VOLUME III: CHAPTER 4

DRY CLEANING

Final Report

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DISCLAIMER

As the Environmental Protection Agency has indicated in Emission Inventory Improvement Program (EIIP) documents, the choice of methods to be used to estimate emissions depends on how the estimates will be used and the degree of accuracy required. Methods using site-specific data are preferred over other methods. These documents are non-binding guidance and not rules. EPA, the States, and others retain the discretion to employ or to require other approaches that meet the requirements of the applicable statutory or regulatory requirements in individual circumstances.

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INTRODUCTION

This chapter describes the procedures and recommended approaches for estimating emissions from dry cleaning. Section 2 of this chapter contains a general description of the dry cleaning category and an overview of available control technologies. Section 3 of this chapter provides an overview of available emission estimation methods. Section 4 presents the preferred method for emission estimation for dry cleaning, and Section 5 presents the alternative emission estimation techniques. Quality assurance issues and emission estimate quality indicators for the methods presented in this chapter are discussed in Section 6. Data coding procedures are discussed in Section 7, and Section 8 is the reference section.

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SOURCE CATEGORY DESCRIPTION

The dry cleaning industry is a service industry for the cleaning of garments, draperies, leather goods, and other fabric items. Dry cleaning operations do not use water that can swell textile fibers but typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes. Use of solvents rather than water prevents wrinkles and shrinkage of fabrics. The dry cleaning industry is the most significant emission source of perchloroethylene (PERC) in the United States.

The two major types of dry cleaning operations are coin-operated (coin-op) (Standard Industrial Classification [SIC] Code 7215) and commercial (SIC 7216). Industrial launderers (SIC 7218) are usually associated with soap and detergent cleaning, but also use large-capacity dry cleaning units. Coin-operated dry cleaning units are self-service machines that are usually found in laundromats. Commercial dry cleaners are independent small businesses that offer dry cleaning services to the public. Some commercial dry cleaning businesses provide numerous drop-off/pick-up outlet stores that are serviced by a single dry cleaning plant, and thus some sites identified as dry cleaners may not be emissions sources. Industrial launderers who use dry cleaning solvents are usually part of a business operation that generates soiled fabrics, where it is convenient or cost-effective to perform dry cleaning on site. Industrial launderers can also be large businesses that provide uniform and other rental services to business, industrial, and institutional customers.

The primary synthetic halogenated dry cleaning solvent is PERC; small quantities of 1,1,1-trichloroethane (TCA) and trichlorofluoroethane (CFC-113) are used in specialty cleaning operations. The petroleum solvents most used in dry cleaning are a mixture of paraffins and aromatic hydrocarbons. Stoddard solvent (mineral spirits) is the primary petroleum solvent used in dry cleaning. PERC is used for its aggressive solvent properties, whereas CFC-113 is well suited for cleaning delicate clothing. TCA is a more aggressive solvent than PERC, but may damage some clothing and must be used in stainless steel dry cleaning machines.

Dry cleaning facilities may be point or area sources. Most coin-op and commercial dry cleaners are expected to be area sources. Commercial dry cleaners are responsible for the greatest amount of emissions. Industrial launderers that do dry cleaning are expected to be point sources except for a few facilities. Point source emissions must be subtracted from total emissions to produce an estimate of dry cleaning area source emissions.

2.1 EMISSION SOURCES

Volatile organic solvents that are used as cleaning solvents are emitted during the dry cleaning process. The petroleum solvents most commonly used in dry cleaning are Stoddard solvent (mineral spirits) and 140-F (EPA, 1985). The synthetic solvents that are used in dry cleaning, PERC, TCA, and CFC-113, are not considered photochemically reactive and should not be included in an ozone (volatile organic compound [VOC]) inventory; PERC and TCA, however, are hazardous air pollutants (HAPs) that should be included in an air toxic inventory. TCA and CFC-113 are ozone-depleting substances (ODSs), and CFC-113 may be listed in some state regulations as a toxic air pollutant.

It is estimated that 82 percent of all dry cleaning facilities use PERC, 15 percent use petroleum solvents, 3 percent use CFC-113, and less than 1 percent use TCA (EPA, 1991a). However, based on a study of national solvent use, 57 percent of all dry cleaning solvents are petroleum solvents (primarily mineral spirits), 39 percent of the solvents are PERC, and 3 and 1 percent are TCA and CFC-113, respectively, with a minor amount of unspecified solvents (Frost & Sullivan, 1990). Small dry cleaning facilities, such as coin-operated sites use PERC exclusively, and larger facilities, such as commercial facilities use petroleum solvents, resulting in this disparity.

2.2 FACTORS INFLUENCING EMISSIONS

Emissions from dry cleaning operations are influenced by the type of dry cleaning machines used. Dry cleaning machines are either dry-to-dry or transfer machines. In the dry-to-dry process, both washing and drying takes place in one machine. Dry-to-dry machines are either vented during the drying cycle or are ventless, where emissions occur only during loading and unloading operations. With transfer machines, the material is washed in one machine and manually transferred to another machine to dry. Emissions occur during the transfer as well as from the washer and dryer vents. Facilities using petroleum solvents have typically used transfer machines. Transfer units are an older technology; all the demand for new equipment in the dry cleaning industry is for dry-to-dry machines. Some petroleum solvent dry-to-dry machines are now being produced in the United States and Europe, and may become more significant in the industry in the future.

Most facilities using PERC use dry-to-dry machines. CFC-113 is used exclusively in dry-to-dry systems. Because petroleum solvents are flammable and may form explosive mixtures, their use has been limited to transfer machines where the solvent concentration in vapors do not build up to high levels. However, commercial petroleum solvent dry-to-dry machines are now being manufactured. National Fire Protection Association codes may limit the locations, such as shopping centers, that petroleum solvents can be used.

