



# Perchloroethylene in Dry Cleaning

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Reducing Worker Exposure



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### INTRODUCTION

Perchloroethylene (“perc”) has long been recognized as an effective dry-cleaning solvent, and today it is the most commonly used solvent in dry-cleaning shops by far. However, as a volatile organic solvent, perc may pose serious health hazards if exposure is not properly controlled. Dry-cleaning workers who routinely breathe excessive amounts of the solvent vapor or spill perc on their skin are at risk of developing health problems.

Special precautions are recommended in order to avoid health risks from perc exposure. The purpose of this guidance is to provide practical and effective ways for dry-cleaning operators to reduce worker exposure to perc. The guidance emphasizes reducing perc exposure through a combination of using modern equipment and preventive maintenance, control of leaks in dry-cleaning equipment, proper ventilation and good work practices.

### Health Hazards

During dry cleaning, perc primarily enters the body from inhalation of the vapors, potentially resulting in the following health hazards:

- Dizziness, drowsiness and loss of coordination
- Mild loss of memory as well as loss of visual perception and reaction time after several years of exposure
- Redness and blistering of the skin after prolonged dermal contact

There is some evidence of an association between perc and an increased risk of certain cancers in dry-cleaning workers exposed for many years. The National Institute for Occupational Safety and Health (NIOSH) has designated perc as a “potential occupational carcinogen.” The National Toxicology Program has designated it as “reasonably anticipated to be a human carcinogen.” The International Agency for Research on Cancer (IARC) has designated perc as a “probable human carcinogen.”

The possibility of the health hazards can be minimized by reducing worker exposure and avoiding skin contact with perc.

### Primary Sources of Perc Exposure

Dry-cleaning employees may be exposed to perc while performing both routine tasks and machine maintenance. Activities that result in elevated exposure include the following:

- Loading dirty clothes into the machine (when perc-contaminated air is displaced and forced out of the machine)
- Removing clothes, especially thick items, before the drying cycle is finished
- Transferring solvent-laden clothes into the dryer
- Cleaning lint and button traps
- Raking out the still (distillation unit residue)

This guide is merely a guideline. It is not meant to be exhaustive nor be construed as legal advice. It does not address all potential compliance issues with Federal, State, local OSHA or any other regulatory agency standards. Consult your licensed Commercial Property and Casualty representative at Irving Weber Associates or legal counsel to address possible compliance requirements.

- Changing the solvent filter
- Maintenance of water separator
- Handling and storage of hazardous waste

### Machine Fugitive Emissions

Uncontrolled emissions, also called “fugitive emissions,” from dry-cleaning machines can also expose workers to high levels of perc. These include:

- Perc emissions not captured by vapor recovery and thus released when the loading door is opened or through the vent
- Perc emissions from leaks in machines, hoses, valves and ducts

### Secondary Sources of Perc Exposure

Other possible sources of perc exposure not directly associated with the dry-cleaning equipment include:

- Pressing freshly dry-cleaned clothes
- Using a perc-based spotting agent
- Using a perc-based waterproofing agent<sup>1</sup>

### Current Regulations

OSHA has set mandatory permissible exposure limits (PELs) for perc, presented in Table 1. This table also lists perc exposure limits **recommended** by other safety and health organizations.

Other OSHA standards that may apply when workers are exposed to perc include: Hazard Communication (29 CFR 1910.1200); General requirements for personal protective equipment (29 CFR 1910.132); and Respiratory Protection (29 CFR 1910.134).

In addition to these worker exposure limits, dry-cleaning facilities must comply with EPA regulations controlling the release of perc into the environment—air, land and water. EPA has developed regulations that affect many aspects of dry-cleaning operations, including machine operation and maintenance, building design and ventilation, work practices, as well as perc storage and disposal. There are also EPA requirements on air monitoring for perc release, recordkeeping and perc-use reporting. (For further information on EPA regulations, see Plain English Guide for Perc Cleaners, EPA, 2003.).

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<sup>1</sup> Use of perc-based spotting or waterproofing agents is not current practice in the dry-cleaning industry. However, these operations are addressed in this document for the few dry-cleaning establishments that may still use these products.

**Table 1. Worker Exposure Limits for Perchloroethylene (Tetrachloroethylene)**

Organization	8-hour time-weighted average (TWA)	Other limits
OSHA (mandatory)	Permissible Exposure Limit (PEL): 100 parts per million (ppm)	Ceiling: 200 ppm (for 5 mins. in any 3-hr. period), with a maximum peak of 300 ppm
ACGIH (voluntary)	Threshold Limit Value (TLV): 25 ppm	Short-term exposure limit (STEL): 100 ppm (as a 15-min. TWA)
NIOSH	Potential Occupational Carcinogen; Minimize workplace exposure concentrations.	

