VOLUME III: CHAPTER 6

SOLVENT CLEANING

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CONTENTS

Section **Page**

1 Introduction 6.1-1

2 Source Category Description 6.2-1

2.1 Solvent Cleaning Activities 6.2-1
2.1.1 Batch Cold Cleaning Machines 6.2-1
2.1.2 Batch Vapor Cleaning Machines 6.2-3
2.1.3 In-line Cleaning Machines 6.2-4
2.1.4 Cleanup Solvent Use 6.2-5

2.2 Emission Sources 6.2-6
2.2.1 Cleaning Machines 6.2-6
2.2.2 Cleanup Solvents 6.2-7

2.3 Factors Influencing Emissions 6.2-7

2.4 Control Techniques 6.2-8
2.4.1 Cleaning Machines 6.2-8
2.4.2 Cleanup Solvents 6.2-11

2.5 Regulatory Status 6.2-12
2.5.1 Solvent Cleaning Machines 6.2-12
2.5.2 Cleanup Solvents 6.2-13
2.5.3 Summary 6.2-13

3 Overview of Available Methods 6.3-1

3.1 Emission Estimation Methodologies 6.3-1
3.1.1 Solvent Emissions 6.3-1
3.1.2 Surveys 6.3-3
3.1.3 Facility-specific Data 6.3-4
3.1.4 Emission Factors 6.3-4
3.1.5 Speciated Emissions (VOCs, HAPs) 6.3-5

CONTENTS

Section **Page**

3.2 Data Needs 6.3-7
3.2.1 Data Elements 6.3-7
3.2.2 Application of Controls 6.3-8
3.2.3 Spatial Allocation 6.3-8
3.2.4 Temporal Resolution 6.3-9
3.2.5 Projecting Emissions 6.3-9

4 Preferred Methods for Estimating Emissions 6.4-1

4.1 Emission Estimation Methodologies 6.4-1

4.2 Facility-specific Data 6.4-1

4.3 Surveys 6.4-2
4.3.1 Cold Cleaners 6.4-2
4.3.2 Cleanup 6.4-4
4.3.3 Survey Compilation and Calculations 6.4-4

5 Alternative Methods for Estimating Emissions 6.5-1

5.1 Solvent Cleaning Equipment 6.5-1
5.1.1 Facility-specific Data 6.5-1
5.1.2 Emission Factors 6.5-1

5.2 Solvent Cleanup Activities 6.5-4

6 Quality Assurance/Quality Control 6.6-1

6.1 Emission Estimate Quality Indicators 6.6-1
6.1.1 Data Attribute Rating System (DARS) Scores 6.6-1
6.1.2 Sources of Uncertainty 6.6-1

7 Data Coding Procedures 6.7-1

7.1 Process and Control Codes 6.7-1

8 References 6.8-1

Appendix A - Example Survey for Solvent Cleanup Activities

FIGURES AND TABLES

Figure **Page**

6.4-1 Example Survey for Cold Cleaning Full Service Suppliers 6.4-3

Table **Page**

6.2-1 State Regulations 6.2-14

6.2-2 Cleanup Solvent Regulations by State 6.2-16

6.3-1 Summary of Available Estimation Methods for Solvent Cleaning Activities 6.3-2

6.3-2 Commonly Used Cleanup Solvents 6.3-6

6.4-1 Solvent Cleaning Activities by Industry 6.4-5

6.5-1 1994 Safety-Kleen Emissions Data for Cold Cleaners 6.5-3

6.5-2 Per Capita and Per Employee Solvent Cleaning Emission Factors 6.5-4

6.5-3 Estimates of the Amount of VOC Cleaning Solvent Used by Industry 6.5-6

6.5-4 Nationwide VOC Solvent Usage and Emission Estimates for Selected Industries 6.5-8

6.6-1 Facility-specific Equipment Solvent Cleaning: Preferred for Halogenated Cleaners, Alternative 1 for Non-Halogenated Cold Cleaning and Solvent Cleanup 6.6-3

6.6-2 Survey of Solvent Cleaning Uses (Equipment or Solvent) in the Inventory Region: Preferred for Non-Halogenated Cleaners and Solvent Cleanup, Alternative 1 for Non-Halogenated Cold Cleaners 6.6-4

6.6-3 Cold Cleaning Unit Emission Factor: Alternative 2 for Cold Cleaners 6.6-5

6.6-4 Solvent Cleanup Emission Factors: Alternative 2 for Solvent Cleanup 6.6-5

6.6-5 National Factors Applied to Local Activity Data (Number of Employees): Alternative 2 for All Cleaning Types 6.6-6

FIGURES AND TABLES (CONTINUED)

Table **Page**

6.6-6 National Factors Applied to Local Activity Data (Population): Alternative 2 for All Cleaning Types 6.6-7

6.7-1 AIRS AMS Codes for Solvent Cleaning Machines by Industry 6.7-2

6.7-2 AIRS Control Device Codes 6.7-4

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1

INTRODUCTION

Solvent cleaning operations are an integral part of many industries and involve the use of solvents or solvent vapor to remove water-insoluble contaminants such as grease, oils, waxes, carbon deposits, fluxes, and tars from metal, plastic, glass, and other surfaces. Solvent cleaning is usually performed prior to painting, plating, inspection, repair, assembly, heat treating, and machining (EPA, 1991; EPA, 1993a).

Section 2 of this chapter contains general descriptions of the solvent cleaning source category, a listing of emission sources commonly associated with solvent cleaning operations, and an overview of the available control technologies for various solvent cleaning operations. Section 3 of this chapter provides an overview of available emission estimation methods. Section 4 presents the preferred emission estimation methods for solvent cleaning operations, and Section 5 presents alternative emission estimation techniques. Quality assurance (QA) and quality control (QC) procedures are described in Section 6 and data coding procedures are discussed in Section 7. Section 8 lists references. Refer to Chapter 1, *Introduction to Area Source Emission Inventory Development*, for general concepts and technical approaches.

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2

SOURCE CATEGORY DESCRIPTION

There are two basic types of cleaning machines: batch and in-line cleaning machines (also called continuous cleaning machines). Both of these equipment types are designed to use solvent to clean parts. The solvent is either used to clean in its nonvapor liquid form (at a temperature below the boiling point, referred to as cold cleaning), or heated to a temperature above its boiling point (referred to as vapor cleaning). Other solvent cleaning operations involve the use of solvent in wipe-cleaning and equipment cleanup.

Solvents used in cleaning machines include 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), methylene chloride, perchloroethylene (PERC), carbon tetrachloride, chloroform, chlorofluorocarbons (CFCs), petroleum distillates (e.g., Stoddard solvent, mineral spirits, naphthas), and alcohols. Solvents used in cleanup include acetone, alcohols, butyl acetate, cyclohexanone, ethyl acetate, ethylbenzene, ethylene glycol, methyl ethyl ketone, methyl isobutyl ketone, naphthas, toluene, and xylene. Acetone, CFCs, methylene chloride, PERC, and TCA are specifically exempted from the EPA's definition of reactive volatile organic compounds (VOCs) due to their low photochemical reactivity. TCA, carbon tetrachloride, and CFCs such as CFC-11 and CFC-13 will not be produced after January 1, 1996 as part of the Montreal Protocol to reduce stratospheric ozone depletion. Higher molecular weight organics (i.e. naphthas) usually have lower vapor pressures and thus lower emissions and less impact on ozone levels. Water-based cleaners may also be substituted for organic solvents to eliminate any ozone impacts.

2.1 SOLVENT CLEANING ACTIVITIES

2.1.1 BATCH COLD CLEANING MACHINES

Batch cold cleaning machines use solvent in the liquid phase to clean and remove foreign material such as oils and grease from the surface of materials. These machines are batch loaded, and cleaning operations include spraying, flushing, solvent or parts agitation, wipe cleaning, brushing, and immersion. Both halogenated and nonhalogenated solvents are used in batch cold cleaning machines. Carburetor cleaners use halogenated solvents and Stoddard solvent. The predominant solvent used for all other batch cleaning machines are nonhalogenated solvents.

Nonhalogenated solvents used in cold cleaning machines include aliphatic petroleum distillates (e.g., mineral spirits, Stoddard solvent, petroleum naphthas), alcohols, ketones, glycol ethers and others. In some carburetor cleaners, a mixture containing halogenated solvents, such as methylene chloride and nonhalogenated solvents, is used. The total halogenated and nonhalogenated solvents used in cold cleaning machines in the past has been estimated as

430,000 tons, based on several year's data (EPA, 1991). However, halogenated solvent use in cold cleaning machines has been estimated as 65,000 tons for the year of 1991 (EPA, 1993a). Cold cleaners are usually individually small emission sources and, because they are widely scattered and frequently used, they are most easily treated as area sources. If they are collocated at a major source, they may be included in the point source inventory and those emissions will need to be subtracted from the area source estimate.

Ninety percent of Stoddard solvent batch cold cleaning machines use a remote reservoir and 10 percent use immersion; however, many cold cleaning machines are a combination of both types (EPA, 1991; EPA, 1994a). Remote reservoir cleaning machines pump solvent through a sink-like work area. The solvent drains back into an enclosed container through a small drain while the contaminated parts (called workload) are being cleaned. Fewer vapors are emitted from the solvent in the enclosed container during nonuse compared to immersion cleaners. In immersion cold cleaning machines, the workload is simply immersed in the liquid solvent (EPA, 1994a). Solvent may also be sprayed on the parts to enhance cleaning. Combination remote reservoir/immersion cleaning machines resemble a remote reservoir machine in that solvent is pumped to a sink-like work area. However, the machine's work area contains a shelf that can be removed; once the shelf is removed, the workload can be cleaned by immersion (EPA, 1994a). Machines that can be either a remote reservoir or an immersion cleaning machine are considered to be immersion cleaning machines by the Environmental Protection Agency (EPA) (*Federal Register*, 1994).

Approximately one million cold cleaning machines were estimated to be in operation in the United States in 1994 (EPA, 1994a). Approximately 50 percent of batch cold cleaning machines are used in automotive repair shops (Standard Industrial Classification [SIC] Code 753). This includes top, body, and upholstery repair and paint shops (SIC Code 7532), automotive exhaust system repair shops (SIC Code 7533), tire retreading and repair shops (SIC Code 7534), automotive glass replacement shops (SIC Code 7536), automotive transmission repair shops (SIC Code 7537), general automotive repair shops (SIC Code 7538), and automotive repair shops not elsewhere classified (SIC Code 7539). Automotive repair shops generally use smaller cold cleaning machines with a solvent/air interface less than or equal to 0.4 m^2. Larger immersion batch cold cleaning machines are used in manufacturing processes as well as automotive rebuilding and repair, and machining industries (EPA, 1991; EPA, 1994a).

2.1.2 BATCH VAPOR CLEANING MACHINES

Batch vapor cleaning machines represent the largest source of halogenated solvent (e.g., TCA, TCE, methylene chloride, PERC, carbon tetrachloride, and chloroform) emissions. The most common type of batch vapor cleaning machine is the Open Top Vapor Cleaner (OTVC). The OTVC is a tank designed to generate and contain solvent vapor. The tank is equipped with a heating system that uses steam, electricity, hot water, or a heat pump to boil the liquid solvent. As the solvent boils, dense solvent vapors rise and displace the air in the tank. Coolant is

circulated in condensing coils on the top of the tank to create a controlled vapor zone within the tank. Condensing solvent vapors dissolve the contaminants on the surface of the workload and flush both the dissolved and undissolved contaminants from the workload. When the temperature of the workload equals the temperature of the vapor, no further cleaning will occur by this mechanism (because solvent will no longer condense on the part). The vapor cleaning phase may be supplemented, or even replaced, by the immersion of the workload into the hot liquid solvent. Several operational variations are possible. The cleaning cycle can be modified from a basic vapor cleaning cycle to improve cleaning efficiency. One OTVC operational variation is the immersion-vapor-spray cycle where the workload is first immersed in the warm or boiling solvent for precleaning. The workload is then cleaned in the vapor section and sprayed with the solvent. Organic impurities (e.g., grease and oil) do not contaminate the vapor because of their higher boiling points. Because the solvent remains clean, it can be used for longer periods of time compared to cold cleaning.

Non-OTVC batch vapor cleaning machines are a hybrid of the OTVC and in-line machines. They tend to be larger, with an enclosed design with conveyorized systems for moving large parts and parts baskets. Non-OTVC batch cleaning machines include the cross-rod, the vibra, the Ferris wheel, and the carousel cleaners. All of these cleaning machines tend to have multiple loads within the machine simultaneously. The cross-rod degreaser contains rods with suspended parts baskets and is fully enclosed with the exception of one opening. Through this opening, parts enter and exit the machine. Since parts tend to be loaded semicontinuously and typically manually, the machine is classified as a batch unit. In the vibra cleaning machine, the soiled parts are fed in a batch into a pan and flooded with boiling solvent at the bottom of the machine. The machine includes a vibrating spiral elevator that lifts the parts through the increasing cleaner solvent baths (either vapor or liquid). This unit can clean large volumes of small parts. The Ferris wheel machine is so named because it is typically characterized by four baskets rotating in a vertical plane. The cleaner would typically have four stages; at any one time, one parts basket is in each stage. One stage is for loading and unloading of parts and is located at the only opening in the machine. The other three stages are various cleaning stages including spray, solvent bath, and/or vapor cleaning. The carousel cleaning machine is similar to the Ferris wheel machine except that parts move through a horizontal plane.

In 1991, 16,400 batch vapor cleaning machines using halogenated solvents were estimated to be in operation in the United States, and it is estimated that those machines used approximately 104,500 tons of methylene chloride, PERC, TCE, TCA, and 1,1,1-trichloro-2,2,2-trifluoroethane (CFC-113) (EPA, 1993a). Stoddard solvent is not used in batch vapor cleaning machines due to its flammability. Thus, only machines using TCE would need to be considered for a VOC inventory.

An estimated 10,000 to 13,500 small vapor cleaning machines could potentially be small sources for hazardous air pollutants (HAPs) that would need to be inventoried as area sources unless they are collocated and counted as part of a major source. Assuming no emissions control, it is

estimated that half of the large vapor cleaning machines (those with an average 16 ft^2 working area) emit less than 10 tons per year of a HAP, and could also be counted as area sources (EPA, 1993a).

