VOLUME III: CHAPTER 8

INDUSTRIAL SURFACE COATING

September 1997

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Prepared for:
Area Sources Committee
Emission Inventory Improvement Program

DISCLAIMER

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

ACKNOWLEDGEMENT

This document was prepared by TRC Environmental Corporation for the Area Sources Committee of the Emission Inventory Improvement Program and for Charles Mann of the Air Pollution Prevention and Control Division, U.S. Environmental Protection Agency. Members of the Area Sources Committee contributing to the preparation of this document are:

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1

INTRODUCTION

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

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2

SOURCE CATEGORY DESCRIPTION

2.1 CATEGORY DESCRIPTION

Surface coating operations involve applying a thin layer of coating (e.g., paint, lacquer, enamel, varnish, etc.) to an object for decorative or protective purposes. The surface coating products include either a water-based or solvent-based liquid carrier that generally evaporates in the drying or curing process. In 1989, approximately 3.8 billion pounds of organic solvents, roughly one-third of all solvents purchased that year, were used in surface coating operations. These solvents were used both as carriers for coatings and to clean up coating equipment (EPA, 1991).

The use of surface coatings by manufacturing industries and other sectors of the economy is pervasive. Applications include: (1) coatings that are applied during the manufacture of a wide variety of products by Original Equipment Manufacturers (OEMs) including furniture, cans, automobiles, other transportation equipment, machinery, appliances, metal coils, flat wood, wire, and other miscellaneous products, (2) architectural coatings, and (3) special purpose coatings used for applications such as maintenance operations at industrial and other facilities, auto refinishing, traffic paints, marine finishes, and aerosol sprays. For area source purposes, the small industrial surface coating category includes OEM applications, some marine coatings, and maintenance coatings not accounted for by point sources. This category does not include architectural surface coatings, traffic markings, automobile refinishing, or aerosols. These categories are covered in other EIIP area source chapters. Architectural coatings are covered in Chapter 3; graphic arts in Chapter 7; auto refinishing in Chapter 13; traffic markings in Chapter 14; and aerosols in Chapter 5, which covers consumer and commercial solvent use.

Ideally, all industrial surface coating facilities would be inventoried as point sources. Preferred and alternative methods for estimating point source emissions from industrial surface coating operations are given in EIIP Volume II, Chapter 7. That chapter also includes more detailed discussion of surface coatings technology and controls, as well as process descriptions for industries having significant point source emissions. As a practical matter, it is not usually possible to account for all industrial surface coating facilities as point sources. Although the majority of industrial surface coating emissions may be inventoried as point sources, remaining emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) from industrial surface coating operations must be accounted for as area sources. Since the use of surface coatings by manufacturing industries is so widespread, it is extremely difficult to identify all of the industries in which coating materials are consumed. This makes the job of compiling a truly complete and accurate area source inventory for this category a difficult one. The following

tables list Standard Industrial Classification (SIC) codes that are likely to be associated with industrial surface coating operations. Table 8.2-1 lists the SIC codes for which national level data are available to estimate the quantities of coatings consumed. The largest of these industries are shown in Table 8.2-2, which lists those industries accounting for 90 percent of reported OEM coating consumption on a dollar value basis for 1992. Finally, Table 8.2-3 lists other manufacturing SICs known to consume surface coatings, but for which no reliable national data are available to estimate the volume used. All of the SICs listed in Tables 8.2-1 and 8.2-3 may be thought of as possible industries to be considered for inclusion in an area source industrial surface coating inventory. However, there is no assurance that this list is totally inclusive, nor can it be stated that these SICs always represent categories that include area source industrial surface coating operations.

2.2 PROCESS DESCRIPTION AND EMISSION SOURCES

Surface coating is the process by which paints, inks, varnishes, adhesives, or other decorative or functional coatings are applied to a substrate (e.g., paper, metal, plastic) for decoration and/or protection. This can be accomplished by brushing, rolling, spraying, dipping, flow coating, electrocoating, or specialized combinations or variations of these methods. The process by which the coating is applied is determined in part by the product's intended end use, the substrate to which the coating is applied, and the composition of the coating itself.

After the coating has been applied, it is cured or dried either by conventional curing or radiation curing processes. Conventional curing is accomplished through the use of thermal ovens. The heat from these ovens causes the solvents and/or water trapped in the coating to be driven off into the atmosphere. Coatings can also be cured using radiation. The two types of radiation curing processes currently in use are ultraviolet (UV) curing and electron beam (EB) curing.

Emissions result from the evaporation of the paint solvent and any additional solvent used to thin the coating. Emissions also result from the use of solvents in cleaning the surface prior to coating and in cleaning coating equipment after use.

2.3 FACTORS INFLUENCING EMISSIONS

VOC emissions from small industrial surface coating operations are influenced by several factors. Emissions from surface preparation and coating applications are a function of the VOC content of the product used. Emissions are also a function of the coating process used, including the transfer efficiency of the spray equipment. Transfer efficiency is the percentage of coating solids sprayed that actually adhere to the surface being coated. Emissions from cleaning operations are dependent on the type of cleanup and housekeeping practices used.