In facilities that use PERC, solvents recovered during the dry cleaning process are usually filtered and distilled for recycling back to the process. Emissions occur from the equipment, such as filters, muck cookers, oil cookers, and other stills, that is used to filter and distill the dirty solvent. Filters may be reusable or the cartridge type that is drained, air dried, and discarded. With petroleum solvents, the residue (muck) is drained of excess solvent, air dried, and discarded. Because of the low cost of petroleum solvents, recycling is not emphasized at dry cleaning facilities using these solvents.

Industrial launderers usually have efficient recycling and recapture procedures. Most industrial and commercial cleaners use off-site solvent recycling businesses for solvent waste recovery and disposal services, whereas few coin-op dry cleaners utilize these services.

Solvent use is dependent upon the amount of material cleaned. Transfer machines can have a much larger capacity than dry-to-dry units, and therefore involve the use of more solvents. In general, industrial dry cleaning machines are larger than both commercial and coin-op machines, with commercial units larger than coin-op units. Coin-op units usually have a capacity of 8 to 25 pounds of clothes per load, with one or two machines per facility. The average capacity of commercial dry cleaning units is 35 pounds, with a range of 15 to 97 pounds per load. Most of these units are dry-to-dry. The average capacity of industrial dry cleaners is 140 pounds per load for dry-to-dry units and 250 pounds per load for transfer units. Most of the industrial units are transfer units, although their use is being phased out as new dry-to-dry units are purchased to replace the older transfer units.

2.3 CONTROL TECHNIQUES

Control strategies for dry cleaners include the use of add-on controls such as refrigerated condensers and carbon adsorbers to capture and reduce emissions from dry cleaning machine air vents. Emission control is also achieved through changes in operational practices to reduce fugitive emissions. Examples of changes in operational methods include prompt detection and repair of leaky valves, hose connections, and gaskets; storage of solvents and wastewater in tightly sealed containers; and minimization of the time the door of the dry cleaning machine is open.

The Occupational Safety and Health Administration requires that all equipment that uses PERC be enclosed to meet the permissible exposure level for PERC in the workplace. Under the National Emission Standards for Hazardous Air Pollutants (NESHAP) program, the EPA has passed regulations that require the control of emissions for dry cleaning units using PERC. The NESHAP requirements, shown in Table 4.2-1, include the use of refrigerated condensers, leak detection and seal inspection programs, and monitoring and reporting requirements. Coin-op dry cleaning units are exempt from all but the initial reporting NESHAP requirements. Dry cleaning with petroleum solvents will be regulated under

TABLE 4.2-1

NESHAP REQUIREMENTS FOR DRY CLEANING SOURCES OF PERC (58 FR 49354)

Source Size/ Machines	PERC Consumption Limits (gal/yr)	Process Vent Controls		Fugitive Controls	
		Existing	New	Existing	New
Small Area Source					
Dry-to-Dry Transfer Combination	Less than: 140 200 140	None	RC	LDR/SC	LDR/SC and NNT
Large Area Source					
Dry-to-Dry Transfer Combination	Between: 140 - 2,100 200 - 1,800 140 - 1,800	RC or CA[a]	RC	LDR/SC	LDR/SC and NNT
Major Source					
Dry-to-Dry Transfer Combination	More than: 2,100 1,800 1,800	RC or CA[a]	RC/CA	LDR/SC Room enclosure	LDR/SC Room enclosure

[a] A carbon adsorber can be used if already in place.

CA = Carbon absorber.
LDR/SC = Leak detection and repair, and storage of PERC in sealed containers.
NNT = No new transfer units.
RC = Refrigerated condenser (or equivalent).
RC/CA = Refrigerated condenser followed by carbon adsorber.

NESHAP in 2000.

Many states also regulate emissions from dry cleaners. Inventory planning for this source category should include inquiries to the local air pollution control authorities about applicable regulations.

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3

OVERVIEW OF AVAILABLE METHODS

3.1 EMISSION ESTIMATION METHODOLOGIES

There are several methodologies available for calculating emissions from dry cleaning. The method used is dependent upon the degree of accuracy required in the estimate, available data, and available resources. Since dry cleaning has been one of the top ten largest area sources in area source ozone inventories, this category warrants time and effort in the calculation of emission estimates for it.

This section discusses the methods available for calculating emission estimates from dry cleaning and identifies the preferred method of calculation. A discussion of the data elements needed for each method is provided.

3.1.1 VOLATILE ORGANIC COMPOUNDS AND HAZARDOUS AIR POLLUTANTS

The VOCs emitted from dry cleaning operations are from the solvents used to clean in the dry cleaning process. These VOCs may be emitted from dry cleaning machines during operation of the units or during solvent reclamation processes. There are several approaches to estimating the amount of VOCs emitted from this category, depending on the information sought and the data available.

- Number of facilities or dry cleaning units:
  - Local per facility emission factors (using survey or permit information);
  - Emission factors based on type of machine;
  - National average per facility emission factors;
- Number of employees:
  - Local per employee emission factors (using survey or permit information);
  - National average per employee emission factors;

- Per capita: National average per capita emission factor.

Use caution when applying emission factors that are more than 3 years old, since emission factors can quickly become obsolete due to compliance efforts by the industry.

HAP emissions from this source are determined by the same approaches discussed for VOC emissions, in conjunction with a survey or estimate of the proportion of each solvent type used in the dry cleaning facilities in the inventory area. The emissions of each HAP are assumed to be proportional to the amount of each HAP used as solvent.

The preferred approach depends on the type of dry cleaning facilities for which emissions are being estimated. Table 4.3-1 summarizes these options.