The largest amounts of halogenated solvent used for cleaning are in the manufacture of furniture and fixtures (SIC Code 25), fabricated metal manufacturing (SIC Code 34), electric and electronic equipment (SIC Code 36), transportation equipment (SIC Code 37), and miscellaneous manufacturing industries (SIC Code 39). Other industries that use halogenated solvents for cleaning include food and kindred products (SIC Code 20), primary metals (SIC Code 33), nonelectric machinery (SIC Code 35), and instruments and clocks (SIC Code 38). Nonmanufacturing industries such as railroad, bus, aircraft, and truck maintenance facilities, automotive and electric tool repair shops, automobile dealers, service stations, and miscellaneous repair services (SIC Codes 40, 41, 42, 45, 49, 55, 75, and 76, respectively) also use halogenated solvents for solvent cleaning (EPA, 1993a).

2.1.3 IN-LINE CLEANING MACHINES

In-line cleaners are usually inventoried as point sources (EPA, 1991). In-line cleaning machines employ automated loading on a continuous basis. These machines are often custom made for large-scale operations and can work in a vapor or nonvapor mode. However, the vapor mode is most commonly used. A continuous or multiple-batch loading system greatly reduces or even eliminates the manual parts handling associated with batch cleaning. The cross-rod batch cleaning machine can also be designed to operate continuously with no manual loading. The same cleaning techniques are used for in-line cleaning as for batch cleaning but on a larger scale. In-line cleaning machines are enclosed to prevent solvent losses; however, entry and exit openings cannot be sealed (EPA, 1993a). The four types of in-line cleaning machines are: monorail, belt, strip, and printed circuit board processing equipment (e.g., photoresist strippers, flux cleaners, and developers). The monorail vapor cleaning machine is used when the workload to be cleaned is being transported between manufacturing operations on a monorail conveyor (EPA, 1993a). A belt cleaning machine conveys the workload through a long and narrow boiling chamber where the workload is cleaned by condensing vapor or immersion. The strip cleaning machine is similar to the belt cleaner except the strip is the material being cleaned. Printed circuit boards are cleaned with photoresist strippers and circuit board cleaning machines (EPA, 1993a).

The five most common halogenated solvents used in in-line solvent cleaning operations are methylene chloride, PERC, TCE, TCA, and CFC-113 (EPA, 1993a). PERC, TCE, and TCA are commonly used because they are not flammable and their vapors are much heavier than air (EPA, 1991). In 1991, an estimated 39,000 tons of halogenated solvents were used by vapor in-line solvent cleaning machines (EPA, 1993a). Approximately 2,500 to 4,000 in-line cleaners employing halogenated solvents were estimated to be in operation in 1991 (EPA, 1991).

In-line solvent cleaning machines are used by a broad spectrum of industries but are most often found in plants where there is a constant stream of parts to be cleaned, such as printed circuit boards for the electronic and electrical components industry (EPA, 1991; EPA, 1993a).

2.1.4 CLEANUP SOLVENT USE (EPA, 1994B)

Cleanup solvents are used to clean external surfaces, such as products, parts and equipment, floors, tables, and walls, and internal surfaces or containers, such as tanks and supply lines. Cleaning processes may include wiping using mops, brushes, and rags, spraying, flushing the interiors of equipment, purging spray equipment, or dipping small parts in vessels of solvents. These processes are used to clean products as part of the manufacturing process, such as before painting, cleaning of process equipment, and cleaning before maintenance.

Wiping is perhaps the most common cleaning activity because the contaminant is quickly removed. Wipe cleaning is easily performed anywhere in the plant and is a frequent part of maintenance activities (e.g., cleaning machinery, floors). Surfaces can be cleaned while in place without disassembly. Wipe cleaning is an integral part of many production processes including automotive manufacturing, truck and bus manufacturing, and automotive parts and accessories manufacturing; in the manufacture of adhesives, packaging, plastics, furniture, fiberglass boats, electrical equipment, magnetic tape, and photographic chemicals; and rotogravure printing and autobody refinishing as well as offset lithographic printing.

Frequently used industrial cleaning solvents include acetone, butyl acetate, cyclohexanone, ethanol, ethyl acetate, ethylbenzene, ethylene glycol, isopropyl alcohol, methanol, methyl ethyl ketone, methyl isobutyl ketone, naphtha, PERC, toluene, and xylene. Estimated annual cleaning solvent usage ranges from 270,000 to 1,400,000 tons per year; however, this estimate is for the industries listed above. Nationwide use of cleaning solvents has not been quantified and is expected to be much higher.

2.2 EMISSION SOURCES

2.2.1 CLEANING MACHINES

Batch and in-line solvent cleaning machines are characterized by three operating modes that have characteristic emission mechanisms. The operating modes are idling, working, and downtime. Cold cleaners do not have an idling mode. Fugitive emissions also occur as a result of leaks, filling/draining losses, wastewater losses, start-up/shutdown losses, distillation losses, and solvent decomposition losses.

Idling emissions occur when the cleaning machine is turned on and ready to operate, but is not actively processing parts. Air and solvent interface losses consist of solvent vapor diffusion (or

evaporation from liquid solvent in cold cleaning machines) and solvent convection caused by a warm freeboard (freeboard is the distance between the top of the tank and the solvent/air interface). Diffusion occurs because solvent molecules move from areas of higher concentration in the vapor zone to areas of lower concentration in the air. Idling diffusion is the greatest when air flow is introduced across the solvent/air interface from room drafts. Drafts can also sweep solvent-laden air from the freeboard area into the ambient air. Convection occurs from the tank walls being heated from the heated liquid solvent and vapor. Emissions occur as a result of the convective flow up along the freeboard that carries solvent vapor out of the cleaning machine. If freeboards are kept at ambient temperatures, emissions will be minimized. Emission rate variance can be explained by the varying primary condensing temperatures; however, emission rates are lowest when the primary condenser temperature of the cleaning machine is the lowest. Typical idling losses are 0.03 $lb/ft^2/hr$ (EPA, 1993a).

Working emissions occur when the cleaning machine is turned on and operating and include idling emissions with additional emissions from the introduction of parts being cleaned, the cleaning process (e.g., spraying), the evaporation of solvent from the part as the workload is pulled out of the cleaning machine, and solvent carryout. Working emissions from cold cleaners include solvent carryout and cleaning process losses. The typical emission rate for working emissions is 0.40 $lb/ft^2/hr$. Emission rate variability is caused by varying operational parameters (EPA, 1993a).

Downtime emissions occur when the heat to the sump (cleaning machine tank) is turned off and the cleaning machine is not operating. Downtime emission mechanisms include evaporation of solvent from the liquid solvent surface and subsequent diffusion into the air. Downtime emission rates are estimated to be 0.30 $lb/ft^2/hr$ (EPA, 1993a).

2.2.2 CLEANUP SOLVENTS

Emission sources from the use of cleanup solvents occur due to solvent evaporation. Typical sources of evaporation are emissions from storage and handling of fresh and spent solvents, solvent evaporation from the cleaned surfaces, evaporation as the solvent is splashed or sprayed, fugitive emissions from flushing or spray systems, and evaporation from solvent-soaked rags or cleaning tools. All solvent not recycled or sent to waste disposal is eventually emitted into the atmosphere (EPA, 1994b).

2.3 FACTORS INFLUENCING EMISSIONS

Process operating factors largely influence emissions from cleaning machines and wipe cleaning. These are:

- Leaks from manufacturing defects or equipment use;

- Manual filling and draining of cleaning machines, especially with open buckets and drums;
- Water/solvent separators;
- Start-up operations that cause solvent-laden air to be dispersed into the ambient air when a new solvent vapor layer is being established;
- Shutdown operations that create emissions from evaporation of hot solvent;
- Emissions from distillation/sludge disposal that occur when spent solvent is regenerated on-site:
- Excessive pooling/entraining of solvents on improperly oriented or drained parts;
- Solvent decomposition;
- Turbulence from high conveyor belt speeds and from manual removal of parts;
- Exhaust systems used without a carbon adsorber;
- Careless or improper use of cleaning tools (e.g., rags, brushes) or parts during and after cleaning;
- Splashing and spilling of the solvent;
- Lack of a cover over solvent;
- Drying of parts in areas vented directly to the atmosphere; and
- Using adsorbent or porous items such as ropes and bags for handling solvent-soaked items (EPA, 1993a, 1994b).

Emissions from cold cleaning machines may also be influenced by physical and chemical properties of the solvent in the machine. These chemical factors include volatility, viscosity, boiling points, and surface tension.

2.4 CONTROL TECHNIQUES

2.4.1 CLEANING MACHINES

Techniques used to control emissions from solvent cleaning machines include both machine design controls as well as improved operating procedures. Control technologies are based on the size, design, application, and operation of the machines. Many of these control techniques are required on all sizes of halogenated cleaners by the National Emission Standards for Hazardous Air Pollutants: Halogenated Solvent Cleaning. Design features that control solvent emissions from batch cold cleaning machines include:

- Increased freeboard ratio;
- Covers;
- Internal drainage rack; and
- Visible fill line.

Emissions from carburetor cold cleaning machines are well controlled because the cleaning solutions contain water, which forms a layer above the solvent mixture in the tank. This water layer significantly reduces the evaporation of methylene chloride into the air (EPA, 1994a).

Design features that decrease emissions from batch vapor and in-line cleaning machines include the following:

- Covers to eliminate drafts, control vapor/air interface emissions, and reduce diffusion losses;
- Freeboard refrigeration devices that use a second set of cooling coils cool the air directly above the vapor zone forming a cool air blanket and decreasing diffusional losses;
- Hot vapor recycle or superheated vapor designs to create a zone of superheated solvent vapor within the vapor layer. Cleaned parts are passed through the superheated zone so the liquid solvent is evaporated prior to the part being withdrawn from the batch or in-line cleaner. This method is expected to be used mostly with chlorofluorinated solvents;

- Increased freeboard height to decrease turbulence caused by room drafts and increase the diffusion column;

- Vacuum chamber cleaning machines, a new type of batch cleaning machine that decreases emissions by cleaning items in a sealed decompression chamber. Emission concentrations of less than 50 parts per million (ppm) per cleaning cycle have been reported (EPA, 1993a);

- In-line cleaning machines that can be designed with a U-turn to decrease entrance and exit opening emissions by reducing drafts within the in-line cleaning machines. Hanging flags over these openings will also reduce drafts;

- Freeboard refrigeration devices, which are similar to those used in batch cleaning machines, to decrease emissions;

- A drying tunnel, which is an added enclosure that extends the exit area for drying purposes, to reduce carryout emissions because evaporated solvent will sink back into the vapor zone instead of the atmosphere;

- Rotating baskets to prevent the trapping of liquid solvent in parts and, therefore, also reduce carryout emissions; and

- The use of carbon adsorption when a lip exhaust system is used to reduce solvent concentration around the top perimeter of the cleaner. This is done by capturing solvent vapors from peripheral exhaust ducts and ducting to an activated carbon bed before the vent stream is exhausted to the atmosphere. The bed is desorbed and the recovered solvent can be reused in the cleaning machine. This option may increase solvent usage and waste if the solvent is not removed (EPA, 1994a).

Work practice modifications to decrease emissions from batch, in-line, and cold cleaning machines include the following:

- Decreasing the speed at which parts are moved in and out of openings in a solvent cleaning machine;

- Reducing room drafts;

- Limiting the horizontal area of the load to be cleaned to 50 percent or less of the batch cleaning machine solvent/air interface area;

- Spraying within the vapor zone at a downward angle helps control excess emissions;
- Turning on the primary condenser before heating the solvent will reduce solvent emissions at start-up;
- Allowing the cooling system to stay on after the heater is shut off will reduce shutdown emissions;
- Using covers and freeboard refrigeration devices during downtime;
- Pumping the solvent into an airtight storage container during downtime;
- Detecting and repairing routine leaks on a regular schedule;
- Employing submerged pipe filling to decrease solvent transfer losses;
- Not bypassing carbon adsorbers during the desorption cycle; and
- Replacing the carbon bed often to prevent solvent breakthrough (EPA, 1993a).

Many of these work practices have been proposed in the New Source Performance Standards for cold cleaning machines.

In addition, alternative cleaning solvents are being developed that may be substituted for halogenated or nonhalogenated solvents in some cases. Alternative cleaning solvents are generally grouped into the following categories: (1) hydrochlorofluorocarbons (HCFCs); (2) aqueous; (3) semiaqueous; and (4) organic solvents. HCFCs are used to replace CFCs and TCA; however, the use of these HCFCs are temporary because their production will be banned by the Montreal Protocols. Aqueous cleaners can be substituted for solvents, because they use water as the primary solvent with alkaline salts, surfactants, and other additives. Aqueous cleaners can effectively clean inorganic or polar soils, oils, greases, and films. Semiaqueous cleaners can be substituted for halogenated solvents. These solutions combine terpenes or hydrocarbons with surfactants along with additives such as corrosion inhibitors. These cleaners can effectively remove heavy grease, tar, waxes, hard-to-remove soil, and polar and nonpolar contaminants. Organic solvent cleaners use no water and include oxygenated hydrocarbon formulations, aliphatic hydrocarbons, esters, glycol ethers, alcohols, aromatics, and ketones. These solvent alternatives should be identified and included in a VOC inventory.

Alternative cleaning technologies currently being developed include ice particle cleaning, plasma cleaning, and cleaning with high-pressure gases, supercritical fluids, and ultraviolet ozone (EPA,

1993a). The Solvent Alternatives Guide (SAGE), a software system distributed by EPA, can provide recommendations for solvent replacements in cleaning operations.[a]

2.4.2 CLEANUP SOLVENTS

Emission reduction techniques for solvent cleaning activities include substituting a less volatile solvent, reducing usage rates, and better management of the spent solvent and the wipes, rags, other cleaning tools. Improved work practices are particularly important in minimizing evaporative emissions.

2.5 REGULATORY STATUS

Based on the high usage and emissions of these cleaners throughout industry as well as the large number of cleaners, the EPA determined that there is a great potential for exposure to HAPs used as solvents in solvent cleaning machines. In addition, the EPA has determined that these compounds present a threat of adverse effects to human health or the environment.