TABLE 8.2-1

PRINCIPAL INDUSTRIAL SURFACE COATING SIC

SIC Code	SIC Description
2451	Mobile Homes
2452	Prefabricated Wood Buildings and Components
2493	Reconstituted Wood Products
2499	Wood Products, Not Elsewhere Classified
2511	Wood Household Furniture, Except Upholstered
2512	Wood Household Furniture, Upholstered
2514	Metal Household Furniture
2517	Wood Television, Radio, Phonograph, and Sewing Machine Cabinets
2519	Household Furniture, Not Elsewhere Classified
2521	Wood Office Furniture
2522	Office Furniture, Except Wood
2531	Public Building and Related Furniture
2541	Wood Office and Store Fixtures, Partitions, Shelving, and Lockers
2542	Office and Store Fixtures, Partitions, Shelving, and Lockers, Except Wood
2599	Furniture and Fixtures, Not Elsewhere Classified
3411	Metal Cans
3412	Metal Shipping Barrels, Drums, Kegs, and Pails
3441	Fabricated Structural Metal
3443	Fabricated Plate Work (Boiler Shops)
3444	Sheet Metal Work
3446	Architectural and Ornamental Metal Work
3448	Prefabricated Metal Buildings and Components
3449	Miscellaneous Structural Metal Work
3465	Automotive Stampings
3466	Crowns and Closures
3469	Metal Stampings, Not Elsewhere Classified
3471	Electroplating, Plating, Polishing, Anodizing, and Coloring
3479	Coating, Engraving, and Allied Services, Not Elsewhere Classified
3523	Farm Machinery and Equipment
3524	Lawn and Garden Tractors and Home Lawn and Garden Equipment

TABLE 8.2-1

(CONTINUED)

SIC Code	SIC Description
3531	Construction Machinery and Equipment
3532	Mining Machinery and Equipment, Except Oil and Gas Field Machinery and Equipment
3536	Overhead Traveling Cranes, Hoists, and Monorail Systems
3561	Pumps and Pumping Equipment
3563	Air and Gas Compressors
3581	Automatic Vending Machines
3585	Air Conditioning and Warm Air Heating Equipment
3586	Measuring and Dispensing Pumps
3593	Fluid Power Cylinders and Actuators
3594	Fluid Power Pumps and Motors
3612	Power, Distribution, and Specialty Transformers
3613	Switchgear and Switchboard Apparatus
3621	Motors and Generators
3631	Household Cooking Equipment
3632	Household Refrigerators and Home and Farm Freezers
3633	Household Laundry Equipment
3634	Electric Housewares and Fans
3635	Household Vacuum Cleaners
3639	Household Appliances, Not Elsewhere Classified
3711	Motor Vehicles and Passenger Car Bodies
3713	Truck and Bus Bodies
3714	Motor Vehicle Parts and Accessories
3715	Truck Trailers
3716	Motor Homes
3721	Aircraft
3724	Aircraft Engines and Parts
3728	Aircraft Parts and Auxiliary Equipment, Not Elsewhere Classified
3731	Ship Building and Repairing
3732	Boat Building and Repairing

TABLE 8.2-1

(CONTINUED)

SIC Code	SIC Description
3792	Travel Trailers and Campers
3799	Transportation Equipment, Not Elsewhere Classified
3931	Musical Instruments
3949	Sporting and Athletic Goods, Not Elsewhere Classified
3951	Pens, Mechanical Pencils, and Parts
3952	Lead Pencils, Crayons, and Artists' Materials
3953	Marking Devices
3993	Signs and Advertising Specialties
3995	Burial Caskets

TABLE 8.2-2

1992 MANUFACTURING INDUSTRY SURFACE COATING CONSUMPTION[a]

SIC Code	Description	Cost of Coatings Consumed (Million $)
371	Motor Vehicles and Equipment	1770.1
341	Metal Cans and Shipping Containers	328.2
347	Metal Services, Not Elsewhere Classified	321.7
289	Misc. Chemical Products (Printing Ink)[b]	318.2
344	Fabricated Structural Metal Products	218.1
251	Household Furniture	173.3
363	Household Appliances	142.3
254	Partitions and Fixtures	87.7
373	Ship and Boat Building and Repairing	87.7
346	Metal Forgings and Stampings	86.9
352	Farm and Garden Machinery	85.6
249	Miscellaneous Wood Products	82.8
252	Office Furniture	80.2

[a] Information has been compiled from: *1992 Census of Manufactures, Geographic Area Series,* U.S. Department of Commerce, Bureau of the Census, Washington, DC.

[b] Represents coating materials consumed for printing ink manufacture. Therefore, this SIC should not be included for inventory purposes as an industrial surface coating end use category.