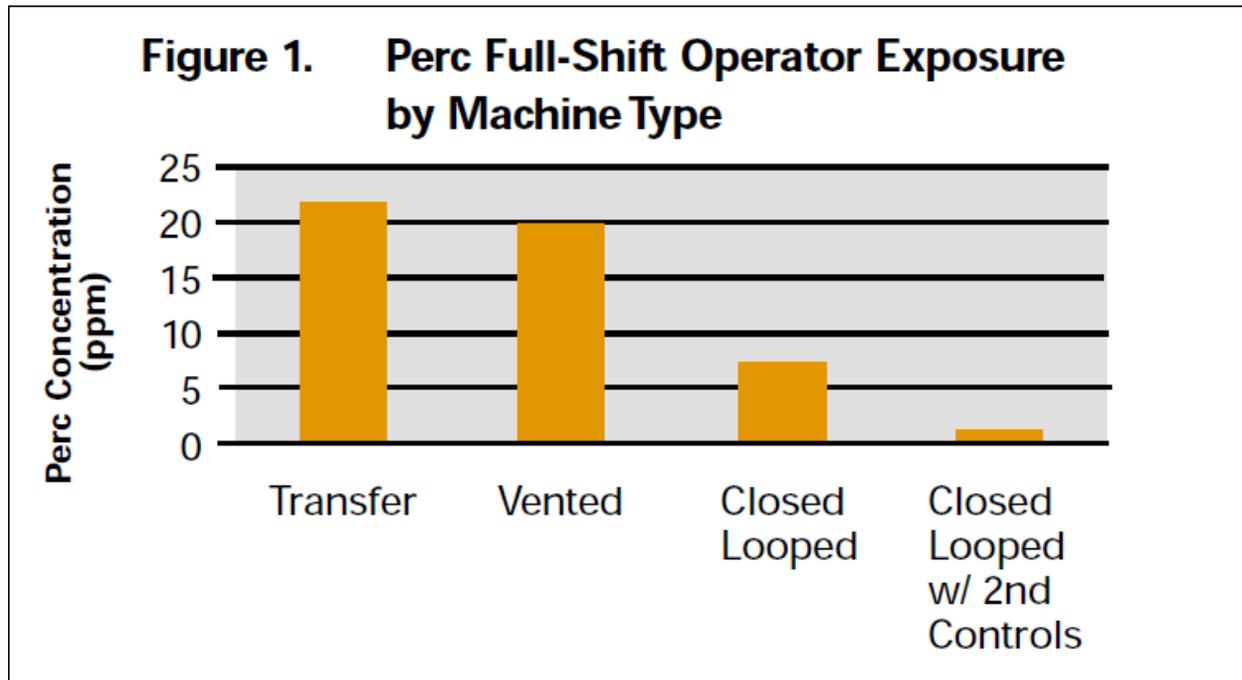
Source: OSHA

### Machine Design and Maintenance

Dry-cleaning technology has evolved substantially over the decades. The newer machine designs (dry-to-dry, closed looped) greatly reduce the amount of perc vapor released into the air inside the shop as well as outdoors, resulting in cost savings since more perc is recovered for reuse, as well as safer working conditions and a cleaner environment.

The oldest type of dry-cleaning machines—**transfer** machines—can expose workers to high amounts of perc, particularly during transfer of solvent-laden clothing from washer to dryer. Newer equipment (**dry-to-dry** machines) reduces worker exposure by eliminating this transfer step (clothes enter and exit the machine dry).

The first dry-to-dry equipment, dry-to-dry **vented**, exhausts residual solvent vapors either directly outside or first through a perc-vapor recovery system. The present designs, dry-to-dry **closed loop** machines, recirculate perc rather than release it outdoors. The latest technology incorporates a secondary vapor recovery system on the dry-to-dry **closed loop machines** that most effectively minimizes perc usage, environmental releases and worker exposure to perc. Figure 1 below illustrates the perc exposure levels of machine operators associated with the various dry-cleaning machines:



Source: NIOSH

Replacing equipment (that wears out) with modern equipment can reduce exposures. Also, routine machine maintenance combined with detection and the timely repair of identified leaks can be extremely effective in controlling airborne levels of perc vapor.

The EPA estimates that as much as 25 percent of solvent emissions can be attributed to leaks. In addition to creating unsafe airborne levels of perc, leaks are wasteful and costly. Routine machine maintenance needs to be performed to ensure optimal operation of all components. Appropriate personal protective equipment (PPE) needs to be worn during maintenance activities to ensure protection from perc hazards. (See Page 7 for more information on PPE.)