3.1.2 AVAILABLE METHODOLOGIES

Coin-op

Please note that coin-op dry cleaners use PERC. For a VOC inventory, coin-op dry cleaners may not need to be inventoried. Also, all dry cleaners using PERC have been required under the dry cleaning NESHAP to report to their EPA Regional Office a description of each dry cleaning machine and the amount of PERC used. For a facility designated as a "small area source" (see Table 4.2-1), only PERC used in 1994 needs to be reported (58 FR 49354). Individual states may have more stringent rules requiring more detailed information.

For coin-op dry cleaners, development and use of a local per facility emission factor is the preferred method. Data collected under the dry cleaning NESHAP can be used if it reflects current local conditions. If a local per facility emission factor cannot be developed for coin-op dry cleaners, a locally developed per dry cleaning unit emission factor for commercial dry cleaners can be used as the first alternative method. If this approach is not practical, then the national per employee emission factor for dry cleaning is recommended. County employment data are the best source of the total number of employees. The third alternative method is a survey of the number of dry cleaning units in the inventory area, used with the corresponding appropriate emission factors. The effectiveness of any of these methods will depend on how well the activity and emission factors used or developed reflect all of the local conditions.

Commercial and Industrial Dry Cleaners

For commercial dry cleaners and industrial launderers, development of a per facility solvent consumption factor is the preferred approach. For this method, the number of facilities in the area must be obtained. NESHAP requirements promulgated in 1993 (58 FR 49354) require

TABLE 4.3-1

PREFERRED AND ALTERNATE METHODS FOR ESTIMATING EMISSIONS FROM DRY CLEANING FACILITIES

Methods	Coin-op (SIC 7215)	Commercial (SIC 7216)	Industrial Laundries (SIC 7218)
Preferred Method	Survey a subset of facilities for the amount of solvent used, using data collected under the dry cleaning NESHAP, if it reflects current local conditions. Develop a per facility emission factor, based on either total solvent use by facility or solvent used by dry cleaning unit.	Survey a subset of facilities for the amount of solvent used, using data collected under the dry cleaning NESHAP. Develop a per facility emission factor, based on either total solvent use by facility or solvent used by dry cleaning unit.	Survey a subset of facilities for the amount of solvent used, using data collected under the dry cleaning NESHAP. Develop a per facility emission factor, based on either total solvent use by facility or solvent used by dry cleaning unit.
Alternative Method 1	Use the per dry cleaning unit emission factor developed for commercial laundries (see next column).	Survey a subset of facilities for the amount of solvent used and the number of employees. Develop a per employee emission factor.	Survey a subset of facilities for the amount of solvent used and the number of employees. Develop a per employee emission factor.
Alternative Method 2	Use the national average per employee emission factor.	Use the national average per employee emission factor.	None[a]
Alternative Method 3	Use the national average per facility emission factor.	None	None

[a] There is no national average per employee emission factor for industrial laundries.

reporting of this information by commercial and industrial PERC dry cleaning facilities on an annual basis to the EPA Regional Office. The amount of solvent sent to off-site recycling should also be determined to estimate emissions. The first alternative method to estimate emissions for these categories is to use locally developed per employee emission factors. National emission factors can be used if local factors cannot be developed. A survey of the number of dry cleaning units can be used as another alternative method, as discussed above for coin-op dry cleaners. Industrial dry cleaners often use large dry cleaning units that may emit more than 10 tons/yr per unit. Inventory preparers should be careful that these industrial facilities and larger commercial facilities are treated as point sources.

All Cleaners

To determine the total emissions from dry cleaning in an inventory area, emissions from each of the types of dry cleaning are summed. All procedures discussed above must account for point source emissions.

3.2 DATA NEEDS

3.2.1 DATA ELEMENTS

The data elements needed to calculate emission estimates for dry cleaning sources will depend on the methodology used for data collection. The data elements that are needed for each emission estimation technique are presented in Table 4.3-2.

Some of the data elements in Table 4.3-2 are listed as "optional." Inventory preparers will need to consider current and future needs for the current and possibly other inventories. If the preferred methods are used, the extra work of collecting additional information will be small in comparison to repeating the survey effort later.

The number of employees and plants can be determined from local employment offices. The consumption data can be obtained from a limited survey of representative facilities.

3.2.2 ADJUSTMENTS TO EMISSION ESTIMATES

Data needs for adjustments to emission estimates are presented in Table 4.3-3. Any of these adjustments may be necessary, depending on the type of inventory being prepared. For instance, projections or temporal resolution may not be necessary for an annual inventory.

Point Source Corrections

The dry cleaning source category can include point and area sources. Because methods presented in this chapter may be used to estimate emissions from the entire source category,

TABLE 4.3-2

DATA ELEMENTS NEEDED FOR EACH METHOD

Data Element	Local Per Employee Emission Factor (from a survey)[a]	Local Per Facility or Per Unit Emission Factor (from a survey)[a]	National Average Emission Factors	Local Per Employee Emission Factor for Commercial and Industrial Dry Cleaners
Survey Information:				
Types of solvents used	X	X		
Amount of solvent used (purchased - shipped off-site)	X	X		
Amount of solvent shipped off-site	Optional[b]	Optional[b]		
Number of employees for each surveyed facility site	X	X		
Number of employees for inventory area for the SIC	X	X		
Number of dry cleaning units for a facility	Optional	X		
Type of dry cleaning units for a facility	Optional	X		
Control types and efficiencies for each equipment type	Optional	Optional		
Number of facilities in an inventory area for the SIC	Optional	X		
Emission Factor Methods:				
Local per employee factor				X
Number of employees or facilities for inventory area for the SIC			X	X
National average per employee or per facility factor			X	

[a] If information collected under the NESHAP requirements is available, it should be the preferred and most accurate data source. If this is not available, survey a subset of facilities. See Volumes I and VI of this series and Chapter 1 of this volume for more information about surveys.