TABLE 8.2-3

OTHER INDUSTRIES THAT MAY CONSUME SURFACE COATINGS

SIC Code	SIC Description
2436	Softwood Veneer and Plywood
262	Paper Mills
263	Paperboard Mills
265	Paperboard Containers and Boxes
3069	Fabricated Rubber Products, Not Elsewhere Classified
308	Miscellaneous Plastic Products, Not Elsewhere Classified
331	Blast Furnace and Basic Steel Products
3433	Heating Equipment, Except Electric
3494	Valves and Pipe Fittings, Not Elsewhere Classified
3452	Bolts, Nuts, Rivets, and Washers
364	Electric Lighting and Wiring Equipment
366	Communications Equipment
367	Electronic Components and Accessories
3812	Search and Navigation Equipment
382	Measuring and Controlling Devices
384	Medical Instruments and Supplies
3861	Photographic Equipment and Supplies
3942	Dolls and Stuffed Toys
3944	Games, Toys, and Children's Vehicles

2.4 CONTROL TECHNIQUES

The main approaches for reducing VOC emissions from small industrial surface coating operations are (1) use of lower-VOC coatings, (2) use of enclosed cleaning devices, and (3) increased transfer efficiency. Other housekeeping activities can also be used to reduce emissions from small industrial surface coating operations. These activities include using tight-fitting containers, reducing spills, mixing paint to need, providing operator training, maintaining rigid control of inventory, using proper cleanup methods, etc.

Regulations designed to reduce VOC emissions have led to the development of high-solids and powder coatings, as well as increased use of water-based coatings. Although water-based coatings include some organic solvents, water makes up the main carrier component (generally at least 80 percent) in these formulations.

3

OVERVIEW OF AVAILABLE METHODS

3.1 EMISSION ESTIMATION METHODOLOGIES

There are several methodologies available for calculating emissions from small industrial surface coating operations. The selection of a method to use depends on the degree of accuracy required in the estimate, the available data, and the available resources. This section discusses the methods available for estimating emissions from small industrial surface coating operations and identifies the preferred method for this category.

3.1.1 AVAILABLE METHODOLOGIES

Volatile Organic Compounds

Methods available for estimating emissions from small industrial surface coating operations include the following: (1) using SIC-specific, inventory area-specific per employee emission factors; (2) using national default per employee emission factors; and (3) using per capita emission factors. These methods are summarized in Table 8.3-1. Because of the potentially large number of small industrial surface coating operations within an inventory area and the difficulty in identifying candidate industries to be surveyed, conducting surveys to collect activity, product use, and product-specific VOC content data to develop product-specific, site-specific detailed emissions estimates is generally not recommended. A survey methodology is likely to be too resource intensive for both the facilities surveyed and the inventorying agency.

The preferred method for estimating emissions from small industrial surface coating operations involves developing and applying SIC-specific, inventory area-specific per employee emission factors based on reported point source emissions. Other methods for estimating emissions from this category include using national default per employee and per capita emission factors. *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume 1* (EPA, 1991) and *AP-42* (EPA, 1995) contain per employee and per capita emission factors for this category.

TABLE 8.3-1

PREFERRED AND ALTERNATIVE METHODS FOR ESTIMATING EMISSIONS FROM SMALL INDUSTRIAL SURFACE COATING OPERATIONS

Methods	Description
Preferred Method - SIC-Specific, Area-Specific Per Employee Factor	• Divide total reported point source emissions (by SIC) for inventory area by total point source employment (by SIC) for inventory area to develop SIC-specific, inventory area-specific per employee emissions factor. • Subtract total point source employment from total employment within the SIC to develop total area source SIC employment. • Multiply area source employment by SIC-specific, inventory area-specific employee factor.
Alternative Method 1 - National Default Per Employee Factor	Use national default per employee emission factors and number of employees in SIC to estimate emissions.
Alternative Method 2 - Per Capita Factor	Use per capita emission factor and population in inventory area to estimate emissions.

Hazardous Air Pollutants

HAP emissions from this source are determined by the same methods discussed above for VOC emissions. Again, conducting a survey to gather specific HAP information may be too resource-intensive for the inventorying agency to undertake. Using the preferred method described above assumes that the coatings and HAP contents used in small facilities are similar to those used and reported by large facilities. The agency may want to verify this assumption with local industry experts.

3.1.2 DATA NEEDS

Data Elements

The data elements needed to calculate emission estimates for small industrial surface coating operations depend on the methodology used for data collection. Each methodology requires some measure of activity (or surrogate for activity) and an emission factor. The data elements needed for each emission estimation technique are presented in Table 8.3-2.

TABLE 8.3-2

DATA ELEMENTS NEEDED FOR EACH METHOD

Data Element	Preferred Method[a]	Alternate Method 1[b]	Alternate Method 2[c]
Point source emissions by SIC	x		
Point source employment by SIC	x	x	
Total employment by SIC	x	x	
Population (inventory area)			x
SIC-specific, area-specific per employee emission factor	x		
National default per employee emission factor		x	
Per capita emission factor			x

[a] Preferred method is the SIC-specific, area-specific per employee factor method.
[b] Alternative Method 1 is the national default per employee factor method.
[c] Alternative Method 2 is the per capita factor method.

Adjustments to Emissions Estimates

Adjustments applied to annual emissions estimates include point source corrections, applications of controls, spatial allocation, and temporal resolution. The type of adjustment is dependent on the type of inventory required. The data needs for point source emission estimate adjustments are dependent in part on the methodology used. Data needs for the adjustments listed below are as follows:

- Point source corrections require point source emissions or point source employment data for inventory area for the specific SIC;
- Application of controls requires information about control efficiency, rule effectiveness; and rule penetration;
- Spatial allocation requires employment, population, facility location, zoning, or business districts location data;

- Temporal resolution requires data for seasonal throughput, operating days per week, and operating hours per day.

