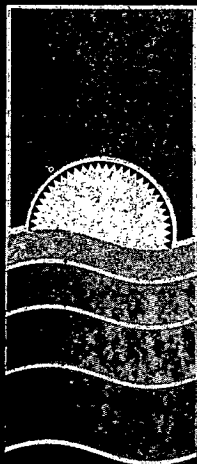


# **ENVIRONMENTAL CODE OF PRACTICE FOR THE REDUCTION OF SOLVENT EMISSIONS FROM DRY CLEANING FACILITIES**



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The Canadian Council of Ministers of the Environment (CCME) is the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international and global concern. The 13 member governments work as partners in developing nationally consistent environmental standards, practices and legislation.

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from Dry Cleaning Facilities  
for CCME

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# Glossary of Terms

Words and phrases that are not included in the list of defined terms in this part shall have the meanings that are commonly assigned to them in the context in which they are used in this Code.

The following words and terms used in the Code shall have the indicated meaning:

**Consumed solvent** - the amount of solvent purchased and emitted to the environment (air, water and land) in that year.

**Dry-to-dry systems** - refers to systems in which the washing and drying is done in a single machine that is vented to a control device or to the atmosphere during the deodorizing part of the drying cycle.

**Fully enclosed (refrigerated) systems** - refers to systems in which the washing and drying is done in a single machine that is not vented to either a control device or the atmosphere.

**Perchloroethylene** - an aliphatic halogenated hydrocarbon having the chemical formula  $\text{CCl}_2=\text{CCl}_2$ . It is a colourless, volatile liquid that is essentially non-flammable (synonym: tetrachloroethylene).

**Perchloroethylene dry cleaning facility** - any facility engaged in the cleaning of fabrics or leather using one or more washes in perchloroethylene solvent, extracting excess solvent by spinning and drying by tumbling in an airstream. The facility includes, but is not limited to, washers, dryers, filter and purification systems, waste disposal systems, holding tanks, pumps and attendant piping and valves.

**Petroleum dry cleaning facility** - any facility engaged in the cleaning of fabrics or leather using petroleum solvent. The facility includes, but is not limited to, washers, extractors, dryers, filters, purification systems, waste disposal systems, holding tanks, pumps and attendant piping and valves.

**Petroleum solvent** - a petroleum distillate used for dry cleaning purposes, such as Stoddard and 140-F solvents.

**Solvent recovery dryer** - a class of dry cleaning dryers that employs a condenser to liquefy and recover solvent vapours evaporated in a closed-loop, recirculating stream of air.

**Transfer systems** - refers to systems in which the washing and drying of the clothes is done in separate machines.

**Volatile organic compound (VOC)** - organic compounds that participate in atmospheric photochemical reactions, excluding methane, ethane, methyl chloroform, methylene chloride, most chlorofluorocarbons (CFCs) and hydrogenated chlorofluorocarbons (HCFCs).

# Abbreviations

The abbreviations used in this Environmental Code for units of measure, names of associations, government agencies and other words shall have the meanings assigned to them in this section.

ANSI	American National Standards Institute
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
IFI	International Fabricare Institute, 12251 Tech Road, Silver Spring, Maryland, USA
kg	Kilogram
kPa	KiloPascal, unit of pressure
L	Litre, unit of volume
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NO <sub>x</sub>	Nitrogen oxides
°C	Degrees Centigrade, unit of temperature
PERC	Perchloroethylene
ppb	Parts per billion
ppm	Parts per million
PSL	Priority Substances List
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compounds
WHMIS	Workplace Hazardous Materials Information System
wt %	Percent by weight

## Preface

Ground-level ozone concentrations often exceed more than twice the Canadian maximum acceptable objective of 82 ppb in the summer months in a number of locations in Canada. These ozone episodes are a result of photochemical reactions between nitrogen oxides ( $\text{NO}_x$ ) and volatile organic compounds (VOC). The problem is most acute in urban centres, the worst being in the Lower Fraser Valley of British Columbia, the Windsor-Quebec City corridor and St. John, New Brunswick. Ozone is known to decrease lung function, cause premature aging of the lung and cause damage to vegetation such as crops and forest species.

A reduction in the formation of ground-level ozone can be achieved by controlling emissions of volatile organic compounds and nitrogen oxides. Extensive study by the U.S. EPA (1990) has indicated that control of VOC emissions is usually the preferred strategy for ozone reduction. However, the effectiveness of VOC control,  $\text{NO}_x$  control, or some combination of the two strategies depends very much on the emissions, ambient air quality and meteorology at the site.

Dry cleaning facilities are a source of volatile organic compound emissions in Canada. These result during the dry cleaning process as solvent vapours are vented from process and emission control equipment, and from fugitive losses of liquids and vapours from piping, pump seals, doors of washers and dryers, storage tanks and the like. The two solvent types most commonly used in Canada are synthetic solvents (eg. perchloroethylene) and petroleum solvents. It has been estimated that perchloroethylene accounts for about 75% of the dry cleaning solvent use (CCME, 1990).

VOC emissions from dry cleaning operations were estimated by Environment Canada to be 14 kilotonnes in 1985 and are expected to increase to 15.5 kilotonnes by 2005, assuming no change to current control and operating practices.

The CCME developed a  $\text{NO}_x$ /VOC management plan for Canada (CCME, 1990) to control and reduce emissions of these pollutants in the future. Initiative V310 in this plan referred to the development of a CCME environmental code of practice defining emission limits and outlining available control options, good operating practices and equipment maintenance requirements for dry cleaning facilities for implementation in 1995. Initiative V615 referred to the retrofit of existing dry cleaning facilities in the Lower Fraser Valley and Windsor-Quebec City Corridor by 1997. A National Task Force was formed to develop the Code of Practice. The Task Force was chaired and co-ordinated by Environment Canada, while implementation of the Code of Practice is to be done by the provinces.

In addition to the initiatives stipulated in the  $\text{NO}_x$ /VOC management plan, perchloroethylene is included in Group 2 of the Priority Substances List under the Canadian Environmental Protection Act (CEPA). Consequently, this and other chemicals on the PSL are being assessed for environmental and human health impacts to determine whether or not they should be declared toxic under the Act. The assessment of these chemicals is to be completed by 1994.

The contributions of all participants and stakeholders who helped develop this Code are gratefully acknowledged (see list of Task Force and Corresponding Members in Appendix A). The Code was prepared using technical information contained in an associated background study entitled "Background Information for an Environmental Code of Practice for Dry Cleaning Facilities". The Code and the background document (Edwards et al, 1992) were prepared for Environment Canada.

