Olin™

DOWPER™ PERCHLOROETHYLENE SOLVENT

A BASIC HANDBOOK FOR DRY CLEANERS

DOWPER SOLVENT

Table of Contents

Introduction

Hazard Communication Standard for Employers

The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard requires employers to provide information and training to employees on the hazardous chemicals known to be present in your workplace.

This handbook has been designed to help you inform and train your employees.[1]

As an employer whose employees work with hazardous chemicals, you should:

1. Develop a written hazard communication program that details how you will comply with the federal Hazard Communication Standard
2. Prepare a written list of all hazardous chemicals in your workplace, using the chemical names as given on the Safety Data Sheets (SDSs)
3. Have a readily available, current SDS for each of the chemicals you list
4. Make sure that all containers of hazardous chemicals have prominent, legible hazard labels
5. Provide information and training to all employees on how to work safely with hazardous chemicals. Remember to train new employees as they join your operation. Training should include:
   a. How to recognize the presence of a chemical in the workplace
   b. Hazards associated with the chemical
   c. Routine and emergency handling procedures, and the use of personal protective equipment
   d. How to safely perform nonroutine tasks
   e. Details of your written hazard communication program
   f. Where to find SDSs

Documentation

Employers should document the fact that they have provided their employees with the necessary information and training. This documentation might include:

1. Written summary of the training session
2. Names and signatures of employees attending training sessions
3. Copies of any training materials used
4. Copies of SDSs used

What Is Dry Cleaning?

Dry cleaning, or washing in a non-aqueous fluid or solvent, is the most effective known process for cleaning the broadest spectrum of natural and man-made fabrics. Dry cleaning is essentially a three-step operation: First, solvent is used to dissolve and disperse the soils on the fabric. Second, the solvent and soils are removed from the fabric. Third, the soils are removed from the solvent, and the solvent is used again.

There are many reasons for dry cleaning garments rather than washing them in water. Some fabrics cannot be washed in water for fear of causing shrinkage, while some fabrics are colored with dyes that dissolve in water. In addition, the fashion industry often uses a variety of fabrics in a single garment. This means that the choice of cleaning method becomes critical, and dry cleaning is often the only method that can be used to clean such garments. Whatever the principal reason for dry cleaning a garment, the complete dry cleaning process – which includes spot removal, solvent cleaning and finishing – can restore a "like new" appearance to clothes.

One major advantage of dry cleaning is that the wastes (the soils and used soaps) can be concentrated, minimizing the need to dispose of these wastes.

DOWPER™ Perchloroethylene Solvent

Today, perchloroethylene is the most widely used dry cleaning solvent in the world, and Olin is the world's largest perchloroethylene producer. DOWPER™ Perchloroethylene Solvent is a clear, stabilized solvent manufactured by Olin for dry cleaners. It has many significant benefits in dry cleaning. DOWPER Solvent:

- Is virtually nonflammable. It has neither a flash point nor flammability limits. Since zoning ordinances and leasing agreements are usually less restrictive when using nonflammable solvents, there is greater flexibility in locating a plant.
- Readily dissolves virtually all organic stains, such as oils, greases, fats and waxes
- Is much heavier than water (its specific gravity is 1.619, while the specific gravity of water is 1.0); thus, it provides increased mechanical agitation during the wash cycle as solvent-laden clothes are lifted and fall in the drum (Figure 1)
- Can penetrate fibers to dissolve solvent-soluble soils rapidly, because of its low viscosity and low surface tension
- Evaporates quickly in moderate heat
- Can be recycled and reused repeatedly in a dry cleaning machine
- Is noncorrosive in dry cleaning machines when proper procedures are followed
- Does not affect the fabrics, dyes and trims that are common in the fashion industry
- Meets industry standards for high-quality, dry cleaning-grade, stabilized perchloroethylene

Table 1: Physical Properties of DOWPER™ Perchloroethylene Solvent

Pounds per gallon @ 25°C	13.4
Specific gravity @ 25°C/25°C	1.619
Boiling point @ 760 mm	250°F (121°C)
Freezing point	-8°F (-22°C)
Heat required to vaporize	90.2 BTU/lb
Specific heat	0.21 BTU/lb./°F
Solubility in water @ 77°F (25°C)	0.015 wt. %
Odor detection level	5-70 ppm
Evaporation rate @ 77°F	2.6 lbs./sq. ft./24 hrs
Vapor density (air = 1.00)	5.8
Flash point (COC, TOC)	None

[1]Caution: The following is only a simplified list of requirements under the Occupational Safety and Health Administration's Hazard Communication Standard (29CFR1910.1200). Familiarity with the Standard itself will aid in ensuring compliance. The Standard also imposes protection requirements on subjects other than your own employees. Other state and federal laws may impose additional obligations. Failure to comply with regulations may result in substantial penalties. Legal assistance may be necessary.

Operating with Perchloroethylene

Understanding Perchloroethylene

This handbook is designed to provide guidance in the safe handling and use of perchloroethylene in a dry cleaning operation. Dry cleaners who handle, use and dispose of perchloroethylene properly are helping to protect the health and safety of employees, the public and the environment. The next few pages may seem elementary to some readers. However, reviewing the basics of dry cleaning can help you get the most out of the perchloroethylene you use.

Solvent Flow

To operate safely with perchloroethylene, all employees should be fully acquainted with the flow of perchloroethylene through a typical dry cleaning unit. As outlined in the flow diagram (Figure 1), the perchloroethylene passes from the solvent storage tank into the drum for the wash cycle. From there, it passes through the filter and back into the solvent storage tank. Periodically, perchloroethylene is run through the solvent still for purification, and then returned to the solvent storage tank. Some new dry cleaning machines operate with a continuous still so that the solvent is recycled throughout the day. The drying phase takes place in the drum chamber. Hot air evaporates the perchloroethylene left on the garments. The solvent vapors are condensed and returned as liquid to the solvent storage tank.

Washing/Extraction Step

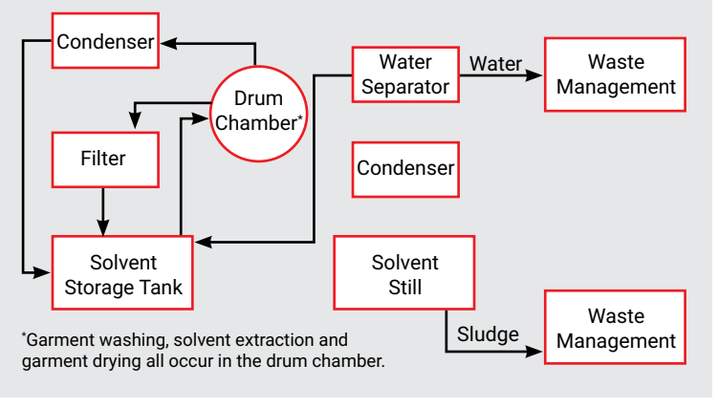
The first step in the dry cleaning process is to place the garments in the drum chamber of the dry cleaning machine. The chamber is then closed and filled with solvent/detergent solution from the storage tank. Here, the clothes are subjected to mechanical agitation in the solution. This causes both water-soluble and solvent-soluble soils to dissolve, and insoluble soils and particulates to disperse.

At the end of the wash cycle, the solvent is drained from the drum chamber and returned through the filter to the storage tank. During the spin cycle, additional solvent is extracted from the garments to help reduce drying time.