Point Source Corrections

If the Preferred Method is used to estimate area source emissions from this category, the point source correction is performed as part of the method itself. If Alternative Method 1 is used, the point source corrections can be performed by one of the following: (1) subtract point source emissions from calculated total emissions, or (2) subtract point source employment in the specific SIC from total employment in that SIC and calculate area source emissions using the remaining employment in the SIC. If Alternative Method 2 is used, the point source corrections can only be performed by subtracting point source emissions from calculated total emissions.

Application of Controls

Section 3.8 of *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I* (EPA, 1991) provides guidance for determining and applying rule effectiveness (RE) for a source category. In addition, the EPA document *Procedures for Estimating and Applying Rule Effectiveness in Post-1987 Base Year Emission Inventories for Ozone and Carbon Monoxide State Implementation Plans* (EPA, 1989) provides more detailed information on RE.

Sections 4.1.1 and 5.4 of the *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I* (EPA, 1991) describe how to account for emissions reductions expected to result from applying a regulation. If a regulation exists for a surface coating operation SIC represented in the inventory areas and the inventorying agency uses a "top down" approach to estimate emissions from this category, the agency should incorporate an estimate of rule penetration.

If an area source is controlled (e.g., VOC content of surface coating products controlled by regulation), the following general equations can be used to calculate emissions:

$$CAE_A = (UAE_A)[1 - (CE)(RP)(RE)] \quad (8.3\text{-}1)$$

or

$$CAE_A = (EF_A)(Q)[1 - (CE)(RP)(RE)] \quad (8.3\text{-}2)$$

where:

CAE_A = controlled area source emissions of pollutant A
UAE_A = uncontrolled area source emissions of pollutant A

CE	=	control efficiency/100
RP	=	rule penetration/100
RE	=	rule effectiveness/100
EF_A	=	emission factor for pollutant A
Q	=	activity factor for category

Spatial Allocation

If the emissions estimates are developed using a per employee factor, the spatial allocation of emissions can be performed according to facility location (if known) as with the point source inventory, or with local employment data. The agency should be aware that since location of surface coating operations does not necessarily mirror location of population within a county, using population to spatially allocate emissions might be misleading. The inventorying agency will need to evaluate options for allocating county emissions, such as zoning information, actual location data identified from surveys, industry publications, etc.

Temporal Resolution

Seasonal Apportioning. Small industrial surface coating emissions do not demonstrate differences in activity from season to season (EPA, 1991). The agency may want to evaluate point source data to determine actual seasonal activity within the inventory area. Area source emissions can be seasonally allocated using the most frequently occurring or average seasonal throughput values found in the point source inventory for the specific SIC.

Daily Resolution. Small industrial surface coating facilities typically operate five days per week (EPA, 1991). This value may be used if local survey data or point source records on daily resolution are not available.

3.2 PROJECTING EMISSIONS

The type of surrogate used to project emissions is dependent on the methodology used to develop the initial emissions estimate. In "growing" the emissions estimate, the inventorying agency should use the same activity parameter as was used to develop the initial estimate. For example, if a per employee factor was used to develop the initial estimate, growth in employment should be used to develop the projected emissions estimate. The agency should use SIC-specific growth information, rather than general business growth projections, if available.

The general equation for developing the projected emissions is:

$$EMIS_{PY} = ORATE_{BY,O} * EMF_{PY,pc} * [1 - (\frac{CE_{PY}}{100})(\frac{RP_{PY}}{100})(\frac{RE_{PY}}{100})] * GF \qquad (8.3\text{-}3)$$

where:

$EMIS_{PY}$	=	projection year emissions: ozone season typical weekday (mass of pollutant/day)
$ORATE_{BY,O}$	=	base year operating rate: ozone season daily activity level
$EMF_{PY,pc}$	=	projection year precontrol emissions factor (mass of pollutant/production unit)
CE_{PY}	=	projection year control efficiency (percent)
RP_{PY}	=	projection year rule penetration (percent)
RE_{PY}	=	projection year rule efficiency (percent)
GF	=	growth factor (dimensionless)

The precontrol emission factor ($EMF_{PY,pc}$) reflects the mass of VOCs per production unit emitted before control (EPA, 1993).

4

PREFERRED METHOD FOR ESTIMATING EMISSIONS

The preferred method for estimating emissions from small industrial surface coating operations uses employment as the activity factor and an inventory area-specific, SIC-specific per employee emission factor. This method essentially scales up point source surface coating emissions by the ratio of total employment to point source employment. This method is most appropriate when most surface coating emissions have been accounted for as point sources. Implicit assumptions are that emissions per employee for area sources are the same as for point sources and that emissions from SICs for which there are no point sources are insignificant. The following procedures should be followed.