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# Introduction

The purpose of the Code is to provide guidance to environmental regulatory agencies and owners of facilities regarding means of reducing emissions of volatile organic compounds from dry cleaning facilities. The Code is intended to provide a basis for implementing consistent and uniform control measures for sources at dry cleaning facilities across Canada.

The owner/operator of a dry cleaning facility will realize a number of benefits by implementing the Code, in addition to reducing discharges of solvent to the environment. These could potentially include reduced solvent use and waste generation, as well as improved product quality, workplace environment, community relations and overall plant operating performance.

The training requirements of the Code will help in maintaining efficient plant operation and the health and safety of workers.

The Code is divided into two Parts:

**Part 1** Perchloroethylene

**Part 2** Petroleum Solvents



# **PART 1**

## **Perchloroethylene**

### **Section 1.1 Applicability**

The new source provisions in this Code of Practice are intended to apply to all new dry cleaning facilities in Canada. The existing source provisions are intended to apply, as a minimum, to existing dry cleaning facilities in the Lower Fraser Valley of British Columbia and the Windsor-Quebec City corridor. Both new and existing source provisions are subject to any exemptions or conditions specified by the appropriate jurisdiction.

### **Section 1.2 Equipment and Performance Standards for New and Existing Facilities**

#### **1.2.1 New Dry Cleaning Machines:**

**1.2.1.1** New machines in applicable facilities should be fully enclosed refrigerated systems, or equivalent, and operate with a solvent loss not exceeding 20 kg/1000 kg clothes cleaned.

**1.2.1.2** The solvent filter for a new dry cleaning machine at an applicable facility should be a cartridge filter, or a filter having the same, or less, solvent loss, after treatment. The waste cartridges should be processed to reduce the solvent content to less than 5 wt %.

**1.2.1.3** The solvent content of the residues generated by the still at an applicable facility should be reduced to less than 10 wt % prior to disposal.

#### **1.2.2 Existing Dry Cleaning Machines:**

**1.2.2.1** Existing transfer or dry-to-dry (hot) systems in applicable facilities should utilize emission controls for the dryer, still vents, drying cabinets and machine doors capable of an emission reduction of greater than 90 wt %, based on the amount of solvent entering the control device over the control cycle, or a VOC concentration at the outlet of the control device of less than 50 ppm on a dry volumetric basis measured over a period of one minute before dilution. Carbon adsorption is one of the options for emission control.

**1.2.2.2** For existing cartridge filters at an applicable facility, the solvent content in the waste cartridge should be reduced to less than 10 wt % in the cartridge housing or by an equivalent process whereby the solvent is recovered for use.

**1.2.2.3** For existing regenerative filters at an applicable facility, the solvent content of the filter muck should be reduced to less than 20 wt %.

**1.2.2.4** The solvent content of the residues generated by the still at an applicable facility should be reduced to less than 10 wt % prior to disposal.

**1.2.2.5** The solvent loss from an applicable facility is recommended to be less than 50 kg/1000 kg clothes cleaned for a transfer system with controls, less than 35 kg/1000 kg clothes cleaned for a dry-to-dry system with controls and less than 20 kg/1000 kg clothes cleaned for a fully enclosed refrigerated system.

**1.2.2.6** The efficiency of the emission control device should be measured according to provincial test methods; a reference method is U.S. Environmental Protection Agency Method 18. Records of the results of these tests are to be maintained.

## **Section 1.3 Installation Practices**

**1.3.1** Dry cleaning equipment should be installed in accordance with appropriate provincial and local government regulations. Guidelines for installation are included in Appendix B.1.

## **Section 1.4 Operating Practices**

**1.4.1** As a minimum, all equipment should be operated in accordance with manufacturer's recommendations and the requirements in this section.

### **1.4.2 Washers and Dryers:**

**1.4.2.1** Transfer-type dry cleaning systems emit solvent during the transfer of clothes from the washer to the dryer. The following operating procedures will minimize this fugitive emission:

- Δ Minimize the time that solvent-laden clothes are exposed to the atmosphere and vapour losses can occur through the washer and dryer doors: typically 1 to 2 minutes. This can be aided by appropriate relative positioning of the two units and training of staff. Reduction of fugitive emissions from this source will reduce the exposure of workers to elevated solvent concentrations. Operators should consult with provincial agencies responsible for occupational health and safety for guidance and information on regulations in this regard.
- Δ Whenever possible, avoid temporary storage of solvent-laden clothes open to the atmosphere. If this cannot be avoided, store solvent-laden clothes in a cabinet ventilated to a control device, or in a sealed enclosure.
- Δ Install exhaust ventilation pickups or a through-door exhaust ventilation interlock and a control device so that fugitive vapours are drawn away from the work area and recovered. Guidance for the face velocity of ventilation air and positioning of pickups are available (IFI, 1987a) and should be consulted. Manufacturers can provide controls and equipment for drawing air in through the dryer door. Suction ventilation has a small area of influence and such limitations must be considered when positioning machines and pickups. A face velocity of greater than 30.5 metres/minute through the washer and dryer door is recommended.

**1.4.2.2** Since fully enclosed units do not vent to the atmosphere, they do not normally include through-door ventilation to capture fugitive emissions when machine doors are opened. A separate ventilation pickup can be added to reduce worker exposure and, if ducted to a control device, recover solvent.

**1.4.2.3** The washer should not be overloaded or substantially underloaded, since it will operate most effectively when operated within its design range. The International Fabricare Institute has published recommended load factors. Ensure that the washer is operating properly and the manufacturer's instructions are followed in its extraction phase so that the maximum recovery of solvent is achieved. Poor extraction will place additional load on the dryer.

**1.4.2.4** Proper operation and maintenance of the dryer is imperative if maximum solvent recovery is to be achieved. An important operating parameter is the condenser temperature which, for a water-cooled unit, is typically 29°C to 32°C and, for a refrigerated unit, is typically 13°C to 16°C. If the condenser temperature is too low, the heating unit may not be able to reheat the air to the optimum temperature for efficient solvent removal from the clothes. The temperature of air leaving the clothes should typically be 57°C to 63°C for a regular cycle and 49°C for a fragile load. Sufficient time must be allowed to achieve efficient solvent recovery. Tests by the International Fabricare Institute (1988) indicate solvent recovery from a normal load typically reaches a maximum after drying for 25 minutes (including 5 minute aeration) and declines quickly with shorter times. A 20 minute drying time is used for most modern dryers because longer times are not economically attractive. Automatic control of the end of the cycle and initiation of the aeration cycle is common, and can be effective as long as essentially all of the solvent has been recovered. Drying time should be extended if the drying temperature has been reduced.