Just how well this process works depends on a number of factors:

Detergent charge. To be capable of removing a wide range of soluble and insoluble soils, an efficient dry cleaning operation requires careful control of the solvent/detergent/moisture ratio. Proper charge levels for most detergents

Figure 1: Simplified Flow Diagram of a Typical Dry Cleaning Plant



can be determined by using a simple but effective test kit (usually supplied by the detergent manufacturer or distributor), and may be controlled with the aid of a detergent metering device. Moisture levels may also be controlled by any of several moisture-control devices.

Cycle time. Some soils are more easily dissolved or dispersed than others, and certain fabrics will free soils more readily. The recommendations of your local dry cleaners' association will help you to set the proper cycle time.

Mechanical action. Generally, both soluble and insoluble soils are removed more quickly as the degree of agitation is increased (although too much mechanical action can damage the garments being cleaned). Agitation is determined by the design of the drum, the speed of rotation and the amount of solvent in the machine. In particular, a load of garments that is less than the machine's recommended capacity will receive greater agitation than one that meets or exceeds the manufacturer's recommendations.

Solvent temperature. The solubility of most soils is directly related to the temperature of the solvent. In particular, partially soluble and gummy soils dissolve more quickly as the temperature increases. A balance must be struck, however, because too high a temperature may soften resin binders – such as those found in printed slipcovers, draperies, cotton dresses and hand-painted fabrics – causing the coloring to disperse. High temperatures may also raise the solvent's relative humidity to levels (80 percent or higher) where garment damage can occur. Ideal

solvent temperature, therefore, is between 75 °F and 80 °F (24 °C and 27 °C). This can be controlled by a solvent-cooling device in the dry cleaning machine.

Cleanliness of solvent. Clean perchloroethylene is essential to providing clean garments to your customers. Filters and stills, when properly maintained, will keep the solvent clean. You can tell how effective these are by inspecting your solvent visually. It should be a clear, colorless liquid, free from suspended matter.

Drying Cycle

The drying process removes any solvent remaining in the clothes following the washing/extraction step. Different types of loads will require different drying times. For example, a load of silk blouses will dry faster than a load of down-filled ski jackets. Several factors in drying must be controlled to ensure an efficient drying period.

1. **Size of load.** Overloading the drum chamber slows the flow of warm air through it. This slows the evaporation of solvent from the clothes.
2. **Airflow.** Warm air is blown through the drum chamber to evaporate the solvent and dry the clothes. Since the flow of air is affected by the amount of lint on the lint filter, this filter should be cleaned frequently. Lint buildup on the condensing coils can also restrict airflow, so these coils should be checked regularly and accumulated lint cleaned off.
3. **Temperature in the drum chamber.** The best temperature for the warm air that blows through the chamber is about 140 °F (60 °C). If the temperature is too cool, some clothes may not dry completely. If the temperature is too warm, wrinkles may set, and some temperature-sensitive fabrics may be affected.
4. **Temperature of the condenser.** In dry-to-dry machines, the vapor-laden air from the drum chamber is circulated over a condenser, which cools the vapor-laden air and recovers liquid solvent. The liquid solvent is returned to the storage tank, and the air is reheated and recirculated back through the clothes for further drying. This recirculation process continues until no more solvent can be condensed from the air. The effectiveness of recovering solvent from the vapor-saturated air around the clothes is dependent on the difference between the temperature of the hot air used to dry the clothes and the temperature at the condenser: the bigger the difference in temperature, the greater the amount of perchloroethylene that will be recovered. Early dry-to-dry machines utilized water-cooled condensers to recover solvent from the solvent-laden air around the clothes. The vapor concentration at the end of the drying cycle in those systems was still high enough that fresh air had to be circulated through the system and then vented outside. Thus, those machines were referred to as vented dry-to-dry machines. Today's dry-to-dry machines utilize refrigerated condensers, operated at 45 °F (7 °C), as the primary control device. These machines are significantly more effective at removing and recovering solvent vapors and, therefore, do not need a vented, fresh-air aeration step. Instead, they use a cool-down step, where the air continues to be recirculated within the machine, but the air is not reheated. This allows the air to equilibrate at a lower temperature, condensing and recovering more perchloroethylene than past machines allowed. These machines are referred to as closed-loop, refrigerated dry-to-dry machines, or third-generation machines.
5. **Secondary vapor control system.** More recent refrigerated dry-to-dry machines are also equipped with an integrated carbon adsorber, which is activated toward the end of the cool-down step. Circulating the air through the activated carbon bed traps even more residual solvent vapor, reducing the solvent concentration in the chamber to < 300 ppmv (parts per million by volume). These adsorbers are typically engineered to automatically regenerate, utilizing hot air to desorb the perchloroethylene from the carbon bed. This solvent is also recycled back to the solvent storage tank for further use. These machines are typically referred to as closed-loop, refrigerated dry-to-dry machines with secondary vapor control, or fourth-generation machines. Fifth-generation machines have an additional analytical device that measures the solvent concentration in the drum chamber during each cycle and is tied to a door-lock mechanism, which will not allow the door to be opened until the desired vapor concentration (i.e., < 300 ppmv) in the drum chamber is achieved.

Balancing these factors will optimize the efficiency of the drying cycle. Actual drying efficiency, however, can be measured through testing. Your equipment manufacturer or local dry cleaners' association can advise you on the proper way to measure efficiency.

Filtering Perchloroethylene

Filtration is an effective and economical method of clarifying solvent for reuse. When filtration is performed properly, the solvent returned to the solvent storage tank will be pure enough to meet the requirements for quality cleaning. A properly equipped and operated filter system can remove most insoluble soils, such as sand, dust, lint, ashes, hair, and various kinds of pigments and dyes.

Filter varieties. There are many different types of filters, and there is endless debate among dry cleaners as to which type is best. Your equipment manufacturer or local dry cleaners' association can give you guidance in selecting a filter for your system, but your own experience is the best guide. The best filter for your system provides you with the cleanest solvent in the most economical way.

Handling filters. Be sure to follow the manufacturer's guidelines when using filters, and to change or recharge them before they get overloaded. Filter waste, and possibly lint traps and button traps, must be handled and disposed of as hazardous waste (see page 13 regarding Disposal Procedures for Perchloroethylene). Lint traps and button traps should be cleaned regularly.

Reclaiming and Recycling Perchloroethylene

Distilling Perchloroethylene

Distillation is one method dry cleaners use to reclaim and recycle perchloroethylene. This is a process where used or impure solvent– perchloroethylene that contains an excessive amount of solvent-soluble, nonvolatile residues, such as fatty acids, greases and oils – is heated to the boiling point (250 °F or 121 °C) and vaporized. Since impurities boil at higher temperatures than perchloroethylene, they are left behind in the still bottoms (or sludges). Perchloroethylene vapors, now free of impurities, pass through a water condenser, where they are liquefied into a solvent/moisture mixture, and then passed through a water separator, where the moisture is removed. The distilled and dried perchloroethylene is returned to the storage tank for reuse.

pH control. Dirty solvent sent to the still can contain acidic substances. To prevent corrosion problems in the still, it is useful to measure the acidity level or pH of the solvent and to neutralize it, if necessary, with a mild alkali, such as sodium bicarbonate (or baking soda). Your DOWPER™ Perchloroethylene Solvent distributor can instruct you on how to measure pH.