[b] Collection of this information is optional, but it is needed for the most accurate results.

TABLE 4.3-3

DATA NEEDS FOR EMISSION ESTIMATE ADJUSTMENTS

Data Element	Local Per Employee Emission Factor (from a survey)	Local Per Facility or Per Unit Emission Factor (from a survey)	National Average Emission Factors	Local Per Employee Emission Factor for Commercial and Industrial Dry Cleaners
Point Source Corrections:				
Point source emissions	Alternate	Preferred	Alternate	Alternate
Point source employment for inventory area for the SIC	Preferred		Preferred	Preferred
Application of Controls:				
Control efficiency (CE)	X	X	X	X
Rule effectiveness (RE)	X	X	X	X
Rule penetration (RP)	X	X	X	X
Spatial Allocation:				
Employment	Preferred		Preferred	Preferred
Number of facilities	Alternate 1	Preferred	Alternate 1	Alternate 1
Population of inventory area	Alternate 2	Alternate 1	Alternate 2	Alternate 2
Temporal Resolution:				
Seasonal throughput	X	X	X	X
Operating days per week	X	X	X	X
Operating hours per day for representative facilities	Optional	Optional	Optional	Optional

TABLE 4.3-3

(CONTINUED)

Data Element	Local Per Employee Emission Factor (from a survey)	Local Per Facility or Per Unit Emission Factor (from a survey)	National Average Emission Factors	Local Per Employee Emission Factor for Commercial and Industrial Dry Cleaners
Projection:				
Projection year precontrol emission factors	X	X		
Projection year CE	X	X	X	X
Projection year RE	X	X	X	X
Projection year RP	X	X	X	X
Projection year growth factor	X	X	X	X

the total emission estimate should be corrected for the amount contributed by the point sources.

There are two ways to correct for point source contributions, and the choice of approach depends on the method used to estimate emissions and the data available. The two methods are either to correct the activity level, such as the number of employees used with an employee-based emission factor, or to subtract the point source emissions from the total calculated emissions. If the inventoried point source emissions are greater than the total estimated emissions, set the area source emissions to zero.

Table 4.3-3 lists the two point source correction methods and shows which is preferred and which is an alternative for each emission estimation method. The procedure for correcting the activity level, such as employment, is shown below.

The general equation to correct activity for point sources is:

$$\begin{bmatrix}\text{Total Employees}\\ \text{at Area Sources}\end{bmatrix} = \begin{bmatrix}\text{Total Employees}\\ \text{in Dry Cleaning}\end{bmatrix} - \begin{bmatrix}\text{Total Employees}\\ \text{at Point Sources}\end{bmatrix} \qquad (4.3\text{-}1)$$

This information may be available from the point source inventory. Be sure to count employment by SIC Code. Match employees of point source commercial facilities (SIC Code 7216) to total commercial employment, and point source coin-op facilities (SIC Code 7215) with total coin-op employment.

If the number of employees at point sources is not known, an alternative method can be used to estimate this value, as follows:

- Use data from the state labor department or *County Business Patterns*[a] to determine the total number of employees reported for SIC 7215 for each dry cleaning facility in each county in the inventory region.

- Use the region's point source files to obtain the number of point sources in the inventory region; if this is not available, then:

  - Use an inventory that lists dry cleaning facilities and their total emissions and determine the number of facilities above the emission

[a] See the most recent publication, which can be obtained from the U.S. Bureau of Census, Department of Commerce, Washington, DC.

cutoff for point sources. This is dictated by the type of inventory; for ozone (VOC) State Implementation Plan (SIP) 1990 base year inventories, the cutoff was 10 tons of VOC per year.

- In the *County Business Patterns*, the number of employees can be determined from information presented as the number of facilities with a total number of employees in a specified range. The total number of employees for all the facilities listed in each range can be estimated by the midpoint of the indicated size range. The following example illustrates this technique:

Example 4.5-1:

If an inventory for the region contains five dry cleaning point sources, and the top five dry cleaning facilities by total employment in the *County Business Patterns* for dry cleaning in the region are distributed as follows: three facilities in the 100 to 149 employees per facility size range and two facilities in the 50 to 99 employee per facility size range, then the total number of employees for point sources can be calculated using the midpoint of the employee size ranges, as in the equation below:

$$\text{Total Employees at Point Sources} = \left[3 \frac{(100 + 149)}{2} + 2 \frac{(50 + 99)}{2} \right] = 3(124.5) + 2(74.5) = 523$$

Assume that point sources correspond to the facilities with the highest number of employees. Start with the facilities with the largest number of employees and sum the number of employees at the largest facilities for as many facilities as there are point sources of dry cleaning in the county for the desired SIC.

Application of Controls

Since the level of control required by regulation is usually determined by factors of individual facility size, type of solvent, and/or machine type, it will be difficult to determine the exact reduction in emissions with controls unless a survey is performed and information on the type of machine is gathered. Information on the age of the units, type and amount of solvent used, and current controls in place may also be needed to estimate the level of control in place. See the section below on projecting emissions to see the calculation for the application of controls.

Spatial Allocation

The spatial allocation of dry cleaning emissions by county can be performed using local population data. If a detailed survey is performed to estimate emissions, the spatial allocation of emissions can be performed according to facility location, as with the point source inventory, or with local employment data. If urban versus rural population is known, urban population should be used to allocate dry cleaning emissions. Urban and rural population information can be found in *Population and Housing Unit Counts*[b] from the U.S. Census Bureau.

