufacturing facilities or use, or by evaporation from products that contain it. Because it has low solubility in water and is highly volatile, perchloroethylene will quickly volatilize (evaporate) to the atmosphere. Perchloroethylene is expected to be mobile in soil, and has the potential to reach underground water supplies. Perchloroethylene that reaches groundwater may be difficult to remediate.
Perchloroethylene is not readily biodegradable under aerobic conditions. However, this does not necessarily mean that the material is not biodegradable in the environment. Biodegradation can occur under anaerobic conditions (in the absence of oxygen).

Perchloroethylene is not likely to accumulate in the aquatic food chain (bioconcentration potential is low). It is moderately toxic to aquatic organisms on an acute basis.

Perchloroethylene does not contribute to the depletion of the stratospheric ozone layer. The U.S. Environmental Protection Agency has determined that perchloroethylene is often an acceptable alternative for ozone-depleting solvents whose production has been phased out by the federal Clean Air Act.

For more information, see the relevant Safety Data Sheet.

**Physical Hazard Information**

Perchloroethylene is thermally stable at typical storage and use temperatures. However, thermal decomposition may occur if the material is near open flames or hot sources. Toxic gases can be released during decomposition. Decomposition products depend upon temperature, air supply, and the presence of other materials, but can include chlorine, hydrogen chloride, and phosgene. Gas generation during decomposition may be sufficient to vent and/or rupture containers.

Do not store perchloroethylene in aluminum or aluminum alloys. Avoid contact with strong bases, amines, and metals such as zinc, aluminum, magnesium, potassium, and sodium.

For more information, see the relevant Safety Data Sheet.

**Regulatory Information**

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of perchloroethylene. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, the Product Stewardship Manual, or Contact Us.

**Additional Information**

- Safety Data Sheet ([http://www.dow.com/webapps/msds/msdssearch.asp](http://www.dow.com/webapps/msds/msdssearch.asp)).
- Contact Us ([http://www.dow.com/gco/contact/](http://www.dow.com/gco/contact/)).
- *DOWPER Perchloroethylene: For Degreasing Light Gauge Metals When Water Is Present*, The Dow Chemical Company, Form No 244-13501, May 2005 ([http://www.dow.com/PublishedLiterature/dh_005a/0901b8038005ab8d.pdf?filepath=gco/pdfs/noreg/244-13501.pdf&fromPage=GetDoc](http://www.dow.com/PublishedLiterature/dh_005a/0901b8038005ab8d.pdf?filepath=gco/pdfs/noreg/244-13501.pdf&fromPage=GetDoc)).
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- Perchloroethylene White Paper, Halogenated Solvents Industry Alliance, Inc. (HSIA), August 2005 (www.hsia.org)

For more business information about perchloroethylene, visit Dow's Chlorinated Organics web site. (www.dow.com/gco)

References

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1 Dow SAFECHEM Website: (http://www.dow.com/safechem/product/perch.htm)
3 Dow SAFECHEM Website: (http://www.dow.com/safechem/product/perch.htm)
14 Dow Chlorinated Organics web site. (http://www.dow.com/gco/)
16 Estimates by The Dow Chemical Company.
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