Control technique guidelines for solvent cleaning were established in 1977 for the control of VOCs from solvent cleaning machines. These recommended requirements were adopted by 33 states. In 1980, a New Source Performance Standard (NSPS) was proposed for the solvent cleaning industry. An Alternative Control Techniques (ACT) document for halogenated solvent cleaning machines was published in 1989 after substantial review by industry. In 1994, a National Emission Standard for Hazardous Air Pollutants (NESHAP) was promulgated to regulate HAP emissions from halogenated solvent cleaning machines. The most recent information about the regulatory status of solvent cleaning processes can be found on the EPA Technology Transfer Network (TTN). See Chapter 1 of this volume for more information about the EPA TTN.

2.5.1 SOLVENT CLEANING MACHINES

The halogenated solvent cleaning NESHAP promulgated in December 1994 (59 FR 61801, December 2, 1994) established standards for both area and major sources of solvent cleaners using HAP solvent. The NESHAP requires batch vapor solvent cleaning machines and in-line solvent cleaning machines to meet emission standards reflecting the application of the maximum achievable control technology (MACT). Area source batch cold cleaning machines are required

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[a] SAGE can be downloaded from the Control Technology Center (CTC) portion of the EPA Technology Transfer Network (TTN) bulletin board. For Internet access to the EPA TTN, use: http://ttn.www.rtpnc.epa.gov.

to achieve generally available control technology (GACT). The rule regulates the emissions of the following halogenated solvents: methylene chloride, PERC, TCE, TCA, carbon tetrachloride, and chloroform.

The proposed NSPS for cold cleaning operations requires sources to control emissions to the level achievable by the best demonstrated technology (BDT) (*Federal Register*, 1994). The proposed BDT is a combination of equipment and work practice standards that allow for the best emission control and enforceability. The BDT for large cold cleaning machines (>1.8 m^2) includes requirements for covers, drain racks, increased drain time, a visible fill line, a freeboard ratio (the relationship of freeboard height divided by the interior width of the cleaning machine) of at least 0.5, solvent pump pressure design limits, work practice labels, and reporting and recordkeeping of solvent usage and disposition.

Twenty-six state agencies currently regulate in-line batch cold, batch vapor, and solvent cleaning machines. These states are listed in Table 6.2-1. All 26 states require the use of control equipment (e.g., covers, increased freeboard ratio) and specify work practices such as leak detection and repair programs.

Consumption of TCA, CFC, and carbon tetrachloride is expected to decline rapidly in solvent cleaning operations because of their scheduled phaseout as a result of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, Title VI of the 1990 Clean Air Act Amendments (CAAA), and an Executive Order (58 FR 65018, December 10, 1993). Production of these solvents is scheduled to cease in 1996.

However, their use will extend into the future. As a result of the Montreal Protocol and the 1994 solvent cleaning NESHAP, it is expected that 27 percent of the 1994 population of cleaning machines will be replaced with new machines. The industry has been shifting from halogenated solvents to nonhalogenated solvents, including aqueous and semiaqueous solvents.

2.5.2 CLEANUP SOLVENTS

Cleanup solvents have not been addressed by federal regulations in the Clean Air Act; however the *Alternative Control Techniques Document - Industrial Cleaning Solvents* (EPA, 1994b) has been developed to assist state and local agencies reducing VOC emissions.

Sixteen states currently regulate VOC emissions from cleanup solvents. In addition, regulations at the city and county level have been developed to control VOCs. Approximately 46 percent of these regulations have only recordkeeping requirements. Eleven agencies regulate control equipment, and 14 agencies regulate work practices. Only five agencies limit VOC emissions, and eight agencies regulate the type of solvents used. A summary of state, county, and city regulations is shown in Table 6.2-2.

2.5.3 SUMMARY

At this time, two federal rules apply to the solvent cleaning source category, the NESHAP promulgated in 1994 for halogenated solvent cleaning and CAAA Title VI, which resulted from the Montreal Protocol on Substances that Deplete the Ozone Layer. The NESHAP requires that all machines (batch vapor, in-line, and batch cold cleaning machines) using halogenated solvents either demonstrate that each machine emits less than a defined limit, or demonstrate compliance through tracking of consumption. All affected facilities must submit an initial notification report at a minimum.

TABLE 6.2-1

STATE REGULATIONS

State	Citation
Alabama	Code of Alabama 22-28-14, 22-22A5, 6, 8
California Bay Area	Regulation 8, Rule 16
California South Coast	Regulation IX Section 1122
Colorado	Colorado Code of Regulations Section 5
Delaware	Dept. of Natural Resources; Regulation 24 Section 33
Florida	F.A.C. Rule 62-296.511
Georgia	391-3-1-.02(w)-(2)(ff)
Illinois	Title 35 Subtitle B Chapter I Section 215-182, 183, 184
Indiana	326 IAC 8-3-1
Kansas	KSA 65-3005, 3010
Kentucky	401 KAR 59:185
Louisiana	LAC 33: III Chapter 21, Subchapter C
Michigan	Rule 336.1612, 1614, 1708, 1710
Missouri	10 CRS 10
New York	Title 6, Chapter 111, Subchapter A, Part 226

North Carolina	Title 15A, Chapter 2, Subchapter 2D
Ohio	Title 3745, Chapter 21
Oregon	Chapter 340, Division 22-180, 182, 186
Pennsylvania	Title 25, Chapter 129.63
South Carolina	Chapter 61-62
Tennessee	TCA 1200-3-18-.31

TABLE 6.2-1

(CONTINUED)

State	Citation
Texas	19 TexReg 3703, 30 TAC Chapter 115, Subchapter E, Sections 115.412-115.419[a]
Utah	R307-1-4.9.4
Virginia	VR 120-04-2403, 2404
Washington	Title 173, Chapter 173-490-40
West Virginia	4521-30
Wisconsin	Natural Resources 423.03

[a] Texas regulations are available on-line in hypertext mark-up language (HTML), PDF, or text versions on the World Wide Web at http://www.tnrcc.state.us.

The processes regulated through the NESHAP use solvents that are mostly non-VOCs. The exceptions are TCE and chloroform. The Montreal Protocol and associated CAAA Title VI rules further reduce the likelihood of emissions of solvents that are being phased out after 1997. Both the NESHAP and Title VI rules simplify tracking and information collection for these processes and the chemicals used in them. It is important to note that the processes regulated under the NESHAP may be limited in importance as VOC emitters, but would be important processes to investigate for a HAP inventory.

The cold cleaner NSPS planned to be promulgated in 1997 will affect cold cleaners with a surface area greater than 1.8 m^2 (19 ft^2), which is a small proportion of cold cleaners that use nonhalogenated solvents. Recordkeeping or reporting requirements have not yet been defined. Cold cleaner processes must be evaluated for emissions to be included in VOC and HAP inventories. No federal rules exist for the use of cleanup solvents. If solvent cleaning machines covered by the NESHAP are inventoried as part of the point source inventory, then cleanup solvent use and cold cleaners will be the only processes that need to be inventoried for a VOC area source inventory.

TABLE 6.2-2

CLEANUP SOLVENT REGULATIONS BY STATE

State	Control Equipment	Work Practice	Recordkeeping	Emission Limits	Solvent Type Restrictions	Source Category Regulated
Alabama, Jefferson County			x			Surface coating operations
Alabama, Huntsville			x			Surface coating operations
Arizona, State				x		
Arkansas, State			x			
California, State		x	x			
California South Coast	x	x			x	Coating, ink, and adhesive applications
California Bay Area	x	x	x			Surface coating operations
California, Ventura County	x	x	x		x	Surface coating operations; aerospace assembly
Colorado, State			x			
Colorado, Denver City/County		x	x			
Florida, Jacksonville	x	x			x	

TABLE 6.2-2

(CONTINUED)

State	Control Equipment	Work Practice	Recordkeeping	Emission Limits	Solvent Type Restrictions	Source Category Regulated
Georgia, State			x			
Indiana, State	x	x	x			
Indiana, Evansville			x			
Iowa, State		x		x		
Iowa, Polk County			x			
Kansas, State	x	x	x			Lithographic printing, metal parts cleaning
Kentucky, State			x			
Louisiana, State			x			
Maryland, Baltimore					x	
Michigan, Wayne County					x	Paint manufacturing
Minnesota, State			x			
Missouri, State	x	x	x		x	Lithographic, rotogravure and flexographic printing
Nevada, Washoe County	x		x			
North Carolina, Buncombe County			x			

TABLE 6.2-2

(CONTINUED)

State	Control Equipment	Work Practice	Recordkeeping	Emission Limits	Solvent Type Restrictions	Source Category Regulated
North Carolina, Forsyth County			x			
Ohio, Dayton		x		x	x	
Oklahoma, Tulsa City/County		x	x			
Pennsylvania, Allegheny County			x	x		Surface coating operations
Pennsylvania, Philadelphia			x			
Pennsylvania, State	x		x			
Tennessee, Memphis County			x			
Tennessee, Shelby County			x			
Tennessee, Metropolitan	x	x	x		x	
Tennessee, State			x			
Texas, selected counties[a]	x	x	x	x[c]	[b] x[d]	Cold cleaning, open-top vapor cleaning, conveyorized cleaning, auto refinishing, and lithographic printing
Virginia, State			x			

TABLE 6.2-2

(CONTINUED)

State	Control Equipment	Work Practice	Recordkeeping	Emission Limits	Solvent Type Restrictions	Source Category Regulated
Washington, Puget Sound	x		x			
Wisconsin, State		x	x	x		

[a] Not all counties in Texas are affected. See footnote to Table 6.2-1 of this chapter for more information about Texas regulations.
[b] Recordkeeping is required for open-top vapor cleaning, conveyorized cleaning, and lithographic printing.
[c] Emission limits apply to open-top vapor cleaning only.
[d] Solvent type restrictions apply to lithographic printing only.

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3

OVERVIEW OF AVAILABLE METHODS

3.1 EMISSION ESTIMATION METHODOLOGIES

A number of methods are available for estimating emissions from solvent cleaning activities. The choice of method depends on the desired degree of accuracy for the estimate while taking into account the availability of data and resources. This section presents and ranks each of the available methods. The first part of this section describes the general methods for estimating emissions. The second part provides ways to determine the species-specific emission estimates. Section 4 of this chapter describes the preferred method, and Section 5 covers the alternative methods for estimating solvent cleaning activity emissions.

Emissions from solvent cleaning machines can also be considered to be point sources; therefore, the estimation process for the source category must take this into account to prevent double-counting of emissions. Additionally, emissions from solvent cleanup may be included as a part of an industry- or process-specific emission estimate. The inventory preparer will need to evaluate how these other sources are inventoried to ensure that double-counting is avoided. Sources of solvent cleaning emissions that will not be addressed through the use of facility-specific data include smaller cold cleaners (less than 1.8 m^2 or 19 ft^2) that are exempt from the NSPS, cleanup solvent uses for permitted facilities that need not report all sources of the pollutant, and nonpermitted facilities.

3.1.1 SOLVENT EMISSIONS

There are four general approaches available for estimating solvent emissions from solvent cleaning:

- Surveys of:
  - Users
  - Suppliers who provide both equipment and solvent ("full service" suppliers), for example, as a part of a service contract (cold cleaners primarily)
  - Solvent suppliers
  - Equipment suppliers

- Facility-specific data;

- Emission factors:
  - Population-based (per capita)
  - Employee-based (per employee)
  - Equipment-based (per unit in use); and

- Apportionment of national/regional/local area solvent uses ("top down" approach).

Emissions from solvent cleaning activities occur as a result of solvent evaporation. Consequently, annual emissions can be estimated based on the amount of solvent used per year. Where the solvent is recycled, reclaimed, or disposed of off-site, the annual usage must be adjusted for this amount. Also, if emissions are being captured by an air emissions control device, this amount must be subtracted from the annual usage.

Table 6.3-1 summarizes and ranks the emission estimation methods for each of the categories of solvent cleaning.

TABLE 6.3-1

SUMMARY OF AVAILABLE ESTIMATION METHODS FOR SOLVENT CLEANING ACTIVITIES

Category	Methods		
	Surveys	**Facility-specific Data**	**Emission Factors**
• Halogenated solvent cleaning equipment	Alternative 1	Preferred	Alternative 2
• Cold cleaning equipment	Preferred[a]	Alternative 1	Alternative 2
• Solvents used for cleanup	Preferred	Alternative 1	Alternative 2

[a] The final NSPS may require facility-specific data for larger cold cleaners. These data would become the preferred method. A survey would still be needed for the smaller cold cleaners.

3.1.2 SURVEYS

Survey methods can usually provide the most locality-specific information, and a higher quality emission estimate. From a practical standpoint, the method is the most expensive, and it is often difficult to identify facilities to participate in the survey and to assure that the group is a representative subset of the entire population. The success of surveys depends heavily on the rate and completeness of the responses, and many small facilities who use solvents for cleaning do not have the resources to participate fully. An example of a large-scale survey for solvent cleaning emissions can be found in Roe, et. al., 1995.

Of the four possible survey populations for this source category, data from the user is theoretically more complete. Not only will the responses supply the kinds of solvent uses, the associated types and quantities of solvents, and the level of emission control, but the detailed information allows for better control strategy development. Furthermore, facilities that have been identified as point sources can be more easily subtracted from the area source inventory so that the inventory preparer can avoid double counting. Because of the wide variety of solvents used for cleaning, surveying the user is the only practical approach for vapor cleaning machines. Even then, the practical difficulties of surveying so many users of solvent cleaning equipment limit the utility of this approach. Industries that may use solvent cleaning processes can be identified through their SIC Codes in permit files, Chamber of Commerce listings, or local property tax listings for solvent cleaning equipment. See Sections 2.1.1, 2.1.2, and 2.1.3 of this chapter for SIC Codes of businesses that may use solvent cleaning.

Surveying the full services supplier (company supplying equipment, solvent, and/or service) instead of the user is primarily feasible for cold cleaners. Surveys of suppliers who provide just equipment or just solvent for cleaning machines are not generally recommended. These groups are too removed from the use of the solvents and many assumptions must be made that introduce a higher degree of inaccuracy in the emission estimates. More detail could be obtained by surveying a subset of users for emissions from specific processes, then using information from suppliers and recyclers to scale up emissions to the entire inventory area.