Perchloroethylene losses to the air can occur because of incomplete drying of clothes, causing high residual levels. There is a potential for this to occur with enclosed and dry-to-dry systems when operators shorten the drying cycle to increase productivity (IFI, 1987a). It is very important to use adequate drying times for bulky articles such as sleeping bags, shoulder pads and the like.

**1.4.2.5** The solvent recovery efficiency of the dryer should be measured at least twice per year (IFI, 1991), or as frequently as needed to achieve reliable performance. Tests should be done in cold and hot weather. The test should be done using the method specified in Appendix C.

If the reclamation efficiency of the dryer is less than 95%, the equipment should be checked and repaired within a reasonable length of time (IFI, 1991). Retest the dryer after repairs have been made.

### **1.4.3 Filters:**

**1.4.3.1** Cartridge filters are the most widely used means of filtering perchloroethylene in the dry cleaning industry. Recommended practices for achieving maximum cartridge life and reducing solvent loss are:

- Δ Install a lint filter upstream of the filter unit to prevent blinding of the filter.
- Δ Consider use of a pump that maintains an adequate flow rate at a pressure no higher than 280 kPa.
- Δ Change cartridges when either the weight of the clothes cleaned or the back-pressure reading exceeds the recommended value.
- Δ Prevent passage of air to the filter by avoiding low solvent levels and by bleeding air from the housing after changing cartridges.
- Δ Avoid excess moisture (relative humidity) in the solvent.
- Δ Shut pump off when machine is not in use.
- Δ Add detergent and sizings into the wheel and mix with solvent before circulating through the filter, or add them into the button trap only when solvent is circulating through it.
- Δ Keep the filter housing full of solvent overnight.

**1.4.3.2** For regenerative filters, follow the manufacturer's recommendations regarding the filter regeneration frequency and filter powder requirements. Monitor filter powder use as an indicator of waste generation rate.

**1.4.3.3** Begin cleaning heavily soiled clothes in a batch run, bypassing the filter, and drop the solvent directly to the still. Continue cleaning using normal operating practice.

**1.4.3.4** Avoid exposure of solvent-laden filter media to the air. If cartridges are drained outside of the filter housing, then do so in a sealed container. Filter muck should be kept in a sealed container while awaiting disposal.

#### **1.4.4 Stills:**

**1.4.4.1** The vent from the water separator on the still may emit solvent vapours and should be connected to a control device to reduce solvent emissions, or piped so that it is submerged into a container of water to create a vapour seal.

**1.4.4.2** To achieve optimum still performance and minimum solvent content in the still bottoms, the still must be operated according to manufacturer's instructions. Recommended practices to reduce environmental discharges and improve still performance are:

- △ Never exceed 75% of the still kettle capacity, or the level recommended by the manufacturer.
- △ Use steam at the pressures recommended by the manufacturer.
- △ Ensure that the condenser is at the operating temperature when beginning distillation. Incoming water should be 10°C to 15°C and outgoing water should be thermostatically controlled at 21°C to 38°C (IFI, 1990). The cooling water should not exit at less than 18°C to prevent premature condensation.
- △ Condenser water flow should be countercurrent to solvent vapour flow.
- △ Keep the solvent return temperature to 32°C or less to minimize evaporative loss through the solvent storage tank vent.

**1.4.4.3** The solvent content in the still bottoms varies depending on the techniques used to recover this solvent at the end of the normal distillation process. Proven and alternate techniques that can be used to minimize the solvent content of still bottoms include:

##### **Common practices :**

- △ Steam sweeping above the residues in the still at the end of the distillation process. This reduces the solvent content to about 5 wt %.
- △ Air sweeping with high-pressure air (250 kPa gauge) above the still bottoms. This is slower, but yields similar results to steam sweeping. The vented air should go to a control device.

##### **Alternate practices for experienced operators:**

- △ Steam sparging directly into the residue while the heating coils are on. The injection rate must be regulated to avoid violent boiling and foaming problems. Drain residues while still warm.

- Δ Allow still to cool to below 85°C after normal distillation, add water to the residues (equal volume), distill with steam at 170 to 240 kPa gauge until water flow from separator stops, cool for 10 to 15 minutes, add water to the residues (equal to 50% volume) and continue boil down as before. The solvent content can be reduced to 1 wt % in still bottoms and filter muck. This technique should be used with care to avoid problems with foaming and violent boiling.
- Δ For older units not incorporating steam sweep/injection or air sweep capabilities, some modifications may be possible to achieve improved solvent recovery.

**1.4.4.4** Minimize the time the still bottoms or filter muck are exposed to the atmosphere and store them in sealed containers that have been properly labelled in accordance with WHMIS and the Transportation of Dangerous Goods regulations.

**1.4.4.5** Have the solvent content of still residues determined regularly to monitor the solvent loss and the performance of the still. A very approximate method has been determined by the International Fabricare Institute (1991) which relates perchloroethylene content to residue density at room temperature. Assuming a solvent-free residue density of 0.9 kg/L and a solvent density in still residues of 13.75 kg/L, the International Fabricare Institute estimates the perchloroethylene content for a range of residue densities at room temperature as follows:

<b>Residue Density (kg/L)</b>	<b>Approximate wt% Perchloroethylene in Residue</b>
0.93	6
0.96	13
0.99	20
1.02	26
1.05	34
1.08	37
1.17	52
1.26	65

These could be plotted on a graph for ease of use. The actual perchloroethylene content of residues may differ from these values depending on the physical characteristics of the still residues.

#### **1.4.5 Muck Cookers:**

**1.4.5.1** The same techniques described for improving solvent recovery from still bottoms can be applied in muck cookers or cooker/still combinations. After normal distillation, using the agitator in the cooker to keep the residue stirred, a steam sweep, air sweep or water addition technique can be used to achieve additional solvent recovery. The solvent content of the muck without these techniques may range from 25 wt % to 50 wt %.

**1.4.5.2** Tests with water addition done by the International Fabricare Institute (1987b) demonstrated that the solvent content of filter muck could be reduced to 2.9 wt % by the following steps:

- Distill and cook as usual.
- Cool cooker to below 85°C.
- Add 2 L of water.
- Resume boil-down with steam at 140 to 240 kPa (gauge) until flow from the separator stops.
- One water addition is usually sufficient.

This technique should only be used by experienced operators exercising care to avoid problems with foaming and violent boiling.

#### **1.4.6 Carbon Adsorbers:**

**1.4.6.1** A filter is needed on the air stream flowing to the carbon bed to remove dust and lint. Otherwise, the dust and lint would gradually build up and plug the bed. Clean the inlet air filter daily to maintain air flow through the adsorber.