Drying the solvent. Before the solvent can be returned from the still to the storage tank, the water must be removed. This is done in a water separator. When a solvent/water mixture is passed through the water separator, the water, which is lighter than the solvent, rises to the surface and can be drawn off. The heavier solvent flows under a baffle and is drained from the other side of the water separator. Traces of impurities in the solvent tend to hold the moisture in solution, but separation can be enhanced when the solution is cooled. Consequently, a cooling coil is usually included in the separator.

Even when the separator is properly operated, water effluent will contain small amounts of perchloroethylene – up to 150 parts per million (ppm) at room temperature. These wastes may be classified as hazardous waste and should be tested with the appropriate methodology. Because waste disposal regulations vary, check with regulators or your local dry cleaners' association to determine proper treatment and disposal of this stream.

Sludge Treatment

Water addition method (azeotropic boil-down). Solvent that remains trapped in the filter sludge and still sludge, following normal distillation, can be recovered through an azeotropic boil-down. After the sludge has cooled from the first boil-down, add an amount of water to the sludge that is equal to 50 percent of the sludge volume. This will then form an azeotropic mixture with the remaining perchloroethylene – a mixture that will boil at a lower temperature than either water or perchloroethylene alone. Then heat the still to 185 °F (85 °C), and slowly increase the temperature to a maximum of 250 °F (121 °C). As you do this, the water/perchloroethylene mixture will boil off, leaving a heavier sludge. The water/perchloroethylene vapors will then condense in the condenser, and the water can be separated from the perchloroethylene in the water separator.

Waste disposal. DO NOT DUMP WASTE INTO ANY SEWERS, ONTO THE GROUND OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all federal, state, provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the sole responsibility of the waste generator.

Unused and uncontaminated product. The preferred options for disposing of unused and uncontaminated solvent include sending it to a licensed, permitted recycler, reclaimer, incinerator or other thermal destruction device.

Other vapor control devices. Large carbon bed systems have been used in the past as control devices to treat the exhaust from vented dry-to-dry systems and even general plant air. Unlike the secondary vapor control systems in fourth- and fifth-generation machines, these systems had to be sized for high airflow rates with relatively high vapor concentrations and were single-pass systems. In these systems, the solvent-laden air is passed through a bed of activated carbon, and the solvent vapors are adsorbed on the carbon. The virtually vapor-free air is then vented outside. Once the carbon becomes fully saturated with solvent vapors, the adsorption process ceases, and the air exiting the unit will still contain solvent vapors ("breakthrough"). Therefore, at regular intervals, and before breakthrough occurs, the carbon bed must be thoroughly regenerated by desorbing the solvent. In these systems, live steam is used to purge the bed, creating a perchloroethylene/water stream from which the perchloroethylene can be separated using a water separator and returned to the dry cleaning machine. Recovered solvent should be piped directly from the water separator of the vapor recovery unit to the storage tank, not transferred in buckets or pails. Remember, an efficiently operated vapor recovery unit can significantly increase your solvent mileage by reclaiming solvent vapors that might otherwise be lost through ventilation. In addition, vapor recovery units can sharply reduce the concentration of solvent vapors and odors in the work area. The wastewater stream from this process still contains some solvent and must be treated as a hazardous waste. Do not discharge water from water separators to drains (see Safe Storage and Disposal of Perchloroethylene on page 13).

Odor control. Bad odors or off odors in the solvent can be carried over into the cleaned garments. Typically, odor-causing soils that are removed from garments are eliminated from the system during the distillation process. Odors that persist in the garments may be a sign that the still is not operating properly. The still should be run at a temperature no higher than the boiling point of perchloroethylene (250 °F or 121 °C) to prevent the odor-causing compounds from boiling and remaining with the distilled solvent. A cotton rag filter in the solvent return line from the still will absorb water and water-soluble, odor-causing compounds from the solvent. If odors persist, your DOWPER™ Perchloroethylene Solvent distributor or local dry cleaners' association representative may be able to help.

Closed-Loop Delivery System

Today, technological advancements in the dry cleaning industry allow for the complete closed-loop delivery of solvent into the dry cleaning machines. The SVR (small volume refillable) system provides the latest technology available to meet today's requirements for environmental responsibility, employee safety and regulatory reporting. For further information, contact your local distributor of DOWPER™ Perchloroethylene Solvent, call Olin at (844) 238-3445, or visit www.dowper.com.

Maintaining High-Quality Solvent

Olin's goal is to produce, store and ship top-quality perchloroethylene. Our rigorous specifications and inspection plan ensure the consistent quality of our products worldwide. At Olin, consistent quality goes beyond simply meeting specifications. It also means meeting, and often exceeding, our customers' requirements for the product purity they need for better cleaning.

Olin's specification system is universal. All Olin production facilities and distribution terminals must review, and formally agree to abide by, the methods and tests published in our Sales Specifications. This system is Olin's guarantee that the material shipped will meet our rigid specifications.

Safety and Health Considerations

Safe Handling of Perchloroethylene

For more than half a century, perchloroethylene has been the preferred solvent for dry cleaning. When proper safety precautions are observed, perchloroethylene can be stored, handled and used safely. At the same time, it is important to understand the hazards associated with perchloroethylene, and to know the first-aid and medical treatment that may be required in an emergency. This section is offered as a guide to safely handle DOWPER™ Perchloroethylene Solvent. However, the most recent detailed information on health effects, handling precautions and first aid is contained in the Safety Data Sheet (SDS) for this product. **Always review the SDS before handling perchloroethylene.** To order a copy of the SDS for DOWPER™ Perchloroethylene Solvent, call Olin at (844) 238-3445, or email info@olinbc.com.

Toxicity is the capability of a substance to produce a harmful effect on a living organism at some level or frequency of exposure, whether through inhalation, ingestion or direct skin or eye contact.

Toxicity, therefore, is a property of all chemicals. The relative degree to which a chemical is toxic is one measure of the potential hazard represented by that chemical. Risk, on the other hand, is the chance or likelihood that a particular hazard may actually cause injury or damage, and depends on actual exposure conditions (duration and level). By using engineering controls, ventilation equipment and personal protection such as gloves, goggles, respirators and other safety equipment when you handle the perchloroethylene, you can effectively manage potential exposure and thus minimize the risks associated with this chemical.

When it is used properly by trained personnel and stored carefully in accordance with accepted guidelines, perchloroethylene should present no risk to workers. At levels within current exposure guidelines, perchloroethylene is unlikely to produce adverse effects, even from repeated exposures.

All personnel who work with perchloroethylene should be carefully and thoroughly instructed in the safety practices associated with its use and should be familiar with procedures to minimize exposure.

The owner of the dry cleaning plant has the ultimate responsibility for making sure perchloroethylene is handled, used and disposed of safely. In addition, each employee who works with perchloroethylene must fully understand the solvent and handle it in a responsible manner. The plant owner must make sure that the employees are fully trained in all safe-handling practices, procedures to minimize exposure hazards, rescue and escape procedures in case of an emergency, and emergency first aid.

Routes of Exposure

Inhalation

Breathing solvent vapor is the most likely route of exposure to perchloroethylene, and it is essential to keep atmospheric levels in the workplace below the exposure guidelines given in the current Safety Data Sheet for DOWPER™ Perchloroethylene Solvent. It is advisable to minimize worker exposure at all times.

There can be considerable variation in the subjective response of different individuals when exposed to the levels of perchloroethylene listed in Table 2, "Solvent Odor and Vapor Concentration." Even if you work with perchloroethylene every day, your response to different exposure levels can vary with the length of exposure and your physical condition.