Temporal Resolution

Seasonal Apportioning. Dry cleaning emissions do not demonstrate differences in activity from season to season (EPA, 1991a). The seasonal activity factor that should be used for this category is 1.0; activity takes place 52 weeks in the year.

Daily Resolution. Commercial and industrial dry cleaning businesses are open 5 to 6 days a week. Commercial cleaners are usually open 12 hours a day (starting from 6 or 7 a.m.) but may only actually do cleaning from 6 to 11 a.m. Industrial dry cleaners may run two shifts, i.e., 16 hours a day. Coin-op cleaners are open 6 to 7 days a week and may operate anywhere from 12 to 24 hours a day (Agyei, 1994; EPA, 1991b). The preferred method for daily resolution is to collect representative information from industrial, commercial, and coin-op facilities. The alternative method is to assume that activity takes place during a 5-day week (EPA, 1991a).

3.3 PROJECTING EMISSIONS

The number of employees or facilities can be adjusted to project future emissions, assuming that there is no change in the basic processes or chemicals that are used. These data may be obtained from information on projected revenue growth in the industry and correlation of revenue to number of employees or facilities.

The equation for projecting emissions in this case is:

[b] See the most recent publication, which can be obtained from the U.S. Bureau of Census, Department of Commerce, Washington, DC.

$$EMIS_{PY} = ORATE_{BY,O} * EMF_{PY,pc} * \left[1 - \left(\frac{CE_{PY}}{100} \right) \left(\frac{RP_{PY}}{100} \right) \left(\frac{RE_{PY}}{100} \right) \right] * GF \qquad (4.3\text{-}2)$$

where:

$EMIS_{PY}$	=	Projection year emissions
$ORATE_{BY,O}$	=	Base year operating rate for each production unit
$EMF_{PY,pc}$	=	Projection year precontrol emissions factor (mass of pollutant/ production unit)
CE_{PY}	=	Projection year control efficiency (percent)
RP_{PY}	=	Projection year rule penetration (RP) (percent)
RE_{PY}	=	Projection year rule effectiveness (RE) (percent)
GF	=	Growth factor (dimensionless)

The precontrol emission factor ($EMF_{PY,pc}$) reflects the mass of pollutant per production unit emitted before control (EPA, 1993). Chapter 1 of this volume, *Introduction to Area Source Emission Inventory Development*, discusses inventory projections in more detail.

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4

PREFERRED METHODS FOR ESTIMATING EMISSIONS

The preferred method to estimate emissions for coin-op dry cleaners is the development of local per facility or per dry cleaning unit emission factors. For commercial dry cleaners and industrial launderers, a per facility emission factor method is the preferred approach. Unless permit information with actual emission values is available, developing local emission factors requires a survey of a subset of dry cleaning facilities. Please refer to Volume I of this series, Chapter 5, *Inventory Development*, Chapter 1 of this volume, and Volume VI of this series, *Quality Assurance*, for more detailed information about using surveys.

4.1 SURVEY PLANNING

A sample survey cover sheet and form is included in Figures 4.4-1 and 4.4-2. Recommended data elements to be requested on the forms are:

- Solvent types used;
- Amounts of each type of solvent purchased for inventory year;
- Listing of equipment types at the facility;
- Controls in place at the facility;
- Operating days per week, hours per day;
- Facility employment; and
- Estimated amount of solvent sent for off-site disposal or recycling.

The remainder of this section describes the preferred method of estimating emissions from all types of dry cleaning sources. Note that total emission estimates for dry cleaners must be adjusted for point sources to estimate area source emissions.

4.2 PER DRY CLEANING UNIT EMISSION FACTOR METHOD

Name of Facility:_____

Street Address:_____

City/State:_____

Contact Person:_____

Telephone Number:_____

Please check the appropriate box describing your operation.

1. Solvent Used	Amount Purchased Annually (gallons)
☐ PERC (Perchloroethylene)	_____
☐ Petroleum (Stoddard Solvent)	_____
☐ Other Petroleum Solvents	_____
☐ CFC-113 (Trichlorofluoroethane)	_____
☐ TCA (1,1,1-Trichloroethane)	_____
☐ Other	_____

FIGURE 4.4-1. SAMPLE SURVEY COVER SHEET

For each machine at your facility, please provide the following information:

Machine Type	Load Capacity (pounds of garments)	Estimated Solvent Use Per Load (gallons of solvent)	Controls in Place

For your entire facility, please estimate the amount of solvent sent for off-site disposal or recycling:

Solvent Type	Estimated (gallons/year)
PERC (Perchloroethylene)	
Petroleum Solvents:	
TCA (1,1,1-Trichloroethane)	
CFC-113 (Trichlorofluoroethane)	
Other (please specify):	

For your facility, please estimate the average days per week and hours per day that dry cleaning equipment is operating:

_____ days per week _____ hours per day

Please list the number of employees at this facility:

_____ employees

FIGURE 4.4-2. SAMPLE SURVEY FORM

The following list identifies the steps involved in developing a local per unit emission factor.

- Identify facilities that would be suitable survey recipients, noting those that are point sources. Facilities can be identified from the local employment office or tax office records; because many of these facilities are small, they do not usually belong to dry cleaning associations. However, as more rules come into place affecting the dry cleaning industry, local information should be easier to collect.

- Conduct a survey of the total number of dry cleaning units and solvent consumed for a representative sample of facilities and develop a per unit emission factor for coin-op dry cleaners. Emission factors that can include the type of dry cleaning machine as well as the method of control will produce a more accurate estimate of emissions, and provide a good basis for projections.