**1.4.6.2** The following practices are recommended to maintain efficient adsorber operation and to minimize solvent loss:

- Δ Desorb the carbon bed regularly to recover solvent and ensure that breakthrough of solvent flow to the exhaust stack does not occur, resulting in high emissions and solvent loss. It is better to desorb the bed early than to lose solvent by desorbing too late.
- Δ Desorb the carbon adsorber according to manufacturer's instructions.
- Δ Determine when to desorb the carbon bed by tracking the weight of clothes cleaned or number of loads dried. Determine the quantity of clothes which can be dried per adsorber cycle every three months. In these tests calculate the quantity of clothes which can be cleaned without perchloroethylene being discharged in the exhaust stack. Monitor the exhaust stack through a small hole in the exhaust vent using a colorimetric detector tube, an ionization detector, or equivalent sensor.
- Δ Monitor the inlet air flow to detect any plugging of the bed.
- Δ Dry the bed fully at the end of the desorption cycle, as recommended by the manufacturer, to restore the full adsorption capacity of the carbon bed and to preclude water subsequently reacting in the bed, forming acids that will corrode the adsorber vessel.
- Δ Use only dry cleaning products approved for perchloroethylene systems and prevent entry of petroleum solvents into the system to avoid degrading the adsorption capacity of the carbon bed.
- Δ Replace the carbon bed according to the manufacturer's recommendations.
- Δ Do not operate the dry cleaning machine unless the dryer exhaust is directed to an active adsorber.

- Δ Inspect the physical condition of the hardware inside the adsorber above the bed at intervals suggested by the manufacturer to ensure it is functioning properly.

#### **1.4.7 Water Separators:**

**1.4.7.1** It is very important that the solvent/water mixture has been separated properly. To avoid operating problems, inspect and clean the water separator regularly on a continuing basis. As a precaution against accidental discharge of solvent to the sewer from a malfunctioning or ineffective separator, wastewater should be piped from the separator to a transparent container where it can be checked for droplets of solvent before disposal. Allow the liquid collected in the container to stand overnight, then dispose of the water in accordance with local sewer use bylaws and return perchloroethylene to the separator. Recurring overflow of perchloroethylene from the separator indicates that the unit needs to be cleaned and, possibly, repaired. The concentration of perchloroethylene in wastewater may be increased by the presence of co-solvents, so their use should be minimized.

**1.4.7.2** Water separators must be kept clean and must be primed properly to be effective.

**1.4.7.3** The concentration of perchloroethylene in wastewater from the separator can be reduced below the level possible with gravity separation by using steam stripping or carbon adsorption technology. Steam strippers are capable of reducing non-miscible organics in the water to less than 1 ppm. Carbon adsorption is capable of reducing the perchloroethylene concentration in wastewater to low parts per billion levels.

### **Section 1.5 Maintenance**

**1.5.1** As a minimum, equipment should be maintained in accordance with manufacturer's recommendations and the requirements in this section. Owners and operators should be particularly attentive to maintenance practices that reduce solvent loss.

**1.5.2** The plant owner/operator is responsible for ensuring that the dry cleaning equipment is maintained leak-free and vapour-tight. Leaks shall be considered as those evident by visual inspection or that bubble after application of a soap solution. Liquid and vapour leaks should be repaired promptly following their discovery.

#### **1.5.3 Washers and Dryers:**

**1.5.3.1** Poor reclamation efficiency may be caused by the following maintenance problems (IFI, 1988):

- dirty lint trap
- clogged condenser or heating coils
- leaks at door gaskets
- leaky inlet and exhaust damper
- clogged solvent drain from separator
- clogged air vent in separator
- fan not operating properly (eg. reversed polarity)
- lint on fan blades.

#### **1.5.4 Filters:**

- Δ Replace felt seals on cartridge filters after three changes, or if damaged.

### **1.5.5 Stills:**

- Δ Keep the steam coils clean of scale and hardened residues. Clean the coils after use to prevent residue buildup.
- Δ Keep the condenser coils clean of dirt and lint to avoid corrosion problems and condenser malfunction.
- Δ Follow the manufacturer's instructions for cleaning and maintaining the still. This will ensure that the steam heating coils and condenser are operating effectively.

### **1.5.6 Muck Cookers:**

- Δ The cooker must be maintained according to manufacturer's instructions. The recommended operating practices for stills also apply to cookers.

### **1.5.7 Carbon Adsorbers:**

- Δ Monitor the condition of the condenser coil and repair it as appropriate.
- Δ Monitor the condition of dampers and gaskets and repair or replace if malfunctioning or damaged.

### **1.5.8 Refrigeration Systems:**

- Δ These systems need to be kept in good working order to ensure efficient solvent recovery in the condenser. Manufacturer's service instructions should be followed to ensure that the refrigeration unit is operating properly and to avoid leakage of the refrigerant.

### **1.5.9 Water Separators:**

- Δ To avoid operating problems, inspect and clean the water separator regularly. Recurring overflow of perchloroethylene from the separator may indicate that the unit needs to be repaired.

### **1.5.10 General Maintenance Requirements:**

**1.5.10.1** Fugitive emissions result from liquid and vapour leaks, and are strongly influenced by maintenance practices. Liquid and vapour leaks can essentially be stopped by repair or replacement of the equipment or gasket material from which they occur. Slight fugitive solvent losses will occur from even the most well maintained system because of slight imperfections in the sealing surfaces of joints and fittings, and from various vents and door openings that are impractical or too small to control.

**1.5.10.2** Liquid Leaks: Liquid leaks are visible and should be found as part of a regular visual inspection of all areas where leaks may occur. The machine must be kept relatively clean to ensure that the leaks are apparent to the eye.



**Sources:**

- hose connections, unions, couplings and valves
- machine door gasket and seating
- filter head gasket and seating
- pumps
- base tanks and storage container
- water separators (lost in water due to poor separation)
- filter sludge recovery
- distillation unit
- diverter valves
- saturated lint in lint basket
- cartridge filters
- spills

**1.5.10.3 Vapour Leaks:** Routine inspection and replacement of failed or failing gaskets on doors (washer, button trap, cooker, recovery tumbler, lint trap, etc.) should be completed. Gaskets that are worn, cracked or hard allow unnecessary escape of vapours.