Recommended machine maintenance activities include the following:

- Clean lint and button traps regularly to prevent the clogging of condensers and fans.
- Rake out still daily. (Consider installing a pump that allows residue to be pumped directly into a safety can.) Change all filters as necessary.
- Desorb carbon adsorber before it reaches its saturation point.
- Adjust refrigerated condensers to ensure proper temperature of drying air.
- Maintain and repair exhaust fans.

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Never perform maintenance while dry-cleaning equipment is operating. To control perc leaks from dry-cleaning equipment:

- Perform daily checks for leaks in door gaskets, valves, hoses, pumps, tubing and piping connections. Look for liquid pools and droplets on or around equipment.
- Unusual solvent odor may indicate a vapor leak (do not rely only on the sense of smell for detecting leaks).
- Replace gaskets before they become hard, cracked or worn.
- Use a direct-reading air-monitoring device (see Page 8) to detect vapor leaks in piping, exhaust ductwork and associated components.
- Use perc-resistant seals and fittings recommended by the manufacturer of the machine.
- Repair leaks immediately.

A recommended schedule of maintenance activities is provided in Appendix A.

### Ventilation

Adequate ventilation is essential for controlling perc levels within the dry-cleaning shop. General ventilation, provided by equipment such as overhead fans, is useful for reducing heat and humidity, and diluting perc levels. Such ventilation can be designed to move the perc vapors away from workers and customers while continuously supplying clean, fresh air to the dry-cleaning area.

Local exhaust ventilation (LEV) captures perc vapor at the source of the release, removing the vapor before it enters the air inside the shop. Well-designed LEV may be provided where perc exposure is highest, for example, at the loading door. Newer dry-cleaning equipment has built-in LEV designed to prevent the escape of vapors during machine loading and unloading. For machines without built-in LEV, an external ventilation hood outside the machine door can be installed to control vapors when the door is open.

Detailed information regarding desirable configurations for general ventilation and LEV as well as recommendations on exhaust fan placement and capacity can be found in pamphlets by the International Fabricare Institute (IFI) (1989)<sup>2</sup> and NIOSH (1998)<sup>3</sup>.

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<sup>2</sup> IFI. 1989. Reducing Vapor Exposure: OSHA compliance. International Fabricare Institute. Vol. 13, No. 5.

<sup>3</sup> NIOSH. 1998. Control of Exposure to Perchloroethylene in Commercial Drycleaning. NIOSH Hazard Controls. DHHS (NIOSH) Publication No. 97-154. <http://www.cdc.gov/niosh/hc16.html>

### Personal Protective Equipment

Personal protective equipment (PPE)—including aprons, gloves, goggles and respirators approved for use with organic chemicals—is used to help workers avoid perc exposure. Workers must wear respirators equipped with filters or cartridges specifically designed for organic vapors when elevated perc exposures are anticipated (29 CFR 1919.134).

Tasks where elevated exposure may occur include machine maintenance, filter changes, waterproofing operations and loading/unloading machines (depending on the equipment in use). Workers using transfer machines may also need to wear chemical-resistant aprons. Spotters can wear goggles, chemical-resistant aprons and gloves. Spill cleanup workers always need to wear respirators and gloves.

### Work Practices

Good work practices can greatly minimize worker exposure to perc vapors. For example, peak exposure levels can be reduced by several hundred parts per million simply by proper positioning of the worker's head and body during transfer operations. Other important work practices to reduce perc exposures are listed below:

- Do not load the machine past its capacity.
- Do not open the machine door when the cycle is running.
- Keep the machine door closed as much as possible.
- Do not “shortcut” the drying cycle by removing garments from the machine before the cycle is finished.
- Keep your head and face turned away from the machine door and clothes when removing solvent-laden clothes from the washer.
- Do not transfer perc to machines by hand or with open buckets. Use a closed piping system that connects directly to the machine drum.
- Wait until the machine and solvent are cold before performing maintenance.
- Use spotting agents sparingly.
- Use perc-free spotting agents.
- Clean up perc spills immediately. The shop should have a plan in place for safely responding to perc spills.
- Store containers of perc and perc wastes in tightly sealed containers.
- Position your hand away from the door when opening a transfer machine.

### Training

Dry-cleaning employees need training on how to protect themselves from the hazards of perc (OSHA Hazard Communication Standard, 29 CFR 1910.1200). Employees should be trained in proper work

practices for all of their expected tasks—operating and maintaining machines, spotting, waterproofing, housekeeping, and perc transfer and storage.