For solvent cleanup activities, a survey of solvent suppliers is one of the few options available unless facility-specific data include these uses. Even though the solvent supplier may provide usage data for the different solvents, the inventory preparer must still determine what other uses the solvents might have and estimate how much is actually used for cleaning. As in the case for cold cleaners, a survey of a small subset of users could be used to determine the type and amounts of solvents used for cleaning, and emissions could be scaled up with a surrogate such as amounts of solvents distributed or recyled.

3.1.3 FACILITY-SPECIFIC DATA

The use of facility-specific data that may already be in house at the state or local agency has some clear advantages. With reporting requirements under the halogenated solvent cleaning NESHAP

soon to take effect, all users of halogenated solvent cleaning equipment will be required to submit an initial notification to state agencies. As a part of the notification, users also are to provide annual solvent consumption and control practices information. Emissions can be estimated from this information. A requirement for initial notification has also been proposed under the cold cleaners NSPS, thus information for this part of the solvent cleaning category may soon be available as well. Facility permit files such as those required by Title V are also a possible source of information.

Solvent cleaning activities that either are not or are unlikely to be subject to the standards include small cold cleaners and solvent cleanup. For some facilities, estimates may be available if the facility has had to report these sources as a part of a permit application. These data would need to be available for a majority of the facilities to be inventoried, or at least for a representative number of the facilities where the number and type of facilities are known, and the data should be reasonably current.

Facility-specific data are often already incorporated into point source inventories. The goal in an area source inventory is to account for emissions that have not be included in the point source inventory, but information being compiled is less detailed. In some cases, it may be possible to define some assumptions about industries that allow for less data collection and compilation. The first step in area source inventory preparation is to determine how much of the source category emissions have been included in the point source inventory.

3.1.4 EMISSION FACTORS

Emission factors are an alternative estimation method to surveys and facility-specific data. Some emission factors may need to be used in conjunction with surveys where a survey would be used to determine activity (e.g., number of cold cleaners in use). Several emission factors are available for VOCs from solvent cleaning machines. There are three types:

- Per capita;
- Per employee; and
- Per equipment unit in use.

Of these, per unit-in-use emission factors would be the most accurate, followed by per employee emission factors. Per capita emission factors would be the least accurate because solvent cleaning is not necessarily related to population.

For solvent cleanup emissions, solvent use and emission estimates presented in the EPA document *Alternative Control Techniques - Industrial Cleaning Solvents* (industrial solvent

cleaning ACT) are based on emission factors (EPA, 1994b). However, the emission factors are not presented in that document.

To apportion national/regional/local area solvent uses, a "top-down" approach has the benefit of providing a conservative estimate of emissions but runs the risk of overestimating the contribution of solvent use for cleanup. All of the solvents used in cleaning have other applications; therefore, care must be taken to subtract these other uses from the total if a reasonable estimate of emissions attributable to solvent cleaning is to be determined. Identifying these other uses and the associated solvent consumption can be difficult. Consequently, the resulting emission estimate may be inaccurate. This method is not recommended as an inventory method, and is perhaps best used as an order-of-magnitude reality check on estimates derived using one of the recommended methods.

3.1.5 SPECIATED EMISSIONS (VOCS, HAPS)

Cold cleaners can be divided into two groups: carburetor cleaners and other cold cleaners. Carburetor cleaners may use halogenated cleaners such as methylene chloride, and nonhalogenated solvents. As a result, carburetor cleaners that use halogenated solvents are subject to NESHAP reporting requirements. Other types of cold cleaning equipment use nonhalogenated solvents and are not subject to NESHAP reporting. For batch vapor and in-line degreasers, TCE is the only common solvent that is a VOC. In general, cold cleaner solvents are not EPA-listed HAPs. For the batch and in-line degreasers, all the common solvents except CFC-113 are EPA-listed HAPs.

Solvents frequently used in cleanup tend to be used both as pure solvents and as mixtures. The solvents identified as commonly used in the industrial solvent cleaning ACT are listed in Table 6.3-2. Also shown is whether the solvent is classified as a reactive VOC for inventory purposes, and/or a HAP. Please note that acetone and perchloroethylene are not listed as reactive VOCs.

For purposes of future inventory development, it is important to note that production of CFC-113 and TCA, which are regulated under Title VI of the Clean Air Act Amendments, will cease in 1996. Inventory preparers should also be aware that air toxics regulations may cause the types of solvents used for cleaning to change further. Some companies have begun moving away from the more toxic solvents as a part of corporate objectives to be more environmentally conscientious.

TABLE 6.3-2

COMMONLY USED CLEANUP SOLVENTS[a]

Solvent	Volatile Organic Compound[b]	Hazardous Air Pollutant[c]
Acetone	No	No
Alcohols[d]	Yes	—[e]
Butyl Acetate	Yes	No
Cyclohexanone	Yes	No
Ethanol	Yes	No
Ethyl Acetate	Yes	Yes
Ethylbenzene	Yes	Yes
Ethylene Glycol	Yes	Yes
Isopropyl Alcohol	Yes	No
Methanol	Yes	Yes
Methyl Ethyl Ketone	Yes	Yes
Naphtha[f]	Yes	—[g]
Perchloroethylene	No	Yes
Toluene	Yes	Yes
Xylene	Yes	Yes

[a] EPA, 1994b, p. 3-15.
[b] These are reactive VOCs.
[c] The HAPs are subject to regulation under Section 112 of the 1990 Clean Air Act Amendments.
[d] Total nonspecified production of C_{11} or lower unmixed alcohols.
[e] This class may include the use of methanol, phenol and cresols, which are HAPs.
[f] This solvent includes naphthas, petroleum naphtha, VM&P naphtha, mineral spirits, Stoddard solvent, naphthols, and naphthanols.
[g] Naphthas may include HAPs but generally only in trace amounts.

Speciated emission factors are not generally available. When a survey or facility-specific data from reporting and permits are used for the inventory, VOC and HAP contents of the solvents used can be obtained along with the rest of the inventory data. This is the preferred method of speciating emissions for this source category. For vapor cleaning equipment, the solvent is usually a single compound. The second alternative method for cold cleaners recommends using cleaning unit solvent information from suppliers to develop a VOC emission factor. This solvent information also can be used to estimate HAP emissions.

3.2 DATA NEEDS

3.2.1 DATA ELEMENTS

The data needed to estimate emissions depend on the estimation method selected. Minimum elements for a survey on solvent cleaning machines would include:

- The type of solvent cleaning machine(s) used; and

- For each solvent cleaning machine:
  - The type of solvent(s) used;
  - Solvent composition and characteristics (supplying a material safety data sheet will suffice);
  - How much solvent is used per year, on average (annual purchases can serve as a surrogate);
  - How much of the solvent used is recycled off-site and not returned to the site;
  - How much of the solvent used is disposed of off-site (i.e., is not recycled);
  - The types of emission controls in use; and
  - Work practices that may affect emissions.

For a cleanup solvents survey, information requested should include:

- The types of solvents used;

- A general description of the use for each solvent;

- The annual amount of each solvent used; and

- Any recycling, reclamation, and off-site disposal amount for the reporting year.

Facility-specific information will include initial reports submitted under the halogenated solvent cleaning NESHAP that contain solvent usage and emission control information. For larger cold

cleaners, similar reports may be required under the cold cleaners NSPS as well. For smaller cold cleaners and solvent cleanup, data would only have been provided to the state as a part of another requirement, such as a part of the facility's operating permit required under Title V. To use this information, facilities likely to do solvent cleaning must be identified, then the facility files must be located and the relevant data extracted.

If an emission factor approach is to be used, the relevant activity data must be collected. Adjustments may be necessary if the activity data do not exactly match the area to be inventoried. Additionally, if speciated emissions are desired, solvent composition information is needed that can be applied to the VOC emission factor. Further adjustments may also be needed depending on the use of controls.

3.2.2 APPLICATION OF CONTROLS

In determining emissions, the inventory preparer should take any existing emission controls into account. The importance of the emission controls on the estimate depends on how the estimate is derived. If, for example, solvent use is the basis for the estimate, the only control technique that will affect emissions is one where the solvent evaporative losses are captured but not recovered and returned to the process. As another example, if the estimate is based on the rate of evaporation from the exposed surface of the cold cleaner, then controls that prevent evaporation must be considered.

Some controls will be established by regulatory requirements; therefore, the inventory preparer can assume some percentage of the industry is applying the required controls and can adjust the emission estimate accordingly. For example, by 1997 the halogenated solvent cleaning NESHAP will impact all solvent cleaning machines using halogenated solvents. Similarly, once the cold cleaners NSPS has been promulgated, larger cold cleaners will be subject to requirements that reduce emissions. These issues are discussed in Chapter 1 of this volume, *Introduction to Area Source Emission Inventory Development*, in the section on Control, Rule Effectiveness, and Rule Penetration.

3.2.3 SPATIAL ALLOCATION

Spatial allocation may be needed in two cases during inventory preparation: (1) allocation of state or regional activity to a county level, and (2) allocation of county- level emission estimates to a modeling grid cell. Facility-specific data may be used if they are available and comprehensive. However, more often a surrogate for activity must be used to approximate spatial allocation for solvent cleaning activities. One readily available surrogate is employment data by SIC Code published by the U.S. Department of Commerce, Bureau of the Census in

County Business Patterns.[a] This is preferred over population data because employment is expected to be better correlated to solvent cleaning than population. SIC codes for industries that use solvent cleaning are listed with the cleaning type descriptions in Section 2.1 of this chapter.

3.2.4 TEMPORAL RESOLUTION

For most solvent cleaning activities, seasonal variability is not expected. Daily variations may apply for some of the industries. Some industries operate seven days per week, others only five days. Some industries are likely to operate two or three shifts per day, others may only have one. Information on the operating schedule may be available from existing files at the agency doing the inventory. Alternatively, State Implementation Plan (SIP) Inventory Guidance material provides a default value of uniform activity throughout the year, six days per week (EPA, 1991).

3.2.5 PROJECTING EMISSIONS

In many instances, the inventory will be used as the baseline from which future emissions are estimated. Projecting emissions is discussed in Chapter 1 of this volume. The most common way to project emissions is to apply a growth factor to the baseline estimate. If surveys are used to collect data, another option is to request the forecasting information from the recipient.

The following should be used when emissions are calculated by methods other than use of an emission factor (EPA, 1993b):

$$EMIS_{PY} = EMIS_{BY,O} * \left[\frac{1 - \left(\frac{CE_{PY}}{100} * \frac{RE_{PY}}{100} * \frac{RP_{PY}}{100} \right)}{1 - \left(\frac{CE_{BY}}{100} * \frac{RE_{BY}}{100} * \frac{RP_{BY}}{100} \right)} \right] * GF$$

where:

$EMIS_{PY}$	=	Projection year emissions for an ozone season, typical weekday (mass of pollutant/day)
$EMIS_{BY,O}$	=	Base year ozone season actual emissions (mass of pollutant/day)
CE_{PY}	=	Projection year control efficiency (percent)

[a] See the publication for the inventory year, which can be obtained from the U.S. Bureau of the Census, Department of Commerce, Washington, D.C.

CE_{BY}	=	Base year control efficiency (percent)
RE_{PY}	=	Projection year rule effectiveness (percent)
RE_{BY}	=	Base year rule effectiveness (percent)
RP_{PY}	=	Projection year rule penetration (percent)
RP_{BY}	=	Base year rule penetration (percent)
GF	=	Growth factor (dimensionless)

The following equation should be applied when emissions are calculated using an emission factor and control efficiencies are used to reflect current or future control strategies (EPA, 1993b):

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

where:

$EMIS_{PY}$	=	Projection year emissions for an ozone season, typical weekday (mass of pollutant/day)
$ORATE_{BY,O}$	=	Base year operating rate (activity level): ozone season, daily (production units/day)
$EMF_{PY,\ pc}$	=	Projection year pre-control emission factor (mass of pollutant/production unit)
CE_{PY}	=	Projection year control efficiency (percent)
RE_{PY}	=	Projection year rule effectiveness (percent)
RP_{PY}	=	Projection year rule penetration (percent)
GF	=	Growth factor (dimensionless)

4

PREFERRED METHODS FOR ESTIMATING EMISSIONS

4.1 EMISSION ESTIMATION METHODOLOGIES

The preferred method for estimating emissions from solvent cleaning operations varies with the type of solvent cleaning activity. For halogenated solvent cleaning machines, use of the facility-specific data submitted under the halogenated solvent cleaning NESHAP is the preferred method. For cold cleaners until the NSPS is promulgated, the preferred method is to conduct a survey of suppliers. For solvent cleanup, the preferred method is to conduct a survey of a subset of users.

4.2 FACILITY-SPECIFIC DATA

Facility-specific data already collected by the agency can be a good source of emissions information. First, the inventory preparer must identify:

- Facilities reporting under the halogenated solvent cleaning NESHAP; and/or
- Facilities permitted as VOC and/or HAP sources.

The initial report required by the halogenated solvent cleaning NESHAP must include an estimate of annual halogenated HAP solvent consumption for each solvent cleaning machine. These reports are due to EPA by August 29, 1995 (59 FR 61814, December 2, 1994). These numbers may or may not include amounts sent off-site for recycling, reclamation, or disposal, and the emissions calculated may overestimate emissions. To address this potential problem, the inventory preparer may be able to identify cases where no adjustment appears to have been made by comparing all the reports by cleaning machine type and looking for outliers. A follow-up with the facility can be used to determine whether all necessary adjustments have been made.

Many of the solvent cleaning machine reports received to comply with the NESHAP will be large individual emitters or part of an operation that emits large amounts of VOCs or HAPs. The facilities that will be reported as point sources should be identified to avoid double counting, but data from these reports do not need to be compiled as part of the area source inventory.