**Sources:**

- deodorizing and aeration valves on dryer (poor sealing or failure)
- air and exhaust ductwork
- doors left open
- button trap and lint basket openings
- process vents to atmosphere (eg. still, separator)
- spills

Ductwork, joints, pickups and dampers can result in solvent vapour leaks. The following maintenance items should be addressed:

- Δ The ductwork should be free of holes and firmly supported at regular intervals.
- Δ Duct joints should be screwed/riveted and taped.
- Δ When a carbon adsorber is installed and receives vapours from the dryer and room-air pickups, butterfly dampers should be used in the ducts to the room-air pickups to prevent reverse flow when the dryer is deodorizing. The butterfly dampers should be kept clean and in good mechanical condition to avoid reverse flow of solvent vapour to the room.

The inlet and exhaust dampers on a reclaiming dryer and dry-to-dry machine must be inspected and cleaned regularly to ensure efficient solvent recovery. If the exhaust damper is malfunctioning or does not seat tightly, solvent will escape from the reclaimer during the solvent recovery cycle and overload the emission control equipment. If a carbon adsorber is being used, this condition could saturate the adsorber prematurely, causing unexpected loss of solvent during the deodorizing cycle and for subsequent dry cleaning loads. This may easily go unnoticed. Solvent will be vented into the plant from an unseated air inlet damper during the recovery cycle.

Inlet and exhaust dampers should be cleaned and lubricated monthly. Check for damper leakage by disconnecting ducting and using a perchloroethylene detector at the point of exhaust.

The tumbler can also be a source of vapour leaks as a result of loose fittings and attachments. Check for leaks from the tumbler using a soap solution or a smoke pencil while operating the dryer in the recovery cycle.

**1.5.10.4** Table 1 provides guidance for schedules of maintenance for dry cleaning equipment which has been developed partly from recommendations of the International Fabricare Institute (1984).

## **Section 1.6 Solid Waste Handling and Disposal**

**1.6.1** The storage and disposal of solid wastes, such as used filter cartridges, filter muck, still bottoms and empty solvent containers, must be conducted in a safe and effective manner. Solid wastes should be stored in sealed containers that have been labelled in accordance with the Transportation of Dangerous Goods regulations and WHMIS regulations (federal and provincial). The wastes should be disposed of in accordance with applicable federal, provincial and local waste management legislation.

**1.6.2** Offer empty solvent containers to qualified reconditioners, or crush and dispose of the containers in accordance with applicable federal, provincial and local waste management legislation.

**1.6.3** Under most provincial regulations, used filter cartridges, filter muck and still bottoms are classified as hazardous wastes and must be disposed of by approved means.

**1.6.4** Assistance with finding those who can make use of waste materials can be obtained through the Canadian Waste Materials Exchange, 2395 Speakman Drive, Mississauga, Ontario, L5K 1B3. Most provinces also operate waste exchange programs and should be contacted for assistance.

## **Section 1.7 Solvent Handling and Storage**

**1.7.1** Solvents should not be stored or transferred in open or leaking containers.

**1.7.2** Reclaimed solvent from dryers, stills, muck cookers and vapour recovery units should be piped directly to the solvent storage tank.

**1.7.3** When delivered, solvent should be piped directly to the solvent storage tank, or, if this is not practical, transferred in a dedicated, properly labelled and sealed container.

**1.7.4** If a solvent spill should occur:

- △ Immediately leave the area to put on NIOSH-approved respiratory protection.
- △ Clean up the spill promptly, preferably with rags or old sleeping bags from which the solvent can subsequently be recovered.
- △ Provide all possible ventilation such as fans, open doors and windows.
- △ Have an observer present while you clean up the spill.

Exposure to solvent vapours in high concentrations can be harmful to human health and could even cause death.

A solvent spill should be reported in accordance with applicable federal, provincial and local regulations.

## **Section 1.8 Recordkeeping**

**1.8.1** The owner or operator should maintain the information described in this section for the current year and previous two years, and make such information available for review upon request by authorized representatives of regulatory agencies.

**1.8.2** Records should be kept monthly of the solvent purchases and inventory, the pre-washed weight of clothes cleaned and the calculated solvent loss at the plant. The solvent loss is to be calculated as:

$$\text{solvent loss} = \frac{\text{kg solvent consumed}}{1000 \text{ kg of clothes cleaned}}$$

**1.8.3** A record should be kept of the date and results of all tests conducted for verification of compliance with Performance Standards described in Section 1.2.

**1.8.4** A record should be kept of the date of replacement of the carbon adsorber bed, and of the quantity replaced.

**1.8.5** A record should be kept of the dates and quantities of wastes disposed of by the facility.

## **Section 1.9 Training**

**1.9.1** Before operating dry cleaning equipment, operating personnel should receive training and instructions in the following areas to the extent appropriate to their responsibility:

- safety, health and environmental rules and regulations
- proper handling of solvent and wastes
- rules and regulations regarding storage, handling and disposal of plant wastes
- proper operation and maintenance of equipment
- proper housekeeping of the plant
- procedures for response to spills or other emergencies
- use of protective and monitoring equipment
- benefits of following this Code of Practice.

Suggested sources of additional information are:

- provincial and federal environmental regulatory agencies
- provincial occupational health and safety agencies
- Dry Cleaners and Launderers Institute
- provincial fabricare associations
- solvent suppliers
- International Fabricare Institute of Silver Spring, Maryland.

Membership in an industry association may be beneficial for obtaining current environmental information relevant to drycleaning.

# TABLE 1 SUGGESTED MAINTENANCE SCHEDULE FOR PERC DRY CLEANING EQUIPMENT

## Water Separator

Daily  
Weekly  
Monthly

- Check discharge water for presence of solvent
- Clean
- Check vents are clear

## Pumps

Daily  
Every 3 months

- Clean lint strainer if so equipped
- Check gaskets for leaks

## Transfer Units

Daily  
Every 3 months  
  
Every 6 months  
  
Every 3 years

- Clean button traps and all lint strainers
- Check operation of exhaust damper if so equipped
- Check V-belt tension
- Check shaft and bearing seals for leaks
- Check solvent line heat exchanger for leaks
- Replace loading door and lint trap gaskets

## Dry-to-Dry Units Hot & Fully Enclosed

Daily  
Monthly  
Every 3 months  
Every 6 Months  
  
Yearly  
Every 3 years

- Clean button traps and all lint strainers
- Check and clean condensing coils
- Check operation of exhaust damper if so equipped
- Check shaft and bearing seals for leaks
- Check solvent line heat exchanger for leaks
- Replace lint filter
- Replace loading door, lint trap and coil cover gaskets

## Recovery Tumbler

Daily  
Weekly  
Monthly  
Every 3 months  
  
Yearly  
Every 3 years

- Clean lint filter
- Clean lint out of all parts of tumbler
- Check and clean condensing coils
- Check all gaskets for leakage
- Check dampers for leakage
- Replace lint filter
- Replace all damper, loading door and cleanout door gaskets