(1) Develop an SIC-specific, inventory area-specific per employee emission factor. The total reported point source emissions for all of the surface coating classification codes (SCCs) reported within an SIC are divided by the point source employment for the SIC. This method may not be practical if emissions, SCCs and SIC codes for each facility are not all available.

- Point source surface coating emissions are reported under the 402***** SCC. Table 7.2-1 of EIIP Volume II, Chapter 7 gives a full list of applicable point source surface coating SIC codes.

- Emissions by SCC can be obtained from state emissions databases or the Aerometric Information Retrieval System (AIRS) Facility Subsystem (AFS). AIRS AFS allows reporting of SIC codes for facilities, but they are not required. State databases may be a more complete source of information for this procedure. Database queries should request a list of facilities' emissions that are reported for SCC 402*****, and those facilities' SIC codes. Facilities may list themselves as being in more than one SIC code. Inventory preparers will have to use some judgement to decide which SIC code is the most appropriate match, both for the per employee emission factor, and the point source correction.

- County employment information can be obtained from state or local records, such as state or local commerce departments, or *County Business Patterns*.[1] *County Business Patterns* lists employment by SIC code.

$$\text{SIC-specific, area-specific, per Employee Emission Factor} = \frac{PSE_{SIC}}{PSEmp_{SIC}} \qquad (8.4\text{-}1)$$

where:

PSE_{SIC} = total point source SIC emissions for coating SCCs
$PSEmp_{SIC}$ = total point source SIC employment

A variation of the above procedure would be to develop the area-specific, SIC-specific per employee emission factors based on a selected sample of the point source facilities, instead of basing emission factors on all point sources. A suggested approach is to plot a distribution of emissions per employee values for all point sources. Those sources that have values that may be considered "outliers" (extremely high or low compared to other sources) could be excluded from the sample. The justification for the exclusion is that if a large enough sample of point sources exists, and this sample contains sources with excessively large or small emissions per employee factors, these may not be representative of the typically small sources being inventoried as area sources. In theory, this approach might produce more representative emission factors for area sources. By deliberately excluding some point sources from the sample, however, the sample becomes biased. It is a matter of engineering judgement as to whether this bias would cause less inventory error than basing area source emission factors on a sample of all point sources. Excluding some individual point sources from the sample for those SICs for which there are only a very small number of point sources is generally not a good idea, since the sample is too small to establish a representative average value for emissions per employee.

(2) Subtract total point source employment from total employment for each SIC to calculate total area source employment. (Point source employment may be available from state inventory or permit files, or from industrial directories or commercially available databases. Alternatively, point source employment may be estimated from *County Business Patterns* data using the procedure described later in this section.)

$$ASEmp_{SIC} = TEmp_{SIC} - PSEmp_{SIC} \qquad (8.4\text{-}2)$$

[1] *County Business Patterns*, U.S. Department of Commerce, Bureau of the Census, Washington, DC. Annual publication.

where:

$TEmp_{SIC}$ = total SIC employment
$PSEmp_{SIC}$ = total point source SIC employment
$ASEmp_{SIC}$ = area source SIC employment

(3) Multiply area source employment by per employee emission factor developed in Step 1.

$$ASE_{SIC} = ASEmp_{SIC} * \text{per Employee Emission Factor} \quad (8.4\text{-}3)$$

where:

$ASEmp_{SIC}$ = area source SIC employment
ASE_{SIC} = area source SIC emissions

(4) Sum area source surface coating emissions.

$$ASE_{surf} = \sum_{n}^{1} ASE_{SIC_x} \quad (8.4\text{-}4)$$

where:

ASE_{surf} = total small industrial surface coating emissions
ASE_{SICx} = area source SIC emissions for SIC *x*

The following procedures can be used to determine total point source employment if these data are not available from the point source or permit files.

Using *County Business Patterns*:

(1) Assume that the point source facilities are the facilities reported in *County Business Patterns* as having at least *x* employees. The term *x* may vary by SIC and location, and can be appropriately selected for each SIC.

(2) Determine the number of point sources reporting from the AFS or state/local records.

(3) *County Business Patterns* reports the number of facilities by employment class size. These classes are represented by a range (e.g., 20 to 49 employees, 50 to 99 employees, 100 to 249 employees, etc.). Total numbers of employees are given for all facilities in the SIC, except where the information does not meet Bureau of the Census requirements to

prevent disclosure of data for individual facilities. In these instances, assume that the facility is at the midpoint of the range, if you cannot estimate the number of employees from the available data.

(4) Using the *County Business Patterns* size-class distribution and number of point sources reporting, sum the number of employees, starting with the largest size class and working down until all reporting point sources have been considered.

(5) Area source SIC employment is then estimated by subtracting estimated point source SIC employment from total SIC employment as given in *County Business Patterns*. Example 8.4-1 presents through a typical calculation.