The presence of solvent vapor in the air can produce an odor. Given the high odor threshold for perchloroethylene, odor is not an adequate warning of potential over-exposure. If odor is detected, it requires immediate investigation. To ensure worker safety, the workplace should be monitored regularly by a trained individual (see page 12 regarding Exposure Monitoring).

Exposure to perchloroethylene vapor concentrations within the recommended exposure guidelines should not result in any known adverse effects. Exposure above guideline levels, however, may cause adverse effects, including anesthetic or narcotic effects, and liver and/or kidney effects.

Because perchloroethylene vapor is heavier than air, it can readily accumulate in tanks, pits, small rooms or poorly ventilated areas, resulting in concentrations that can cause unconsciousness and even death. When solvent vapor odor is distinctly noticeable or high vapor concentrations are otherwise suspected or anticipated, follow the procedures outlined in American Society for Testing and Materials (ASTM) publication 4276, "Standard Practice for Confined Area Entry."

Approved industrial respirators are permissible for temporary emergency use, such as escape from contaminated areas, but never for entry into confined spaces or as a substitute for adequate ventilation or proper operation. Respirator cartridges should be discarded after each use. All equipment should be maintained and serviced according to the manufacturer's recommendations. Periodic drills are recommended for practice in using personal protective equipment, including attaining proper fit and securing hoses.

Safety and Health Considerations

Table 2: Solvent Odor and Vapor Concentration

Subjective Effects	Parts per Million by Volume Perchloroethylene in Air[1]
Odor	
Odor threshold	5-70
Slight odor, not unpleasant	100-200
Strong odor, unpleasant	>280
Vapor Inhalation	
No subjective response	<75
Eye irritation	75-200
Nose, throat irritation	100 transient 600 severe
Slight anesthetic effects (light-headedness, dizziness, etc.)	100 in 7 hours 200 in > 20 minutes 600 in 10 minutes
Exposure Guidelines	
ACGIH TWA	25*
Respirator Selection Criteria	
NIOSH IDLH	150**

[1]Values based on published literature and unpublished data from Olin Corporation.
*The American Conference of Governmental Industrial Hygienists (ACGIH) Time weighted average (TWA) concentration for a conventional 8-hour workday and a 40-hour work week, to which it is believed that nearly all workers maybe repeatedly exposed, day after day, without adverse effect.
**The National Institute for Occupational Safety and Health (NIOSH) atmospheric concentrations considered to be immediately dangerous to life and health (IDLH) as guidance for respirator selection criteria.

In addition, the workplace should be carefully monitored for vapor levels on a regular basis by trained personnel (see page 12 regarding Exposure Monitoring).

To reduce exposure to concentrated perchloroethylene vapors, organic-vapor cartridge respirators or positive-pressure supplied-air breathing apparatus may be necessary, depending on the operation. Some activities – including maintenance processes, such as cleaning a still or changing filters – may also require these or similar precautions. Always follow good standard safety practices.

First aid for inhalation. Move person to fresh air. If not breathing, give artificial respiration; if by mouth-to-mouth, use rescuer protection (pocket mask, etc.). If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician, or transport to a medical facility.

Note to physician: Exposure may increase "myocardial irritability." Do not administer sympathomimetic drugs such as epinephrine unless absolutely necessary. Maintain adequate ventilation and oxygenation of the patient. Physicians may consult with Olin physicians by calling Olin Emergency Services at the emergency numbers as listed on the back cover.

Skin Contact

Perchloroethylene is not likely to be absorbed in acutely toxic amounts through the skin. Frequent daily contact with perchloroethylene can defat the skin and cause dermatitis. Skin contact may cause sensitization. Occasional brief skin contact is not likely to produce any significant adverse effects. If perchloroethylene is confined to the skin (e.g., under clothing) and cannot evaporate, severe irritation, even a burn, may result. For protection, wear gloves of VITON fluoroelastomer, nitrile butadiene rubber (NBR), neoprene or polyvinyl alcohol (PVA), and discard them when they begin to deteriorate. See Table 3, on page 8, "Permeation Resistance of Common Glove Materials to Perchloroethylene."

First aid for skin contact. In case of contact, immediately flush the skin thoroughly with water while removing any contaminated clothing. Thoroughly clean and dry contaminated clothing before reuse.

Eye Contact

Undiluted solvent spattered into the eyes will produce slight to severe eye irritation, and possible transient and reversible corneal injury. Although no serious injury may result, exposure can cause extreme discomfort. Under routine conditions, use safety glasses or their equivalent. Contact lenses are not recommended. Where liquid-splash contact is likely, wear chemical goggles.

First aid for eye contact. Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial one to two minutes, and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

Ingestion

The least likely route of exposure is ingestion, or swallowing perchloroethylene. There is little likelihood of ingesting perchloroethylene when handling it in a dry cleaning plant. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury.

Never store solvent in unlabeled or improperly labeled containers, particularly drinking containers. Never smoke, eat or drink in areas where perchloroethylene is being used.

First aid for ingestion. If ingestion occurs, do not induce vomiting. Call a physician, or take the worker to an emergency medical facility.

Note to physician: If perchloroethylene is aspirated, rapid absorption through the lungs may cause systemic effects. Thus, the decision on whether or not to induce vomiting should be made by the attending physician. If lavage is performed, endotracheal and/or esophageal control is suggested. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach.

Effects of Long-Term Exposure

Numerous long-term studies in animals, as well as genetic toxicity tests and human epidemiology studies, have been conducted with perchloroethylene. When the results of these studies are considered in total, there is no indication that workers exposed to perchloroethylene in the workplace, at or below the current occupational levels, are likely to develop cancer from these exposures. Refer to the latest SDS for current workplace exposure standards.

In addition, studies on laboratory animals indicate that exposure to perchloroethylene that has no toxic effect on a mother is unlikely to produce birth defects in a fetus.

Protecting Personnel

There are no specific health requirements for persons assigned to jobs involving the handling of perchloroethylene.

Protective equipment should be provided and used consistently in accordance with the manufacturer's instructions and with all government regulations for safeguarding the health and safety of operators, maintenance workers and others who work with chlorinated solvents. Eye baths and showers should be easily accessible for emergency use as specified by government regulations, and walkways should be free of obstructions. Safety equipment is not intended as a substitute for proper operating and maintenance practices.

Operators handling perchloroethylene should wear the following:

- **Gloves:** Made from fluoroelastomer, nitrile rubber, neoprene or polyvinyl alcohol (see Table 3)

Safety and Health Considerations

- **Eye protection:** Safety glasses or their equivalent; chemical goggles where liquid-splash contact is likely (see the Safety Data Sheet)
- **Apron:** Neoprene

Maintenance personnel should wear the following:

- **Gloves:** Chemical-resistant, as above
- **Eye protection:** Chemical goggles
- Rescue harness and lifeline for entering confined spaces
- Positive-pressure air-line masks with proper reduction valves and filters, or supplied-air positive-pressure breathing equipment

Table 3: Permeation Resistance of Common Glove Materials to Perchloroethylene

Class	Material	Thickness (mm)	Breakthrough Time Thickness – Minutes Material (mm) (Permeation Rate – mg/sec/m^2)
Heavy Duty	Polyvinyl alcohol[1]	0.45	> 480
Medium Duty	Butyl rubber	0.40	8 (149)
	NBR (nitrile)	0.34	211 (4.7)
	Neoprene	0.48	12 (163)
Light Duty	Polyethylene	0.07	< 1 (128)
	PVC (vinyl)	0.10	< 1 (124)[2]

Use class definitions:
Heavy Duty Continual use. For use where prolonged solvent contact is likely, such as frequent immersion in dip, wipe or spray applications. Test results show best extended resistance to the solvent.
Medium Duty Intermittent use. For use where brief solvent contact is likely, such as handling wet parts or parts containing solvent. Test results show that considerable protection is offered when immersion is for brief periods.
Light Duty One-time use, disposable. For use where frequent light contact may be encountered.
[1]Polyvinyl alcohol is water soluble, glove can soften.
[2]Stiffened after test.