Workers must be trained on the health hazards and symptoms associated with perc exposure. Workers should become familiar with Safety Data Sheets (SDSs) and container labels for perc (OSHA Hazard Communication Standard, 29 CFR 1910.1200). In addition, workers should be familiar with the location and proper use of eyewash stations as well as the procedures for responding to first-aid emergencies, such as eye splashes and skin contamination. OSHA requires employers to train their employees on the hazards and methods to prevent exposure to chemicals used in the workplace (OSHA Hazard Communication Standard, 29 CFR 1910.1200). Workers must also be trained on the proper use of respirators (Respiratory Protection Standard, 29 CFR 1910.134).

### Perc Air Monitoring

A variety of devices and instruments are available to measure perc levels in the air. Reasons for performing air monitoring include:

- To determine the perc exposure levels of individual employees
- To identify sources of leaks in equipment
- To measure perc levels before and after modifications to equipment or procedures

The type of air monitoring method used depends on the purpose of the sampling, the technical abilities of the person who conducts the testing and the cost of the equipment. To determine the perc exposures of individual workers, a sample can be obtained by clipping a monitoring device to the worker's collar either with a battery-powered pump or a simple monitoring badge.

The samples are then sent to a qualified laboratory to analyze the perc concentration. The results can be compared with the OSHA PEL and other recommended exposure limits for perc (listed in Table 1, on Page 4).

For detecting equipment leaks and other emissions, portable, direct-reading devices provide either a visual/audible indication of a leak or an instantaneous measurement of the perc-vapor concentration at the source of the emission. These instruments vary in terms of cost, accuracy and ease of use.

Two relatively inexpensive, easy-to-use leak-detection devices are:

- Small, hand-held refrigerant leak detectors that indicate a perc leak by a visual and audible signal
- Colorimetric detector tubes (used with small, hand-operated pumps) that change color depending on the perc-vapor concentration

More sophisticated types of direct reading devices include infrared analyzers and photoionization detectors that provide accurate measurements of perc concentration, but they are more expensive and require technical expertise to operate.

### Assistance

OSHA has a free consultation service for small- and medium-sized businesses with hazardous operations. The service is confidential and offers the expertise of qualified occupational safety and health professionals to employers who request advice and assistance. OSHA consultation is available in all 50 States, the District of Columbia, Guam, Puerto Rico, the Northern Mariana Islands and the Virgin Islands. Information on OSHA consultation services can be found [here](#).

For assistance with perc monitoring, consult your perc supplier's product stewardship program or a professional dry-cleaning association, such as the International Fabricare Institute. If you need the technical expertise of an industrial hygienist, the American Industrial Hygiene Association (AIHA) offers a listing of qualified consultants that can be found [here](#).

And, as always, for further assistance with safety, compliance and risk mitigation, contact Irving Weber Associates today.

*Source: OSHA*

## APPENDIX A – Recommended Maintenance Schedule for Dry-cleaning Machines

### Daily Maintenance Tasks

- Clean button trap strainer and lint bag.
- Dispose of contaminated water from the water separator. Desorb the carbon adsorber.
- Rake out the still of the distillation unit (or weekly, if needed).

### Weekly Maintenance Tasks<sup>4</sup>

- Check door seatings and gaskets of machine cylinder for liquid and vapor leaks.
- Check the button trap for lid leaks. Launder the lint bag.
- Check seals and gaskets of the refrigerated condenser's diverter valve, distillation unit, filters, filter housings and muck cooker for liquid and vapor leaks.
- Rake out the still of the distillation unit (or daily, if needed).
- Clean the separator tank of the water separator and perform leak checks.
- Measure the exhaust temperature of the refrigerated condenser. Measure perc in the exhaust system.
- Perform leak checks on hose and pipe connections, fittings, couplings and valves.

### Monthly Maintenance

- Check the exhaust damper (vented machines) for liquid and vapor leaks.
- Check for lint buildup on the heating and condensing coils and refrigerated condenser coils.
- Check for leaks in the ductwork of the lint trap and carbon adsorber.
- Check for lint buildup on the temperature probe of the lint trap.
- Clean the vent of the water separator.

### Semi-annual Maintenance

- Clean the muck cooker's steam and condensation coils.

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<sup>4</sup> Note: The EPA requires weekly leak detection and repair for large dry cleaners and bimonthly leak detection and repair for small dry cleaners. The type of machine (dry-to-dry or transfer) and the amount of perc purchased each year determines whether a dry cleaner is large or small. Refer to the Plain English Guide for Perc Cleaners for details.

### Annual Maintenance Tasks

- Clean the heating/condensing and refrigerated condenser coils.

### Other

- Clean and change filters according to the manufacturer's schedule.