- Determine the total number of coin-op dry cleaning facilities in the inventory region in SIC 7215 from data acquired by state or local labor departments, or *County Business Patterns*. If county figures are not available for 4-digit SICs, state data (which are given in both 2-digit and 4-digit levels) can be used to break county 2-digit levels into 4-digits.

- Scale up the number of dry cleaning units reported in the survey for all of the coin-op facilities in the area.

- Correct for point source facilities by subtracting the number of units at the point source facility sites for this SIC from the estimated total number of area source dry cleaning units.

- Multiply the per unit emission factor obtained by the procedures described above by the estimated number of dry cleaning units in area source facilities of SIC 7215 to obtain an estimate of emissions at dry cleaning area sources.

4.3 PER PLANT CONSUMPTION FACTOR METHOD (COMMERCIAL DRY CLEANERS AND INDUSTRIAL LAUNDERERS)

- Determine the number of facilities in the SIC from local employment offices or dry cleaning trade association.

- Determine average solvent consumption per facility through a survey of a representative number of facilities in the SIC.

- Total solvent consumption is estimated by multiplying the number of facilities times the average solvent consumed per facility.

- For commercial dry cleaners, total emissions are estimated by reducing the total estimated solvent consumption by the average percent of solvent sent off-site for recycling. This amount can either be collected by the survey of facilities, or be obtained from local waste processing and solvent recovery companies that can be identified from the Yellow Pages. A typical plant produces approximately one 55-pound bucket of solvent-laden wastes every 2 months.

- For industrial launderers, total emissions are estimated as a percentage of solvent purchased that cannot be accounted for in its off-site disposal or recycling manifests. If this information is not available, it can be assumed to be 5 percent (Agyei, 1994).

- To obtain area source emissions for commercial or industrial dry cleaners, subtract point source emissions from the total emissions estimated above.

As a gauge of the information returned by the surveys, average annual consumption for commercial dry cleaning facilities with dry-to-dry units is approximately 40 gallons PERC per facility (±10 percent). Fewer facilities use transfer machines, since these units are being phased out. For transfer machines, the annual PERC consumption rate can be assumed to be in the range of 80 gallons per facility (±10 percent) for facilities with controls, up to 200 gallons per facility for facilities without controls (Agyei, 1994). Please keep in mind that any projections from this information should reflect this change in equipment type.

In 1993, NESHAP regulations were put into place that require reporting from commercial and industrial PERC dry cleaners (58 FR 49354). Reports include information about the dry cleaning machines used at a facility, and the PERC consumption at that facility. The EPA has distributed this information to their ten Regional Offices. Inventory preparers should contact the Air Toxics Coordinator in the Air Division of their Regional Office for more information.

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5

ALTERNATIVE METHODS FOR ESTIMATING EMISSIONS

The alternative methods for estimating dry cleaning emissions are described below, by industry type.

5.1 METHODS FOR COIN-OP DRY CLEANERS (SIC 7215)

The three alternative methods are, in order of preference:

- Use the per dry cleaning unit factor developed as the first alternate method for commercial dry cleaners (SIC 7216).
- Use the national per employee emission factor.
- Use the national per facility emission factor.

5.1.1 ALTERNATIVE ONE

The first alternative, using the per unit factor that has been developed for commercial dry cleaners, is described in Section 4.2 of this chapter for the commercial dry cleaning category.

5.1.2 ALTERNATIVE TWO

The steps needed to use the second alternative method are as follows:

- Subtract the number of employees at dry cleaning point sources using information acquired from the point source inventory, or use the method for point source correction described in Section 3.2.2 of this chapter. Be sure to match only those employees working at coin-op facilities.
- Multiply the per employee emission factor, either the local commercial per employee factor, or the national per employee factor (listed in Table 4.5-1), by the number of employees in area sources of SIC 7215 to obtain an estimate of emissions at dry cleaning area sources.

TABLE 4.5-1

NATIONAL PER EMPLOYEE EMISSION FACTORS FOR DRY CLEANING OPERATIONS FROM (EPA, 1991A)

Subcategory	Reactive VOC (lb/year/employee)	Applicable SIC	Total Organics (lb/year/employee)	Applicable SIC
All solvents (total)	1,800[a]	7216	2,300[b]	7215, 7216
Halogenated Solvents (total PERC, TCA and CFC 113)			980[c]	7215 & 7216
Coin Operated			52[c]	7215
Commercial/Industrial			1,200[c]	7216
Mineral Spirits & Other Unspecified Solvents	1,800	7216	1,800	7216

[a] Emission factor excludes emissions of PERC, TCA, and CFC 113, and represents only emissions of mineral spirits and other solvents. Thus, this factor is not applicable for coin-operated facilities (SIC 7215) that use exclusively PERC.

[b] Total organics are the sum of the PERC, TCA, CFC 113, mineral spirits, and unspecified other solvents.

[c] These emission factors would not be used in a VOC inventory, but could be used for an inventory of HAPs. Readers are encouraged to review the source document for more information about these factors (EPA, 1991a).

5.1.3 ALTERNATIVE THREE

The third alternative method is the use of a national average per facility emission factor of 0.8 tons/facility-year (EPA, 1988). Please note that this number is based on the following assumptions:

- The average coin-op facility has two dry cleaning units; and
- Each unit emits 0.4 tons of PERC per year.

The total number of coin-op facilities can be determined using the same method as the one described in Section 4 for the coin-op preferred method. Point source facilities should be subtracted from this total amount of facilities to determine the number of area source facilities. This number is applied to the emission factor to calculate the emission estimate.

5.2 METHODS FOR COMMERCIAL AND INDUSTRIAL DRY CLEANERS (SIC 7216 AND 7218)

For commercial dry cleaners and industrial launderers, the alternative methods are the same for the two industry types, except that the national per employee factor should not be used to estimate emissions from industrial launderers. The two alternative methods are, in order of preference:

- Use a local per employee emission factor developed by surveying a subset of facilities.
- Use a national per employee emission factor (only for commercial dry cleaners).