## Carbon Adsorber

Weekly  
  
  
Every 2 years  
  
Every 5 years  
Every 8 years

- Clean lint filter
- Monitor exhaust for perchloroethylene
- Clean floor pick-up screens
- Remove top and bottom plates and check damper operation
- Check condition of activated carbon
- Disassemble and check condenser column

## Stills

Monthly  
Every 6 months

- Check all gaskets and seals for leaks
- Clean heating coils and/or steam chests
- Check condensing coil for leaks
- Check water drain catch basins for presence of perchloroethylene

## Muck Cookers

Monthly  
  
  
Every 6 months

- Check all gaskets and seals for leaks
- Clean heating coils and/or steam chests
- Check condensing coil for leaks
- Check water drain catch basins for presence of perchloroethylene

## Cartridge Filters

Monthly

- Check all gaskets and seals for leaks

# **PART 2**

## **Petroleum Solvents**

### **Section 2.1 Applicability**

The new source provisions in this Code of Practice are intended to apply to all new dry cleaning facilities in Canada. The existing source provisions are intended to apply, as a minimum, to existing dry cleaning facilities in the Lower Fraser Valley of British Columbia and the Windsor-Quebec City corridor. Both new and existing source provisions are subject to any exemptions or conditions specified by the appropriate jurisdiction.

### **Section 2.2 Equipment and Performance Standards for New and Existing Facilities**

**2.2.1** New or replaced petroleum solvent dryers in an applicable facility should be a solvent recovery dryer.

**2.2.2** The petroleum solvent filter in an applicable facility should be a cartridge filter. Cartridge filters should be drained in the sealed filter housing for at least 12 hours prior to their removal.

**2.2.3** The solvent content of the residues generated by the still at an applicable facility should be reduced to 40 wt %, or less, prior to disposal.

**2.2.4** The overall loss of petroleum solvent from all sources at the applicable facility should be less than 65 kg/1000 kg clothes cleaned.

### **Section 2.3 Installation Practices**

**2.3.1** Dry cleaning equipment should be installed in accordance with appropriate provincial and local government regulations. Guidelines for installation are included in Appendix B.2.

### **Section 2.4 Operating Practices**

**2.4.1** As a minimum, all dry cleaning equipment should be operated in accordance with the manufacturer's recommendations and the requirements in this section.

#### **2.4.2 Washers and Dryers:**

**2.4.2.1** The operation of recovery dryers should be in accordance with the manufacturer's specifications. Of particular importance are steam pressure, condenser water inlet flow rate and temperature, tumbler drying temperature and tumbler load weight.

**2.4.2.2** Solvent recovery per dry weight of clothes cleaned is highest when the temperature decrease of the condenser vapour stream is at its maximum. The optimum operating condition can be indicated by the temperature difference between the condenser cooling water inlet and outlet. Generally the difference should not exceed about 15°C during the recovery cycle.

**2.4.2.3** The flow rate of recovered solvent at the end of each recovery cycle should be no greater than 0.05 litres per minute. At values below this level, additional recovery cycle time will produce only minimal increases in the volume of recovered solvent.

**2.4.2.4** Petroleum solvent losses to the air can occur because of incomplete drying of clothes, causing high residual levels. It is very important to use adequate drying times for bulky articles such as sleeping bags, shoulder pads and the like.

**2.4.2.5** The following practices will minimize fugitive emissions:

- Δ Minimize the time that solvent-laden clothes are exposed to the atmosphere and vapour losses can occur through the washer and dryer doors: typically 1 to 2 minutes. Position the washer and dryer to ease the transfer.
- Δ Do not temporarily store solvent-laden clothes open to the atmosphere. If they must be stored, place solvent-laden clothes in a cabinet ventilated to a control device.

**2.4.2.6** The solvent recovery efficiency of the dryer should be measured at least twice per year, or as frequently as needed to achieve reliable performance. Tests should be done in cold and hot weather. The test should be done using the method specified in Appendix C.

If the reclamation efficiency of the dryer is less than 70%, the equipment should be checked and repaired within a reasonable length of time. Retest the dryer after repairs have been made.

#### **2.4.3 Filters:**

- Δ The solvent in a filter cartridge can be reduced to acceptable levels by draining the cartridge in the filter housing for 12 hours or more.

#### **2.4.4 Water Separators:**

- Δ It is very important that the solvent/water mixture has been separated properly. To avoid operating problems, inspect and clean the water separator regularly on a continuing basis. As a precaution against accidental discharge of solvent to the sewer from a malfunctioning or ineffective separator, wastewater should be piped from the separator to a transparent container where it can be checked for solvent before disposal. Allow the liquid collected in the container to stand overnight, then dispose of the water in accordance with local sewer use bylaws and return petroleum solvent to the separator. Recurring overflow of petroleum solvent from the separator indicates that the unit needs to be cleaned and, possibly, repaired.

## **Section 2.5 Maintenance**

**2.5.1** As a minimum, equipment should be maintained in accordance with manufacturer's recommendations and the requirements in this section. Owners and operators should be particularly attentive to maintenance practices that reduce solvent loss.

**2.5.2** The plant owner/operator is responsible for ensuring that the dry cleaning plant is maintained leak-free and vapour-tight. Leaks shall be considered as those evident by visual inspection or that bubble after application of a soap solution.

**2.5.3** Poor reclamation efficiency and higher solvent losses may be caused by the following maintenance problems:

- dirty lint trap
- clogged condenser or heating coils
- leaks at door gaskets

- leaky inlet and exhaust dampers
- clogged solvent drain from separator
- fan not operating properly (eg. reversed polarity)
- lint on fan blades.

## **2.5.4 General Maintenance Requirements:**

**2.5.4.1** Fugitive emissions result from leaks of solvent liquid and vapour from piping, machine doors, various gasketed joints and petroleum solvent tankage. These emissions are strongly influenced by maintenance practices and can be kept to a minimum by eliminating leaks.

**2.5.4.2** Liquid Leaks: Liquid leaks are visible and should be found as part of a regular visual inspection of all areas where leaks may occur. The machine must be kept relatively clean to ensure that the leaks are apparent to the eye.

### **Sources:**

- hose connections, unions, couplings and valves
- machine door gasket and seating
- filter head gasket and seating
- pumps
- base tanks and storage containers
- water separators (lost in water due to poor separation)
- filter sludge recovery
- distillation unit
- diverter valves
- saturated lint in lint basket
- cartridge filters
- spills

**2.5.4.3** Vapour Leaks: Routine inspection and replacement of failed or failing gaskets on doors (washer, button trap, recovery tumbler, lint trap, etc.) should be undertaken. A gasket should be replaced if it is worn, cracked or hardened.