Additional Information Sources

Chlorinated Solvents Product Stewardship Manual. Chlorinated solvents, such as perchloroethylene, have been widely used for more than 50 years. They are ideal for a wide variety of uses, including metal cleaning, the manufacture of pharmaceuticals, paint removal, the cleaning of printed circuit board components and dry cleaning. As a leading producer of chlorinated solvents, Olin is committed to encouraging the proper use of these products in the interests of environmental protection and the health and safety of those who use them. Considerable resources have been devoted to promoting the safe and effective use of chlorinated solvents, as well as correct storage and disposal.

Safety Data Sheets. Every workplace that uses hazardous substances must have a Safety Data Sheet (SDS) for each of these substances available for inspection by employees. All employees must be trained on the information provided in the SDS. Perchloroethylene is the most commonly used hazardous substance in dry cleaning plants, and the one used in greatest quantity. A perchloroethylene SDS, which is available directly from your supplier or distributor of DOWPER™ Perchloroethylene Solvent, contains the most recent information on the health effects of perchloroethylene, proper handling precautions and first-aid procedures. Since the SDS is revised periodically to keep it current with developments in research and regulations, it is important to make sure that you have the most current version at all times.

Labels. Another important source of information is the product's label. All chemical products are required to have a label on their packaging that covers warnings and safety instructions. Olin places such a label on all drums of DOWPER Perchloroethylene Solvent, and if the distributor delivers DOWPER Solvent directly to your storage tank, a label or identification sticker can be provided. Be sure this is displayed prominently where all employees can see it.

Olin websites. Information on chlorinated solvents, including DOWPER Perchloroethylene Solvent, can be found at www.dowper.com.

Halogenated Solvents Industry Alliance (HSIA) website. Information can be found on the HSIA website at www.hsia.org.

Thermal Degradation of Perchloroethylene

When perchloroethylene vapors are exposed to extreme heat, they tend to decompose, yielding hydrogen chloride, carbon dioxide, carbon monoxide and chlorine. By a secondary reaction, carbon monoxide and chlorine may combine to form very low levels of phosgene. These thermal breakdown products can create far greater hazards than the solvent itself. They can be extremely toxic, causing serious injury or death, as well as corrosion to metals in the workplace. Of all gases produced by the decomposition of perchloroethylene, hydrogen chloride creates the greatest concern because it is produced in the greatest quantity and is highly corrosive to metals. Because it is a strong respiratory irritant, hydrogen chloride provides a warning that thermal decomposition is occurring. This will generally allow users enough time to correct the condition or vacate the area before hazardous vapor levels accumulate. Note, however, that dangerous concentrations of chlorine or phosgene can sometimes build up before the warning properties of hydrogen chloride become intolerable.

If hot processes such as welding must be performed in an area where solvent vapors may be present, the decomposition products (see above) should be vented outside the building through corrosion-resistant ducts. Also, when space heaters, water heaters, clothes dryers in a laundry operation, or boilers are situated where solvent vapors may be present, air for combustion should be drawn from the outside atmosphere, well away from the outlet of any exhaust vent

General Safety Rules

Most potential problems can be avoided if dry cleaning personnel adhere consistently to the following general safety rules when working with perchloroethylene:

- Be aware of the toxic properties and hazards associated with the use of perchloroethylene in dry cleaning

For more information on all chlorinated solvents from Olin, refer to the Chlorinated Solvents Product Stewardship Manual, which can be found at www.dowper.com.

Safety and Health Considerations

- Always consult the Safety Data Sheet for DOWPER™ Perchloroethylene Solvent before using it (ask your supplier for the most recent version)
- Use impervious gloves when prolonged or frequently repeated contact could occur. Chemical workers' goggles are recommended if splashing is likely, because eye contact with perchloroethylene may cause pain, although it is unlikely to cause injury if proper first-aid procedures are followed.
- When respiratory protection is required for certain operations, use an approved air-purifying respirator for organic vapors. For emergency or other conditions where exposure guidelines may be exceeded, use an approved positive-pressure, self-contained breathing apparatus.
- Do not use perchloroethylene in open containers
- Be alert when working with perchloroethylene, and avoid situations that might result in overexposure
- Odor alone cannot be relied upon as an indicator of hazardous exposure levels. Solvent concentrations in the air should be measured regularly by a trained person to ensure worker safety and compliance with government regulations.
- A worker who becomes light-headed or dizzy while working with perchloroethylene should leave the work area immediately, seek fresh air and report to the supervisor. Dizziness and lack of coordination may not only be effects of toxicity, they can also lead to other accidents.
- Do not arc weld or torch cut in any area where there may be perchloroethylene vapors, because air currents might direct vapors toward the welding operation and cause thermal degradation of the solvent
- Do not weld or torch cut any drums that have contained perchloroethylene
- Avoid prolonged or repeated contact of perchloroethylene with the skin
- Do not eat, drink or smoke in areas where perchloroethylene is being used
- Alcohol consumed before or after perchloroethylene exposure may increase adverse effects
- When perchloroethylene has been transferred from its original container, the new container should be properly labeled to identify its contents and to display the proper use, storage and disposal practices listed on the original Olin label. In addition, the container should be kept closed.

Spills and Leaks

Anyone who observes a spill of perchloroethylene should report it immediately, but only persons properly equipped and trained in safety procedures should clean up a spill.

Planning ahead for potential emergencies is a key part of the overall management of your facility. Each dry cleaning plant must have an emergency spill cleanup plan so that ventilation procedures and remedial action can be implemented immediately. In many jurisdictions, formal emergency response plans are required to be filed with local emergency response providers. Your local dry cleaners' association or distributor can help provide contacts for specific local regulations. Another part of your management plan is to have built-in safety features in your facility to help mitigate the potential for harm in the event of an accident. Some common examples of pollution prevention practice include sealing floor drains, installing dikes or containment pans around dry cleaning equipment, and using perchloroethylene-resistant floor coatings. In some cases, these practices have become part of state or local regulations for dry cleaning facilities.

Continually inspect and maintain all equipment, holding tanks and spill control devices to ensure that spills, leaks and releases do not occur. Establish a regular inspection and maintenance procedure. Install and maintain a solvent-resistant coating on floors.

To prevent environmental contamination, act promptly in the event of a spill, leak or release. Be sure to use proper protective equipment to avoid excessive exposure while cleaning up a spill. Comply with federal, state, provincial and local laws in responding to, reporting and cleaning up spills.

Spilled solvent and contaminated solvent should not be flushed into sewers, dumped into any body of water, or poured onto the ground or any permeable surface such as concrete.

Process water that comes in contact with solvent and/or water separators of distillation equipment and vapor recovery systems should be treated as hazardous waste. Do not discharge water from water separation to drains.

What to Do When Spills or Leaks Occur

Spilled solvent and solvent-contaminated water should never be allowed to drain into sewers, into any body of water or onto the ground. It is important to continually inspect and maintain your process equipment, holding tanks and spill control devices, and to know what to do ahead of time if a spill or leak occurs.