Example 8.4-1

County X reports 12 point source facilities in SIC yyyy. For County X, the total employment from *County Business Patterns* for SIC yyyy is 3,281 and the distribution of facilities by size class is:

Size Class	No. of Facilities	No. of Employees
1,000 or more	0	--
500 to 999	1	not available
250 to 499	0	--
100 to 249	5	964
50 to 99	6	871
20 to 49	2	not available
10 to 19	1	not available
5 to 9	0	--
1 to 4	0	--
Total		3,281

Point source employment = 750 (one facility in size class 500 to 999, using 750 as the midpoint) + 964 (five facilities in size class 100 to 249, with total employment of 964) + 450 (6 facilities in size class 50 to 99, using midpoint of 75)

= 2,164

Area source employment is then calculated:

Area Source Employment for SICyyyy in County X = 3,281 - 2,164 = 1,117

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5

ALTERNATIVE METHODS FOR ESTIMATING EMISSIONS

5.1 ALTERNATIVE METHOD 1 - DEFAULT PER EMPLOYEE FACTORS

Alternative Method 1 uses the national default per employee emission factors given in the *Procedures* (EPA, 1991). These emission factors are presented in Table 8.5-1. Emissions are estimated by either of the following procedures:

(1) Determine point source SIC employment as outlined in the preferred method. Subtract point source SIC employment from total SIC employment to determine area source SIC employment. Multiply area source SIC employment by the appropriate default emission factor from Table 8.5-1.

(2) Multiply total SIC employment by the appropriate default emission factor from Table 8.5-1. Subtract total point source surface coating emissions for the SIC from total emissions. The result is the area source emissions for the SIC. If the result is negative for an SIC, set the area source emissions equal to zero. If many negative results occur, use of procedure 1 may be a better approach.

Note that these two methods may provide slightly different results because the default emission factor may not accurately represent conditions in the inventory area.

The inventorying agency will need to evaluate which procedure is more representative of activity in the inventory area. Information on temporal allocation and seasonal adjustment factors can be found in Chapter 1 of this volume, or the *Procedures*, (EPA, 1991).

TABLE 8.5-1

NATIONAL DEFAULT PER EMPLOYEE EMISSION FACTORS (EPA, 1991)

Category	SIC Code	Per Employee VOC Emission Factor (lb/yr)	Per Employee Coating Usage Factor (gal/yr)
Furniture and Fixtures	25	944	175
Metal Containers	341	6,029	1,218
Automobiles (new)	3711	794	131
Machinery and Equipment	35	77	17
Appliances	363	463	181
Other Transportation Equipment	37, except 3711 and 373	35	14
Sheet, Strip, and Coil	3479	2,877	474
Factory Finished Wood	2426-9, 243-245, 2493, 2499	131	40
Electrical Insulation	3357, 3612	290	114
Other Product Coatings	NA[a]	NA	NA
High-Performance Maintenance Coatings	NA	NA	NA
Marine Coatings	373	308	47
Other Special Purpose Coatings	NA	NA	NA

[a] NA = not available, use per capita emission factors from Table 8.5-2.

Example 8.5-1

Assume that point source employment for the SIC is 200, total employment for the SIC is 250, default emission factor is 80 lb/employee, and total surface coating SCC point source emissions for the SIC are 15,000 lb.

Using procedure 1 above, area source emissions would be calculated as follows:

250 employees - 200 employees = 50 employees
(50 employees) (80 lb/employee) = 4,000 lb

Using procedure 2 above, area source emissions would be calculated as follows:

(250 employees) (80 lb/employee) = 20,000 lb
20,000 lb - 15,000 lb = 5,000 lb

5.2 ALTERNATIVE METHOD 2 - PER CAPITA EMISSION FACTOR

In this alternative method, population in the inventory area is used with SIC-specific default per capita VOC emission factors to estimate emissions by SIC:

$$E_{a,SIC} = POP_a * EF_{SIC}$$

where:

$E_{a,SIC}$	=	SIC emissions for area a
POP_a	=	population in area a
EF_{SIC}	=	per capita SIC VOC emission factor

Population data may be obtained from state or local records or from national databases and publications maintained by the U.S. Department of Commerce, Bureau of the Census. The recommended per capita VOC emission factors are shown in Table 8.5-2. As with other emissions estimation methodologies, point source emissions for this category should be subtracted from the total emissions generated using this methodology. Information on temporal allocation and seasonal adjustment factors can be found in Chapter 1 of this volume, or the *Procedures* (EPA, 1991).

TABLE 8.5-2

NATIONAL DEFAULT PER CAPITA VOC EMISSION FACTORS

Category	SIC Codes	Per Capita VOC Emission Factor (lb/yr)	Per Capita Coating Usage Factor (gal/yr)
Furniture and Fixtures	25	2.0	0.37
Metal Containers	341	1.3	0.26
Automobiles (new)	3711	1.1	0.18
Machinery and Equipment	35	0.7	0.15
Appliances	363	0.2	0.10
Other Transportation Equipment	37, except 3711, 373	0.2	0.08
Sheet, Strip, and Coil	3479	0.5	0.08
Factory Finished Wood	2426-9, 243-245, 2493, 2499	0.3	0.08
Electrical Insulation	3357, 3612	0.1	0.06
Other Product Coatings	NA[a]	0.6	0.23
High-Performance Maintenance Coatings	NA	0.8	0.13
Marine Coatings	373	0.2	0.04
Other Special Purpose Coatings	NA	0.8	0.18

[a] NA = not available.