5.2.1 ALTERNATIVE ONE

The first alternative method, developing a local per employee emission factor, involves sending out a survey to a subset of commercial or industrial laundry facilities in the area. Note that per employee emissions will be significantly different between commercial and industrial laundries, and separate factors for the two should be developed. Survey forms should request solvent use, employment numbers, operating days and hours, equipment types and solvent use, off-site waste disposal, and controls. Emission factors that can incorporate the type of dry cleaning machine as well as the method of control will produce a more accurate estimate of emissions. Be certain that point source emissions are not included in the estimate of area source emissions estimates. See the point source correction discussion in Section 3.2.2.

5.2.2 ALTERNATIVE TWO

The steps needed to use the second alternative method for commercial dry cleaners, using a national per employee emission factor (listed in Table 4.5-1), are similar to the steps required in the first alternative method for commercial dry cleaners and industrial launderers. These steps are:

- Subtract the number of employees at dry cleaning point sources using information acquired from the point source inventory, or using the method described in Section 3.2.2, for point source corrections. Be sure to match only those employees working at commercial facilities to the commercial dry cleaning employment and industrial laundries to industrial laundry employment.

- Multiply the per employee emission factor, either the local per employee factor, or the national per employee factor, by the number of employees in area sources of SIC 7216 to obtain an estimate of emissions at dry cleaning area sources for commercial dry cleaners.

- Multiply the local per employee emission factor by the number of employees in area sources of SIC 7218 to obtain an estimate of emissions at dry cleaning area sources for industrial launderers.

6

QUALITY ASSURANCE/QUALITY CONTROL

When using the preferred method, or alternative survey methods, the survey planning, sample design, and data handling should be undertaken according to the inventory work plan and Quality Assurance/Quality Control (QA/QC) plans. Refer to the discussion of survey planning, QA/QC, and the Data Attribute Rating System (DARS) in Volume I of this series and in the QA volume of this series. No category-specific issues need to be considered.

Data handling for the survey data and for data collected for the other methods should also be undertaken according to the inventory QA/QC plan. Since facilities may use different acronyms or trade names for solvents, and may use different measurement units in describing their operations, care should be taken in the review and collation of the information gathered from the surveys. No other category-specific issues need to be addressed.

6.1 EMISSION ESTIMATE QUALITY INDICATORS

The preferred method and the alternative survey methods give higher quality estimates than the alternative national emission factor method, but require significantly more effort. The level of effort required to calculate emissions using any of the national emission factor methods ranges from 8-40 hours. Conducting a survey requires between 100 to 800 hours depending on the size of inventory region and the desired level of detail of the survey. However, the resultant increase in the quality may justify this expenditure of resources, especially if this category is believed to be a significant contributor to emissions. Emissions from dry cleaning operations, when calculated using national emission factors, are typically among the top ten area sources of VOCs and HAPs in urban areas.

6.1.1 DATA ATTRIBUTE RATING SYSTEM (DARS) SCORES

The DARs scores for each method are summarized in Tables 4.6-1 through 4.6-6. A range of scores is given for several of the survey methods because the scores are dependent on the representativeness, sample size, and other survey characteristics.

For example, in Table 4.6-1 the score for the activity data will be at the lower end of the ranges shown if the sample size is small or does not adequately sample facilities of different sizes because the variability in emissions between facilities can be high. Source

TABLE 4.6-1

PREFERRED METHOD DARS SCORES: SURVEY SIC 7215, 7216, AND 7218: DEVELOP A LOCAL PER UNIT OR PER FACILITY EMISSION FACTOR

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.7 - 0.9	0.4 - 0.7	0.28 - 0.54
Source Specificity	1.0	1.0	1.0
Pollutant	0.6 - 1.0	1.0	0.6 - 1.0
Spatial	0.8 - 1.0	0.8 - 1.0	0.64 - 1.0
Temporal	0.7 - 1.0	0.7 - 1.0	0.49 - 1.0
Composite Scores	0.76 - 0.98	0.78 - 0.94	0.60 - 0.92

TABLE 4.6-2

ALTERNATIVE METHOD 1 FOR SIC 7215 (COIN-OP): USING A LOCAL COMMERCIAL (SIC 7216) PER DRY CLEANING UNIT EMISSION FACTOR

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.7 - 0.9[a]	0.5	0.35 - 0.45
Source Specificity	0.5	0.8	0.40
Pollutant	1.0	1.0	1.0
Spatial	0.8	0.9	0.72
Temporal	0.8	0.7	0.56
Composite Scores	0.76 - 0.8	0.78	0.60 - 0.62

[a]Assumes a factor developed by the preferred method.

TABLE 4.6-3

ALTERNATIVE METHOD 1 FOR SIC 7216 AND 7218 (COMMERCIAL AND INDUSTRIAL CLEANERS): SURVEY TO DEVELOP A LOCAL PER EMPLOYEE FACTOR

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.7 - 0.9	0.3 - 0.5	0.21 - 0.45
Source Specificity	0.9	0.8	0.72
Pollutant	0.6 - 1.0	1.0	0.6 - 1.0
Spatial	0.8	0.8	0.64
Temporal	0.7 - 1.0	0.7 - 1.0	0.49 - 1.0
Composite Scores	0.74 - 0.92	0.72 - 0.82	0.53 - 0.75

TABLE 4.6-4

ALTERNATIVE METHOD 2 FOR SIC 7215 AND 7216 (COIN-OP AND COMMERCIAL CLEANERS): USING A NATIONAL PER EMPLOYEE FACTOR

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.4	0.4	0.16
Source Specificity	0.5	0.9	0.45
Pollutant	1.0[a]	1.0	1.0
Spatial	0.4	0.9	0.36
Temporal	0.7[b]	0.7[b]	0.49
Composite Scores	0.6	0.78	0.47

[a] Lower for speciated emissions.
[b] Assumes factor/activity data year is different than inventory year, but not by much.