In Case of a Solvent Spill

1. Evacuate the spill area, and start as much airflow through the area as possible
2. If the release of perchloroethylene exceeds the reportable quantity, notify the appropriate emergency response and regulatory authorities
3. The spill must be cleaned up promptly. The liquid must be contained to prevent contamination of soil, surface or groundwater, and entry into drains or sewers
4. Follow confined-space entry procedures. Only persons properly equipped with respiratory protection and trained in safety procedures should clean up a spill. Always use a "buddy system" when cleaning up a spill; keep a backup person, also properly equipped, directly outside the spill area, ready to assist if the cleanup person is overcome.
5. The cleanup person should throw a blanket, cloths or rags on the spill to absorb the solvent and reduce the surface area available for evaporation. As an alternative, a noncombustible adsorbent material, sold specifically for cleaning up chemical spills, may be used.
6. Blankets, cloths or rags used to absorb a solvent spill should be put into the empty drum of a dry cleaning machine, and the door should then be closed. If an adsorbent material has been used, it should be shoveled into labeled, sealed containers, and disposed of in accordance with applicable waste disposal regulations.
7. Repeat this procedure until all liquid solvent is picked up and the floor is dry. Put the dry cleaning machine on the drying cycle to remove the solvent from the blanket, cloths or rags, and recycle the perchloroethylene into the base tank.
8. Never stay in an area where you detect the odor of perchloroethylene through your respirator. Leave the area immediately, and use a new mask or fresh cartridges before re-entering. If you expect to exceed the capacity of your respirator, use a positive-pressure, self- contained or air-supplied breathing apparatus.
9. In case of a boil-over of a still, immediately leave the area, and do not return without wearing proper respiratory protection. Turn off the steam line to the still – from a remote location, if possible. Start the cooling water through the coils, if it is not already on.

Reducing Worker Exposure and Environmental Emissions

Keeping Workers and the Environment Safe

Reducing emissions of perchloroethylene to the workplace atmosphere and the environment improves both worker safety and environmental air quality. The dry cleaning industry as a whole has worked toward these initiatives by replacing transfer equipment with closed-loop, refrigerated dry-to-dry equipment (third-generation). Fourth- and fifth-generation equipment, which includes additional vapor recovery technology, reduces emissions even further.

Whatever your equipment, further efforts to reduce your perchloroethylene waste and decrease solvent losses from your equipment will help improve air quality both inside and around your plant. A waste reduction/waste minimization program and scheduled equipment maintenance are the most effective actions you can take to improve air quality.

Waste Reduction, Waste Minimization

The aim of your waste reduction program should be to reduce the volume of wastes produced, as well as the volume of perchloroethylene in your exhaust air, through improving overall efficiency of solvent handling and use. Such a program should include both internal (on-site) solvent recycling and source reduction. Source reduction includes:

- **Process operating changes:** modifications in procedures that reduce air emissions, water discharges and the volume of accumulated wastes
- **Administrative changes:** improved housekeeping, purchasing and full cost accounting that lead to real reductions in wastes and their hazard potentials. As an example, take disposal costs into account when comparing filter systems.
- **Equipment changes:** modifications to existing equipment or installation of new equipment for the purpose of reducing both waste volume and solvent losses

The result of these changes should be a reduction in waste volume, in losses due to emissions and improper or inefficient equipment operation, and in solvent consumption.

Waste minimization includes all waste reduction techniques described above, as well as the following:

- **Waste treatment practices:** including an element of recycling should also be considered waste minimization techniques. One example is using a vapor recovery system to trap solvent vapors in the plant air and recycle the solvent into the dry cleaning machine.
- **In-house distillation:** using azeotropic boil-down will maximize perchloroethylene recovery from your waste (see page 5 regarding Sludge Treatment)
- **Resource recovery:** taking filter cartridges apart to separate clean metal for recycling by a scrap metal dealer
- **External (off-site) recycling:** use of solvent reclaiming or recycling services outside the dry cleaning plant. A number of companies offer this service.

NOTE: It is recommended that customers always purchase virgin DOWPER™ Perchloroethylene Solvent. By using virgin solvent, the customer is able to avoid the problems that can occur when using recycled solvent. These may include dye bleeding caused by the presence of solvents more aggressive than perchloroethylene, and odor problems or staining caused by the reaction of contaminants with detergents or pre-spotting chemicals. Long-term problems may also occur, such as corrosion of stills and recovery systems, which can decrease equipment life.

Reducing Solvent Losses

In today's economic and business climate, it is in the dry cleaner's best interest to minimize all solvent losses from the dry cleaning process. Primary sources of solvent losses include:

- Leaks, both liquid and vapor
- Cartridge filter disposal
- Still residues
- Improperly operated equipment

Reducing solvent losses from these sources can minimize solvent exposure to personnel, reduce the amount of hazardous waste disposed and save money through lower solvent consumption. One easy and effective way to measure progress in waste minimization is by calculating solvent mileage (see page 16 regarding Solvent Mileage). By tracking solvent mileage, you can demonstrate how effective your program of waste minimization has been. The following are suggestions for reducing solvent losses from your operation.

Leaks. Periodically inspect all gaskets, pipe joints and unions, seals, valves and hose connections for liquid leaks. Look for peeling paint and brown residues that may indicate intermittent leaks. Vapor leaks are more difficult to detect, and may require using a halogen leak detector. Check with your supplier of DOWPER™ Perchloroethylene Solvent to determine if a leak detector is available. Vapor can also be lost through button traps and water separators. Clamp covers down, check damper seals to make sure they seal properly and seal vent duct-work joints tightly.

Cartridge filters. Drain cartridges overnight to remove excess solvent. Three common practices are to let them drain in their housing, in the washer/extractor and in a separate still. Solvent content can be reduced even further by steam stripping the cartridge in a still equipped to do this, or by drying it in a drying cabinet. Steam stripping is especially effective because it leaves only a residual perchloroethylene content of less than one percent by weight. By removing as much perchloroethylene as possible before disposing of the cartridge, you not only reduce the amount of hazardous wastes, you also recover solvent for use. Spent filter material from cartridges, however, must still be disposed of as hazardous waste.

Today's new dry cleaning equipment options also include the use of spin disc filters. Some dry cleaners minimize solvent losses by reducing the total number of cartridge filters they have to use. This can be done by substituting spin disc filters for general particulate removal, followed by carbon filters for pigment and dye removal.

Still residues. Boil down the still before cleaning it out and disposing of the residue, following the manufacturer's recommendations for proper boil-down procedures. This will reduce the amount of solvent in the residue. You can reduce the solvent content even further through the "water-addition method" or azeotropic boil-down (see page 5 regarding Sludge Treatment).

Clothing transfer. Use of closed-loop, refrigerated dry-to-dry machines instead of old transfer machine technology has had significant, industry-wide impact in reducing solvent usage, emissions and worker exposure.

Further, use of integrated secondary control devices – which reduce vapor concentrations in the washer/extractor to less than 300 ppm and can be combined with analytical devices to directly measure vapor concentration in the washer/extractor – has had additional positive impact in reducing emissions.