6

QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

When using any of the methods for estimating emissions from industrial surface coating, data compilation should be planned and documented in the inventory QA/QC plan. When using the preferred method, all assumptions made about facilities that are excluded from the emission factor calculations, and the use of emission factors developed from facilities in one specific SIC being used for a less specific SIC group must be documented and justified. If permit data for facilities in a particular SIC are not available, employment for that SIC should be checked before it is assumed that emissions from the SIC do not need to be calculated. Refer to the discussion of survey planning and survey QA/QC in Chapter 1 of this volume if the preferred method is used.

Data handling for data collected for all of the methods should be planned and documented in the inventory QA/QC plan and does not involve any category-specific issues. Please consult EIIP Volume VI on inventory QA/QC for more information.

6.1 EMISSION ESTIMATE QUALITY INDICATORS

The preferred method results in higher quality estimates than either of the alternative methods, but it requires significantly more effort. The level of effort required to calculate emission estimates using either of the two national default emission factors is estimated to be between 8 and 40 hours. The preferred method will require two to three times as much time. Inventory preparers will need to decide if the use of the preferred method in their areas will result in enough of an increase in quality to justify the use of this more detailed method. Inventory planners may wish to review the number of employees in industrial surface coating-related SICs and the information available through point source reporting for the inventory area to determine if the preferred method can be used. Planners should also investigate potential differences in coating formulations between area source and point source operations.

6.1.1 DATA ATTRIBUTE RATING SYSTEM (DARS) SCORES

The DARS scores for each method are summarized in Tables 8.6-1, 8.6-2, and 8.6-3. A range of scores is given for the preferred method to reflect variability in the results of the technique. All scores assume that good QA/QC measures are performed and that no significant deviations from

the prescribed methods have been made. If these assumptions are not correct, new DARS scores should be developed according to the guidance provided in Appendix F of EIIP Volume VI.

The preferred method results in higher DARS scores than either of the alternative methods. The preferred method's DARS scores are between 0.42 and 0.51 and the alternative method DARS scores range between 0.27 and 0.34. The preferred method scores higher on the emission factor-related attributes than the alternative methods. The preferred and first alternative methods use the same activity factor, and thus have the same activity attribute scores. The second alternative method, which uses population as an activity surrogate, has a lower activity source specificity score because there may be a low correlation between population and industrial surface coating activity.

The preferred method compiles existing information from local permits to develop an area source emission factor. This method depends on several assumptions concerning point and area industrial surface coating sources being true:

- That most surface coating emissions have been accounted for as point sources;
- That emissions for area sources are the same as those for point sources (i.e., processes and materials are similar, emissions per employee are similar, and controls in permitted facilities are similar to those in nonpermitted facilities); and
- That emissions are insignificant from SICs for which there are no permit data.

Ranges in the scoring for the emission factor depend on several issues. The measurement of the emission factor, based on permit data, will vary depending on the original data collection effort's data quality objectives and the methods used to measure emissions. Potential measurement methods can be plant-specific material balance, continuous emission monitoring, source sampling, or *AP-42* emission factors.

The score for the source specificity attribute addresses the application of a few point source facilities' emission rates to all of the area sources. Source specificity scores depend on whether the assumptions listed above are true. The source specificity score will be reduced considerably if data collected for one SIC are used for a more general SIC grouping that includes that SIC. The greatest advantage that this method has over the alternatives is that it should address spatial and temporal variability that is problematic for the alternative methods.

Emission factors for the alternative methods are scored lower than the preferred methods because they use national-level emission factors based on 1989 solvent usage for all industrial surface coatings. Such factors do not take into account controls in place, changes in processes and materials since 1989, or differences in climate that may result in different formulations of coatings from region to region. Emissions calculated using these factors need to be corrected for

point source emissions in the inventory area. When using the population-based emission factor, spatial attributes are scored lower because the single factor does not reflect any variation in different types of industry in the inventory area.

6.1.2 SOURCES OF UNCERTAINTY

The statistics needed to quantify the uncertainty of the preferred and alternative methods are incomplete. Because of the number of different processes used in this source category and the use of surface coatings in so many different industries, it is a very difficult emission source to characterize, and area source methods will necessarily carry a heavy load of uncertainty.

Factors that influence the uncertainty for the preferred method depend on variations between large and small operations. Processes, materials, controls, and the number of employees actually engaged in surface coating may be quite different depending on the size of the operation. Also, assuming that area source emissions will be unimportant if there are no permitted facilities could result in a major underestimation for the SIC. Checking the employment for that SIC will reduce the uncertainty of that assumption.

Factors that influence the uncertainty for the two alternative methods are:

- The proportion of coating solvent emitted, as opposed to that assumed from the top-down national material balance estimate;
- Changes in the solvent usage since 1989, when the emission factor was prepared (see the discussion in Section 6.1.1 about changes since 1989);
- Regional variability in the types of coatings used depending on climate-based drying or curing times; and
- The number of employees that are actually involved in the surface coating operation at a facility, as opposed to other operations.

For the per capita factor method (Alternative Method Two) only, one additional factor influences uncertainty: the regional distribution of industries that do surface coating.