4.3 SURVEYS

An example of a survey of solvent cleaning operations and the survey's results can be found in Roe et al. (1995). Specific discussion of surveys for area sources is provided in Chapter 1 of this volume. However, the general approach for surveys is as follows:

- Identify the industries most likely to have solvent cleaning operations and the facilities to be surveyed within each of these industries. Use the data quality objectives of the inventory to determine the size of the survey subset. Manufacturing directories, or local or state property tax records may be useful for identifying businesses with certain types of equipment.

- Decide whether to prescreen survey recipients. Prescreening can be helpful to identify survey recipients when a subset of facilities are to be surveyed, and to define scaling factors for scaling up the results of the survey. Conduct prescreening;

- Develop and distribute a survey;

- Design a database if the number of responses is expected to be large;

- Collect surveys, follow up with respondents if there are any questions, and transfer information to the database; and

- Compile the data and develop the emission estimate(s).

4.3.1 COLD CLEANERS

For cold cleaners, a survey of the equipment suppliers who also provide service for the facility ("full service" suppliers) is the preferred method. These suppliers are limited in number and maintain accurate records on solvent usage because this is the basis upon which the facility is billed. A potential drawback to this method is that some suppliers may be reluctant to report the information needed for an emission estimate. In addition, some cold cleaning activity can overlooked if not all of the suppliers are included in the survey or if some facilities in the inventory area service their own equipment. An example survey is provided in Figure 6.4-1. The survey may be designed to identify some of the cold cleaners that may be overlooked (see Part III of Figure 6.4-1). Point source emissions from cold cleaners will need to be totaled and then subtracted from the area source estimate.

FIGURE 6.4-1. EXAMPLE SURVEY FOR COLD CLEANING FULL SERVICES SUPPLIERS

SURVEY NO: _____

DATE: _____

PAGE: 1 of__

PART I

Company Name: _____

_____

Address: _____

_____

Contact Name, Title: _____

_____

Contact Phone No: _____

Region for which information is provided: _____

PART II

For equipment that you service, please provide the following:

Model Number	Equipment Description [a]	No. of Services in year	Solvent Type	Annual Amt. of Solvent Delivered [b] (gal)	Annual Amt. of Solvent Returned (gal)

[a] Attach equipment information.
[b] Attach material safety data sheets.

PART III

For equipment that you sold since year[a] but do not service, please provide the following:

Model Number	Equipment Description [b]	Solvent Type[c]	Description of Client's Business[d]	Typical Annual Solvent Usage per Unit (gal)[e]

[a] Select a time period based on the datedness of the existing equipment population data. [b] Attach equipment information.
[c] Attach material safety data sheets. [d] If known. [e] Provide a range if necessary.

4.3.2 CLEANUP

The preferred method for estimating emissions from solvent cleanup is to conduct surveys of key industries using solvents in this manner. To identify and survey all industries that use solvent for cleanup would be impractical. A recent EPA publication, *Alternative Control Techniques Document - Industrial Cleaning Solvents* (EPA, 1994b),identifies 15 industries using solvents for cleanup and surveyed 6 of these for specific solvent cleanup information. The 15 industries and their solvent uses are shown in Table 6.4-1. Given resource constraints, state and local agencies should focus on these first. Some industries may not be located in the areas to be inventoried; however, the agency may want to include others in their area that they have reason to believe may have significant solvent cleanup emissions. The agency may also want to limit the survey to facilities that are area sources. Otherwise, emissions calculated from the survey data will need to be corrected for point source emissions.

An example survey for solvent cleaning activities used by the EPA is provided in Appendix A. Questions were developed to collect the data based on a material balance around a unit operation system (UOS) at the facility. The UOS provides a framework for describing and understanding the cleaning activities. Based on the survey results, nine such UOSs appear to represent most solvent cleanup activities. These are spray gun cleaning, spray booth cleaning, large manufactured parts cleaning, small manufactured parts cleaning, equipment cleaning, floor cleaning, line cleaning, tank cleaning, and parts cleaning (each column in Table 6.4-1 represents a UOS). General descriptions of these UOSs are provided as an attachment to the survey; more detailed descriptions with diagrams are provided in the Industrial Cleaning Solvents ACT (EPA, 1994b).

Although the Industrial Cleaning Solvents ACT specifically excluded metal parts cleaning using vapor and cold cleaning equipment [this is addressed in another report: *Control of Volatile Organic Emissions from Solvent Metal Cleaning* (EPA-450/2-77-022)], a survey using the UOSs may collect this information as well. To avoid double-counting between cleanup operations and solvent cleaning machine use of solvents, these results must be compared to estimates derived from solvent cleaning equipment. The solvent cleaning equipment emissions will need to be subtracted from the total.

4.3.3 SURVEY COMPILATION AND CALCULATIONS

From the survey data collected, emissions can be calculated for a given facility as the difference between annual solvent use and the amount of solvent that is sent off-site for recycling, reclamation, or is otherwise captured such as in an emission control device. The assumption is that any solvent that is not accounted for through recycling, reclamation, or captured by a control device like carbon adsorption, evaporates.

TABLE 6.4-1

SOLVENT CLEANUP ACTIVITIES BY INDUSTRY[a]

Industry	Spray Gun	Spray Booth	Equip.	Floor	Line	Tank	Parts	Large Mfd Components	Small Mfd Components
Automotive-Manufacturing (SIC Code 3711)	X	X	X	X	X	X	X	X	X
Automotive-Parts/Access. (SIC Code 3714)	X		X				X		
Automotive-Trucks and Buses (SIC Code 3713)	X							X	
Automotive-Stamping (SIC Code 3465)							X		X
Electrical Equipment	X		X	X			X		X
Furniture	X		X				X	X	X
Magnetic Tape			X		X	X	X		
Packaging			X	X			X		
Photographic Supplies (chemicals)	X		X	X		X	X		

[a] Adapted from EPA, 1994b, Table 3-6, p. 3-19. No data were provided for adhesives, autobody refinishing, fiber-reinforced plastic (FRP) boats, offset lithographic printing, plastics, or rotogravure printing.

Emissions are calculated from survey data by the following equation:

$$\text{Annual emissions} = \text{Annual solvent use} - \left(\text{Annual amount of solvent recycled off-site} + \text{Annual amount of solvent reclaimed off-site} + \text{Annual amount of solvent sent off-site for disposa} \right.$$

Where only a subset of the population of facilities provided data, the estimated emissions will need to be scaled up. This is discussed in Chapter 1 of this volume; however, for this source category, scaling can be done using the total number of facilities, the total number of employees, or the total number of units in use. The choice of which to use will depend on which best represents the population of interest, and how accurate and readily available the chosen scaling factor may be.

5

ALTERNATIVE METHODS FOR ESTIMATING EMISSIONS

To estimate emissions from halogenated solvent cleaning equipment, the alternatives to the preferred method are to conduct a survey and to use emission factors. For cold cleaners and solvent cleanup, the alternatives are to use facility-specific data and emission factors. Surveys were described in Section 4 and are covered in detail in Chapter 1 of this volume. Additional information concerning facility-specific data and use of emission factors is provided below.

5.1 SOLVENT CLEANING EQUIPMENT

5.1.1 FACILITY-SPECIFIC DATA

Use of facility-specific data is the first alternative method for estimating emissions from cold cleaners and for the use of solvents for cleanup. This method is usable only if facility-specific information is available for a reasonable subset of cold cleaners and operations where cleanup solvents are used. The subset will need to include a cross-section of the industries, processes, and solvents present in the inventory area, or there will need to be a way to estimate emissions from occurrences that have not been included in the subset. Facility-specific information will be available for facilities that are permitted as VOC and/or HAP sources as well as facilities that are reporting under the NSPS requirements once the cold cleaner NSPS is promulgated.

Sources of solvent cleaning emissions that will not be addressed through the use of facility-specific data include smaller cold cleaners (less than 1.8 m^2 or 19 ft^2) that are exempt from the NSPS, cleanup solvent uses for permitted facilities that need not report all sources of the pollutant, and nonpermitted facilities. As a result, these will need to be addressed separately. This step may have already been completed during the point source inventory development process; therefore, preparing the point and area source inventories for this source category should be coordinated to minimize duplication of effort. The remaining uncounted emissions can then be estimated by either scaling up the existing data or by using one of the other alternative methods.

5.1.2 EMISSION FACTORS

Emission factors are another alternative to surveys for estimating emissions from solvent cleaning equipment, and these are available in EPA publications. Recent data on cold cleaners collected

by the EPA as a part of NSPS development for cold cleaners are reproduced in Table 6.5-1 (EPA, 1994c). Submitted by Safety-Kleen, these data represent model-specific emission estimates for several of their cold cleaner models. Table 6.5-1 provides typical annual solvent loss estimates for five cold cleaner models, and for five service intervals. Service intervals for these machines vary based on how often customers need the solvent in their cold cleaners replaced. A longer service interval indicates a lower level of use of the cold cleaner and results in lower emissions, which are reflected in the lower solvent loss numbers. Although manufacturer models will vary, the broad range is probably representative of the industry. Furthermore, Safety-Kleen holds a significant share of the market so these data will be accurate for a high percentage of the cold cleaners in use.

Two emission factors from *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone: Volume I: General Guidance for Stationary Sources* (EPA, 1991) may be used to estimate emissions from solvent cleaning. Based on how the category is described, this does not include cleanup solvent uses. The basis for the emission factors is 1989 industrial solvent consumption and (1) 1989 U.S. population (245.7 million) and (2) industrial employment in SIC Codes 25, 33-39, 417, 423, 551, 552, 554-556, and 753. Per capita and per employee emission factors are presented in Table 6.5-2.

State and local agencies may want to update the emission factors using the same or similar references used in the *EPA Procedures* document and recalculating the emission factors to reflect more recent usage, and to reflect the delisting of acetone and PERC as reactive VOCs. The solvent usage data in EPA's *Procedures* report were taken from *Industrial Solvents - Winter 1989* (Frost and Sullivan, Inc., New York, NY, 1990), *Chemical Economics Handbook* (SRI International, Menlo Park, CA, 1991), *Chemical Marketing Reporter* (Schnell Publishing Company, Inc., New York, NY, 1991) and *Chemical Products Synopsis* (Mannsville Chemical Products Corporation, Asbury Park, NJ, 1991). Population data are collected by the U.S. Department of Commerce, Bureau of the Census, and published in *Statistical Abstracts of the United States (year)*. The employment data are available from *Employment and Wages Annual Averages (year)*, published by the U.S. Department of Labor, Bureau of Labor Statistics. Such data may also be found in *County Business Patterns*[a], published annually by the Bureau of the

[a] See the publication for the inventory year, which can be obtained from the U.S. Bureau of the Census, Department of Commerce, Washington, D.C.

TABLE 6.5-1

1994 SAFETY-KLEEN EMISSIONS DATA FOR COLD CLEANERS[a]

Service Interval (weeks)	Typical Annual Solvent Loss (gallons)[b,c] by Safety-Kleen Model Number[d]				
	14	**16**	**30**	**34**	**44**
4	19	33	51	64	81
5	16	26	41	52	66
6	13	22	34	44	55
7	11	19	30	38	48
8	10	17	26	34	43

[a] EPA, 1994c. Safety-Kleen caveat: emissions may not reflect true losses of a particular customer's equipment. Emissions include losses during machine use, carry-off on parts, and carry-off in small cups for remote cleaning.
[b] Based on SK-105 Solvent: 85% mineral spirits, 12% C_8 and aromatics, 1% xylene, 0.5% each toluene and ethylbenzene, 0-1% chlorinated solvents (TCA, PERC).
[c] To obtain the weight of solvent loss, multiply number of gallons by 6.5 pounds per gallon.
[d] From the reference, descriptions of the models are as follows:
Model 16: 9-gallon parts cleaner
Model 30: 17-gallon parts cleaner

Census. Local planning departments may also have population and employment data that are specific to the area of interest.

Because EPA emission factors are based on national consumption and may not accurately reflect local consumption, state and local agencies may consider using local solvent usage data where these are available (a top-down approach). In some cases, local solvent usage data may be available but the total includes more uses than just solvent cleaning. These additional uses must be identified and quantified, then subtracted from the total. Because such information is typically limited and the level of effort is significant, the cost of using this approach outweighs the benefit (accuracy) of the resulting estimate.

TABLE 6.5-2

PER CAPITA AND PER EMPLOYEE SOLVENT CLEANING EMISSION FACTORS (EPA, 1991)

Subcategory	SIC Codes	Per Capita Factor (lb/yr/person)		Per Employee Factor (lb/yr/employee)	
		VOCs	Organics	VOCs	Organics
Solvent Cleaning (total)	25, 33-39, 417, 423, 551, 552, 554-556, 753	4.3	7.2	87	144
Cold Cleaning					
Automobile Repair	417, 423, 551, 552, 554-556, 753	2.5	2.5	270	270
Manufacturing	25, 33-39	1.1	1.1	24	24
Vapor and In-Line Cleaning					
Electronics and Electrical	36	0.21	1.1	29	150
Other	25, 33-39, 417, 423, 551, 552, 554-556, 753	0.49	25	9.8	49

5.2 SOLVENT CLEANUP ACTIVITIES

Alternative methods for estimating solvent cleanup emissions are the facility-specific method described in Section 5.1.1 and emission factors developed from information collected for the Industrial Cleaning Solvents ACT, which will be described here (EPA, 1994b).

The Industrial Cleaning Solvents ACT provides estimates of solvent amounts used at the national level for cleanup for 15 industries (Table 6.5-3). These estimates were drawn from references that were prepared as early as 1979 and as recently as 1993. For 9 of the 15 industries, the ACT provides estimates of national VOC emissions from cleanup

processes (Table 6.5-4). These estimates are based on usage-per-employee and emissions-per-employee factors from studies at a small number of test facilities.

There are limitations to using this study for inventory preparation that should be kept in mind. Although these industries are not the only industries that use the solvent cleanup process, they are thought to be most significant sources. The study had to use assumptions based on studies of only a few facilities for each industry. The study was limited to 15 solvents (see Table 6.3-2), but there may be others that could also be used as cleaners. Using a material balance method to develop an emission factor for this process will result in a very conservative estimate for emissions. Some of the solvent can be expected to be collected and reclaimed off-site or disposed of in some other manner. Even with these limitations, these estimates provide industry-specific estimates of a subcategory of solvent cleaning that is otherwise difficult to characterize and may have previously not been included in emission estimates.