### **Sources:**

- aeration valves on reclaiming
- air and exhaust ductwork
- doors left open
- button trap and lint basket openings
- process vents to atmosphere (eg. still, separators)
- spills

Ductwork, joints, pickups and dampers can leak solvent vapours. To reduce or avoid these leaks:

- Δ The ductwork should be free of holes and firmly supported at regular intervals.
- Δ Duct joints should be leak-tight.
- Δ Ductwork, dampers and condensers should be kept free of lint to maintain proper air flows and pressures and reduce the risk of fire.

The inlet and exhaust dampers on a reclaiming dryer must be inspected and cleaned regularly to ensure efficient solvent recovery. If the exhaust damper is malfunctioning or does not

seat tightly, solvent vapours can escape from the reclaimer during the recovery cycle and be exhausted to the air. This may easily go unnoticed. Solvent will be vented into the plant from an unseated air inlet damper during the recovery cycle. These dampers should be cleaned and lubricated monthly.

The dryer may be a source of vapour leaks as a result of loose fittings and attachments. Check for leaks from the tumbler using a soap solution or a smoke pencil while operating the dryer in the recovery cycle.

**2.5.4.4** All openings where solvent could be exposed to the atmosphere should be kept closed at all times except where required for proper operation or maintenance. This applies to doors, inspection and cleanout doors, etc. The machine should not be operated if significant leaks of solvent liquid or vapour are present.

**2.5.4.5** A plan for maintenance of the equipment should be prepared based on the recommendations of equipment manufacturers. Such a plan will reduce emissions and lengthen the operating life of plant equipment.

Regular inspection of pumps, storage and settling tanks, water separators and the general solvent piping system could result in substantial reduction in solvent emissions through the control of liquid and vapour leaks. A suggested schedule for maintenance is illustrated in Table 2.

## **Section 2.6 Solid Waste Handling and Disposal**

**2.6.1** The storage and disposal of solid wastes, such as used filter cartridges, filter muck, still bottoms and empty solvent containers, must be conducted in a safe and effective manner. Solid wastes should be stored in sealed containers that have been labelled in accordance with the Transportation of Dangerous Goods regulations and WHMIS regulations (federal and provincial). The wastes should be disposed of in accordance with applicable federal, provincial and local waste management legislation.

**2.6.2** Offer empty solvent containers to qualified reconditioners, or crush and dispose of the containers in accordance with applicable federal, provincial and local waste management legislation.

**2.6.3** Under most provincial regulations, used filter cartridges, filter muck and still bottoms are classified as hazardous wastes and must be disposed of by approved means.

**2.6.4** Assistance with finding those who can make use of waste materials can be obtained through the Canadian Waste Materials Exchange, 2395 Speakman Drive, Mississauga, Ontario, L5K 1B3. Most provinces also operate waste exchange programs and should be contacted for assistance.

## **Section 2.7 Solvent Handling and Storage**

**2.7.1** Solvents should not be stored or transferred in open or leaking containers.

**2.7.2** Reclaimed solvent from dryers and stills should be piped directly to the solvent storage tank.

**2.7.3** When delivered, solvent should be piped directly to the solvent storage tank, or, if this is not practical, transferred in a dedicated, properly labelled and sealed container.



**TABLE 2****SUGGESTED MAINTENANCE SCHEDULE FOR  
PETROLEUM DRY CLEANING EQUIPMENT****Tumblers**

Daily

Weekly

Monthly

Every 3 months

Yearly

Every 3 years

- Check lint filter
- Check condenser and stack temperatures
- Clean air filter
- Clean lint out of all parts of tumbler
- Check and clean condensing coils
- Check gaskets for leakage
- Check dampers for leakage
- Replace lint filter
- Replace loading door and cleanout door gaskets

**Washer/Extractor Unit**

Daily

Monthly

Every 3 months

Every 6 months

- Clean button traps and all lint strainers
- Check all safety devices to insure proper operation
- Check V-belt tension
- Check shaft and bearing seals for leaks
- Check all gaskets for leaks
- Check solvent line heat exchanger for leaks

**Still**

Daily

Weekly

Monthly

Every 6 months

- Check rag filter - change rags if necessary
- Check grease on pick-up body
- Check packing gland on vacuum pump shaft
- Check all gaskets and seals for leaks
- Check and clean condenser
- Check float and needle valve assembly
- Clean strainer on solvent line
- Clean heating coils and/or steam chests
- Check water drain catch basins for presence of solvent

**Pumps**

Daily

Every 3 months

- Clean lint strainer if so equipped
- Check gaskets for leaks

**Water Separator**

Daily

Weekly

Monthly

- Check discharge water for presence of solvent
- Clean
- Check to see if vents are clear

**Cartridge Filters**

Monthly

- Check all gaskets and seals for leaks

#### **2.7.4 If a solvent spill should occur:**

- Δ Immediately leave the area to put on NIOSH-approved respiratory protection.
- Δ Clean up the spill promptly, preferably with rags or old sleeping bags from which the solvent can subsequently be recovered.
- Δ Provide all possible ventilation such as fans, open doors and windows.
- Δ Have an observer present while you clean up the spill.

Exposure to solvent vapours in high concentrations can be harmful to human health and could even cause death.

A solvent spill should be reported in accordance with applicable federal, provincial and local regulations.

### **Section 2.8 Recordkeeping**

**2.8.1** The owner or operator should maintain the information described in this section for the current year and previous two years, and make such information available for review upon request by authorized representatives of regulatory agencies.

**2.8.2** Records should be kept monthly of the solvent purchases and inventory, the pre-washed weight of clothes cleaned and the calculated solvent loss at the plant. The solvent loss is to be calculated as:

$$\text{solvent loss} = \frac{\text{kg solvent consumed}}{1000 \text{ kg of clothes cleaned}}$$

**2.8.3** A record should be kept of the date and results of all tests conducted for verification of compliance with Performance Standards described in Section 2.2.

**2.8.4** A record should be kept of the dates and quantities of wastes disposed of by the facility.

### **Section 2.9 Training**

**2.9.1** Before operating dry cleaning equipment, operating personnel should receive training and instructions in the following areas to the extent appropriate to their responsibility:

- safety, health and environmental rules and regulations
- proper handling of solvent and wastes
- rules and regulations regarding storage, handling and disposal of plant wastes
- proper operation and maintenance of equipment
- proper housekeeping of the plant
- procedures for response to spills or other emergencies
- use of protective and monitoring equipment
- benefits of following this Code of Practice.