TABLE 8.6-1

PREFERRED METHOD DARS SCORES: AREA-SPECIFIC PER EMPLOYEE FACTOR

Attribute	Scores		
	Factor	Activity	Composite
Measurement	0.3 - 0.5	0.9	0.27 - 0.45
Source Specificity	0.3 - 0.6	0.5	0.15 - 0.3
Spatial	0.7 - 0.7	0.9	0.63 - 0.63
Temporal	0.8 - 0.8	0.8	0.64 - 0.64
Composite Scores	0.53 - 0.65	0.78	0.42 - 0.51

TABLE 8.6-2

ALTERNATIVE METHOD 1 DARS SCORES: NATIONAL DEFAULT PER EMPLOYEE FACTOR

Attribute	Scores		
	Factor	Activity	Composite
Measurement	0.3	0.9	0.27
Source Specificity	0.5	0.5	0.25
Spatial	0.5	0.9	0.45
Temporal	0.5	0.8	0.4
Composite Scores	0.45	0.78	0.34

TABLE 8.6-3

ALTERNATIVE METHOD 2 DARS SCORES: NATIONAL DEFAULT PER CAPITA FACTOR

Attribute	Scores		
	Factor	Activity	Composite
Measurement	0.3	0.9	0.27
Source Specificity	0.5	0.3	0.15
Spatial	0.3	0.9	0.27
Temporal	0.5	0.8	0.4
Composite Scores	0.40	0.73	0.27

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7

DATA CODING PROCEDURES

This section presents the codes available to characterize small industrial surface coating emission estimates. Consistent categorization and coding will result in greater uniformity among inventories.

7.1 PROCESS AND CONTROL CODES

The process codes for the industrial surface coating category are shown in Table 8.7-1. These codes are compatible with the AIRS Area and Mobile Source Subsystem (AMS) source category codes (EPA, 1994). The control codes for use with AMS are shown in Table 8.7-2. Federal, state, and local regulations can be used as guides to estimate the type of control used and the level of efficiency that can be achieved. Be careful to apply only the regulations that specifically include area sources. If a regulation is applicable only to point sources, it should not be assumed that similar controls exist at area sources. A survey should be conducted to determine if similar controls exist at area sources. The "099" control code can be used for miscellaneous control devices that do not have a unique identification code. The "999" code can be used for a combination of control devices where only the overall control efficiency is known.

TABLE 8.7-1

AMS CODES FOR THE INDUSTRIAL SURFACE COATING CATEGORY

Category	Process Description	AMS Code	Units
Factory Finished Wood (SIC 2426-2429, 243-245, 2492, and 2499)	Total: All Solvent Types	24-01-015-000	Number of Employees
Wood Furniture (SIC 2511, 2571, 2521, and 2541)	Total: All Solvent Types	24-01-020-000	Number of Employees
Metal Furniture (SIC 2514, 2522)	Total: All Solvent Types	24-01-025-000	Number of Employees
Metal Cans (SIC 341)	Total: All Solvent Types	24-01-040-000	Number of Employees
Miscellaneous Finished Metals (SIC 34, not including 341 and 3498)	Total: All Solvent Types	24-01-050-000	Number of Employees
Machinery and Equipment (SIC 35)	Total: All Solvent Types	24-01-055-000	Number of Employees
Large Appliances (SIC 363)	Total: All Solvent Types	24-01-060-000	Number of Employees
Electronic and Other Electrical (SIC 36, not including 363)	Total: All Solvent Types	24-01-065-000	Number of Employees
Motor Vehicles (SIC 3711, 3713, 3715)	Total: All Solvent Types	24-01-070-000	Number of Employees
Marine (SIC 373)	Total: All Solvent Types	24-01-080-000	Number of Employees
Railroad (SIC 3743)	Total: All Solvent Types	24-01-085-000	Number of Employees
Miscellaneous Manufacturing	Total: All Solvent Types	24-01-090-000	Population of Area
Industrial Maintenance Coatings	Total: All Solvent Types	24-01-100-000	Population of Area
Other Special Purpose Coatings	Total: All Solvent Types	24-01-200-000	Population of Area

TABLE 8.7-2

AIRS CONTROL DEVICE CODES

Control Device	Code
Wet Scrubber - High Efficiency	001
Wet Scrubber - Medium Efficiency	002
Wet Scrubber - Low Efficiency	003
Mist Eliminators - High Velocity	014
Mist Eliminators - Low Velocity	015
Catalytic Afterburners	019
Catalytic Afterburners with Heat Exchangers	020
Direct Flame Afterburners	021
Direct Flame Afterburners with Heat Exchangers	022
Flares	023
Activated Carbon Adsorption	048
Packed-Gas Absorption Column	050
Tray-Type Gas Absorption Column	051
Impingement Plate Scrubber	055
Mat or Panel Filter	058
Dust Suppression by Water Sprays	061
Refrigerated Condenser	073
Barometric Condenser	074
Process Modification - Water-based Coatings	101
Process Modification - Low-Solvent Coatings	102
Process Modification - Powder Coatings	103
Miscellaneous Control Device	099
Combined Control Efficiency	999

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8

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