Please note that in order to avoid double-counting within the area source inventory, inventory preparers should note when other area source categories include solvent cleanup. In particular, area source emission estimating methods for the printing, packaging, and furniture (as a surface coating process) industries and the autobody refinishing industry may include solvent cleanup emissions.

Emission factors for the nine industries listed in Table 6.5-4 can be developed by dividing the national emissions number by either national employment for that industry or by national population.

The national numbers presented in Tables 6.5-3 and 6.5-4 may be used to estimate local emissions for the 15 industries by developing a national per employee or per capita emission factor. A per employee factor should more accurately reflect emissions, but the per capita emission factor will be easier to calculate. A per employee emission factor is calculated from any of the national emission estimates by the following steps:

- Determine the national-level number of employees in the industry. Employment information at the national level can be found in the Census Bureau report, *Statistics for Industry Groups and Industries.*[a]

[a] See the publication for the year matching the year of the usage estimate, which can be obtained from the U.S. Bureau of the Census, Department of Commerce, Washington, D.C.

TABLE 6.5-3

ESTIMATES OF THE AMOUNT OF VOC CLEANING SOLVENT USED BY INDUSTRY, X 10^3 TONS/YR[a]

Industry (SIC Code)	Reference Year					Low	High
	1990	1988	1979	1988	1993		
Automotive-Manufacturing (3711)	89 - 410	[b]			72	72	410
Automotive-Trucks and Buses (3713)					16	16	16
Automotive-Parts/Access. (3714)					7.7	7.7	7.7
Automotive-Stamping (3465)					1.0	1.0	1.0
Adhesives	73 - 330		46 - 210			46	330
Packaging[c]					30	30	30
Plastics			28 - 130			28	130
Furniture[c]	19 - 88				230	19	230
Rotogravure Printing[c]		14 - 62				14	62
FRP Boats[d]		8.3[d]				8.3	8.3
Autobody Refinishing[c]	7.8 - 35		16 - 72	26 - 120		7.8	120
Electrical Equipment					5.6	5.6	5.6
Magnetic Tape		5.5	[e]		11	5.5	11

TABLE 6.5-3

(CONTINUED)

Industry	Reference Year					Low	High
	1990	1988	1979	1988	1993		
Offset Lithographic Printing[g]		1.1 - 6.6[e]				1.1	6.6
Total						270	1,400

[a] Adapted from EPA, 1994b, pp. 3-11.
[b] This range may represent usage in more than the 3711 SIC Code subcategory.
[c] Please note that for these industries, cleaning solvent use may be estimated as part of another area source category. Preparation of emission inventories for these categories should be coordinated.
[d] FRP = fiber-reinforced plastic.
[e] Estimate based on a usage equals emissions assumption.

TABLE 6.5-4

NATIONWIDE VOC SOLVENT USAGE AND EMISSION ESTIMATES FOR SELECTED INDUSTRIES, TONS/YR[a] (EPA, 1994B)

Industry	Equipment Cleaning	Floor Cleaning	Large Manuf'd. Component Cleaning	Line Cleaning	Parts Cleaning	Small Manuf'd. Component Cleaning	Spray Booth Cleaning	Spray Gun Cleaning	Tank Cleaning	Total[b]
Automotive - Manufacturing										
Solvent Usage	220	570	8,400	14,000	129	180	17,000	28,000	3,100	72,000
Emissions	220	570	7,700	130	130	180	15,000	9,500	110	34,000
Automotive - Trucks and Buses										
Solvent Usage			6,900					8,800		16,000
Emissions			6,900					8,800		16,000
Automotive - Parts/Accessories										
Solvent Usage	15				7,600			130		7,700
Emissions	15				2,100			55		2,200
Automotive - Stamping										
Solvent Usage					1,000	13				1,000
Emissions					320	13				330
Electrical Equipment										
Solvent Usage	500	77			1,900	290		2,800		5,600
Emissions	450	77			520	220		1,100		2,400

TABLE 6.5-4

(CONTINUED)

Industry	Equipment Cleaning	Floor Cleaning	Large Manuf'd. Component Cleaning	Line Cleaning	Parts Cleaning	Small Manuf'd. Component Cleaning	Spray Booth Cleaning	Spray Gun Cleaning	Tank Cleaning	Total[b]
Furniture										
Solvent Usage	7,300		900	39,000	1,800	130		180,000		230,000
Emissions	5,600		840	3,800	540	72		36,000		47,000
Magnetic Tape										
Solvent Usage	670			330	2,400				7,700	11,000
Emissions	230			6.6	440				430	1,100
Packaging										
Solvent Usage	1,300	5,900			23,000					30,000
Emissions	960	2,500			3,500					7,000
Photographic Supplies										
Solvent Usage	4,400	3.1			130			5.3	36,000	41,000
Emissions	110	3.1			1.3			5.3	360	480
Total Usage[c]	14,000	6,600	16,200	53,000	38,000	610	17,000	220,000	47,000	410,000
Total Emissions[c]	7,600	3,200	15,400	3,900	7,600	490	15,000	55,000	900	109,000

[a] Usage and emission values are from a 1990 report.
[b] Estimates based on nationwide extrapolation of usage-per-employee factors from surveyed plants (using total plant employment).
[c] Totals are different due to rounding.

- Divide the usage estimate by the national-level employment. The resulting number is a per employee emission estimate for that industry for that year.

- Determine the employment in the industry for the inventory area and the inventory year. Using local employment data or employment data from the U.S. Census Bureau report, *County Business Patterns*.

- Local employment multiplied by the per employee emission factor calculates the emission estimate for the industry.

A per capita emission factor is calculated by dividing the usage value by the national population for the year of the data.

6

QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

Prior to inventory preparation during the planning process, the agency must delineate the data quality objectives for the inventory. As a part of these objectives, the agency may elect to establish specific goals for individual categories. Depending on the data quality objectives, the QA and QC methods to be applied will vary. *Quality Assurance Procedures*, Volume VI of this series of reference volumes, is dedicated to the discussion of methods to be used to ensure the development of a quality inventory. QA for area source inventories is discussed in Chapter 1 of this volume.

6.1 EMISSION ESTIMATE QUALITY INDICATORS

The preferred method will produce the most accurate estimate of emissions; however, surveys can be an expensive undertaking. Furthermore, the success of the survey depends heavily on the rate and completeness of the responses. The accuracy of facility-specific data and the top-down approach vary depending on the availability of information. Both can be resource-intensive too. Emission factors are the easiest method but may be relatively inaccurate.

6.1.1 DATA ATTRIBUTE RATING SYSTEM (DARS) SCORES

One way to evaluate the estimates calculated using each of the alternatives is to calculate the DARS scores for each. The DARS methodology is presented in the *Quality Assurance Procedures* volume. The resulting scores for estimates based on facility-specific data for halogenated solvent cleaning equipment, surveys of cleaning solvent equipment uses, and uses of emission factors are presented in Tables 6.6-1 through 6.6-5. All scores assume that good QA/QC measures have been 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 in the *Quality Assurance Procedures* volume.

6.1.2 SOURCES OF UNCERTAINTY

Another way to assess the emission estimate is to look at the associated uncertainty. For estimates derived from survey data, the uncertainty can be quantified. Similarly, the uncertainty can be determined for the facility-specific data if the basis for the emission estimate is provided

(see *Quality Assurance Procedures*, Volume VI, Chapter 4). Statistics needed to quantify the uncertainty for the emission factor and top-down approaches are incomplete.

For a per capita emission factor, the uncertainty of the resulting emission estimate depends on how closely related solvent cleaning activities are to population and how well the emission factor represents the area to be inventoried. Although it is reasonable to expect more commercial and industrial activity near centers of population, a statistical correlation has not been attempted; therefore, the association between population and solvent cleaning activity is weak. A per employee emission factor assumes that solvent cleaning is related to employment in specific industries identified as conducting solvent cleaning activities. Again, the estimate depends on how well the emission factor represents local practices. Emissions based on a per unit emission factor would intuitively seem to produce a more accurate estimate than those derived from the other types of emission factors but uncertainty is introduced in determining the total number and types of units in use. There is also variability in emissions that depend on the unit type and operating practices that may not be accommodated in the emission factor. A choice of emission factor based on the uncertainty would require an assessment of the basis for each.

Determining sources of uncertainty associated with an estimate derived using the top-down approach begins with the solvent usage data. Each step taken to apportion the total solvent usage to solvent cleaning in the inventory area introduces additional sources of uncertainty. Even if care is taken in the apportionment of solvent usage, the resulting estimate may not truly represent emissions, for example, where local recycling or add-on controls have not been taken into account.

TABLE 6.6-1

FACILITY-SPECIFIC EQUIPMENT SOLVENT CLEANING: PREFERRED FOR HALOGENATED CLEANERS, ALTERNATIVE 1 FOR NONHALOGENATED COLD CLEANING AND SOLVENT CLEANUP

Attribute	Scores[a]		
	Factor	Activity	Emissions
Measurement	0.7	0.9	0.63
Source Specificity	1.0	1.0	1.0
Spatial	1.0	1.0	1.0
Temporal	1.0	0.7 - 1.0	0.7 - 1.0
Composite Scores	0.93	0.9 - 0.98	0.83 - 0.9

[a] This is essentially a point source methodology. Temporal activity depends on whether an annual, daily, or other time period is needed (The score for when solvent consumption annual emissions are used to calculate daily emissions is 0.7).

TABLE 6.6-2

SURVEY OF SOLVENT CLEANING USES (EQUIPMENT OR SOLVENT) IN THE INVENTORY REGION: PREFERRED FOR NONHALOGENATED CLEANERS AND SOLVENT CLEANUP, ALTERNATIVE 1 FOR HALOGENATED COLD CLEANERS

Attribute	Scores[a]		
	Factor	Activity	Emissions
Measurement	0.7	0.7	0.49
Source Specificity	0.8	0.7 - 0.9[b]	0.56 - 0.72
Spatial	0.8	0.9	0.72
Temporal	1.0	0.9 - 1.0[b]	0.9 - 1.0
Composite Scores	0.83	0.8 - 0.88	0.67 - 0.72

[a] Scores for activity will depend on how good and thorough the survey is. These scores assume that less than 100 percent of the population is sampled; therefore, the estimate is scaled up by the ratio of the number surveyed to the number in the population.

[b] Activity score ranges depend on the accuracy of the surrogate used to scale the survey subset to the entire inventory area.

TABLE 6.6-3

COLD CLEANING UNIT EMISSION FACTOR: ALTERNATIVE 2 FOR COLD CLEANERS

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.3 - 0.4	0.6 - 0.7	0.18 - 0.28
Source Specificity	0.7	0.7	0.49
Spatial	0.7	0.7	0.49
Temporal	0.8	0.7	0.56
Composite Scores	0.63 - 0.65	0.68 - 0.7	0.43 - 0.46

TABLE 6.6-4

SOLVENT CLEANUP EMISSION FACTORS: ALTERNATIVE 2 FOR SOLVENT CLEANUP

Attribute	Scores		
	Factor	Activity	Emissions
Measurement	0.3 - 0.5	0.9	0.27 - 0.45
Source Specificity	0.6	0.5	0.3
Spatial	0.7	0.8	0.56
Temporal	0.5	0.6	0.3
Composite Scores	0.53 - 0.58	0.7	0.36 - 0.41

TABLE 6.6-5

NATIONAL FACTORS APPLIED TO LOCAL ACTIVITY DATA (NUMBER OF EMPLOYEES): ALTERNATIVE 2 FOR ALL CLEANING TYPES

Attribute	Scores[a]		
	Factor	Activity	Emissions
Measurement	0.3	0.9	0.27
Source Specificity	0.5 - 0.6	0.5 - 0.6	0.25 - 0.36
Spatial	0.5	0.8	0.40
Temporal	0.5 - 0.8	0.6	0.3 - 0.48
Composite Scores	0.45 - 0.55	0.7 - 0.73	0.31 - 0.40

[a] Notes:

Factor measurement: does not include all losses.
Source specificity: cleanup solvent use may not be included.
Spatial: national taken to the county level.
Temporal: annual taken to the daily level, 1989 to inventory year.
Activity: assumes some estimation/scaling from national or state data was used. Also, assumes some variability in employment with the year and from year to year.

TABLE 6.6-6

NATIONAL FACTORS APPLIED TO LOCAL ACTIVITY DATA (POPULATION): ALTERNATIVE 2 FOR ALL CLEANING TYPES

Attribute	Scores[a]		
	Factor	Activity	Emissions
Measurement	0.3	0.9	0.27
Source Specificity	0.5 - 0.6	0.3	0.15 - 0.18
Spatial	0.5	0.8	0.4
Temporal	0.5 - 0.8	0.6	0.3 - 0.48
Composite Scores	0.45 - 0.55	0.65	0.28 - 0.36

[a] Notes:

Factor measurement: does not include all losses.
Source specificity: cleanup solvent use may not be included.
Spatial: national taken to the county level.
Temporal: annual taken to the daily level, 1989 to inventory year.
Activity: assumes some estimation/scaling from national or state data was used. Also, assumes some variability in employment with the year and from year to year.

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7

DATA CODING PROCEDURES

This section describes the codes available to characterize solvent cleaning emission estimates. Consistent categorization and coding will result in greater uniformity between inventories. Inventory planning for data collection calculations and inventory presentation should take the data formats presented in this section into account. Available codes and process definitions may impose constraints or requirements on the preparation of emission estimates for this category.

7.1 PROCESS AND CONTROL CODES

The source category process codes for solvent cleaning operations are shown in Table 6.7-1. These codes are derived from the EPA's Aerometric Information Retrieval System (AIRS) Area and Mobile Source (AMS) source category codes (EPA, 1994d). Codes have not been assigned for all the individual solvents in this source category or for all of the industries where solvent cleaning may take place.

The control codes for use with AMS are shown in Table 6.7-2. 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. 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 a regulation is applicable only to point sources, it should not be assumed that similar controls exist at area sources without a survey. The equations used to apply control efficiency, rule penetration, and rule effectiveness for area sources are discussed in Chapter 1 of this volume.