Suggested sources of additional information are:

- provincial and federal environmental regulatory agencies
- provincial occupational health and safety agencies
- Dry Cleaners and Launderers Institute
- provincial fabricare associations
- solvent suppliers
- International Fabricare Institute of Silver Spring, Maryland.

Membership in an industry association may be beneficial for obtaining current environmental information relevant to dry cleaning.

## References

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# Appendix A

## List of Task Force and Corresponding Members

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*Gilles Castonguay	Ontario Ministry of the Environment
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*Marshall Kern	Dow Chemical Canada
*Claude Fréchette	Canadian Launderers & Allied Trades Association
*John Clinton/Ken Murdoch	Canadian Launderers & Allied Trades Association
*Harold Cadloff	Calmek Equipments
*Ellen Schwartzel	Pollution Probe
*Don Wedge	STOP
*Fred Chen	Environment Canada
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Dalex Co. Ltd.  
Safety-Kleen Canada Inc.  
Federation of Canadian Municipalities  
STOP  
Windsor & District Labour Council  
Canadian Environmental Network  
Stanchem Inc.  
Radian Corporation of Canada Ltd.  
Unisearch Associates Inc.  
Sypher:Mueller International Inc.

\* Members present at the Task Force consultation meeting held in October, 1991.

## **Appendix B**

### **Installation Practices for Dry Cleaning Equipment**

#### **B.1 Perchloroethylene**

**B.1.1** Before beginning any construction or development of, alteration to, or installation in, a building or structure that is, or will be used as, a dry cleaning facility, the owner should file the necessary drawings and specifications with the appropriate provincial and local government regulatory agencies for review and approval.

**B.1.2** Installation of a dry cleaning facility in a building occupied in part as a dwelling should be prohibited, except upon the submission of a report by the prospective owner that states that the facility is located or constructed, or both, in a manner that will not create a potential health hazard or nuisance for the building occupants, or the public.

**B.1.3** All buildings in which dry cleaning machinery is installed should be structures with concrete floors in good condition.

**B.1.4** Dry cleaning machinery should not be installed in a basement or other location which is difficult to ventilate, unless design features are used so that the installation will not create a potential health hazard or nuisance for the building occupants, or the public.

**B.1.5** A dry cleaning facility with adjacent occupancies within the same building or in other adjoining buildings should be provided with an effective vapour seal to prevent infiltration of dry cleaning solvent vapours into the adjacent occupancies of buildings. Porous walls, partitions and roof-to-partition wall areas should be effectively sealed.

**B.1.6** The dry cleaning machinery exhaust ducts and deodorizing vents should be adequately sized. The joints of the ducts should be effectively sealed to prevent any fugitive solvent vapour emissions into the building spaces.

**B.1.7** The dry cleaning machinery exhaust should be ducted to a sufficient height that will prevent re-entry of solvent-contaminated air into the dry cleaning facility, or any other neighbouring building. For a typical single-storey dry cleaning facility, a recommended stack design practice is to duct the exhaust to a point not less than 1.5 meters above the roof line, or any adjacent building, whichever is applicable and a minimum of 6 meters away from any return air opening. Consideration should be given to prevailing wind direction. The stack should be leak-tight to prevent vapours from entering the workroom environment and should be equipped with a vertical discharge cap and a closable port to allow emission sampling.

**B.1.8** The air supply and exhaust rates in a dry cleaning facility should be properly balanced to maintain the facility under negative pressure with respect to the adjacent building spaces, preventing any solvent vapour infiltration.

**B.1.9** Guidance for the design of dry cleaning facilities is provided in "NFPA 32 Dry Cleaning Plants 1990 Edition" issued by the National Fire Protection Association and in "ANSI 78.1 - 1990 American National Standard for Commercial Laundry and Dry Cleaning Operations - Safety Requirements".

## **B.2 Petroleum Solvents**

**B.2.1** Before beginning any construction or development of, alteration to, or installation in, a building or structure that is, or will be used as, a dry cleaning facility, the owner should file the necessary drawings and specifications with the appropriate provincial and local government regulatory agencies for review and approval.

**B.2.2** All buildings in which dry cleaning machinery is installed should be structures with concrete floors in good condition.

**B.2.3** The dry cleaning machinery exhaust ducts and deodorizing vents should be adequately sized. The joints of the ducts should be effectively sealed to prevent any fugitive solvent vapour emissions into the building spaces.

**B.2.4** The dry cleaning machinery exhaust should be ducted to a sufficient height that will prevent re-entry of solvent-contaminated air into the dry cleaning facility, or any other neighbouring building. For a typical single-storey dry cleaning facility, a recommended stack design practice is to duct the exhaust to a point not less than 1.5 meters above the roof line, or any adjacent building; whichever is applicable and a minimum of 6 meters away from any return air opening. Consideration should be given to prevailing wind direction. The stack should be leak-tight to prevent vapours from entering the workroom environment and should be equipped with a vertical discharge cap and a closable port to allow emission sampling.

**B.2.5** The air supply and exhaust rates in a dry cleaning facility should be properly balanced to maintain the facility under negative pressure with respect to the adjacent building spaces, preventing any solvent vapour infiltration.

**B.2.6** Guidance for the design of dry cleaning facilities is provided in "NFPA 32 Dry Cleaning Plants 1990 Edition" issued by the National Fire Protection Association and in "ANSI 78.1 - 1990 American National Standard for Commercial Laundry and Dry Cleaning Operations - Safety Requirements".



## Appendix C

### Determination of the Recovery Efficiency of a Reclaiming Dryer

The solvent recovery efficiency of a reclaiming dryer should be measured at least twice per year (IFI, 1991), or as frequently as needed to achieve reliable performance. Tests should be done in cold and hot weather. The test should be done as follows:

- Load washer and run a normal cleaning and extraction cycle.
- Personnel should put on a NIOSH approved respirator.
- Remove clothes from the washer, weigh them as quickly as possible, then place them inside the dryer and close the dryer door.
- Redirect the water and solvent lines from the separator on the dryer to two preweighed buckets (minimize solvent loss by covering the buckets).
- Dry the clothes.
- At end of the drying cycle, weigh the collected water and solvent, as well as the dried clothes.
- Calculate recovery efficiency in percent as,

$$\text{efficiency} = \frac{\text{wt perchloroethylene recovered}}{\text{wt wet} - \text{wt water} - \text{wt dry clothes recovered clothes}} \times 100$$