Routine maintenance. No matter what type of system you use, or how new, you should perform routine maintenance on all equipment. This will help avoid expensive downtime. Refer to the equipment operating manuals for complete instructions, and utilize personal protective equipment (PPE). Some examples of routine maintenance are:

- Daily cleaning of the lint trap
- Weekly cleaning of the water separator
- Weekly inspection of cooling coils for lint buildup and proper operating temperature
- Monthly testing of dampers for air leaks
- Monthly examination of rubber gaskets for hardening or cracking

Solvent Mileage

Solvent mileage is a useful tool for a dry cleaner to measure the performance of equipment and procedures. High solvent mileage, indicating good performance, means that perchloroethylene is being conserved. It also implies that emissions of perchloroethylene into the workplace are minimized. Finally, it shows that you are reducing emissions of perchloroethylene to the environment.

Mileage calculation is simple if each load of clothes is weighed before going into the dry cleaning machine, and the volume of perchloroethylene used to refill the dry cleaning machine is measured. The total weight of clothes cleaned is divided by the volume of solvent used to refill the machine. The result is the solvent mileage. In other words:

$$\frac{\text{Total weight of clothes cleaned}}{\text{Total volume of perchloroethylene to refill}} = \text{Solvent Mileage}$$

The following conversion chart will help you calculate solvent mileage.

To Convert Solvent Mileage		
From	To	Divide By
lb. clothes per U.S. gal. solvent	kg clothes per litre solvent	8.34
lb. clothes per U.S. gal. solvent	lb. clothes per litre solvent	3.79
lb. clothes per litre solvent	kg clothes per litre solvent	2.2

Examples of Equivalents		
lb. clothes per U.S. gal. solvent	lb. clothes per litre solvent	kg clothes per litre solvent
150	40	18
300	79	36
450	119	54
600	159	72

A simple chart can be used for recording and tabulating the amount of garments cleaned. Most solvent suppliers and distributors can supply such charts. Olin's DOWPER™ Solvent Mileage Report, also includes a daily maintenance checklist covering items that should be checked. You can obtain it from Olin or from your distributor of DOWPER™ Perchloroethylene Solvent.

Reducing Worker Exposure

An effective way to minimize the hazards of exposure to perchloroethylene in the workplace is to control perchloroethylene vapors. The first step in controlling perchloroethylene vapors is to eliminate the sources of vapors. This means reducing solvent losses, as explained on page 10.

Fugitive vapors can be captured and recovered with vapor recovery units and equipment vent fans. The vapor recovery unit is described on page 5.

Ventilation can be used to move perchloroethylene vapors away from workers to a vapor recovery system, or to exhaust the vapors from the work area. Adequate ventilation can also be part of a program of minimizing exposure to perchloroethylene in the workplace. Since each dry cleaning plant is unique, it is wise to consult a competent ventilation contractor. You should also contact public health authorities for information on local air quality standards. Here are some guidelines for achieving good ventilation:

1. **Exhaust fans.** A wall- or roof-mounted ventilation fan is a good device for removing vapor buildup. As a rule of thumb, choose a fan that can provide a complete change of air every three to five minutes. For example, if the dry cleaning area measures 10,000 cubic feet, the rated exhaust capacity of the fan should be between 2,000 and 3,500 (cfm) at 1⁄2-inch static pressure. A larger area may need more than one fan.

   A good location for an additional exhaust fan is behind the dry cleaning machine, where it will draw vapors away from equipment operators and pull fresh air through the area. With a remote switch to turn it on, this exhaust fan can also be used in case of a solvent spill (see page 9 regarding Spills and Leaks).

2. **Equipment vent fans.** In many areas, regulations require an equipment vent fan that operates automatically when the dry cleaning machine door opens. This fan should provide airflow of at least 100 cfm (30.5 meters per minute) through the door opening to draw solvent vapors away from the workers and into a vapor recovery unit.

3. **Make-up air.** An adequate source of fresh make-up air is also necessary to replace the air that is removed. Ideally, this source should be located

on the other side of the dry cleaning machine from the ventilation fan to ensure a good cross-flow of air. The air intake should be situated at least 20 feet away from the ventilation exhaust to minimize recirculation of exhausted air, and should provide one square foot of louvered opening for every 500 cfm of rated face capacity.

Exposure Monitoring

Vapor concentrations should be kept below the exposure guidelines (see the SDS). Although odor by itself is not an acceptable measure of vapor concentration, it can serve as a warning of a condition that requires investigation. If solvent odor is strong, increase ventilation immediately or evacuate the area.

To ensure worker safety, the work area should be regularly monitored by a trained individual. A good monitoring program should measure both the normal situation that employees are exposed to, and a worst-case short-term exposure level.

The results of your monitoring can be used to show the effect of reducing solvent losses (see page 15 regarding Reducing Solvent Losses), safe work practices (see page 8 regarding General Safety Rules), and adequate ventilation (see page 11 regarding Reducing Worker Exposure).

BF Average exposure. Most regulations governing worker exposure are based on an eight-hour workday, so an eight-hour exposure, averaging both ambient (continuous) perchloroethylene concentrations and any higher short-term concentrations, should be determined. Seasonal changes occur in the working environment as doors and windows are opened during warm weather and closed during cool seasons. This affects ventilation patterns in the plant. Your vapor monitoring program should include testing at different times of the year so that you can identify seasonal variations and make appropriate adjustments.

A commonly used, and relatively inexpensive, sampling method is a dosimeter, a badge that can be worn by workers. To use this device, unseal it, clip it to the collar of an employee who runs the dry cleaning machine or works directly with perchloroethylene, and leave it there for the duration of the employee's shift. It is important that the badge be worn near the person's "breathing zone," so the collar is the best place to pin it. At the end of the employee's shift, reseal the badge, record the hours and minutes worn, and send it to a laboratory for analysis. Complete instructions should come with the dosimeter badge. Your supplier of DOWPER™ Perchloroethylene Solvent or your local dry cleaners' association will be able to direct you to a source for dosimeters and to a laboratory for analysis.

Short-term exposure. This is the measurement of exposure during specific jobs, such as cleaning the lint and button traps, changing filter cartridges, cleaning out the still and refilling the perchloroethylene solvent storage tank. One simple piece of equipment to measure short-term exposure is a handheld air pump with an indicator tube. This device works by pulling air through a glass tube containing a chemical that changes color when exposed to perchloroethylene vapors. The tube is calibrated so that the length of the stain in the chemical immediately shows the concentration of perchloroethylene in the air.