TABLE 4.6-5

ALTERNATIVE METHOD 3 FOR SIC 7215 CLEANERS: USING A NATIONAL PER FACILITY FACTOR

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.3	0.3	0.09
Source Specificity	0.4	0.9	0.16
Pollutant	0.6 - 1.0	1.0	0.6 - 1.0
Spatial	0.3	0.9	0.27
Temporal	0.6	0.7	0.42
Composite Scores	0.44 - 0.52	0.76	0.33 - 0.40

TABLE 4.6-6

COMPOSITE EMISSIONS DARS SCORES: SUMMARY FOR ALL INDUSTRIES, ALL METHODS

Method	Coin-op (SIC 7215)	Commercial (SIC 7216)	Industrial (SIC 7218)
Preferred Method	0.60 - 0.92	0.60 - 0.92	0.60 - 0.92
Alternate Method 1	0.60 - 0.62	0.53 - 0.75	0.53 - 0.75
Alternate Method 2	0.47	0.47	--
Alternate Method 3	0.33 - 0.40	--	--

specificity is set to 1.0 assuming that the specific inventory region is surveyed; if the survey region is different, then this score should be lowered.

In the summary tables, scores may be presented as a range for a particular method because of variability in the survey sample size, the region covered, or the applicability of the emission factor to individual sources. For each attribute, issues that would influence scores would be:

- Measurement--sample size and representativeness of the sample determine the score. The score will also be affected by the correlation between emissions and the choice of a surrogate activity.

- Source Specificity--is based on whether the emission factor and activity factor, particularly a surrogate activity factor, are specific to the source being inventoried or is based on a subset, superset, or category that has been judged similar.

- Pollutant--a high score is given if the emission factor is developed specifically for the intended pollutant, and a lower score if less specific methods, such as speciation profiles are used.

- Spatial--a high score is given if the method was developed for the inventory region. A lower score is given if the emission factor or activity factor is extrapolated from a larger or smaller region.

- Temporal--scores will vary based on how specific the emission factor or activity factory is to the inventory year.

All scores assume that good QA/QC measures are performed and that no significant deviations from the prescribed methods have been made. If these assumptions are not met, new DARS scores should be developed according to the guidance [refer to Source Document (Beck et al., 1994)].

The preferred method gives higher DARS scores than any of the alternative methods. The alternative methods have composite scores ranging between 0.33 and 0.75, while the scores for the preferred method vary from 0.6 to 0.92. Furthermore, the scores on all attributes for the preferred method are higher compared to the alternatives. The highest possible scores for alternative methods are for well-run surveys of solvent used per employee or amount of clothes cleaned. The lowest score is for a national average per facility emission factor for coin-op dry cleaners. The measurement and spatial attribute scores have the greatest variations amongst the different types of attributes. National level emission factors, because they represent top-down methods and will not reflect spatial variations, are the methods most strongly affected by the measurement and spatial attributes.

6.1.2 SOURCES OF UNCERTAINTY

The uncertainty of the emission estimates can be quantified if any of the survey methods is used. [See QA Source Document, Chapter 4]. However, the statistics needed to quantify the uncertainty of the national emission factor methods and the national solvent use method are incomplete. Factors that affect the uncertainty for these methods are:

- Regional variability of activity;
- Spatial variability of locations of facilities;
- The number of employees that actually are involved with operations; and
- The amount of true activity that takes place relative to that implied by a surrogate activity.

7

DATA CODING PROCEDURES

This section describes the codes available to characterize dry cleaning emission estimates. Consistent categorization and coding will result in greater uniformity between inventories.

7.1 PROCESS AND CONTROL CODES

The process codes for dry cleaning operations are shown in Table 4.7-1. These codes are compatible with the Aerometric Information Retrieval System (AIRS) Area and Mobile Source (AMS) source category codes (EPA, 1994). The control codes for use with AMS are shown in Table 4.7-2. Federal, state, and local regulations can be used as guides to estimate the type of control used and the level of efficiency that can be achieved. Be careful to apply only the regulations that specifically include area sources. If the regulation is applicable only to point sources, it should not be assumed that similar controls exist at area sources without a survey. The "099" control code can be used for miscellaneous control devices that do not have a unique identification code. The "999" code can be used for a combination of control devices where only the overall control efficiency is known.

TABLE 4.7-1

AIRS AMS CODES FOR THE DRY CLEANING CATEGORY

Category Description	Process Description	AMS Code
Commercial/Industrial Cleaners (SIC 7216 and SIC 7218)	Perchloroethylene	24-20-010-055
	Special Naphthas	24-20-010-370
	Solvent - Other	24-20-010-999
	Total: All Solvent Types	24-20-010-000
Coin-Operated Cleaners (SIC 7215)	Perchloroethylene	24-20-020-055
	Special Naphthas	24-20-020-370
	Solvent - Other	24-20-020-999
	Total: All Solvent Types	24-20-020-000
All Processes	Perchloroethylene	24-20-000-055
	Special Naphthas	24-20-000-370
	Total: All Solvent Types	24-20-000-000

TABLE 4.7-2

AIRS CONTROL DEVICE CODES

Control Device	Code
Carbon Adsorption	048
Refrigeration System	073
Miscellaneous Control Device	099
Combined Control Efficiency	999

8

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