TABLE 6.7-1

AIRS AMS CODES FOR SOLVENT CLEANING MACHINES BY INDUSTRY

SIC Code	Industry	Process Description	AMS Code[a]
	All Industries	All processes	24-15-000-x
25	Furniture and Fixtures	All processes	24-15-005-x
33	Primary Metal	All processes	24-15-010-x
33	Secondary Metal	All processes	24-15-015-x
34	Fabricated Metal Products	All processes	24-15-020-x
35	Industrial Machinery & Equipment	All processes	24-15-025-x
36	Electronic & Other Electronics	All processes	24-15-030-x
37	Transportation Equipment	All processes	24-15-035-x
38	Instruments & Related Products	All processes	24-15-040-x
39	Miscellaneous Manufacturing	All processes	24-15-045-x
40-45	Transportation Maintenance Facilities	All processes	24-15-050-x
55	Automotive Dealers	All processes	24-15-055-x
75	Auto Repair Services	All processes	24-15-060-x
76	Miscellaneous Repair Services	All processes	24-15-065-x
	All Industries	Open top degreasing	24-15-100-x
25	Furniture and Fixtures	Open top degreasing	24-15-105-x
33	Primary Metal	Open top degreasing	24-15-110-x
33	Secondary Metal	Open top degreasing	24-15-115-x
34	Fabricated Metal Products	Open top degreasing	24-15-120-x
35	Industrial Machinery & Equipment	Open top degreasing	24-15-125-x
36	Electronic & Other Electronics	Open top degreasing	24-15-130-x
37	Transportation Equipment	Open top degreasing	24-15-135-x
38	Instruments & Related Products	Open top degreasing	24-15-140-x
39	Miscellaneous Manufacturing	Open top degreasing	24-15-145-x
40-45	Transportation Maintenance Facilities	Open top degreasing	24-15-150-x

TABLE 6.7-1

(CONTINUED)

SIC Code	Industry	Process Description	AMS Code[a]
55	Automotive Dealers	Open top degreasing	24-15-155-x
75	Auto Repair Services	Open top degreasing	24-15-160-x
76	Miscellaneous Repair Services	Open top degreasing	24-15-165-x
	All Industries	Conveyorized degreasing	24-15-200-x
25	Furniture and Fixtures	Conveyorized degreasing	24-15-205-x
33	Primary Metal	Conveyorized degreasing	24-15-210-x
33	Secondary Metal	Conveyorized degreasing	24-15-215-x
34	Fabricated Metal Products	Conveyorized degreasing	24-15-220-x
35	Industrial Machinery & Equipment	Conveyorized degreasing	24-15-225-x
36	Electronic & Other Electronics	Conveyorized degreasing	24-15-230-x
37	Transportation Equipment	Conveyorized degreasing	24-15-235-x
38	Instruments & Related Products	Conveyorized degreasing	24-15-240-x
39	Miscellaneous Manufacturing	Conveyorized degreasing	24-15-245-x
40-45	Transportation Maintenance Facilities	Conveyorized degreasing	24-15-250-x
55	Automotive Dealers	Conveyorized degreasing	24-15-255-x
75	Auto Repair Services	Conveyorized degreasing	24-15-260-x
76	Miscellaneous Repair Services	Conveyorized degreasing	24-15-265-x
	All Industries	Cold cleaning	24-15-300-x
25	Furniture and Fixtures	Cold cleaning	24-15-305-x
33	Primary Metal	Cold cleaning	24-15-310-x
33	Secondary Metal	Cold cleaning	24-15-315-x
34	Fabricated Metal Products	Cold cleaning	24-15-320-x
35	Industrial Machinery & Equipment	Cold cleaning	24-15-325-x
36	Electronic & Other Electronics	Cold cleaning	24-15-330-x

TABLE 6.7-1

(CONTINUED)

SIC Code	Industry	Process Description	AMS Code[a]
37	Transportation Equipment	Cold cleaning	24-15-335-x
38	Instruments & Related Products	Cold cleaning	24-15-340-x
39	Miscellaneous Manufacturing	Cold cleaning	24-15-345-x
40-45	Transportation Maintenance Facilities	Cold cleaning	24-15-350-x
55	Automotive Dealers	Cold cleaning	24-15-355-x
75	Auto Repair Services	Cold cleaning	24-15-360-x
76	Miscellaneous Repair Services	Cold cleaning	24-15-365-x

[a] x = solvent type:
000 = total: all solvent types
300 = monochlorobenzene
350 = perchloroethylene
370 = special naphthas
385 = trichloroethylene
999 = solvents: not elsewhere classified (NEC)

TABLE 6.7-2

AIRS CONTROL DEVICE CODES

Control Device	Code
Vapor Recovery System	047
Activated Carbon Adsorption	048
Process Enclosed	054
Miscellaneous Control Device	099
Combination Control Device	999

8

REFERENCES

EPA. 1994a. *Cold Cleaning Machine Operations New Source Performance Standards. Background Information Basis and Purpose Document.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-453/D-94-067. Research Triangle Park, North Carolina. August.

EPA. 1994b. *Alternative Control Techniques Document - Industrial Cleaning Solvents*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, EPA-453/R-94-015. Research Triangle Park, North Carolina. February.

EPA. 1994c. *Emission Losses from Safety-Kleen Parts Cleaner Models: 14, 16, 30, 34 and 44.* Docket No. A-94-08, Item No. II-D-5. Information provided by Safety-Kleen during information gathering for Standards of Performance for New Stationary Sources, Cold Cleaning Machine Operations.

EPA. 1994d. AIRS Database. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1993a. *National Emission Standards for Hazardous Air Pollutants: Halogenated Solvent Cleaning - Background Information Document for the Proposed Rule.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-453/R-93-054. Research Triangle Park, North Carolina. November.

EPA. 1993b. *Guidance for Growth Factors, Projections and Control Strategies for the 15 Percent Rate-of-Progress Plans.* U.S. Environmental Protection Agency, Office of Quality Planning and Standards, EPA-453/R-93-002. Research Triangle Park, North Carolina. March.

EPA. 1991. *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I: General Guidance for Stationary Sources*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-450/4-91-016. Research Triangle Park, North Carolina. May.

Federal Register. September 9, 1994. Standards of Performance for New Stationary Sources Cold Cleaning Machine Operations. 40 CFR Part 60. Office of the Federal Register, Washington, D.C. Volume 59, page 46602.

Roe, S.M., P. Costello, L. Jones, C. DiSogra, and R. Grant. 1995. Improved VOC Emission Estimates for Solvent Cleaning and Degreasing in California. In: *The Emission Inventory: Programs and Progress*. Proceedings of a Specialty Conference, VIP-56, Air Waste Management Association, Pittsburgh, Pennsylvania.

APPENDIX A

EXAMPLE SURVEY FOR SOLVENT CLEANUP ACTIVITIES

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REQUESTED INFORMATION FROM MANUFACTURERS

The information received in response to this information request will be used to develop a control technique guideline (CTG) document for industrial cleanup solvent operations. The document is intended for State and local agencies to use as a guide in estimating emissions of volatile organic compounds (VOCs) from the use of cleanup solvents and in developing regulations to reduce such emissions. For the purposes of this document, cleanup solvent operations are defined as those which remove adhesives, inks, uncured coatings, and contaminants such as dirt, soil, oil, and grease from parts, products, tools, machinery, process vessel interiors, piping, equipment, and general work areas. The definition of a VOC is provided, for your information, on the last page of this enclosure.

The intent of this information request is to quantify the amount of solvent evaporated (resulting in VOC emissions) that results from cleaning operations. The specific techniques employed may include wiping, dipping (immersing), spraying, or flushing. Specialized items of equipment which may be used include ultrasonic cleaners, spray gun washers, and parts washers. A broad range of solvent cleaning operations is being considered in the "source category" for this CTG. Intermittent swabbing of oil drips on a floor with a solvent-soaked rag and large-scale solvent flushing of process lines and batch reactors would both be considered cleanup solvent operations. Vapor degreasers, conveyorized degreasers, and batch-loaded cold cleaners, used for solvent metal cleaning, are excluded from consideration in the current study because a CTG already exists for these specific cleaning operations. Perchloroethylene dry cleaning is also excluded because a CTG exists for it as well.

Please feel free to report any information which you consider to be relevant to the development of this document that is not specifically addressed in the information request. If you are unable to respond to an item as stated or would like clarification of some question, please contact_____.

Please return the completed information request to:

This request should be completed for each plant using cleanup solvents. If multiple plants exist, reproduce and complete the forms for each plant and identify each plant by a number (e.g., Plant Nos. 1, 2, 3).

Name of company: _____

Name of plant: _____

SIC Code for this plant: _____

Response completed by: _____

Title: _____

Plant address: Physical (No. and Street):

_____

City _____

State _____ Zip _____

Plant mailing address (No. and Street or Post Office Box):

_____

City _____ State _____ Zip _____

Plant telephone No.: ( ) _____

Mailing address of respondent (if different from above):

_____

Telephone No. of respondent (if different from above):

( ) _____

I. Plant/Process Information

A. Provide a general description of the product(s) manufactured and the process(es) used to produce them. (Or attach brochures, handouts, or other prepared material that includes this information)

_____

_____

B. How many production lines? _____

How many are currently operating? _____

C. Plant layout

1. Provide a simplified flowchart of product flow through the plant.

2. Provide a floor plan highlighting those areas where cleanup solvents are used, handled, and stored.

D. How many working days per year? _____

E. What are the hours of operation

(hr/d ____, hr/wk ____, hr/yr ____)?

F. What is the typical duration of a run? _____

G. What is the number of employees for 1990:

1. For the site? _____

2. That occasionally use cleanup solvents in the normal course of their work?

_____

3. Whose primary job function is the use of cleanup solvent? _____

H. What is the production rate?

1. Maximum hourly? _____

2. Maximum yearly? _____

3. Average hourly? _____

4. Average yearly? _____

II. Description of all Processes Requiring Use of Cleanup Solvents

In Table 6.A-1 (attached), indicate all process steps in your plant that require the use of cleanup solvents. For the purpose of this document, cleanup solvent operations are defined as those which remove adhesives, inks, uncured coatings, and contaminants such as dirt, soil, oil, and grease from parts, products, tools, machinery, process vessel interiors, piping, equipment and general work areas. Please identify the particular type of cleaning operation - wiping, dipping, spraying, or flushing - that is used in each process step. If these words for type of cleaning "operation" do not accurately describe the way the cleanup solvent is used, please use (and define) your own terminology. The type of solvent used (brand name and/or chemical composition or formulation) and the frequency of use should also be included in Table 6.A-1.

For each solvent listed in Table 6.A-1, please provide a copy of the manufacturer's Material Safety Data Sheet (MSDS). If the MSDS does not have a detailed breakdown of composition, which will enable the VOC content to be calculated, then please provide the composition, by chemical name (and CAS number, if available). For in-house solvent blends, please provide the composition of the resulting mixture, or the "recipe" used to generate the mixture.

Note: Section C of this information request asks that a copy of Table 6.A-2A be completed for each process step listed in Table 6.A-1. To simplify the completion of Section C, if a particular process step involves more than one cleanup operation, e.g., dipping a part to remove the majority of contaminants and then wiping the excess solvent from the part, choose the operation which constitutes the majority of the process. Furthermore, if you cannot determine if a particular operation involves wiping, dipping, spraying, or flushing, please describe the operation as thoroughly as possible and complete the table in Section C that most closely resembles the operation.

III. Detailed Description of Cleanup Solvent Operations

Attached are four tables labeled Tables 6.A-2A through 6.A-2D; each is titled with a specific cleanup operation, such as "wiping" (Table 6.A-2A). For each of the process steps listed in Table 6.A-1, please fill out the appropriate Table 6.A-2A for the cleanup operation associated with that step. If your plant has more than one process step employing a cleanup operation (i.e., wiping), then multiple copies of the appropriate table should be made and completed individually for each process step.

IV. Total Cleanup Solvent Consumption

Please complete Table 6.A-3 for all of the cleanup solvents used in your plant. If VOC emissions from cleanup operations is included in your State or local air permit, please answer the following questions:

A. Total VOC emissions permitted, tons/yr: _____

B. Cleanup VOC emissions permitted, tons/yr: _____

C. Actual total VOC emissions, tons/yr: _____

D. Actual cleanup VOC emissions, tons/yr: _____

V. Solvent Recovery

A. Is any solvent used in your plant (process and/or cleanup) recovered, reclaimed, or recycled? _____

In house or by an outside firm? _____

1. If in house, describe process (e.g., distillation).

_____

2. If by an outside firm, give name and address, and pickup and delivery interval (e.g., weekly, bimonthly).

_____

B. If not currently practiced, are there any plans to institute recovery/recycle programs? (for example, to reduce the cost of solvent disposal.) Why or why not?

C. Are the cleanup solvent wastes segregated from other solvent wastes?

D. Are waste cleanup solvents that are used in different process steps or different cleanup operations segregated, even though they are the same material? (e.g., are spent "manufacturing" cleanup solvents segregated from spent "maintenance" cleanup solvents?)

Why and how is this done?

Are other wastes from equipment cleanup (e.g., caustic wash water) segregated from solvent wastes?

E. Can the waste cleanup solvent from one operation be used for another cleaning operation?

Is this technique practiced at your plant?

How is it done?

F. Can the number of different cleaning agents be reduced to simplify the waste solvent mixtures, thereby enabling reuse or recycling? Why or why not?

VI. Recordkeeping Requirements

A. Describe the recordkeeping practices for cleanup solvents at your facility:

_____

_____

B. What is the frequency with which measurements are made and recorded?

_____

C. Are the recordkeeping practices based on corporate, site, or regulatory requirements?

_____

D. Provide copies of recordkeeping forms and material balance worksheets. Include forms/worksheets relating to solvent recovery.

E. Evaluate and briefly discuss the feasibility and additional manpower requirements associated with recording the following information on an hourly basis:

1. Surface area cleaned.

2. The aggregate total amount of cleanup solvent used (gallons).

3. Name and total amount of each individual cleanup solvent used (gallons).

F. Evaluate the feasibility of and additional recordkeeping burden associated with recording the same information on a daily and monthly basis.