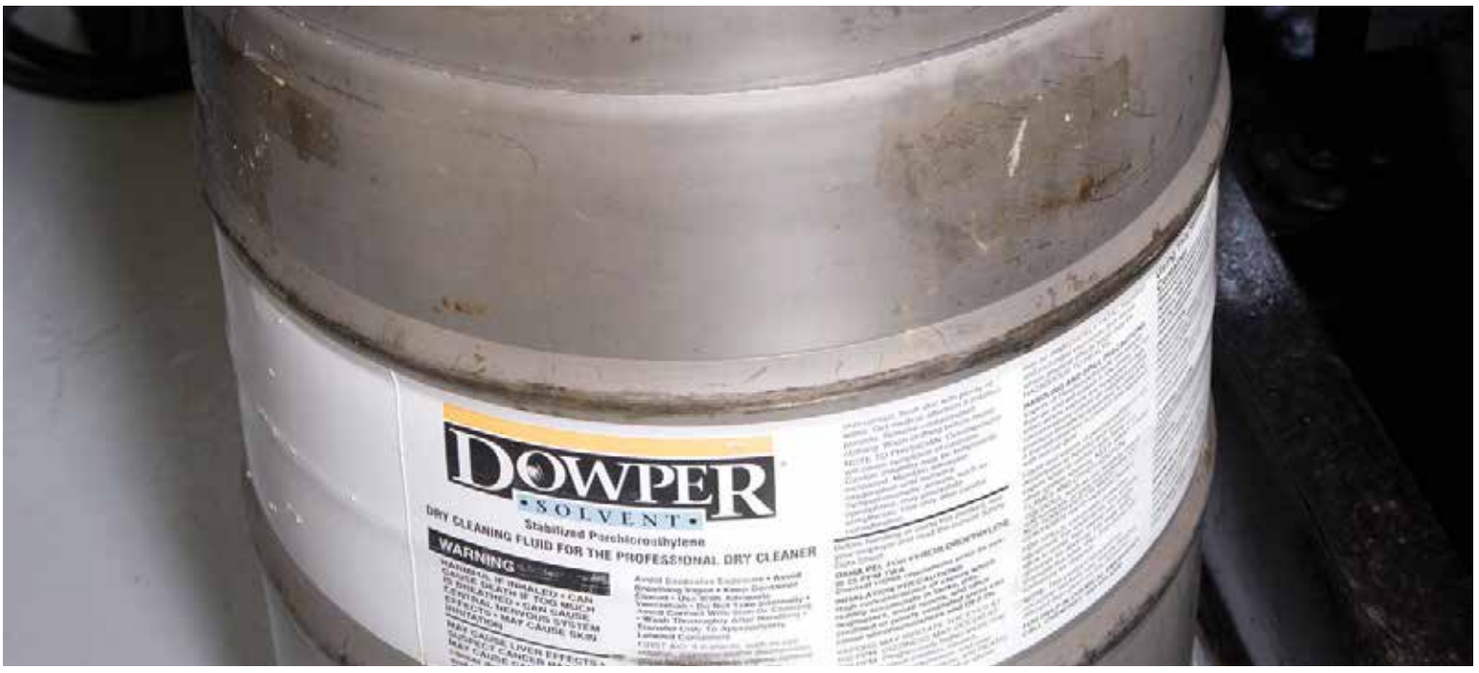
You can use this equipment at any time to measure the concentration of perchloroethylene present for a short period of time and in a specific place. Again, your supplier of DOWPER™ Perchloroethylene Solvent or your local dry cleaners' association can direct you to a source for this equipment.

Results. When you have the results of average and short-term exposure, you will be able to determine whether vapor levels are below mandated levels or within the recommended guidelines. Refer to the SDS for information on exposure guidelines. You can also obtain additional guidance through your supplier of DOWPER™ Perchloroethylene Solvent or your local dry cleaners' association.

If exposure levels are higher than the exposure guidelines, you need a plan to reduce them. Consider the following:

- Tighten your equipment to prevent any unnoticed vapor leaks. Check gaskets and pipe fittings. Cover any open containers.
- If one specific task is causing high exposure, find another way to do it that releases less perchloroethylene
- Increase ventilation. Repair any problems with your sniffer and exhaust system, or install a better system.
- Finally, if the source of exposure cannot be controlled, Olin recommends wearing a properly fitted and properly maintained organic-vapor cartridge respirator

Safe Storage and Disposal of Perchloroethylene



Regulation and Your Responsibility

Owners of dry cleaning plants must be aware of, and comply with, all appropriate federal, state, provincial and local regulations governing the use, storage and disposal of perchloroethylene. Regulations concerning storage and disposal are chiefly intended to limit solvent contamination of air, water and soil. There are numerous sources of information to help you better understand regulations and your responsibilities as an owner, manager or operator of a dry cleaning facility. Trade associations, such as the International Fabricare Institute (IFI) and the National Cleaners Association (NCA), offer numerous educational programs for dry cleaners that cover not only best practices to help produce a high-quality garment, but also safe handling and sound environmental practices. Some states, like California and New York, require certification for owners and/or operators. There are classes available to help prepare you for passing these certification requirements. The Small Business Ombudsman's office, associated with each state's environmental protection office, was created specifically to assist small businesses in understanding and complying with federal and state regulations. In many states, this office provides information programs specifically for dry cleaners. In addition, your supplier of DOWPER™ Perchloroethylene Solvent and your local dry cleaners' association can be resources for information.

You must be certain that the way you store, use, process and dispose of perchloroethylene will not result in environmental contamination. Without proper controls, very small quantities of perchloroethylene (e.g., one quart or one litre) or wastes containing perchloroethylene can reach and contaminate soil, surface water or groundwater. Contamination can travel great distances through soil or groundwater, and through other water systems.

Contamination can occur from spills, leaking equipment or holding tanks, releases or disposal of unused or dirty solvent, wastes containing perchloroethylene, and used perchloroethylene containers. Special care should be taken to prevent the entry of perchloroethylene into sewers, lakes, rivers, surface waters and water systems. Process water, such as separator water, should not be disposed of down drains or sewers. Proper spill containment should be provided where spills may occur (see In Case of a Solvent Spill on page 9).

Key pollution-prevention steps include sealing floor drains, installing dikes or containment pans around dry cleaning equipment, and using perchloroethylene-resistant floor coatings. A supplier of chemical-resistant floor coatings will be able to provide you with information so that you can choose a coating that will meet your specific needs.

The SVR alternative. A safer alternative to the storage tank is the small volume refillable container, or SVR, which Olin distributors use for the delivery of DOWPER™ Perchloroethylene Solvent. This stainless steel drum is a unique closed system for packaging DOWPER Solvent. It comes completely sealed and can provide safe and leak-proof storage until the solvent is needed. A dry disconnect fitting on the container permits virtually spill-proof hookup to the dry cleaning machine.

Disposal Procedures for Perchloroethylene

By reducing the concentration of perchloroethylene in your waste, you will reduce the hazard of the waste. In addition, by reducing the volume of your waste, you will reduce its environmental impact. These actions will help you comply with regulations and – by keeping your solvent in your dry cleaning machine rather than in your waste – will save you money.

When disposing of unused fluid, spent materials or process wastes (including separator water) containing any quantity of perchloroethylene, the preferred option is to send waste via a permitted waste hauler to licensed reclaimers or permitted incinerators. Disposal practices must be in compliance with laws and regulations intended to prevent solvent contamination of water and soils.

DO NOT DUMP SOLVENT, WASTE OR PROCESS WATER INTO ANY SEWERS, ONTO THE GROUND OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all federal, state, provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the sole responsibility of the waste generator.

For unused and uncontaminated product, the preferred options include sending to a licensed, permitted recycler, reclaimer, or incinerator or other thermal destruction device.

Global Contact Information

Info@olinbc.com

USA: +1 844 238 3445

Argentina: +54 1150789792

Brazil: +55 6135500717

Canada: +1 877 304 4442

China: +86 4008859485

France: +33 176361145

Germany: +49 41417693000

Hong Kong: +852 58081886

www.Olin.com

Italy: +39 0694805761

Japan: +81 345406770

Mexico: +52 5553518395

Russia: +7 4996092327

Singapore: +65 31632006

South Korea: +82 260221296

United Kingdom: +44 8000869047

Toll free service not available in all countries

Emergency Telephone Number (Chemical Incident Only)

USA: +1 800 424 93 00

Canada: +1 613 996 6666

Europe/Middle East/Africa/India: +32 3 575 55 55

China: 0532-83889090

Asia/Pacific: +65 6542 9595

RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

Form No. 100-05803-1016PI