VII. Reduced VOC Cleaners

A. Are you aware of substitute cleaners not containing VOCs, or that are very low in VOCs, that will meet your needs? If so please identify the alternatives and the solvents and uses for which they could be substituted.

_____

_____

B. Will the use of these alternative cleaners pose any operating problems such as requiring modification of your process operation, additional cleaning steps/ time, or reduced effectiveness/quality? Please explain.

_____

_____

C. Will the use of alternatives affect the cost of your clean-up operations? _____ If yes, by how much and on what is that estimate based? _____

_____

_____

D. Do you have a program in place at your plant to reduce VOC emissions from cleanup solvent operations? _____ If so, please describe.

_____

_____

_____

VIII. Hazardous Air Pollutants

The 189 HAPs defined by the 1990 CAAA are listed in Enclosure _____. For each solvent listed in Table 6.A-1 that contains one or more HAPs please answer the following questions:

A. If you were required to eliminate the use of HAPs from your clean-up operations, are you aware of substitute solvents not containing HAPs that would meet your needs? _____ If so please identify the alternative solvents.

_____

B. Will the use of these alternative solvents pose any operating problems such as requiring modification of your process operation, additional cleaning steps/ time, or reduced effectiveness/quality? _____

_____

C. Will the use of alternatives affect the cost of your clean-up operations? _____
If yes, by how much, and or what is that estimate based?

IX. Definitions

Volatile Organic Compounds (VOC)

[NOTE: This definition may subsequently change. The Code of Federal Regulations (40 CFR 51.100[s]) will provide the current legal definition.] Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

1. This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity: methane; ethane; methylene chloride (dichloromethane); 1,1,1-trichloroethane (methyl chloroform); 1,1,1-trichloro-2,2,2-trifluoroethane (CFC-113); trichlorofluoromethane (CFC-11); dichlorodifluoromethane (CFC-12); chlorodifluoromethane (CFC-22); trifluoromethane (FC-23); 1,2-dichloro 1,1,2,2-tetrafluoroethane (CFC-114); chloropentafluorethane (CFC-115); 1,1,1-trifluoro 2,2-dichloroethane (HCFC-123); 1,1,1,2-tetrafluoroethane (HFC-134a); 1,1-dichloro 1-fluoroethane (HCFC-141b); 1-chloro 1,1-difluoroethane (HCFC-142b); 2-chloro 1,1,1,2-tetrafluoroethane (HCFC-124); pentafluoroethane (HFC-125); 1,1,2,2-tetrafluoroethane (HFC-134); 1,1,1-trifluoroethane (HFC-143a); 1,1-difluoroethane (HFC-152a); and perfluorocarbon compounds which fall into these classes:

   (a) Cyclic, branched, or linear, completely fluorinated alkanes;

   (b) Cyclic, branched, or linear, completely with fluorinated ethers with no unsaturations;

   (c) Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and

   (d) Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

2. For purposes of determining compliance with emission limits, VOC will be measured by the test methods in the approved State implementation plan (SIP) or 40 CFR Part 60, Appendix A, as applicable. Where such a method also measures compounds with negligible photochemical reactivity, these negligibility-reactive compounds may be deducted from the reported VOC if the amount of such compounds is accurately quantified, and such exclusion is approved by the enforcement authority.

3. As a precondition to excluding these compounds as VOC or at any time thereafter, the enforcement authority may require an owner or operator to provide monitoring or testing methods and results demonstrating, to the satisfaction of the enforcement authority, the amount of negligibly-reactive compounds in the source's emissions.

4. For the purposes of Federal enforcement for a specific source, the EPA shall use the test method specified in the applicable EPA-approved SIP, in a permit issued pursuant to a program approved or promulgated under Title V of the Act, or under 40 CFR Part 51, Subpart I or Appendix S, or under 40 CFR Parts 52 or 60. The EPA shall not be bound by any State determination as to appropriate methods for testing or monitoring negligibly-reactive compounds if such determination is not reflected in any of the above provisions.

TABLE 6.A-1

GENERAL INFORMATION OF CLEANUP OPERATIONS

Process No.	Cleanup Description	Surface Being Cleaned	Cleanup Operation[a]	Solvent Used[b]	Frequency of Operation
Example 1	Blanket wash	Press roll	Wiping	SK 105	Once/shift
Example 2	Press cleaning	Machine	Wiping	SK 105	Continuous
Example 3	Spill mopping	Floor	Wiping	SK 105	When spills occur; estimated three times/shift
Example 4	Gun wash	Spray gun	Flushing	Lacquer thinner	Once per hour

[a] Use terminology corresponding to Tables 6.A-2A, 6.A-2B, 6.A-2C, or 6.A-2D (wiping, dipping, spraying, or flushing) or other, more precise terms, with definition appended.

[b] Provide copy of MSDS plus other documentation (if required) to establish VOC content of each solvent listed in this table.

TABLE 6.A-2A

WIPING OPERATION QUESTIONNAIRE

Question	Response and Comments
Process step (taken from Table 6.A-1)	
Description of part or machine being cleaned	
How much labor time is spent in this cleaning operation?	
Cleanup solvent used/Brand Name/Identification No.	
Is the cleanup solvent diluted with water before use?	
If so, what is the ratio of solvent to water?	
How much of the concentrated cleanup solvent is used: For this operation? Per shift?	
How much of the spent solvent is collected?	
How much of the solvent evaporates during this wiping operation?	
Describe the contaminant or soil that is being removed.	
To what degree do the following factors affect your selection of the cleanup solvent used in this cleaning operation? A - Primary consideration B - Secondary consideration C - Not important If your answer is "A" or "B", please elaborate.	
Physical and chemical properties of contaminant to be removed	A B C

TABLE 6.A-2A

(CONTINUED)

Question	Response and Comments
Physical and chemical properties of the substrate on which the contaminant is deposited	A B C
The degree of cleaning efficiency required	A B C
The size, shape, and complexity of parts or objects to be cleaned	A B C
The volume or number of parts or objects to be cleaned per unit of time	A B C
The substrate preparation required	A B C
Solvent costs	A B C
Worker exposure concerns	A B C
Fire code or insurance protection requirements	A B C
Recycle and recovery options	A B C
Regulatory requirements	A B C
Ventilation requirements	A B C
Waste disposal (including wastewater treatment)	A B C
Availability of factory floor space	A B C
Other special considerations	A B C
Does this cleanup activity have particular requirements that either require or preclude the use of any specific types(s) of cleanup solvent(s)? If so, specify.	
What material is used to wipe the solvent on the substrate (e.g., rag, brush, sponge, paper towel, etc.)?	
How is the solvent applied to the wiping material?	

TABLE 6.A-2A

(CONTINUED)

Question	Response and Comments
If rags are used:	
What is the size of the rags?	
How many rags are used per week?	
Are they reusable?	
How are the used rags handled for cleaning or disposal (i.e., hand wrung, stored wet in closed drum, left to air dry, sent out for laundering, washed on the premises, etc.)?	
Is the spent or dirty solvent collected from this operation reused, recycled, or disposed? If so, how much?	
Explain how a dirty solvent is handled.	
Are any steps taken in this wiping operation to minimize the release of organic vapors into the workplace (e.g., by working in a hood)? If so, describe.	
Are any steps taken to minimize the release of organic vapors into the atmosphere (e.g., is there an emission control device on hood exhaust)? If so, describe.	

A - Primary consideration, B - Secondary consideration, C - Not important.

TABLE 6.A-2B

DIPPING OPERATION QUESTIONNAIRE

Question	Response and Comments
Process step number (taken from Table 6.A-1)	
Description of part or machine being cleaned	
How much labor time is spent in this operation?	
Cleanup solvent used/Brand Name/Identification No.	
Is the cleanup solvent diluted with water before use?	
If so, what is the ratio of solvent to water?	
How much of the concentrated cleanup solvent is used: For this operation? Per shift?	
How much of the spent solvent is collected?	
How much of the solvent evaporates during this dipping operation?	
Describe the contaminant or soil that is being removed.	
To what degree do the following factors affect your selection of the cleanup solvent used in this cleaning operation? A - Primary consideration B - Secondary consideration C - Not important If your answer is "A" or "B", please elaborate.	
Physical and chemical properties of contaminant to be removed	A B C

TABLE 6.A-2B

(CONTINUED)

Question	Response and Comments
Physical and chemical properties of the substrate on which the contaminant is deposited	A B C
The degree of cleaning efficiency required	A B C
The size, shape, and complexity of parts or objects to be cleaned	A B C
The volume or number of parts or objects to be cleaned per unit of time	A B C
The substrate preparation required	A B C
Solvent costs	A B C
Worker exposure concerns	A B C
Fire code or insurance protection requirements	A B C
Recycle and recovery options	A B C
Regulatory requirements	A B C
Ventilation requirements	A B C
Waste disposal (including wastewater treatment)	A B C
Availability of factory floor space	A B C
Other special considerations	A B C
Does this cleanup activity have particular requirements that either require or preclude the use of any specific types(s) of cleanup solvent(s)? If so, specify.	
Describe the type of equipment used (dip tank, vessel, etc.) to apply the solvent to the substrate (how are parts added/removed, etc.).	
Are capture/control devices for VOC emissions (hoods, etc.) In place and operating during dipping operations? If so, explain.	

TABLE 6.A-2B

(CONTINUED)

Question	Response and Comments
Is the spent or dirty solvent collected from this operation reused, recycled, or disposed of? If so, how much?	
Explain how a dirty solvent is handled.	

A - Primary consideration, B - Secondary consideration, C - Not important.

TABLE 6.A-2C

SPRAYING OPERATION QUESTIONNAIRE

Question	Response and Comments
Process step number (taken from Table 6.A-1)	
Description of part or machine being cleaned	
How much labor time is spent in this operation?	
Cleanup solvent used/brand name/identification No.	
Is the cleanup solvent diluted with water before use?	
If so, what is the ratio of solvent to water?	
How much of the concentrated cleanup solvent is used: For this operation? Per shift?	
How much of the spent solvent is collected?	
How much of the solvent evaporates during this spraying operation?	
Describe the contaminant or soil that is being removed.	
To what degree do the following factors affect your selection of the cleanup solvent used in this cleaning operation? A - Primary consideration B - Secondary consideration C - Not important If your answer is "A" or "B", please elaborate.	
Physical and chemical properties of contaminant to be removed	A B C
Physical and chemical properties of the substrate on which the contaminant is deposited	A B C
The degree of cleaning efficiency required	A B C

TABLE 6.A-2C

(CONTINUED)

Question	Response and Comments
The size, shape, and complexity of parts or objects to be cleaned	A B C
The volume or number of parts or objects to be cleaned per unit of time	A B C
The substrate preparation required	A B C
Solvent costs	A B C
Worker exposure concerns	A B C
Fire code or insurance protection requirements	A B C
Recycle and recovery options	A B C
Regulatory requirements	A B C
Ventilation requirements	A B C
Waste disposal (including wastewater treatment)	A B C
Availability of factory floor space	A B C
Other special considerations	A B C
Does this cleanup activity have particular requirements that either require or preclude the use of any specific types(s) of cleanup solvent(s)? If so, specify.	
Describe the type of spray equipment used to apply the solvent to the substrate.	
Are solvents applied in-place, or is the part/machine taken to a designated station?	
Are capture/control devices for VOC emissions (hoods, etc.) in place and operating during this spraying operation? If so, explain.	
Is any spent or dirty solvent collected from this operation reused, recycled or disposed of? If so, how much?	
Explain how a dirty solvent is handled.	

A - Primary consideration, B - Secondary consideration, C - Not important.

TABLE 6.A-2D

FLUSHING OPERATION QUESTIONNAIRE

Question	Response and comments
Process step number (taken from Table 6.A-1)	
Description of part or machine being cleaned	
How much labor time is spent in this operation?	
Cleanup solvent used/brand name/identification No.	
Is the cleanup solvent diluted with water before use?	
If so, what is the ratio of solvent to water?	
How much of the concentrated cleanup solvent is used: For this operation? Per shift?	
How much of the spent solvent is collected?	
How much of the solvent evaporates during this flushing operation?	
Describe the contaminant or soil that is being removed.	
To what degree do the following factors affect your selection of the cleanup solvent used in this cleaning operation: A - Primary consideration B - Secondary consideration C - Not important If your answer is "A" or "B", please elaborate.	
Physical and chemical properties of contaminant to be removed	A B C

TABLE 6.A-2D

(CONTINUED)

Question	Response and Comments
Physical and chemical properties of the substrate on which the contaminant is deposited	A B C
The degree of cleaning efficiency required	A B C
The size, shape, and complexity of parts or objects to be cleaned	A B C
The volume or number of parts or objects to be cleaned per unit of time	A B C
The substrate preparation required	A B C
Solvent costs	A B C
Worker exposure concerns	A B C
Fire code or insurance protection requirements	A B C
Recycle and recovery options	A B C
Regulatory requirements	A B C
Ventilation requirements	A B C
Waste disposal (including wastewater treatment)	A B C
Availability of factory floor space	A B C
Other special considerations	A B C
Does this cleanup activity have particular requirements that either require or preclude the use of any specific types(s) of cleanup solvent(s)? If so, specify.	
Describe the type of equipment used in the flushing operation (i.e., is there a drain, how is the operation done, etc.).	

TABLE 6.A-2D

(CONTINUED)

Question	Response and Comments
Does the drain direct the waste to a sludge reservoir or a water treatment system?	
Does any of your solvent enter the local municipal waste treatment system? If so, how much?	
Are capture/control devices for voc emissions in place and operating during flushing operations? If so, explain.	
Is the spent or dirty solvent collected from flushing reused, recycled, or disposed of? If so, how much?	
Explain how dirty solvent from flushing is handled.	

A - Primary consideration, B - Secondary consideration, C - Not important.

TABLE 6.A-3

PLANT CONSUMPTION OF CLEANUP SOLVENT

Solvent[a]	Source (supplier)	Amount purchased per year	Amount of used solvent recovered as liquid waste	Amount of cleanup solvent that is contained in solid waste or product shipped	Net loss of cleanup solvent by evaporation[b]

[a] Use the same identification for each solvent in this table that was used in Table 6.A-1.

[b] If any of this evaporated solvent is subsequently treated by an emission control device, please explain.

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